Mercury Outreach and Education: A Literature Review of Best Practices

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Pollution Probe is a non-profit environmental organization that works in partnership with all sectors of society to protect health and the environment by promoting clean air and clean water. Since its founding at the University of Toronto in 1969, the organization has become national in scope. In the 1990s, Pollution Probe focused its program work on issues related to climate change, energy, air quality, water pollution and human health, including a major programme to remove human sources of mercury from the environment. Pollution Probe's scope has also expanded to new environmental contaminants pose to children and the development of innovative tools for promoting responsible environmental behaviour. For more information visit, www.pollutionprobe.org.

Since 1996 Pollution Probe has been a national leader in actions and policies aimed at fighting mercury pollution in Canada and North America. Pollution Probe has developed a comprehensive, multi-faceted approach to achieving this goal, through advocating the elimination and reduction of mercury use and release, and setting the stage for corporate mercury reductions. Based on our experience working with industry and government to achieve significant changes in mercury use in Ontario, we have developed a high level of leadership and credibility internationally.

Pollution Probe's mercury work is divided into two main activities: increasing public awareness of Mercury-containing products and their impacts, and our Mercury Policy work.

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1 Introduction

1.1 Purpose

The goal of Pollution Probe's mercury project, which started in 1996, is to protect human and environmental health by reducing and/or eliminating the use and release of mercury from human sources to the environment. The Canadian government is currently finalizing a risk management strategy for mercury-containing products which will prohibit the sale, import, export and manufacture of all mercury-containing products (with some exceptions) by 2012.[1] While the passing of this Canadian policy is a key milestone to accomplishing the goal of eliminating the use of mercury, there will still be a need for Canadians' to properly dispose of legacy mercury-containing products and monitor their fish consumption to prevent exposure.

The purpose of this report is to inform Pollution Probe's development of educational materials in order to increase public awareness of mercury-containing products, health risks, and actions to reduce consumption and increase diversion. This report, and Pollution Probe's subsequent educational and communication materials, will focus on three main topics: the health and environmental impacts of mercury, including fish consumption guidelines; mercury containing products, including mercury-free alternatives; and the proper disposal of mercury-containing products, including current options, recommendations for improvements, and what citizens can do to change the current situation.

1.2 Methodology

In order to inform the ongoing mercury education and communication campaign, Pollution Probe draws on its 12 years of experience, including the development of a switch out campaign, a mercury-free hospitals campaign, and the production of a Primer titled "Mercury in the Environment". Pollution Probe also organized a mercury constellation, comprised of medical practitioners, and representatives from public health, environmental, and health organizations, to share information about mercury related issues and to provide feedback on potential outreach and education strategies that are most effective for their members and constituents. Finally, Pollution Probe conducted a literature review to investigate what is being done in other jurisdictions to determine best case examples of public education and outreach related to mercury and mercury-containing products.

[1] Environment Canada. 2007. Proposed Risk Management Instruments for Mercury-Containing Products: Consultation Document. http://www.ec.gc.ca/CEPARegistry/documents/part/wmd-dgd/pro-ris.cfm#backtotop.

2 Health and Environmental Impacts of Mercury

Education and communication materials that deal with mercury-related issues almost always start off with a section primarily focused on the effects mercury has on human health. This emphasis immediately deals with the audience question of "why should I care about this?". The environmental impacts of mercury are also usually mentioned, but unless the medium is a nature magazine or the author is a nature conservancy, these impacts are usually presented as how mercury in the environment can affect human health. The relationship drawn between environment and human health impacts will be emphasized later in the section on fish consumption guidelines.

The groups that are most sensitive to mercury exposure are pregnant women, breastfeeding mothers, infants, and children. This demographic poses benefits and challenges to organizations looking to develop communications to raise awareness of the impacts of mercury. This is a relatively easy to reach and target demographic — through doctors, paediatricians, Lamaze/parenting classes, day cares, etc; however, since children's health is such an emotionally sensitive issue, it is also an easy demographic to scare, and if communications are not explicit, could result in parents reacting with unwanted behaviours. As a result, best case communications of the effects of mercury on health and mercury for mothers and parents are highly targeted and contain explicit information on the health impacts of mercury, but avoid sounding alarmist.

Communicating the impacts of mercury to less sensitive, but still exposed groups — men over the age of 18 and women past childbearing years — has almost the opposite challenges to those previously discussed. This group is less easy to target, and since the threat is much less, are less concerned about their own exposure. As a result, best case communications for these audiences tend to be more alarmist, in order to grab their attention.

The benefits and challenges of communicating the health and environmental impacts of mercury to specific audiences will be discussed in the following sections on fish consumption guidelines, biomonitoring, and health promotion.

2.1 Fish Consumption Advisory Guidelines

Fish consumption guidelines or advisories should be a familiar concept to most people. While they can be focused on one specific issue, like mercury, they may also be issued to protect consumers from a combination of contaminants present in the fish they consume. Governments tend to issue fish consumption advisories at the federal, provincial or local level, if the content of contaminants in fish is found to be higher than Health Canada's recommended guidelines. This ultimately leaves the responsibility up to consumers to determine whether they are at-risk and if so, what species they should avoid. There are a number of barriers to changing fish consumption behaviours that outreach should address. A main barrier that fish advisories must overcome is limited awareness, and when individuals are aware they must understand the relationship between mercury and fish, and the recommended consumption behaviour.[2]

[2] Burger, J., Hughes McDermott, M., Chess, C., Bochenek, E., Perez-Lugo, M., and Pflugh, KK. 2003. Evaluating Risk Communication about Fish Consumption Advisories: Efficacy of a Brochure versus a Classroom Lesson in Spanish and English. *Risk Analysis*. 23: 4: 791-803.

Fish consumption guidelines are most commonly separated into two categories — sport fish consumption or commercial consumption guidelines. While the message for both of these categories is similar, the target audiences and distribution methods, as well as the barriers and challenges of reaching these audiences, are quite different. The following sections will identify both common and unique techniques to reach certain audiences, and will highlight the concerns and lessons learned that should inform the development of future campaigns and materials.

2.1.1 Sport fishing guidelines

Sport fishing guidelines are most commonly targeted toward anglers, specifically those who are licensed. Their purpose is to both inform audiences of the contaminants in fish and techniques to reduce their exposure, while at the same time reminding consumers of the many health benefits of fish.[3] Both in the US and Canada, state or province sport-fishing advisories usually appear in annual fishing regulation booklets. The underlying assumption in using this medium is that licensed anglers are accustomed to abiding by existing restrictions and recommendations for specific lakes and species and should easily accommodate new consumption recommendations into their catch and diets.

Unfortunately, by relying on regulation booklets as the medium to raise awareness, current sport fish advisories neglect two audiences who may consume large amounts of sport fish, unaware of restrictions: unlicensed anglers and the families of anglers. In order to assess women of childbearing years' awareness of state sport-fish consumption advisories, and consequently evaluate the advisory effectiveness, Anderson *et al* conducted a survey of the target audience to "assess the prevalence of fish consumption, understanding of mercury toxicity, and awareness of state sport-fish consumption advisories".[4]

In this US study, frequent consumers of fish, those who have a higher level of exposure to mercury than most (i.e., consume fish twice or more per week), were found to be slightly more aware of sport-fish consumption advisories and slightly more knowledgeable of mercury issues than less frequent consumers. However, there was still a substantial proportion of the target audience that lacked knowledge of advisories and mercury issues. This unaware demographic was identified as being more likely to be a minority, to have an income above $25, 000, to be over the age of 30, and have more than a high school education.[5]

Anderson *et al* found that only 20 per cent of women were aware of their state's sport fish consumption advisory. However, awareness was higher for women who actually consumed sport fish and had a member in their household who held a fishing license. Those who did possess knowledge of their states' sport fish consumption advisory were also more likely to know more about mercury (i.e., the risk of mercury to the developing fetus, the effect of mercury on the functioning of muscles, and the relationship between mercury and fish). However, over the course of the study, researchers noted that women aware of the advisory were likely to confuse recommendations made for avoiding PCBs with those made for mercury (e.g., women thought that removing fat and skin from fish would reduce their exposure to mercury). Awareness of state sport fish consumption advisories was dependant on whether there was a fishing license in the household, whether the household consumed sport fish, and the individual's level of education.

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[3] Anderson, HA., Hanarahan, LP., Smith, A., Draheim, L., Kanarek, M., and Olsen, J. 2004. The Role of Sport-fish Consumption Advisories in Mercury Risk Communication: A 1998-1999 12- state survey of women age 18-45. *Environmental Research*. 95: 315-324.

[4] Ibid. p.316

[5] Ibid

Anderson *et al* emphasized that minorities are more likely to consume sport fish regularly and to be unaware of advisories, giving them a higher risk of exposure than other demographics. They concluded that distributing advisory information with fishing licenses is not a good technique for reaching minority women who are frequent consumers. This study also found that since frequent fish consumers were likely to have higher education, be more wealthy and over 30, advisory outreach must target higher socio-economic consumers. This finding contradicted earlier assumptions that extra outreach was necessary for low-income subsistence anglers, who did not register as frequent fish consumers.

Case Study: the 1989–1999 Athabasca River fish consumption advisory effectiveness

In 1989 the Government of Alberta issued a public fish consumption advisory for certain fish species in the Athabasca River. All consumers were recommended to limit consumption of specific species to once per week based on levels of mercury, dioxins and furans that exceeded Health Canada's guidelines, while women of child-bearing age and children under the age of 15 were recommended to avoid specific species entirely due to their mercury-content. [6]

In a study conducted in 1998–1999 across Alberta, Jardine found that awareness of the advisory was localized around the Athabasca River. The majority of individuals attributed their knowledge of the advisory to the fishing regulation that had been implemented; however, newspapers and word of mouth also played a role in awareness. Despite being aware of the advisory, a very limited number of people actually knew which species were covered by it. Many who claimed to know listed species that were not covered under the advisory and failed to mention species actually covered by it. Although the majority of residents claimed to be aware of the advisory, many wanted more information and were unaware of where they could get it.

Through quantitative and qualitative research, Jardine outlined the specific information that the public wanted. The public wanted to know the potential health effects of the chemical; the types, sources and extent of the contamination; what is being done to reduce the contamination; any improvements in the contamination; what monitoring and testing is occurring; and additional background information (including why these chemicals only, why in this area only, etc.).[7] In addition, people wanted multiple independent sources for information, and for government to be more proactive in distributing information, ensuring that it is timely and up to date.

When asked where they would like to get information, respondents wanted multiple sources, including local media, advisory signs at popular fishing access points, internet, verbal prompting and reminding at the point of purchase for fishing licenses, promotion through local organizations, as well as trained conservation officers and health professionals who could explain the advisory as well as provide additional information.[8]

[6] Jardine, CG. 2003. Development of a Public Participation and Communication Protocol for Establishing Fish Consumption Advisories. *Risk Analysis*. 23: 3: 461-471.
[7] Ibid
[8] Ibid

2.1.2 Commercial fish guidelines

Commercial fish advisory communications most commonly target the most at risk group — pregnant or breastfeeding women and children. These advisories tend to chart which fish should be consumed regularly, rarely or never and are distributed as pamphlets and brochures[9], wallet cards,[10,11,12] or more recently as mobile guides[13,14]. The goal of these easily accessible fish advisories is to make fish advisories quickly referable so that people can remind themselves of what to avoid when buying or ordering fish.

Many organizations advocate that labeling of high mercury-content fish should be regulated and that grocery stores and restaurants should be required to inform their customers of the risks associated with some of their products. In the absence of government regulation however, much effort has been expended to develop highly effective fish consumption reminders as well as to develop campaigns to encourage corporate social responsibility among grocery chains and restaurants. In these campaigns, organizations have leveraged consumer concern to demonstrate the business case for gaining customer trust by voluntarily posting warning signs targeted to the most sensitive demographic.

BEST PRACTICES: Restaurant card campaign

A restaurant card campaign depends on highly aware and concerned consumers. This type of campaign has been conducted by organizations like seafood WATCH in the US, and SeaChoice in Canada, in order to encourage restaurants and chefs to serve sustainable fish choices. The following card was designed by Seafood WATCH, who relies on engaged customers to distribute the information to the restaurants they frequent.

[9] Toronto Public Health. A Guide to Eating Fish for Women, Children and Families. http://www.toronto.ca/health/fishandmercury/pdf/guide_eat_fish.pdf. Accessed 17/02/09.
[10] SeaChoice. Canada's Seafood Guide. http://www.seachoice.org/files/asset/file/37/SeaChoice_Alertcard.pdf. Accessed 17/02/09.
[11] Toronto Public Health. A Guide to Buying Fish for Women, Children and Families. http://www.toronto.ca/health/fishandmercury/pdf/guide_buy_fish.pdf. Accessed 17/02/09.
[12] Seafood WATCH. Sushi Guide 2009. http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SushiGuide.pdf. Accessed 17/02/09.
[13] Seafood WATCH. Mobile Seafood WATCH. mobile.seafoodwatch.org.
[14] Seafood WATCH. iPhone Application. http://www.montereybayaquarium.org/cr/SeafoodWatch/web/sfw_iPhone.aspx. Accessed 17/02/09.

Figure 1: Seafood Watch Become Aware Campaign

(Source: Seafood Watch)

The same idea could be adopted for restaurants that serve fish high in mercury. Environmental NGOs could develop information cards targeted to restaurateurs and chefs that provide information on the health impacts of consuming large amounts of mercury, highlight the highest mercury-content fish that they should avoid serving, and promote healthy low-mercury alternatives.

As a complementary measure to this campaign, seafood WATCH promotes a sustainable seafood policy for restaurants and retailers. Seafood WATCH has developed a number of resources to help businesses implement this policy, including alternative choices,[15] fact cards for staff members,[16] and a guide for best practices.[17] Finally, seafood WATCH creates a business incentive for restaurants and retailers to adopt a sustainable seafood policy by promoting their partners through links and recommendations to their audiences.[18] This process could again be adopted for a high mercury content fish campaign.

[15] Seafood WATCH. 2008 Culinary Chart of Alternatives. http://www.montereybayaquarium.org/cr/cr_seafoodwatch/sfw_alternatives.aspx. Accessed 17/02/09.
[16] Seafood WATCH. Fish Fact Cards. http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_FishFactCards.pdf. Accessed 17/02/09.
[17] Seafood WATCH. Sustainable Seafood Business Practices. http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_BusinssPractices.pdf. Accessed 17/02/09.
[18] Seafood WATCH. Partnerships. http://www.montereybayaquarium.org/cr/cr_seafoodwatch/sfw_partner.aspx. Accessed 17/02/09.

BEST PRACTICES: Grocery Chain campaign

The grocery chain campaign has leveraged customer petitions to convince the Safeway grocery chain to voluntarily display warning signs at their fish counters that target pregnant and nursing women, women who may become pregnant, and children, and warn against the most significant mercury-content fish (i.e., swordfish, shark, king mackerel, tilefish and tuna). While this does warn against the most significant threats, it does not point attention to the potential health impacts of high consumption of lower mercury-content fish.

Case Study: the 2001 Food and Drug Administration (FDA) methyl-mercury fish advisory

In early 2001, the FDA issued a commercial fish consumption advisory that cautioned at-risk individuals about the health impacts of consuming high mercury-content fish. According to Shimshack *et* al[19], The targeted at-risk individuals were infants, small children, pregnant or nursing mothers, and women who may become pregnant. The advisory warned of the damage methyl-mercury does to the developing or young nervous system and listed the large fish that should be completely avoided. It also indicated that general fish consumption by at-risk individuals should be limited to no more than 12 ounces per week.

The advisory communication campaign consisted of two phases. In the first phase, the FDA released pre-prepared newsprint and television press releases, sent media kits to targeted print sources such as weekly newspapers, parenting magazines, and women's health periodicals, and sent letters to physicians and health organizations. In the second phase, the same methods were used, but the message was framed as a reminder to the specific audiences.

Following the campaign, Shimshack *et al* found that responses to the commercial fish consumption advisory depended on education and newspaper readership. In households that had college educated consumers with young and nursing children, there was a significant decline in the consumption of canned fish after the advisory (approximately 50 per cent); however in households with less educated consumers that had young and nursing children, there was no change in fish consumption habits after the advisory. Households that had newspaper or magazine purchases also showed a reduction in fish consumption after the advisory (approximately 19 per cent); however within the less educated demographic, both targeted and non-targeted readers changed their fish consumption behaviour.

In concluding the study, researchers determined that access to information, and the ability to understand the information both determine whether consumers make the preferred behaviour changes following commercial fish consumption advisories. As a result, having access to newspapers may be enough to get information to readers, but unless those readers have a higher education, it is likely that untargeted audiences will make the consumption changes as well as the targeted audiences. Importantly for future campaigns, researchers found that in releasing information-based commercial fish consumption advisories, the FDA did not reach at-risk, non-college educated, non-readers of newspapers.

[19] Shimshack, JP., Ward, MB., Beatty, TKM. 2007. Mercury Advisories: Information, Education, and Fish Consumption. *Journal of Environmental Economics and Management*. 53: 158-179.

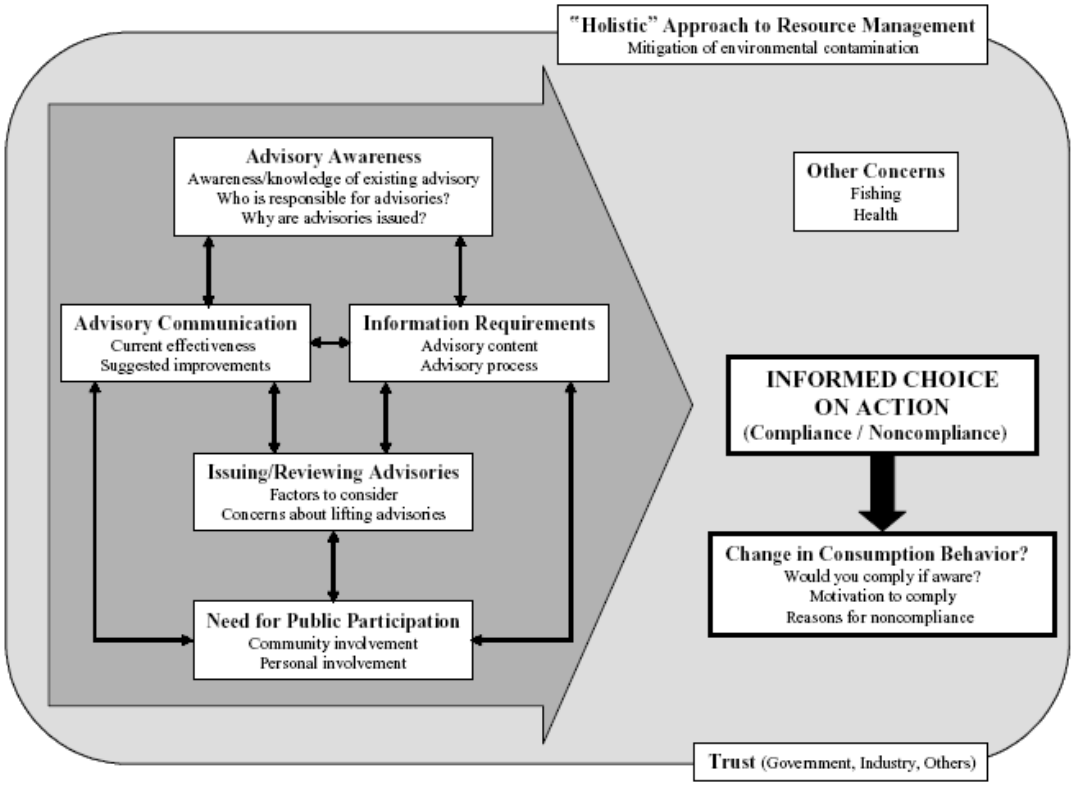
2.1.3 Lessons Learned

The FDA national commercial fish consumption advisory demonstrated that information-based communication policies can be effective for highly educated households that have access to information through newspaper or magazine subscriptions. However, it also revealed that information policies have significant distributional limitations and cannot be relied on to reach entire at-risk populations who have lower education and/or limited access to information. Finally, it was found that information policies result in spillover effects where not-at-risk consumers reduced their commercial fish consumption. This was mainly seen as a result of less educated households who had access to information that they were unable to understand.

The lack of reaction by less educated consumers led Shimshack *et al* to recommend broader and more targeted outreach programs, including health-advertising campaigns on public transportation, in-store advisory signs, and mandatory product labeling.

Through talking to the residents of the Athabasca River, a community with a long history of fish advisories, Jardine developed a conceptual framework for the interrelationship of the factors necessary for a successful and effective fish consumption advisory (see Figure 2).

Figure 2: Conceptual Framework for a Successful and Effective Fish Consumption Advisory



(Source: Jardine, 2003)

Jardine also determined that public participation should be sought by governments, industries, or organizations when issuing advisories to ensure a high level of compliance with the advisory. In order to facilitate this process, Jardine developed a list of fourteen "guiding principles for the public participation and communication component in the process to set and evaluate fish consumption advisories":

1. Protection of public health should be the primary objective of all health risk consumption advisories.
2. Advisories should be specific to the area and community involved. Advisories should be based on both scientific information and community needs and values.
3. All interested and affected parties should be given the opportunity to be involved in the process to set or review health risk consumption advisories.
4. Involvement of all parties should occur at the beginning of the process when the problem is defined.
5. The purpose of the process, the roles of those involved, and the design of the process should be clearly explained and agreed upon by everyone involved in the process.
6. All interested and affected parties should have equal access to relevant information and support a mutual learning environment.
7. The diverse values, interests, and knowledge of everyone involved in the participation process should be respected.
8. All parties should be willing to participate and work together.
9. Communication of the advisory should be complete and ensure public knowledge of the content and rationale for the advisory.
10. All communication should be open, honest, and accurate.
11. Communications should be balanced. In addition to the health risk information, communications should include information on the health benefits of eating fish and wildlife, and an explanation of other risk-reducing behaviours.
12. Participation and communications should be meaningful.
13. Evaluation should occur both throughout and at the end of the process.
14. Issuing health advisories is only one of the strategies to address the potential human health impact of contaminated fish consumption. Longer-term environmental improvement activities should also be part of an overall management plan.

2.1.4 Considerations for future development

A main concern for those issuing fish advisories is that by raising public awareness, communication and education campaigns may inadvertently drive the public to cut all fish species from their diet. Shimshack *et* al found that not-at-risk individuals aware of commercial fish consumption advisories responded by reducing their fish consumption, despite the intent of the advisory.[20] Anderson *et al* noted that communicating the risks of fish consumption while at the same time acknowledging the cardio and fetal development benefits is a complex process, stating "balancing the risk and benefit message needs to provide consumers the confidence that when informed, they can safely select and consume fish rather than simply avoid fish altogether".[21]

Another difficulty in communicating the impacts of mercury on health from the consumption of fish is that there are other issues of concern that tend to be acknowledged in fish advisories. Other issues of concern include sustainability issues like overfishing and environmental degradation, and

[20] Ibid.

[21] Anderson, HA., Hanarahan, LP., Smith, A., Draheim, L., Kanarek, M., and Olsen, J. 2004. The Role of Sport-fish Consumption Advisories in Mercury Risk Communication: A 1998-1999 12- state survey of women age 18-45. *Environmental Research*. 95: P.323.

other toxics like PCBs and dioxins. As a result, most mercury-based fish advisories do not deal with mercury in isolation. They integrate species of concern for other issues into the recommended list of fish to avoid and consume. However, in light of Anderson *et al*'s findings, that individuals were confusing techniques of how to avoid PCBs with how to avoid mercury, communication/advisory developers should ensure that messaging does not conflict. In cases where recommendations vary, chemical-specific advisories may be necessary.

Next Steps for Canadian Communications

This section will outline target audiences and messages for future fish consumption campaigns.

Based on mostly American research, the following audiences are not likely receiving understandable information on fish consumption that will motivate them to change their behaviour: those that do not have post-secondary education, as well as those who do not engage in news media. Another group of concern are higher income earners who are more likely to be high consumers of fish, and consequently may have higher exposures to mercury. Different communication methods will likely be necessary to target these groups.
Based on Canadian research of individuals who are accustomed to fish advisories, an advisory should be complemented by the following information:

- The potential health effects of the chemical;
- The types, sources and extent of the contamination;
- What is being done to reduce the contamination;
- Any improvements in the contamination;
- What monitoring and testing is occurring; and
- Additional background information (including why these chemicals only, why in this area only, etc.).[22]

Information should be shared by multiple independent sources, and government should be more proactive in distributing information, ensuring that it is timely and up to date.

There is recognition that for sport-fish advisories, messages will have to be further tailored for the regions they intend to serve. As a result, community groups, angling associations, and conservation authorities may be the best choice for disseminating information on regional advisories. Conversely, on the national scale many public health, environment and health organizations have developed consumption guides for fish purchased at grocery stores or eaten at restaurants. These campaigns have had varying levels of success, but could be complemented by campaigns targeting wholesalers and retailers, similar to the projects undertaken by Seafood WATCH.

2.2 Biomonitoring

Biomonitoring is defined by the United States Centers for Disease Control and Prevention (CDC) as "the direct assessment of human exposure to environmental chemicals by measuring the chemicals or their breakdown products in people's blood or urine". The goal of biomonitoring, which has been conducted since the late 1990's, is to both identify exposures to environmental chemicals as well as determine the potential correlations between exposure and disease.

[22] Ibid.

Technology developments over the past decade continuously improve the sensitivity of biomonitoring to extremely low levels of certain chemicals. However, since this type of testing is so relatively new, it is unknown what those levels mean in terms of human health. A workshop report on the scientific and technical issues of human biomonitoring programs states "biomonitoring indicates substances present in the body at a single point in time, corresponding to when the specimen was taken, but such data alone provide no information on the source, the magnitude, the frequency or the duration of exposure"[23] — in other words "the measurement of an environmental chemical in a person's blood or urine does not by itself mean that the chemical causes disease".[24] The National Research Council has stated "we do not know how to convey the biomarker-presence-does-not-indicate-health-effects message effectively".[25] As a result, interpretation and communication of the results are extremely difficult for health care practitioners or public health workers. Since mercury is measured by biomonitoring research, doctors will eventually be asked to explain the presence of this toxic metal in their patients' bodies. This section will examine the recommendations for biomonitoring communication in general in order to extrapolate how doctors should be prepared to discuss mercury specifically. The following section will identify recommendations and best practices as well as highlight the problems that practitioners have encountered with the public understanding of biomonitoring.

2.2.1 Biomonitoring Communication

While there are many issues associated with interpreting biomonitoring results, this task has been taken up by scientists and public health organizations, and as such, will not be examined in this chapter. However, once results have been interpreted, non-governmental organizations and health professionals will need to proactively communicate the interpretations to their audiences. The following section will identify the guidelines for how NGOs and health professionals should approach this interaction. One of the primary recommendations for this communication process is to abide by the steps dictated by traditional risk communication, specifically to ensure transparency and to discuss confidence and uncertainty.[26]

According to Bates *et al*, biomonitoring communication should explain the absolute rather than relative risk, as well as the clinically rather than statistically significant effects.[27] The same group highlighted additional communication needs — specifically "an established architecture to help audiences understand the meaning of individual and population-based biomonitoring results".[28] Often general practitioners are unprepared to deal with their patients inquiries about

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[23] Borgert, CJ. 2005. Workshop Report: Understanding Human Biomonitoring. *Regulatory Toxicology and Pharmacology*. 43. P215.

[24] United States Centers for Disease Control and Prevention. In Borgert, CJ. 2005. Workshop Report: Understanding Human Biomonitoring. *Regulatory Toxicology and Pharmacology*. 43. P215.

[25] National Research Council. 2006. As quoted in LaKind, JS., Aylward, LL., Brunk, C., DiZio, S., Dourson, M., Goldstein, DA., Kilpatrick, ME., Krewski, D., Bartels, MJ., Barton, HA., Boogaard, PJ., Lipscomb, J., Krishnan, K., Nordberg, M., Okino, M., Tan, YM., Viau, C., Yager, JW., and Hays, SM. (2008). Guidelines for the Communication of Biomonitoring Equivalents: Report from the Biomonitoring Equivalents Expert Workshop. *Regulatory Toxicology and Pharmacology*. 51: S16-S26.

[26] LaKind, JS., Aylward, LL., Brunk, C., DiZio, S., Dourson, M., Goldstein, DA., Kilpatrick, ME., Krewski, D., Bartels, MJ., Barton, HA., Boogaard, PJ., Lipscomb, J., Krishnan, K., Nordberg, M., Okino, M., Tan, YM., Viau, C., Yager, JW., and Hays, SM. 2008. Guidelines for the Communication of Biomonitoring Equivalents: Report from the Biomonitoring Equivalents Expert Workshop. *Regulatory Toxicology and Pharmacology*. 51: S16-S26.

[27] Bates, MN., Hamilton, JW., LaKind, JS., Langenberg, P., O'Malley, M., and Snodgrass, W. 2005. Workgroup Report: Biomonitoring Study Design, Interpretation, and Communication – Lessons Learned and Path Forward. *Environmental Health Perspectives*. 113:11: 1615-1621.

[28] Ibid.

biomonitoring, and often must refer them to a poison control centre that may subsequently refer them to a clinical toxicologist. One recommendation for improving this situation is to develop a line of communication between general practitioners to public health officials and use this link to transfer targeted information to physicians and their patients.

LaKind *et al* have identified three key questions that must be answered when communicating information related to biomonitoring: what health effects could this result have, how are people exposed to this chemical, and where can more information be found.[29] The same group of risk communicators further identified the key requirements for effective communication with health care professionals (HCPs): developing general biomonitoring background information for physicians and preparing HCPs for questions about biomonitoring from their patients.[30] These communications and messaging should include the following information:

- Interpretation of individual biomonitoring results in terms of probable disease can be impossible.
- The detection of a chemical does not mean disease is probable or likely
- Results can be dependent on the half-life of the chemical or the length of exposure.
- Fluctuations in chemical levels are normal and may not reflect a change in exposure. Identifying a trend requires repeated sampling over a period of time.
- Biomarkers are limited in the information they provide. They can demonstrate the presence of a chemical, but they do not demonstrate the source or the exposure.
- Biomarkers that demonstrate long-term exposure cannot identify the precise time of exposure.
- Different exposure pathways can result in varying levels of chemical concentrations.

When training physicians in how to talk with their patients about biomonitoring, LaKind *et al* point out that since very few physicians order biomonitoring tests for their patients, they are most likely to encounter the issues associate with interpretation of results when their patient has obtained biomonitoring data independently.[31] Based on this scenario, the following recommendations are made for physicians:

1. Discuss why the patient ordered the biomonitoring data in the first place. If they are concerned about point-source pollution near their home or workplace exposure, the physician may be able to direct them to a government agency for more information.
2. Compare the patient's concentrations to the available data for the general population. If any chemical concentrations are above average than physicians can order further tests and refer their patient to clinical toxicologists.

[29] LaKind, JS., Aylward, LL., Brunk, C., DiZio, S., Dourson, M., Goldstein, DA., Kilpatrick, ME., Krewski, D., Bartels, MJ., Barton, HA., Boogaard, PJ., Lipscomb, J., Krishnan, K., Nordberg, M., Okino, M., Tan, YM., Viau, C., Yager, JW., and Hays, SM. 2008. Guidelines for the Communication of Biomonitoring Equivalents: Report from the Biomonitoring Equivalents Expert Workshop. *Regulatory Toxicology and Pharmacology*. 51: S16-S26.

[30] Ibid.

[31] Ibid.

2.2.2 Case Study: The Flemish Centre of Expertise of Environment and Health[32]

The Flemish Centre of Expertise for Environment and Health started a human biomonitoring campaign in 2001 that not only measured environmental pollutants but focused on the necessary risk communication to accompany the results. The project team consisted of environmental and health experts as well as social science experts. In communicating to the public, the centre employed a mixed-methods approach that included traditional one-way expert-to-public risk communication as well as modern two-way risk communication techniques that engaged the public in the process.

The Centre developed three general principles for communicating human biomonitoring results:

- "Environmental and health problems are looked at differently depending on differences in personal background. Differences in risk perceptions are based on differences in the problem definition.
- All forms of knowledge (science, intuition, experience, values) are relevant and should be taken seriously.
- As a consequence of the complex character of environmental — and health research, scientific controversies and uncertainties are inevitable."[33]

The Centre also developed two specific directives for the communication of their biomonitoring results: transparency and participants first.

Before beginning the biomonitoring process, the Centre organized meetings and developed an information-based website to proactively explain and engage the public in the goals and aims of the project. Press conferences and additional information-based meetings were ongoing throughout the biomonitoring research to keep the public informed of progress and to encourage two-way communication between the public and experts.

To follow the participant first directive, the Centre first informed individuals of their results and provided them with international scientific information, information about uncertainties or unknowns, the possible risks of certain substances, and recommended ways to reduce risk or exposure. This information was also provided to health and environment experts as well as some general practitioners.

The Centre followed up this individual and public information dissemination with surveys to monitor risk perception. They monitored the level of trust that the public had in the communications of various organizations and identified three groups that hold varying levels of public trust. The group that holds the highest trust is comprised of general practitioners, scientists and environmental organizations. The public was found to have moderate trust in governmental authorities and the media. Finally, the public had the least amount of trust in polluters and politicians.

Focus groups of local stakeholders were also organized to inform the environmental, health, and social science experts at the Centre of local concerns and to make recommendations for information that should be included.

[32] Keune, H., Morrens, B., and Loots, I. 2007. Risk Communication and Human Biomonitoring: Which Practical Lessons from the Belgian Experience are of use for the EU Perspective? *Environmental Health*. 7 (Suppl 1): S11. Available at http://www.ehjournal.net/content/7/S1/S11.

[33] Ibid.

The Centre of Expertise for Environment and Health identified key success factors for biomonitoring risk communication plans: the direct and constant engagement of social scientists and open and transparent discussion among experts of other scientific disciplines, a mixed-method communication process as described above, and finally recognition of the need to balance quality communications with resources and realism.

2.2.3 The Problem of Polluted Breastmilk

The use of breastmilk as a biomonitoring indicator of the presence of environmental pollution in mothers can create communication opportunities as well as significant problems. Often activist environmental or health groups can point to the contamination of breastmilk as "a shock tactic to push for stronger laws".[34] While this communication can create a substantial spike in public awareness and significant policy results, it can also cause a backlash against breastfeeding by overshadowing the recognized nutritional benefits of the practice.

Upon review of breastmilk biomonitoring communication pieces, Arendt makes the recommendation that the presence of residues in breastmilk should be presented as the body burden of all humans, rather than "contaminated breastmilk". Arendt suggests communication should focus on the routes of exposure and that breastmilk biomonitoring campaigns should include lactation consultants as well as NGOs who are involved in protecting and supporting breastfeeding.

2.2.4 Next steps for Canadian communication

While interpretation of biomonitoring results will be left to public health agencies, this process should be transparent and involve the public. Proactive ongoing communication throughout the biomonitoring process should introduce the public to the concept and prepare general practitioners, public health experts, and environmental and health organizations for public questions and concerns about the implications of the results.

Finally, a role for non-governmental organizations would be to engage in this process as stakeholders, but also to develop a clear line of information exchange between the scientists who interpret the results, and the on-the-ground health care practitioners who are expected to explain those results to their patients. This role ties into the following section which examines existing materials that are designed to help health-care professionals both understand the main concerns about mercury exposure and toxicity and to discuss those issues with their patients.

2.3 Health Promotion

General practitioners are often the main point of contact for individuals who are concerned about their exposure to environmental toxics or their biomonitoring test results. Dentists can also be a point of contact for patients who are concerned about mercury exposure from dental amalgam. Through consultations, health organizations and public health agencies have indicated that general practitioners and dentists are often ill-equipped to translate issues related to mercury exposure, risk or avoidance into terms their patients can understand. Along the same lines, the US Environmental Protection Agency has listed providing outreach to health professionals and health

[34] Arendt, M. 2007. Communicating Human Biomonitoring Results to Ensure Policy Coherence with Public Health Recommendations: Analyzing Breastmilk Whist Protecting, Promoting and Supporting Breastfeeding. *Environmental Health*. 7 (Suppl 1):S6.

care associations as one of their priority activities for mercury risk communication.[35] In response to this need, organizations have developed briefing documents for physicians as well as communication materials for physicians to distribute to their patients. The following chapter outlines best practices for briefing physicians and for informing patients, as well as makes recommendations for areas where further materials or interactions may be necessary.

2.3.1 Materials for Physicians

While physicians must be prepared to talk about mercury to their patients, they should also be aware of the mercury-containing devices they might have in their own clinic or hospital. The following sections will examine materials that have been developed for physicians to reduce the presence of mercury within their own facilities, as well as to educate and raise the awareness of their patients about mercury.

Mercury-Containing Healthcare Devices

Health Care Without Harm (HCWH), a global coalition of organizations, and Health & Environment Alliance (HEAL), a European network of organizations, have combined their efforts in the "Stay Healthy, Stop Mercury" campaign to develop briefing fact sheets to help health care professionals avoid or properly dispose of mercury-containing devices in their workplace. Initial factsheets introduce health care workers to the prevalence of mercury in the health care industry, the concerning trend of breakage and improper disposal of mercury containing devices in the health care industry that results in exposure to staff and patients and release to the atmosphere, the laws and regulations that apply to the proper handling of mercury-containing devices, as well as existing alternatives and substitutions.[36] The factsheet also suggests campaigns that physicians could lead in their own place of work, including conducting a mercury audit, developing a mercury management policy if there are still mercury-containing devices in use, implementing a mercury-free purchasing policy, organizing education and information for employees, replacing mercury-containing devices, and organizing battery round-ups and thermometer exchanges for employees, family members, and the community.

Subsequent factsheets for the "Stay Healthy, Stop Mercury" campaign dealt with managing small mercury spills in the event of breakage of a mercury-containing device,[37] as well as substituting mercury sphygmomanometers (blood pressure measuring devices).[38] The latter factsheet was primarily intended to dispel common concerns or misconceptions about non-mercury containing medical devices, namely that they are less accurate and more expensive. In Europe, research has shown that general practitioners are hesitant to replace mercury sphygmomanometers because historically they have been considered more reliable: "there is a need for clearer statements

[35] United States Environmental Protection Agency. 2006. Communicating to the Public about Mercury Exposure Risks. *EPA's Roadmap for Mercury*. http://www.epa.gov/mercury/roadmap/htm. Accessed 11/13/2008.

[36] Health and Environment Alliance & Health Care Without Harm. Mercury in Health Care Factsheet. *Stay Healthy, Stop Mercury Campaign.* http://www.env-health.org/IMG/pdf/Health_Care_Industry_final.pdf. Accessed 28/01/09.

[37] Health and Environment Alliance & Health Care Without Harm. Managing Small Mercury Spills. *Stay Healthy, Stop Mercury Campaign*. http://www.env-health.org/IMG/pdf/Managing_Small_Spills_B-2.pdf. Accessed 28/01/09.

[38] Health and Environment Alliance & Health Care Without Harm. Substituting Mercury \ Sphygmomanometers. *Stay Healthy, Stop Mercury Campaign*. http://www.env-health.org/IMG/pdf/Sphygmo.pdf. Accessed 28/01/09.

distinguishing between the different types of alternatives, especially to differentiate between devices that comply with all international protocols, and less reliable equipment".[39]

Health Care Without Harm (HCWH) has further developed a pledge and resolution for "Making Medicine Mercury Free". [40] This pledge asks hospitals and other health care providers to commit to eliminating mercury from their facilities. The voluntary pledge commits hospitals and health care providers to conducting a mercury audit, eliminating the use of mercury by phasing out mercury-containing devices, approving a resolution to become mercury free, implementing a mercury-free purchasing policy, implementing a waste segregation and recycling program to prevent the improper disposal of mercury-containing devices, educating staff, conducting an assessment of the mercury management program, and collaborating with hospital associations and environmental services on the continued regulation of mercury. To help hospitals and healthcare providers to meet these commitments, HCWH has developed a peer-to-peer listserve "to share and learn technical information, find educational tools and identify practical strategies for mercury elimination and discuss other pollution prevention and waste minimization issues".[41]

Education for Healthcare professionals

While factsheets on mercury intended for the general public can be helpful to physicians, organizations have developed communications and educational kits targeted specifically to answer general practitioners questions.

In the US, The Agency for Toxic Substances and Disease Registry (ATSDR) has developed a "series of self-instructional publications designed to increase the primary care provider's knowledge of hazardous substances in the environment and to aid in the evaluation of potentially exposed patients".[42] Specifically, the ATSDR has developed a case study on Pediatric Environmental Health that includes an appendix on "Important Issues Regarding Mercury" that explains the basic forms of mercury as well as the indicators and treatments. It also indicates the three exposure sources that parents might be most concerned about: dental amalgam, thimerosal in vaccines and fish consumption. Other educational materials from ATSDR tend to be more scientific than the appendix and contain overviews of the health effects of acute and chronic exposure, specific sources, and the proper medical treatment for an individual who has suffered acute vapour inhalation.

In Canada, The Women's College Hospital has developed a "Mercury Detoxification Protocol" for doctors.[43] This protocol outlines the steps that a doctor should take when their patient has been diagnosed with having elevated blood mercury levels. The document identifies possible sources of

[39] COWI A/S and Concorde East/West Sprl European for the European Commission Directorate-General Environment. 2008. Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society. Contract: ENV.G2/ETU/2007/0021.

[40] Health Care Without Harm. Making Medicine Mercury Free – A pledge and resolution. http://www.h2e online.org/pubs/mercfree.pdf. Accessed 28/01/09.

[41] Health Care Without Harm. http://www.noharm.org/us. Accessed 28/01/09.

[42] Agency for Toxic Substances and Disease Registry. 2002. Pediatric Environmental Health. *Case Studies in Environmental Medicine*. http://www.atsdr.cdc.gov/csem/pediatric/docs/pediatric.pdf. Accessed 28/01/09.

[43] Bray, RI. Information for Doctors – Mercury Detoxification Protocol. The New Women's College Hospital. www.womenscollegehospital.ca. (2/12/08).

the exposure (i.e., dental amalgam or diet) and outlines procedures for eliminating mercury from the body. These procedures include:

- A low fat, high fibre diet
- Eating cooked prunes in rolled oats with ground flaxseed in the morning
- Drinking at least eight glasses of purified or filtered water per day
- Exercising daily for 20-30 minutes.
- Taking supplements (including vitamin C, selenium, magnesium, vitamin E, and zinc)

Materials for Patients

In addition to developing materials to educate doctors about mercury, organizations have developed materials for patients that communicate mercury issues in an accessible way. The Ontario College of Family Physicians and the Environmental Health Clinic at Sunnybrook and Women's College have developed a pamphlet on mercury exposure for doctors to distribute to their patients.[44] This pamphlet provides a comprehensive overview of what mercury is, how it is absorbed, what the health effects of exposure are, what types of exposure sources exist, who is most at risk, what exposure sources should be most concerning, what level of exposure is safe, how you can test your exposure, and how exposure and risk can be reduced.

A less comprehensive, but perhaps more accessible pamphlet has also been produced by the Environmental Health Clinic at the Women's College Hospital, called "the importance of being mercury-free".[45] This document presents the following information in simple and direct sections:

- What is Mercury?
- Effects on Adults and the elderly
- Effects on Children
- Exposure Sources of Mercury
    - At work
    - In the community
    - Personal
    - Home
- How to Avoid Exposure

Mercury in Vaccines

Thimerosal is a preservative that has historically been used in multi-dose vaccines to prevent bacteria and fungi from growing. Approximately fifty per cent of the weight of thimerosal is made up by ethyl-mercury. [46] As the quantity of necessary childhood vaccines have grown, so too has concern about the amount of mercury to which children are being exposed. At the same time, concerns about a link between thimerosal in early childhood vaccines and autism have grown, leading to a small but vocal opposition to the use of vaccines. While there is no scientific

[44] Bray, RI., and Kerr, K. 2003. Mercury Exposure: Information for Patients. Ontario College of Family Physicians (Environmental Health Committee) and Sunnybrook & Women's College (Environmental Health Clinic).

[45] Environmental Health Clinic. The Importance of being Mercury-Free. Women's College Hospital.

[46] Health and Environment Alliance & Health Care Without Harm. Mercury and Vaccines. *Stay Healthy, Stop Mercury Campaign*. http://www.env-health.org/IMG/pdf/Mercury_and_vaccines.pdf. Accessed 28/01/09.

correlation between the use of vaccines and neurological damage, many countries including Canada have acted with precaution and removed Thimerosal from most vaccines, except the flu shot and other multi-dose vaccinations (including Hepatitis B).

The issue of mercury in vaccines, similar to the issues of mercury in fish and "contaminated breastmilk" is that concern over exposure to toxics might result in extreme behaviour change that omits the benefits of the common behaviour (in this case, being vaccinated against serious diseases). General practitioners should be prepared to discuss the issues associated with mercury and be able to compare the relative risk of small or no exposure to the risk of not being vaccinated.

Health Canada and Public Health agencies have developed factsheets for individuals who are concerned about Thimerosal in vaccines. These sheets are mostly focused on dispelling myths or misconceptions about vaccines, specifically explaining that Canadian childhood vaccines do not contain Thimerosal.

2.3.2 Materials for Dentists

Dentists should be aware of the environment and health impacts of the mercury amalgam that they use in their offices. In Ontario, dentists are advised to fit their drainage sinks with devices that capture mercury and prevent its release to the environment. However through consultations, health organizations and public health agencies have indicated that despite installing mercury traps, some dentists may lack a comprehensive understanding of mercury issues. Without a significant understanding of mercury, dentists may be unable to discuss the health implications of fillings with their patients. Furthermore, dentists may be unable to provide the proper guidance when patients are concerned or have questions about removing older mercury-containing fillings.

Education for Dentists

The International Academy of Oral Medicine and Toxicology (IAOMT) is "a network of dental, medical and research professionals who seek to raise the standards of scientific biocompatibility in the dental practice".[47] IAOMT has prepared documents for dentists to raise their awareness about the health impacts of amalgam as well as to recommend best practices in the dental office to protect staff, patients and the environment. These documents include "The Scientific Case Against Amalgam"[48] and "Safe Removal of Amalgam Fillings".[49] The former document outlines the case against amalgam, the health effects of mercury exposure, the health implications for dentists themselves, as well as a summary of anecdotal experiences that patients claim to have had after the removal of their mercury fillings. The latter document acknowledges that while dentists may refuse to use amalgam, they still must be prepared to deal with it by removing it from their patients. This document provides a step-by-step checklist of issues dentists should consider before removing mercury fillings from their patients' mouths.

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[47] International Academy of Oral Medicine and Toxicology (IAOMT). http://www.iaomt.org/index.asp. Accessed 29/01/09.

[48] Koral, SM. 2005. The Scientific Case Against Amalgam. *International Academy of Oral Medicine & Toxicology.* http://www.iaomt.org/articles/files/files193/The%20Case%20Against%20Amalgam.pdf. Accessed 29/01/09.

[49] Koral, SM. 2007. Safe Removal of Amalgam Fillings. *International Academy of Oral Medicine & Toxicology*. http://www.iaomt.org/articles/files/files288/Safe%20Removal%20of%20Amalgam%20Fillings.pdf. Accessed 29/01/09.

Finally, the IAOMT has developed a lecture to teach dentists to "Protect yourself from dental office contaminants".[50] The lecture identifies the exposure risk that dentists, their staff and their patients face, and also identifies the most at-risk group: women of childbearing age that work in the office. The purpose of the lecture is to teach dentists to minimize their exposure to mercury, and to educate them to take greater precaution than is taught by the American Dental Association (ADA).

Materials for Patients

Various state government departments have developed informational brochures about mercury amalgam and fillings. In both Connecticut and Maine, the state legislatures passed a law requiring the Department of Environmental Protection[51] and the Bureau of Health[52] respectively to "make a brochure about the advantages and disadvantages to human health and the environment of using mercury amalgam fillings in dental work". Since the Maine State Legislature passed the law before the Connecticut State Legislature, the Connecticut Department of Environmental Protection was able to adapt the brochure already developed by Maine. These brochures detail the presence of mercury in amalgam fillings, and raise the health and environmental concerns about the use of it to fill cavities. They promote preventative measures to avoid cavities. The brochure also points out some of the key health questions that should dictate what type of filling should be used to fill a cavity. These are:

- Are you pregnant or nursing?
- Do you have any allergies?
- Do you soon plan to have braces?
- Are you taking any medications? What for?
- Do you have any kidney problems or a family history of them?
- Do you have any other health conditions of specific health concerns?

Finally, the brochures outline the pros and cons of amalgam and three alternatives (composite, glass ionomer, and gold or gold alloy) for filling cavities.

Another brochure on mercury amalgam for patients has been developed by the Dental Board of California and the California Department of Consumer Affairs titled "The Facts about Fillings".[53] This brochure is very similar to those produced in Maine and Connecticut, but includes profiles for additional alternatives to amalgam (e.g., porcelain fused to metal, porcelain, and nickel or cobalt-chrome alloys). Furthermore, this brochure identifies that by law, dentists must provide the brochure to every patient before beginning any cavity filling procedure. While this brochure contains less content than the others described previously, it identifies at-risk individuals (i.e., those with allergies, women of childbearing age and children) and emphasizes that patients discuss any dental treatment thoroughly with their dentist.

[50] International Academy of Oral Medicine and Toxicology. 2008. Protecting yourself from dental office contaminants. http://www.iaomt.org/articles/files/files301/Dental%20Office%20Contaminants.pdf. Accessed 29/01/09.

[51] Connecticut Department of Environmental Protection. 2006. Fillings: The Choices You Have – Mercury Amalgam and Other Filling Materials. http://www.ct.gov/dep/lib/dep/mercury/gen_info/fillings_brochure.pdf. Accessed 29/01/09.

[52] Maine Department of Human Services, Bureau of Health. 2002. Fillings: The choices you have – Mercury Amalgam and Other Filling Materials. http://www.maine.gov/dhhs/boh/files/odh/25-108-02%20PTMIental%20Brochur.pdf. Accessed 29/01/09.

[53] Dental Board of California. 2004. The Facts About Fillings. http://www.dbc.ca.gov/formspubs/pub_dmfs2004.pdf. Accessed 29/01/09.

2.3.3 Next Steps for Canadian Communication

The existing American informational and educational materials that have been identified here should be adapted for Canadian physicians and dentists. Building on the work done by the Ontario College of Family Physicians and the Environmental Health Clinic, Canadian health and environment organizations could develop resources for physicians and dentists to distribute to their patients. While developing these communications for dentists, Canadian organizations could also advocate for regulations that are similar to those in California that require dentists to provide the brochures to their patients before a filling decision is made.

Canadian organizations could also facilitate training workshops for Canadian physicians or dentists from American-based groups like the Agency for Toxic Substances and Disease Registry or the International Academy of Oral Medicine and Toxicology respectively.

Finally, Canadian organizations could follow the lead of Health Care Without Harm and the Health & Environment Alliance by promoting the elimination of mercury-containing devices from the Canadian healthcare system. By helping conduct facility mercury audits using materials similar to those developed by HCWH, and asking hospitals to make pledges for mercury-free procurement and managed disposal, Canadian organizations could help make Canadian hospitals safer for staff, patients, and the environment.

3 Mercury Sources and Exposure

3.1 Common Product Sources and Routes of Exposure

The main source of exposure to mercury for humans is through fish consumption.[54] As discussed previously, mercury that is released to the atmosphere through the burning of coal for electricity or the breakage and improper disposal of mercury-containing products eventually is deposited into aquatic systems where it bio-accumulates and magnifies through the food chain, resulting in the largest predatory fish having extremely high mercury content. A secondary exposure route for consumers is the accidental breakage of a mercury-containing product that can affect indoor air quality and potentially lead to hazardous exposure through inhalation of mercury vapours. Finally a tertiary exposure route, that is not examined in this report, is the use of mercury for cultural or religious purposes.

Government and industry can reduce the mercury content of fish and reduce the risk of mercury inhalation, and subsequently protect human health, by eliminating the non-essential use/production of mercury. The Canadian government is in the process of regulating the use of mercury, but in the meantime, and once the regulation is in place, consumers will need to be educated about the legacy mercury-containing products that remain in their households that could eventually harm their health directly, through breakage and inhalation, or indirectly, through improper disposal and release to the atmosphere. As a result, effective communication and outreach to consumers on mercury-containing products and mercury-free substitutes is a priority activity for mercury risk communication by the US Environmental Protection Agency.[55] The list of products that potentially contain mercury can be overwhelming (See Appendix);[56] however in Canada, most products have either had the metal phased out or replaced, or contain the less life-threatening form of mercury: ethyl-mercury. The following sections will outline the best practices and lessons learned from communication campaigns designed to raise awareness about mercury in products.

3.1.1 Vehicles

Until 2003 in the United States, mercury was used in most vehicles' convenience lighting (i.e., trunk and hood lights) and also in anti-lock brakes. Since that time, new uses for mercury in high intensity discharge (HID) headlights and lights in backlit panel displays have become common in vehicles. As a result of the new mercury-containing devices, as well as the longevity of vehicles (up to 20 years), there is, and will be, a legacy of vehicles that contain mercury that could pose a significant release of mercury in the future if scrapped improperly.

To bring this mercury legacy to the attention of the American public, the US based Ecology Center's Clean Car Campaign released a brochure in 2004.[57] This brochure consisted of graphs to

[54] United States Environmental Protection Agency. 2006. Communicating to the Public about Mercury Exposure Risks. *EPA's Roadmap for Mercury*. http://www.epa.gov/mercury/roadmap/htm. Accessed 11/13/2008.
[55] Ibid.
[56] United States Environmental Protection Agency. 2008. Table of products that may contain mercury and recommended management options. http://epa.gov/epawaste/hazard/tsd/mercury/con-prod.htm. Accessed 11/06/2008.
[57] Clean Car Campaign. 2004. Mercury in Vehicles Update: Automotive Mercury Releases to the Environment Reach Record Levels. Environmental Impact of Cars. http://ecocenter.org.

demonstrate the potential mercury releases without the elimination of mercury from vehicle production and the removal of mercury-containing devices from end-of-life vehicles. Frequently asked questions about mercury in vehicles were also answered at the end of the brochure to let consumers know what aspects of vehicle scrappage or purchasing they should be concerned about.

The Clean Air Foundation in Canada has taken a somewhat different approach to reducing the toxic emissions from the improper scrappage of vehicles that have mercury-containing devices. Instead of focusing on convincing consumers to do the right thing by demanding proper switch removal and disposal from their recycler, they have developed a campaign that enlists the cooperation of vehicle recyclers and dismantlers in removing, collecting, and managing mercury switches before scrappage. In return, participating recyclers and dismantlers are recognized by the "Switch Out" program and promoted as an environmentally responsible business. A further incentive to participating in the program is that the CAF have convinced Canadian steel producers to only purchase mercury-free auto scrap from automotive recyclers and dismantlers. To encourage participation in this campaign and to ensure responsible removal, collection and management of mercury switches and ABS brakes the Clean Air Foundation has developed a number of resources including:

- A Switch Removal Guide[58]
- A List of vehicles that may contain mercury convenience lighting switches[59]
- A List of vehicles that contain mercury ABS sensor modules[60]
- Detailed removal instructions for mercury convenience light switches[61]
- Detailed removal instructions for mercury ABS sensor modules for specific vehicle types[62]
- A general "Switch Out" brochure (to promote the benefits of the program)[63]
- A how-to movie on Removing a Convenience Lighting switch[64]
- A how-to movie on Removing the ABS Sensor Module from a Jeep Grand Cherokee[65]
- A how-to movie on Removing the ABS Sensor Module from a Ford Explorer[66]
- "Switch Out" Clean up Instruction (in case of breakage)[67]

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[58] Clean Air Foundation. Switch Removal Guide: Instructions for Removing, Collecting, and Managing Mercury Convenience Lighting Switches and Anti-lock Braking System Sensor Modules from End-of-life Vehicles. *Switch Out Campaign*. http://switchout.ca/documents/Switch_Out_Removal_Guide.pdf. Accessed 30/01/09.

[59] Clean Air Foundation. Vehicles that May Contain Mercury Convenience Lighting Switches. *Switch Out Campaign.* http://switchout.ca/documents/Switch_Out_Conv_Light_Vehicle_List.pdf. Accessed 30/01/09.

[60] Clean Air Foundation. Vehicles that Contain Mercury ABS Sensor Modules. *Switch Out Campaign*. http://switchout.ca/documents/Switch_Out_ABS_Sensor_Vehicle_List.pdf. Accessed 30/01/09.

[61] Clean Air Foundation. Removal Instruction for Mercury Convenience Lighting Switches. *Switch Out Campaign.* http://switchout.ca/documents/Switch_Out_Conv_Light_Instructions.pdf. Accessed 30/01/09.

[62] Clean Air Foundation. Removal Instructions for Mercury ABS G-Force Sensor Modules. *Switch Out Campaign*. http://switchout.ca/documents/Switch_Out_ABS_Sensor_Instructions.pdf. Accessed 30/01/09.

[63] Clean Air Foundation. Switch Out. *Switch Out Campaign.* http://switchout.ca/documents/Switch_Out_Brochure.pdf. Accessed 30/01/09.

[64] Clean Air Foundation. Removing a Convenience Lighting Switch. *Switch Out Resources*. http://switchout.ca/educational-materials/switch-out-resources/index.aspx. Accessed 30/01/09.

[65] Clean Air Foundation. Removing the ABS Sensor Module from a Jeep Grand Cherokee. *Switch Out Resources*. http://switchout.ca/educational-materials/switch-out-resources/index.aspx. Accessed 30/01/09.

[66] Clean Air Foundation. Removing the ABS Sensor Module from A Ford Explorer. *Switch Out Resources.* http://switchout.ca/educational-materials/switch-out-resources/index.aspx. Accessed 30/01/09.

[67] Clean Air Foundation. Switch Out Mercury Clean-up Instructions. *Switch Out Campaign*.

These resources have been developed to help recyclers and dismantlers adopt the proper mercury management habits. Most of the Clean Air Foundation's "Switch Out" campaign is directed towards the scrappage industry rather than towards the public.

3.1.2 Thermostats

Thermostats are another consumer product that have had mercury phased out, but whose legacy still raises concern over disposal. Replacing mercury-containing thermostats and properly disposing of them has two benefits: the first, that mercury has been safely removed from an individuals' home and has been prevented from entering the atmosphere by improper disposal; and the second, that newer mercury-free thermostats, especially those that are programmable, are more energy-efficient than older models and can consequently reduce a household's demand for coal-power generation.

The Clean Air Foundation in Canada has created a thermostat replacement and collection program in response to the legacy issue of mercury containing thermostats called "Switch the 'Stat". Unlike their "Switch Out" program, "Switch the 'Stat" targets consumers as well as service providers (i.e., contractors and wholesalers). The instructions for service providers are much simpler than those for auto recyclers and dismantlers since contractors do not need to remove the mercury switch from the thermostats — they only need to recover and ship the entire thermostat for safe disposal. Contractors who provide this service are recognized and promoted by the Clean Air Foundation.

To reach consumers, the Clean Air Foundation has produced a "Switch the 'Stat" brochure that expresses the prevalence of mercury-containing thermostats in Canada and emphasizes the environmental and health concerns that are raised from their improper disposal.[68] This brochure advocates both the energy-efficiency and conservation benefits of switching to a programmable thermostat as well as the health and environmental benefits from preventing the release of mercury to the atmosphere through improper disposal. Finally, by recognizing "Switch the 'Stat" compliant contractors, the brochure becomes a promotional piece that contractors can use to increase their own business.

In a factsheet titled "Phasing out Mercury Thermostats: Solving a persistent pollution problem", the US based National Wildlife Federation also advocates for the safe replacement of mercury-containing thermostats.[69] This factsheet introduces the problem of improperly disposing of mercury-containing thermostats during renovations and attempts to convince homeowners and contractors to properly replace old thermostats immediately rather than keeping the toxic-containing device in their home indefinitely. The factsheet addresses some barriers to making the switch, highlighting efficient alternatives that are available and illustrating the lack of major cost differences between purchasing mercury and non-mercury thermostats, as well as gives homeowners incentive for responsibly making the change, describing the pollution and health impacts of improperly disposing of mercury-containing products and illustrating the potential magnitude of the issue based on the number of mercury-containing devices across the state.

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http://switchout.ca/documents/Switch_Out_Clean_Up_Instructions.pdf. Accessed 30/01/09.

[68] Clean Air Foundation. Make the Right Switch! *Switch the 'Stat Campaign*. http://www.cleanairfoundation.org/switchthestat/documents_sts/Switch_the_Stat_Brochure.pdf. Accessed 30/01/09.

[69] Lipman, Z. 2006. Phasing out Mercury Thermostats: Solving a persistent pollution problem. *National Wildlife Federation's Clean the Rain Campaign*. http://www.nwf.org/wildlife/pdfs/MercuryThermostats.pdf. Accessed 11/13/2008.

Finally, the National Wildlife Federation uses the brochure to build public support for its policy recommendations: phase out the sale of mercury-containing thermostats, ensure the proper collection and recycling of thermostats for an extended period of time, prohibit the improper disposal of mercury-containing thermostats, require or incent developers and contractors to use energy efficient products and designs, and require state agencies to have toxic-free procurement policies.

3.1.3 Lamps

Unlike vehicles and thermostats, which have viable mercury-free alternatives, there are no cost-effective energy-efficient alternatives for mercury-containing lamps. Recent regulations in Canada and the US have actually ensured that mercury-containing compact fluorescent light bulbs (CFLs) will replace mercury-free incandescent light bulbs by 2012. The primary reason behind this change is the energy-efficiency savings that CFLs provide over incandescent lamps. According to Natural Resources Canada, "CFLs use far less energy than incandescent bulbs, so they reduce greenhouse gas emissions from electrical generating stations powered by fossil fuels".[70] This does not mean however, that governments have chosen increased mercury exposure to prevent greenhouse gas emissions. Moreover, by reducing energy demand from coal-power plants, the production of mercury through the burning of coal for energy will also be reduced. According to US based Physicians for Social Responsibility, "Coal Powered Electricity Plants are the largest industrial emitter of mercury — producing one-third of all mercury pollution in the US."[71] As a result, governments have decided that adding mercury to lamps will still result in a net reduction of atmospheric mercury.

While scientists and governments have researched the risks and benefits of CFLs and decided that the outcome of reduced energy demand is best for human health and the environment, there has been significant public concern and reaction to the use of mercury in residential lightbulbs. As a result, governments and non-governmental organizations have developed communication materials that attempt to overcome concerned public sentiments.

Communicating the benefit of a mercury-containing product

In Canada, Natural Resources Canada (NRCan) has an energy-efficient product website that provides information on CFLs. The webpage on "Mercury in Compact Fluorescent Lights" answers questions such as how much mercury is in a CFL and whether CFLs are safe. The webpage also emphasizes the energy savings that results from using a CFL compared to a regular incandescent bulb. In addition, the webpage addresses how CFLs can reduce the amount of mercury released to the atmosphere despite containing it: "coal fired power plants are the country's largest source of human-made mercury. The less power the facilities produce, the less mercury is released into the environment. CFLs actually reduce the amount of mercury introduced into the environment because of their greater efficiency when compared to incandescent lighting".[72]

[70] Natural Resources Canada. 2008. Energy Star Canada: Questions and Answers on CFLs. http://oee.nrcan.gc.ca/energystar/English/consumers/questions-answers.cfm?attr=4. Accessed 11/6/2008.

[71] Physicians for Social Responsibility (PSR). (2004). Environment and Health Program: Sources of Mercury. http://www.psr.org/site/DocServer/Mercury_Fact_Sheet__2.pdf?docID=709. Accessed 11/13/2008.

[72] Natural Resources Canada. Mercury in Compact Fluorescent Lights. http://oee.nrcan-rncan.gc.ca/residential/business/manufacturers/mercury.cfm?attr=8. Accessed 03/30/09.

Another webpage developed by NRCan on CFLs is "Switch and Save — Questions and Answers on CFLs". This page further addresses health concerns that individuals may have about using mercury-containing lamps in their home. A few noteworthy points from this document come from the answers to two questions: the first — "If CFLs contain mercury, how can they be better for the environment than incandescent lights?", and the second "how much mercury is in compact fluorescent bulbs?" In response to the former, NRCan makes the following points:

- "CFLs use far less energy than incandescent bulbs, so they reduce greenhouse gas emissions from electrical generating stations powered by fossil fuels
- CFLs last up to 10 times longer than incandescent bulbs, so fewer bulbs and less packaging ends up in landfills
- The amount of mercury in a CFL is so small — less than one-fifth of the mercury found in a wristwatch battery — that it does not pose a significant threat to human health of the environment (nevertheless, CFLs should be handled with care and disposed of properly)
- By decreasing the demand for electricity from coal-fired generation plants — one of the largest sources of mercury emissions in Canada — CFLs can actually reduce mercury levels in the environment." [73]

In response to the latter question, NRCan states:

> "The average mercury content in a CFL is about three milligrams — roughly the amount it would take to cover the tip of a ball-point pen. By comparison, older thermometers contain 500 milligrams of mercury — the equivalent of more than 100 CFLs. A common wristwatch battery contains five times more mercury than a CFL.
>
> Although there is currently no substance that can replace the efficiency properties of mercury to produce light in fluorescent lamps, manufacturers have reduced the amount of mercury used in lamps. Some manufacturers have voluntarily reduced the mercury content in CFLs by about 80 per cent in the past decade, to as little as two milligrams per bulb. Research is ongoing to achieve further reductions and, ultimately, to develop a mercury-free fluorescent lamp.
>
> The chart below compares the mercury content in a CFL to other household items."[74]

Product	Amount of Mercury	Number of Equivalent CFLs
Compact fluorescent lamp	5 milligrams	1
Watch battery	25 milligrams	5
Dental amalgams	500 milligrams	100
Home thermometer	500 milligrams – 2 grams	100 – 400
Float switches in sump pumps	2 grams	400
Tilt thermostat	3 grams	600
Electrical tilt switches and relays	3.5 grams	700

(Source: Natural Resources Canada, "Switch and Save", 2008)

[73] Natural Resources Canada. 2008. Switch and Save – Questions and Answers on CFLs. http://oee.nrcan.gc.ca/energystar/English/consumers/questions-answers.cfm?attr=4. Accessed 11/16/2008.

[74] Ibid.

Addressing Common Concerns Among the Public

The United States Environmental Protection Agency and Department of Energy have collaborated on the ENERGY STAR program, to encourage the use of energy efficient products and practices to save money and protect the environment. Together they have developed a factsheet titled "Frequently Asked Questions: Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury".[75] This factsheet identifies why CFLs should be used, why they contain mercury, why they should be concerned about mercury, and significantly, how a CFL produces less mercury than an incandescent, despite containing it: "[coal generated] electricity use is the main source of mercury emissions in the US. CFLs use less electricity than incandescent lights, meaning CFLs reduce the amount of mercury into the environment".[76] The following chart and graph were used to illustrate that a single 13 watt CFL improperly disposed of will still produce 4.5 mg less of mercury than a mercury-free incandescent bulb.

Light Bulb Type	Watts	Hours of Use	kWh Use	National Average Mercury Emissions(mg/kWh)	Mercury from Electricity Use (mg)	Mercury From Landfilling (mg)	Total Mercury (mg)
CFL	13	8,000	104	0.012	1.2	0.6	1.8
Incandescent	60	8,000	480	0.012	5.8	0	5.8

(Source: ENERGY STAR, 2008)

The concern has been raised that the reduced production of GHGs and mercury from coal plants due to the increased efficiency of mercury-containing lamps, is not necessarily a viable argument in regions that only rely on hydro-electric power (i.e., Quebec and British Columbia). In response to these concerns, the Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG) has conducted a comparative lifecycle assessment of incandescent and compact fluorescent bulbs in the Quebec context.[77] With regards to mercury, CIRAIG found that the advantages of CFLs significantly outweighed the issue of mercury content: "the significance of the mercury and electronic ballast...represent no more than one per cent of the potential environmental damages".[78]

Project Porchlight is the household efficiency project of One Change, a non-governmental organization in Canada. The aim of the project is to encourage individuals to reduce their energy consumption by making the switch to more efficient light bulbs (i.e., CFLs). Their website contains a factsheet that addresses some of the main informational barriers that might prevent consumers

[75] US Environmental Protection Agency & US Department of Energy. 2008. Frequently Asked Questions: Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury. *ENERGY STAR PROGRAM.* http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf. Accessed 11/13/2008.

[76] Ibid.

[77] Michaud, R., Belley, C. 2007. Comparative Life Cycle Assessment of Compact Fluorescent and Incandescent Light Bulbs. Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG).

[78] Ibid.

from making the switch. Most of the dispelled myths are not associated with mercury, and rather have to do with the reliability and longevity of the bulb. The main mercury message emphasizes disposal:

> "**Dispose of CFL bulbs properly:** The bulbs have a **minute amount of mercury.** It is important that CFL bulbs not be thrown in the regular garbage. All household hazardous waste (CFL bulbs, batteries, old cell phones, etc.) should be **disposed of properly.** Check your municipal website for disposal options. You can also bring spent bulbs to Home Depot stores."[79]

BEST PRACTICES

Project Porchlight features a video titled "CFL Lightbulbs in Plain English by Common Craft.[80] This video communicates the same messages used in the government and non-government communications (i.e., CFLs reduce money and pollution), but has been created by Common Craft for non-commercial use. As a result, governments and NGOs can use this material to promote the use of energy-efficient CFLs. The mention of mercury-content in this video comes at the end and is tied to reminding individuals of the need to properly dispose of the bulbs at their end-of-life. There is no mention however, of the proper clean up technique.

CFL Breakage

In the US, the EPA and DOE ENERGY STAR Frequently Asked Questions article targets the concern that individuals may have about bulbs breaking in their house and how to properly clean up afterwards by outlining "the six steps to cleaning up breakage":

1. Open a window and air out the room for 15 minutes or more
2. For hard surfaces, use stiff paper or cardboard to scoop up glass fragments and powder and place in a glass jar or plastic bag. DO NOT use a vacuum or broom.
3. For carpeting or rug, pick up glass and use sticky tape to pick up remaining glass and powder. Vacuum the rest of the materials and immediately put all materials (including vacuum bag or debris) in a sealed plastic bag.
4. Throw away clothing or bedding — DO NOT wash.
5. Place all clean up materials outdoors and wash hands.
6. For future cleaning, air out room before, during and after vacuuming.[81]

Natural Resources Canada's recommendations mirror those made by the EPA and DOE. However, one extra line is added "All of this can be done by oneself — no need to call in a hazardous waste team."[82]

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[79] Project Porchlight. Fact Sheet. *One Change*. http://www.projectporchlight.com/bulb/factsheet. Accessed 11/13/2008.

[80] LeFever, L & S. CFL Lightbulbs in Plain English. *Common Craft*. http://www.youtube.com/watch?v=cF5g0FgZQsA. Accessed 2/2/09.

[81] US Environmental Protection Agency & US Department Of Energy. 2008. Frequently Asked Questions: Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury. *ENERGY STAR PROGRAM.* http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf. Accessed 11/13/2008.

[82] Natural Resources Canada. 2008. Switch and Save – Questions and Answers on CFLs. http://oee.nrcan.gc.ca/energystar/English/consumers/questions-answers.cfm?attr=4. Accessed 11/16/2008.

In Canada, Project Porchlight provides a simpler description for dealing with broken CFLs:

> "One of the questions that comes up frequently with CFL bulbs is...
> "How do I dispose of them?"
>
> Disposal is a concern because CFLs do contain very small amounts of mercury (two to five miligrams).
> But don't worry. CFLs are still perfectly safe to use. To put it in perspective a watch battery has about 25 mg and a tooth filling 100 mg. Even if a CFL breaks, you need to be more worried about getting cut by the glass than the mercury.
>
> Just sweep up the glass and put it in a safe container for disposal."[83]

This description goes on to describe the proper disposal methods that will be discussed in the next section.

Reduced Mercury or Mercury-Free Options

Natural Resources Canada notes that while all fluorescent lamps contain a small amount of mercury to function efficiently, the mercury-content can vary among manufacturers. They point out that ENERGY STAR qualified bulbs must meet the most stringent standards for content:

> "**Note:** CFLs built by different manufacturers will vary in performance and quality. However, if they are ENERGY STAR qualified, they are required to meet stricter standards including mercury content, and must be tested in laboratory. ENERGY STAR qualified CFLs are the only products we can be sure meet these performance standards. On the other hand, all CFLs must be tested for "safety"; this is a mandatory requirement for ALL CFLs."[84]

Project Porchlight discusses the future for lighting, specifically the mercury-free alternatives for CFLs:

> "**Other types of energy-efficient lighting:** LED technology is the next wave of energy efficient lighting. LED bulbs as they currently stand are too expensive and not of a light quality appropriate for most consumers. In a few years they will be appropriate for mass consumption. LED lights are 95 per cent more energy efficient than incandescent bulbs."[85]

3.1.4 New Applications of Mercury for Future Concern

While most of the mercury emissions that consumers can control have been covered in previous sections, current applications of mercury have been identified that will be of concern in the future: backlighting in electronics displays, batteries for purposes exempted by the battery directive, mercury biocides in paints, mercury used in the maintenance of lighthouses, and the mercury used as catalysts in the production of polyurethane elastomers.[86]

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[83] Project Porchlight. Bulb Disposal. *One Change*. http://www.projectporchlight.com/bulb/disposal. Accessed 11/13/2008.

[84] Natural Resources Canada. 2008. Mercury in Compact Fluorescent Lights. *Office of Energy Efficiency*. http://oee.nrcan.gc.ca/energystar/english/consumers/mercury.cfm?text=N&printview=N. Accessed 2/2/09.

[85] Project Porchlight. Fact Sheet. *One Change*. http://www.projectporchlight.com/bulb/factsheet. Accessed 11/13/2008.

[86] COWI A/S and Concorde East/West Sprl European for the European Commission Directorate-General Environment. 2008. Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society. Contract: ENV.G2/ETU/2007/0021.

3.1.5 Next Steps in Canadian Communication

As the concern with mercury in products becomes a legacy issue, current programs run by the Clean Air Foundation will be increasingly helpful in raising awareness and preventing the improper releases of the toxic to the atmosphere. However, there is a need to improve the public's awareness of the presence of mercury in new compact fluorescent lightbulbs. Recommendations for communication on labeling and disposal will follow; however, environmental organizations could address the presence of mercury in lamps proactively while promoting their efficiency savings. This may include an insert or promotional item to accompany new bulb purchases.

3.2 Labeling of Mercury-Containing Products

Labeling mercury-containing products is an identified risk-management strategy for alerting consumers of the need to handle the product carefully and to dispose of it properly to prevent hazardous exposures or releases of mercury. Since proposed legislation by Environment Canada will limit the use of mercury in products to lamps and amalgam, there will be little use for labeling of other products after 2012, when the proposed regulations should come into effect. Some American states have implemented more stringent labeling requirements for mercury-containing products. At points these requirements are product specific, while in Vermont there is a standard labeling requirement for **all** mercury-containing products. The following sections will provide an overview of some labeling requirements, both standard and product specific, and will highlight unique contents.

3.2.1 Standard Labeling Requirements

The Vermont Department of Environmental Conservation has developed guidelines for the label wording, specifications and packaging of mercury-containing products.[87] The requirements for the wording and content of the label include:

- Wording must be at a minimum 10 point font, including information placed in sales literature, care and use manuals, as well as product labels.
- There is no minimum label size, but it must accommodate minimum wording at 10 pt font
- Must appear on the surface of the product in materials sufficiently durable to remain legible for the useful life of the product
- Must clearly inform the consumer that mercury is present AND provide information for disposal.
- Must identify the component within a larger product with sufficient detail so that it can be located for removal.

[87] Vermont Department of Environmental Conservation. 2007. Standard Labeling Requirements. *Mercury Education & Reduction Campaign*. http://www.mercvt.org/manreq/1998reqmts/stdlabel.htm. Accessed 2/2/09.

In Vermont, labels indicating mercury content must be displayed directly on the product as well as on the package label. Requirements for labeling include:

- Be placed directly on the mercury-added component and package;
- Be placed directly on the incorporated component in addition to the larger product for products which incorporate mercury added components;
- Be placed on the package of the larger product;
- Provide a prior-to-purchase label which notifies the customer of the presence of mercury before its purchase (depends on how the product is marketed, may be by website, sales literature, packaging);
- Be a legible label that is visible on the product;
- Is required on all mercury containing products except when the product does not have a package or its package is unable to support a label;
- Is required on replacement part packages; and
- Is required on repackaged products — the manufacturer repackaging the product is responsible for the labeling of the new package.

Products that fall under alternative mercury labeling requirements are exempted from this standard labeling requirement (e.g., products with mercury containing lamps as the only component, vehicles, etc.). Furthermore, manufacturers can submit an alternative label request if the body of the product makes it difficult to attach a label directly to the surface.

3.2.2 Vehicles

Although most mercury-containing devices in vehicles have been phased out (i.e., in switches and brakes), there are product-specific mercury labeling requirements for vehicles in the United States. The US based Coordinating Committee for Automotive Repair (CCAR) has outlined these requirements in a document.[88] According to CCAR, vehicle mercury labeling requirements are as follows:

- "Labels must appear as words or symbols or both to indicate to the buyer that mercury is present.
- Labels must be clearly visible prior to any sale
- Labels must be affixed to the product and must be durable for the useful life of the product.
- Both the product and package or the care and use manual must be labeled.
- If a mercury-containing product is a component of another product, the product containing the component and the component must both be labeled if the component is easily removable from the product by the consumer."[89]

3.2.3 Lighting

In 2003 the National Electrical Manufacturers Association, the US trade association of choice for the electrical manufacturing industry, initiated a nationwide program to label mercury-containing lamps and their packaging. In their description of the labeling initiative, NEMA indicates its preference for labeling requirements, points our issues that exist with current labeling laws, and makes recommendations for the national implementation of a mercury labeling program.[90]

[88] Coordinating Committee for Automotive Repair (CCAR). 2003. "Labeling Requirements for Products the Contain Mercury". http://www.ccar-greenlink.org/mercury/labeling.html accessed 11/13/2008.
[89] Ibid.
[90] National Electrical Manufacturers Association (NEMA). 2003. "The Labeling of Mercury Containing

NEMA recommends the development of a harmonized national approach, opposed to regulations that vary by region. A main issue for manufacturers is that they produce products for a national market and have no way of knowing where the lamps will end up. This role is relegated to distributors (wholesalers and retailers) and as a result manufacturers cannot assume the destination and affix regional labels. In addition to lacking control over distribution, the required regional content of labels are so varied that manufacturers have difficulty creating a label that satisfies all regions that their product may end up in (e.g., in some states it is illegal to dispose of mercury-containing lamps with solid waste, whereas other states do not provide recycling opportunities).

Industry Recommendations

NEMA recommends that the international symbol for mercury (Hg) be used on the product to indicate the content of mercury. This would eliminate language issues. Packaging labels in the proper language could then further explain what Hg means. In order to satisfy regional disposal regulations, NEMA recommends that all packaging state "MANAGE IN ACCORD WITH DISPOSAL LAWS", making it the consumer's responsibility to determine what their regional disposal laws are. Finally, in order to help consumers to find their regional disposal laws, NEMA has created and maintains a website that links to disposal regulations in all regions to which the lamps are distributed. The website url, www.lamprecycle.org, is included on the packaging of the mercury-containing lamps.

OSRAM SYLVANIA demonstrates their mercury labeling program on their website.[91] The following label appears either on the innermost package of the mercury-containing lamp, the outer carton, or both:

3.2.4 Next Steps for Canadian Communication

Labeling of products is a complex process that requires cooperation between industry, government and stakeholders. The current role for environmental organizations is to take part in labeling discussions as a stakeholder.

Alternatively, organizations could promote Energy Star certified bulbs, which have been tested for quality and mercury content, as the best choices for consumers in terms of conserving energy, saving money, and reducing mercury in the household and environment.

Lamps". http://ecom.mysylvania.com/miniapps/saveenergy/labelingofmercurylamps.pdf. Accessed 12/04/2008.

[91] OSRAM SYLVANIA. 2007. "Labeling of Products – Mercury Labeling". http://www.sylvania.com/aboutus/energyandenvironment/regulationslegislation/environment/mercurylabeling/. Accessed 11/13/2008

4 Disposal of Mercury-Containing Products

While government and manufacturers should be ensuring the steady reduction of the presence of mercury in consumer products, there is still a need for communication materials and educational kits that promote the proper disposal of legacy mercury-containing products as well as mercury-containing lamps, whose volume will continue to grow as incandescent lamps are phased out. Government, industry and non-government organizations have developed materials for audiences such as general public consumers, building owners, contractors and distributors, recyclers and household hazardous waste managers, and governments, to promote responsible disposal of mercury-containing devices. The following sections outline the materials that have been developed for these target audiences.

4.1 Information for End Users

End users of mercury-containing products can include individual consumers or owners and managers of commercial businesses or agencies. This audience is ultimately responsible for the disposal or management of the mercury-containing products and as a result has been targeted by municipalities, retailers, and industry associations to encourage proper management.

Information for Homeowners

The City of Toronto has developed a section of its waste diversion website to provide "safe disposal options for fluorescent tubes and compact fluorescent light bulbs (CFLs)".[92] This webpage highlights the benefits of energy-saving fluorescent lamps (i.e., conserve energy and last longer) and addresses the concern of mercury content. The City of Toronto points out that although residential CFLs are not legally considered hazardous waste (and consequently homeowners cannot be charged for disposing of them with residential waste) there are better and safer options for the environment and human health. The three options for Toronto residents to properly dispose of their CFLs are as follows:

- Drop off CFLs at one of the city's six Solid Waste drop-off depots (provides a listing of locations and a phone number to call.
- Use Toronto's "Toxic Taxi" service if you have between 10-50 litres of household hazardous waste (HHW).
- Bring CFLs to local community environment day events. (The website provides a listing of days/locations).

Information on energy efficient lights and recycling are also available on IKEA's Canadian website under a section on social and environmental responsibility.[93] This webpage informs consumers about mercury in products and justifies their use by emphasizing their energy saving capabilities and longevity. Finally, IKEA offers a free light bulb take back program by providing recycling bins in all IKEA stores. By advertising this program to consumers, IKEA is reminding them of proper disposal techniques.

[92] City of Toronto. 2008. "Safe disposal options for fluorescent tubes and compact fluorescent lamps/compact fluorescent light bulbs (CFLs)". http://www.toronto.ca/garbage/fluorescent.htm. Accessed 11/13/2008.

[93] IKEA. 2004. "Social & Environmental Responsibility". http://ikea.com/ms/en_US/about_ikea/social_environmental/environment.html. Accessed 11/13/2008.

Instructions for Building Owners and Managers

The industry organizations involved in the US Lamp Recycling Outreach Program (LROP) (i.e., Association of Lighting and Mercury Recyclers (ALMR), National Electric Manufacturers Association (NEMA), and Solid Waste Association of North America (SWANA)) have developed a brochure for consumers or building lighting procurers, identifying their role as being the "lamp disposal decision makers".[94] It goes on to more specifically target decision makers and influencers:

Decision makers — building owners and commercial property managers, industrial facilities, government institutions, electrical, lighting maintenance and demolition contractors.

Influencers — solid waste industry, local governments, electrical distributors, Energy Star buildings and Rebuild America partners.

To target building owners, the US LROP has developed a specific "Message for Building Owners and Managers".[95] This message identifies the role of building owners and managers as having responsibility to manage the mercury-containing lighting used in most commercial properties. The message goes on to identify what building owners/managers should do (i.e., educate employees on proper disposal of end-of-life bulbs), and what responsibilities owners/managers have (i.e., health concerns, legal regulations and financial incentives). It identifies existing recycling services and indicates best practices for their level of lamp generation. For example, small generators could participate in a box program where owners/managers ensure that spent lamps are loaded into specific lamp containers that are in turn sent to recyclers via ground mail when full. Large generators on the other hand have the ability to organize pick-ups by carriers to transport spent bulbs to accumulation facilities for consolidation prior to shipment.

Finally, the message for building owners and managers provides guidelines to support owners/managers in their transition to lamp recycling. First, the message tackles pricing, recommending that owners/managers question pricing and get more than one quote from their distributor or recycler and cautions that the cheapest quotes may not necessarily result in the proper disposal of the lamps. Secondly, the message recommends considering service as a selection criteria (i.e., responsiveness, timeliness, program flexibility and customization, personnel, capabilities and equipment). Finally, the guide provides a list of important factors for evaluating recyclers to ensure that lamps are properly being disposed of:

1. Whether they meet insurance requirements for general and pollution liability
2. The financial health of the company
3. What indemnities or other assurances they offer clients
4. Their environmental record and compliance history
5. The existence of government permits and approvals for facility operation or transportation
6. Operations and safety procedures and records
7. Vapour control technology and monitoring records
8. Hygiene and medical surveillance information
9. Status of a facility closure plan
10. Facility audit reports
11. Availability of key regulatory contacts.

[94] Association of Lighting and Mercury Recyclers (ALMR), National electrical Manufacturers Association (NEMA) and Solid Waste Association of North America (SWANA). 2003. "The Lamp Recycling Outreach Program – Lamp Recycling: The responsible thing to do!" Vol 1. Iss. 1. http://www.lightcorp.com/PDFs/LampRecycling.pdf. Accessed 11/02/09.

[95] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for Building Owners and Managers". http://nema.org/lamprecycle/support_files/builders.htm. Accessed 11/13/2008.

4.2 Information for Distributors

Distributors of mercury-containing products can include retail distributors (i.e., retail stores), wholesale distributors who deliver lamps to buildings, contractors who replace mercury containing products in homes or buildings, or environmental groups who encourage the use of mercury-containing lamps to reduce energy consumption. This audience can act as an influencer and consequently could be responsible for notifying end-users of the toxic contents of their products, as well as for providing a take-back for recycling service.

Industry and environmental organizations as well as governments have developed communication materials and campaigns to take advantage of the relationship between distributors and end-users. The following section will highlight communications and campaigns that have been designed for distributors to ensure the proper disposal of mercury containing products.

Information for Environmental Organizations

The US Lamp Recycling Outreach Project (LROP) has developed a "Message for Environmental Groups" to define their role in ensuring proper disposal of mercury-containing products.[96] The message identifies the role for environmental groups as being that of promoting recycling through education and outreach, as well as raising public awareness of the dangers and health impacts of mercury pollution and the subsequent need to recycle. The message provides action items and pre-developed messaging that environmental organizations can use to accomplish these goals. The recommended action items for environmental organizations include distributing/using pre-developed materials in educational programs (sourced from www.lamprecycle.org) and to campaign for the inclusion of mercury and lamp recycling in public policy development and initiatives for both businesses and households.

The messaging recommendations for environmental organizations are targeted toward homeowners and residential lighting. Messaging should include advising homeowners of their responsibility (legally and morally), advising them of recycling opportunities (e.g., recycling centres, household hazardous waste facilities, collection events, etc.), and advising them of the significant energy efficiency benefits of CFLs compared to traditional incandescent lights.

Information for Contractors

As mentioned previously, the Clean Air Foundation (a Canadian environmental organization) has developed a contractor take-back program for residential mercury-containing thermostats called "Switch the Stat".[97] In this program, the Clean Air Foundation aims to inform contractors of the presence of mercury switches in thermostats and the danger they pose to health and environment when disposed of improperly. This information gives contractors the responsibility of positively or negatively impacting their community's health: they could dispose of the old thermostat with household waste and send the mercury to landfill, which subsequently will release 2.5-10 grams of mercury, which has the potential to contaminate a 20–80 hectare lake to the point where the fish are not edible for a full year; or they could participate in the "Switch the Stat" program and responsibly dispose of the old mercury-containing thermostat and a recycling facility will

[96] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for Environmental Groups". http://nema.org/lamprecycle/support_files/environ.htm. Accessed 11/13/2008.

[97] Clean Air Foundation. 2008. Switch The Stat Website. http://www.cleanairfoundation.org/switchthestat/index.asp. Accessed 12/16/2008.

dismantle the thermostat, recycle the parts, and prevent the mercury from contaminating air, soil and water.

The US Lamp Recycling Outreach Project (LROP) has also developed a "Message for Contractors" to address the opportunities that exist for them to support or promote the recycling of mercury-containing products.[98] This message identifies the contractors who could influence the disposal decisions: those involved in electrical, maintenance, relamping, janitorial, and demolition. Lamp recycling is presented as a new business opportunity for contractors, emphasizing that collecting and transporting materials to recycling facilities could generate profit or add value for better customer relations. Mirroring the LROP's message for building owners and managers, this message outlines federal regulations and laws that contractors should be aware of, and cautions contractors about the dangers of lamp breakage. Finally, this message makes recommendations for proper packing and shipping techniques, as well as provides the same guidelines for selecting a recycler as outlined earlier in the "message for building owners and managers".

Information for Sellers

The Recycling Council of Ontario (RCO) has developed a distributor take-back program called "Take Back the Light".[99] This program is aimed at lamp sellers and buyers with the goal of recovering and recycling the mercury-containing fluorescent lamps generated by the industrial, commercial and institutional sector (IC&I). This program encourages sellers who are dropping off new lamps at IC&I buildings to simultaneously provide a take-back program for their customer's spent lamps. Alternatively, this program is used by environmentally-minded customers who demand that their lamp seller provide a recycling service. The Recycling Council of Ontario has developed a list of reasons to convince distributors to participate in the program, including:

1. Participation will reduce the impacts of the business on human health and the environment.
2. Participation will add value to the relationship between distributor and client.
3. Participation increases the visibility of the distributor by being recognized for their participation through the program.
4. Participation increases the perception of the distributor or the building as an environmental leader.

The US Lamp Recycling Outreach Project (LROP) has a specific "Message for Distributors" that provides distributors with the justification for initiating a take-back program and the rationalization to use when approaching building owners/managers or contractors.[100] The message is mostly an explanatory document that communicates the regulations that may apply to building owners and contractors (i.e., can accumulate lamps for up to one year, transportation can be done via common carrier and that no permitting is required), as well as the regulations associated with disposal (i.e., those who crush their own mercury containing lamps are subject to

[98] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for Contractors". http://nema.org/lamprecycle/support_files/contractors.htm. Accessed 11/13/2008.
[99] Recycling Council of Ontario. 2008. Take Back the Light. http://takebackthelight.ca/why.htm. Accessed 11/13/2008.
[100] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for Distributors". http://www.nema.org/lamprecycle/support_files/distributors.htm. Accessed 11/13/2008.

more stringent regulations). Furthermore this message provides two situational examples of when distributors need to reassess their responsibility:

1. Lighting Retrofits: during a lighting retrofit, the large number of waste lamps may classify as hazardous waste, and consequently it is the responsibility of the owner and contractor to manage the waste properly. Distributors are not legally responsible, but they can notify the owner/contractor of their responsibility and can assist with recycling options.
2. Broken Lamps: breaking lamps are responsible for the highest levels of exposure to mercury. Distributors should ensure proper handling techniques (i.e., carefully pack end-of-life bulbs to avoid breakage in the package that the new lamps arrive in). Some states have limits on the number of broken lamps allowed in a shipment of waste that can result in higher disposal costs.

This message also suggests existing best practices for the various levels of lamp generation (i.e., for small, large and very large lamp generators).

4.3 Information for Processors

Processors of mercury-containing products can include product-specific or general recyclers, household hazardous waste managers, or solid waste managers. This audience is responsible for following best practices to ensure that mercury-containing products are properly dismantled to ensure minimal mercury release through breakage, or for monitoring the waste stream to identify level of recycling compliance.

Information for Solid Waste Managers

The US Lamp Recycling Outreach Project (LROP) has developed a "Message for the Solid Waste Industry" that identifies who is responsible, what regulations exist, and what recycling/diversion processes exist.[101] In this instance, government and private solid waste haulers, solid waste transfer facilities, municipal solid waste landfills, municipal refuse facilities, recyclers, contractors, industry, and local government solid waste agencies are classified as solid waste managers. The message identifies federal and state regulations that solid waste managers should be aware of and identifies roles and best practices for specific types of managers:

Haulers and Collectors: encourage recycling of mercury-containing lamps by setting up collection services for generators and transporting spent lamps to recycling facilities. Haulers and Collectors could charge a fee for picking up lamps or organizing a drop-off location. Another responsibility could be educating customers on the health and environmental impacts of mercury and on how to handle and pack spent lamps.

Facility Operators: encourage recycling by developing a protocol for screening loads for mercury-containing lamps as well as for dealing with hazardous loads of waste if they are brought to the facility. Operators could also proactively educate haulers about the impacts of mercury-containing lamps and direct them to the proper recycling facilities.

Solid Waste Agencies: encourage recycling through education, outreach and by collecting lamps directly or through a private company. Agencies should enforce regulations when granting permits and making inspections.

[101] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for the Solid Waste Industry". http://www.nema.org/lamprecycle/support_files/solidwasteind.htm. Accessed 12/05/2008

Information for Product-Specific Recyclers

As mentioned previously, in Canada the Clean Air Foundation has developed a program called "Switch Out" that encourages auto recyclers to remove mercury switches from vehicles before processing them. In order to overcome any knowledge barriers that recyclers may have, CAF has developed a series of educational materials, including the "Switch Removal Guide: Instructions for Removing, Collecting and Managing Mercury Convenience Lighting Switches and Anti-lock Braking System Sensor Modules from End-of-life Vehicles".[102] This guide outlines where recyclers should look in specific makes and models of vehicles to find the mercury-containing switches, as well as the process of removing the switches and brake sensors.

The guide also highlights two important motivators for recyclers to participate in "Switch Out":

1. Canadian Steel Producers will only be purchasing mercury-free auto scrap (business case)
2. Mercury will be prevented from entering the environment and affecting human health (altruistic case).

4.4 Information for Government

The US Lamp Recycling Outreach Project has a final message: for local governments.[103] This identifies local governments' role as being the first contact point for businesses and the public and therefore should be familiar with regulations for lamp disposal and should be able to direct inquiries to local recyclers. Local governments could take a step further and provide assistance to local businesses in setting up mercury-free procurement, management or recycling plans.

Other roles identified by the LROP include:

- Offer and advertise household hazardous waste recycling programs for residential and IC&I sectors
- Offer collection for small quantity generators
- Organize collection points
- Commission contractors or hazardous waste depots to recycle end-of-life lamps
- Add lamps to the checklist of compliance items for building inspectors — check what companies do with their lamps and then provide information on recycling.
- Encourage green building procurement programs.
- Require contractors to provide customers with containers for end-of-life lamps

[102] Clean Air Foundation. 2008. Switch Removal Guide: Instructions for Removing, Collecting, and Managing Mercury Convenience Lighting Switches and Anti-lock Braking System Sensor Modules from End-of-life Vehicles. http://www.switchout.ca/documents/Switch_Out_Removal_Guide.pdf. Accessed 11/02/2009.

[103] National Electrical Manufacturers Association (NEMA). "Lamp Recycling Outreach Project – Message for Local Governments". http://www.nema.org/lamprecycle/support_files/localgov.htm. Accessed 11/13/2008.

4.5 Next Steps for Non-Government Organization Communication

The Ontario Provincial government is currently developing a plan to deal with waste from mercury-containing lamps. This plan is expected to be presented to government from the stewardship organization in early summer 2009 with implementation to follow. In the meantime, environmental organizations can play a role in raising public awareness of the special disposal needs of these bulbs at end-of-life. An additional role for NGOs could be the development of educational materials for distributors to provide to consumers, as well as the production of informational kits to educate municipalities, household hazardous waste facilities and other so-called "solid waste managers" who may not be familiar with the concerns associated with mercury-containing lamps.

Once the provincial recycling plan is implemented, environmental organizations can support the recommendations and continue playing a role in educating and encouraging households to recycle their lamps.

5 Summary

This literature review has examined public education and outreach related to mercury and mercury-containing products in other jurisdictions to identify best case examples. Pollution Probe and other organizations can adapt these examples to better educate the citizens of Ontario to prevent the health and environmental impacts of mercury release and exposure. In the interest of simplicity, this report segmented communication and public outreach materials into three categories: Health and Environmental Impacts, Mercury Sources and Exposures, and Disposal of Mercury-Containing Products.

The extent of communications and outreach that has been conducted on the health and environmental impacts of mercury required a further segmentation of materials into sections on fish consumption, biomonitoring, and health promotion. Based on best practices in other jurisdictions, Pollution Probe or other organizations could conduct the following projects to improve public outreach on these topics:

Fish Consumption

- Organize workshops or prepare education kits for local conservation authorities, angling associations, and permit sales locations (e.g., Canadian Tire) to prepare them to act as disseminators of information on sport fish advisories.
- Organize workshops or prepare education kits for restaurants and retailers to encourage sustainable business decisions and responsible customer service.
- Develop materials for responsible retailers to provide to their customers, explaining fish advisories and mercury-related concerns.

Biomonitoring

- Develop a line of communication between scientists and health-care providers.
- In partnership with medical associations or schools, organize workshops or training sessions for health-care providers.

Health Promotion

- Help hospitals and doctors' offices conduct mercury audits by adapting pre-developed checklists of common mercury containing devices and promoting their proper disposal as well as viable alternatives.
- Promote and enlist commitments from hospitals and doctors' offices to develop mercury-free procurement policies.
- In partnership with medical associations or schools, organize workshops and training for health-care providers on the health and environmental effects of mercury exposure and techniques to avoiding it.
- Draw upon existing resources to develop information for health-care providers to distribute to their patients, including:
    - Information for mothers on fish consumption
    - Information on Thimerosal in vaccines
- Adapt and promote the information developed in the US that is intended to educate dentists on the health effects of mercury and prepares them to talk with their patients about the issues associated with dental amalgam.
- Develop materials on fillings for dentists to give to their patients.

Due to expected Canadian legislation that will ban non-essential uses of mercury, the sections on mercury sources and exposure as well as disposal mainly focused on mercury-containing lamps. Based on best practices in other jurisdictions, Pollution Probe or other organizations could perform the following roles to improve public outreach on these topics:

Promotion and Labeling

- In partnership with manufacturers and/or retailers design an insert or promotional material to accompany new bulb sales that emphasizes their efficiency, but also mentions the presence of mercury.
- Organize a workshop to proactively engage CFL promoters in raising the public's awareness of the mercury-content of the new lamps.
- Participate in labeling negotiations as a stakeholder.
- Promote the Energy Star label as the most reliable, efficient and reduced mercury option.

Recycling

- Target residential lighting and promote recycling.
- Develop prompts for homeowners to prevent disposal of mercury-containing bulbs
    - Stickers for recycling bins
    - Partner with garbage/recycling collectors to deliver prompts when improper disposal of CFLs occur.
- Provide support to existing recycling programs by developing communication materials and distributing to networks and communities.
- Develop materials for distributors (e.g., retailers, contractors, etc.) to distribute to their customers regarding proper disposal techniques.
- Organize workshops or produce educational kits for municipalities and household hazardous waste depots to promote safe handling and disposal.