Spring 5-15-2010

Assessment of Existing Mercury Fact Sheets for Development of a Revised Mercury Fact Sheet

Subash C. Patel
Georgia State University

Abstract

Subash Patel
Assessment of Existing Mercury Fact Sheets for Development of a Revised Mercury Fact Sheet
Committee Chair: Dr. Christine Stauber

Introduction:

A mercury fact sheet that contains essential information and can be clearly understood by majority of adults is needed. In Fiscal Year 2009, EPA responded to more releases related to mercury than any other release. Since 2003, EPA has responded to more than 200 mercury releases. The American Association of Poison Control Centers estimate more than 50,000 people have been exposed to mercury vapors from 2003 to 2008, and 19,000 mercury cleanups have occurred from 2006 to 2008.

Purpose:

To determine what information needs to be included in a mercury fact sheet and how it should be created to inform adults who may be important in preventing and limiting exposure during accidental mercury release in the United States.

Methods:

The Flesch-Kincaid Grade Level Formula Data and the Suitability Assessment of Materials (SAM) tool were used to determine readability and appropriateness of twelve fact sheets related to elemental mercury. Length of fact sheets and illustration coverage percentage were also assessed. In addition, surveys were performed with four people who were involved in response to mercury releases in 2007 to 2009. The information they provided was also summarized to determine important elements that should be included in the fact sheets.

Results:

Information in a fact sheet should include the background of mercury, procedures in the event of a release, and ways to prevent releases. Based on the Flesch-Kincaid Grade Level, the literacy levels required to comprehend the 12 facts sheets was 11.4 on average. The majority of adults cannot comprehend the twelve fact sheets evaluated. Based on the evaluation of the material using SAM, none of the fact sheets scored higher than adequate with SAM. Only two fact sheets were written on one page and none of the fact sheets used relevant, simple illustrations with captions.

Discussion:

An effective mercury fact sheet needs to be about one page long and focuses on background, procedures, and prevention of exposure during a mercury release. Information obtained from interviews found that people focused the majority of their attention on the first page only. The fact sheet needs to be written at a sixth grade reading and to be able to receive a superior rating

when assessed with SAM. This will ensure that the fact sheet is readable and comprehendible by the majority of adults and include the necessary information that the public must know regarding mercury. A new fact sheet was developed and assessed using both Flesch-Kincaid level and SAM and was found to have a 6.6 reading grade level and received a superior score under SAM. This fact sheet will be used by EPA along with the existing more comprehensive fact sheets at state agencies, and poison control centers for future releases and will be given to schools to educate and prevent future releases.

Assessment of Existing Mercury Fact Sheets for Development of a Revised Mercury Fact Sheet

By Subash Patel

B.S.E, Mercer University, 2003

A Capstone Submitted to the Graduate Faculty of Georgia State University in Partial Fulfillment of the Requirements for the Degree

Master of Public Health

Atlanta, GA 30303

2010

Assessment of Existing Mercury Fact Sheets for Development of a Revised Mercury Fact Sheet

By

Subash Patel

Approved:

Christine Stauber, Ph.D., M.S.
Committee Chair

John Steward, M.P.H.
Committee Member

Glenn Adams
Committee Member

Date:

Acknowledgements

I would like to thank the Institute of Public Health's faculty for an exceptional learning environment at Georgia State University. I want to give a big thank you to Dr. Christine Stauber, Professor John Steward, and Glenn Adams for their patience, direction, and knowledge in making a product that is beneficial to the public health of millions of Americans. I also want to thank Professor Russ Toal for encouraging me to continue with my MPH. I would like to thank Fernando Rivera for assisting with the Spanish translation of the new fact sheet. Lastly, I would like thank my family, fiancée, and friends for the unconditional love and support while pursuing the MPH.

Authors' Statement

In presenting this thesis as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish this thesis may be granted by the author or, in her absence, by the professor under whose direction it was written, or in his absence, by the Associate Dean, College of Health and Human Sciences. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve any potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without written permission of the author.

_____

Signature of the Author

Notice to Borrowers

All these deposited in the Georgia State University Library must be used in accordance with the stipulations described by the author in the preceding statement.

The author of this capstone is:

Subash Patel
70 East Lake Terrace
Atlanta, GA 30317

The Chair of the committee for this capstone is:

Christine Stauber, Ph.D., M.S.
Institute of Public Health
Georgia State University
P.O. Box 4018
Atlanta, GA 30302-4018

Users of this thesis who not regularly enrolled as student as Georgia State University are required to attest acceptance of the preceding stipulation by signing below. Libraries borrowing this thesis for the use of their patrons are required to see that each user records here the information requested.

NAME OF USER	ADDRESS	DATE	TYPE OF USE (EXAMINATION ONLY FOR COPYING

Curriculum Vitae

Subash Patel
70 East Lake Terrace, Atlanta, Georgia 30317
Subash.Patel@gmail.com

Education:

Georgia State University, Atlanta, GA
Master of Public Health, Health Policy & Management – May 2010

Mercer University, Macon, GA
Bachelor of Science and Engineering, Environmental Engineering – May 2003

Experience:

United States Environmental Protection Agency, Atlanta, GA
Emergency Response & Removal Branch
On-Scene Coordinator (Aug. 2006 to Present)

- Respond to emergencies that threaten public health and environment
- Perform oversight and directions of federal time-critical superfund site
- Assess sites to determine if it needs to be addressed by the agency
- Address impacted communities through interviews and public meetings

Air Enforcement Section
Environmental Engineer (Aug. 2003 to Aug. 2006)

- Conduct facility inspections subject to the Secondary Aluminum MACT and the Stratospheric Ozone Protection Program
- Briefed Regional Administrator to recommend referral of a multi-regional case and of a secondary aluminum case to the Department of Justice
- Awarded Silver Medal for efforts towards settlement of multi-regional case and Bronze Medal for enforcement cases involving Secondary Aluminum MACT

Air Toxics Implementation & Assessment Section
Detail (Nov. 2004 to Feb. 2005)

- Assist in development of a revised relative risk ranking, hot spot analysis, and risk driver analysis

United States Environmental Protection Agency, Washington, DC
Environmental Engineer Intern (Summer 2003)
Water & Groundwater Section

- Interviewed city water municipalities to determine efforts to treat cryptosporidium

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

Background

The United States Environmental Protection Agency (EPA) responded to more elemental mercury (mercury) releases than any other release nationwide in Fiscal Year 2009 (EPA Accomplishments, 2010). Since 2003, the EPA has responded to more than 200 mercury releases. Many of these incidents occurred when a student brings mercury to school, shares it with friends, and then it is spread throughout the school and brought home. Many more students and faculty unintentionally track mercury with their shoes when it is spilled. It is then tracked to buses, cars, and homes. Faculty, students, and their families become exposed.

In addition to the health risks from exposure, the decontamination process for mercury is stressful and resource intensive for those involved. During this process, EPA provides oversight or initiates the process. The school may have to shutdown for several days. Families whose homes are contaminated may be required to relocate while their homes are cleaned for mercury, and personal items that came in contact with mercury may have to be discarded. The majority of mercury sources during the mercury release incidents appear to be from parents or grandparents who store mercury in a container such as a jar, mercury thermometers where several are broken and the mercury is collected, and stolen from dental offices (personal communication with Carbonaro, January 11, 2010, and Easton, 2007).

In addition to EPA's responses to mercury releases, the American Association of Poison Control Centers (AAPCC) have counted more than 50,000 people have been exposed to mercury from 2003 to 2008, and more than 19,000 mercury cleanups have occurred from 2006 to 2008 (AAPCC, 2008). Therefore, it is vital that a mercury fact sheet is created for parents and the

school's faculty that is readable, comprehendible, and contains essential information to prevent exposure and minimize contamination during accidental mercury releases.

Purpose of Study

The purpose of this study was to determine what essential information needs to be included in a mercury fact sheet and if the existing mercury fact sheets effectively communicated information to the public. The study included primary data from:

- Interviews with mercury experts, toxicologists, and risk assessors from EPA, Agency for Toxic Substances and Disease Registry (ATSDR), and/or Georgia Poison Control Center,
- Interviews with EPA and state responders,
- Flesch-Kincaid readability assessment of fact sheets, and
- Suitability Assessment of Materials assessment of fact sheets.

The study also included a literature review and case studies from scientific articles and public data from agencies' websites and reports. A mercury fact sheet was then created to reflect the data obtained from the study.

Research Questions

To create an improved mercury fact sheet, the analysis of the data focused on two specific questions:

- What is the essential information that needs to be included in a mercury fact sheet?
- What are important components to a fact sheet that could be read and understood by the majority of adults in the United States?

Chapter II

Review of Literature

The purpose of this study was to determine needed information for an elemental mercury fact sheet which can be used for outreach to prevent mercury releases, and to be given to residents impacted by an emergency response for elemental mercury contamination. The literature review focused on the following nine areas with respect to elemental mercury and health communication:

1) Physical properties,
2) Exposure,
3) Health effects,
4) Methods to reduce exposure and prevent spread of contamination,
5) Reading level of educational material,
6) Applying Suitability Assessment of Materials and Flesch-Kincaid Grade Level Formula to educational materials,
7) Use of illustrations and captions,
8) Typography, and
9) Content.

Physical Properties

Mercury is a metallic element. It is a silver-white, heavy, odorless metal that exists naturally in nature. Mercury is in a liquid state between the temperatures of -37ºF and 674ºF and therefore in a liquid state at typical room temperature. Elemental mercury has exceptionally high surface tension of 480 dynes/cm. This is almost seven times higher than water (Sax & Lewis,

1987). The high surface tension causes droplets to appear as beads (WaterCampWS). Therefore, when spilled or swept, the droplets "break" into very small droplets that can fall into tiny spaces. Elemental mercury is highly volatile (Caussy, Gochfeld, Gurzau, Neagu, & Ruedel, 2003). Droplets of mercury will emit vapors for a long period of time (Gouchfeld, 2003). Vapors are odorless and colorless (ATSDR, 2010). However, when viewed under ultraviolet light with a fluorescent background as done in Figure 2.1, shadows of mercury vapor evaporating can be seen (Bowling Green State University, Ohio EPA, & Rader Environmental, 2009).

Figure 2. 1: Mercury vapor off-gassing from a dish (Bowling Green State University et al., 2008).

The video found at http://wbgustream.bgsu.edu/bgsu/epa/index-fl.html clearly illustrates shadows of mercury vapor when two hundred grams are left alone in a dish (Bowling Green State University et al., 2008). Mercury vapor is seven times heavier than air (Caravati et al., 2008). Therefore, young children are at high risk for exposure in a contaminated area since vapors will accumulate in low-lying areas, specifically near the breathing zones of children (Caravati et al., 2008 and Cherry, Lowry, Velez, Cotrell, & Keyes, 2002).

Exposure

Exposure Routes

Inhalation is the primary exposure route of elemental mercury due to its high bioavailability within humans' respiratory tract (Caussy et al., 2003). About 74-80% of the elemental mercury vapors inhaled will enter the bloodstream and accumulate in the central nervous system (ATSDR, 2010 and Cherian, Hursh, Clarkson, Thomas, & Allen, 1978). There is negligible absorption when ingesting elemental mercury in the gastrointestinal tract (Caussy et al., 2003, Gochfeld, 2003, and ATSDR, 2010). One study estimates 0.01% of ingested mercury is absorbed in the gastrointestinal tract (Fagala & Wigg, 1992). Elemental mercury is also poorly absorbed through skin (Gochfeld, 2003 and Smith, Jaffe, & Skinner, 1997).

Sources

Sources of common household items containing mercury include mercury fever thermometers, thermostats, antique items such as clocks, barometers, and mirrors, batteries made before 1996, compact fluorescent light bulbs, jewelry containing liquid mercury from Mexico, and switches and relays (EPA Mercury). When mercury is released from these sources, mercury vapors are emitted into the air. The concentration of mercury vapors produced varies by the amount of mercury found in each product. Table 2.1 estimates the amount of mercury found in a list of common household sources.

Table 2.1: Amount of mercury found in common household items.

Household Items Containing Mercury	**Estimated Amount of Mercury**
Compact Fluorescent Light Bulbs	0.005 grams (EPA Mercury)
Oral Mercury Fever Thermometers	0.61 grams (EPA Mercury)
Thermostats	3 grams (Caravati et al, 2008)
Switches and Relays	0.050 grams to over 400 grams (NEWMOA, 2010a)
Jewelry Containing Liquid Mercury	3 grams to 5 grams (NEWMOA, 2010b)
Antique Mirrors	450 grams (MMWR, 2007)
Barometers	540 grams (MMWR, 2007)
Antique Clocks	450 grams to 7,000 grams (MMWR, 2007)

Exposure Pathways

Humans in close proximity to the spilled area of these items may inhale the mercury vapors. Humans may unknowingly spread mercury contamination by tracking mercury beads from the spilled area to other areas. A study was conducted to determine if mercury from a sphygmomanometer can contaminate indoor air (Ye, Katsumata, & Minami, 2000). A total of 0.15g of mercury was placed on a piece of carpet inside a chamber. This is almost equivalent to a spill occurring from two broken oral thermometers (see Table 2.1). The chamber was heated to

30°C. Vapor concentrations thirty centimeters above the carpet surface had reached 10 mg/m^3 eighty minutes after the spill (Ye et al., 2000). This was 10,000 times more than the current EPA residential Removal Action Level of 1 ug/m^3.

In another study, a clinical thermometer was broken on a kitchen floor which was made of vinyl (Smart, 1986). Visible beads from the spill were removed from the house with a postcard. Windows throughout the house were kept close. Mercury vapor concentrations were measured at face level on the same day, one week, two weeks, and three weeks after the spill throughout the house. A concentration of 0.025 mg/m^3 was measured in the kitchen on the same day of the spill. However, the highest concentration of 0.14 mg/m^3 was found in the hallway outside adjacent to the kitchen door. It is suggested that foot traffic tracked mercury from the kitchen to the hallway. After three weeks, mercury vapor was no longer detected (Smart, 1986).

The current EPA residential Removal Action Level for mercury vapor is 1 µg/m^3. Therefore, releases occurring from items containing more mercury than a single oral fever thermometer (about 0.61 grams) require the attention of the local health department, state environmental agency, or EPA (EPA, 2009) since air concentration in room is likely to exceed EPA's current residential Removal Action Level (personal conversation with Glenn Adams on February 23, 2010). The current Removal Action Level for schools is 3 µg/m^3. It is assumed that people are in school for up to eight hours per day; whereas people may be at home 24 hours per day (personal conversation with Glenn Adams on February 23, 2010).

If an exposure to mercury vapor has occurred, it may be important to determine the dosage. Measuring concentration of mercury in excretion processes such as urine inaccurately reflects the inhaled dosage for short-term exposures (Pogarev, Ryzhov, Mashyanov, Sholupov, & Zharskaya, 2002). Blood sampling is more effective; however, the process of determining the

dose is complicated and taking blood samples is invasive especially if daily monitoring is required. Therefore, an equation was created to estimate the inhaled mercury dosage that is reliable for short-term exposures and would eliminate the need for blood sampling. An estimated dosage of inhaled mercury can be calculated using the following equation (Pogarev et al., 2002):

$$M = A \times C_{inh} \times V \times t$$

- Where M is the dose of mercury,
- A is the inhalation coefficient of absorption,
- C_{inh} is the concentration of mercury in inhaled air,
- V is the average lung ventilation, and
- t is the inhalation time.

Due to mercury vapor's high bioavailability from the lungs to the bloodstream (Caussy et al., 2003) the inhalation coefficient of absorption (A) is 74% to 80% (ATSDR, 2010, and Cherian et al., 1978). This is the estimated amount of mercury that will enter the bloodstream. The average lung ventilation rate (V) for a twenty-four hour period is 0.83 m^3/hr (Pogarev, 2002). The concentration of mercury inhaled air (C_{inh}) was determined by using the RA-915+ mercury analyzer.

If a person is exposed to an average mercury vapor concentration of 1.0 µg/m^3 for twenty-four hours, the person's mercury dose is about 16 µg. This assumes an 80% inhalation coefficient of absorption and an average lung ventilation rate of 0.83 m^3/hr for the past 24 hours. The following is an example of the calculation.

$$M = A \times C_{inh} \times V \times t$$

- M = Mercury dosage
- A = 80%
- C_{inh} = 1.0 µg/m^3
- V = 0.83 m^3/hr
- t = 24 hours

$$M = 0.80 \times \frac{1.0\ \mu g}{m^3} \times \frac{0.83\ m^3}{hr} \times 24\ hr$$

$$M = 16\ \mu g$$

Measuring Mercury Vapor Concentration

To measure mercury vapor concentration in air, EPA uses a RA-915+ Mercury Analyzer from Ohio Lumex Company (see Figure 2.2). The portable instrument uses atomic absorption spectrometry to measure mercury vapor in air in real-time with a one second response time (Ohio, 2001). It has a detection limit as low as 2 µg/m^3. The instrument also calculates ten second averages (Ohio, 2001). This average is typically used by the EPA to determine air concentration levels of mercury.

Figure 2. 2: The RA-915+ used by EPA to measure mercury vapor concentration in air.

Background Concentrations

The average residential background indoor air concentration in one study was found to be 0.069 µg/m^3 (Capri & Chen, 2001), whereas the average background outdoor air concentration is about 0.020 µg/m^3 (EPA, 1980). The main source of background mercury indoors is from products containing mercury salts such as latex paints from the 1980s, contact lens solutions, nasal sprays (Capri & Chen, 2001), and household cleaners with chlorine emit trace amounts of mercury into the air (EPA, 2008). Another potential source could be residual mercury from a release of a household item containing mercury (Capri & Chen, 2001).

Excretion

Mercury is excreted mostly from expired breath, urine, and feces (Cherian et al., 1978). About seven percent of the initial retained dose is excreted from exhaled breath and 11.6% is excreted from urine and feces seven days after termination of exposure. Mercury is also excreted through body hair and finger and toenails (Ritchie et al., 2002).

Health Effects

Acute Symptoms

Acute exposures to mercury typically occur for fourteen days or less as defined by ATSDR (ATSDR, 1999) and usually occur when a person is heating mercury vapors without appropriate protection (Caravati et al., 2008). A person undergoes three distinct phases after an acute exposure (Solis et al., 2000). During the first phase, flu-like symptoms may last for one to three days. Symptoms include salivation, swollen gums in mouth, fever, dry cough, shortness of breath, dyspnea, abdominal pain, nausea, vomiting, and diarrhea. During the second phase, the person will experience severe pulmonary toxicity, progressive hypoxia, and may potentially die. If the person survives the second phase, the third phase will experience gingivostomatatis, tremor, erethism, memory loss, depression, insomnia, and shyness (Solis et al., 2000). Acute exposures can also have an effect on the cardiovascular system by increasing blood pressure (Hallee, 1969) and heart rate (Fagala & Wigg, 1992) and can also impact the gastrointestinal system by causing stomatitis (Garnier et al., 1981). Acute symptoms are commonly seen when mercury is volatilized (Caravati et al., 2008 and ATSDR 1999). The LD_{50} and LC_{50} for elemental mercury are unknown (MSDS, 2007). However, the National Institute of Occupational Safety and Health (NIOSH)'s Immediately Dangerous to Life or Health (IDLH) which is defined as the maximum exposure where a person can escape within thirty minutes without escape-impairing symptoms or irreversible health effects is 10 mg/m^3 (EPA, 2007).

Acute Dose-Response Studies

There have been several animal studies examining dose-response studies for acute inhalation exposure to mercury. It appears there is only one study which examined the relationship in humans. The exposure to mercury in this study was caused by an accidental exposure in humans. A summary of the studies can be found in Table 2.2.

In toxicological studies, rats and rabbits were exposed to about 30 mg/m^3 mercury vapor for a short duration (Livardjani, Ledig, Kopp, Dahlet, Leroy, & Jaeger, 1991 and Ashe, Largent, Dutra, Hubbard, & Blakstone, 1953). This is three times the IDLH defined by NIOSH and 30,000 times the residential EPA Removal Action Level. The animals were found to have similar health effects experienced by humans after indoor exposure to volatized mercury. Details of these studies and others can be found in Table 2.2.

Table 2.2: Summary of dose-response studies for acute exposures to animals.

Animal	**Exposure**	**Concentration**	**Health Effects**	**Citation**
Rats	1 or 2 hours	30 mg/m^3	Histological lesions, hyaline membranes, and fibrosis. About 50% died in 2 weeks.	Livardjani et al. 1991
Rats	100 hours	1 mg/m^3	Congested lungs.	Gage, 1961
Rats	3 hours per day 5 days per week 12 to 42 weeks	3 mg/m^3	No health effects.	Kishi et al., 1978
Rabbits	4 hours	28.8 mg/m^3	Cellular degeneration and necrosis with all major systems.	Ashe et al., 1953

Animal	Exposure	Concentration	Health Effects	Citation
Rabbits	20 hours	28.8 mg/m^3	All rabbits survived.	Ashe et al., 1953
Rabbits	30 hours	28.8 mg/m^3	One of two rabbits died.	Ashe et al., 1953
Pregnant Rats	6 days 1.5 hours/day 14 to 19 gestational days	1.8 mg/m^3	Offspring were hyperactive with spatial learning deficits and significant issues were found with adaptive behavior.	Fredriksson et al., 1996
Pregnant Rats	8 days 1 to 3 hours/day 11 to 14 and 17 to 20 gestational days	1.8 mg/m^3	Offspring were hypoactive at three months old, then hyperactive at fourteen months old, had reduced ability to adapt, and showed signs of retardation with radial arm maze.	Danielsson et al., 1993
Humans	4 to 8 hours	44.3 mg/m^3	Flu-like symptoms, dyspnea, hemoptysis, pulmonary function impairment, diffuse pulmonary infiltrates and interstitial. pneumonitis.	McFarland & Reigel, 1978

Case Studies

Cases are also available regarding acute exposure from heating mercury indoors, with information available regarding urine excretion, and survival. It is often unknown how soon

patients were tested after exposure or what concentrations patients were exposed to. Therefore it is difficult to determine a dose-response. In addition, urine excretion is not a suitable measurement to determine inhaled dosage when exposure occurred for less than one month (Pogarev et al., 2002). A summary of studies that can provide information about human exposure to mercury is provided in Table 2.3.

Two adults aged 67 years and 77 years developed pneumonitis and died after heating 1.1 grams of elemental mercury from a thermometer (Jaeger, Tempe, Leroy, Porte, & Mantz, 1979). Three hours after initial exposure, the adults experienced symptoms of shivering, vomiting, thoracic pain, and diarrhea. Both adults were put on artificial respiratory assistance. The younger adult died seven days after exposure and the older adult died seventeen days after exposure. The younger adult had 24 hour urinary mercury excretion concentration of 579 µg/l before treatment. The older adult had 24 hour urinary mercury excretion concentration of 1,302 µg/l before treatment (Jaeger et al., 1979).

A 45-day-old girl and a 13-month-old boy were admitted to the hospital for acute exposure to mercury vapor (Solis, Yuen, Cortez, & Goebel, 2000). The parents were using heat to try to extract a gold ore in their kitchen. The two children were also in the kitchen. Six hours after initial exposure, the children began to show respiratory symptoms and mild hypoxemia. After 24 to 36 hours of admission, the children developed pneumonia and required mechanical ventilation. The girl's urinary mercury excretion concentration was 35 µg/l and the boy's was 120 µg/l. Each child was given chelation therapy. After twenty-five days, the girl was discharged from the hospital. One month later, the girl had no residual pulmonary disease or any significant development delay. The boy experienced cardiopulmonary arrest on the 25th day and died (Solis et al., 2000).

A 38-year-old lady was admitted to the Intensive Care Unit with a diagnosis of pneumonia (Solis et al., 2000). However, it was later known that she was exposed to an acute concentration of mercury vapor. Chelation therapy was given; however, she soon had multiorgan failure and died after being hospitalized for ten days. Her 24 hour urinary mercury excretion concentration was 163 µg/l (Solis et al., 2000).

Four children ages three, seven, ten, and fourteen years old were admitted to the hospital for acute mercury vapor exposure (Solis et al., 2000). The parent was trying to extract gold from an ore by heating it in the kitchen. Six days after exposure, each child suffered from sore throat, coughing, and headaches. The 24 hour urinary mercury excretion concentrations for each child respectively were 161 µg/l, 177 µg/l, 485 µg/l, and 107 µg/l. All four children survived. The kitchen air was later sampled at an undisclosed time and mercury concentration was 0.193 mg/m^3 (Solis et al., 2000).

Table 2.3: Patients' age, 24 hour urinary mercury excretion concentration, and outcome summarized from case studies of acute exposure to mercury.

Age	**Concentration (µg/l)**	**Outcome**	**Citation**
45 days	35	Survived	Solis et al., 2000
13 months	120	Died	Solis et al., 2000
3 years	161	Survived	Solis et al., 2000
7 years	177	Survived	Solis et al., 2000
10 years	485	Survived	Solis et al., 2000

Age	Concentration (µg/l)	Outcome	Citation
14 years	107	Survived	Solis et al., 2000
38 years	163	Died	Solis et al., 2000
67 years	579	Died	Jaeger et al., 1979
77 years	1302	Died	Jaeger et al., 1979

Chronic Symptoms

Chronic exposures typically occur for 365 days or more as defined by ATSDR (ATSDR, 1999). This type of mercury exposure typically occurs in occupational settings such as dentistry or from areas where sources of mercury linger for years such as a residential home. Chronic exposure to elemental mercury vapors primarily affects the central nervous system. Symptoms include erethism, irritability, excessive shyness, insomnia, severe salivation, gingivitis, and tremors (EPA 1997 and EPA Air, 2007). Chronic exposure can also affect the kidneys and cause acrodynia (EPA Air, 2007 and Diner & Brenner, 2009). Human studies associating elemental mercury exposure with cancer are inconclusive as well as studies examining cardiovascular effects (Cragle, Hollis, Qualters, Tankersley, & Fry, 1984, and Schoeny, 1996).

Chronic Dose-Response Studies

There are few animal studies dose-response studies for chronic inhalation exposure to mercury, and even fewer for humans. Animals exposed to 0.1 mg/m^3 for more than a year had

no evidence of health effects. Workers exposed to mercury vapor as high as 270.6 $\mu g/m^3$ at a thermometer plant for up to five years were found to have health effects related to chronic exposure (Ehrenberg et al., 1991). This is almost eleven times higher than the industrial EPA Removal Action Level of 25 $\mu g/m^3$. Dentists exposed to a geometric average of 0.014 mg/m^3 of mercury for about 5.5 years were found to have lower neurobehavioral test results than a control group (Ngim, Foo, Boey, & Jeyaratnam, 1992). Details of the studies can be found in Table 2.4.

Table 2.4: Summary of dose-response studies for chronic exposures to animals and humans.

Animal	**Exposure**	**Concentration**	**Health Effects**	**Citation**
Rats	72 weeks 5 days/week 7 hours/day	0.1 mg/m^3	None for renal system.	Ashe et al., 1953
Dogs	83 weeks 5 days/week 7 hours/day	0.1 mg/m^3	None for renal system.	Ashe et al., 1953
Rabbits	83 weeks 5 days/week 7 hours/day	0.1 mg/m^3	None for renal system.	Ashe et al., 1953
Humans	1 to 5 years	Up to 270.6 $\mu g/m^3$	Higher prevalence of static tremor, abnormal Romberg test, dysdiadochokinesia, and difficulty with the heel-to-toe gait	Ehrenberg et al., 1991
Humans	7 to 24 years	0.014 mg/m^3	Reduced performance with neurobehavioral tests	Ngim, 1992

Methods to Reduce Exposure & Prevent Spread of Contamination

Regardless of how exposure occurs, once elemental mercury is released into the environment there are specific steps that should be followed to minimize exposure. Below is the list of steps for mercury releases that resulted from objects not including a compact fluorescent light bulbs or a single thermometer.

- Avoid touching or cleaning the spilled area.
- Cover spill with a newspaper.
- Open all windows of the building.
- Keep everyone away from the room with spill.
- Call EPA, state environmental agency, or local health department/poison control center for assistance. Phone numbers will vary depending on the location of the spill.

To prevent mercury beads from spreading to personal items and other rooms, it is important to avoid touching or cleaning the spilled area (EPA, 2010). It is unlikely a person without equipment designed for mercury releases can properly clean spills originating from objects other than compact fluorescent light bulbs or a single thermometer. Instead, the person will be exposed to mercury vapor concentrations that are likely to exceed the EPA residential Removal Action Level. Instead of cleaning up the spill, the person should cover the spill with a newspaper to prevent tracking. All windows of the building should be opened to reduce mercury vapor concentration buildup in the indoor air. Everyone should avoid entering the room with the spill. If possible, the door of the room with spill should be kept closed. This will help contain mercury vapors to the room (EPA, 2010).

In addition to the steps above, the following tasks should be avoided:

- Vacuuming and sweeping the spilled area.
- Pouring mercury down drains.
- Washing clothes that come in contact with mercury.

A vacuum cleaner is not to be used to remove elemental mercury from carpets. Filters on household vacuum cleaners do not trap elemental mercury. Instead, they will release vapors into the air which will increase exposure. Exposure to the vapors emitted while vacuuming can cause acute symptoms that require hospitalization (Zellman, Camfield, Moss, Camfield, & Sweet, 1991). To properly clean up mercury releases originating from objects other than compact fluorescent light bulbs or a single thermometer, a mercury vacuum cleaner may be required.

A broom is not to be used to sweep up elemental mercury. Sweeping will cause mercury beads to break into tinier beads and roll into other areas which will spread contamination. The beads will also fall into cracks in the floor and between baseboards (EPA, 2009). This will make it more difficult to decontaminate the impacted area since it will be more difficult to find and collect beads (Caravati et al., 2008). Extensive gutting may be required to remove beads from cracks and baseboards.

Mercury releases resulting from compact fluorescent light bulbs or a single thermometer can be cleaned without assistance (EPA, 2009). All windows need to be opened prior to cleanup and stiff paper or cardboard will be needed to scoop debris containing mercury beads. Cleanup procedures will depend on the type of surface (carpet or hard surface). Details can be found on EPA's website at www.epa.gov/mercury/spills/index.htm#thermometer (EPA, 2009).

Elemental mercury must not be discarded in trash, drains, and sewer systems. Pouring elemental mercury down a drain may cause it to become trapped in the plumbing. This can lead

to inhalation exposures if it cannot be dislodged. If elemental mercury is dislodged, it may cause treatment issues for a septic tank or a municipality (EPA, 2009). Instead elemental mercury should be kept in a sealed, unbreakable jar in the garage or outside storage area away from children (EPA, 2009). The county's waste collection program should then be contacted for amnesty collection days where hazardous wastes will be collected free of charge or for a minimal fee. If collection days are not available, or if it is impossible to store away from children, the jar should be discarded in a trash container outside assuming it is legal to do so (personnel communication with Mark Durno, January 19, 2010).

Clothes that have come in contact with elemental mercury should not be washed in a washing machine (EPA, 2009). Elemental mercury will contaminate the washing machine and the clothes in it. Instead clothes that have come in contact with elemental mercury should be discarded in a trash container outside. Shoes that have come in contact with elemental mercury should also be discarded in a trash container outside (numerous personnel communication with Glenn Adams, January 2010). Wearing contaminated shoes will potentially spread elemental mercury to other areas (EPA, 2009). Any items used to clean up a mercury spill should also be discarded in a trash container outside (EPA, 2009).

Below are three examples of mercury releases that resulted when children had access to mercury or items containing mercury. All three cases involved an acute exposure at home that required children to be hospitalized. The first case study occurred in 2005 where a child heated mercury in the oven, the second case study occurred in 2002 where a child played with mercury and contaminated his home, and the third case study occurred in 1991 where a teenager vacuumed mercury contaminated carpet. All three cases occurred in the United States.

Case Study #1

A child obtained mercury from a friend and believed that the mercury would turn into nickels if heated in the oven (personnel conversation with Bob Safay, Senior Regional Representative for ATSDR, January 21, 2010). The child then went home and placed the mercury in the oven and heated it to 400^{o}F (Jones, 2005). The child and sibling were sent to the hospital due to acute exposure to elemental mercury vapors. The pet dog died. Indoor air concentration in the home was 370 µg/m^{3}; however, it is unknown how soon measurements were taken after exposure. Efforts to decontaminate the mobile home and many personal items failed since air concentrations could not be reduced to 1 µg/m^{3} for mercury. The home and personal items were then sent to a landfill (Jones, 2005).

Case Study #2

A 3-year-old girl was admitted to the hospital after having flu-like symptoms, weight loss, and progressive neurological symptoms for six months (Cherry et al., 2002). While awake, she would have tremors and drool. The family had recently moved into their new home. During the assessment, there was speculation that the previous tenants spilled elemental mercury in a room. One of the sons eventually admitted to spilling mercury on the carpet. After four months of undergoing treatment for mercury poisoning, there were no symptoms of mercury toxicity. The home had to be decontaminated before the family could return (Cherry et al., 2002).

Case Study #3

A 14-year-old boy developed serve mercury poisoning when vacuuming a spilled area (Zellman et al., 1991). He obtained mercury from two thermometers and poured it into test

tubes. He spilled half of the mercury on the carpet. The boy then vacuumed over the spilled area. The boy continued to use the vacuum cleaner once every two to three weeks and was the only person in the family to use it. Two months after the spill, the boy began to develop flu-like symptoms. He then became weak to the point where he could not button his shirt or hold a cup. Four months after spill, the boy became depressed and cachectic. He was admitted to a hospital. Mercury concentration in serum was seven times higher than normal and almost forty times higher than normal in urine. The home was assessed and mercury vapor concentration in the vacuum cleaner was higher 1.0 mg/m^3 (Zellman et al., 1991).

In order to mitigate exposures to mercury vapor, the procedures to prevent exposure and spread of contamination must be understood by the public. Therefore, fact sheets must be written and designed in a manner where the majority of adults can comprehend and retain the information. The following sections discuss studies on how a fact sheet be should written and designed to ensure that the messages are communicated effectively to as many adults as possible.

Reading Level of Educational Material

According to the Rapid Estimate of Adult Literacy in Medicine, there are four groups of reading levels (Murphy, David, Long, Jackson, & Decker, 1993). Patients who read at third grade and below cannot understand simple prescription labels and cannot read most educational materials. Oral instructions must be used and verbally repeated to enhance comprehension. Patients who read at fourth to sixth grade level can read and comprehend information written at an elementary school level. However, they may still need assistance understanding the material. People who read at a seventh to eighth grade level can understand reading material at a fourth to sixth grade level. However, material written at a very low level, such as a first grade, may be too

simple. Complex material may still be too difficult. People who read at a ninth grade level or higher can begin understanding medical information and educational brochures (Murphy et al., 1993).

Seventy-five percent of adults can read at a sixth grade reading level (Doak, Leonard, & Jane, 1996). Adults learn more and prefer reading instructions that they deem easy to read. Therefore, a person reading at a ninth grade level or higher will benefit from sixth grade level reading material. For most educational materials aimed at adults, a sixth grade reading level is a reasonable goal for health educators to achieve (Doak et al., 1996).

A study was conducted to compare reading ability of caretakers (mostly parents) of pediatric outpatients with the reading level of educational materials commonly used (Davis et al., 1994). The study included 396 caretakers age 15 to 73 years old with the average age being thirty years old. The reading level of each caretaker was obtained as well the average reading level of 129 pediatric health education materials. Materials included brochures and pamphlets from the Centers for Disease Control and Prevention (CDC), American Academy of Pediatrics, March of Dimes, and others, reference books, baby books, *Healthy Kids* magazines typically found in pediatric clinic waiting rooms, a poster, and a vaccination card (Davis et al., 1994).

Results from the reading test showed that 73% of the caretakers could not read at a ninth grade level, 55% could not read at seventh grade level, and 31% could not read at a fourth grade level (Davis et al., 1994). The average and medium reading level was sixth grade. Of the 129 educational materials, 81% required at least a ninth grade reading level. The American Academy of Pediatrics materials had a reading average of tenth grade, the *Healthy Kids* magazines and CDC materials simplest reading material required at least a tenth grade reading level, the simplest reference book had a reading level of twelfth grade, and the average reading level of the

baby books was thirteenth grade. No materials were written at a fourth grade level or lower. Therefore, at least 73% of the caretakers studied cannot comprehend 81% of the educational material available and 31% of the caretakers cannot understand any of the educational material (Davis et al., 1994).

People who can read at a high grade level may find it difficult to read information written at a high level under stressful situations (Plimpton & Root, 1994). Emergency responses can be a stressful situation for many people, especially if the response is occurring in their homes or schools. Therefore, it is vital that fact sheets be easy to read to ensure comprehension during stressful situations.

Health education experts recommend that educational material is written at a sixth to eighth grade level (Freda 2005). In addition, personnel interviews conducted with Glenn Adams, Sherryl Carbonaro, Dr. James Webster, Section Chief of Removal & Oil Section at EPA, Dr. Robert Geller, Medical Director at Georgia Poison Control Center, and Bob Safay recommend that the new fact sheet be written at a sixth grade reading level.

Applying Suitability Assessment of Materials and Flesch-Kincaid Grade Level Formula

The Suitability Assessment of Materials (SAM) was applied a study to determine if prostate cancer educational materials could be understood by adult men in the United States (Weintraub, Maliski, Fink, Choe, & Litwin, 2004). Twenty-nine related educational materials consisting of brochures, booklets, books, fact sheets and a flyer were assessed by three people who have backgrounds in prostate cancer and patient education. Overall educational materials scored well with factors regarding purpose, cover graphic, layout, and typography. However, educational materials did not achieve superior scores with factors regarding behavior-related

context, summary, readability, vocabulary, use of relevant illustrations with captions, learning stimulation, and motivation. Lastly, more than half of the materials were not assessed for cultural appropriateness since it appears these materials were written for all ethnicities. Six of the twenty-nine educational materials were considered superior with SAM. Most educational materials were considered adequate with SAM. Ninety percent of the educational materials were rated not-suitable for reading grade level factor and the remaining ten percent were rated adequate for reading grade level factor (Weintraub et al., 2004).

SAM was applied in another study to determine if FDA-approved Medication Guides were useful to patients using them (Wolf, Davis, Shrank, Neuberger, & Parker, 2006). Forty Medication Guides were evaluated by three master's level adult literacy educators. Cultural appropriateness factors were not included since the Medication Guides appear to be created for the general population. The average SAM score for the Medication Guides was 42% which is considered adequate. Only three Medication Guides were considered superior. All Medication Guides were rated not-suitable for the reading grade level factor (Wolf et al., 2006).

Flesch-Kincaid Grade Level Formula (Flesch-Kincaid) was applied in a study to determine reading level of ten patient education pages that are typically copied and used as handouts (Cotugna, Vickery, & Carpenter-Haefele, 2005). They were randomly selected from health care journals published in 2002 to 2003. Text from the pages was typed into Microsoft Word. Text omitted included journal identification, author's name(s), sources cited, editorial information, disclaimers, sponsor names, and addresses. Scores for handouts ranged form 5.8 to 12.0. Two of the ten patient education pages were written at a sixth grade reading level or lower. Five patient education pages had a reading level exceeding than ninth grade (Cotugna et al., 2005).

Flesch-Kincaid was applied in a study to determine reading level of 74 brochures written or copyrighted by the American Academy of Pediatrics (Freda, 2005). Text from the brochures was typed into Microsoft Word. The average reading level was tenth grade. Eighty percent of the brochures were found to have a reading grade level of at least seventh grade (Freda, 2005).

Use of Illustrations and Captions

In an illustration study, it was determined that there was an "overwhelming advantage for the inclusion of pictures" in educational materials (Levie & Lentz, 1982). Test results show that people who read information that contain pictures relevant to the information learned 33% more than those who read material without pictures. Information containing illustrations were found to be more enjoyable to read. Illustrations also help readers understand relevant text, can be effective in providing instructions, and help readers remember what they read. Illustrations may be more beneficial to poor readers (Levie & Lentz, 1982).

Another study conducted on adults showed that when written information includes relevant illustrations, up to 15% percent more information is retained after 55 days than written information without relevant illustrations (Anglin, 1987). These results are similar to another study conducted by Peng and Levin in 1979, where the recall rate was up to 20% higher among children (Anglin, 1987).

Simple line drawings should be used because they offer less background distractions (Doak et al., 1996). Photographs tend to have backgrounds that can distract the reader. Illustrations that are familiar and easily recognized have a higher recall rate than unrecognizable illustration. Illustration should not be drawn with elaborate borders and include a picture caption (Doak et al., 1996).

Simple line illustrations that are black and white are as valuable as colored illustrations (Falvo, 2004). The illustrations should be used a tool to reinforce information in the text. In addition, it allows the reader not to have to search for information within the text. The illustration should not have to be studied. Illustration captions are helpful and should be short and straight to the point (Falvo, 2004). Black, line drawings and clip art will also help reduce costs and allow the fact sheets to be easily reproduced with a copy machine (Plimpton & Root, 1994).

Typography

The appearance of educational material can increase comprehension (Doak et al., 1996 and Ivnik & Jett, 2008). Information should not look cramped. If so, it may intimidate readers. Serif fonts, such as Times New Roman should be used for text since they are easier to read. Twelve points should be used for the font size. Color of material body should contrast color of type. Color or bold can be used to highlight messages, but is not required. A text box can be used for a specific message (Doak et al., 1996 and Ivnik & Jett, 2008). Using bullets can attract attention to key messages (Invik and Jet, 2008). Black font is sufficient to reduce costs and allow fact sheets to be easily reproduced with a copy machine (Plimpton & Root, 1994).

Words should not be typed in all capital letters because this will reduce reading speed. Reading speed is reduced by up to 20% if all capital letters are used (Walsh, 1991). Less than six types of font sizes should be used (Doak et al., 1996). If more than six font sizes are used, the brochure will appear confusing. Typographic cues to highlight key points are recommended. Typographic cues can include bolding, changing the font size, or using color. Subheadings are recommended and up to five items should be included in one subheading. The reason for this is

because adults with low literacy skills may only remember up to five items on a list (Doak et al., 1996).

Content

Content must not overwhelm the reader by containing too much information. Behavior changes should be stressed and the purpose should be clearly stated (Doak et al., 1996 and Plimpton & Root, 1994). Technical language and jargon should be avoided. An inviting tone should be used and language should be appropriate for the intended readers (Doak et al., 1996 and Plimpton & Root, 1994). Common vocabulary words and a summary highlighting the key messages should be included (Doak et al., 1996).

Content should be written in second person when possible (McKenna & Scott, 2007). Second person makes the content more personal. Sentences should be written in active voice (McKenna & Scott, 2007). Line length should be a total of thirty to fifty characters and spaces (Doak et al., 1996). Main points should be bulleted and headings are recommended (McKenna & Scott, 2007). Information obtained by readers significantly improved when educational material's format was changed to include a question and answer format, illustrations, and twelve point font, bulleted main points, and headings, and active voice (McKenna & Scott, 2007).

Summary

Numerous studies have shown that inhalation of mercury vapors can cause serious health effects. It can be difficult to see since mercury beads may not be visible and its vapors are invisible and odorless. Normal activities at home such as vacuuming, sweeping, and walking on

a spilled surface as well as washing clothes can spread mercury contamination to other areas of a house. Simple procedures can be taken to contain mercury contamination and reduce exposure.

To effectively communicate these procedures to the public, the fact sheet must be written and designed where the majority of adults will be able to comprehend and retain fact sheet's information. Many studies have shown that the fact sheet should be written sixth grade reading level to effectively communicate information to the majority of adults. Fact sheet should also include simple, line, illustrations with caption, written with twelve point Time New Roman font, and key points should be emphasized with bullets or bolding. Text should be written in second person when possible and use active voice. Line length should be a total of thirty to fifty characters and spaces and a summary should be included in the fact sheet.

This study will focus on what necessary information should be included in a mercury fact sheet, and if existing mercury fact sheets effectively communicate information to the majority of adults. Results from this study will be used to create a new mercury fact sheet that can be used as a tool to inform the public of procedures to mitigate exposure and contamination from mercury releases.

Chapter III

Methodology

The methodology will focus on five areas in order to assess the twelve fact sheets used in the study. Information obtained from these areas will then be used to create a new fact sheet. The following studied areas are:

1) Information obtained from interviews including the purpose, who were interviewed, why they were selected, how they were conducted;
2) How fact sheets were gathered;
3) Reading analysis;
4) SAM; and
5) Development of new brochure.

Interviews

The purpose of interviews was to gain first-hand information from people who interacted with the impacted community or provided support and assistance with health-related issues regarding mercury responses. These people responded to mercury releases that impacted a community, presented and answered questions at public meetings, interacted with the public, responsible for answering health-related questions, and/or conducted risk assessments for responses. Below is a list of the people who were interviewed, why they were selected, and how the interviews were conducted. Detailed summaries of the interview can be found in Appendix A. The EPA responder to Calexico High School Mercury Release could not be contacted.

- Glenn Adams, Section Chief of Technical Services Section for EPA Region IV. Mr. Adams and his section conduct risk assessment analysis for the EPA. He has also responded to about twelve mercury releases as an On-Scene Coordinator and is considered to a technical expert for mercury releases at EPA. Interview conducted in person.
- Ryan Atencio, Responder for Department Toxic Substances Control of California Environmental Protection Agency. Mr. Atencio responded to a mercury release in a residential home in Calexico, California. The city is adjacent to the Mexico border. Interview conducted by phone.
- Sherryl Carbonaro, Community Involvement Coordinator with EPA Region IV, Atlanta. Ms. Carbonaro worked individually with the public as well as organized and led the public meeting at Pooler. She has responded to about twelve mercury releases. Interview conducted in person.
- Mark Durno, Section Chief for Emergency Response Section for EPA Region V, Chicago. Mr. Durno is the first-line manager of On-Scene Coordinators for Region V and has responded to at least twenty mercury releases as an On-Scene Coordinator. Interview conducted by phone.
- Marjorie Easton, Federal On-Scene Coordinator for EPA Region III, Philadelphia. Ms. Easton was the EPA responder for the Clendenin Elementary Mercury Response in Clendenin, West Virginia where the school and students' home were impacted by mercury. She has responded to five to ten mercury releases. Interview conducted by phone along with follow-up emails.

- Dr. Robert Geller, Medical Director for Georgia Poison Control Center. Dr. Geller is a board certified in medical toxicology and pediatrics. He provides assistance with health-related issues with mercury responses. Interview conducted over the phone.
- Bob Safay, Senior Regional Representative for ATSDR. Mr. Safay is EPA's contact person for health-related issues for responses. He has provided health-related information to sixty to sixty-five mercury releases and at about thirty-five public meetings. Interview conducted in person.
- Dr. James Webster, Section Chief of Removal & Oil Section for EPA Region IV. Dr. Webster was the EPA Federal On-Scene Coordinator and Incident Commander for the Pooler Elementary Mercury Response in Pooler, Georgia where the school and students' homes were impacted by mercury. Dr. Webster has responded to least six mercury releases. Interview conducted in person.

Fact Sheets

Fact sheets used during the Clendenin, West Virginia and Pooler, Georgia mercury responses were used for the study. Both responses impacted the elementary schools and students' homes. The 1999 ATSDR ToxFAQs fact sheet was used at Clendenin and was obtained from the Clendenin Elementary Mercury Response website found at www.epaosc.net. The 2001 ATSDR ToxFAQs fact sheet was used during the Pooler Elementary Mercury Response. It was obtained from Sherryl Carbonaro, Community Involvement Coordinator for EPA, who currently uses this fact sheet for current mercury responses in Region IV. A fact sheet was used during the Calexico High School Mercury Response in California; however, the type of fact used is unknown since the responder could not be contacted. The nine state fact sheets,

Alabama, California, Florida, Illinois, Maryland, New Hampshire, New York, Ohio, and Tennessee, and the one county fact sheet, Cuyahoga County, Ohio, were found online and were included in this study to help determine pros and cons of other available mercury fact sheets which can be helpful in creating a new fact sheet. Table 3.1 summarizes the content of the twelve fact sheets used in this study.

Table 3.1: Summary of the fact sheets used in the study.

Fact Sheet	**Summary**
1999 ATSDR ToxFAQs	• Physical properties of elemental mercury. • How mercury combines with other elements to form mercury compounds. • Exposure pathways, health effects, and how to reduce exposure. • Types of medical tests to determine exposure levels. • EPA, FDA, and OSHA limits for drinking water, seafood, and air in work environment. • Website and contact number for additional information.
2001 ATSDR ToxFAQs	• Physical properties of elemental mercury. • Common items containing mercury. • Exposure routes and pathways and health effects for adults and children. • Types of medical tests to determine exposure levels. • What to do and not do if a small or large spill occurs. • Websites and contact number for additional information.
Alabama	• Common items containing elemental mercury. • Exposure routes, pathways, and health effects • What to not do if a spill occurs. • How to clean a small spill. • How to properly dispose of mercury and contaminated items. • Websites and contact number for additional information.

Fact Sheet	Content Summary
California	• Physical properties of elemental mercury. • Exposure routes and pathways and health effects. • Types of medical tests to determine exposure levels. • OSHA limits for work environment. • What to do and not do if a spill occurs. • Safe work practices including personal protective equipment recommendations. • A link for disposal information. • Contact number for additional information.
Cuyahoga County, OH	• Physical properties of elemental mercury. • How mercury combines with other elements to form mercury compounds. • Exposure routes and pathways and health effects of various types of mercury. • Methods to reduce exposure and how to handle a small spill. • Contact number and website included for additional information.
Florida	• Physical properties of elemental mercury. • Common items containing elemental mercury. • Exposure pathways and health effects. • Methods to prevent exposure. • What to do if there is a large or small spill. • Contact number and website included for additional information.
Illinois	• Common items containing mercury. • How to store and dispose of items containing mercury. • What to do and not do if mercury is released. • Health effects from exposure.
Maryland	• Physical properties of elemental mercury. • Where elemental mercury and methyl mercury are found. • Exposure routes and pathways and health effects • Ways to reduce mercury pollution. • Common items containing elemental mercury and replaceable items. • Contact number and website included for additional information.

Fact Sheet	Content Summary
New Hampshire	• Physical properties of elemental mercury. • Common items containing mercury. • Exposure routes and pathways and health effects. • What not to do if a spill occurs. • How to clean up a small spill. • How to properly dispose of mercury and contaminated items. • Contact number and website included for additional information.
New York	• Physical properties of elemental mercury. • Exposure routes and pathways and health effects. • Common items containing mercury in schools. • What to do and not do if a spill occurs. • Case study examples of mercury release in school. • Contact number and website included for additional information.
Ohio	• Physical properties of three forms of mercury. • How mercury enters the environment. • Exposure pathways and health effects. • Methods to reduce exposure and what not to do if a spill occurs. • EPA, FDA, OSHA, and ATSDR limits and guidelines for drinking water, seafood, and air in work environment and residential homes. • Contact number and website included for additional information.
Tennessee	• Physical properties of elemental mercury. • Exposure routes and pathways and health effects. • How to clean up a spill from a thermometer and what to avoid. • Who to contact about disposing of mercury and contaminated items. • Who to contact if spill is from a source larger than a thermometer.

Reading Analysis

The Flesch-Kincaid was chosen to test readability level of fact sheets. It is easily accessible to most people since it is available on Microsoft Word. Flesch-Kincaid measures the

readability level of written text based the United States' school grade level. A score of 8.0 means a student in the eighth grade can comprehend the information. The formula is Grade Level = (.39 x ASL) + (11.8 x ASW) - 15.59 where ASL is the number of words divided by the number of sentences and ASW is the number of syllables divided by the number of words (Microsoft, 2010). To utilize the test, text of fact sheets were typed into Microsoft Word. Headings and lists were excluded (Doak et al., 1996) as well as references. The test was then applied. One reading level result was obtained for each fact sheet.

Suitability Assessment of Materials

The Suitability Assessment of Materials (SAM) tool assesses the appropriateness of educational material. The tool uses a simple formula to evaluate up to twenty-two different factors. These factors are grouped into six sections: Content, Literacy Demand, Graphics, Layout & Typography, Learning Stimulation, and Cultural Appropriateness. A description of all the factors is provided in Appendix B. Based on the scoring, the material will fall in one of three categories: superior, adequate, or not suitable material. For factors that occasionally do not apply, the formula can be adjusted. There is a high correlation with SAM and the readability level of material (Doak et al., 1996).

Since an audience is not always available to sample written materials, SAM was created to allow the author to assess written materials "at your desk" (Doak et al., 1996 and Sandra Smith, personal communication on February 2, 2010). One or more people can use SAM to evaluate the same material. However, the percentage score will differ if more than one person uses SAM. This will generate discussion that will improve the material (Smith, 2010).

There were five factors that were not used with all fact sheets were: graphics pertaining to lists, tables, etc., subheadings, motivation, cultural match, and cultural images. None of the fact sheets evaluated used graphics to illustrate a list, table, or chart. Subheading was not evaluated since it was not used in any of the fact sheet to a significant extent. Subheadings would probably be more useful with longer material such as an instructional manual. Motivation factor was not included since topics were not subdivided into smaller sections to allow reader to understand the material better. Since fact sheets are very short in length, the sections used are typically no more than one or two paragraphs. Lastly, cultural match and images were not included in the assessment since it is intended that one copy of the fact sheet will be used nationwide. Therefore, to create numerous fact sheets for the many different cultures in the United States is outside the scope the project. However, it is recommended that the fact sheet be translated to Spanish for communities where Spanish is the primary language.

There were fourteen factors that applied to all fact sheets when applying SAM. These included purpose, content topics, scope, summary and review, reading grade level based on the Fry readability formula, writing style, vocabulary, in sentence construction, learning enhancement by advance organizers, relevance of illustrations, layout, typography, interaction included in text, and model of desired behavior patterns.

For scope factor, if the fact sheet focused on elemental mercury only, it would receive a superior score. If the fact sheet focused on more than one type of mercury such as methylmercury, it would receive an adequate score.

For writing style fact, if the fact sheet contained no passive sentences and used simple sentences consistently, it would receive a superior score. If the fact sheet had some passive sentences and did not use simple sentences consistently, it would receive an adequate score.

For vocabulary factor, common words are required to be used nearly all the time to attain a superior score. It is difficult to determine what is considered a common word. An assumption will be made that if the reading material is written at a sixth grade reading level or lower according to the Flesch-Kincaid readability test, the fact sheet consistently uses commonly known words and will receive a superior score for this factor. If the reading level exceeds sixth grade but under and eleventh grade, and a technical word is defined at least once, it received an adequate score. It is assumed that reading material under eleventh grade level frequently uses common words. If the reading level is at least eleventh grade and technical words are rarely defined, the fact sheet will receive a not suitable score.

For sentence construction factor, if second person is used consistently throughout the fact sheet, it would receive a superior score. If second person is used 50% of the time, the fact sheet will receive an adequate score. If there is no use of second person, the fact sheet will receive a not suitable score.

There were three factors that were applied to specific fact sheets only: cover graphic, type of illustration, and captions used. If there was no cover graphic or illustrations in the fact sheet, these three factors were omitted from the score since it could not be applied.

The Fry readability formula used with SAM to assess readability level was consistently applied to three specific sections with the fact sheets: background on mercury, health effects, and ways to prevent contamination. For material less than fifty pages long, SAM recommends the assessment be applied to three sections of material with each section containing one hundred words. From each section, the number of syllables and sentences were counted. Fractional length of incomplete sentences was included. The average of the number of syllables and number of sentences from the three sections were calculated. The averages were then compared

to the Fry graph to estimate readability level which is illustrated in Figure 3.1 (Doak et al., 1996).

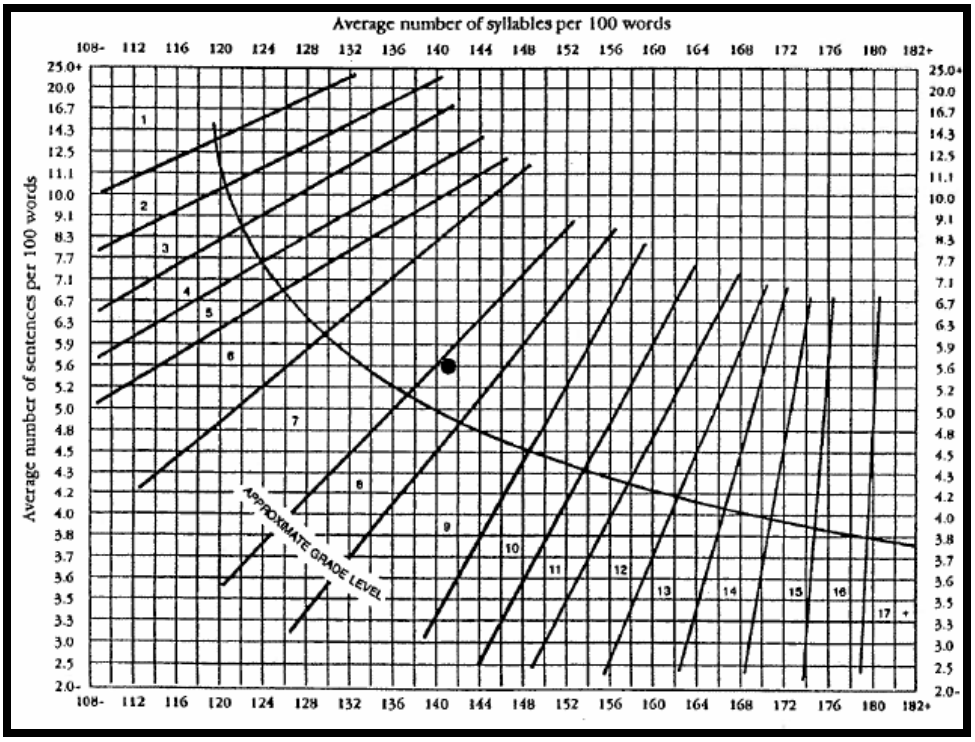


Figure 3. 1: Fry Graph used to determine readability level (Doak et al., 1996).

Fact sheets that scored between 70% and 100% were considered superior, 40% and 69% were considered adequate, and fact sheets that scored between 0% and 39% were considered not suitable. Each factor applied was rated not suitable, adequate, or superior based on specific requirements. Not suitable received zero points, adequate received one point, and superior received two points. To calculate the final score, the following equation was used:

$$\text{SAM \%} = \frac{\text{Total score of fact sheet}}{(\text{Number of factors used} \times 2)}$$

According to author, it is important to note that even though a score of 100% is possible with SAM, it is rare that educational materials will attain a perfect score (Doak et al., 1996).

Development of New Fact Sheet

A new fact sheet has been created based on information obtained from this study. Information, length, and the appropriate reading grade level for the new fact sheet was decided and determined from literature review and/or interviews. The Flesch-Kincaid was used to determine reading grade level. The new fact sheet was also designed to receive a superior score with SAM. Details of the SAM analysis can be found in Appendix C.

Chapter IV

Results

Below are descriptions of three responses where mercury was released at a school. Personal interviews, press releases, EPA OSC website, and/or Pollution Reports were used to obtain the information. The response and public interaction are detailed. All three responses required the school be shutdown during the response and personal items and homes had to be assessed and decontaminated. A mercury response can cost taxpayers several hundred thousand dollars (EPA SCORPIOS, 2010). In addition, hidden costs such as lost pay for teachers, parents taking time off from work to take care of children, bad publicity for the school district and community, and potential legal action can be a significant burden to a community.

Pooler Elementary School, Pooler, Georgia

For more information, visit http://www.epaosc.org/site/site_profile.aspx?site_id=4155.

Response

In June 2008, EPA received a phone call that a student brought elemental mercury to Pooler Elementary School which is located in the suburbs of Savannah, Georgia (Webster, 2009). It was spilled in the gymnasium, cafeteria, and several classrooms. A school dance was held later that night in the gymnasium. Beads of elemental mercury were found after the school dance. The school contacted local authorities who then contacted the Georgia Environmental Protection Division and the EPA. Using a RA-915+ Mercury Analyzer, mercury indoor air concentrations had exceeded EPA's residential Removal Action Level of 1 $\mu g/m^3$ in most areas of the school. In the gymnasium, concentrations were more than 30 times above EPA's action level, and the custodial storage room exceeded 50 $\mu g/m^3$. Twelve days were needed to

decontaminate the school (Webster, 2009). Figure 4.1 shows one method of treatment applied to the gymnasium (EPA photo 2008).

Figure 4. 1: Decontamination efforts in the gymnasium (EPA photo, 2008).

Also, 115 additional facilities were assessed due to potential contact tracking (Webster, 2009). These included residential homes, daycare facilities, and commercial facilities. Many homes were found to have elevated levels of mercury (see Figure 4.2). Several homes required extensive decontamination efforts and residents in these homes had to be temporarily relocated during the decontamination process (Webster, 2009). Figure 4.3 shows a personal item being screened for contamination with a RA-915+ Mercury Analyzer, and Figure 4.4 show personal items being collected from a contaminated house for treatment or disposal after treatment efforts failed (EPA photo, 2008).

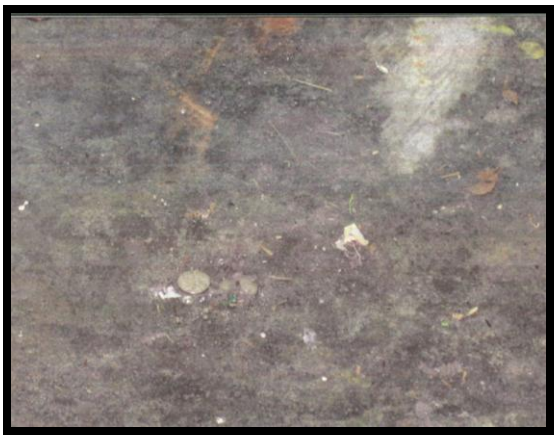


Figure 4. 2: Beads of mercury on floor in laundry room of house (EPA Photo, 2008).

Figure 4. 3: Personal items being screened (EPA Photo, 2008).

Figure 4. 4: Personal items from home being treated (EPA Photo, 2008).

About seven tons of wastes were generated due to elemental mercury contamination. Wastes included contaminated floors and walls of buildings, washing machines and dryers, vacuums, personal items such as books, shoes, and clothing (Webster, 2009). Wastes were sent to a lined landfill.

Communicating with the Public

According to Sherryl Carbonaro, Community Involvement Coordinator, (personal communication, January 11, 2010) and Dr. James Webster, Section Chief of Removal & Oil Section, (personal communication, January 15, 2010), the school used a notification system to

send out a voice mail to all the parents of the students. The message informed the parents of the mercury release and the need to bring to school belongings such as backpacks, shoes, and clothing worn the day of the release to school to be assessed for contamination. The county health department submitted a press release to the local newspaper with a similar message. Dr. James Webster and Sherryl Carbonaro conducted interviews with the local news networks and press about the mercury release and the request for parents to comply with the principal's message (see Figure 4.5).

Figure 4. 5: EPA interviewed by local media (EPA Photo, 2008).

The 2001 ATSDR ToxFAQs fact sheet (see Appendix D) for mercury was given to the local news networks. When parents and students brought their items to school to be assessed for contamination, the fact sheet was handed to them and a verbal summary was given. From June 11, 2008 to June 22, 2008, twelve articles were posted in the local papers and local television's website discussing the response at Pooler Elementary, encouraging students to bring their personal items testing, and to encourage students' parents to allow EPA to test their homes for contamination.

A public meeting was held to update the public of ongoing events (see Figure 4.6). Fact sheets were given to the public as they entered. USEPA, ATSDR, Georgia Environmental

Protection Division (GAEPD), and the local health department attended the meeting. From personal observations, about 100 people attended the public health meeting which consisted of parents, students, school's staff, and local elected officials attended. Updates of the decontamination process at the school were given. Decontamination process at the school as well as several homes required heating and venting treatment of the property and items inside the buildings and removing contaminated floors, carpets, baseboards, and sheetrock as needed to reduce the mercury indoor air concentrations to less than the EPA's residential Removal Action Level of 1 $\mu g/m^3$. EPA then restored the buildings. The total cost of the response was about $500,000 (EPA SCORPIOS, 2010).

Figure 4. 6: Updates given during public meeting (EPA Photo, 2008).

Clendenin Elementary School, Clendenin, West Virginia

For more information, visit http://www.epaosc.org/site/site_profile.aspx?site_id=2892.

Response

In March 2007, EPA received a call from the National Response Center regarding an elemental mercury release at Clendenin Elementary School in Clendenin, West Virginia (Easton, 2007). Elemental mercury beads were found on the school's front steps, pavement, and in the

computer room. Four students brought a total of four pounds of mercury to school and shared it with friends (Saturday Gazette-Mail, 2007). The source appeared to have originated from a nearby dental office that had reported four vials of elemental mercury were stolen. Fifteen students were believed to have come in contact with elemental mercury (Easton, 2007). West Virginia Department of Environmental Protection oversaw the cleanup of the school. The spill occurred on a Friday and the cleanup was completed by Sunday. Personal items of 400 students were screened for elemental mercury contamination. Sixty-three personal items were taken for treatment. The items taken for treatment can be seen in Figure 4.7 (Easton, 2007). It is unknown what levels of mercury vapor were found; however, it is likely that indoor air concentration exceeded 1 $\mu g/m^3$.

Figure 4. 7: Personal items being treated (Easton, 2007).

Fifteen houses were assessed for contamination of which five houses required to be decontaminated. Several washing machines had to be discarded due to contamination. Minuscule beads of mercury on resident's carpet can be seen in Figure 4.8. A washing machine been assessed for mercury contamination is illustrated in Figure 4.9 (Easton, 2007).

Figure 4. 8: Beads of mercury on carpet inside home (Easton, 2007).

Figure 4. 9: Washing machine assessed for contamination (Easton, 2007).

The local public library and local churches were also assessed. Beads of mercury were found on outdoor steps leading to the sanctuary of the church (see Figure 4.10).

Figure 4. 10: Bead of mercury found on church steps (Easton, 2007).

Treatment failed to reach appropriate air levels for one school bus and fifteen personal items. These items were sent for disposal (Easton, 2007). The school and West Virginia Department of Environmental Protection coordinated the disposal of the bus and personal items (personal communication with Marjorie Easton, February 19, 2010). Details of the disposal process could not be attained.

Communicating with the Public

A total of six local papers and local television's website were found online that discussed the mercury response at Clendenin Elementary. A public meeting as seen in Figure 4.11 was held at the local community center (Easton, 2007). A copy of the 1999 ATSDR ToxFAQs (see Appendix D) fact sheet for mercury was provided to all attendees. Kanawha-Charleston Health Department, USEPA, and West Virginia Department of Environmental Protection provided information and answered questions from the public. The majority of the questions dealt with whether or not the student who brought elemental mercury to school would face consequences. The school and homes were decontaminated to an indoor air concentration below EPA's Removal Action Level. The exact level could not be attained, but it is likely below 1 $\mu g/m^3$. Estimated costs of the spill could not be attained.

Figure 4. 11: Public meeting during response (Easton, 2007).

Calexico High School, Calexico, California

For more information, visit the EPA Press Releases.

Response

In January 2009, elemental mercury was released at Calexico High School. A blood pressure cuff broke and about two tablespoons of mercury spilled. Twelve rooms in the school as well as the three outdoor areas were contaminated. The school shutdown for two days and parts of the building were inaccessible for up to five days due to cleanup efforts (EPA Press Release #2, 2009). The high school identified about 200 students who most likely came into contact with the contaminated areas. These students reported to the school cafeteria to be screened for mercury (EPA Press Release #1, 2009). Twenty to forty homes were surveyed for mercury contamination (EPA Press Release #2, 2009). It is unknown what the concentration of mercury vapors were found in the air indoors; however, it is likely to have exceeded 1 $\mu g/m^3$.

Communicating with the Public

A total of four local papers and local television's website as well as two EPA press releases were found online that discussed the mercury response at Calexico High School. A fact sheet on mercury was provided to students to take home. It is unknown which fact sheet was provided. A public meeting was held at the gymnasium to discuss elemental mercury, its health effects, and the problems elemental mercury has when contaminated items such as clothing are brought home. Also, the possibility of needing to decontaminate homes and relocating residents were discussed. EPA then received access agreements to screen homes for contamination. The school and homes were decontaminated to an indoor air concentration below EPA's Removal

Action Level. The exact level could not be attained, but it is likely below 1 µg/m^3. Estimated costs of the spill could not be attained.

Interview Summaries

A set of questions were asked to responders, toxicologists, risk assessors, and experts in the field of mercury. The questions focused on their experience and knowledge with mercury in three areas:

- Does the public appear to understand the fact sheet used?
- What information does the public need to know about mercury?
- What are the common communication challenges and barriers during these responses?

A summary of their responses is provided below. Details of the interviews can be found in Appendix A.

Fact Sheets Comprehension

The ATSDR ToxFAQs fact sheet appears to be difficult for many people to read. According to the interviews, it appears to be the most widely used fact sheet for responses. People do attempt to read it; however, many may not understand the information presented. There are several instances where the person handing out the fact sheet will need to go over it with the reader to help them understand it. Also, people become frightened when they attempt to read the fact sheets and miss the point that the fact sheet's purpose is to provide educational information. The fact sheets also appear to be too long and too complicated. From observations, most people appear to read the first page and then quickly glance through the remaining pages.

Therefore, to increase comprehension of new fact sheets, the following information was suggested from the interview:

- Font size should be at least twelve point;
- Illustrations should be provided;
- Written text should be at a sixth grade reading level;
- Information should written in a friendly tone to avoid fear or panic; and
- The fact sheet should be one page and one-sided with essential information only.

Additional details should be provided by listing website addresses. Also, contact numbers should be included to allow people to directly ask questions if they do not have internet access or have follow up questions.

Information for Fact Sheet

The fact sheet should include the most critical information the public needs to know that can be quickly read understood by parents and faculty of a school during a potentially stressful situation. For releases, the information should include what needs to be done and what must be avoided such as;

- Covering the spill to prevent tracking;
- Open all windows in building to reduce mercury indoor air concentration;
- Keep people out of room containing spill and close door of room if available to help contain mercury vapor;
- Avoid vacuuming or sweeping the spilled area since this will increase vapor concentration and spread contamination to other areas of the building; and

- Call EPA, state environmental agency, or local health department for guidance, especially if the release did not come from a compact fluorescent light bulb or a single thermometer. Releases from other sources will generally result in concentrations above Removal Action Levels. Concentrations above Removal Action Levels will trigger an emergency response.

For prevention purposes, the information for the new fact sheet should include information on identifying mercury, common household sources of mercury, and how to properly dispose of mercury. This information includes:

- Physical description of mercury so people know how to recognize it;
- A picture or a website address showing mercury vapors evaporating under ultraviolet light to illustrate that vapors are constantly being released even if you cannot see or smell it;
- A list of common household items containing mercury such as antique clocks, switches and relays, batteries made before 1996, and thermometers and thermostats containing a silver liquid;
- Potential symptoms related to exposure from mercury vapors;
- Disposal information such as discarding items that have come in contact with mercury in a trash can outside of the home, placing mercury in a sealed, unbreakable jar in a garage, detached storage building, or similar area where it is out of sight and reach from children and will prevent exposure to living areas until it can be properly be sent for disposal, and contacting the county's waste program to inquire about amnesty collection days where hazardous items can be dropped for proper disposal for free. If collection days are not

available, the public needs to check to see if it is acceptable to dispose of mercury in with household trash; and

- A website address to EPA's mercury education website should also be included for additional details.

Length and Illustrations

The length of the fact sheet should be no more than one page and one-sided. From observations by responders, it appears many readers focus on the first page of a fact sheet. Relevant illustrations need to be included since it helps readers comprehend and retain information.

Challenges

Common issues were noted during the interviews. Many responders find it difficult to convince some adults that mercury is a health hazard and can cause serious health effects. During public meetings, one of the common comments made were adults stating that they played with mercury as a child and appeared not to experience any health effects. It was also difficult to convince some residents that mercury contamination exists with their personal belongings or in their homes since mercury since it has no odor and can be difficult to see in small quantities. During public meetings, more questions about other topics such as consequences for the student who brought mercury to school and fewer questions on health effects. In addition, communicating the dangers of mercury exposure without creating a sense of fear is often difficult. Fact sheets need to be written with a friendly tone to mitigate fear, but still contain a sense of urgency for people to follow during a response.

Responses in communities where the public speaks Spanish as their primary language are difficult when responders' fact sheets are provided only in English. Therefore, fact sheets need to be written in both English and Spanish. Communities located near the border of the United States and Mexico need to be informed of common items that may contain mercury. Commonly used items that contain mercury may be difficult to find in the United States, but may be readily available in Mexico. Mercury thermometers are an example. According to Ryan Atencio, responder for the Department of Toxic Substances Control of California, he responded to a mercury release in a community adjacent to the border of Mexico where the release originated from a mercury thermometer that was given to them by a physician in Mexico (personal communication on December 23, 2009). During the response, many neighbors informed the responder that they see the same doctor in Mexico and they were given the same type of thermometers to use. Therefore, it important to educate communities near the border about items containing mercury.

Assessment

Each fact sheet was evaluated using a readability test to determine grade level of written text and a tool that assesses appropriateness. The fact sheets were also assessed for length and illustration coverage percentage. This analysis was performed to determine if the commonly used fact sheets meet the criteria that suggest successful transfer and communication of information (as previously discussed in the literature review).

Essential Information for Fact Sheet

Based on the literature review and interviews, the essential content that needs to be included in a mercury fact sheet is background information on mercury, exposure pathways, initial signs of exposure, what must be done if released, how to prevent contamination from spreading, common household items containing mercury, and how to properly dispose of items that have come in contact with mercury. Background facts include a physical description of mercury as it is normally seen, the characteristics of its vapors, and a website address where readers can view the demonstration and attain more information related to mercury. Exposure pathways should focus primarily on inhalation. Initial signs of exposure should include coughing, chest pains, vomiting, headaches, and shakiness. If mercury is released, the following steps should be included: Avoid touching mercury, cover the spill with a newspaper, open all windows, close door of room with spill if available and keep everyone away, and then call EPA, state environmental agency, or local health department for guidance. To prevent contamination from spreading, information should include no vacuuming, sweeping, washing clothes, or pouring mercury down drains. For proper disposal information, fact sheet should include information about contacting the county's solid waste program and inquire about amnesty days for disposing of household hazardous items.

Assessment Results

All of the fact sheets' reading grade level evaluated by Flesch-Kincaid was above sixth grade. The reading grade level ranged from 8.4 to 13.6. The average grade level for the twelve fact sheets was 11.4. Only two fact sheets could be read at a reading level below the eleventh grade. Therefore, with the use of the currently evaluated fact sheets, more than 75% of the adult

population in the United States will not be able to comprehend them (Doak et al., 1996). Table 4.1 summarizes the reading grade level of the twelve fact sheets used in this study.

Table 4.1: Reading grade level of the twelve fact sheets used in this study.

Source	**Flesch-Kincaid Level**
1999 ATSDR ToxFAQs	11.5
2001 ATSDR ToxFAQs	12.7
Alabama	11.5
California	11.8
Cuyahoga County, OH	12.2
Florida	9.5
Illinois	11.8
Maryland	13.6
New Hampshire	10.2
New York	12.4
Ohio	11.2
Tennessee	8.4

During the SAM, none of the fact sheets received a superior score. Six fact sheets were considered adequate, and six fact sheets were considered not suitable. New Hampshire and Tennessee scored highest at 54%. Maryland scored lowest at 27%. All fact sheets would have significantly improved their score if the reading level was reduced to a sixth grade reading level and if simple, relevant illustrations with captions were included. Details of how each fact sheet was scored are found in Appendix C.

Only two fact sheets were one page in length: Alabama and Maryland. However, Alabama's font size throughout the fact sheet is nine point and Maryland's font size appears to be smaller than nine point. If a font size of twelve points was used with Alabama's and Maryland's fact sheets, it appears they would exceed one page in length. California's fact sheet had the longest fact sheet at six pages. Its font size appears to be slightly larger than twelve points.

None of the fact sheets strongly utilized relevant illustrations to communicate its message. Only three fact sheets used some form of illustration. Of these three fact sheets, none used captions to explain the illustrations. It appears that the twelve facts were designed to educate readers with text only. Table 4.2 displays the results of the assessment.

Table 4.2: Results from the assessment.

Source	Number of Pages	Illustration Coverage %	SAM
1999 ATSDR ToxFAQs	2	0	Not Suitable
2001 ATSDR ToxFAQs	3	0	Not Suitable
Alabama	1	0	Not Suitable
California	6	0	Adequate
Cuyahoga County, OH	2	0	Not Suitable
Florida	2	20	Not Suitable
Illinois	2	0	Adequate
Maryland	1	0	Not Suitable
New Hampshire	4	0	Adequate
New York	2	< 5	Adequate
Ohio	2	< 5	Adequate
Tennessee	2	0	Adequate

SAM Assessment

Content Section

Overall, the fact sheets scored well with the following factors: Purpose, Content Topics, and Scope. In most cases, the purpose was clearly stated in the title or introduction. Most fact sheets' content topic included desirable behaviors or actions instead of facts. All fact sheets' scope focused on mercury and most focused on elemental mercury. The fact sheets scored poorly with the Summary and Review factor. Eleven of the twelve fact sheets did not contain a summary and review section. Table 4.3 summarizes the SAM results of the Content Section.

Table 4.3: SAM results for Content Section.

Source	Purpose	Content Topics	Scope	Summary & Review
1999 ATSDR ToxFAQs	Superior	Not Suitable	Adequate	Not Suitable
2001 ATSDR ToxFAQs	Not Suitable	Not Suitable	Superior	Not Suitable
Alabama	Adequate	Adequate	Superior	Not Suitable
California	Superior	Not Suitable	Superior	Adequate
Cuyahoga County, OH	Adequate	Not Suitable	Adequate	Not Suitable
Florida	Superior	Adequate	Superior	Not Suitable
Illinois	Superior	Adequate	Superior	Not Suitable

Source	Purpose	Content Topics	Scope	Summary & Review
Maryland	Not Suitable	Not Suitable	Adequate	Not Suitable
New Hampshire	Superior	Superior	Superior	Not Suitable
New York	Superior	Not Suitable	Superior	Not Suitable
Ohio	Not Suitable	Adequate	Adequate	Not Suitable
Tennessee	Superior	Adequate	Superior	Not Suitable

Figures 4.12 to 4.15 graphically illustrate how the twelve fact sheets score with the Content Section of SAM.

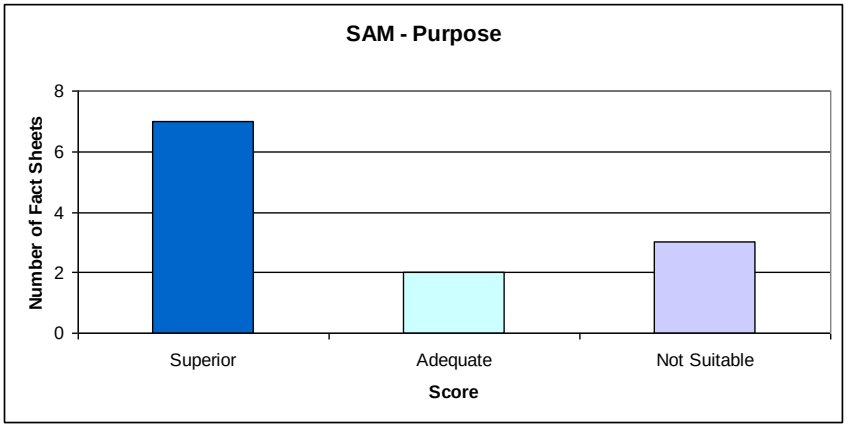


Figure 4. 12: Fact sheets' SAM scores for purpose.

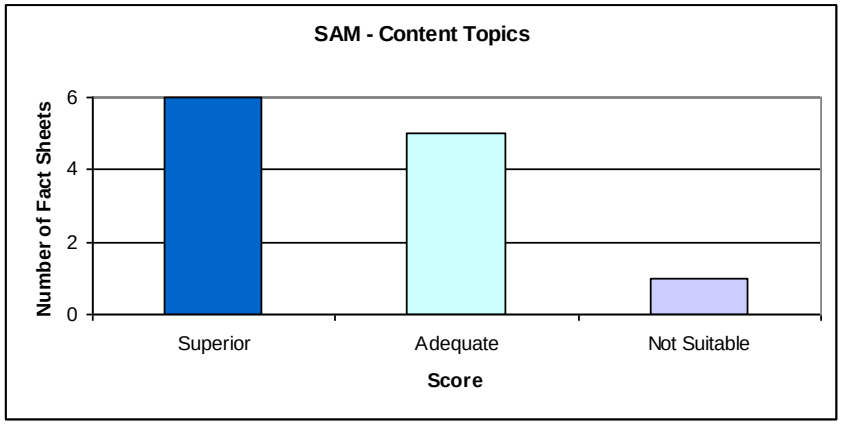


Figure 4. 13: Fact sheets' SAM scores for content topics.

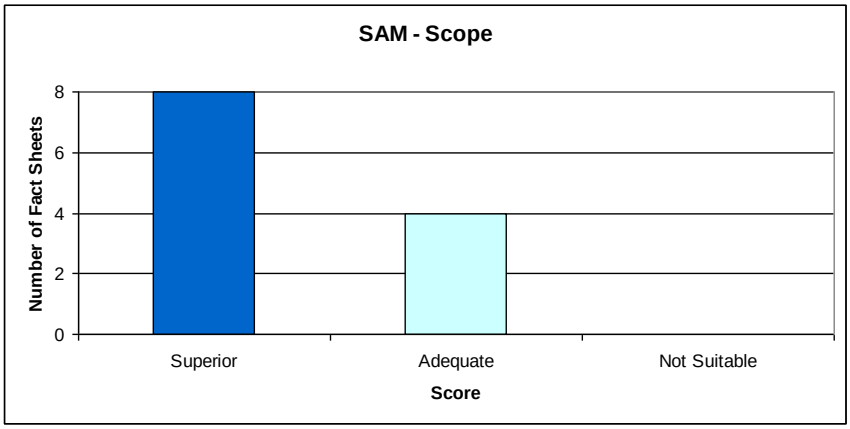


Figure 4. 14: Fact sheets' SAM scores for scope.

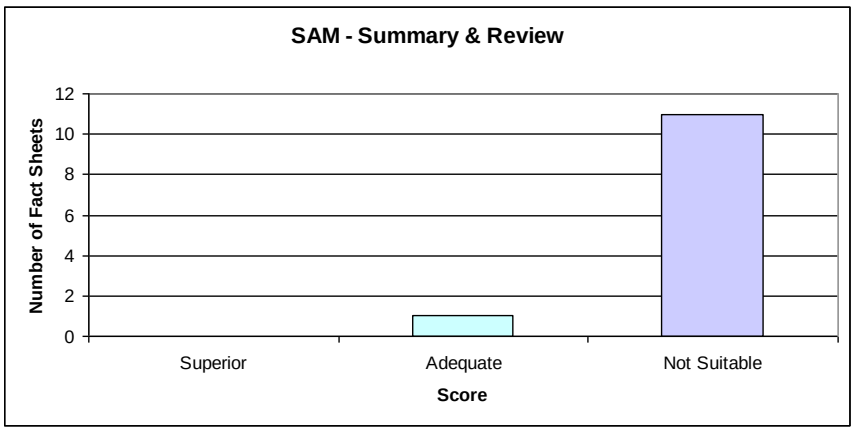


Figure 4. 15: Fact sheets' SAM scores for summary and review.

Literacy Demand Section

Overall, the fact sheets scored well with only one factor in this section: Learning Enhancement. All fact sheets used headings to inform the reader the next section. All fact sheets scored adequately for the Writing Style factor. To improve the writing style, the majority of the sentences used in fact sheets needs to use simple sentences instead of using compound and complex sentences. In addition, all fact sheets contain sentences using passive voice. It is believed that minimal effort is needed to change these sentences to active voice. The fact sheets scored poorly with the Fry Reading Grade Level, Vocabulary, and In Sentence Construction factors. All fact sheets had reading levels at eighth grade or above. The fact sheets' vocabulary choices included many technical words that raised the reading level and made it difficult to read. In addition, the reading level of the material was too high to ensure consistent use of commonly used words. For In Sentence Completion factor, many of the fact sheets were written in third person or used second person occasionally. Table 4.4 summarizes the SAM results of the Literacy Demand Section.

Table 4.4: SAM results for Literacy Demand Section.

Source	Fry Reading Grade Level	Writing Style	Vocabulary	In Sentence Construction	Learning Enhancement (Road Signs)
1999 ATSDR ToxFAQs	Not Suitable	Adequate	Not Suitable	Not Suitable	Superior
2001 ATSDR ToxFAQs	Not Suitable	Adequate	Not Suitable	Not Suitable	Superior
Alabama	Not Suitable	Adequate	Not Suitable	Not Suitable	Superior
California	Not Suitable	Adequate	Adequate	Adequate	Superior
Cuyahoga County, OH	Not Suitable	Adequate	Not Suitable	Adequate	Superior
Florida	Not Suitable	Adequate	Not Suitable	Not Suitable	Superior
Illinois	Not Suitable	Adequate	Not Suitable	Adequate	Superior
Maryland	Not Suitable	Adequate	Not Suitable	Not Suitable	Superior
New York	Not Suitable	Adequate	Adequate	Adequate	Superior
Ohio	Not Suitable	Adequate	Adequate	Not Suitable	Superior
Tennessee	Adequate	Adequate	Adequate	Not Suitable	Superior

Figures 4.16 to 4.20 graphically illustrate how the twelve fact sheets score with the Literacy Demand Section of SAM.

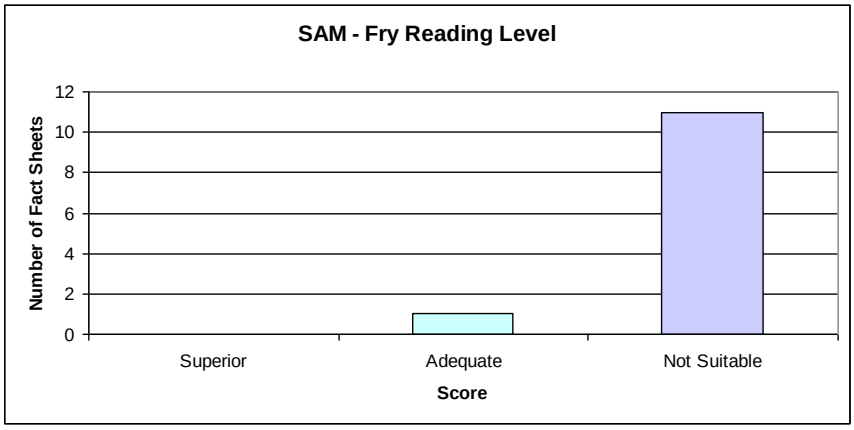


Figure 4. 16: Fact sheets' SAM scores for Fry reading grade level.

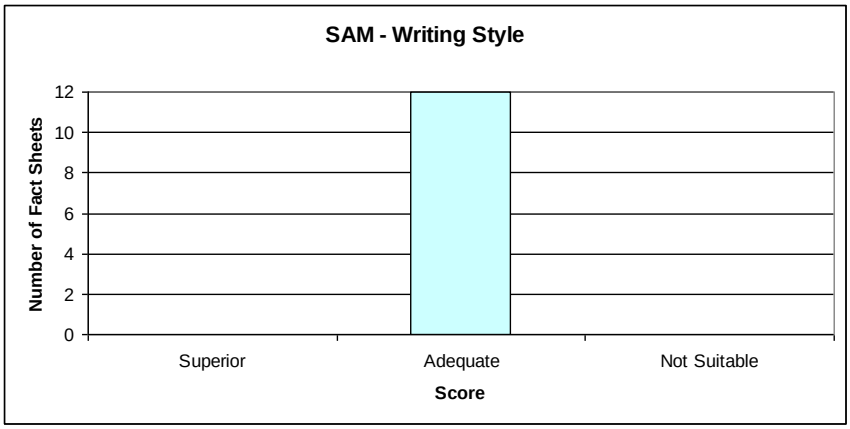


Figure 4. 17: Fact sheets' SAM scores for writing style.

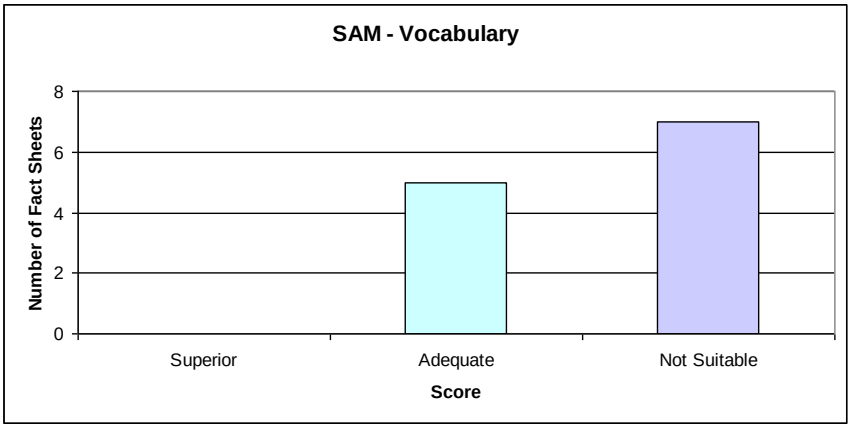


Figure 4. 18: Fact sheets' SAM scores for vocabulary.

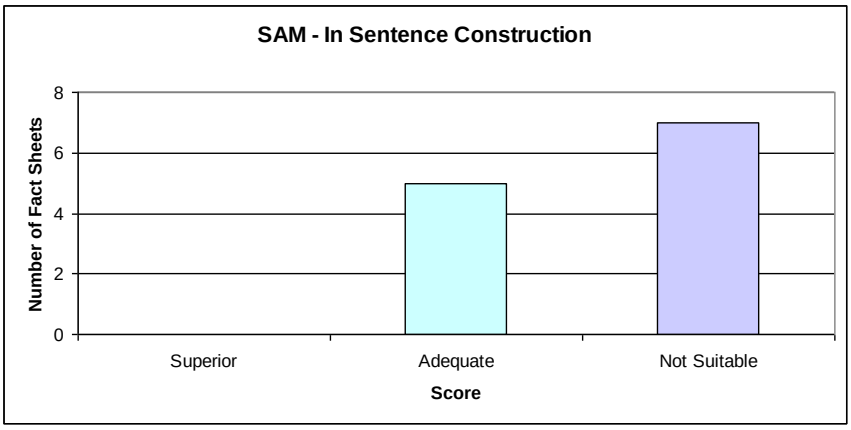


Figure 4. 19: Fact sheets' SAM scores for in sentence construction.

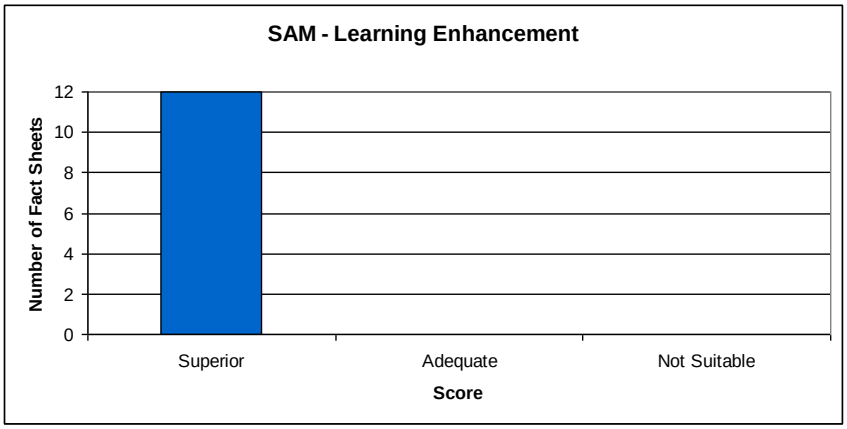


Figure 4. 20: Fact sheets' SAM scores for learning enhancement.

Graphics, Learning Stimulation, and Layout & Topography Sections

All the fact sheets met at least half of the criteria for typography. Most were written using serif or sans-serif fonts and the size was twelve points or more. Most fact sheets scored adequately with the interaction factor; however, this is the best score for fact sheets since the question and answer format is the preferred format (McKenna & Scott, 2007).

All fact sheets scored adequately for Layout. To improve the score, most fact sheets need to include relevant illustrations on the same page of the referred text, and reduce the line length to a total of thirty to fifty character and spaces. All but one fact sheet scored adequately for Desired Behavior Patterns. To improve this score, technical words need to be substituted for common words. This will also reduce the reading grade level of the fact sheet (Doak et al., 1996). Fact sheets scored poorly with Relevant of Illustrations. Only two fact sheets used relevant illustrations to help the reader understand the material. Table 4.5 summarizes the SAM results of the Graphics, Learning Stimulation, and Layout & Topography sections.

Table 4.5: SAM results for Graphics, Learning Stimulation, and Layout & Topography sections.

Source	Relevance of Illustrations	Layout	Typography	Interaction	Desired Behavior Patterns
1999 ATSDR ToxFAQs	Not Suitable	Adequate	Superior	Adequate	Adequate
2001 ATSDR ToxFAQs	Not Suitable	Adequate	Superior	Adequate	Adequate
Alabama	Not Suitable	Adequate	Adequate	Not Suitable	Adequate
California	Not Suitable	Adequate	Adequate	Not Suitable	Adequate
Cuyahoga County, OH	Not Suitable	Adequate	Superior	Adequate	Adequate
Florida	Not Suitable	Adequate	Adequate	Adequate	Adequate
Illinois	Not Suitable	Adequate	Superior	Adequate	Adequate

Source	Relevance of Illustrations	Layout	Typography	Interaction	Desired Behavior Patterns
Maryland	Not Suitable	Adequate	Adequate	Adequate	Adequate
New Hampshire	Not Suitable	Adequate	Superior	Not Suitable	Adequate
New York	Superior	Adequate	Adequate	Adequate	Adequate
Ohio	Superior	Adequate	Adequate	Adequate	Adequate
Tennessee	Not Suitable	Adequate	Adequate	Adequate	Superior

Figures 4.21 to 4.25 graphically illustrate how the twelve fact sheets score with the Graphics, Learning Stimulation, and Layout & Topography sections of SAM.

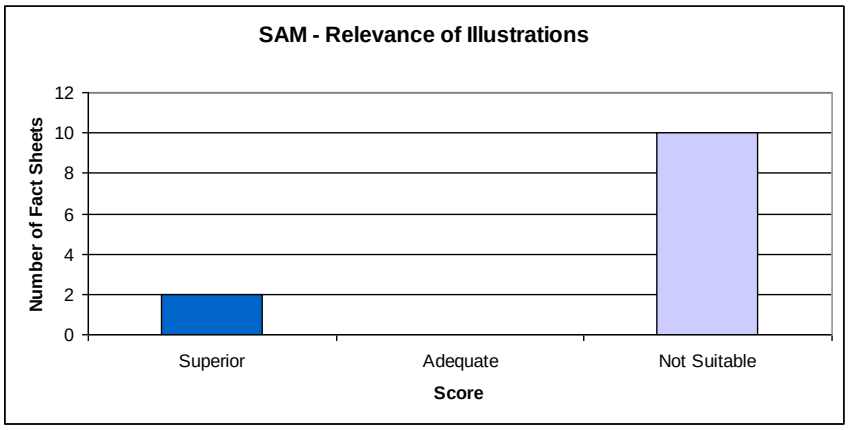


Figure 4. 21: Fact sheets' SAM results for relevance of illustrations.

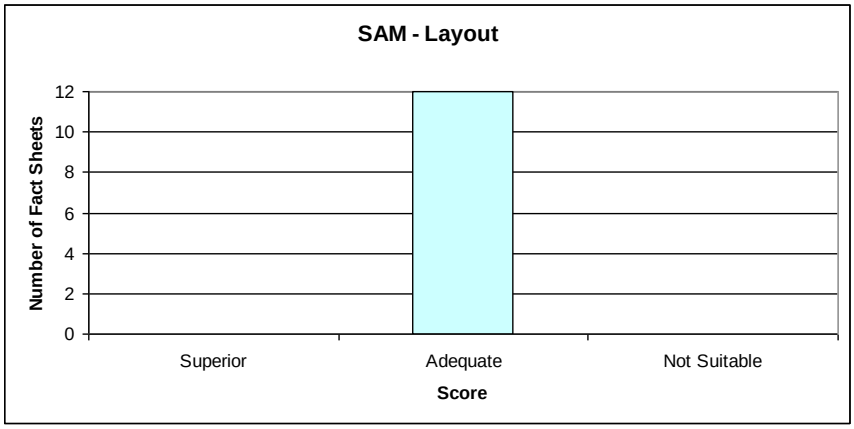


Figure 4. 22: Fact sheets' SAM scores for layout.

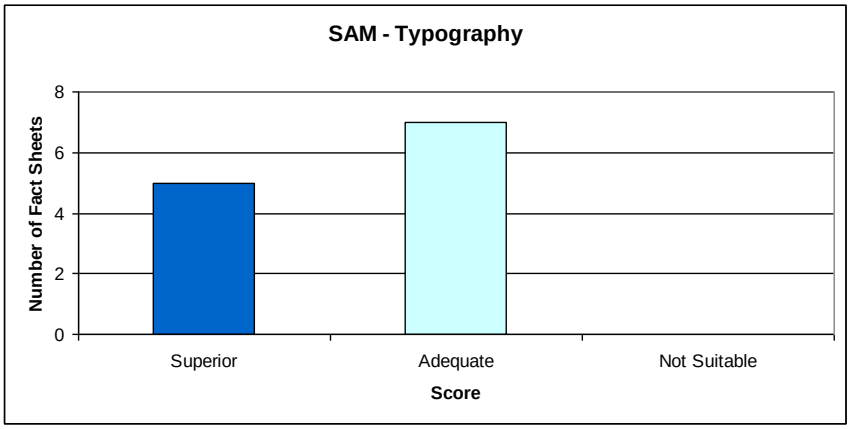


Figure 4. 23: Fact sheets' SAM scores for typography factor.

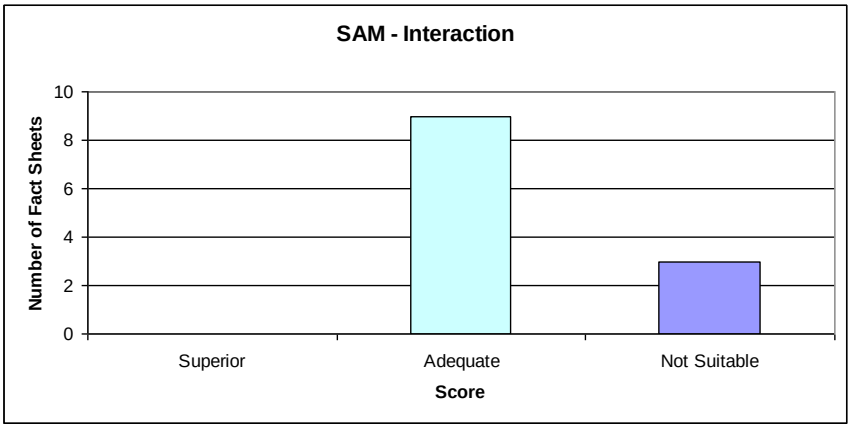


Figure 4. 24: Fact sheets' SAM scores for interaction.

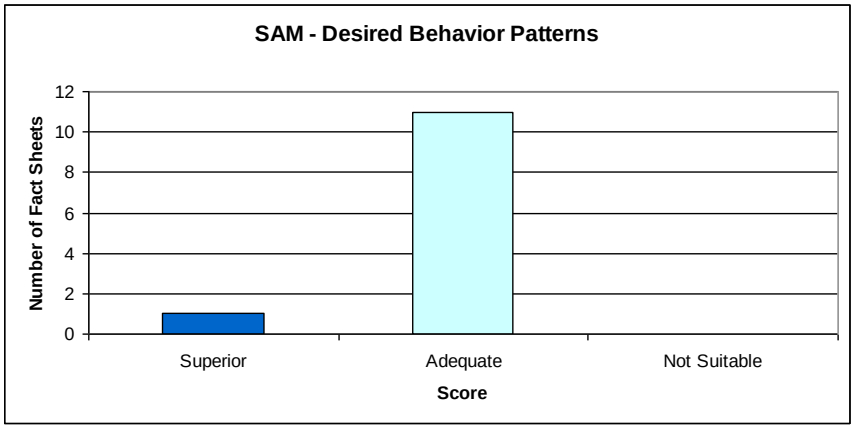


Figure 4. 25: Fact sheets' SAM scores for desired behavior patterns.

All fact sheets scored adequate for writing style and layout, and all but one fact sheet scored adequately for desired behavior patterns (see Figures 4.12 to 4.14). These scores can be improved to superior by making subtle changes such as changing passive sentences to active sentences, adding illustrations, change line length to 30-50 characters and spaces, replacing technical words with common words, and using simple sentences.

Many sentences in the fact sheets appeared to be lengthy which may result in a higher reading grade level. An average of sentence length was taken with the same three sections used in the Fry reading grade level evaluation: background on mercury, health effects, and ways to prevent contamination. The 2001 ATSDR ToxFAQs fact sheet had the highest average sentence length at 125 characters per sentence for the evaluated sections. Florida had the lowest average at 70 characters per sentence. The results of average sentence length are shown below in Table 4.6.

Table 4.6: Average number of characters and spaces of sentences evaluated with SAM.

Fact Sheet	Average Number of Characters and Spaces
1999 ATSDR ToxFAQs	81
2001 ATSDR ToxFAQs	125
Alabama	117
California	105
Cuyahoga County, Ohio	103
Florida	70
Illinois	97
Maryland	116
New Hampshire	102
New York	94
Ohio State	104
Tennessee	78

A relationship can be drawn with the fact sheets' reading level and sentence length. Fact sheets with longer sentences tend to have higher reading level. Figure 4.26 clearly displays this trend.

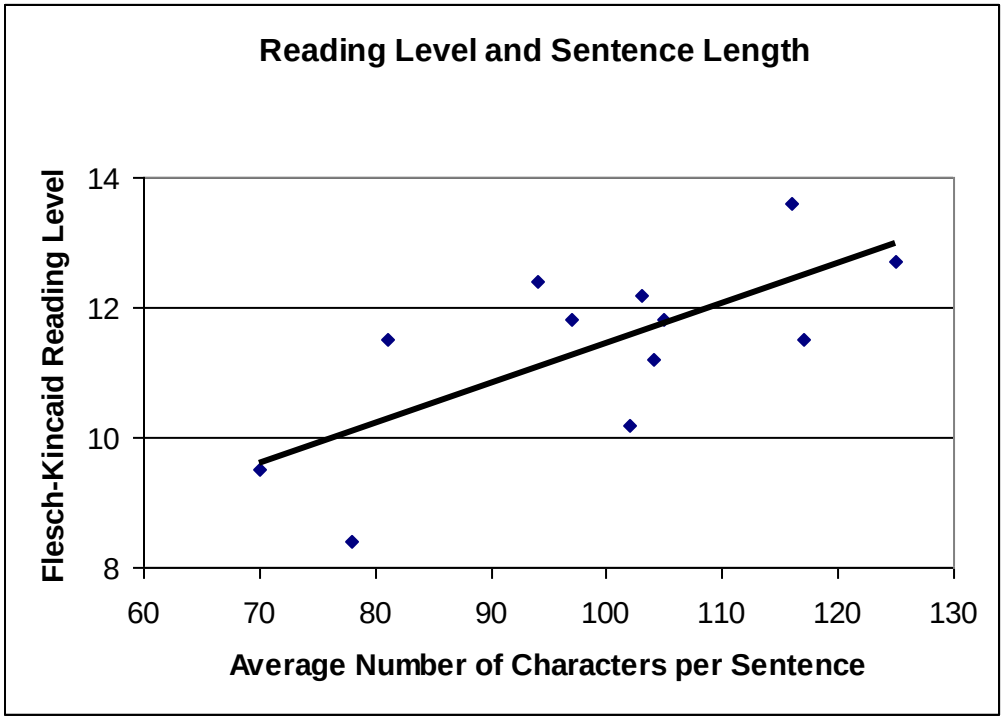


Figure 4. 26: Fact sheet with long sentences is likely to have higher reading level.

When comparing the fact sheet with the highest reading grade level, Maryland, to the fact sheet with the lowest reading grade level, Tennessee, significant difference can be seen with vocabulary and average sentence length. Excluding headings and lists, Maryland's fact sheet choice of vocabulary includes thirty-one words containing at least four syllables. Some of these words were used several times. Many of these words may potentially be substituted with simpler choice of words. In addition, the average sentence length was 116 characters and spaces per sentence. Excluding headings and lists, Tennessee's fact sheet choice of vocabulary that contained more than four syllables was fourteen words of which three words were included in proper nouns. Tennessee's fact sheet averaged a total of 78 characters and spaces per sentence.

Maryland's fact sheet had the lowest percentage score with SAM at 27%, and Tennessee's fact sheet was tied for the highest score at 54%. Comments on some SAM factors and other assessments used to evaluate the two fact sheets can be seen in Figures 4.27 and 4.28. Note that the actual fact sheet size is larger and can be viewed in Appendix D.

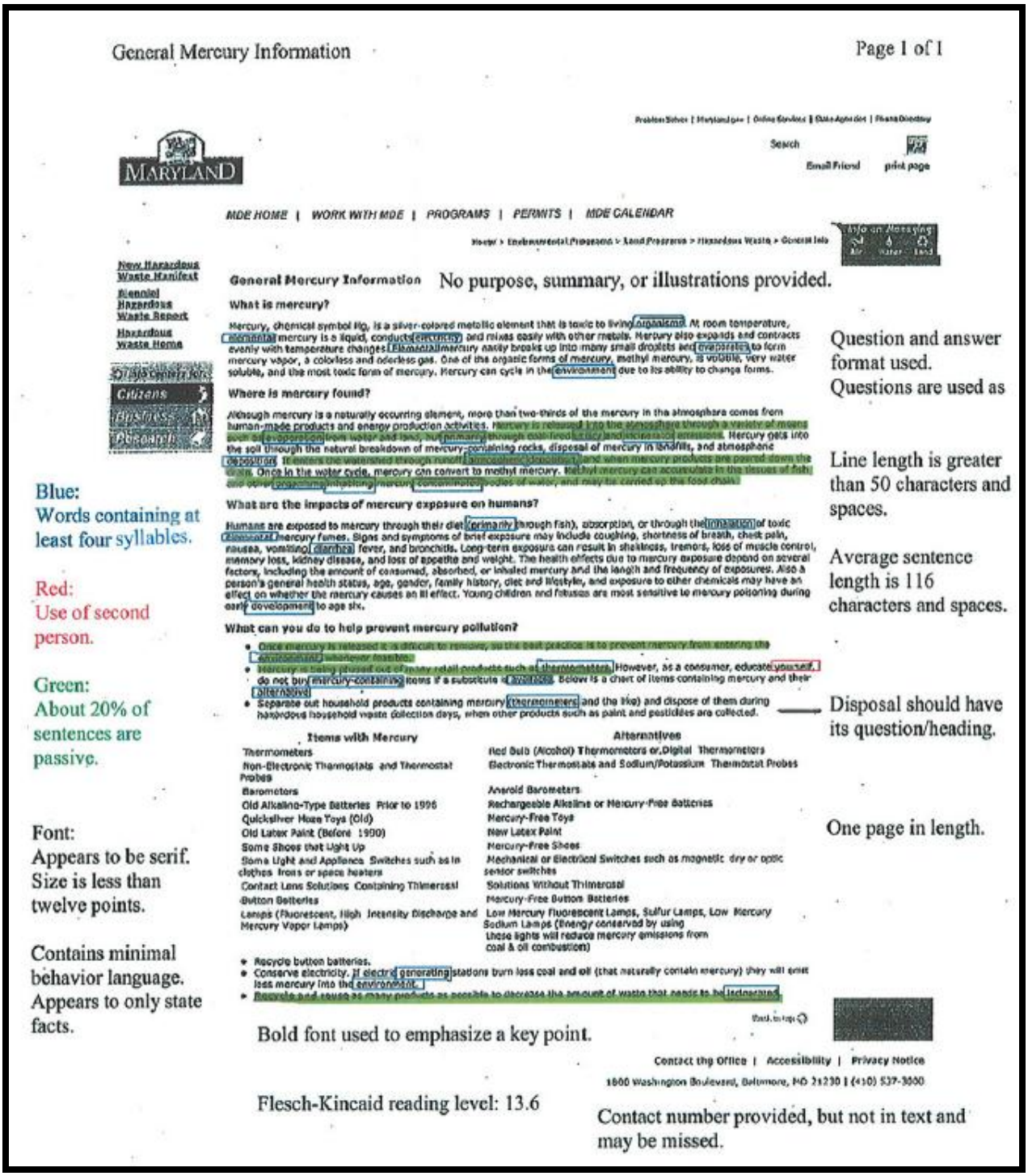


Figure 4. 27: Comments on Maryland's fact sheet based on some SAM factors.

Department of Health
Susan R. Cooper, MSN, RN, Commissioner

Health Fact Sheets

Purpose clearly stated in introduction.

Mercury Clean-Up

This fact sheet answers questions about broken thermometers and mercury. The effects of exposure to any chemical depend on how much you are exposed to, how long you are exposed, and how you are exposed.

What is mercury?

Mercury is a metal that exists naturally in the earth's crust, soil, air, and food. In thermometers the mercury is a shiny, silver-colored liquid that is in the elemental form.

What happens to mercury when you break a thermometer?

When a thermometer is broken, the mercury can spill out. Because mercury evaporates at room temperature, mercury vapors will get into the air.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Breathing mercury vapors can harm the nervous system, the lungs, and the kidneys. Mercury vapors pass easily from the lungs into the blood stream. Swallowing or touching elemental mercury will not harm a person. Exposure to the mercury in an ordinary thermometer will not harm a person if it is cleaned up correctly.

What do I do if I have breathed in or accidentally eaten mercury?

Call your local Poison Control Center: 1-800-222-1222

How do I cleanup the mercury from a broken thermometer?

DO NOT VACUUM UP THE MERCURY! BE CAREFUL WITH THE BROKEN GLASS!

If the mercury spilled on a hard surface:

Use a piece of paper or cardboard to gently push the balls of mercury onto a piece of paper. Put the collected mercury into a jar with a lid or into a zip lock bag.

If the mercury spilled on a carpet or rug:

Clean it up as above. If it is difficult to gently push the balls of mercury through the pile of the carpet or rug, try using a medicine or eye dropper to pick up the mercury.

If all the tiny balls of mercury cannot be picked up from a carpet:

Gently work an absorbent material into the carpet (Capture ® Carpet Cleaner, kitty litter, etc.)
Leave it alone for ½ to 1 hour.
Open the windows.
Vacuum up the area and immediately take the vacuum cleaner bag outside to the garbage can.

If all the tiny balls of mercury cannot be picked up from a small rug:

Take the rug outside and shake it well.
If the clothes dryer is vented to the outside, dry the rug for a few minutes to let the mercury vapor go outside.

If the mercury spilled in the sink:

Collect as much of the mercury as you can, as described above.
Wash the rest of mercury down the drain with dilute chlorine bleach and run the cold water for about 15 minutes.

How do I dispose of the collected mercury?

Take it to the household hazardous waste disposal site in your county (call 1-866-891-6332 to find location and day for your county).

OR

If you cannot safely keep children away from the mercury, throw the jar or bag into the outside garbage.

What do I do if the mercury cannot be cleaned up immediately?

Cover the mercury with a piece of plastic wrap.
Open the window in the room with the broken thermometer.
Close the door to the room.
Keep young children out of the room until the mercury is cleaned up.

Font:
Appears to be serif.
Size is less than twelve points.

Blue:
Words containing at least four syllables.

Red:
Use of second person.

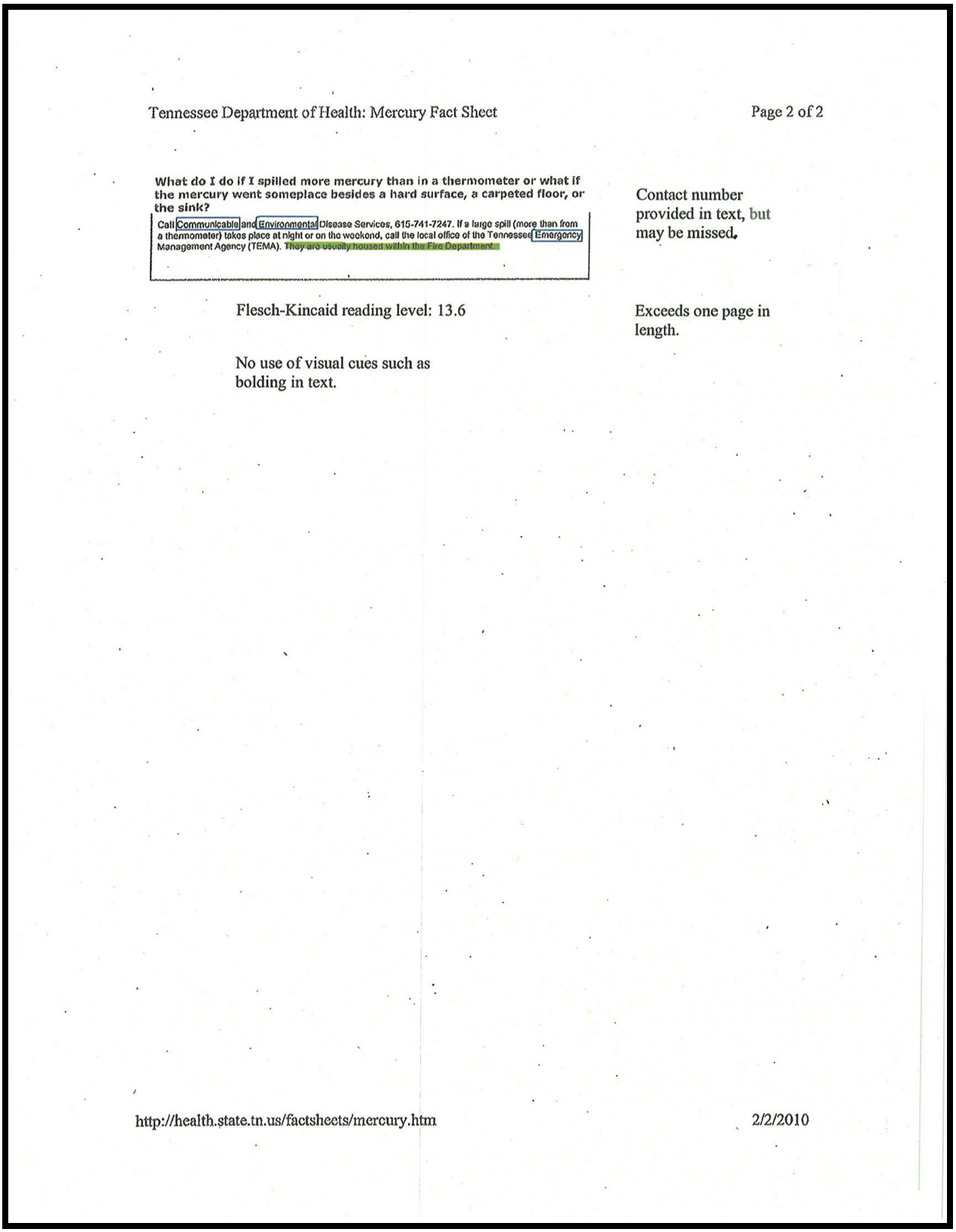
Green:
About 10% of sentences are passive.

Question and answer format used. Questions are used as headings.

This section discusses behaviors and actions to address threat.

Line length is greater than 50 characters.

Average sentence length is 78 characters.



Tennessee Department of Health: Mercury Fact Sheet Page 2 of 2

What do I do if I spilled more mercury than in a thermometer or what if the mercury went someplace besides a hard surface, a carpeted floor, or the sink?

Call Communicable and Environmental Disease Services, 615-741-7247. If a large spill (more than from a thermometer) takes place at night or on the weekend, call the local office of the Tennessee Emergency Management Agency (TEMA). They are usually housed within the Fire Department.

Contact number provided in text, but may be missed.

Flesch-Kincaid reading level: 13.6

Exceeds one page in length.

No use of visual cues such as bolding in text.

http://health.state.tn.us/factsheets/mercury.htm 2/2/2010

Figure 4. 28: Comments on Tennessee's fact sheet based on some SAM factors.

New Fact Sheet

Using the data obtained from interviews, reading level analysis and SAM, a new mercury fact sheet was written. This fact sheet is intended for use as educational material and during mercury release responses. For educational purposes, the fact sheet includes information on physical properties of mercury and its vapors, a picture of mercury vapor's shadows as mercury evaporates, how mercury is dangerous, initial symptoms, common household items that may contain mercury, and how to dispose of mercury. For response purposes, the fact sheet includes relevant illustrations and captions of the six steps homeowners should take if mercury is spilled, and relevant illustrations with captions of the four common ways to prevent mercury from spreading. The illustrations are simple line drawings that are easily recognizable. For behavior that must be avoided, X's or a "do not" sign is placed on top of the illustrations. At the end of the fact sheet, a summary outlined in a box reviews the information in the fact sheet. The summary also includes an EPA contact number for spills and the website address to attain additional information. The title, "What You Must Know about Mercury" clearly states the purpose of the fact sheets.

The fact sheet is one page long in a question and answer format. The illustrations are in color, but can be printed in black and white and be just as effective. The fact sheets reads at a 5.6 grade level when using the Flesch-Kincaid test. Vapor is defined incase readers are not familiar with this word. Line length is kept under a total of fifty characters and spaces except for the summary. This was done in order to have enough room to include the necessary information without using a second page. The average sentence length is a total of 50 characters and spaces. A superior score was achieved when evaluating the fact sheet with SAM. Details of the SAM score can be found in Appendix C.

Chapter V

Discussion and Conclusion

Discussion

The EPA responded to more mercury releases in Fiscal Year 2009 than any other event (EPA Accomplishments, 2009). Many of these releases occur at a school where mercury comes in contact with students and faculty and is spread to other areas of the school and to their homes. Hundreds of people become unexpectedly exposed to mercury vapors. If left alone, exposures to mercury vapor can cause serious health effects. The decontamination process of the school and homes can take several days. Temporarily relocation from homes may be required and personal items may be discarded. The total response cost can be several hundred thousand dollars.

Major Findings

The first question of the study focused on what essential information needs to be included in a mercury fact sheet. From literature review and interviews of experts, risk assessors, toxicologists, and responders, the information should include two main items: procedures to follow if a release occurs, and ways to prevent a release. Procedural information to include is:

- Covering the spill to prevent tracking,
- Opening all windows in building to reduce mercury indoor air concentration,
- Keeping out of room containing spill and closing door of room if available to help contain mercury vapor,
- Avoid vacuuming or sweeping the spilled area, and
- Call EPA, state environmental agency, or local health department for guidance especially if the spill did not occur from a compact fluorescent light bulb or a single thermometer

since mercury vapor concentration from these releases are unlikely to exceed the residential EPA Removal Action Level.

For prevention information, the new fact sheet should include information on identifying mercury, common household sources of mercury, and how to properly dispose of mercury. This information includes:

- A physical description of mercury so people know how to recognize it,
- A picture or website address showing shadows of mercury vapor evaporating under ultraviolet light even if it cannot be seen and it is odorless,
- A list of common household items containing mercury such as antique clocks, switches and relays, batteries made before 1996, and thermometers and thermostats containing a silver liquid,
- Potential symptoms related to exposure from mercury vapors,
- Disposal information such as discarding items that have come in contact with mercury in a trash can outside of the home, placing mercury in a sealed, unbreakable jar in a garage, detached storage building, or similar area where it is out of sight and reach from children and will prevent exposure to living areas until it can be properly be sent for disposal, and contacting the county's waste program to inquire about amnesty collection days where hazardous items can be dropped for proper disposal for free. If collection days are not available, the public needs to check to see if it is acceptable to dispose of mercury in with household trash, and
- A website address to EPA's mercury education website should also be included for additional details.

The second question focused on how fact sheets must be written where the information can be comprehended and retained by the majority of adults. To achieve this, fact sheets must be written at a sixth grade reading level and receive a superior score with SAM. This will ensure that the information in the fact sheet can be comprehended and retained by 75% of adults (Doak et al., 1996). The average reading grade level of the existing twelve fact sheets was 11.4 and none of the fact sheets received a superior score with SAM. Six fact sheets received an adequate score and six fact sheets received a not suitable score. The fact sheets generally scored well with purpose, content topics, scope, learning enhancement, typography, and interaction factors. Fact sheets scored moderately with writing style, layout, and desired behavior factors. Fact sheets need the most improvement with summary and review, reading grade level, vocabulary, in sentence construction, and relevance of illustrations factors. Lastly, fact sheets need to be one page in length to increase the likelihood that people read the entire fact sheet. Ten of the twelve fact sheets were more than one page long. Therefore, the majority of adults cannot comprehend the fact sheets used in this study.

Challenges

There are two specific challenges and barriers in addressing the public about mercury. Getting the public to understand that mercury is dangerous is difficult since many adults have played with it in the past. A fact sheet that clearly explains the dangers of mercury vapor and includes a picture or a website address that shows shadows of mercury vapors constantly being released will help readers visually see why mercury can be dangerous. Many responders have used the video demonstration in public meetings to convince adults that mercury emits vapors that can cause serious health effects. To reduce anxiety from the public during a response, the

fact sheet needs to clearly state that mercury is found naturally in the environment and will not cause any serious health effects if appropriate precautions are taken. In addition, a fact sheet that is comprehendible by the majority of adults and scores highly with SAM will help educate the public on mercury and alleviate most fears that could result from a response.

Importance of Findings

The findings from this study were used to create an improved mercury fact sheet that can be used by EPA and other agencies to educate the public about the dangers of mercury, ways to mitigate exposure and contamination, and how to prevent mercury releases from occurring. More than 50,000 people have been exposed to mercury from 2003 to 2008 and EPA continues to respond to more mercury releases than any other contaminant (AAPCC, 2008 and EPA Accomplishments, 2009). A new fact sheet that can clearly educate the public about the dangers of mercury, how to reduce exposure, and how to prevent a release from occurring in a manner that can easily be understood by the majority of adults without causing a panic will hopefully reduce the number of mercury releases and reduce the number of people exposed to mercury in schools and homes.

Study Strengths

Studies from literature review consistently show that educational materials written at a sixth grade reading level can be understood by the majority of adults (Doak et al., 1996 and Freda, 2005). Studies consistently show that text written at a ninth grade reading level or higher is inadequate for educational materials (Doak et al., 1996 and Davis et al., 1994). More studies consistently showed that the use of illustrations and captions relevant with the text helped readers

learn and retain more information (Anglin, 1987, Doak et al., 1996, Falvo, 2004, and Levie & Lentz, 1982). Information obtained from numerous EPA and ATSDR websites and personal interviews conducted for this study consistently revealed similar information regarding the dangers of mercury and procedures needed to reduce exposure and prevent contamination. Lastly, the results of this study is similar to numerous studies that show the vast majority of existing educational material is written above a sixth grade reading level and therefore, they cannot be understood by the majority of adults (Cotugna et al., 2005, Davis et al., 1994, Freda, 2005, Grossman, Piantadosi, & Covahey, 1994, Meade & Byrd, 1989, Moon, Cheng, Patel, Baumhaft, & Scheidt, 1998, Singh, 2007, Weintraub et al., 2004, Wolf et al., 2006).

Study Limitations

Reading grade level results from one formula may differ slightly with results from different formula. The formulas used in studies that were referred to in this paper consisted of the Rapid Estimate of Adult Literacy in Medicine, Fry, Flesch-Kincaid, and potentially others. However, the reading grade levels should differ by only one grade level with a 68% confidence factor (Doak et al., 1996).

Interviews included only two of the three responders from the schools involved in the study. The responder for Calexico High School could not be reached and the Pollution Report appears to no longer be available on the EPAOSC website. Therefore, the Calexico High School study is limited to information available from EPA press releases. Instead, an interview was conducted with a state responder who had secondhand knowledge of the Calexico High School response and had responded to a mercury release in a residential community located in Calexico, California.

Prospective of the public's understanding of the fact sheets was based on the responders' memory of past experiences. No direct test was conducted to determine actual comprehension of people who received the fact sheets. Therefore, the information obtained from interviews may be selectively biased.

Some of the factors analyzed with the SAM tool are subjective. Therefore, the result of some factors may vary slightly from the person to person. However, the overall result of the test should be an accurate result since there is a high correlation with reading grade levels and SAM's results (Doak et al., 1996).

Recommendations

New Fact Sheet

It is recommended that when the new fact sheet modified, it is assessed by Flesch-Kincaid and SAM to ensure the modifications can be understood and retained by the majority of the public. This is especially important if the fact sheet is modified to address a targeted population such as doctors of an impacted community. It is also recommended that the fact sheet is assessed with SAM periodically by different individuals. This will ensure that fact sheet continues to be a useful tool for the public and new suggestions may arise to improve the fact sheet.

To reduce communication barriers with Spanish speaking communities, it is recommended that one side of the fact sheet is written in English and the other side of the fact sheet is written in Spanish. This will make it simpler for responders to hand out fact sheets that can be read in both languages and will ensure that Spanish speaking communities will be able to understand the information. Since the new fact sheet has not been used, it is recommended that

it is tested with a sample population prior to use. Results from this test can then be used to modify the fact sheet as needed.

Existing Fact Sheets

To reduce reading grade level of existing fact sheets, it is suggested that technical words be replaced with more common words. Table 5.1 is a list of recommended words that could replace technical words commonly found throughout the fact sheets.

Table 5.1: Recommended words that could replace commonly used technical words.

Technical Words	**Recommended Words**
Inhalation	Breathing in
Ingestion	Swallow
Hazardous	Toxic
Ventilate	Air flow
Odorless	No smell
Carcinogen	Causes cancer
Exposure	Contact
Evaporate	Release
Sphygmomanometers	Blood pressure device

Technical Words	Recommended Words
Isolate	Stay away
Physician	Doctor

Several items can be addressed to existing fact sheets to significantly improve the score of SAM. These items are:

- Reduce the reading level and improved the vocabulary factor by substituting technical words with common words, and reduce sentence length to an average of fifty characters and spaces,
- Add simple, relevant illustrations with captions in the same area as the text it is describing,
- Narrow the scope of the fact sheets to focus on elemental mercury only,
- Clearly state the intended purpose of the fact sheet in the title or introductory paragraph,
- Add a summary,
- Use a font size of at least twelve points,
- Use second person when applicable,
- Use bold letters, increase size of font, or use boxes to stress information that needs attention, and
- Use simple sentences instead of compound and complex sentences.

In addition, fact sheets should be kept to one page since it appears most people focus their attention on the first page only. Lastly, short sentences should be used to reduce the reading grade level.

Conclusion

Fact sheets can be cost-effective tool to quickly inform the public about mercury. They can be used during a response to quickly inform the public of how to reduce exposure or as a prevention tool to prevent responses. Specific information must be included to inform the public on the background of mercury, ways to prevent releases, and necessary steps to prevent exposure if a release occurs. To communicate messages effectively to the majority of adults, it needs to be created where it can be comprehended by the public. Therefore, a one page fact sheet written at a sixth grade reading level that would received a superior score with SAM was developed. Based on the analysis, the new fact sheet can be a valuable asset to educate and prevent releases and exposures from mercury.

References

AAPCC (2008). 2003-2008 Annual Reports of the American of Poison Control Centers' National Poison Data System (NPDS).Retrieved January 11, 2010 from http://www.aapcc.org/dnn/NPDSPoisonData/AnnualReports/tabid/125/Default.aspx.

Anglin, G. (1987). Effect of pictures on recall of written prose: How durable are picture effects? *Educational Technology Research and Development,* 35(1), 25-30.

Ashe, W., Largent, E., Dutra, F., Hubbard, D., & Blakstone, M. (1953). Behavior of mercury in the animal organism following inhalation. *Archives of Industrial Hygiene and Occupational Medicine*. 17, 19-43.

ATSDR. (1999). Systematic Effects. *Toxicological Profile for Mercury*. pp. 31, 43-45.

ATSDR. (2010, January 13). *Public Health Statement for Mercury*. Retrieved January 21, 2010, from: http://www.atsdr.cdc.gov/toxprofiles/phs46.html.

Bowling Green State University, Ohio EPA, and Rader Environmental, (2008). *A Mercury Vapor Experiment*. Retrieved from: http://wbgustream.bgsu.edu/bgsu/epa/index-fl.html.

Capri, A. & Chen, Y. (2001). Gaseous Elemental Mercury as an Indoor Air Pollutant. *Environmental Science & Technology*. 35(21), 4170-4173.

Caravati, E., Erdman, A., Christianson G., Nelson L., Woolf, A., Booze L.,…Troutman W. (2008). Elemental mercury exposure: An evidence-based consensus guideline for out-of-hospital management. *Clinical Toxicology,* 46(1), 1-21.

Caussy, D., Gochfeld, M., Gurzau, E., Neagu, C., & Ruedel, H. (2003). Lessons from case studies of metals: investigating exposure, bioavailability, and risk. *Ecotoxicology and Environmental Safety*, 56(1), 45-51.

Cherian, M., Hursh, J., Clarkson, T., Allen, J. (1978). Radioactive Mercury Distribution in Biological Fluids and Excretion in Human Subjects after Inhalation of Mercury Vapor. *Archives of Environmental Health,* 33(3), 109-114.

Cherry, D., Lowry, L., Velez, L., Cotrell, C., & Keyes, D. (2002). Elemental mercury poisoning in a family of seven. *Family & Community Health,* 24(4), 1-8.

Cotugna, N., Vickery, C., Carpenter-Haefele, K. (2005). Evaluation of Literacy Level of Patient Education Pages in Health-Related Journals. *Journal of Community Health*. 30(3), 213-218.

Cragle, D., Hollis, D., Qualters, J., Tankersley, W., & Fry, S. (1984). A mortality study of men exposed to elemental mercury. *Journal of Occupational Medicine,* 26(11), 817-821.

Danielsson, B., Fredriksson, A., Dahlgren, L., Gardlund, A., Olsson., L., Dencker, L., &Archer, T. (1993). *Neurotoxicology Teratology*, 15(6), 391-396.

Davis T., Mayeaux, E., Fredrickson, D., Bocchini, J., Jackson, R., & Murphy, P. (1994). Reading ability of parents compared with reading level of pediatric patient education materials. *Pediatrics*, 93(3), 460-468.

Diner, B. and Brenner, B. (2009). Toxicity, Mercury. *eMedicine*, Retrieved December 24, 2009, from eMedicine website: http://emedicine.medscape.com/article/819872-overview.

Doak, C., Leonard, G., & Jane, H. (1996). Assessing Suitability of Materials (2 Ed.). *Teaching Patients with Low Literacy Skills*. (pp. 7, 41-59). Philadelphia, PA: J.B. Lippincott.

Easton, M. (2007, October 1). *Clendenin Mercury ER POLREP #1*. Retrieved December 24, 2009, from EPAOSC website: http://www.epaosc.org/site/polrep_profile.aspx?site_id=2892.

Ehrenberg, R., Vogt, R., Smith, A., Brondum, J., Brightwell, W., Hudson, P.,…Phipps, F. (1991). Effects of elemental mercury exposure at a thermometer plant. *American Journal of Industrial Medicine*, *19*(4), 495-507.

EPA. (1980). *Ambient Water Quality Criteria for Mercury*. (pp.C-29).

EPA. (1997, December). *Mercury Study Report to Congress. Volume 5: Health Effects of Mercury and Mercury Compounds*. (pp. 3-11). Retrieved January 21, 2010, from www.epa.gov/ttncaaa1/t3/reports/volume5.pdf.

EPA. (2007, November 6). *Mercury Compounds*. Retrieved December 28, 2009, from www.epa.gov/ttn/atw/hlthef/mercury.html.

EPA. (2008). *Great Lakes Binational Toxics Strategy*. Retrieved February 13, 2010, from http://www.epa.gov/glnpo/bnsdocs/merchealth/.

EPA. (2009). *Mercury Releases and Spills*. Retrieved December 25, 2009, from: www.epa.gov/mercury/spills/index.htm.

EPA. (2010). *Mercury: An Educator's Toolkit*. Retrieved January 21, 2010, from www.epa.gov/region7/mercury/educator_toolkit.htm.

EPA Accomplishments. (2010). *EPA Accomplishments and 2010 Measures*. Presentation material for EPA conference meeting.

EPA Mercury. *Consumer and Commercial Products*. Retrieved February 13, 2010, from www.epa.gov/mercury/consumer.htm.

EPA Press Release #1. (2009, February 4). *Emergency Responders Investigate Calexico High School Spill/ Parents are encouraged to contact their medical provider if they see symptoms describe below*. Retrieved February 4, 2010, from http://yosemite.epa.gov/OPA/ADMPRESS.NSF/d0cf6618525a9efb85257359003fb69d/ec016e4995c8dfdf85257554000a19f9!OpenDocument.

EPA Press Release #2. (2009, February 5). *Classes Resume at Calexico High School Following Mercury Spill/ Public Health Officials Declare it Safe for campus Operations to Resume*. Retrieved February 4, 2010, from http://yosemite1.epa.gov/opa/admpress.nsf/6427a6b7538955c585257359003f0230/e8fe3f8113f28e34852575540065204a!OpenDocument

EPA SCORPIOS. (2010). Superfund Cost Recovery Package Imaging and On-Line System reports.

Fagala, G. & Wigg, C. (1992). Psychiatric manifestations of mercury poisoning. *Journal of the American Academy of Child and Adolescent Psychiatry*. 31(2), 306-311.

Falvo, D. (2004). *Effective Patient Education. A Guide to Increased Compliance.* (3 Ed.). (pp. 343). Sudbury, MA: Jones and Bartlett Publishers.

Freda, M. (2005). The readability of American Academy of Pediatrics patient education brochures. *Journal of Pediatric Health Care*, 19(3), 151-156.

Fredriksson, A., Dencker, L., Arcer, T., & Danielsson, B. (1996). Prenatal coexpsoure to metallic mercury vapour and methylmercury produce interactive behavioural changes in adult rats. *Neurotoxicology and Teratology*, 18(2), 129-134.

Hallee T. (1969). Diffuse lung disease caused by inhalation of mercury vapor. *American Review of Respiratory Disease*, 99(3), 430-436.

Gage, J. (1961). The distribution and excretion of inhaled mercury vapour. *British Journal of Industrial Medicine*, 18(4), 287-294.

Garnier, R., Fuster J., Conso, F., Dautzenberg, B., Sors, C., Fournier, E. (1981). Acute mercury vapour poisoning. *Toxicology European Research*, 3(2), 77-86.

Gochfeld, M. (2003). Cases of mercury exposure, bioavailability, and absorption. *Ecotoxicology and Environmental Safety*, 56(1), 174-179.

Grossman, S., Piantadosi S., & Covahey, C. (1994). Are informed consent forms that describe clinical oncology research protocols readable by most patients and their families? *Journal of Clinical Oncology*, 12, 2211-2215.

Ivnik, M. & Jett M., (2008). Creating Written Patient Education Materials. *Chest*, 133(4), 1038-1040.

Jaeger, A., Tempe, J., Leroy, M., Porte, A., Mantz, J. (1979). Accidental acute mercury vapor poisoning. *Veterinary & Human Toxicology*. 21, 63-63.

Jones, K. (2005, January 10). *Jim Burch (Chapman) Mercury POLREP #4*. Retrieved December 23, 2009, from EPAOSC website: http://www.epaosc.org/site/polrep_profile.aspx?site_id=A4GE.

Kishi, R., Hasimoto, K., Shimizu, S., & Kobayashi, M. (1978). Behavioral changes and mercury concentrations in tissues of rats exposed to mercury vapor. *Toxicology and Applied Pharmacology*, 46(3), 555-566.

Levie, W. & Lentz, R. (1982). Effects of Text Illustrations: A Review of Research. *Educational Technology Research Development*, 30(4), 195-232.

Livardjani, F., Ledig, M., Kopp, P., Dahlet, M., Leroy, M., Jaeger, A. (1991). Lung and blood superoxide dismutase activity in mercury vapor exposed rats: effect of N-acetylcysteine treatment. *Toxicology*, 66(3), 289-295.

McFarland, R. & Reigel, H. (1978). Chronic mercury poisoning from a single brief exposure. *Journal of Occupational Health*, 20(8), 532-534.

McKenna, K. & Scott, J. (2007). Do written education materials that use content and design principles improve older people's knowledge? *Australian Occupational Therapy Journal*, 54(2), 103-112.

Meade, C. & Byrd, J. (1989). Patient Literacy and the Readability of Smoking Education Literature. *American Journal of Public Health*, 79(2), 204-206.

Microsoft. (2010). *Test your document's readability*. Retrieved January 20, 2010, from http://office.microsoft.com/en-us/help/HP101485061033.aspx.

MMWR. (2007). *Elemental Mercury Releases Attribute to Antiques – New York, 2000-2006*. Retrieved February 13, 2010, from www.cdc.gov/mmwr/preview/mmwrhtml/mm5623a2.htm.

Moon, R., Cheng, T., Patel, K., Baumhaft, K., Scheidt, P (1998). Parental Literacy Level and Understanding of Medical Information. *Pediatrics*, 102(2), e25. Retrieved March 12, 2010 from http://pediatrics.aappublications.org/cgi/content/full/102/2/e25.

MSDS. (2007). Material Safety Data Sheet. Mercury, 99.999%. Retrieved March 2, 2010, from Fischer Scientific at https://fscimage.fishersci.com/msds/96252.htm.

Murphy, P., David, T., Long, S., Jackson, R., & Decker, B. (1993). Rapid Estimate of Adult Literacy in Medicine (REALM): A Quick Reading Test for Patients. *Journal of Reading*, 37(2), 124-130.

NEWMOA (2010a). Mercury Use in Switches & Relays. Retrieved February 13, 2010, from www.newmoa.org/prevention/mercury/imerc/factsheets/switches.cfm.

NEWMOA (2010b). Mercury Legacy Products. Retrieved February 13, 2010, from www.newmoa.org/prevention/mercury/projects/legacy/movelty.cfm.

Ngim, C., Foo, S., Boey, K., Jeyaratnam, J. (1992). Chronic neurobehavioural effects of elemental mercury in dentists. *British Journal of Industrial Medicine*, 49(11), 782-790.

Ohio Lumex Company. (2001). Zeeman mercury analyzer RA-915+. Retrieved February 16, 2010 from http://www.lumex.biz/equipment.php?id=2.

Plimpton, S. & Root J., (1994). Materials and Strategies that Work in Low Literacy Health Communication. *Public Health Reports*, 109(1), 86-92.

Pogarev, S., Ryzhov, V., Mashyanov, N., Sholupov, S., & Zharskaya, V. (2002). Direct measurement of the mercury content of exhaled air: a new approach for determination of the mercury dose received. *Analytical and Bioanalytical Chemistry*, 374(6), 1030-1044.

Ritchie, K., Gilmour, W., Macdonald, E., Burke, F., McGowan, D., Dale,…Collington, D. (2002). Health and neuropsychological functioning of dentists exposed to mercury. *Occupational and Environmental Medicine*, 59(5), 287-293.

Rowens, B., Guerrero-Betancourt, D., Gottlieb, C., Boyes, R., & Eichenhorn, M. (1991). Respiratory Failure and Death Following Acute Inhalation of Mercury Vapor. A Clinical and Histologic Perspective. *Chest*, 99(1), 185-190.

Sax N. & Lewis R., 1987. *Hawley's Condensed Chemical Dictionary*. Van Nostrand Reinhold. NY. 11th edition pg. 745, 746, 1232.

Schoeny, R. (1996). Use of Genetic Toxicology Data in U.S. EPA Risk Assessment: The Mercury Study Report as an Example. *Environmental Health Perspectives*. 104(3), 663-673.

Singh, J. (2007). Reading Grade Level and Readability of Printed Cancer Educational Materials. *Oncology Nursing Society*, 30(5), 867-870.

Smart, R. (1986). Mercury vapour levels in a domestic environment following breakage of a clinical thermometer. *The Science of the Total Environment*. 57, 99-103.

Smith, S., Jaffe, D., Skinner., M. (1997) Case report of metallic mercury injury. *Pediatric Emergency Care*, 13(2), 114-116.

Solis, M., Yuen, E., Cortez, P., & Goebel, P. (2000). Family poisoned by mercury vapor inhalation. *The American Journal of Emergency Medicine*. 18(5), 599-602.

Saturday Gazette-Mail (2007, April 5). Youths cause mercury scare in Clendenin. *The Times Record*, 3A.

Walsh, K. (1991). Guidelines for Printing Patient Education Materials. *Plastic Surgical Nursing*, 11(3), 119.

The WaterCampWS. *Surface Tension Teacher's Guide*. Retrieved January 9, 2010, from http://www.watercampws.uiuc.edu/waterclear/labs/lessons/surftension_teacher_guide.pdf.

Webster, J. (2009, September 24). *Pooler Elementary Mercury Spill POLREP #4*. Retrieved December 23, 2009, from EPAOSC website: http://www.epaosc.org/site/polrep_profile.aspx?site_id=4155.

Weintraub, D., Maliski, S., Fink, A., Choe, S., & Litwin, M. (2004). Suitability of prostate cancer education materials: applying a standardized assessment tool to currently available materials. *Patient Education and Counseling*. 55(2), 275-280.

Wolf, M., Davis, T., Shrank, W., Neuberger, M., & Parker, R. (2006). A critical review of FDA-approved Medication Guides. *Patient Education and Counseling*. 62(3), 316-322.

Ye, H., Katsumata, M. & Minami, M. (2000) A study of metallic mercury polluting a room after being spilled from a sphygmomanometer. *Journal of Nippon Medical School*, 67(5). 375-379.

Zellman M., Camfield, P., Moss, M., Camfield, C., & Sweet, L (1991). Toxicity from vacuumed mercury: a household hazard. *Clinical Pediatrics*, 30 (2), 121-123.

References for Photographs

Bowling Green State University, Ohio EPA, & Rader Environmental. [Photograph of mercury vapor shadows]. (2008). Retrieved February 10, 2010, from http://wbgustream.bgsu.edu/bgsu/epa/index-fl.html. Permission to use picture was obtained February 11, 2010.

EPA. [Photograph of EPA interviewed by local media]. (2008). Retrieved from source at EPA.

EPA. [Photograph of decontamination efforts in the gymnasium]. (2008). Retrieved from source at EPA.

EPA. [Photograph of items being treated]. 2007. Retrieved February 19, 2010, from http://www.epaosc.org/site/image_list.aspx?site_id=2892.

EPA. [Photograph of mercury bead found on church steps]. 2007. Retrieved February 19, 2010 from http://www.epaosc.org/site/image_list.aspx?site_id=2892.

EPA. [Photograph of mercury beads on carpet inside home]. 2007. Retrieved February 19. 2010, from http://www.epaosc.org/site/image_list.aspx?site_id=2892.

EPA. [Photograph of mercury on floor in laundry room of house]. (2008). Retrieved from source at EPA.

EPA. [Photograph of personal items being screened]. (2008). Retrieved from source at EPA.

EPA. [Photograph of personal items from home being treated]. (2008). Retrieved from source at EPA.

EPA. [Photograph of public meeting during response]. 2007. Retrieved February 19, 2010 from http://www.epaosc.org/site/image_list.aspx?site_id=2892.

EPA. [Photograph of updates given during public meeting]. (2008). Retrieved from source at EPA.

EPA. [Photograph of washing machine assess for contamination]. 2007. Retrieved February 19, 2010 from http://www.epaosc.org/site/image_list.aspx?site_id=2892.

Ohio Lumex Company. [Photograph of RA-915+ Mercury Analyzer]. (2001). Retrieved February 18, 2010, from http://www.ohiolumex.com/product/ra915.shtml. Permission to use picture was obtained on February 17, 2010.

References for Pictures used in Revised Fact Sheet

Bowling Green State University, Ohio EPA, & Rader Environmental. [Photograph of mercury vapor shadows]. (2008). Retrieved February 10, 2010, from http://wbgustream.bgsu.edu/bgsu/epa/index-fl.html. Permission to use picture was obtained February 11, 2010.

Clip Art. [Picture of broom]. Retrieved February 12, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of cell phone]. Retrieved March 29, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of door]. Retrieved February 11, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of newspaper]. Retrieved February 10, 2010 from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Pictures of shoe]. Retrieved February 10, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of sink]. Retrieved February 10, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of vacuum]. Retrieved February 10, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of washing machine]. Retrieved February 10, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Clip Art. [Picture of window]. Retrieved February 11, 2010, from Microsoft Office Online found at http://office.microsoft.com/en-us/clipart/default.aspx.

Online-Sign. [Do Not Touch Safety Sign] (2010). Retrieved March 29, 2010 from http://www.online-sign.com/build_sign.php?pic=50.

Appendix A

Interview Summaries

Glenn Adams
Section Chief of Technical Services Section
Numerous conversations in person
Dates and times not recorded

What are your thoughts of commonly used fact sheets for elemental mercury?
Fact sheets are used for responses only. A fact sheet that can be used for responses and education/prevention would be ideal.

What to include in a fact sheet?
Information should include background, health symptoms from exposure, a picture and website link to mercury vapors, steps and procedures if a mercury spill occurs from an item containing more mercury than a thermometer, what you should not do if mercury is spilled, a toll free phone number of who to contact if a spill occurs, website link to EPA sites where additional information can be obtained, amnesty days for proper disposal, and items that contain mercury. In addition, spill area should be covered with a newspaper to prevent tracking.

How should the fact sheet be written?

It needs to be written at a sixth grade reading level. It should be one page and be written on one side. On side should be in English, the other side should be in Spanish. Fact sheet needs to be written for education and response efforts.

Do you use fact sheets?

Yes

What do you find challenging when informing the public about a mercury release?

Many people do not realize that acute and chronic exposure to mercury can cause serious health issues.

About how many mercury responses have you worked on?

At least 12.

Which fact sheet have you used in past responses?

2001 ATSDR ToxFAQs

Ryan Atencio
Responder to residential mercury release in Calexico, CA
Department of Toxic Substances Control
December 23, 2009
12:00pm – 12:30pm by phone.

How did the spill occur in the home?

A mercury thermometer from Mexico was broken. Resident went online to look up procedures for cleaning up mercury spills and then contacted the state.

Were any fact sheets used?

No. The response was confined to one home.

What should be included in a fact sheet?

Fact sheets should include items that contain mercury, how to properly dispose of it, and who to contact if a mercury release happens. Fact sheets should also be written in Spanish. English appears to be a second language for many of the people who live in Calexico.

What should be included in a fact sheet?

Pictures to help people understand the information in the fact sheet is needed. Also, items containing mercury and how to dispose of them properly is greatly needed. Lastly, who to contact for guidance if mercury is spilled needed.

What did you find challenging?

Many neighbors came by and said they see the same doctor of the family who had spill. Also, they too have the same mercury thermometer from the doctor. Therefore, many items that may be banned in the U.S. are quite available in Mexico. It is important to educate border communities of items with mercury that they need to avoid that can be easily purchased in Mexico. This will prevent future incidents. A fact sheet detailing items that may contain mercury is needed.

Sherryl Carbonaro
Community Involvement Coordinator
Responded to Pooler Elementary School
January 11, 2010
2:15pm – 3:00pm in person

How were people informed about mercury release at the school?

School used a call down list. The county submitted a press release to the local paper (Savannah Morning News). Ms. Carbonaro conducted interviews with the press and the media. Fact sheets were given to the media. Public meeting was held. Public meeting included GAEPD, USEPA, ATSDR, and local health department. Local politicians, students, parents, and faculty of the school attended the public meeting.

When was the fact sheets distributed and to who?

Fact sheets were handed out at the public meeting. When children and parents brought personal items to school for screening, a fact sheet was handed to them as well.

Do people understand the fact sheet?

People do try to read it. Most probably cannot understand the fact sheets because the reading level is too high. It needs to be written at a sixth grade reading level. Most readers miss the point that exposure to very high levels or exposed to levels for a long period of time can cause health effects. Instead, fact sheet may scare people.

We need to start distributing the fact sheets as an educational tool to try to prevent children from playing with mercury.

What should be included in a fact sheet?

Use of color would be effective. A picture showing someone measuring mercury would be helpful so people know what to expect when responder visits their home. Website for more information should also be included.

Also fact sheet should include:
Info on not to touch mercury and not to clean it up.
Call someone such as a contractor to clean up mercury.
Isolate the area; however, if at school, do not let children go home since this will potentially cause mercury to be tracked home.
How to dispose of mercury – counties have amnesty days which people can take advantage of.

What do you find challenging when informing the public about a mercury release?

Some adults may not think it is a problem since they played with it as kids and it did not hurt them. Also, you cannot see or smell elemental mercury and some adults think that they have completely cleaned it up. This is rarely the case.

Number of mercury responses:

12

Which fact sheet do you use for past responses?

2001 ATSDR ToxFAQs

Mark Durno
Section Chief for Emergency Response.
January 19, 2010
3:35pm to 4:10pm by phone

What to include in a fact sheet?

Prevention side:
Have any mercury in house – get it out.
Household hazardous collection day –double bag, and put it into garage.
Many states have established recycling programs.

Basic education: What can mercury do to you? Put a link in fact sheet of mercury vapor.

Most powerful thing to do is show videos of mercury vapor.

Response:

If you spill it, cover it and call a professional – state agency, health department, EPA.

Do not vacuum it up. Can cause serious problems and require evacuation. Twenty beads can become 20 million beads – more vapor in the air.

Do not try to clean it up on your own without expert guidance. If large spill, call USEPA. Large spill is more than a thermostat.

How many responses have you been on?

At least 20 mercury responses.

Marjorie Easton
On-Scene Coordinator
Clendenin Elementary School response
December 18, 2009
9:00am to 9:45am
January 15, 2010
3:15-3:30pm by phone
Further conversations by emails

How were people informed about mercury release at the school?

Spill was found at 1:00pm on a Friday in a classroom. School sent home a letter that day to students. Students appear to have had it for at least a week. A press release was submitted by KCHD to the local paper.

When was the fact sheets distributed and to who?

Fact sheets were given during the public meeting. People who attended were the local health department, WVDEP, USEPA, parents, faculty, and students of Clendenin Elementary School. 100-200 people. Mayor and other local politicians came to the meeting.

Do people understand the information the fact sheet?

People probably understand.

What should be included in a fact sheet?

Need to address what to do and what not to do. Links to information readily available online in needed.

What do you find challenging when informing the public about a mercury release?

Not causing a panic when people are informed about the health effects of mercury can be an issue. People who work in mines/gas companies appear to be aware of the health effects since they work with mercury. Younger people (age 20 to 30) seem to be more concerned about mercury than adults.

How many Mercury responses have you been on as an On-Scene Coordinator?

About 5 to 10.

Which fact sheet do you use for past responses?

1999 ATSDR ToxFAQs

Dr. Robert Geller
Medical Director
Georgia Poison Control Center
December 29, 2009
Time not documented
January 22, 2010
2:15pm - 2:30pm by phone

What are your thoughts of commonly used fact sheets for elemental mercury?

The fact sheets are too complicated. They focus on several different forms of mercury. They should focus only on elemental mercury and its vapor.

What to include in a fact sheet?

It should include long term and brief exposures. Long term exposures can be defined as more than one week whereas short term exposures can be defined as less than eight hours.

Statement should be made that infants are at a higher risk, elemental mercury can cause neurological problems, personality changes, and include other common mercury health effects. Document may potentially be used in court, so health effects need to be specific.

Pictures should be included. Also, if there's a way to properly dispose of items containing low quantity mercury, it needs to be included in fact sheet.

How should the fact sheet be written?

It should include simple sentences that are written at a sixth grade reading level. No environmental words should be used. For example, "Mercury can cause health problems." Exposure to large amount in air can cause serious health problems. Fact sheet should include one inch margins on all side, 12 point type, and information should be on one side only.

Do you use fact sheets?

Yes. Use fact sheets to share with patients, health care providers, or incident responders. They frequently call the Georgia Poison Control Center for health related questions. Mercury spills from thermometers happen once a week. A big spill (more than a thermometer) occurs about once every two to three months.

What are the challenges in informing educating people about mercury?

Many people think mercury is not dangerous when in fact it is.

Bob Safay
ATSDR
Senior Regional Representative
Division of Regional Operations
January 21, 2010
9:15pm to 9:45pm by phone
Further conversations in person and by emails.

What are your thoughts of commonly used fact sheets for elemental mercury?
We give out fact sheets at almost every response. Fact sheets are available at public meetings and anyone who wants them. We give as many out as possible. We also send it to those on a mailing list.

What to include in a fact sheet?
Chemical name, where it is found in nature, how it is used, exposure routes (inhalation), what the health effects are, what are the symptoms, target population: pregnant women and children, and what kind of tests you can run to determine if a person has elevated levels of mercury.

Educational response should include what not to do. It is very important to educate janitors at school since they usually clean up mercury spills and mercury spills cannot be cleaned using conventional methods. Mercury should not be cleaned up by yourself if spill is more than the mercury in a thermometer. Seal off rooms in school. Isolate, notify parents, tell parents to bring clean clothes, confiscate everything student brought to school.

Do not call the custodian to clean it up. Call EPA.

Schools should contact the state.

How should the fact sheet be written?

It needs to be written at a sixth grade reading level. Website links to ATSDR websites should be available for physicians. Illustrations may be difficult to show with mercury.

First week of school, teachers should talk to students about mercury. Losing items and potentially not getting reimbursed for them is an effective method to mitigate kids from playing with mercury.

Do you use fact sheets?

Yes

About how many mercury responses have you worked on?

60-65 and have been to about 35 public meetings regarding mercury.

Which fact sheets do you use?

ATSDR ToxFAQs

Other comments:

This can cost taxpayers several hundred thousand dollars for each response. This does not include hidden costs that may include lost pay for teachers, parents taking time off from work to take care of children since school is closed, bad publicity for the school district and community, and potential legal action.

Dr. James Webster
Section Chief of Removal & Oil Section
On-Scene Coordinator
Incident Commander for Pooler Elementary School Mercury Response
January 15, 2010
1:10pm to 1:30pm by person

How were people informed about mercury release at the school?

The elementary school notified parents through a notification system that called parents' phone number. The principal recorded voice mail which was then played when parents picked up the phone or was left on the answering machine. County submitted a press release to the local paper. Media received the 2001 ATSDR ToxFAQs fact sheet. The Community Involvement Coordinator conducted interviews with local press and media.

When homes were assessed for contamination, information was students and parents to determine students visited other homes. If so, the other homes were assessed for mercury because mercury is easily tracked.

When was the fact sheets distributed and to who?

Fact sheets were distributed during the public meeting and when people dropped off their personal items at the school for screening. Fact sheets were given to the media so they could inform the public. The door to door method was not needed since there was no need to alarm everyone. Only those who were involved with the school needed to be informed.

Do people understand the information in the fact sheet?

Probably not. People focus on potential effects and that is it. Interpretation is required. It is unknown if people read all the information, but probably unlikely. It appears complicated.

What should be included in a fact sheet?

It should be reading at a 6^{th} grade and there should be a fact sheet for Spanish and English. The fact sheet should be a summary of what elemental mercury is and health effects at the top of the page. Then get into the rest of the information. Also need to include that mercury is commonly found and to ensure people do not get scared. Also include website links to useful, easily readable information. Fact sheet should be one page, front side only.

What do you find challenging when informing the public about a mercury release?

People may not realize that toxic chemicals are potentially used, everyday products.

How many Mercury responses have you been on as an On-Scene Coordinator?

At least 6.

Which fact sheet have you used for past responses?

ATSDR ToxFAQs.

Appendix B

Suitability Assessment of Materials Questionnaire

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

      Adequate: Purpose is not explicit. It is implied, or multiple purposes are stated.

      Not suitable: No purpose is stated in the title, cover illustration, or introduction.

   B. Content Topics

      Superior: Thrust of the material is application of knowledge/skills aimed at desirable reader behavior rather than nonbehavior facts.

      Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

      Adequate: Scope is expanded beyond the purpose; no more than 40 percent is nonessential information. Key points can be learned in time allowed.

      Not suitable: Scope is far out of proportion to the purpose and time allowed.

   D. Summary and Review

      Superior: A summary is included and retells the key message in different words and examples.

      Adequate: Some key ideas are reviewed.

Not suitable: No summary or review is included.

2. Literacy Demand

A. Reading Grade Level (Fry Formula)

Superior: 5th-grade level or lower (5 years of schooling level).

Adequate: 6th-, 7th-, or 8th-grade level (6-8 years of schooling level).

Not suitable: 9th-grade level and above (9 years or more of schooling level).

B. Writing Style

Superior: Both factors: (1) Mostly conversational style and active voice. (2) Simple sentences are used extensively; few sentences contain embedded information.

Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

Not suitable: (1) Passive voice throughout. (2) Over half the sentences have extensive embedded information.

C. Vocabulary

Superior: All three factors: (1) Common words are used nearly all of the time. (2) Technical, concept, category, value judgment (CCVJ) words are explained by examples. (3) Imagery words are used as appropriate for content.

Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

D. In Sentence Construction, the Context is Given Before New Information

Superior: Consistently provides context before presenting new information.

Adequate: Provides context before new information about 50 percent of the time.

Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

Adequate: About 50 percent of the topics are preceded by advance organizers.

Not suitable: Few or no advance organizers are used.

3. Graphics

A. Cover Graphic

Superior: The cover graphic is (1) friendly, (2) attracts attention, (3) clearly portrays the purpose of the material to the intended audience.

Adequate: The cover graphic has one or two of the superior criteria.

Not suitable: The cover graphic has none of the superior criteria.

B. Type of Illustrations

Superior: Both factors: (1) Simple, adult-appropriate, line drawings/sketches are used. (2) Illustrations are likely to be familiar to the viewers.

Adequate: One of the superior factors is missing.

Not suitable: None of the superior factors are present.

C. Relevance of illustrations

Superior: Illustrations present key message visually so the reader/viewer can grasp the key ideas from the illustrations alone. No distractions.

Adequate: (1) Illustrations include some distractions. (2) Insufficient use of ‘ illustrations.

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

Superior: Step-by-step directions, with an example, are provided that will build comprehension and self-efficacy.

Adequate: "How-to" directions are too brief for reader to understand and use the graphic without additional counseling.

Not suitable: Graphics are presented without explanation.

E. Captions are used to "Announce"/Explain Graphics

Superior: Explanatory captions with all or nearly all illustrations and graphics.

Adequate Brief captions used for some illustrations and graphics.

Not suitable: Captions are not used.

4. Layout & Typography

A. Layout

Superior: At least five of the following eight factors are present.

Adequate: At least three of the superior factors are present.

Not suitable: (1) Two (or les) of the superior factors are present. (2) Looks uninviting or discouragingly hard to read.

Factors:

1. Illustrations are on the same page adjacent to the related text.
2. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
3. Visual cuing devices (shading, boxes, arrows) are used to direct attention to specific points or key content.
4. Adequate white space is used to reduce appearance of clutter.
5. Use of color supports and is not distracting to the message. Viewers need not learn color codes to understand and use the message.
6. Line length is 30-50 characters and spaces.
7. There is high contrast between type and paper.
8. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Adequate: Two of the superior factors are present.

Not suitable: One or none of the superior factors are present. Or, six or more type styles and sizes are used on a page.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

Superior: (1) Lists are grouped under descriptive subheadings or "chunks." (2) No more than five items are presented without a subheading.

Adequate: No more than seven items are presented without a subheading.

Not suitable: More than seen items are presented without a subheading.

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Superior: Problems or questions presented for reader responses.

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

Not suitable No interactive learning stimulation provided.

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Superior: Instruction models specific behavior or skills.
Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

Not suitable: Information is presented in nonspecific or category terms such as the food groups.

C. Motivation

Superior: Complex topics are subdivided into small parts so that readers may experience small successes in understanding or problem solving, leading to self-efficacy.

Adequate: Some topics are subdivided to improve the readers' self-efficacy.

Not suitable No partitioning is provided to create opportunities for small successes.

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

Superior: Central concepts/ideas of the material appear to be culturally similar to the LLE of the target culture.

Adequate: Significant match in LLE for 50 percent of the central concepts.

Not suitable Clearly a cultural mismatch in LLE.

B. Cultural Image and Examples

Superior: Images and examples present the culture in positive ways.

Adequate: Neutral presentation of cultural images or foods.

Not suitable: Negative image such as exaggerated or caricatured cultural characteristics, actions, or examples.

Appendix C

Suitability Assessment of Materials Results

1999 ATSDR ToxFAQs
Score: Not Suitable

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Adequate: Scope is expanded beyond the purpose; no more than 40 percent is nonessential information. Key points can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

D. In Sentence Construction, the Context is Given Before New Information

Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.

2. Visual cuing devices (shading, boxes, arrows) are used to direct attention to specific points or key content.
3. There is high contrast between type and paper.
4. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

2001 ATSDR ToxFAQs
Score: Not Suitable

1. Content

   A. Purpose

      Not suitable: No purpose is stated in the title, cover illustration, or introduction.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

   D. In Sentence Construction, the Context is Given Before New Information

      Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. Visual cuing devices (shading, boxes, arrows) are used to direct attention to specific points or key content.
3. There is high contrast between type and paper.
4. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Alabama
Score: Not Suitable

1. Content

A. Purpose

Adequate: Purpose is not explicit. It is implied, or multiple purposes are stated.

B. Content Topics

Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

C. Scope

Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

D. Summary and Review

Not suitable: No summary or review is included.

5. Literacy Demand

A. Reading Grade Level (Fry Formula)

Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

B. Writing Style

Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

C. Vocabulary

Not Suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical words. (3) Extensive jargon.

D. In Sentence Construction, the Context is Given Before New Information

Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

6. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

7. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Typographic cues (bold, size, color) emphasize key points.
3. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

8. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Not suitable No interactive learning stimulation provided.

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

9. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

California
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Adequate: Summary of health hazards is provided.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Not suitable: (1) Passive voice throughout. (2) Over half the sentences have extensive embedded information.

   C. Vocabulary

      Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

NA

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Cuyahoga County, Ohio
Score: Not Suitable

1. Content

   A. Purpose

      Not suitable: No purpose is stated in the title, cover illustration, or introduction.

   B. Content Topics

      Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

   C. Scope

      Adequate: Scope is expanded beyond the purpose; no more than 40 percent is nonessential information. Key points can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

NA

A. Type of Illustrations

NA

B. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

C. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

D. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Florida
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

   D. In Sentence Construction, the Context is Given Before New Information

      Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

Not suitable: None of the superior factors are present.

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

Not suitable: Captions are not used.

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. Visual cuing devices (shading, boxes, arrows) are used to direct attention to specific points or key content.
3. There is high contrast between type and paper.
4. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Typographic cues (bold, size, color) emphasize key points.
3. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Illinois
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Maryland
Score: Not Suitable

1. Content

   A. Purpose

      Not suitable: No purpose is stated in the title, cover illustration, or introduction.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Adequate: Scope is expanded beyond the purpose; no more than 40 percent is nonessential information. Key points can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Not suitable: Two or more factors: (1) Uncommon words are frequently used in lieu of common words. (2) No examples are given for technical and CCVJ words. (3) Extensive jargon.

   D. In Sentence Construction, the Context is Given Before New Information

      Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Typographic cues (bold, size, color) emphasize key points.
3. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

New Hampshire
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Superior: Thrust of the material is application of knowledge/skills aimed at desirable reader behavior rather than nonbehavior facts.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

New York
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

Superior: The cover graphic is (1) friendly, (2) attracts attention, (3) clearly portrays the purpose of the material to the intended audience.

B. Type of Illustrations

Superior: Both factors: (1) Simple, adult-appropriate, line drawings/sketches are used. (2) Illustrations are likely to be familiar to the viewers.

C. Relevance of illustrations

Superior: Illustrations present key message visually so the reader/viewer can grasp the key ideas from the illustrations alone. No distractions.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA.

E. Captions are used to "Announce"/Explain Graphics

Not suitable: Captions are not used.

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Illustrations are on the same page adjacent to the related text.
2. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
3. There is high contrast between type and paper.
4. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Typographic cues (bold, size, color) emphasize key points.
3. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Not suitable No interactive learning stimulation provided.

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Ohio
Score: Adequate

1. Content

   A. Purpose

      Adequate: Purpose is not explicit. It is implied, or multiple purposes are stated.

   B. Content Topics

      Not suitable: Nearly all topics are focused on nonbehavior facts.

   C. Scope

      Adequate: Scope is expanded beyond the purpose; no more than 40 percent is nonessential information. Key points can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Not suitable: 9^{th}-grade level and above (9 years or more of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

   D. In Sentence Construction, the Context is Given Before New Information

      Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

Superior: Both factors: (1) Simple, adult-appropriate, line drawings/sketches are used. (2) Illustrations are likely to be familiar to the viewers.

C. Relevance of illustrations

Superior: Illustrations present key message visually so the reader/viewer can grasp the key ideas from the illustrations alone. No distractions.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

Not suitable: Captions are not used.

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Illustrations are on the same page adjacent to the related text.
2. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
3. There is high contrast between type and paper.
4. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Adequate: Two of the superior factors are present.

Not suitable: One or none of the superior factors are present. Or, six or more type styles and sizes are used on a page.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Adequate: Information is a mix of technical and common language that the reader may not easily interpret in terms of daily living.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Tennessee
Score: Adequate

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Adequate: At least 40 percent of content topics focus on desirable behaviors or actions.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Not suitable: No summary or review is included.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Adequate: 6^{th}-, 7^{th}-, or 8^{th}-grade level (6-8 years of schooling level).

   B. Writing Style

      Adequate: (1) About 50 percent of the text uses conversational style and active voice. (2) Less than half the sentences have embedded information.

   C. Vocabulary

      Adequate: (1) Common words are frequently used. (2) Technical and CCVJ words are sometimes explained by examples. (3) Some jargon or math symbols are included.

   D. In Sentence Construction, the Context is Given Before New Information

      Not suitable: Context is provided last or no context is provided.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

NA

C. Relevance of illustrations

Not suitable: One factor: (1) Confusing or technical illustrations (nonbehavior related). (2) No illustrations, or an overload of illustrations.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

NA

4. Layout & Typography

A. Layout

Adequate: At least three of the superior factors are present.

Factors:

1. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
2. There is high contrast between type and paper.
3. Paper has nongloss or low-gloss surface.

B. Typography

Adequate: Two of the superior factors are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Superior: Instruction models specific behavior or skills.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Draft of New Mercury Fact Sheet
Score: Superior

1. Content

   A. Purpose

      Superior: Purpose is explicitly stated in title, or cover illustration, or introduction.

   B. Content Topics

      Adequate: At least 40% of content topics focus on desirable behaviors or actions.

   C. Scope

      Superior: Scope is limited to essential information directly related to the purpose. Experience shows it can be learned in time allowed.

   D. Summary and Review

      Superior: A summary is included and retells the key messages in different words and examples.

2. Literacy Demand

   A. Reading Grade Level (Fry Formula)

      Superior: 5^{th}-grade level or lower

   B. Writing Style

      Superior: Both factors: (1) Mostly conversational style and active voice. (2) Simple sentences are used extensively; few sentences contain embedded information.

   C. Vocabulary

      Superior: All three factors: (1) Common words are used nearly all of the time. (2) Technical, concept, category, value judgment (CCVJ) words are explained by examples. (3) Imagery words are used as appropriate for content.

   D. In Sentence Construction, the Context is Given Before New Information

      Adequate: Provides context before new information about 50 percent of the time.

E. Learning Enhancement by Advance Organizers (Road Signs)

Superior: Nearly all topics are preceded by an advance organizer (a statement that tells what is coming next).

3. Graphics

A. Cover Graphic

NA

B. Type of Illustrations

Superior: Both factors: (1) Simple, adult-appropriate, line drawings/sketches are used. (2) Illustrations are likely to be familiar to the viewers.

C. Relevance of illustrations

Superior: Illustrations present key messages visually so the reader/viewer can grasp the key ideas from the illustrations alone. No distractions.

D. Graphics: Lists, Tables, Graphs, Charts, Geometric Forms

NA

E. Captions are used to "Announce"/Explain Graphics

Superior: Explanatory captions with all or nearly all illustrations and Graphics.

4. Layout & Typography

A. Layout

Superior: At least five of the following eight factors are present:

Factors:

1. Illustrations are on the same page adjacent to the related text.
2. Layout and sequence of information are consistent, making it easy for the patient to predict the flow of information.
3. Visual cuing devices (shading, boxes, arrows) are used to direct attention to specific points or key content.
4. Adequate white space is used to reduce appearance of clutter.
5. Use of color supports and is not distracting to the message. Viewers need not learn color codes to understand and use the message.

6. Line length is 30-50 characters and spaces.
7. There is high contrast between type and paper.
8. Paper has nongloss or low-gloss surface.

B. Typography

Superior: The following four are present.

Factors:

1. Text type is in uppercase and lowercase serif (best) or sans-serif.
2. Type size is at least 12 point.
3. Typographic cues (bold, size, color) emphasize key points.
4. No ALL CAPS for long headers or running text.

C. Subheadings or "Chunking"

NA

5. Learning Stimulation and Motivation

A. Interaction Included in Text and/or Graphic

Adequate: Question-and-answer format used to discuss problems with solutions (passive interaction).

B. Desired Behavior Patterns are Modeled, Shown in Specific Terms

Superior: Instruction models specific behaviors or skills.

C. Motivation

NA

6. Cultural Appropriateness

A. Cultural Match: Logic, Language, Experience (LLE)

NA

B. Cultural Image and Examples

NA

Appendix D

Fact Sheets

Alabama:
http://adem.alabama.gov/programs/land/landforms/HouseMercury.pdf

ATSDR 1999:
http://www.atsdr.cdc.gov/tfacts46.pdf

ATSDR 2001:
Could not be obtained online

Cuyahoga County Board of Health
http://rrcity.com/blue_spring/mercury_fact_sheet.pdf

California:
http://www.cdph.ca.gov/programs/hesis/Documents/merc.pdf

Florida:
http://www.myfloridaeh.com/community/superfund/pdf/Mercury_Fact_Sheet.pdf

Illinois
http://www.epa.state.il.us/land/hazardous-waste/household-haz-waste/mercury-fact-sheet.html

Maryland:
http://www.mde.maryland.gov/Programs/landprograms/recycling/mercury/mercuryInfo.asp

New Hampshire:
http://www.mde.maryland.gov/Programs/landprograms/recycling/mercury/mercuryInfo.asp

New York:
http://www.mde.maryland.gov/Programs/landprograms/recycling/mercury/mercuryInfo.asp

Ohio:
http://www.odh.ohio.gov/ASSETS/87A7DEBF739D4D90934CB7C1DD748248/mercfaq.pdf

Tennessee:
http://health.state.tn.us/factsheets/mercury.htm