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Lead exposures and public health: A jurisdictional scan of blood lead reporting programs

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Objectives

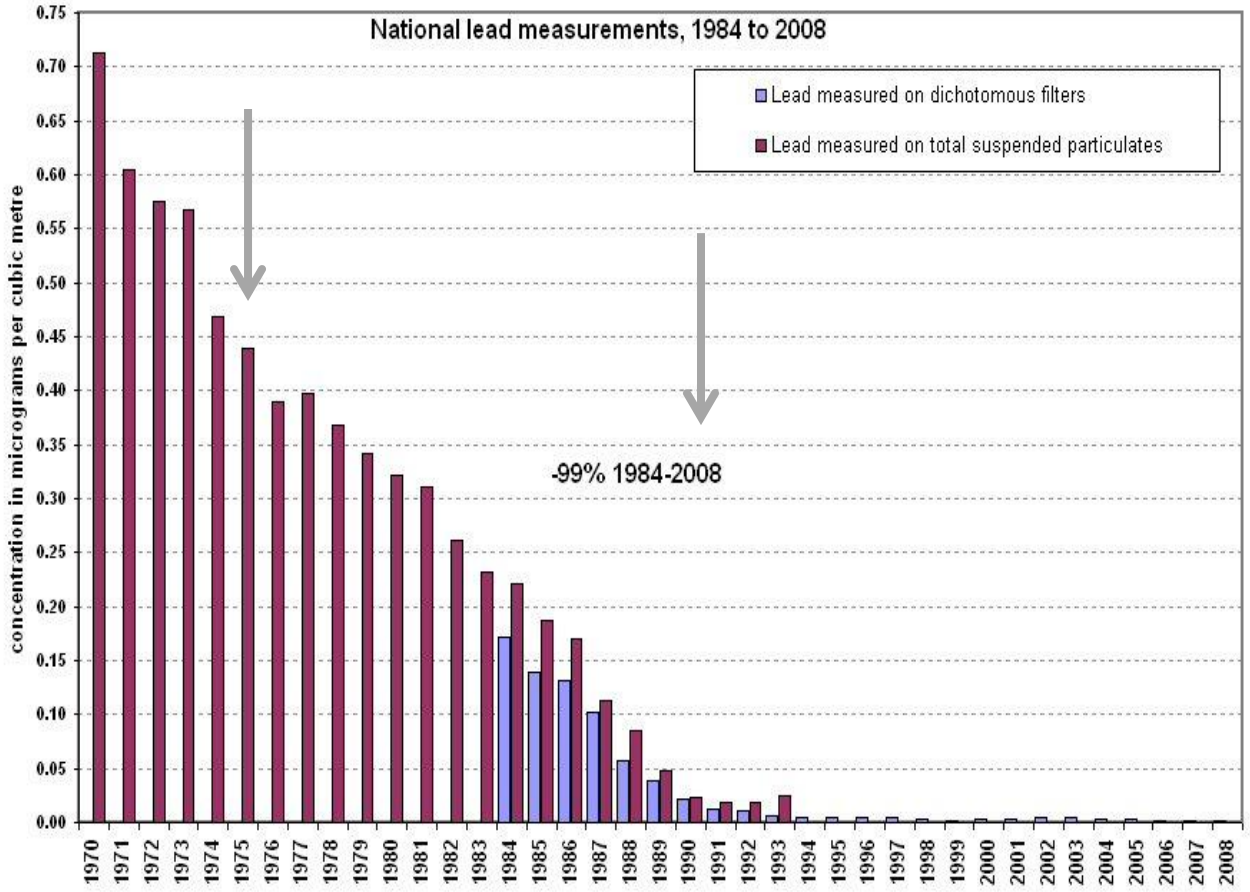
- Describe historical trends in lead use, and exposures among Canadians
- Review cases of lead exposure that have occurred in Ontario
- Describe the findings of a jurisdiction scan of blood lead reporting to public health
- Discuss the potential relevance of blood lead reporting for public health in Ontario

Lead, levels in the environment[1]

- Many useful applications, past and current
  - Paint, storage vessels, cables, pipes, electrical components, construction material
  - 80% of world usage in lead-acid storage battery for motor vehicles

- Lead in the environment
  - Major decreases affecting population exposures
    - Air – tetraethyl lead
    - Paint – lead (II) chromate, lead (II, IV) oxide, lead (II) carbonate
    - Food packaging – lead solder
    - Plumbing – pipes, fitting, solder

Levels in the environment – air[2,3]



Unleaded gasoline introduced 1975

Prohibition of leaded gasoline in on-road vehicles in 1990s

Relevance of lead to health[4]

- Spectrum of effects
- Chronic and acute
- Multiple organ systems affected
  - Cardiovascular, renal, reproductive, neurocognitive, hematologic
- Key concerns: neurocognitive, behavioural (impulsivity) effects on children and population deficits in intelligence
  - Mouthing, hand-to-mouth behaviour, greater absorption
  - No threshold of effect seen at the population level

Treatment and intervention[2,5]

- Where source is known, reduce exposure
  - Chelation at high exposures
- What if the source is not known, or is domestic lead, dust?
  - Cochrane review October 2016
  - 13 RCTs and 1 quasi-RCT, children <6 years
  - Education: ineffective in reducing BLL (mean diff, dichotomous analyses)
  - Dust control interventions: little or no effect in reducing BLL
  - Soil abatement or combination interventions: insufficient evidence
- Canadian F/P/T intervention level: 10 ug/dL (1994)
  - "Provide guidance for the management of exposure to lead in individuals and communities"
- US reference value: 5 ug/dL
  - Based on 97.5 percentile of children 1-5 years

Exposures to lead in Canadians[6-8]

	Then	Now
Canada	4.79 ug/dL (6-79y) 1978-1979 CHS	1.1 ug/dL (3-79y) 2012-2013 CHMS
US	12.8 ug/dL (1-74y) 1976-1980 NHANES	0.973 ug/dL (>1y) 2011-2012 NHANES

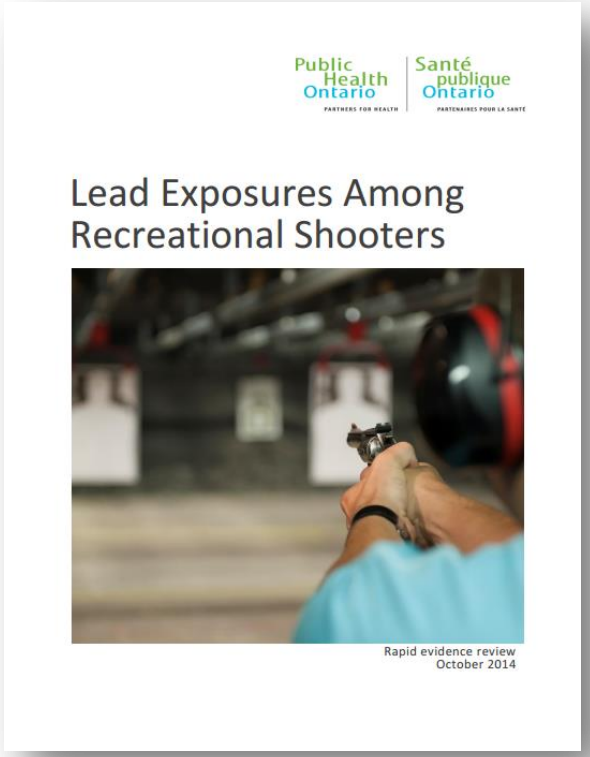
- Population exposures have declined significantly

Exposures in Ontario and elsewhere

- Ongoing exposures in subgroups widely reported
  - Occupational
  - Non-occupational – firearms, cultural practices, consumer products, home renos, food and drink vessels, certain foods, hobby metalwork
  - Children – mouthing, hand-to-mouth

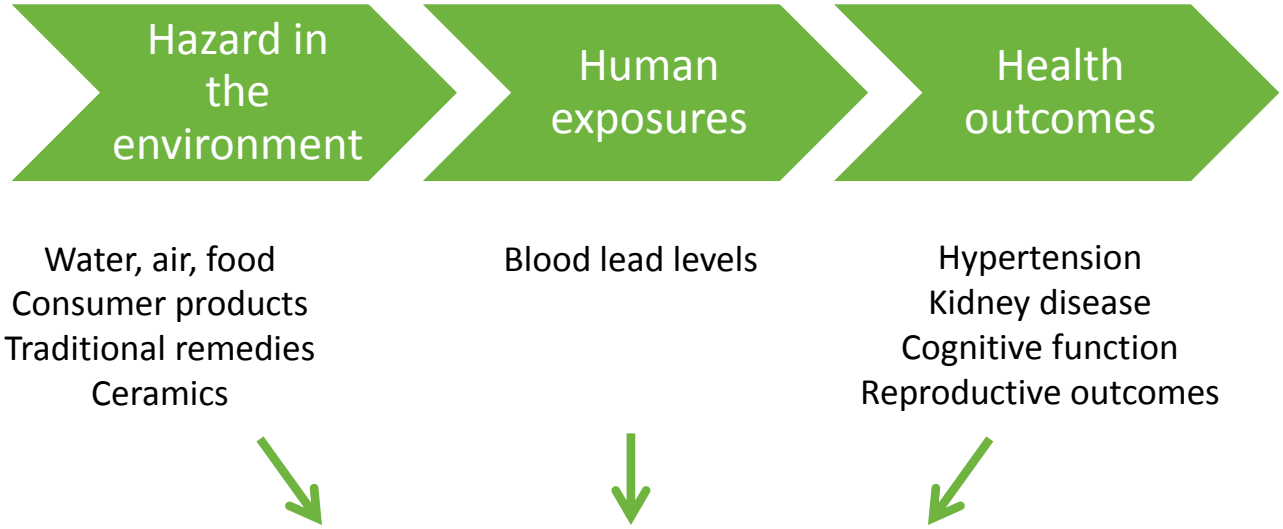
- Ad hoc reporting by physicians to public health
  - Ayurvedic product, glazing on a mug, spices, target shooting ranges, opium, paint, cosmetics
  - Public Health Units have done excellent follow-up work to identify sources

- No systematic reporting of lead exposures



Environmental health tracking[9]

- Surveillance, in environmental health



Characterize baseline levels
Identify high exposures and subgroups at risk
Identify others at risk from same source
Facilitate control of the source
Enhance understanding of risk factors
Support decision making, resource allocation
Track progress on interventions, goals

Tracking of blood lead levels

- Issue: undetected exposures to lead

- Doing tracking:
  - Most US jurisdictions
  - Quebec

- How widespread are such programs?
- How are blood lead levels tracked?
- What have jurisdictions learned from their programs?
- How effective is tracking for reducing exposures?

Jurisdiction scan of blood lead tracking

- Canada, US, UK, Australia, New Zealand

1. Internet scan of all jurisdictions – n=77
   - Every subnational jurisdiction
   - Blood lead reporting requirements (reporting of clinician ordered tests)
   - Roles and responsibilities
   - Focused on exposures in the general public (non-occupational)

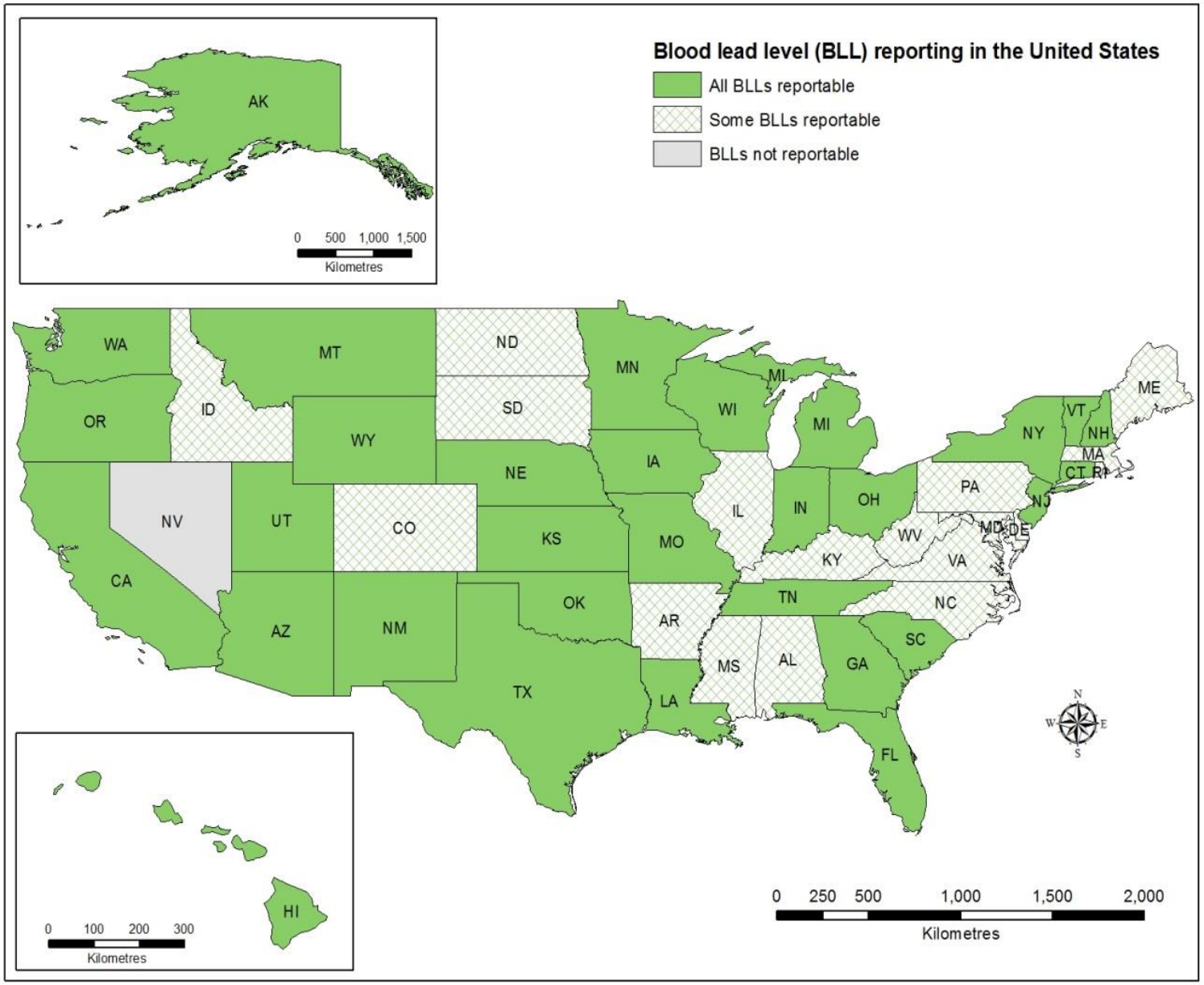
2. Jurisdiction contact (August 2015 – February 2016) – n=40
   - Canadian provinces, UK, NZ, Australian states and mainland territories, select US states
   - Variety of tracking programs
   - Strengths, weaknesses

Interview questions

- Semi-structured, mostly telephone, some email
  - Access to blood lead data
  - Data collection mechanism (electronic, fax, mail)
  - Intervention or action levels
  - Details on intervention – education, investigation
  - Common exposure sources
  - Proportion of elevated cases where source is identified
  - Reflections on program functioning

Results

Country	Total number of jurisdictions	Any reporting of blood lead results, some or all (% in country)	Jurisdictions reporting blood lead results	
			Reporting of some (%)	Reporting of all (%)
Canada	13	1 (8 %)	1 (100%)	0 (0%)
United States	51	50 (98%)	18 (36%)	32 (64%)
United Kingdom	4	0 (0%)	0 (N/A)	0 (N/A)
Australia	8	4 (50%)	4 (100%)	0 (0%)
New Zealand	1	1 (100%)	1 (100%)	0 (0%)
Total	77	56 (73%)	24 (43%)	32 (57%)


Blood lead level (BLL) reporting in the United States
All BLLs reportable
Some BLLs reportable
BLLs not reportable
AK
0 500 1,000 1,500
Kilometres
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
MD
DE
NJ
CT
RI
MA
VT
NH
ME
N
W
E
S
0 250 500 1,000 1,500 2,000
Kilometres
HI
0 100 200 300
Kilometres

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Who reports, and to whom?

Reporting by:	Jurisdictions (% of jurisdictions reporting, i.e., 55)
Laboratories	54 (96%)
Providers	42 (75%)
Other	11 (20%)

Reporting to:	Jurisdictions (% of jurisdictions reporting, i.e., 55)
State health	48 (86%)
Other state level	12 (21%)
Local or regional health	4 (7%)

Response to a high blood lead level

- Clinical management – patient-centred
  - Appropriate treatment
  - Discuss health risks, exposures, diet

- Public health
  1. Support clinical management – for patient, provider
  2. Identify the source of lead – environmental investigation, testing suspect items
     - Identify other people affected by same/similar source
     - Reduce exposures for those affected
  3. Population blood lead tracking

Key findings and themes

- Centralized data collection common
  - Investigations usually based locally, but depends on resources

- Tiered or stratified public health response
  - By age (children prioritized), blood lead level
  - In the US, often separate programs for adults and children (<6 years)

- Strategies for efficiency, harnessing expertise
  - Resource scarcity
  - Automation – electronic reporting of BLL, reports of raw data
  - Prioritize cases for investigation by BLL, age
  - Question of focusing on cases, versus maintaining tracking/surveillance
  - Partnerships - universities

Findings cont.

- Use of a reporting level (e.g., report only ≥10 ug/dL)
  - Jurisdictions that use a reporting level usually initiate response in all cases
  - Many US jurisdictions require reporting of all results
    - Not all individuals with BLL results are followed up
    - Track progress on individual exposure reduction
    - Blood lead is a marker of exposure
    - BLL population trends over time, space, allocate resources, evaluation
- Track patterns in individuals, places, products

Findings cont.

- Surveillance programs have identified risk factors
  - High blood leads in adults commonly due to occupation where source known
  - Non-occupational exposures can lead to very high levels
    - Highest blood lead in NZ in 2014 was from traditional medicine or cosmetic

- Sources
  - Predominantly non-traditional (non-paint) sources found through surveillance: Arizona, Southern Nevada
  - Propane line welding: Quebec
  - Firearm use almost universally cited
  - Deodorant sold at Dominican markets: Rhode Island

Lead Poisoning and Litargirio[10]

CDC Home | Search | Health Topics A-Z

MMWR Weekly

March 11, 2005 / 54(09);227-229

Lead Poisoning Associated with Use of Litargirio --- I Island, 2003

Lead can damage the neurologic, hematologic, and renal systems (*1*). Deteriorated leaded paint in older housing common source of lead exposure for children in the United States; however, other lead sources increasingly are r particularly among certain racial/ethnic populations (*2*). In 2003, the Rhode Island Department of Health (RIDO litargirio (also known as litharge or lead monoxide), a yellow or peach-colored powder used as an antiperspirant/ folk remedy in the Hispanic community, as a potential source of lead exposure for Hispanic children. This report summarizes a case investigation of elevated blood lead levels (BLLs ≥10 µg/dL) associated with litargirio use among two siblings in Rhode Island, the public health action taken, and a survey of parents/guardians in three pediatric clinics in Providence, Rhode Island, to assess litargirio use. Findings underscore the importance of follow-up of elevated BLLs and thorough investigation to identify all lead sources.

FIGURE. Packages of litargirio, a yellow or peach-colored powder, used as an antiperspirant/deodorant and a folk remedy in the Hispanic community

Photo/New York City Department of Health and Mental Hygiene

Case Report

In May 2003, RIDOH and the Health & Education Leadership for Providence (HELP) Lead Safe Center investigated unexplained increases in BLLs in twin Hispanic boys aged 7 years (twins A and B). Annual BLL screenings for the twins since age 9 months were not elevated until June 2001, when twins A and B had elevated BLLs of 14 µg/dL and 15 µg/dL, respectively. Twin A's BLL increased to 42 µg/dL in May 2003, despite completed remediation of interior lead paint hazards in their home in June 2002 and of exterior lead hazards in May 2003, and provision of parental education about lead poisoning. Similarly, twin B's BLL increased to 26 µg/dL during the same period. In contrast, their younger brother's initial elevated BLL of 17 µg/dL in August 2001, at age 9 months, decreased to 8 µg/dL by November 2002.

In May 2003, RIDOH and HELP Lead Safe Center staff conducted a home inspection, which detected litargirio in a small glass jar in the bedroom of the twins, who used the substance as an antiperspirant/deodorant. The youngest brother did not use litargirio and had a separate bedroom. After the litargirio tested positive for lead by a sodium rhodizonate field test, all litargirio was removed from the home, and a sample was sent to the state laboratory for confirmatory lead testing. The litargirio sample contained 790,000 parts per million (ppm) (79%) lead. Follow-up BLLs decreased for twin A (27 µg/dL in June, 22 µg/dL in August, and 13 µg/dL

New York Heavy Materials Registry[11]

Deleted figure: New York State Heavy Materials Registry, 2006-2010 report Table 5

- Greater proportions of non-occupational (compared to occupational) lead exposures associated with higher categories of peak reported blood lead levels

Texas Adult blood lead epidemiology and surveillance program[12]

Deleted figure: Texas Adult blood lead epidemiology and surveillance program (ABLES) report Table 4

- Greater proportion of non-occupational (compared to occupational) lead exposures associated with category including higher reported blood lead levels

Success of source ascertainment

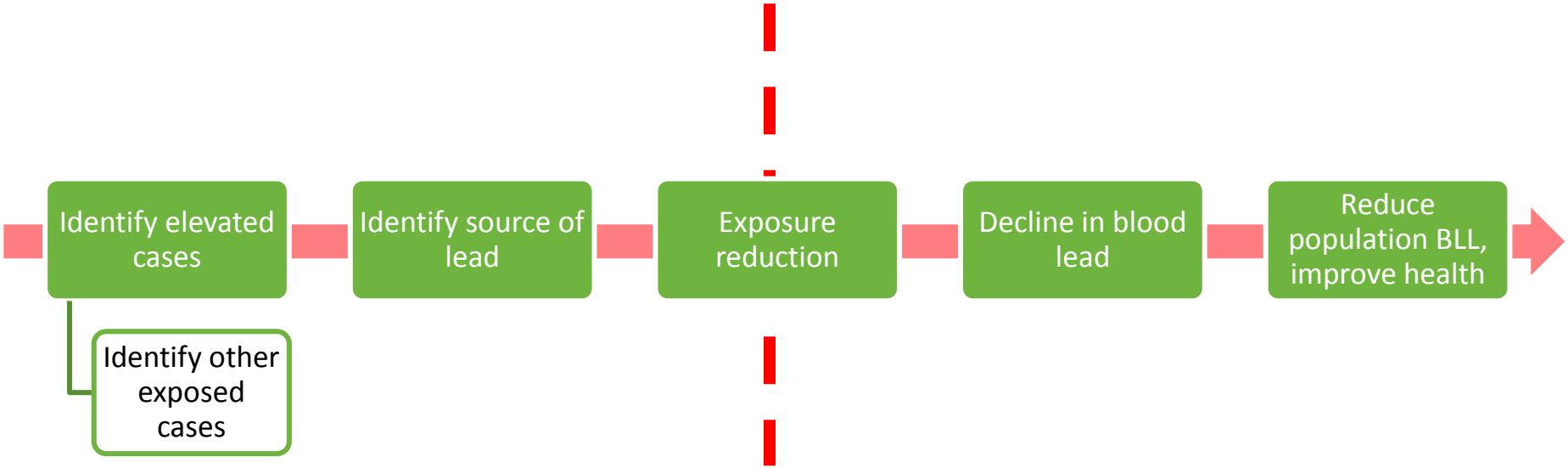
- Difficult to generalize on success rates
  - Some only interview (US adult programs)
  - Different triggers for environmental investigations in jurisdictions
  - Occupational exposures may be easier to identify
  - “Smoking gun” easier to identify at higher blood lead levels
  - Willingness to assign primary exposures when a source is found
    - e.g., assigning source as “occupational” based on report by care provider – inconsistent verification of sources
  - Skill and knowledge of investigators
  - Best estimates were provided verbally in most cases

Source ascertainment cont.

- Programs focused on environmental (non-occupational) exposures:
  - Most programs look for a source around 10 ug/dL
    - There may be other forms of follow-up below 10 ug/dL
  - Combination of interview and environmental investigation as needed or resources allow
  - All but one program contacted reported source identification in at least 50% of cases
    - About half stated source found in >75% cases

Program effectiveness

- Less well documented: effectiveness of exposure reduction
  - Public health may not be directly responsible; neither are clinicians
  - Cases can be lost to follow up
  - Among the programs contacted, only 1 evaluated the program



Potential relevance for Ontario

- Roughly 11,000 blood lead tests done annually (unpublished, 1997/98 to 2010/11)
  - Includes children under 3 years
  - Data on ongoing exposures – *unlikely that all cases warranting some public health response currently being addressed*

- BC's analysis based on anticipated BLL reporting (2009-2010)[13]
  - 6 per 10,000 population had BLL testing annually
  - Severe lead-related outcomes rare
  - ~5% had BLLs ≥10 ug/dL (M >19 years more likely)
  - Equates to roughly 550 people in Ontario with BLL ≥10 ug/dL
    - How much of this would be related to occupational exposures?

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Take home messages for the field

- Exposures in Ontario
  - Preventable, but not being identified
  - Many from non-occupational exposures – no awareness, regulation
  - Can result in very high exposures, involve others in vicinity

- What can public health do?
  - Support affected individuals and clinicians with information, resources
  - Environmental investigation – template available
  - Facilitate testing of suspected sources
  - *Are there others exposed to the same source???*
    - e.g., family of stained glass hobbyist, other gun range members
    - e.g., other members of household using/eating the contaminated product
  - Should we consider tracking BLLs?

SAMPLING FOOD, BEVERAGES, HOME REMEDIES, TOYS, AND JEWELLERY

Collect samples from these sources only if the *"Lead Exposure Assessment Form"* suggests that these are potentially important sources. Obtain sampling instructions from the laboratory.

EVALUATION OF FINDINGS

The purpose of any environmental assessment is to use the data gathered from the blood lead level questionnaires, the visual assessment and the environmental sampling to conclude whether a lead hazard exists. Several different agenci
lead risk assessment purposes. These

Media	Organization
Dust (bare and carpeted floors)	Environmental Protection Agency (EPA)
Paint	Health Canada
	HUD
Soil	Canadian Council of Ministers of the Environment
	Environmental Protection Agency
Drinking water	Health Canada

APPENDIX A

VISUAL INSPECTION FORM

Date and Time	
Sampling Public Health Inspector	
Client	
Property Address	

Any deteriorated paint, visible paint, paint chips, observed? Peeling ☐ Flaking ☐ Ch
Chalking ☐ Cracking ☐

If yes record observation in the table below:

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Summary

- Overall, mandatory blood lead reporting is common
  - Most of US; NZ; half of Australian states/territories
  - Québec, BC likely soon
  - Not done in UK
- Presence of a tracking program does not depend on extent of problem
- Surveillance programs have identified regionally relevant risk factors that have supported public health decision-making
- Exposures occur in Ontario, some that likely warrant public health follow up that are going undetected
- Resources are available if health units encounter cases

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