California Department of Public Health Health-based Permissible Exposure Limit Recommendation for Lead

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Lead in the Workplace – The New Science
November 13, 2013 – Berkeley

Headed toward new lead standards…

Courtesy of Caltrans

Road map

- Intro to Occupational Lead Poisoning Prevention Program (OLPPP)
- Worker blood lead testing in California
- Previous OLPPP recommendations to Cal/OSHA
- Basis for health-based PEL recommendation

OLPPP established in 1991

- Provide services to reduce & prevent lead poisoning
- Work cooperatively with employers, workers, others
- Conduct industry-wide intervention projects

Foundry worker exposed to airborne lead

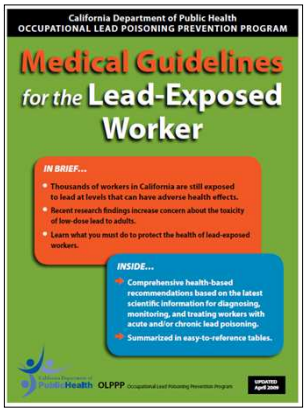
OLPPP's mandated activities

- Track blood lead levels (BLLs) in CA workers
- Provide information, training & technical assistance
- Investigate worker & take-home lead poisoning
- Make prevention recommendations

Demolition worker disturbs old lead paint

Improving worker protection standards

- Review of scientific literature on chronic, low-level lead exposure & toxicity
- Convened expert panel to revise medical management guidelines
- 2007 Environmental Health Perspectives article
- 2009 OLPPP guidelines for health professionals



Occupational Blood Lead Registry

- Labs required to report all BLL* test results to CDPH
- Many reports missing key information
- Not all lead employers offer BLL testing

Phlebotomist draws blood sample for lead test

*BLL = blood lead level

Lead-using industries in CA: % of employers testing blood lead

Industry	% Testing per OLPPP studies
Battery manufacturers	87%
Non-ferrous foundries	56%
Radiator repair	14%
Painting contractors	8%
Wrecking and demolition	1%

Lead-using industries in CA: % of employers testing blood lead

Industry	% Testing per OLPPP studies	% Testing based on U.S. Census
Battery manufacturers	87%	86%
Non-ferrous foundries	56%	48%
Radiator repair	14%	3%
Painting contractors	8%	2%
Wrecking and demolition	1%	2%

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BLL distribution of workers tested, 2012

BLL (µg/dL)	# Workers	Percent
1 - 4	15,263	82%
5 - 9	1727	9%
10 - 19	1097	6%
20 - 29	277	2%
30 - 39	57	<1%
40 - 49	13	<1%
50+	4	<1%
TOTAL	18,438	100%

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Industries with largest # workers tested, 2012

Industry	% ≥10 µg/dL	# Workers	# Employers
Remediation services	3%	1219	134
Storage battery manufacturing	45%	815	12
Recyclable material	14%	620	35
Government, air & water	<1%	565	20
Painting contractors	15%	549	60
Secondary smelting	68%	427	11
Wrecking and demolition	3%	425	50
Fire protection	0%	361	18
Police protection	8%	276	53
Highway/street/bridge construction	9%	236	13

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Industries with highest % elevated BLLs, 2012*

Industry	% ≥10 µg/dL	# Wkrs	# Empl
Firing ranges	80%	154	36
Sheet metal work manufacturing	76%	30	6
Secondary smelting	67%	427	11
Industrial building construction	62%	66	2
Other aircraft parts manufacturing	55%	58	5
Storage battery manufacturing	45%	815	12
Plumbing fixture fittings (brass)	43%	41	3
Other metal valve and pipefitting mfg.	36%	52	1
Structural steel, precast concrete contractors	22%	54	9
Plumbing, heating, A/C contractors	17%	40	8

**Industries that tested ≥ 30 workers in 2012*

Conclusions about blood lead data

- Employer testing is best way to identify high-risk industries for targeted prevention work
- Incomplete picture of magnitude & distribution of BLLs due to lack of testing, missing info
- Some industries & individual employers are successful in maintaining low BLLs

Previous CDPH recommendations to Cal/OSHA

- Lower Medical Removal Protection (MRP) level
- Increased frequency of BLL testing
- Trigger for BLL testing not dependent on air monitoring
- Lower Permissible Exposure Limit (PEL)

See: http://www.cdph.ca.gov/programs/olppp/Pages/leadStdRecs.aspx

CDPH health-based PEL recommendation

- Prevent BLLs 5 – 10 µg/dL over 40 yrs worked
- PEL = 8-hr TWA of 0.5 – 2.1 µg/m^3
- At 0.5 µg/m^3
  - 95% of workers' BLLs stay under 5 µg/dL
- At 2.1 µg/m^3
  - 95% of workers' BLLs stay under 10 µg/dL
  - 57% stay under 5 µg/dL

1978 Federal OSHA lead standard considerations

- Used pharmacokinetic model for PEL development
- Concluded that PEL development must:
  - Consider early and subclinical effects
  - Protect workers over working lifetime
  - Protect susceptible individuals

Lead health effects

- No threshold has been identified for health effects
- Research continues to show effects at lower and lower levels

Key findings from EHP* review (2007)

At chronic BLLs at or above 10 µg/dL:

- Hypertension
- Kidney dysfunction
- Reduced birth weight

*Environmental Health Perspectives journal

NTP* Monograph (2012)

At BLLs less than 10 µg/dL:

- Increased blood pressure and risk of hypertension
- Increased incidence of essential tremor

At BLLs less than 5 µg/dL:

- Decreased kidney filtration rate
- Reduced fetal growth

*National Toxicology Program

US EPA report (2013)

Causal relationship within the range of relevant lead pollutant exposure:

- Hypertension
- Coronary heart disease
- Male reproductive effects

Likely causal:

- Decreased cognitive function
- Psychopathological effects

CDPH conclusions about health effects data

We know with confidence:

- Increased blood pressure / hypertension & other cardiovascular effects
- Multiple high-quality studies
- Effects in adults with chronic BLLs 10 – 25+ µg/dL
- Epidemiological data supported by toxicological data

Health protective PEL goal

- PEL that keeps BLLs under 10 µg/dL
  - Greatly decreases risk of cardiovascular and neurological effects
  - No margin of safety for susceptible workers
- More protective PEL would keep BLLs under 5 µg/dL

Reproductive effects in males

- EHP authors, NTP & EPA noted lead effects on male reproductive function
  - Semen/sperm quality, fertility, time to pregnancy
- Associations found at higher BLLs
- Keeping BLLs under 5 – 10 µg/dL protects against these effects

Reproductive effects in females

- Risk of decreased fetal growth & neurological effects in children at very low levels
- PEL of 0.5 – 2.1 µg/m^3 not sufficiently protective for pregnant workers
  - Medical removal protection benefits can provide temporary protection
  - New standard language should clarify this protection

Air lead / blood lead relationship

CDPH requested that OEHHA:

- Estimate air lead concentration that results in BLLs from 5 to 30 µg/dL over 40 years
- Results would inform recommendation for health-based PEL

Modeled air lead / blood lead relationship

Air lead levels & corresponding BLL in 95th percentile worker for 40-yr job tenure

8-hr TWA air lead level (µg/m^3)	Blood lead level (µg/dL)
0.5	5
2.1	10
3.9	15
6.0	20
10.4	30

Excerpted from Table 2, full OEHHA report, p. 12

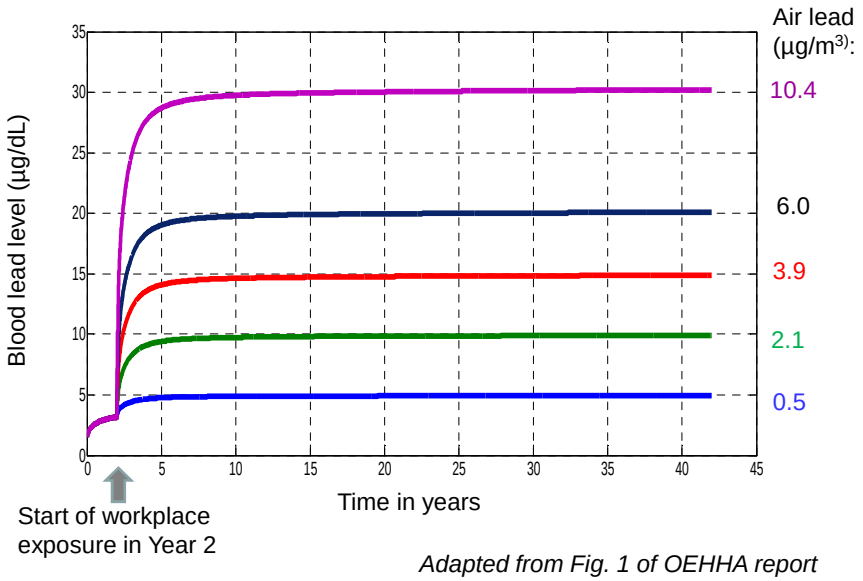
Modeled air lead / blood lead relationship & recommended PEL

Air lead levels & corresponding BLL in 95th percentile worker for 40-yr job tenure

8-hr TWA air lead level (µg/m³)	Blood lead level (µg/dL)
0.5	**5**
2.1	**10**
3.9	15
6.0	20
10.4	30

Excerpted from Table 2, full OEHHA report, p. 12

Rise in BLL in the 95th percentile worker who reaches the limit BLL over 40 yrs of exposure



Adapted from Fig. 1 of OEHHA report

Conclusions

- Outdated lead standards require revision of MRP levels, other key provisions and PEL
- Health effects literature and OEHHA modeling provide basis for PEL recommendation
- CDPH recommends 8-hr TWA of 0.5 – 2.1 μg/m^3
  - Protection for the 95th percentile worker from BLLs above 5 – 10 μg/dL

Key references & resources

- Kosnett MJ et al. (2007). Recommendations for Medical Management of Adult Lead Exposure. Environmental Health Perspect, 115(3):463-471.
- U.S. Environmental Protection Agency (2013). Integrated Scientific Assessment for Lead (EPA/600/R-10/075F). Research Triangle Park, NC: US EPA.
- National Toxicology Program (2012). NTP Monograph on Health Effects of Low-Level Lead.

- All available at: http://www.cdph.ca.gov/programs/olppp/Pages/leadStdRecs.aspx

Continuing down the road…

Courtesy of Caltrans