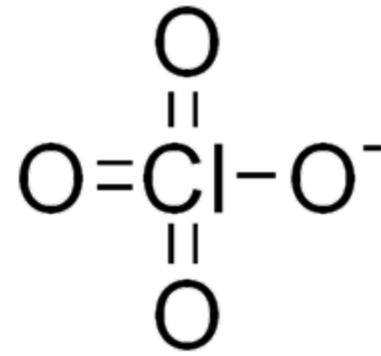


Perchlorate



Structure:	ClO_4
Industrial uses:	Oxidizer in rocket fuel, explosives, road flares, air bag inflation systems
Human exposure:	Contaminated food or water
Sources of exposure:	Industrial contamination or naturally occurring
Mechanism of toxicity:	Competitively inhibits iodide uptake into the thyroid gland, which can cause decreased thyroid hormone production

Potential impacts of decreased thyroid hormone:

- Goiter
- Cretinism
- Cardiovascular disease
- Changes in lipid metabolism
- Developmental and cognitive effects in fetus and children

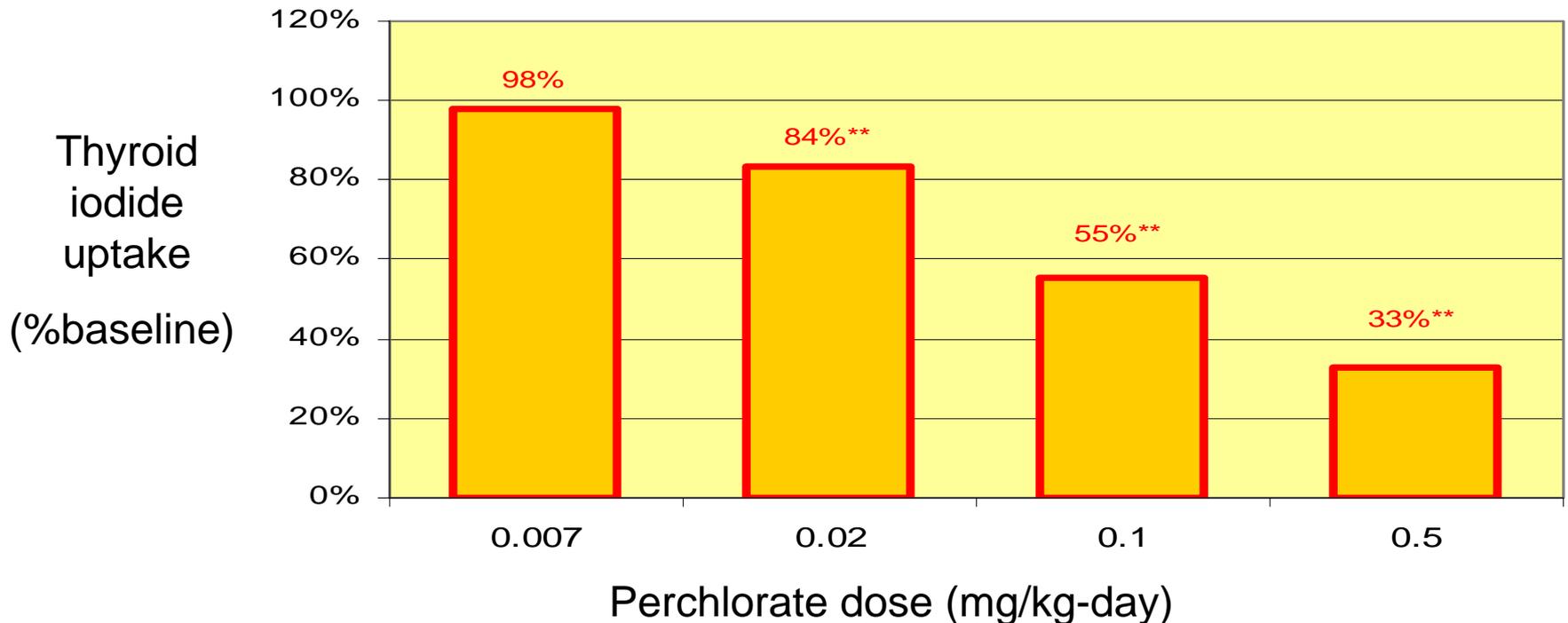
Perchlorate Detections > 4 ppb, California Public Drinking Water 2004-2009 (CDPH, 2009)

County	No. of Sources	No. of Systems	Peak Conc. (ppb)
Los Angeles	117	33	86
Riverside	68	9	73
San Bernardino	58	15	80
Orange	21	11	11
Tulare	9	6	24
Santa Clara	7	3	7
Kern	5	4	34
Sacramento	4	2	10
San Diego	5	2	8
Madera	2	1	7
San Joaquin	1	1	69
Tehama	1	1	82
San Luis Obispo	1	1	20
Monterey	1	1	7
Sutter	1	1	6
Ventura	1	1	5
TOTAL	297	92	-

Critical effect: 5% decrease in iodide uptake into the thyroid. Used to derive the benchmark dose (BMD)

Critical study: Human dosing study, Greer et al 2002

- 37 healthy volunteers
- Daily perchlorate dosing for 2 weeks, 4 dose groups
- Outcome: radioactive iodide uptake into the thyroid



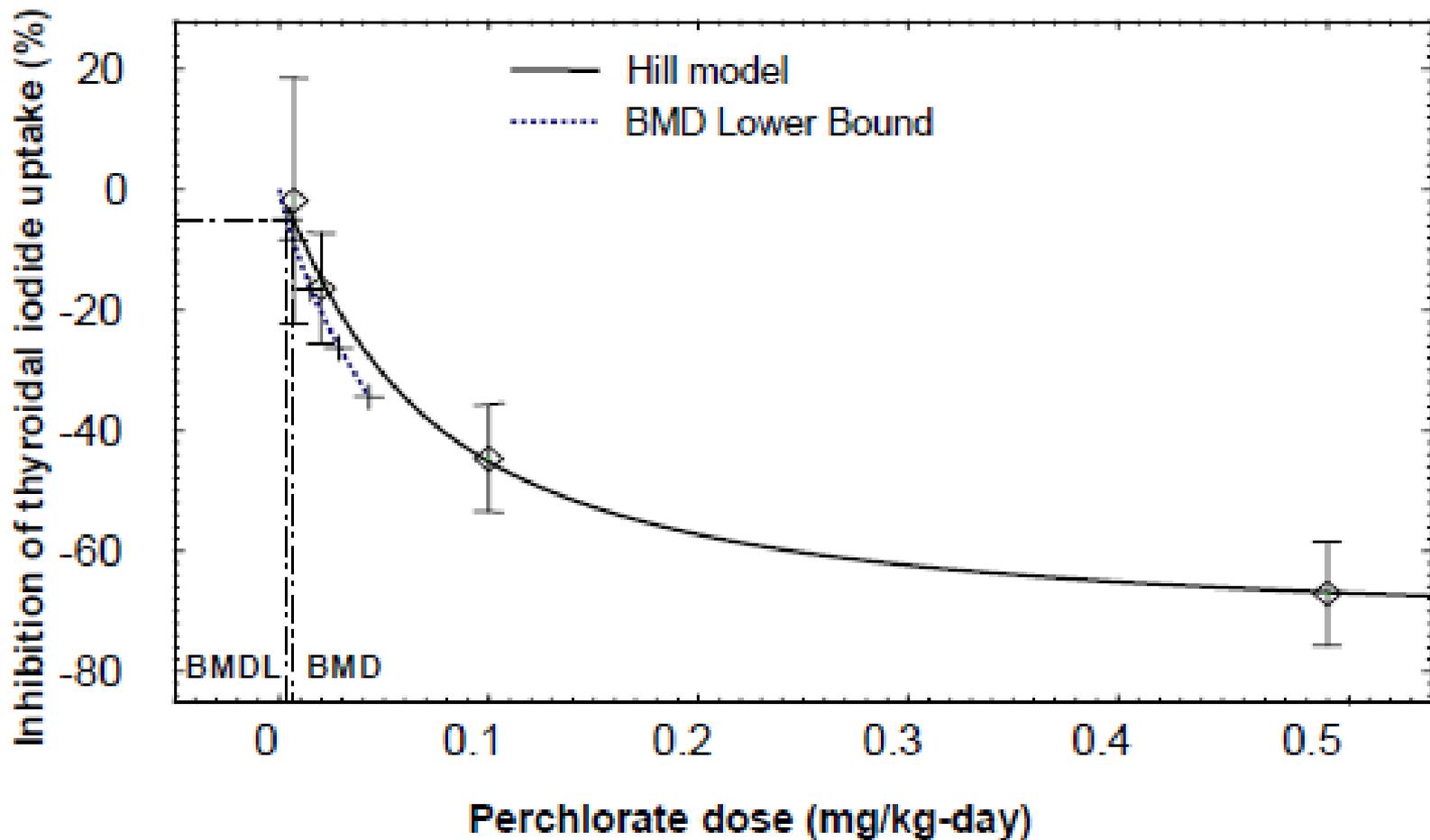


Figure 13. Analysis of the Greer *et al.* (2002) Data by the Benchmark Dose Approach.

BMD = Benchmark dose (the dose estimated to cause the critical effect)
BMDL = Lower 95% confidence interval of the benchmark dose

Major changes from the 2004 PHG

	2004 PHG	Proposed PHG
Level:	6 ppb	1 ppb
Critical effect:	5% decrease in iodide uptake	Same
Critical study:	Greer et al., 2002	Same
Method:	Benchmark dose	Same
BMDL	0.0037 mg/kg-day	Same
Uncertainty factor:	10 in women/pregnancy 3 in infants	10 in women/pregnancy 10 in infants
Relative source contribution:	Pregnant = 0.6 Infant = 1.0	Pregnant = 0.73 Infant = 0.73* <i>*formula, Schier 2009</i>
Drinking water intake (Liters/kg-day)	Pregnant = 0.040 Infants = 0.167	Pregnant = 0.044 Infants = 0.234* <i>*95th percentile, direct & indirect water in drinking water consumers, US EPA 2004</i>

Acceptable daily dose (ADD) = BMDL / Uncertainty factor (UF)

Health Protective Concentration (C) = ADD x BW/WC x RSC

$$C = \frac{\text{BMDL} \times \text{bodyweight} \times \text{RSC}}{\text{UF} \times \text{water intake}}$$

2004 PHG: Pregnant women

$$C = \frac{0.0037 \text{ mg/kg-day} \times 0.60}{10 \times 0.040 \text{ L/kg-day}} = 0.006 \text{ mg/L} = 6 \text{ ppb}$$

Proposed PHG: Infants (blue = changes from 2004 PHG)

$$C = \frac{0.0037 \text{ mg/kg-day} \times 0.73}{10^* \times 0.234 \text{ L/kg-day}} = 0.001 \text{ mg/L} = 1 \text{ ppb}$$

**In the 2004 the PHG UF for infants was 3 (for toxicodynamics only)*

Data on susceptibility of the fetus and infants



- **Small changes in thyroid hormones in pregnancy may be associated with significant developmental and cognitive effects**
- **Low stores of thyroid hormone in infants**
- **Low iodine intakes seen in many infants (Pearce 2007)**
- **New data on low iodine-perchlorate interactions (Blount 2006)**
- **High drinking water intake per body weight (US EPA 2004)**
- **Studies linking low perchlorate exposure to thyroid hormone changes in infants (Cao; Steinmaus; Brechner; others)**