Review of the California Ambient Air Quality Standards for Ozone

Air Resources Board

Office of Environmental Health Hazard Assessment

California Environmental Protection Agency

Overview

- Why are we reviewing the State ozone standard?
- What are the regulatory steps in a standard review?
- What is our draft proposal for revising the ozone standard?
- What are the health effects of ozone?
- What is the health basis of our recommendation?

Why Are We Reviewing the State Ozone Standard?

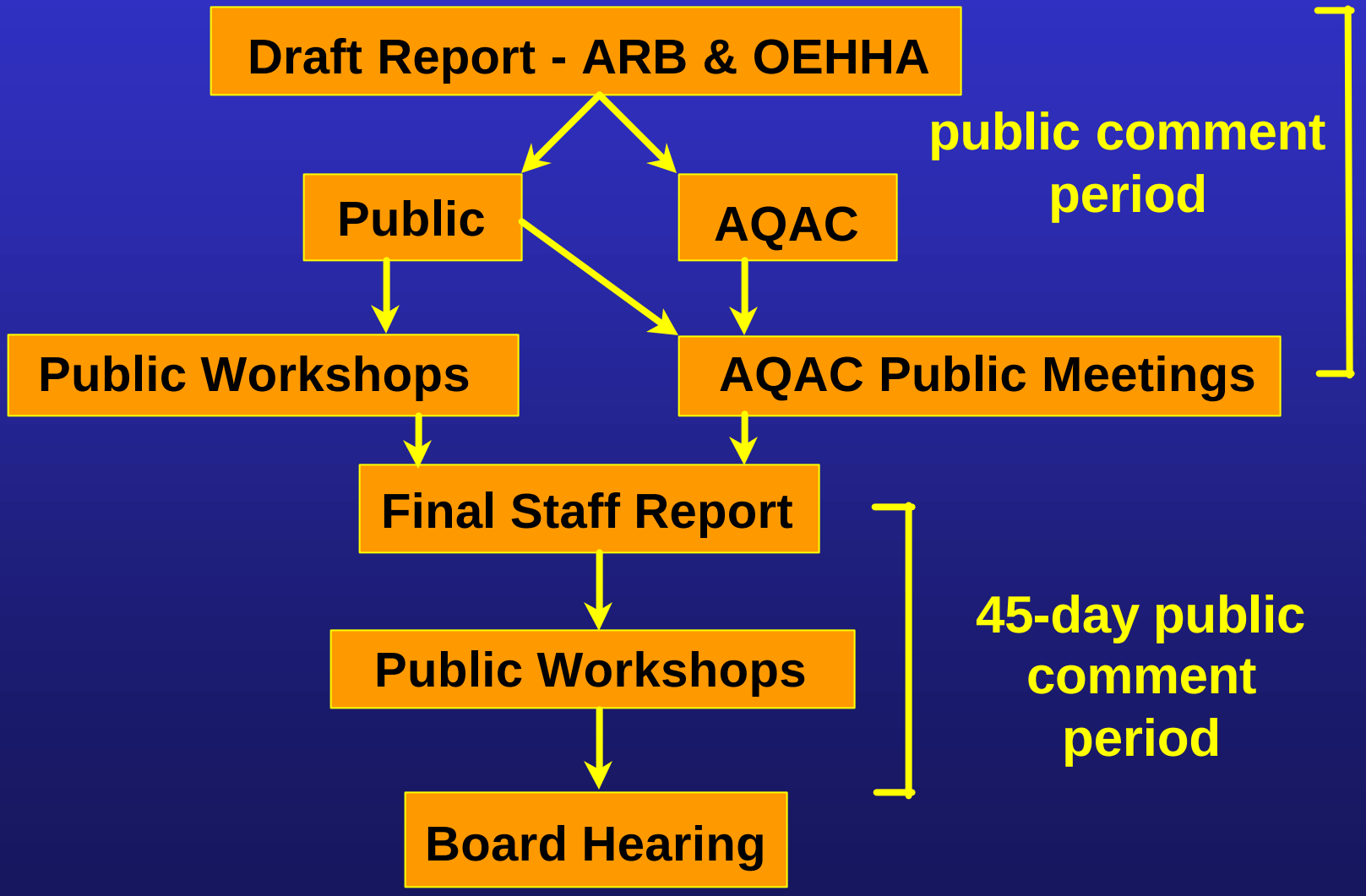
- Protect public health
- Comply with State law
- Address requirements of Children's Environmental Health Protection Act (SB25, Escutia, 1999)

Results of 2000 AAQS Prioritization Process

1st Priority Pollutant	Review Schedule
• PM10 (including sulfates)	2002
• Ozone	2004
• Nitrogen dioxide	2005

Adapted from Staff Report Entitled "Adequacy of CA Ambient Air Quality Standards: Children's Environmental Health Protection Act," December 2000.

What are the Regulatory Steps in a Standard Review?



What Are the Elements of an Ambient Air Quality Standard?

- Air Quality Standard: legal definition of clean air
- Standards have five parts:
  - Pollutant definition
  - Concentration
  - Averaging time
  - Monitoring Method
  - Form, in CA, not to be exceeded

Standard Setting Does Not Include

- Attainment designation
- Feasibility of controls
- Cost of controls
- Implementation of controls

Why Are We Concerned about Ozone?

- Health effects are significant
- Body of evidence is substantial
- Exposure is high in California
- Children may be particularly vulnerable

Who is Most at Risk?

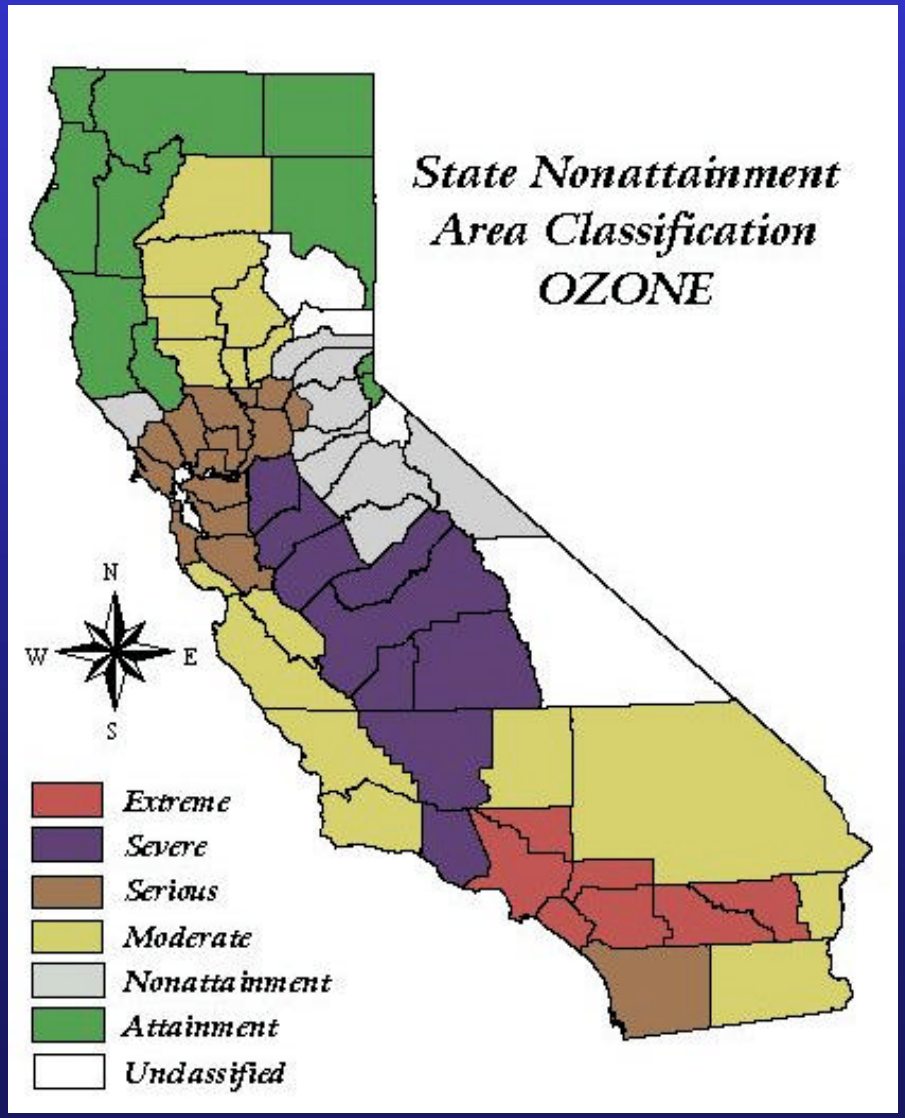
- Primarily an outdoor pollutant
- Health effects proportional to inhaled dose of ozone
- Greatest risk to people who are active outdoors
  - Adults who exercise or work outdoors
  - Children

Current Ozone Standards
(ppm)

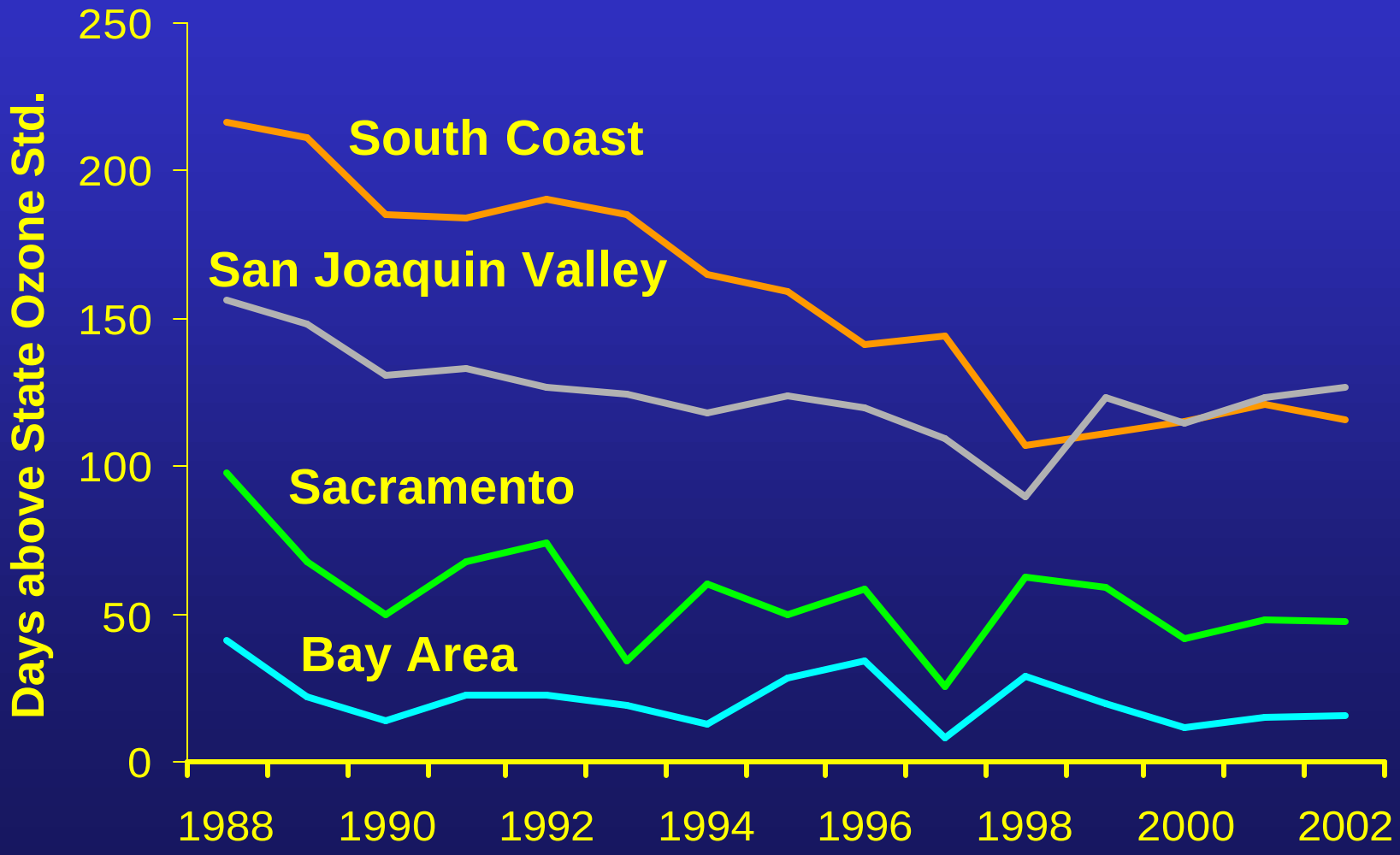
	One Hour	Eight Hour
California	0.09	--
US EPA	0.12	0.08*

*selected from a range of 0.07 to 0.09 ppm

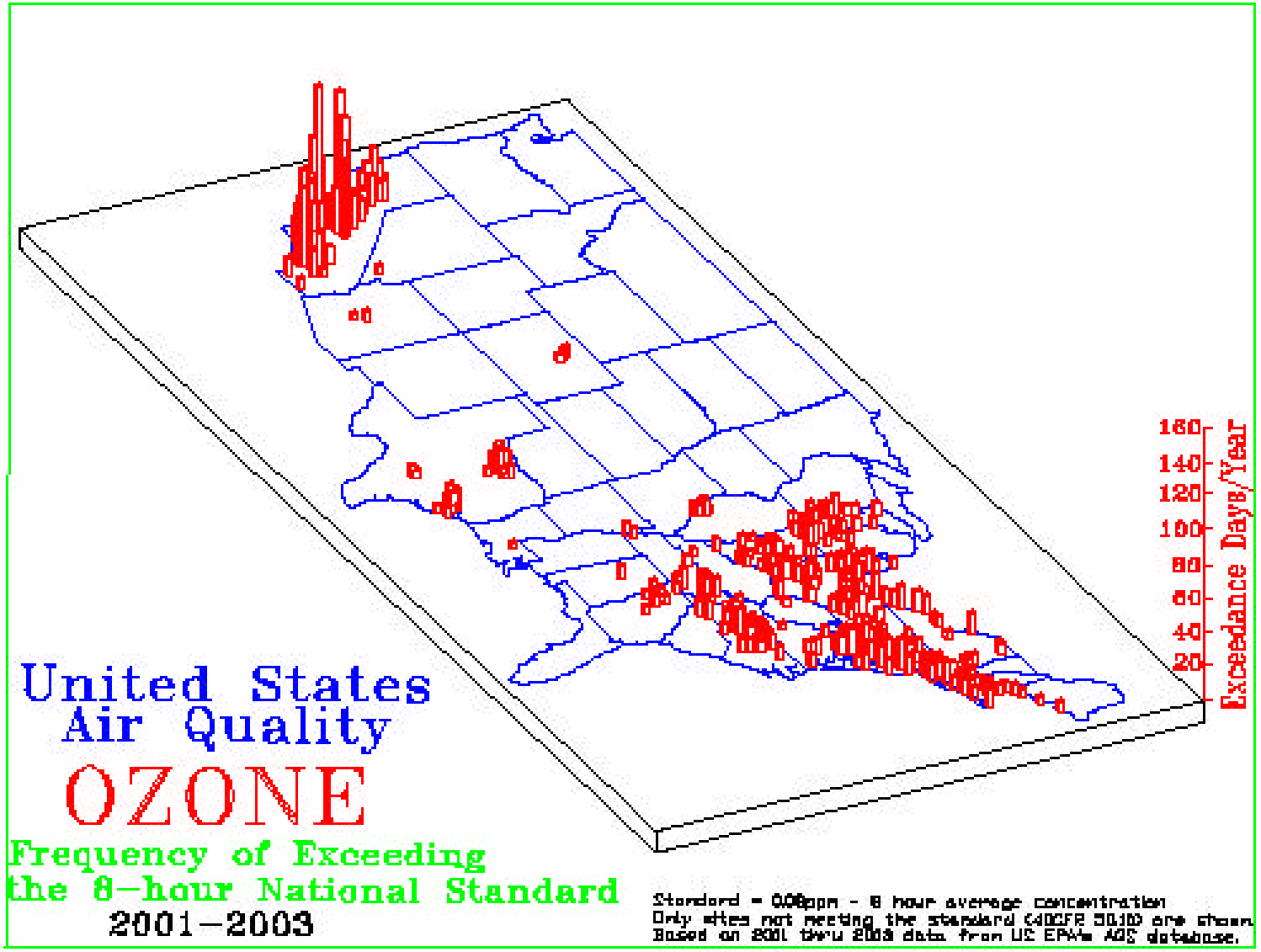
State Nonattainment Area Classification Map
Ozone 1-Hr Standard



Days of Unhealthy Ozone Levels



National 8-Hr O_3 Standard Exceedances



Draft Recommendation to Revise the California Ozone Standard

- Retain ozone as the pollutant definition
- Establish a new 8-hr standard of 0.070 ppm, not to be exceeded
- Retain the current 1-hr standard of 0.09 ppm, not to be exceeded
- Retain the UV monitoring method

What Are the Health Effects of Ozone?

- Airway inflammation
- Reduced lung function
- Respiratory symptoms
- Increased hospital and ER usage
- Increased school absenteeism
- Asthma induction in active children (needs confirmation)

Controlled Human Exposure Studies

- Simulate real world exposures
- Typical subjects: healthy adults
  - Some studies on children and people with heart or lung disease
- Advantage: Good measures of exposure and response
- Disadvantage: Mostly healthy adults; small samples; limited endpoints; few co-pollutants

Inhaled Dose is Important

- Inhaled dose is a function of:
  - O_3 concentration
  - Breathing rate
  - Exposure duration
- Responses proportional to inhaled dose
- Susceptible populations:
  - Children
  - Workers
  - Active and exercising people

ATS* Criteria For What Constitutes An Adverse Health Effect

- Physiologic or pathologic change that interferes with normal activity
- Episodic or incapaciting respiratory illness
- Permanent and/or progressive respiratory injury/dysfunction.
- Reduction in quality of life
- Lung function changes with concurrent symptoms
- Hospitalization or emergency room visits
- Mortality
- Population health in addition to individual risk.

* American Thoracic Society

Controlled Human Studies (1 to 3 Hours): Lowest Concentrations Showing Effects

- Lung Function Decrements: 0.12 ppm
- Increased Respiratory Symptoms: 0.12 ppm
- Increased Airway Resistance: 0.18 ppm
- Airway Inflammation: 0.20 ppm

Studies of Multi-Hour Ozone Exposures: Lowest Concentrations Showing Effects

- Lung function decrements: 0.08 ppm
- Increased respiratory symptoms: 0.08 ppm
- Increased airway reactivity: 0.08 ppm
- Airway inflammation: 0.08 ppm

Change in FEV1 with Length of Exposure

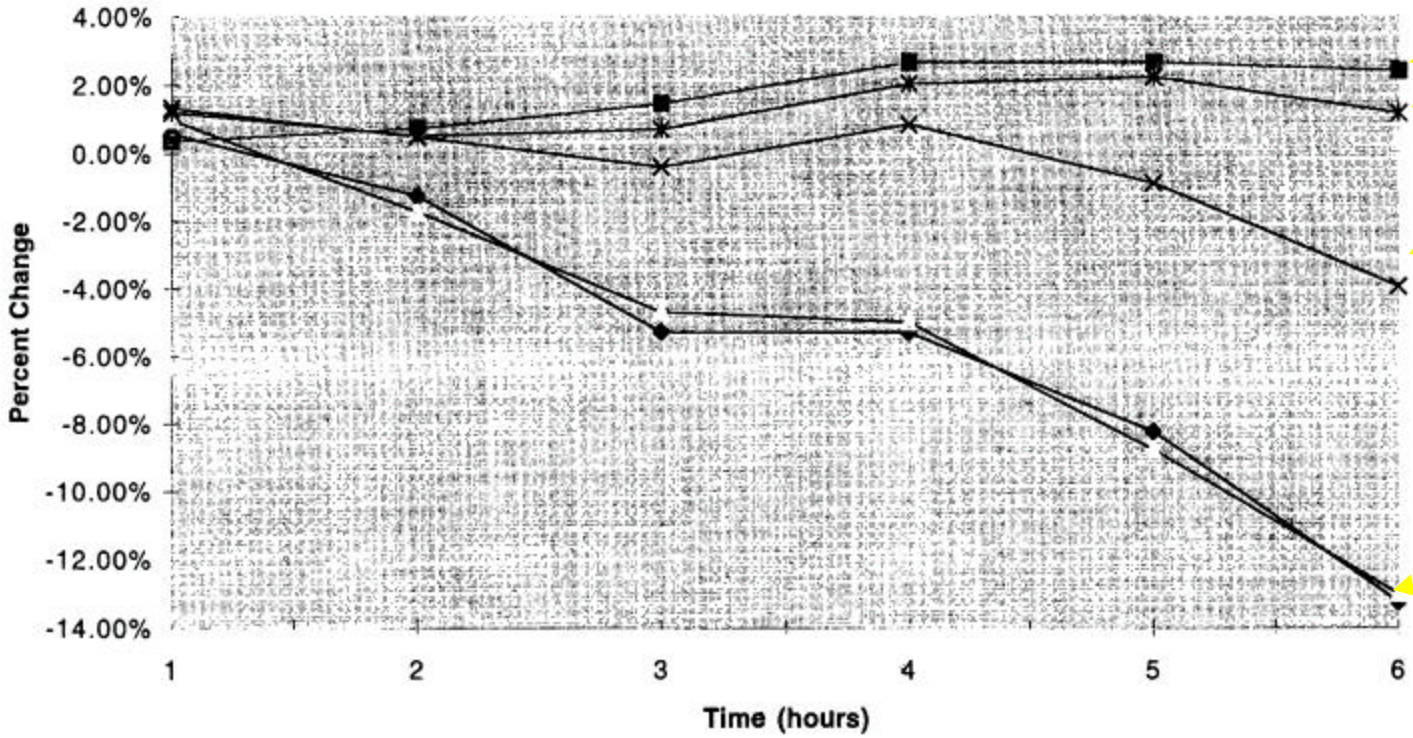


FIGURE 1. Hour-by-hour percent change in $FEV_{1.0}$.

Clean air

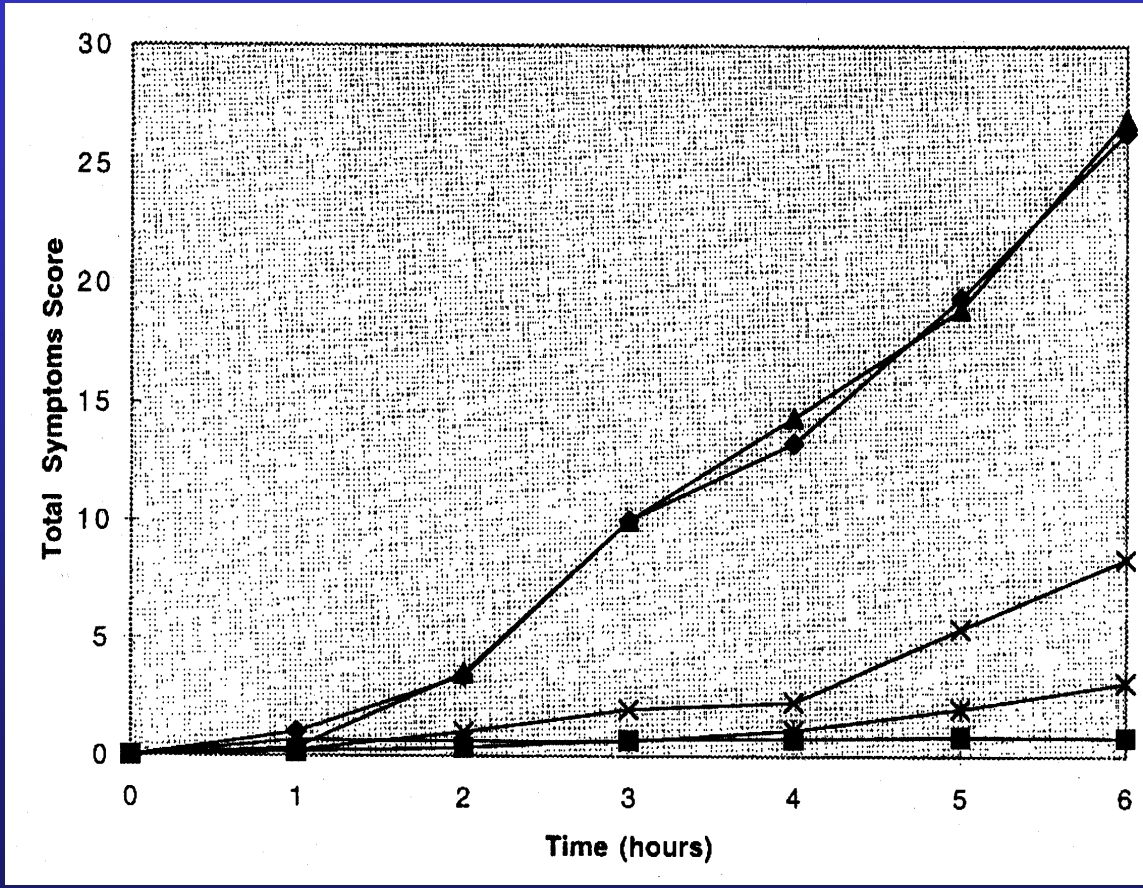
0.04 ppm

0.08 ppm

0.12 ppm

Adams, 2002

Change in Respiratory Symptoms with Length of Exposure



0.12 ppm

0.08 ppm

0.04 ppm

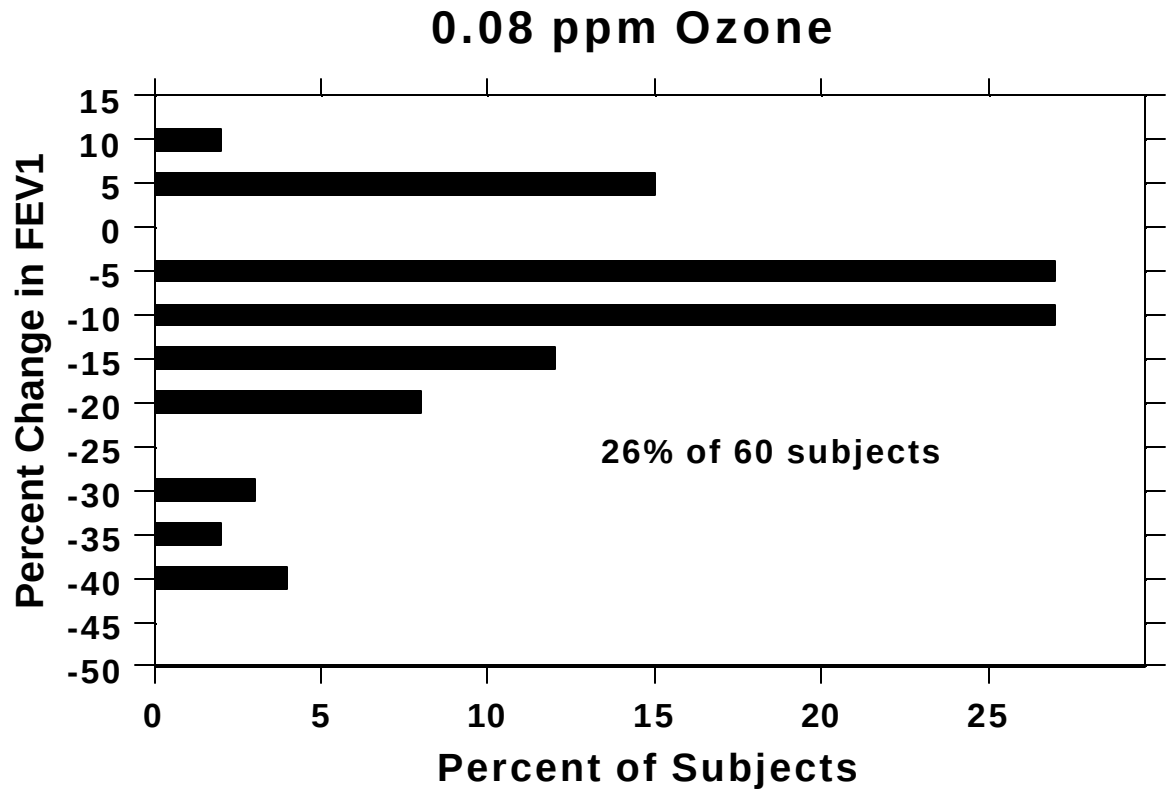
Clean air

Hour-by-hour change in total symptoms score

Adams, 2002

Some Individuals May Be Particularly Responsive

(6.6 hr exposure)



Folinsbee et al., 1991

Influence of Demographics or Ethnicity on Responsiveness

- Few studies conducted
- Factors Investigated
  - Gender
  - Age
  - Socioeconomic Status
  - Ethnicity
- Insufficient data to draw conclusions

Findings From Animal Studies

- Acute responses similar to observations in humans:
  - Increased airway resistance
  - Airway inflammation
- Repeated injury-repair cycles can cause fibrosis (> 0.25 ppm)
- Changes in airway architecture with chronic exposure to high O_3 concentrations (> 0.20 ppm)

Characteristics of Epidemiologic Studies

- Evaluate exposures and responses of free-living populations over a wide range of individuals, behaviors, and subgroups
- Examine both short and long-term exposures
- Difficult to determine exposure averaging time, timing of measurements, and concentrations
- Need to account for other factors such as weather and co-pollutants

Findings From Epi Studies

At current ambient concentrations, effects have been observed for:

- Respiratory hospital admissions for all ages and children < 2 yrs
- Emergency room visits
- Asthma exacerbation
- School absences and respiratory symptoms
- New onset of asthma (with exercise)
- Long term exposure and lung function
- Mortality from acute, and possibly chronic, summertime exposure

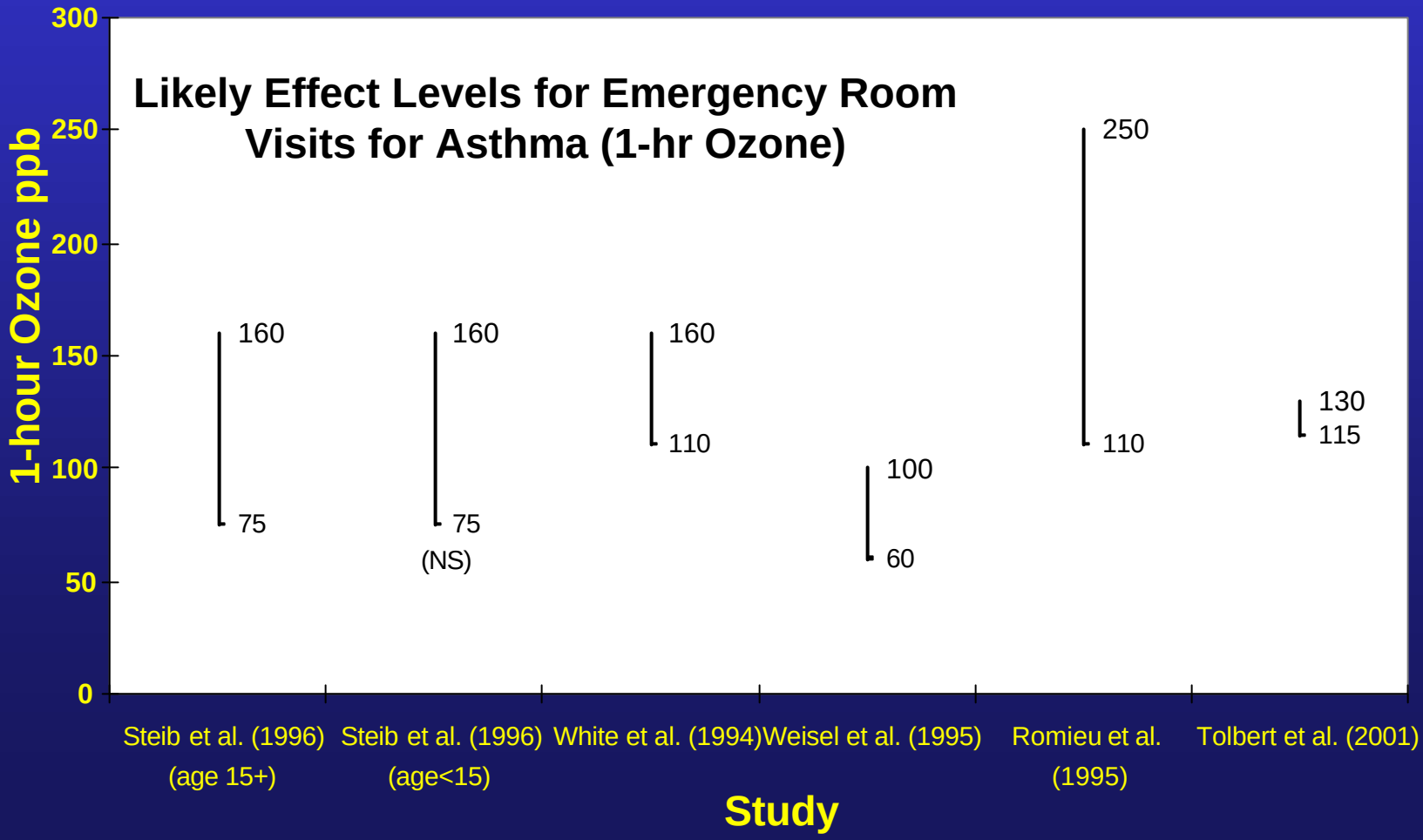
What Is the Basis for OEHHA's Health-Based Recommendation?

Retain the current 1-hr standard of 0.09 ppm

1. Chamber studies indicate effects on lung function and symptoms at 0.12 ppm
2. Add safety margin for children and other susceptibles and for possibility of inflammation
3. Epi studies suggest range of adverse outcomes at 1-hr concentrations below 0.12 ppm

Basis for 1-hr (cont.)

4. Epi studies on ER visits suggest lowest effect levels at 1-hr range of 0.075 to 0.11 ppm



Basis for 1-hr (cont.)

5. Difficult to attribute epi effects to specific averaging time but peak exposures (1-hr) may be important for infants and elderly

6. Include margin of safety for potential effects of long-term exposure (lung function, asthma induction, mortality)

7. Standard protects against peaks in areas that may meet federal 8-hr standard of 0.08 but still have relatively high 1-hr concentrations.

What Is the Basis for OEHHA's Health-Based Recommendation?

Establish an 8-hr standard of 0.070 ppm

1. Chamber studies show adverse effects (lung function, symptoms, airway responsiveness) at multi-hour exposures to 0.08 ppm. Some individuals exhibited large changes

2. Add safety margin for individual responders and others not included in chamber studies

3. Epi studies suggest adverse effects at 8-hr concentrations less than 0.08 ppm.

Basis for 8-hr (cont.)

Establish an 8-hr standard of 0.070 ppm

4. Studies on ER visits suggest effects at 8-hr range of 0.065 to 0.09 ppm (using ratio of 1.2)

5. Include margin of safety for potential effects of long-term exposure (lung function, asthma induction, mortality).

6. Standard provides protection in areas that meet 1-hr 0.09 ppm but still experience 8-hr average between 0.07 and 0.08 ppm.

Special Considerations for Infants and Children Under SB 25

1. Exposure patterns: Children are more likely to have high exposures and also experience greater exposure per unit lung surface than adults
2. Susceptibility: Early exposure may impact lung development and function and induce asthma
3. No clear evidence that children respond at lower levels than adults

Special Considerations (cont.)

4. Interactions: No evidence of interactive effects from other pollutants
5. Several adverse health outcomes observed including:
   - asthma exacerbation and ER visits
   - hospital admissions
   - school loss
   - upper and lower respiratory symptoms
   - possible onset of asthma
   - decreased lung function in young adults raised in high ozone areas

Summary
Draft Staff Recommendation

- Retain ozone as the pollutant definition
- Establish a new 8-hr standard of 0.070 ppm, not to be exceeded
- Retain the current 1-hr standard of 0.09 ppm, not to be exceeded
- Retain the UV monitoring method

Timeline for Ozone Review

Jun. 21	Release of Draft Report
Jul. 14-16	Public Workshops
Aug. 25	Public Workshop
Sept. 1	Public Comments Due
Oct. 2004	AQAC meeting (tentative)
Dec. 2004	Final recommendations to Board (tentative)

Contact Information

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  http://www.arb.ca.gov/research/aaqs/ozone-rs/ozone-rs.htm

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