

CHILDREN DESERVE EXTRA ATTENTION

EXECUTIVE ORDER 13045:

**PROTECTION OF CHILDREN FROM
ENVIRONMENTAL AND SAFETY RISKS**

**US EPA'S OFFICE OF CHILDREN'S HEALTH
PROTECTION:**

**HEALTH PROTECTION ADVISORY
COMMITTEE**

**ECONOMICS AND ASSESSMENT
WORK GROUP**

CHILDREN ARE DIFFERENT

- **HAVE SMALLER BODIES & FASTER METABOLISMS**
- **SPEND MORE TIME OUTDOORS**
- **ARE MORE PHYSICALLY ACTIVE**

**CANNOT BE CONSIDERED
"SCALED-DOWN" ADULTS**

**PARENTS & SOCIETY MAY PLACE MORE
"VALUE" ON IMPROVING
CHILDREN'S HEALTH**

OZONE EFFECTS

- **DAMAGES LUNG TISSUE**
- **CAUSES SYMPTOMS
(COUGH, SORE THROAT)**
- **WORSENS DISEASES
(ASTHMA, BRONCHITIS)**
- **MAY INCREASE RISK OF
PREMATURE MORTALITY**

AS OZONE LEVELS DECLINE, WHAT BENEFITS ARE REALIZED?

REDUCTIONS IN:

- SYMPTOM OCCURRENCES**
- RESPIRATORY HOSPITAL ADMISSIONS**
- ASTHMA-INDUCED EMERGENCY ROOM VISITS**
- SCHOOL ABSENCES**

WHAT WE MEASURED:

**HOW MANY FEWER ABSENCES WERE
THERE IN 1998 DUE TO THE LOWER
OZONE LEVEL?**

FOR 1998 CHILDREN'S POPULATION:

OZONE EXPOSURES IN 1998

**OZONE EXPOSURES USING 1991
POLLUTION LEVELS**

**THE DIFFERENCE IS INSERTED INTO
SYMVAL**

3-STEP VALUATION APPROACH

EXPOSURE

REHEX MODEL

HEALTH

**POLLUTION-RESPONSE FUNCTIONS
(SYMVAL MODEL)**

ECONOMICS

**DOLLAR VALUES FOR
HEALTH EFFECTS**

THE REHEX MODEL

REGIONAL HUMAN EXPOSURE MODEL

**USES DETAILED EXPOSURE DATA FROM
MONITORS IN 48 EXPOSURE DISTRICTS**

**ACCOUNTS FOR DISTRIBUTION OF OZONE
OVER SPACE AND TIME**

SoCal Map here

DATA

POLLUTION DATA

- **MEASURED AT 48 MONITORING STATIONS**
- **HOURLY OZONE VALUES TAKEN**
- **SPATIALLY MAPPED TO 5 x 5 KM GRID**

POPULATION DATA

- **CHILDREN AGED 5-18 (1998)**
- **TOTAL STUDENT ENROLLMENT**
- **YEAR-ROUND SCHOOL**

SUMMER SCHOOL

The SoCAB population aged 5-18 in 1998

Region	Population
Los Angeles County	1,995,548
Orange County	555,618
Riverside County	331,328
San Bernardino County	400,926
South Coast Air Basin	3,283,429

Color bar graph of attendance

EXPOSURE RESULTS

**A STRONG DOWNWARD TREND FROM
1990-1999:**

DAILY 1-HR MAX > 90 ppb:

240 MILLION (1991)

75 MILLION (1998)

10 A.M. - 6 P.M. > 70 ppb:

81 MILLION (1991)

21 MILLION (1998)

exposure line graph

exposure bar graph

CHILDREN'S HEALTH STUDY

(GILLILAND ET AL. 2001)

EXAMINED:

6 MONTHS OF ABSENCE DATA

12 SOCAL COMMUNITIES

OZONE FROM 10 AM TO 6 PM

**FINDING: OZONE STRONGLY ASSOCIATED
WITH SCHOOL ABSENCES**

**e.g. 20 ppb INCREASE IN O₃ LEADS TO
62.9% INCREASE IN ILLNESS-RELATED
ABSENCES**

CONSIDERED:

ALL ILLNESS-RELATED

ABSENCES

RESPIRATORY ILLNESS

UPPER & LOWER RESPIRATORY

ILLNESS

OTHER HEALTH STUDIES USED

**RESPIRATORY HOSPITAL ADMISSIONS
(THURSTON ET AL. 1994)**

**EXAMINED: SUMMER AIR POLLUTION
FINDING: OZONE A SIGNIFICANT FACTOR**

**EMERGENCY ROOM VISITS
(WEISEL ET AL. 1995)**

**CONDUCTED: 5 YEAR SUMMER O₃ STUDY
FINDING: OZONE A SIGNIFICANT FACTOR**

EFFECTS AT LEVELS BELOW FED. STD.

Concentration-response functions for ozone-related school absences
(from Gilliland et al., 2001)

<u>Type of Absence</u>	<u>Concentration-response function</u>	<u>Factor</u>
<u>All Illness</u>	<u>1.64% x 62.9% x D ozone/20 ppb ozone</u>	<u>5.16 x 10⁻⁴</u>
<u>Nonrespiratory Illness</u>	<u>0.06% x 37.3% x D ozone/20 ppb ozone</u>	<u>1.12 x 10⁻⁵</u>
<u>All Respiratory Illness</u>	<u>1.04% x 82.9% x D ozone/20 ppb ozone</u>	<u>4.31 x 10⁻⁴</u>
<u>Upper Respiratory Illness</u>	<u>0.93% x 45.1% x D ozone/20 ppb ozone</u>	<u>2.10 x 10⁻⁴</u>
<u>Lower Respiratory Illness/Wet Cough</u>	<u>0.18% x 173.9% x D ozone/20 ppb ozone</u>	<u>1.57 x 10⁻⁴</u>
<u>Lower Respiratory Illness/ Wet Cough/ Asthma Attack</u>	<u>0.30% x 64.8% x Δ ozone/20 ppb ozone</u>	<u>9.72 x 10⁻⁵</u>

Hospitalizations

Ä all respiratory-related admissions =

$$\hat{a} \Delta O_3 \text{ pop}$$

where: \hat{a} = 1.68×10^{-8}

ΔO_3 = change in daily ozone 1-hour
maximum (ppb)

pop = the affected population

Asthma-related ER visits

Ä asthma-related ER visits =

$$\text{(} \hat{a} / \text{Base Pop) } \Delta \text{O}_3 \text{ pop}$$

where: \hat{a} = 0.0443

Base Pop = 4,436,976 (NJ population)

**ΔO_3 = change in daily ozone 5-hour
ave (10 a.m. - 3 p.m.)(ppb)**

pop = the affected population

HEALTH RESULTS

DIFFERENCES IN ALL-ILLNESS ABSENCES

	<u>TOTAL</u>	<u>PER CAPITA</u>
BASIN	2,884,000	0.9
LOS ANGELES	1,793,000	0.9
ORANGE	266,700	0.5
RIVERSIDE	171,200	0.5
SAN BERNARDINO	652,700	1.6

Other health results Difference in annual ozone-related emergency room visits and respiratory-related hospital admissions from 1990-1992 to 1997-1999 for the 1998 population aged 5-18

Symptom	Basin	Los Angeles County	Orange County	Riversid County	San Bernardin County
Emergency room visits	153	106	16	5	26
Hospitalization	361	235	38	17	71

ECONOMIC VALUES

WILLINGNESS TO PAY, OR ACCEPT

HEDONIC PRICING

AVERTING BEHAVIOR

CONTINGENT VALUATION

COST OF ILLNESS

DIRECT (MEDICAL) EXPENSES

INDIRECT EXPENSES--LOST WAGES

ECONOMIC VALUES USED

**BASED ON SMITH ET AL. (1997):
ONE LOST SCHOOL DAY = \$54 (1994)**

UPDATED, AND APPLIED TO SoCAL:

LOS ANGELES	\$80.97
ORANGE	\$76.54
RIVERSIDE,	
SAN BERNARDINO	\$69.89

Value of avoiding a school absence day (\$2000)

County	Low Estimate	Mid Estimate	High Estimate
Los Angeles	\$51.58	\$80.97	\$110.36
Orange	\$48.75	\$76.54	\$104.32
Riverside, San Bernardino	\$44.52	\$69.89	\$95.26

ECONOMIC VALUES USED

**BASED ON ELIXHAUSER ET AL. (1993):
ONE RESPIRATORY HOSPITAL
ADMISSION = \$4,791 (1987)**

UPDATED, AND APPLIED TO SoCAL:

LOS ANGELES	\$9,869
ORANGE	\$9,844
RIVERSIDE,	
SAN BERNARDINO	\$9,807

Value of avoiding a respiratory hospital admission (\$2000)

County	Low Estimate	Mid Estimate	High Estimate
Los Angeles	\$9,669	\$9,869	\$10,069
Orange	\$9,645	\$9,844	\$10,044
Riverside, San Bernardino	\$9,608	\$9,807	\$10,007

ECONOMIC VALUES USED

BASED ON SMITH ET AL. (1997):

ONE ER VISIT = \$290 (1994)

UPDATED, AND APPLIED TO SoCAL:

LOS ANGELES	\$407.66
ORANGE	\$401.12
RIVERSIDE,	
SAN BERNARDINO	\$398.85

**Value of avoiding an emergency room visit
(\$2000)**

County	Low Estimate	Mid Estimate	High Estimate
Los Angeles	\$305.93	\$407.66	\$509.26
Orange	\$302.39	\$401.12	\$505.72
Riverside, San Bernardino	\$297.12	\$398.85	\$500.45

ECONOMIC RESULTS

DIFFERENCES IN ALL-ILLNESS ABSENCE VALUES

	<u>TOTAL</u>	<u>PER CAPITA</u>
BASIN	\$223,175,000	\$68
LOS ANGELES	\$145,179,000	\$ 73
ORANGE	\$ 20,413,000	\$ 37
RIVERSIDE	\$ 11,965,000	\$ 36
SAN BERNARDINO	\$ 45,617,000	\$114

Range of economic values of differences in annual ozone-related all-illness school absences from 1990-1992 to 1997-1999 in the 1998 population aged 5-18

School Absences	Low	Mid	High
Total All Illness	\$142,165,000	\$223,175,000	\$304,182,000
Per Capita All Illness	\$43	\$68	\$93

Aggregate economic value of differences in annual ozone-related ER visits, hospital admissions, and school absences from 1990-1992 to 1997-1999 for the 1998 population aged 5-18 (millions of \$)

Symptom	Basin	Los Ang. County	Orange County	Riverside County	San Bern. County
ER visits & hosp.	\$ 3.6	\$2.3	\$0.4	\$0.2	\$0.7
School Absence	\$223.2	\$145.2	\$20.4	\$12.0	\$45.6
TOTAL	\$226.8	\$147.5	\$20.8	\$12.1	\$46.3

ADDITIONAL BENEFITS FROM REACHING THE 1-HOUR STATE STANDARD

Health Effect	Basin	Los Angeles	Orange County	Riverside County	San Bern. County
Reduced Absences	918,000	234,500	26,500	300,000	357,000
Economic Value	\$66.9 mil	\$19.0 mil	\$2.0 mil	\$20.97 mil	\$24.9 mil
Reduced Hosp. Visits	129	40	5	36	48
Economic Value	\$1.03 mil	\$310,000	\$40,000	\$297,000	\$386,000
Total Value	\$67.96 mil	\$19.31 mil	\$2.04 mil	\$21.26 mil	\$25.34 mil

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FUTURE RESEARCH NEEDS

- **THE LINK BETWEEN POLLUTION AND CHILDREN**
- **THE VALUE OF HEALTH EFFECTS IN CHILDREN**
- **THE EFFECT OF ABSENCES ON LIFE ACHIEVEMENT**
- **INDIRECT EFFECTS ON CHILDREN**

SOME FACTORS NOT CONSIDERED

- **MEDICAL TREATMENT COSTS**
- **OTHER IMPACTS ON CHILD'S FAMILY**
- **MULTI-DAY ABSENCES**
- **WEEKDAY VS. WEEKEND EFFECTS**
- **EROSION OF LONG-TERM LIFE ACHIEVEMENT**

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