

# ILLNESS COSTS OF AIR POLLUTION

Ted Boadway MD

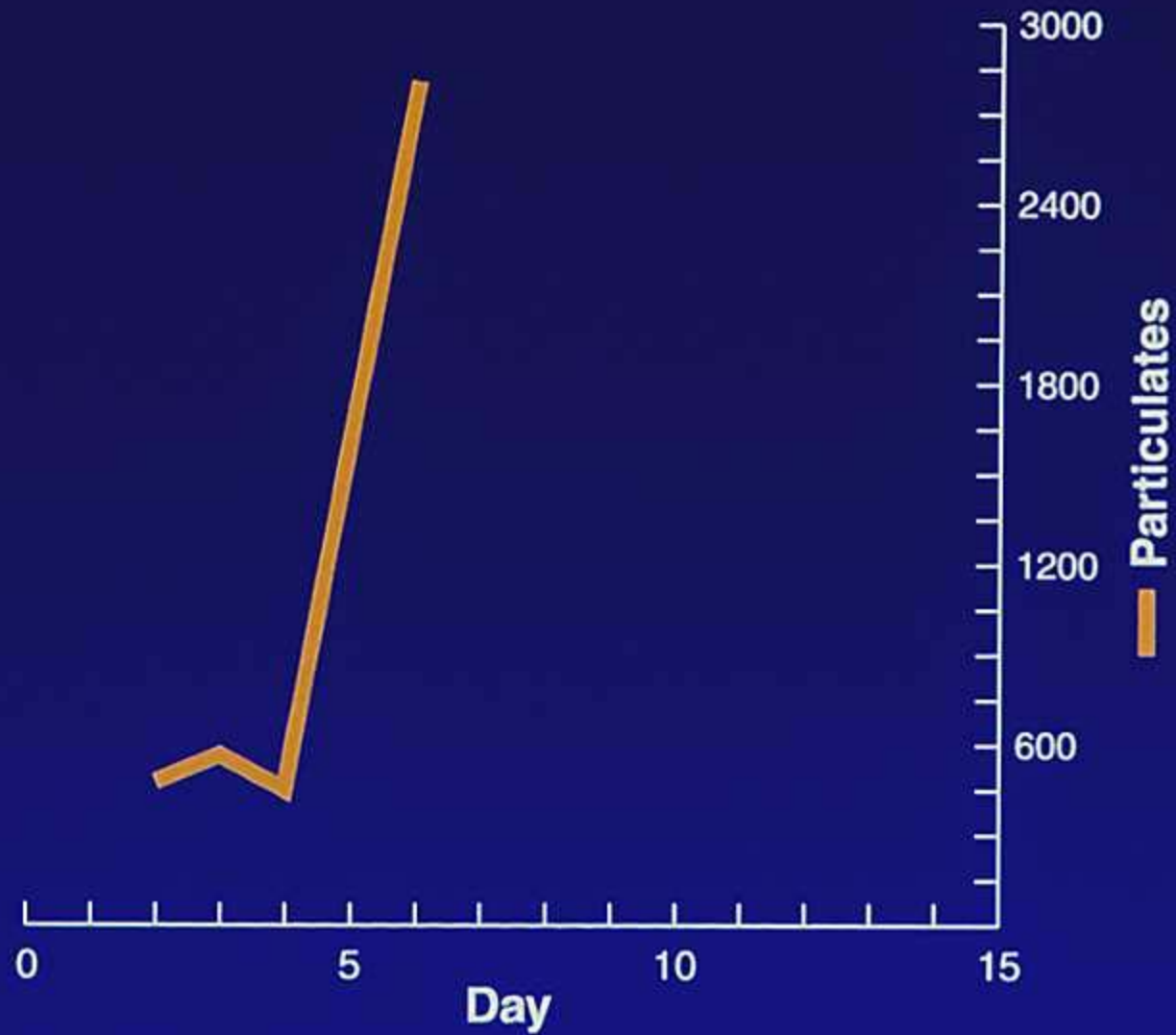
# 3 Parts

- Health Effects...the start...and the recent
- ICAP....a tool for your use
- Action Results in Improvement

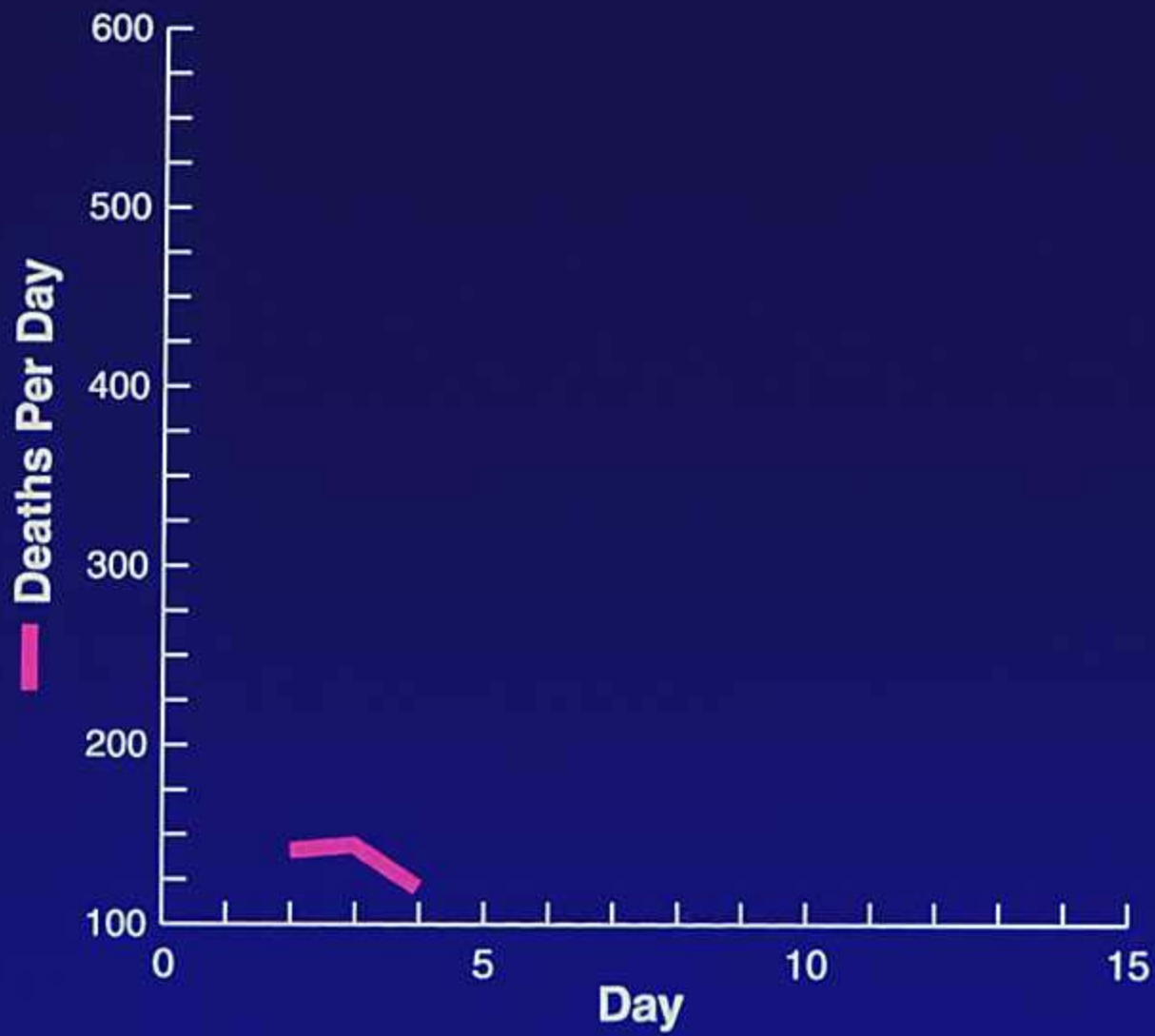
1952

London, England

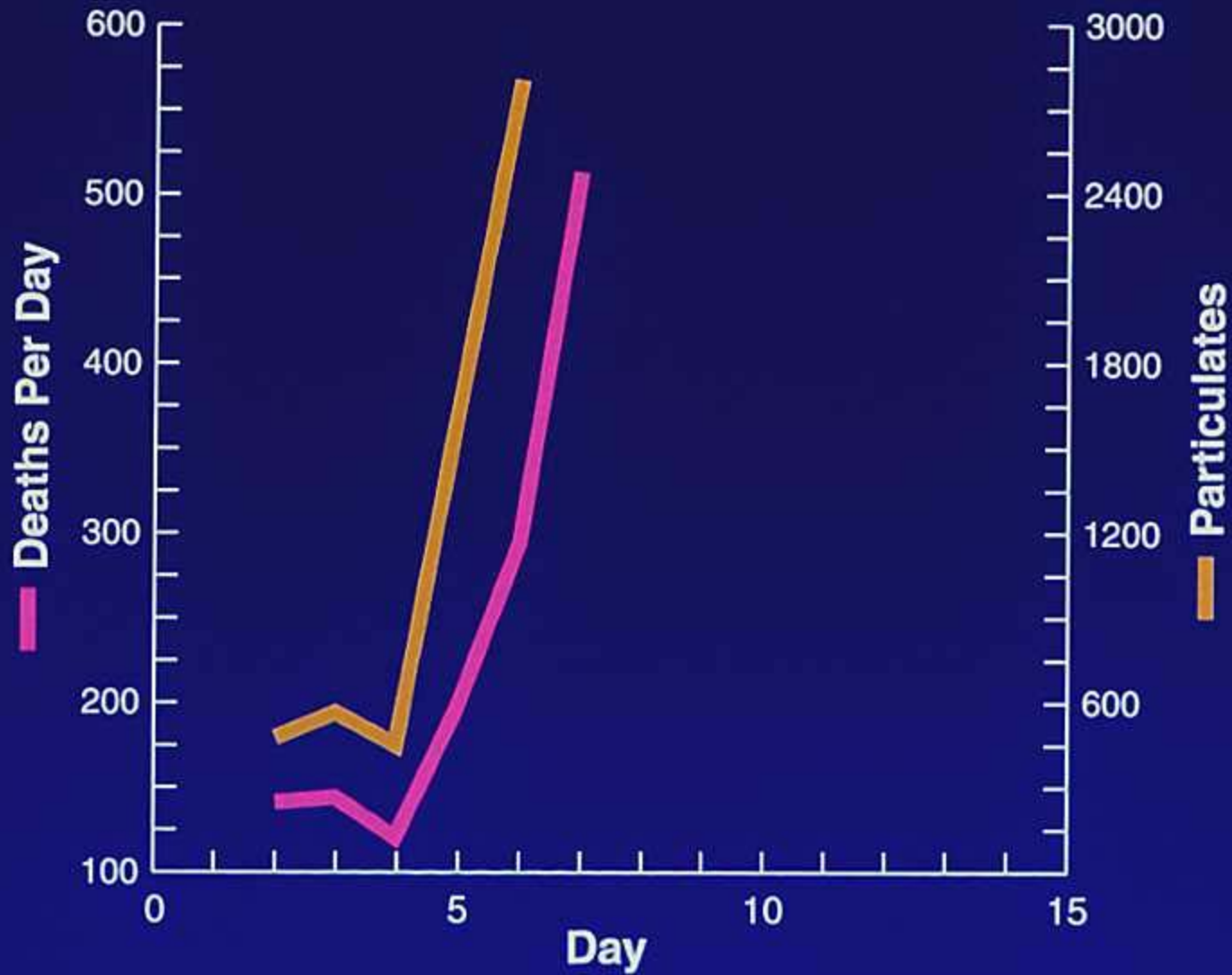
## Air Pollution and Daily Mortality



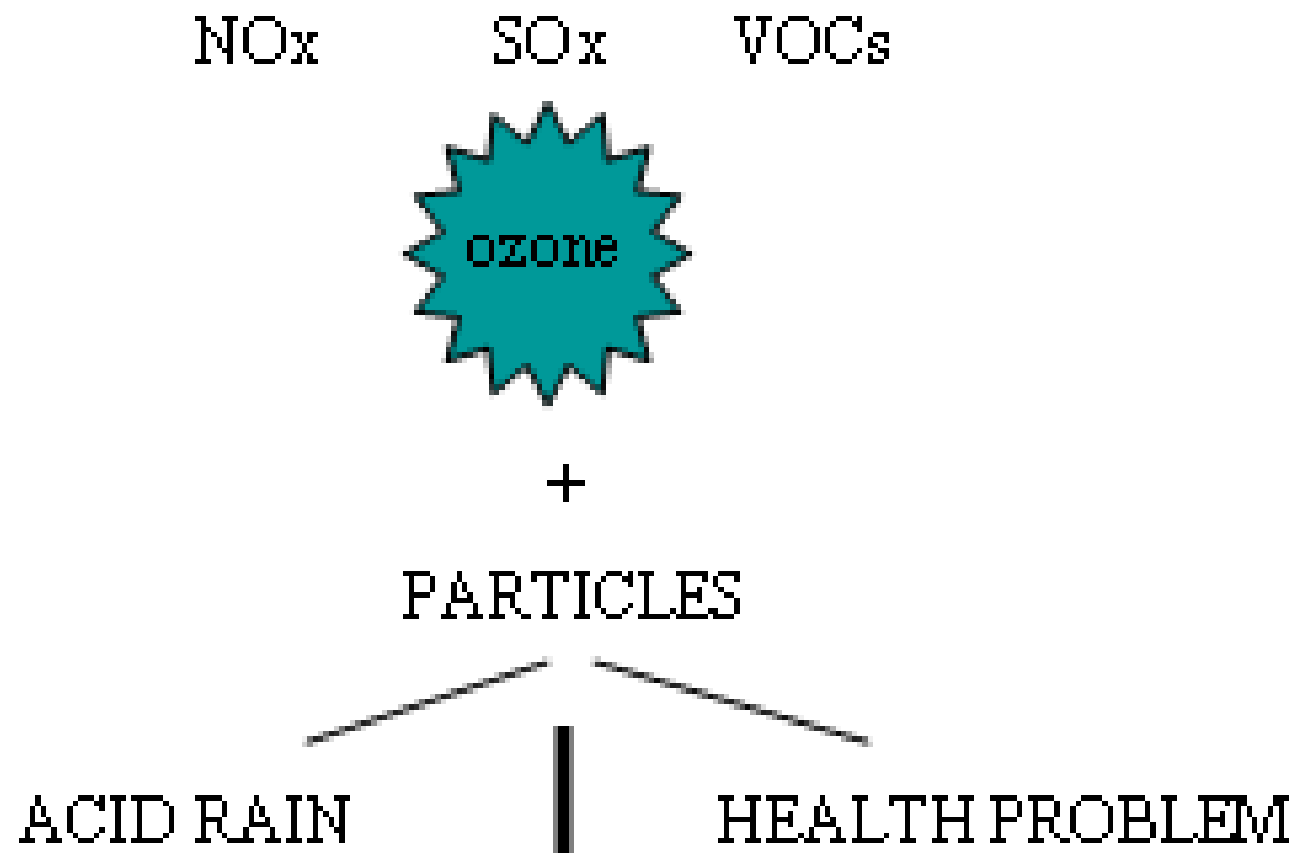
## Air Pollution and Daily Mortality

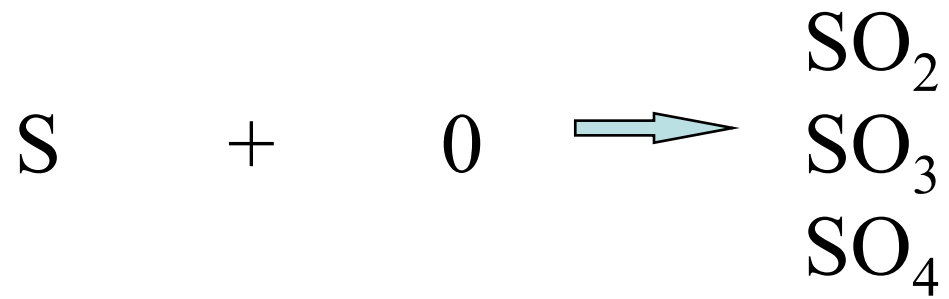


## Air Pollution and Daily Mortality



# OUR AIR POLLUTION

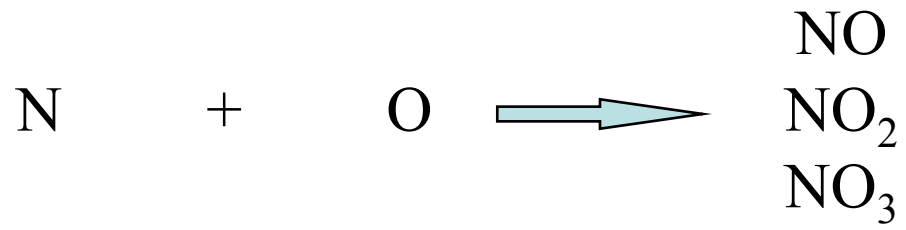




Coal  
Gasoline  
Diesel Fuel  
(Smelters)

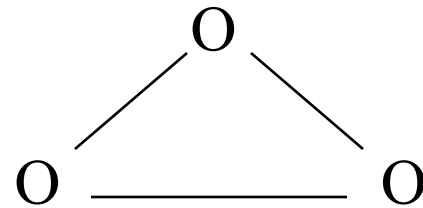
**SO<sub>x</sub>**





**NO<sub>x</sub>**

OZONE = O<sub>3</sub>



(O = O)

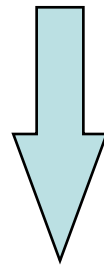
NO<sub>x</sub>

+

O<sub>2</sub>

+

VOCs



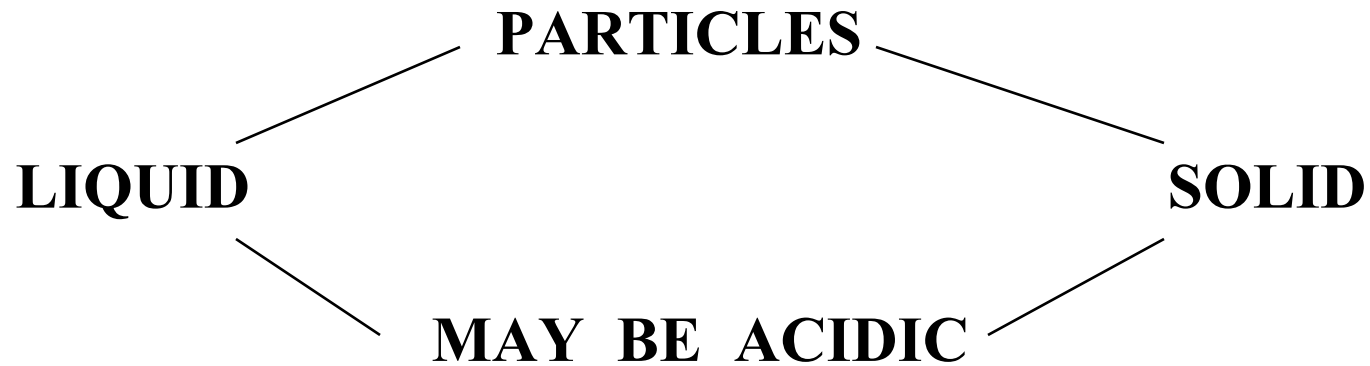
Sunlight

+

Water Vapour

O<sub>3</sub>

REACTIVE !



**SIZE MATTERS**

**PM10                      ≤                      10 micrometres**

**NEVER SETTLE**

**BUT YOU CAN FILTER**

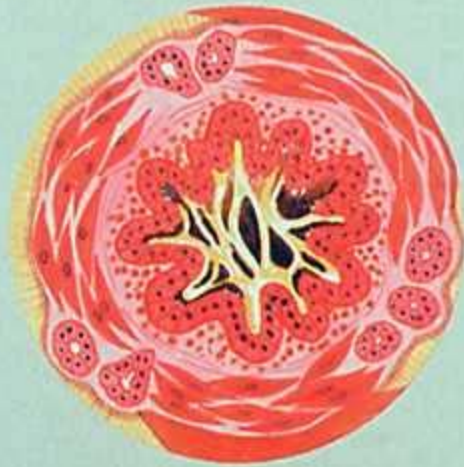
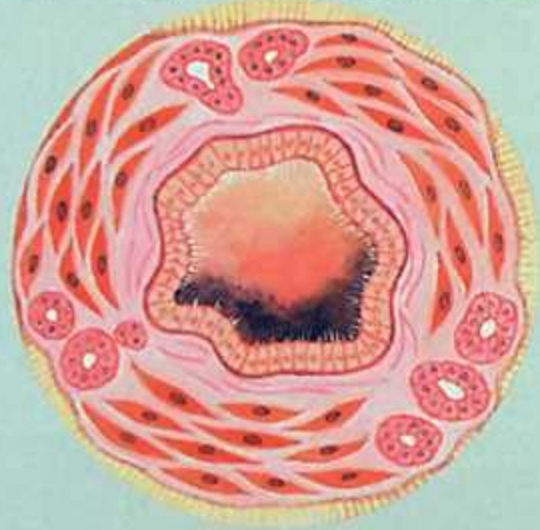
# P.M. → INFLAMMATION

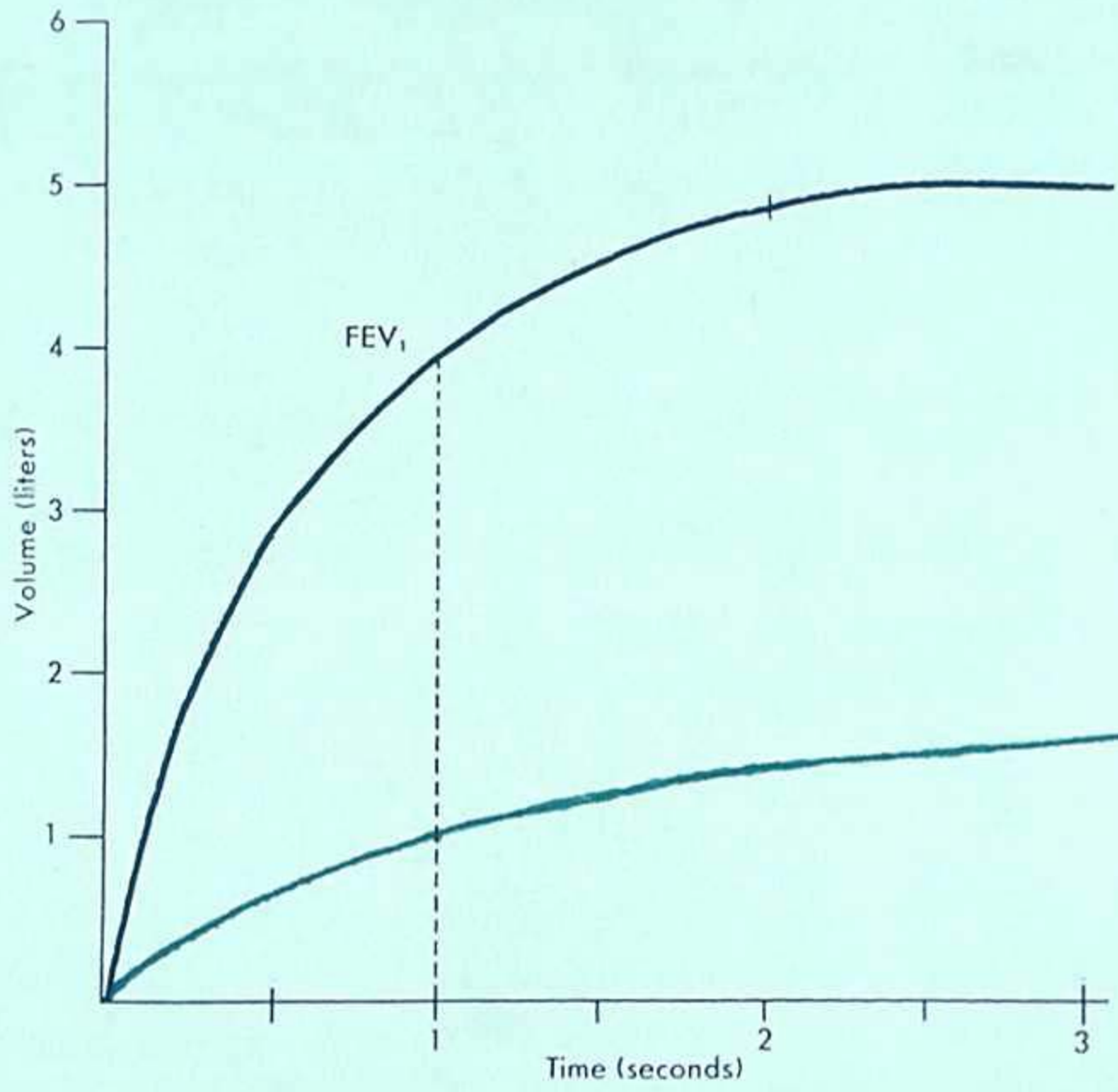
P.M. 10 microns

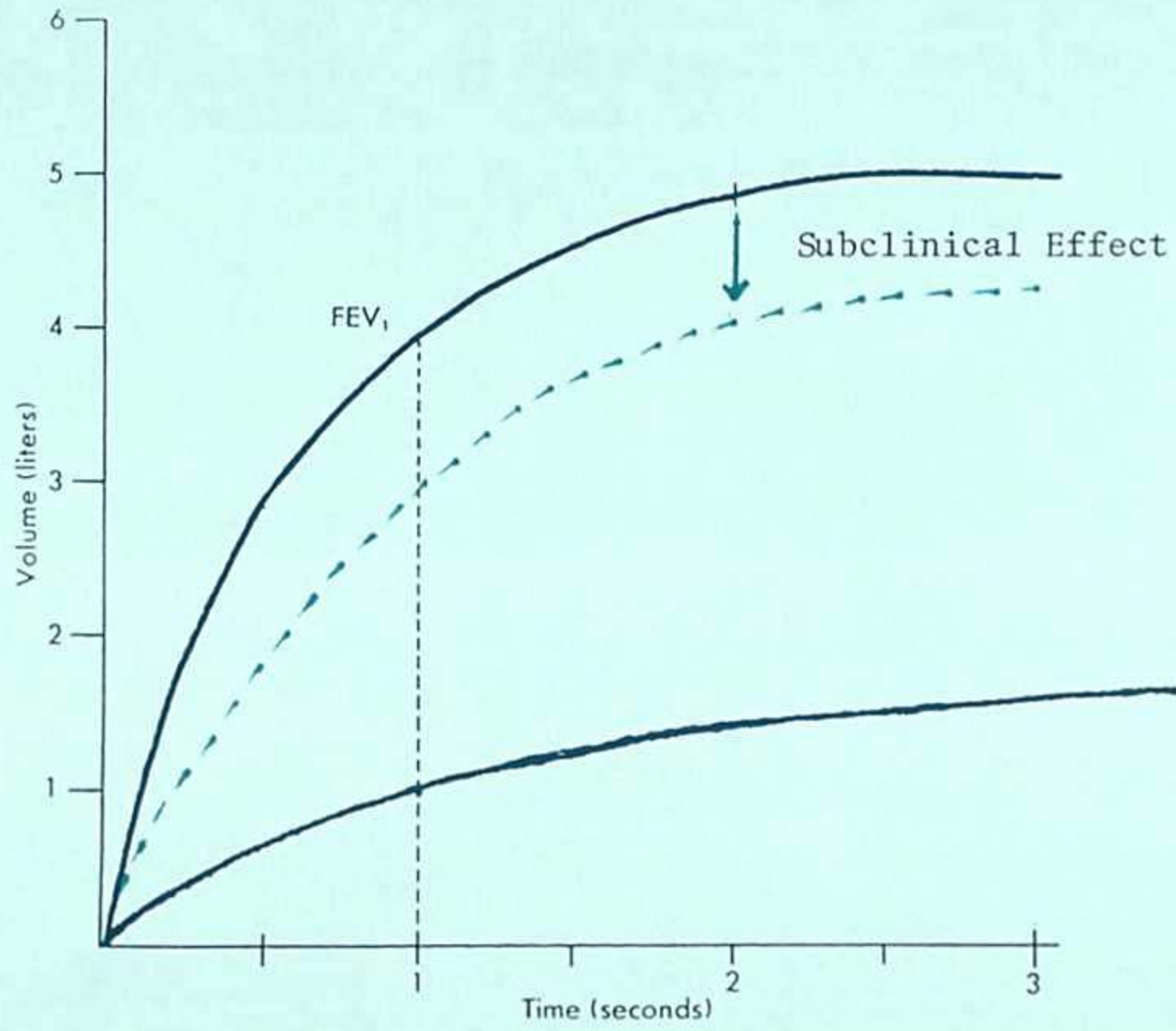
P.M. 2.5 microns

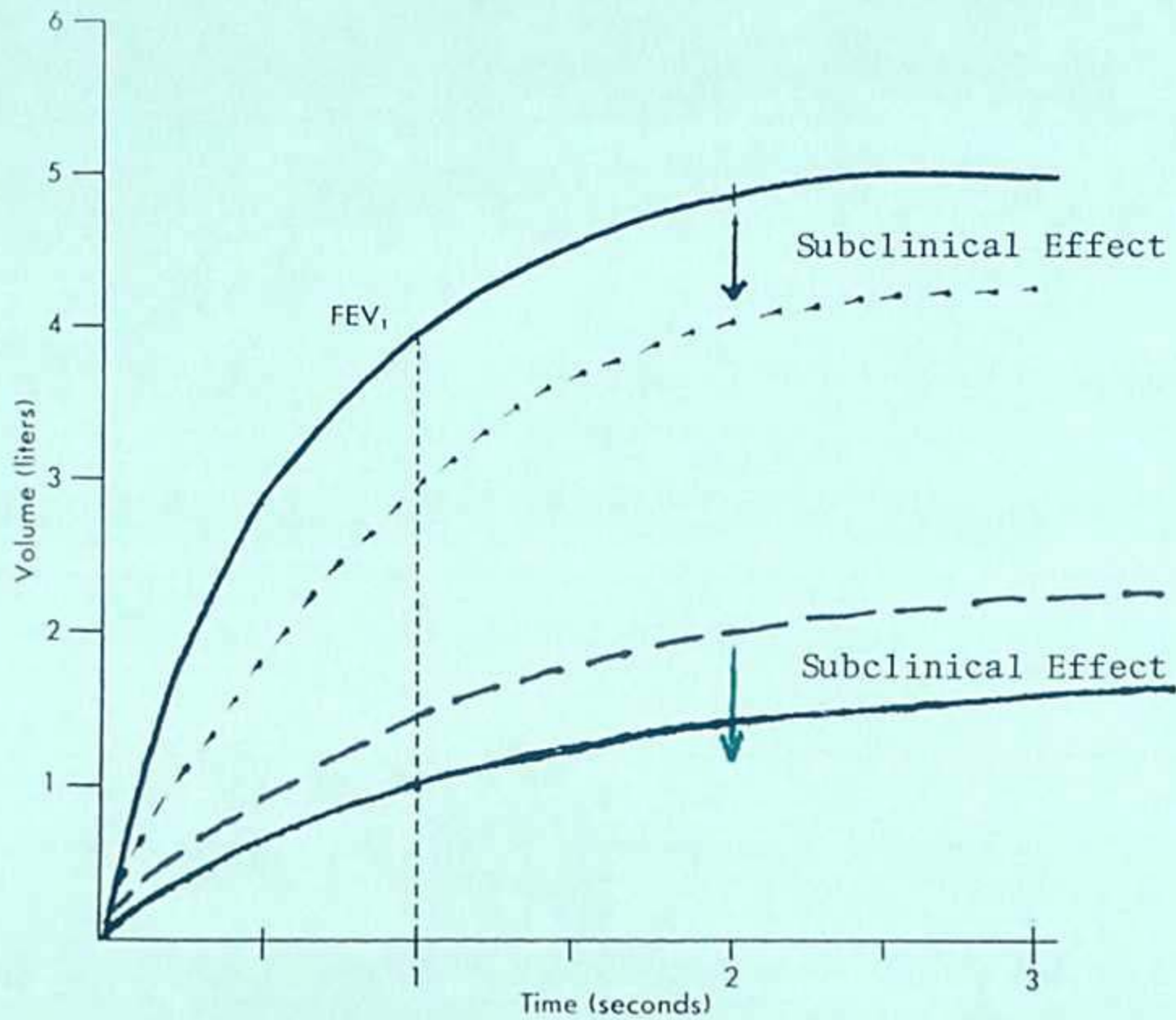
P.M. 0.1 microns

Biologic effect is proportional to surface area  
( $4\pi r^2$ )











# O<sub>3</sub> and Hospital Admission

- 16 Canadian Cities

O<sub>3</sub> ↑ by 30 ppb → 4% ↑ for respiratory

illness

720,500 admissions

DOCKERY ET AL

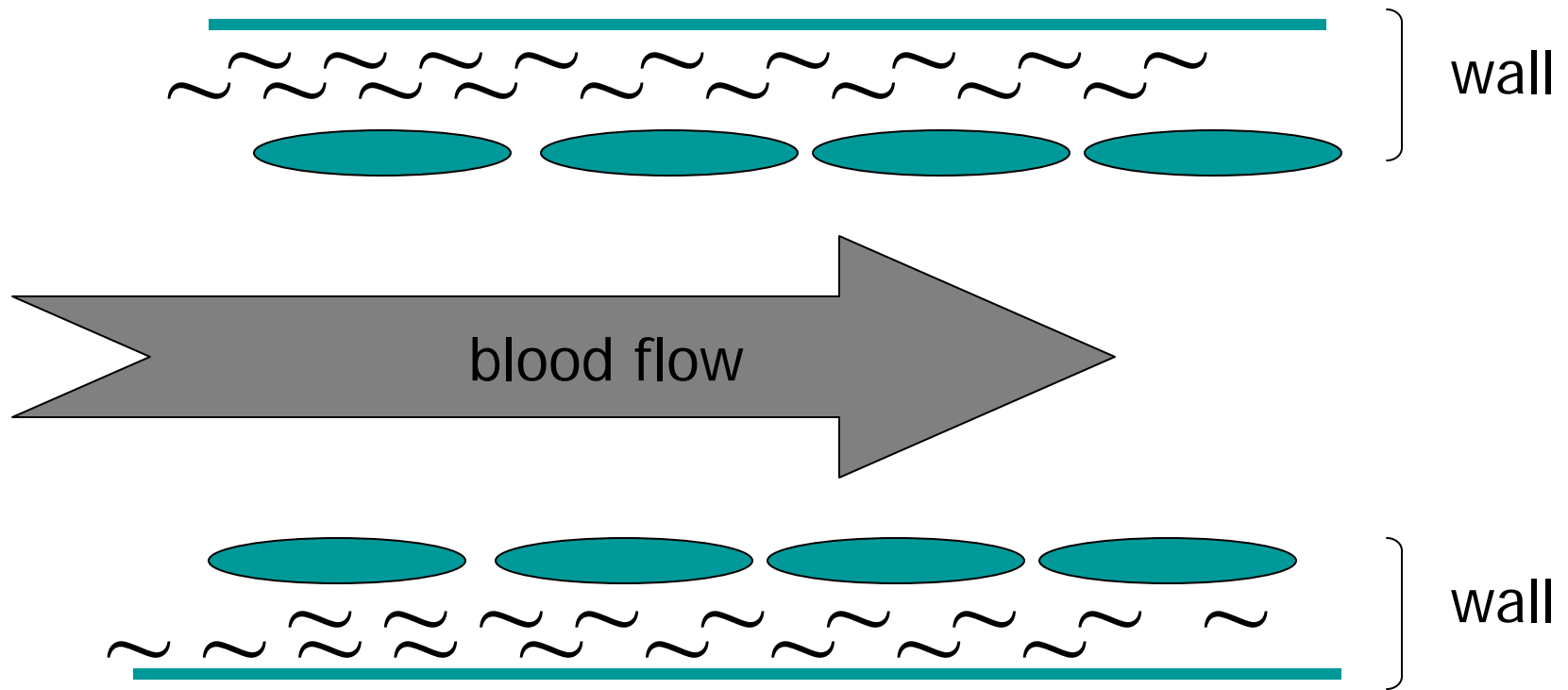
ACID AEROSOLS=PM

13,000 children

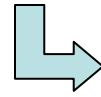
(2,100 Canadian kids)

Small Rural Towns

# Artery Section

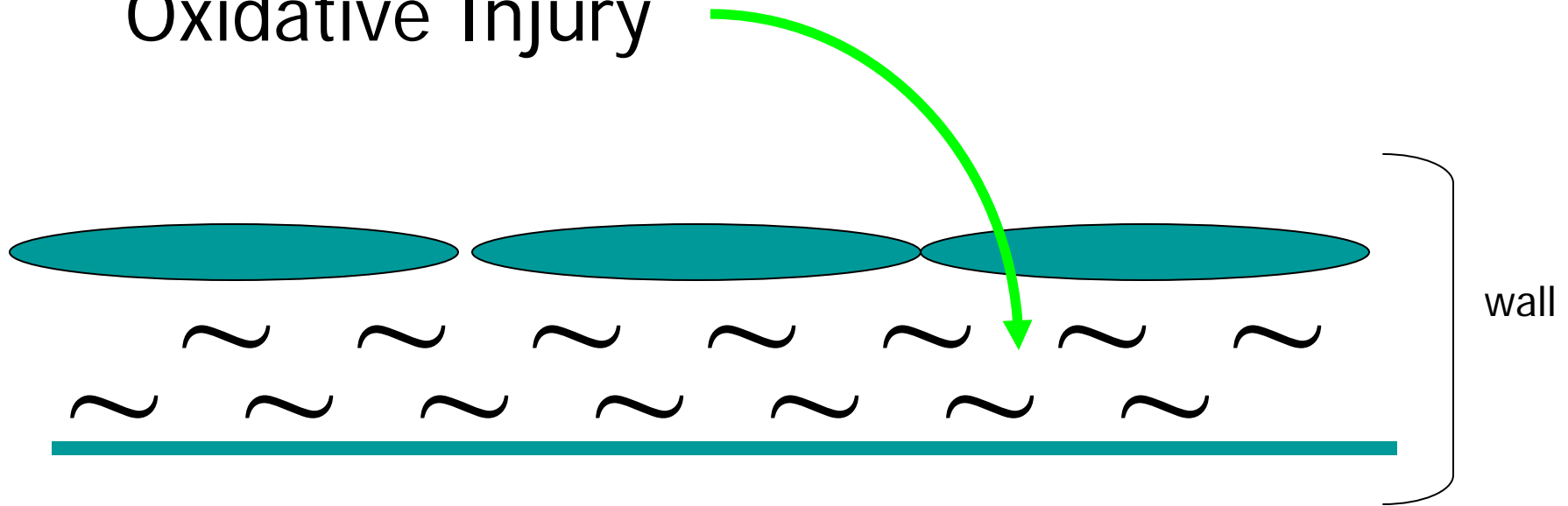


Vascular

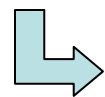


Cardiovascular

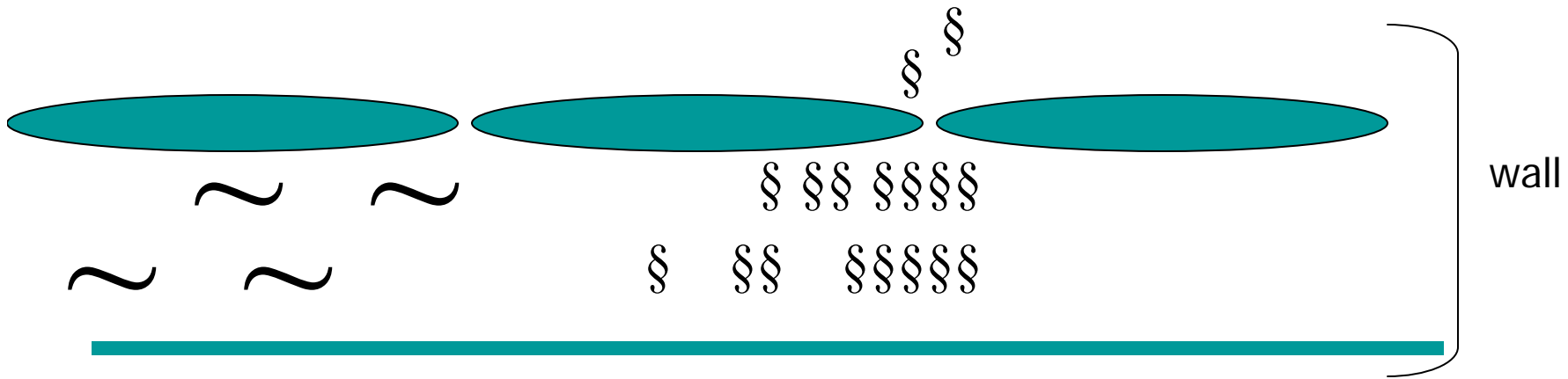
Oxidative Injury



Irreversible change to DNA



Pass to all daughter cells

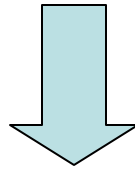


# Endothelium, PM 0.1 & OLP

- PM 0.1 upregulates
- OLP upregulates
- They are synergistic..... $1+1=3$

Health story=Good Science

BUT



NO COST STUDIES

# ICAP

Illness  
Cost of  
Air Pollution

[www.cma.org](http://www.cma.org)



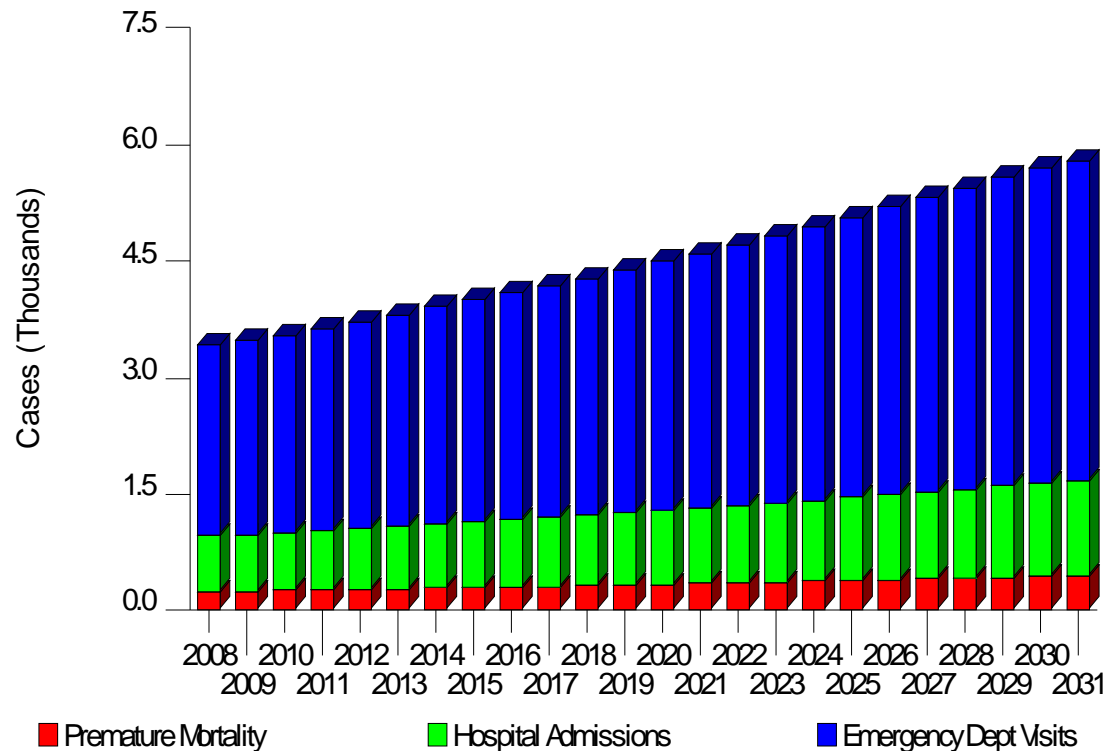
# Data Elements

- Census Data
- Air Quality
- CIHI data

### Annual Number of Cases in Southwest

Attributable to O3, PM2.5

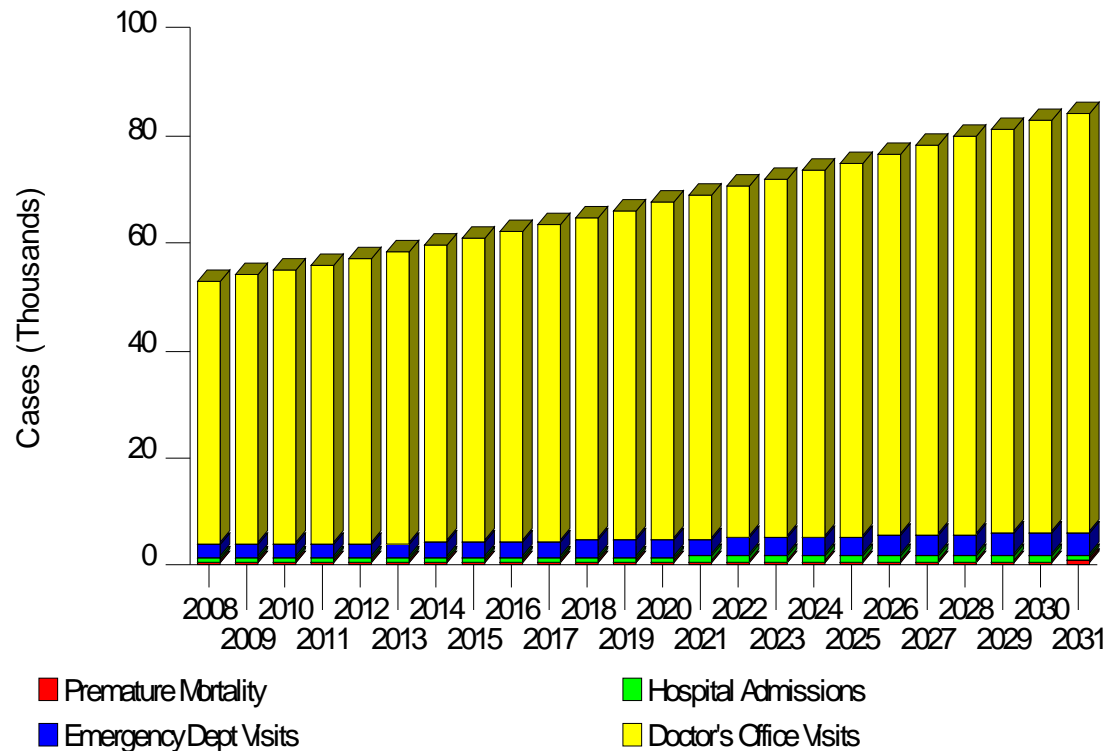
ON\_SCN1\_Timeseries



### Annual Number of Cases in Southwest

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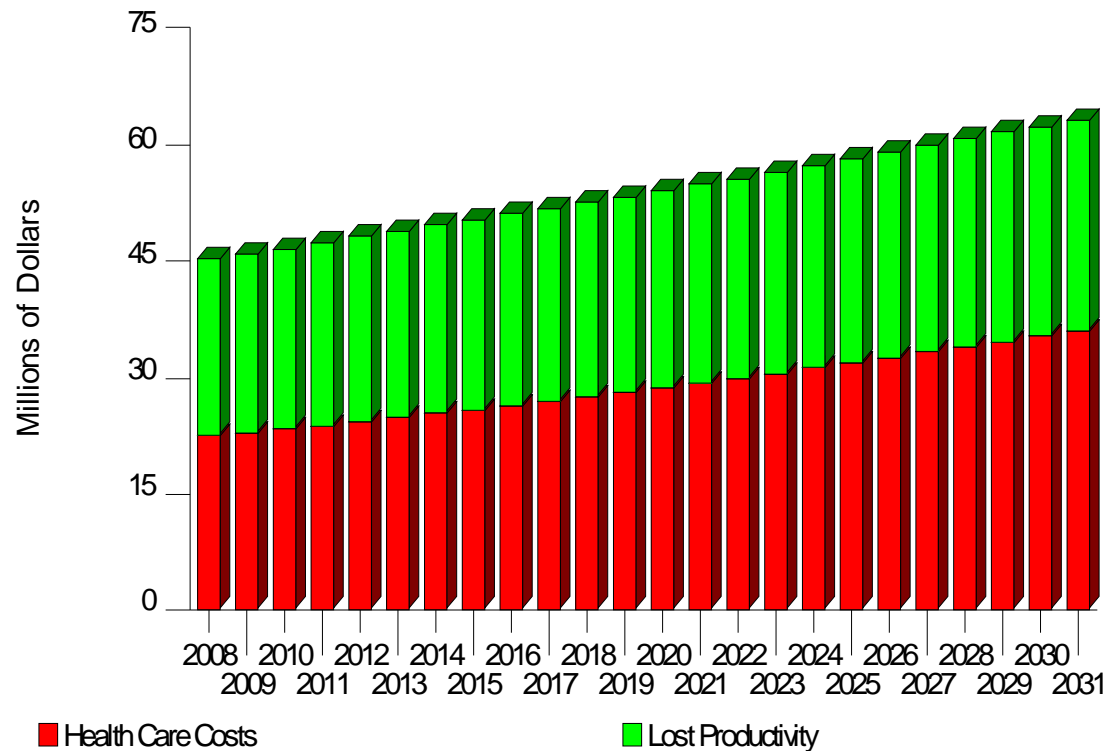
ON\_SCN1\_Timeseries



### Annual Economic Damages in Southwest

Attributable to O3, PM2.5

ON\_SCN1\_Timeseries



# Aug 2008

- Federal government \$
- ICAP Every Province
- [www.cma.ca](http://www.cma.ca)

# Ontario Ministry of Energy

Cost benefit Analysis:  
Replacing  
Ontario's Coal-fired  
Electricity Generation

April 2005

**Table 6-6 Present Value of Health Damages**

	<b>SCENARIO</b>			
	<b>1 Base Case</b>	<b>2 All Gas</b>	<b>3 Nuclear/ Gas</b>	<b>4 Stringent Controls</b>
<b>Premature Deaths - Total</b>	\$33,963 <sup>a</sup> (\$5,238) <sup>b</sup>	\$4,361 (\$672)	\$4,103 (\$632)	\$12,125 (\$1,873)
<b>Hospital Admissions</b>	\$76	\$11	\$10	\$28
<b>Emergency Room Visits</b>	\$15	\$2	\$2	\$6
<b>Minor Illnesses</b>	\$88	\$13	\$12	\$32
<b>TOTAL<sup>c</sup></b>	\$34,142 (\$5,417)	\$4,387 (\$698)	\$4,127 (\$657)	\$12,191 (\$1,939)
<p>a: All values expressed as 2004\$ Millions.                      b: Values shown in brackets are based on acute premature mortality damage estimates.                      c: Column totals may not add up exactly due to rounding.</p>				

Table 8-2 Annualised Financial Costs and Health and Environmental Damages

	SCENARIO			
	1 Base Case	2 All Gas	3 Nuclear/ Gas	4 Stringent Controls
<b>Financial Costs</b>	\$ 985 <sup>a</sup>	\$ 2,076	\$ 1,529	\$ 1,367
<b>Health Damages</b>	\$3,020 (\$479) <sup>b</sup>	\$388 (\$62)	\$365 (\$58)	\$1,079 (\$172)
<b>Environmental Damages</b>	\$371	\$141	\$48	\$356
<b>Total Cost of Generation</b>	\$4,377 (\$1,836)	\$2,605 (\$2,279)	\$1,942 (\$1,635)	\$2,802 (\$1,895)
<b>Health and Environmental Proportion</b>	77% (46%)	20% (9%)	21% (6%)	51% (28%)
a: All values are expressed as annualised costs/damages in 2004\$ Millions. b: Values shown in brackets are based on acute premature mortality damage estimates.				



# Effect of Improvement

- Dublin, and Atlanta studies - foretaste
- NEJM 2009; 360: 376-86
- Pope, Dockery
- 51 Cities – 20 years
- Significant and measurable increases in life expectancy

# Atlanta Olympics 1996

# Atlanta Olympics 1996

Traffic -25%

Ozone -28%

Childhood asthma -44%

# Dublin Coal Ban

# Dublin Coal Ban

- SO<sub>x</sub>...decreased
- Respiratory deaths -16%
- CV -10%
- All for the six year study period

# Dockery - 51 Cities Jan 2009

- 1970s to 2000
- Particulate decreases
- Increase overall life expectancy

# Civic Action is the Only Treatment