

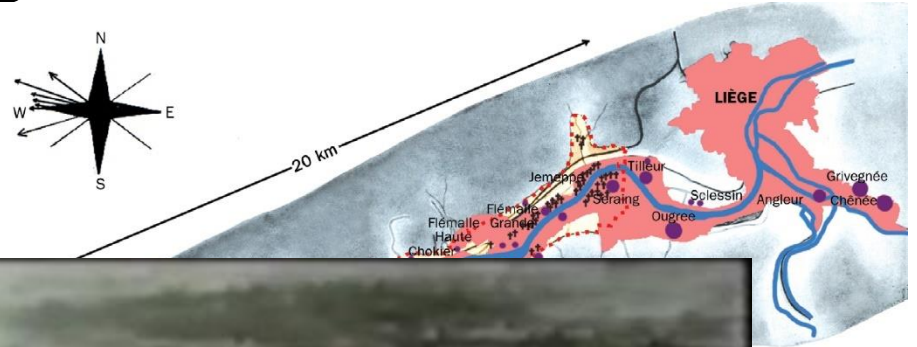
# 유해물질과 폐질환

가톨릭대학교 의과대학 직업환경의학교실  
명준표

# History of Hazards & lung diseases

- 1930 Muse Valley
- 1948 Donra
- 1952 London
- 1954 LA
- .....

# Muse valley 1930



factory  
A

# Donora, 1948



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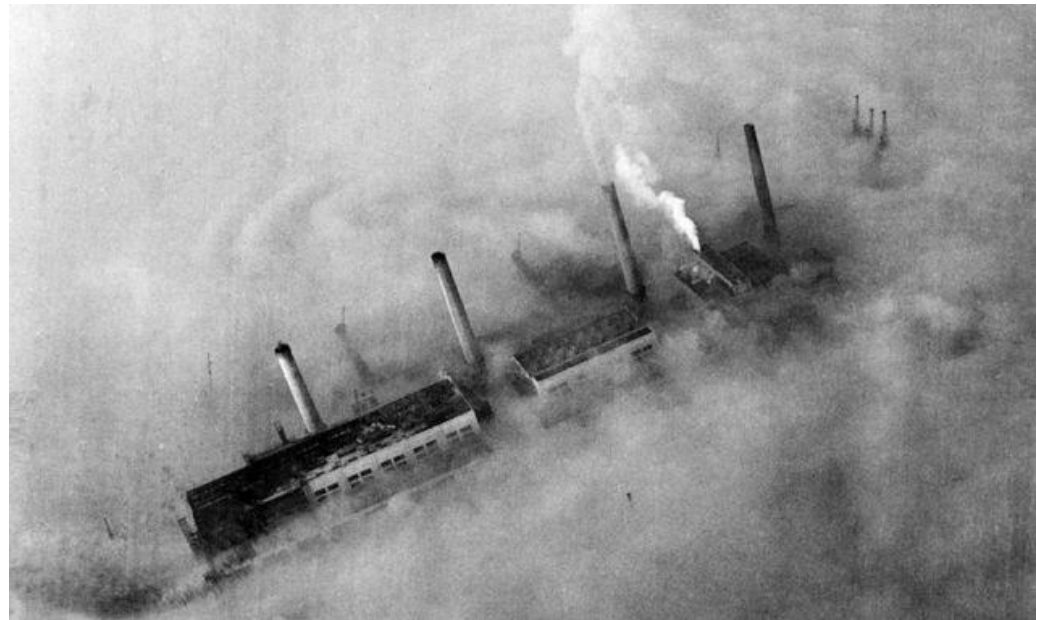


AMERICAN STEEL & WIRE COMPANY  
DONORA, PENN. 1934  
SCALE 1:100,000  
SEPTEMBER 1948  
SERIAL NUMBER 87758-270-01

# Dondon, 1952



52

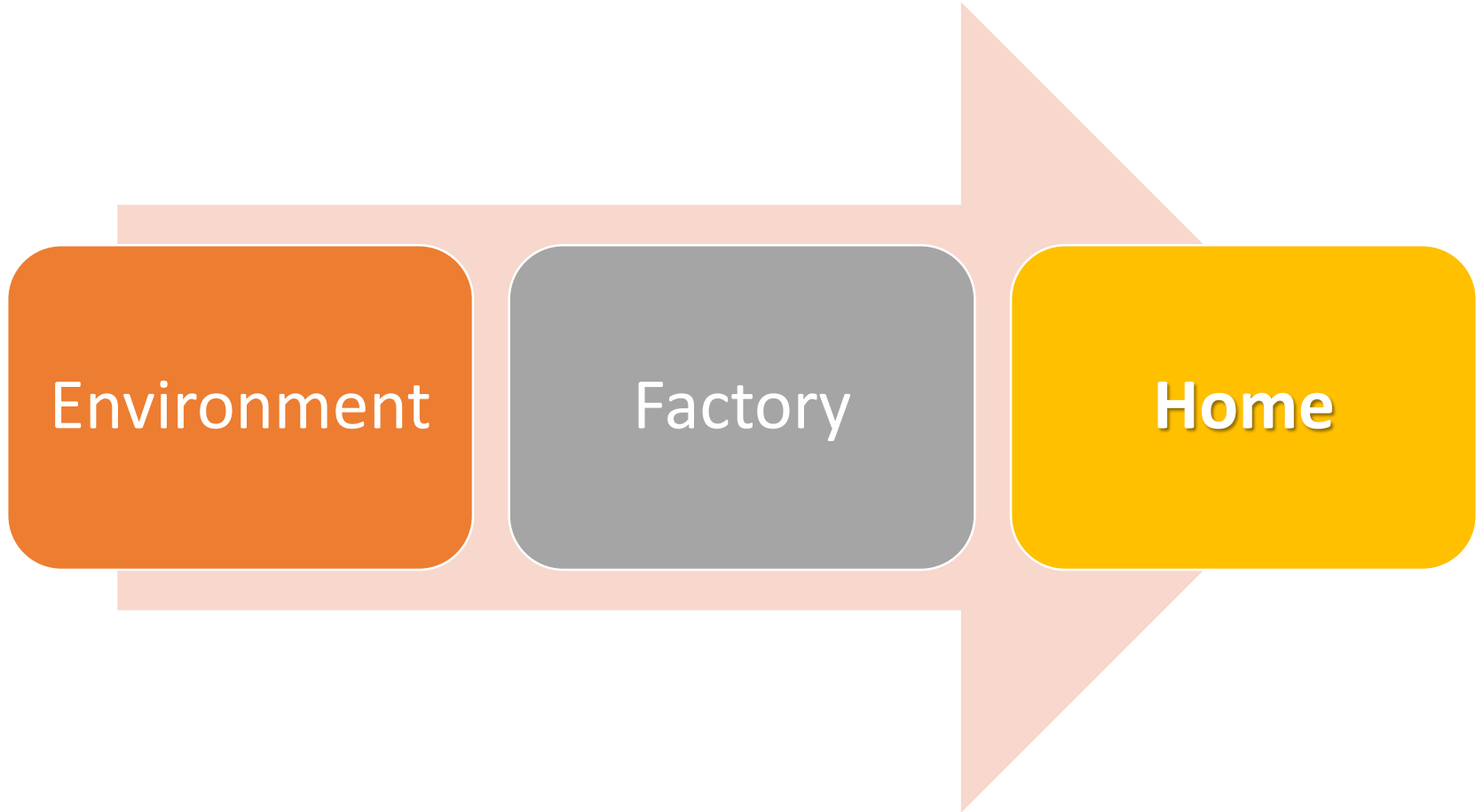


LA, 1954



# Where?

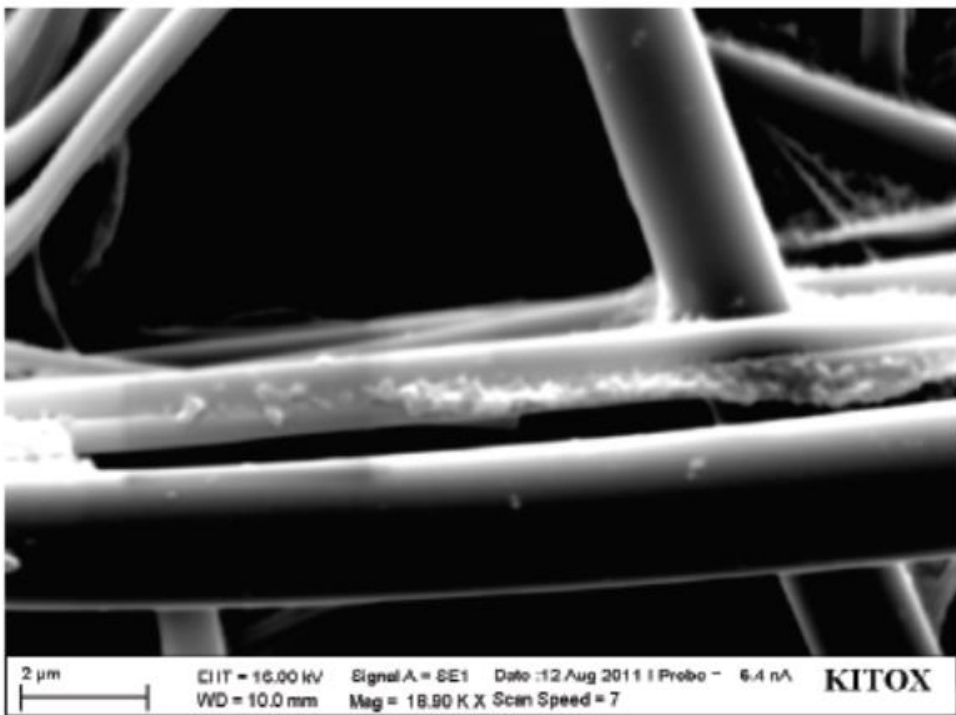
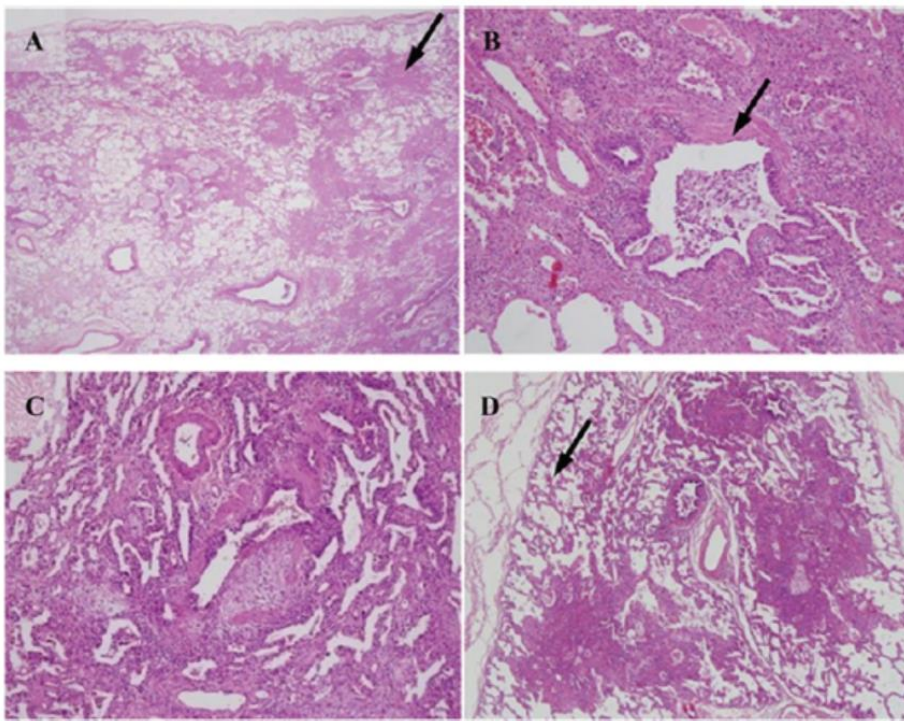


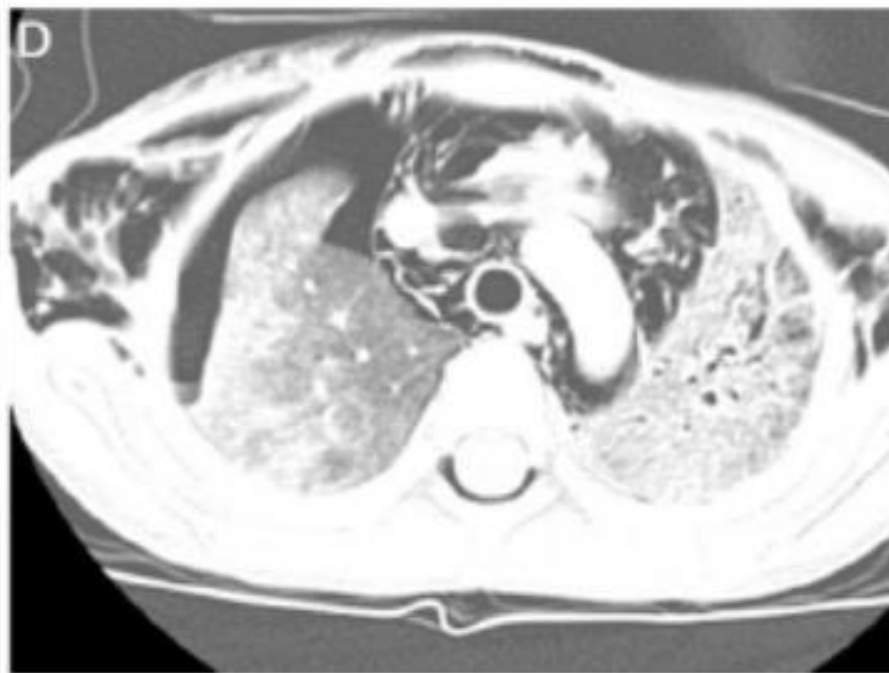
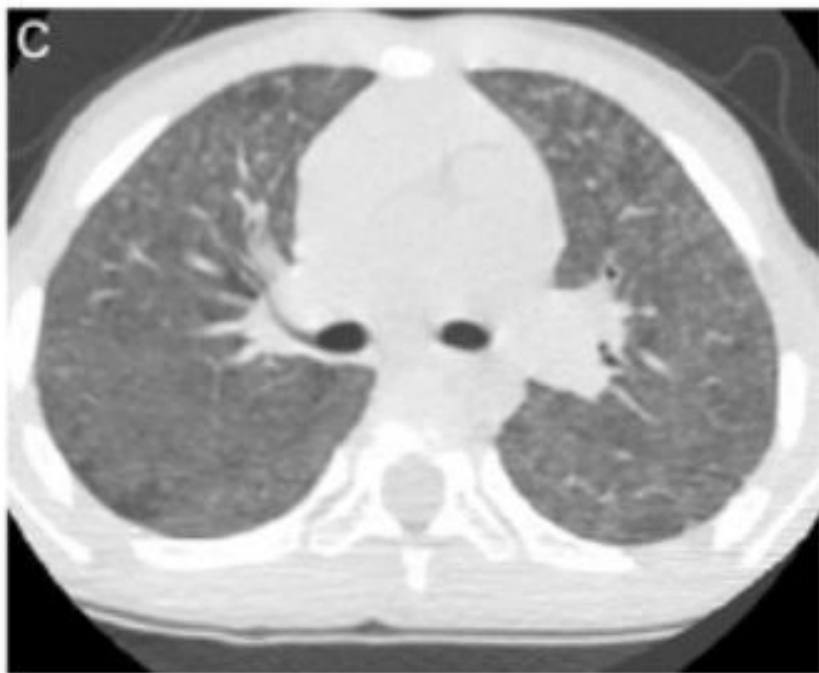
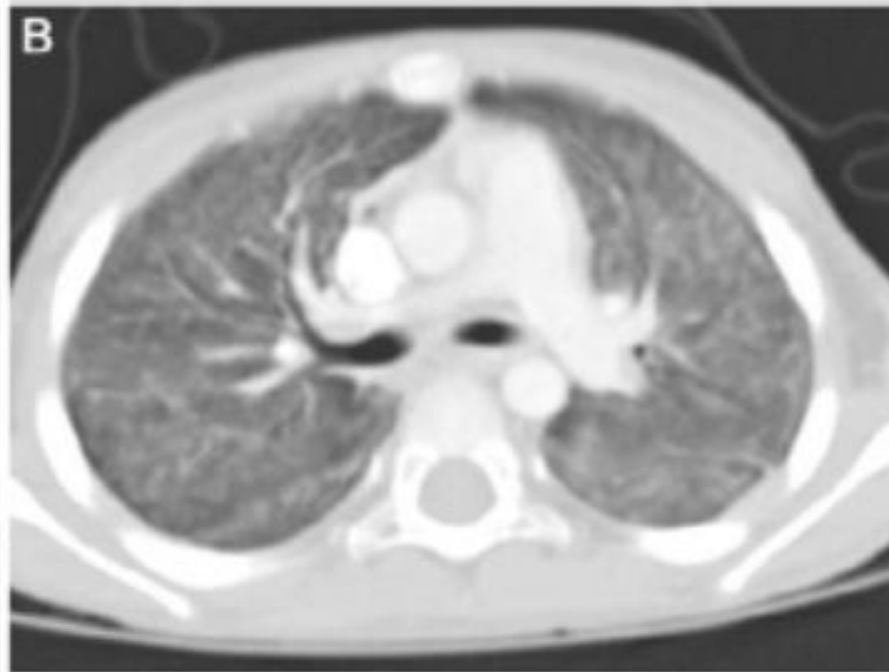
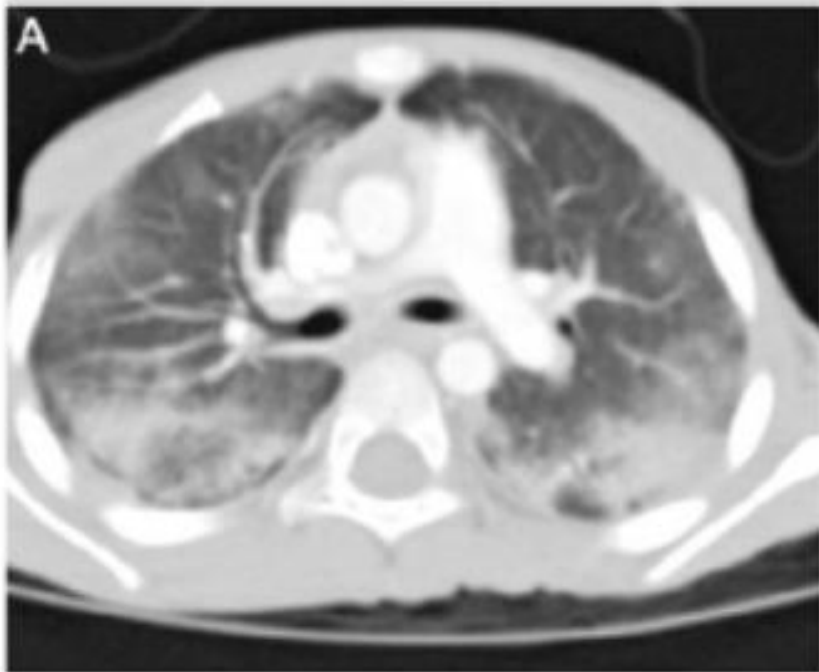


Environment

Factory

Home

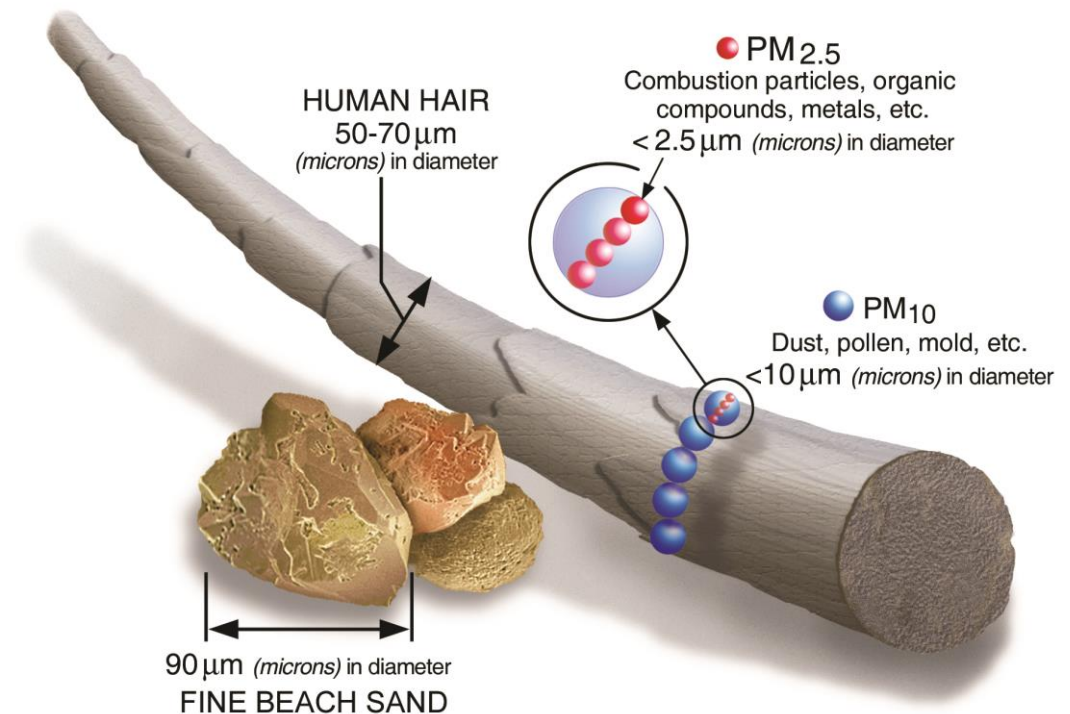




Source: Kim KW, AJRCCM 189(1):48-56.

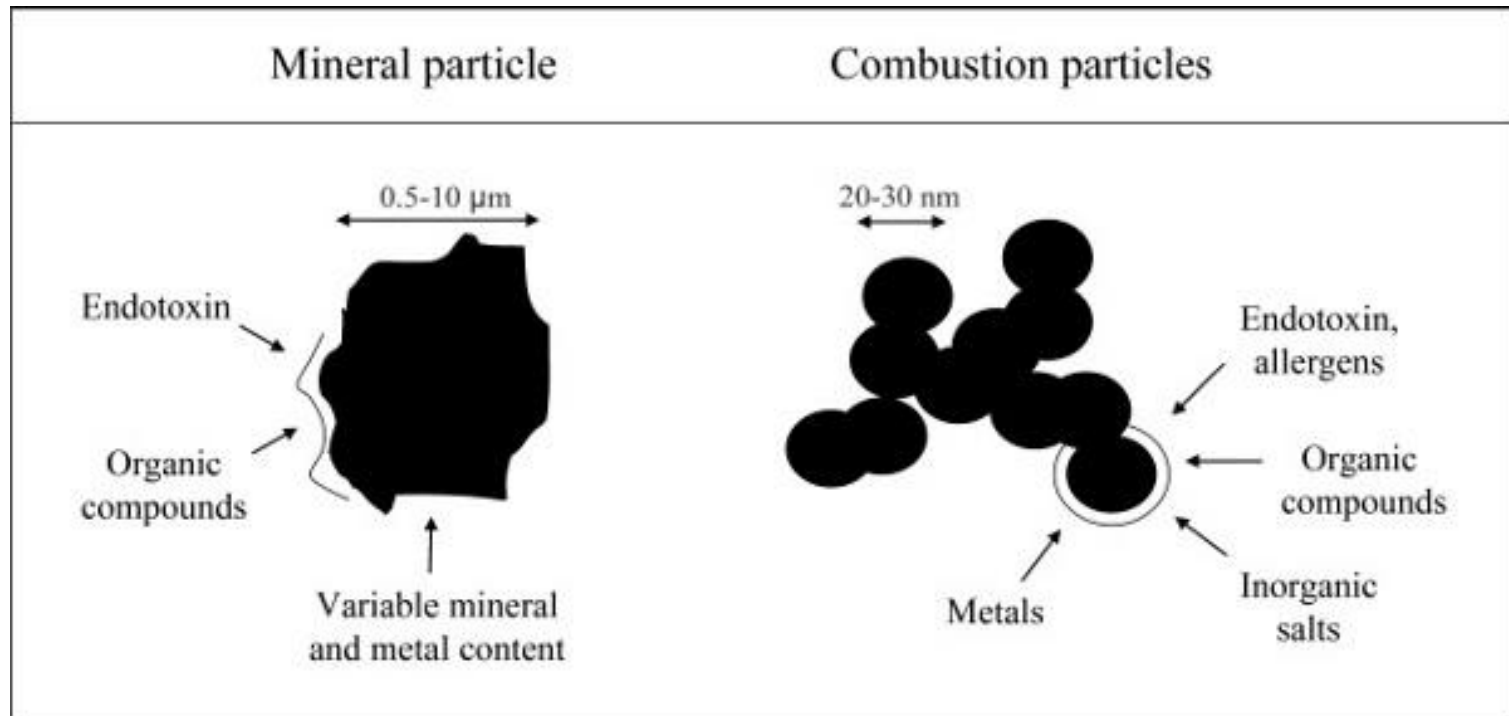
# Particle

- Total suspended particulate
  - 100  $\mu\text{m}$  or less
- Particulate matter 10 ( $\text{PM}_{10}$ )
  - 10  $\mu\text{m}$
- Particulate matter 2.5 ( $\text{PM}_{2.5}$ )
  - 2.5  $\mu\text{m}$
- Particulate matter 0.1 ( $\text{PM}_{0.1}$ )
  - 0.1  $\mu\text{m}$



# Properties of dust

- Origin & generation



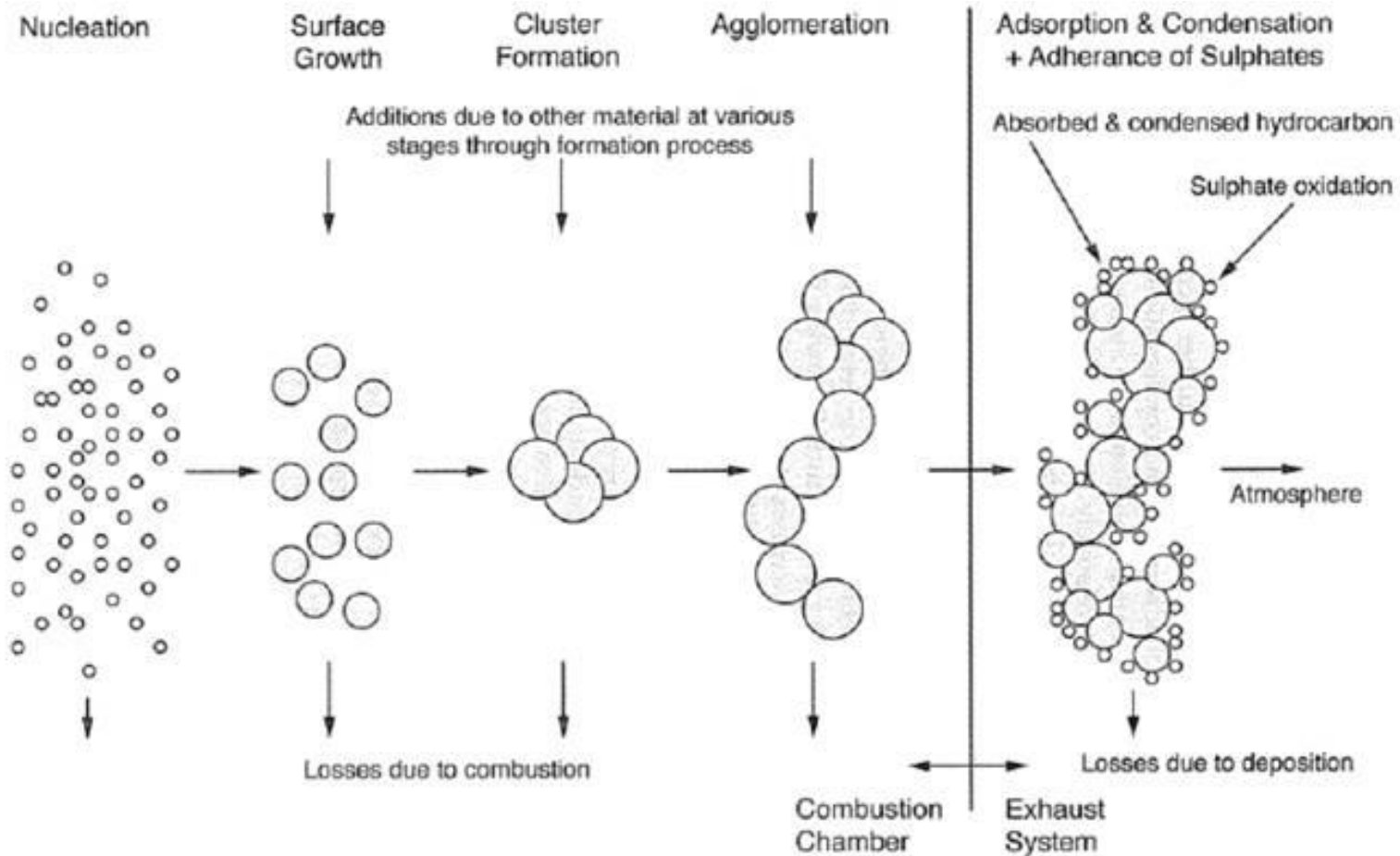
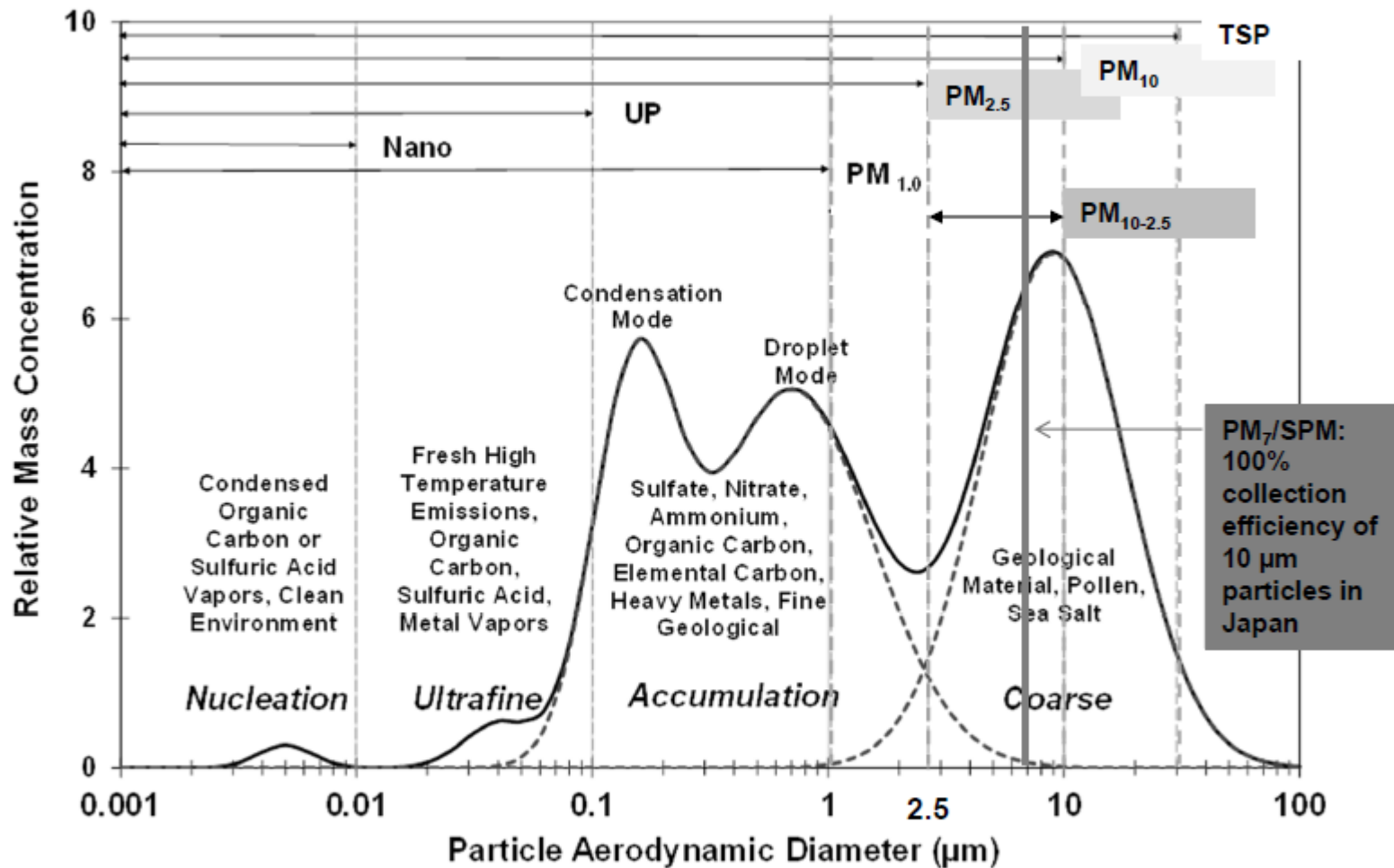
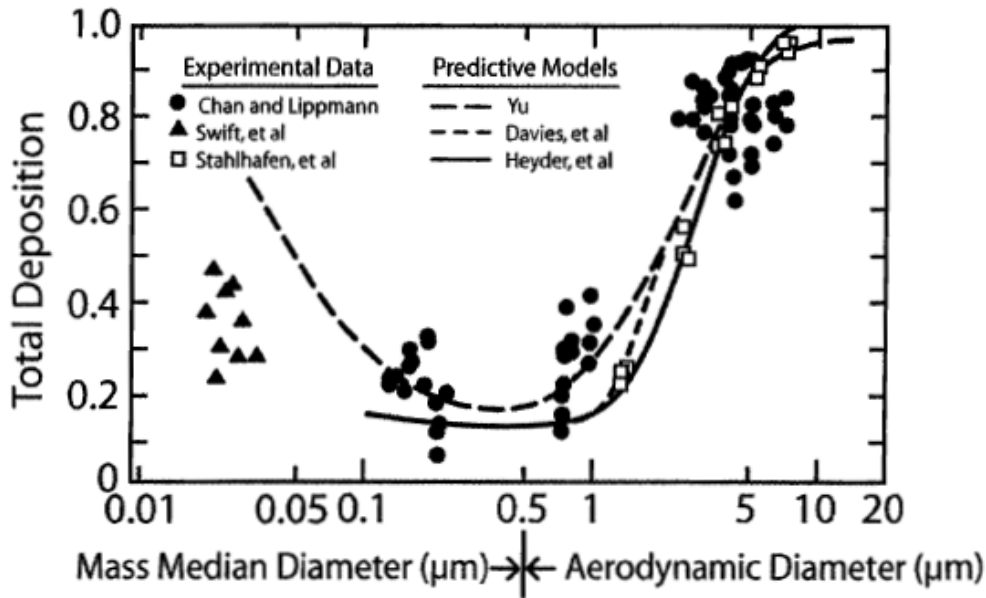


Fig. 1.1 Major features of atmospheric particle mass distribution

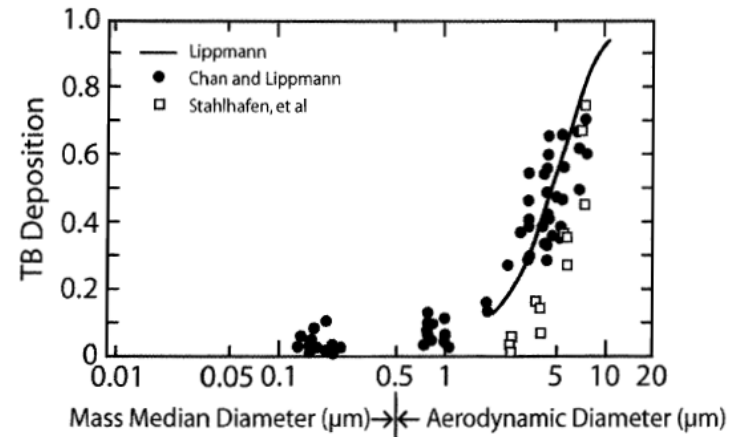


PM<sub>10</sub>, particulate matter with particles of aerodynamic diameter < 10 micrometers; PM<sub>2.5</sub>, particulate matter with particles of aerodynamic diameter < 2.5 micrometers; SPM, suspended particulate matter; TSP, total suspended particles; UP, ultrafine particles.

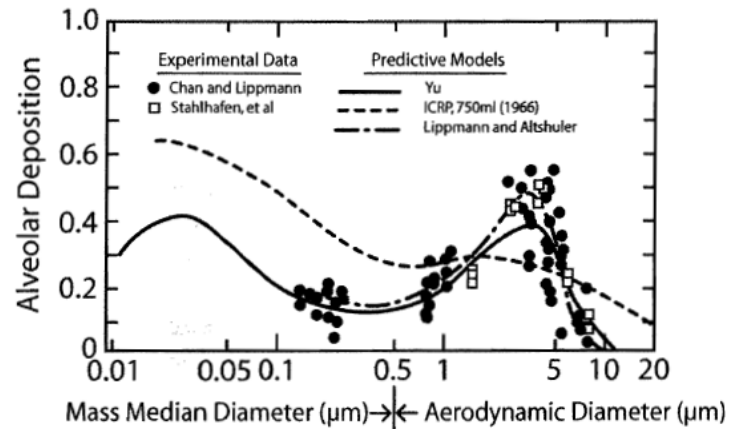
# Size & deposit location



**Figure 13.1** Total deposition (fraction inhaled) as a function of particle size (MMD,  $d < 0.5 \mu\text{m}$ ; MMAD,  $d > 0.5 \mu\text{m}$ ). (From

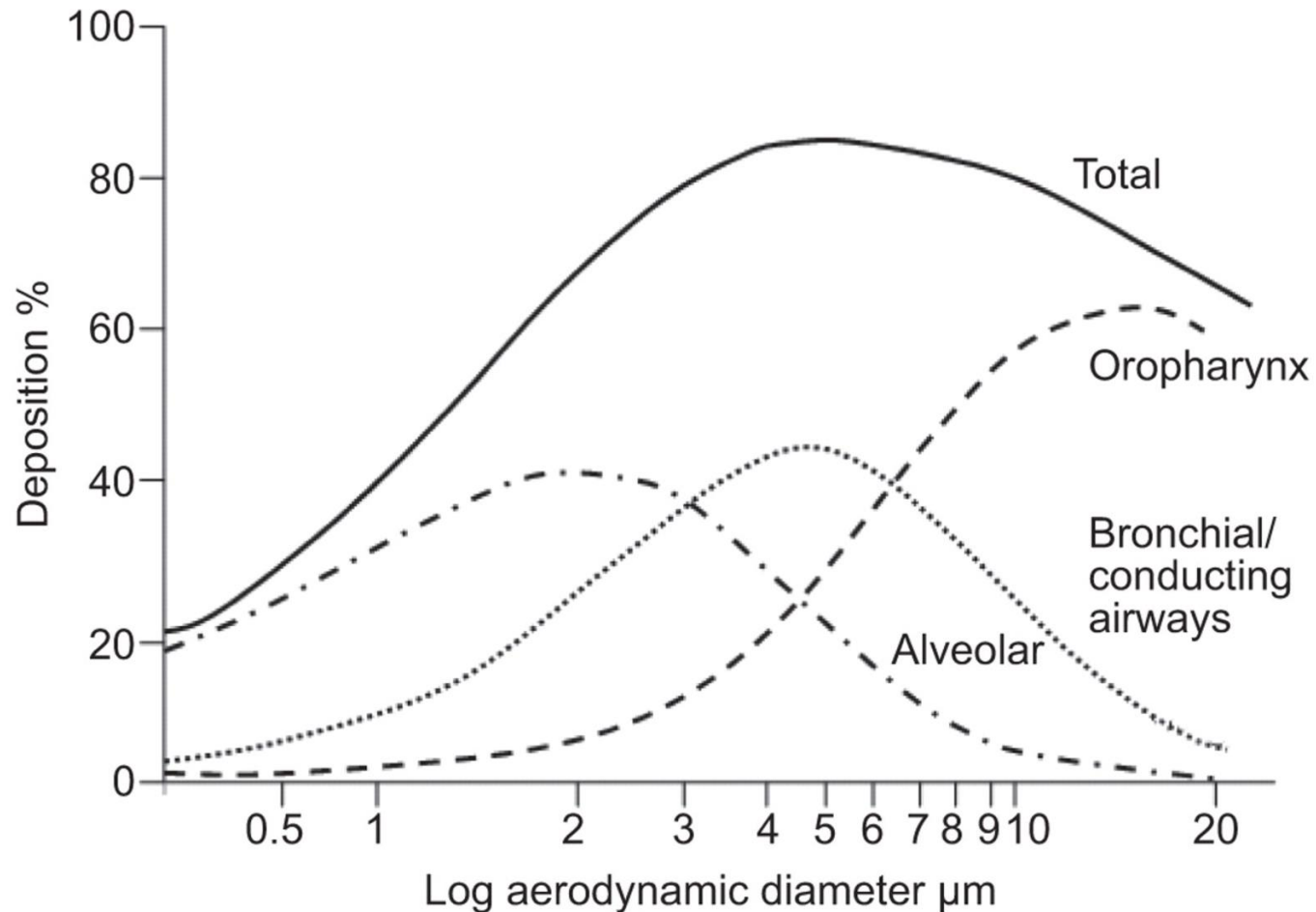


**Figure 13.2** Tracheobronchial (TB) deposition, fraction of aerosol entering the trachea, as a function of particle size (MMD,



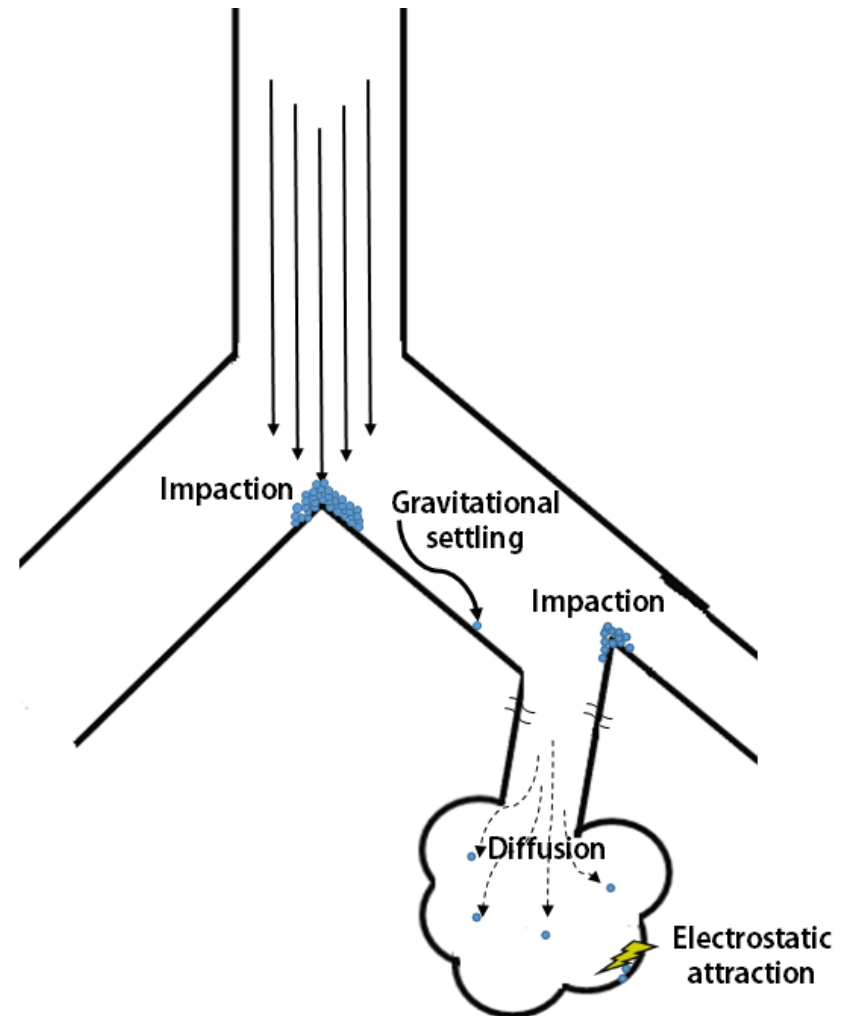
**Figure 13.3** Alveolar (gas-exchanging region) deposition, fraction inhaled, as a function of particle size (MMD,  $d < 0.5 \mu\text{m}$ ;

# Size & deposit location



# Particle deposition effect

- **Impaction**
- **Gravitational sediment**
- **Brownian diffusion**
- **Electrostatic depositor**
- **Interception**



# Composition

TABLE III

The chemical composition of different source types for PM10 in Guangzhou

$\mu\text{g g}^{-1}$	Traffic exhaust	Coal combustion	Soil dust	Sea salt	Secondary aerosol	
					Sulfate	Nitrate
K	0.002	0.0261	0.0182	0.0107	0	0
Na	0	0.0003	0.0025	0.288	0	0
Al	0.0021	0	0.0724	0	0	0
As	0.0006	0.0005	0	0	0	0
Ca	0.0035	0.0044	0.0988	0.011	0	0
Cr	0	0.0003	0.0002	0	0	0
Cu	0.0004	0.0014	0.0001	0	0	0
Fe	0.0031	0.0067	0.0412	0	0	0
Mn	0.0001	0.002	0.0005	0	0	0
Ni	0.0004	0	0.0001	0	0	0
Pb	0.0014	0.0014	0.0017	0	0	0
Se	0.0013	0.0001	0	0	0	0
Ti	0.0002	0.0002	0.0039	0	0	0
V	0.0004	0.0001	0.0002	0	0	0
Zn	0.0003	0.0149	0.0001	0	0	0
Cl	0.0162	0.0019	0	0	0.002	0
NO <sub>3</sub> <sup>-</sup>	0.0031	0.0031	0	0.0023	0.004	0.775
SO <sub>4</sub> <sup>2-</sup>	0.0104	0.2636	0.0047	0.072	0.727	0
NH <sub>4</sub> <sup>+</sup>	0.0087	0.0002	0.0003	0	0.0273	0.226
OC	0.3545	0.0248	0.0628	0	0	0
EC	0.3121	0.0107	0.0072	0	0	0

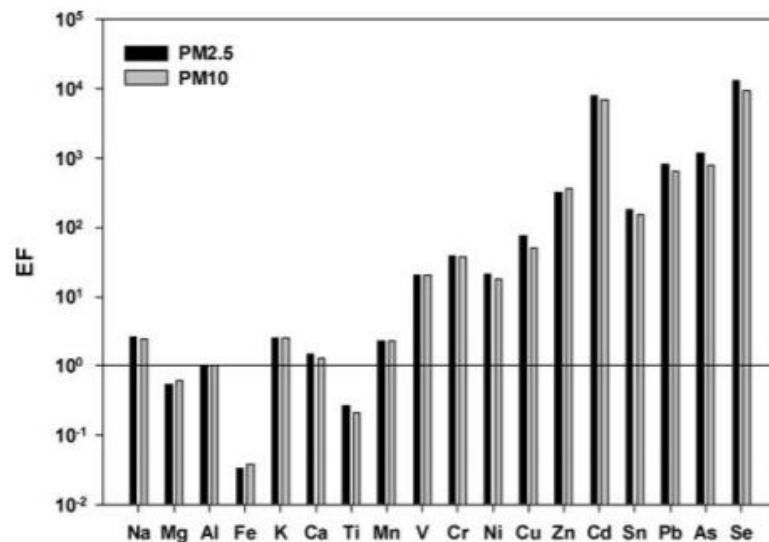


Figure 3. Enrichment factors of elements in PM10 and PM2.5.

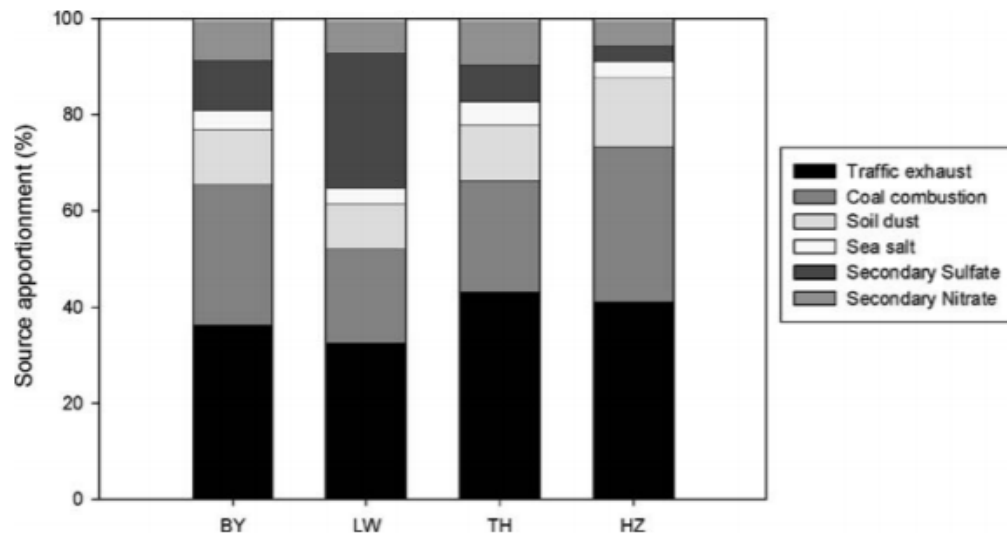
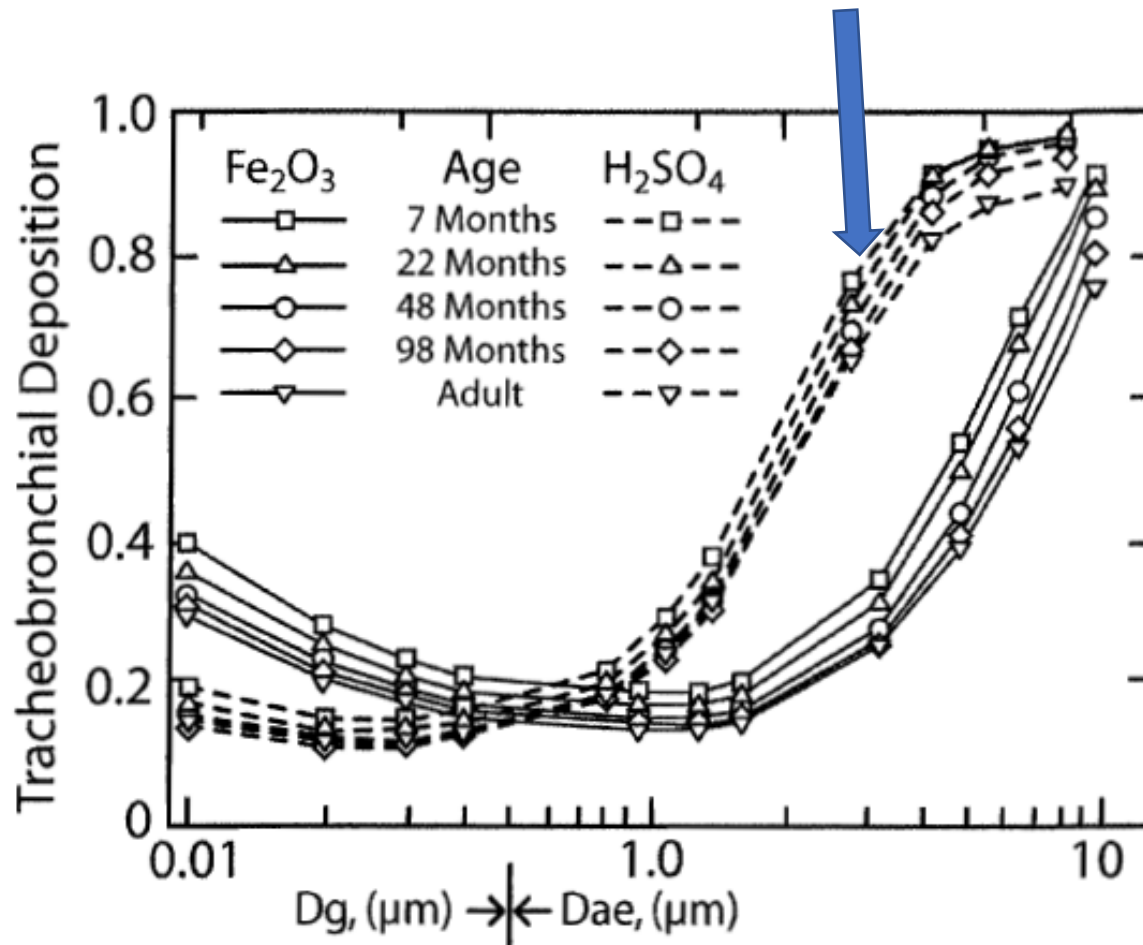


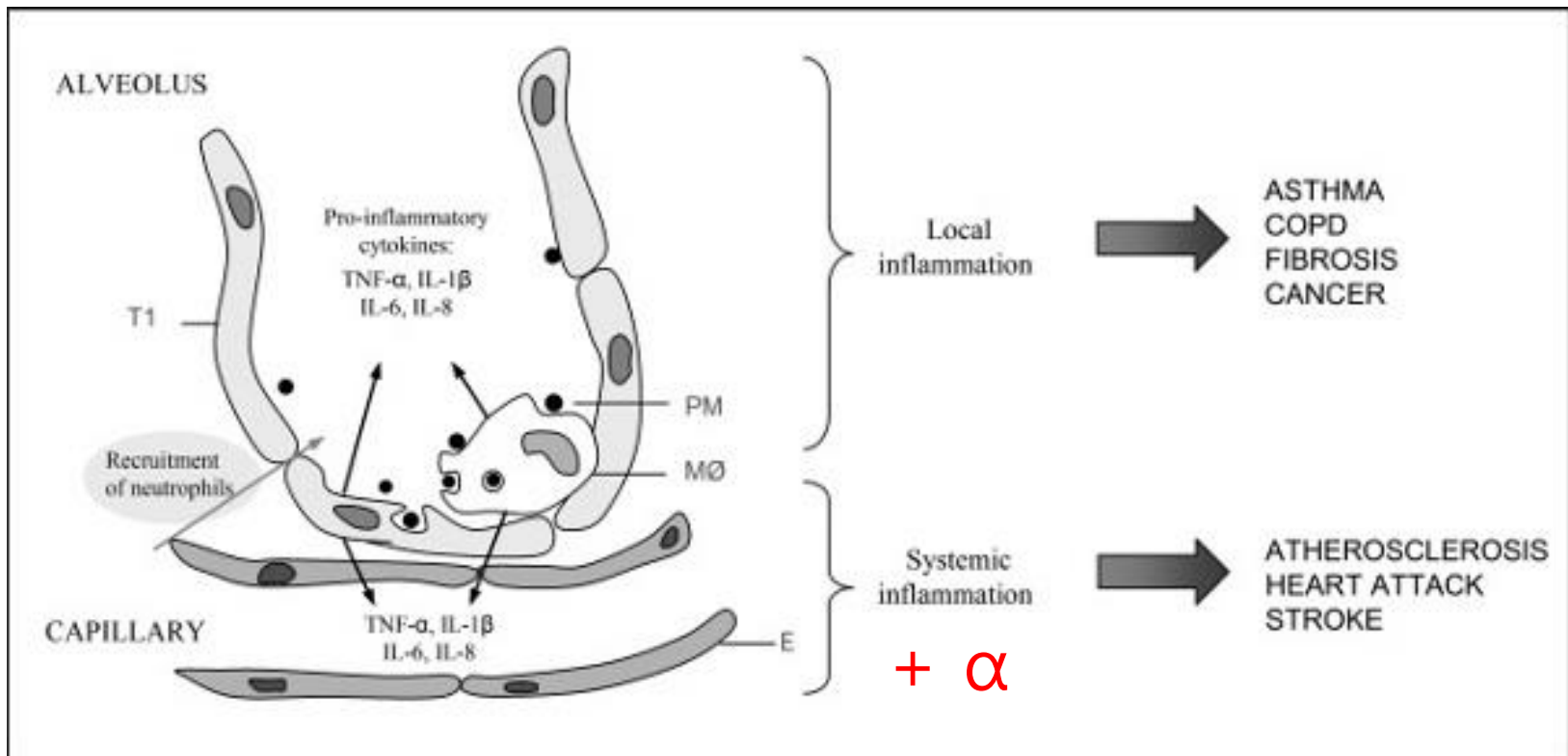
Figure 5. Source apportionments for PM10 at four sites.

# Hydrophilic reaction

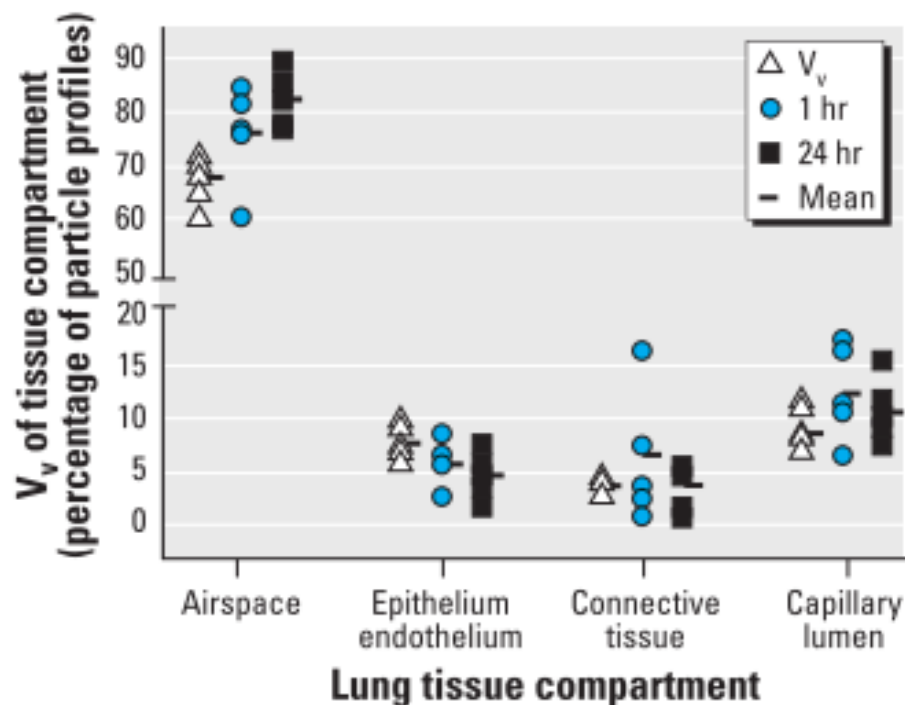


**Figure 13.4** Tracheobronchial deposition of dry  $\text{Fe}_2\text{O}_3$  particles

# Reaction sites and health effect

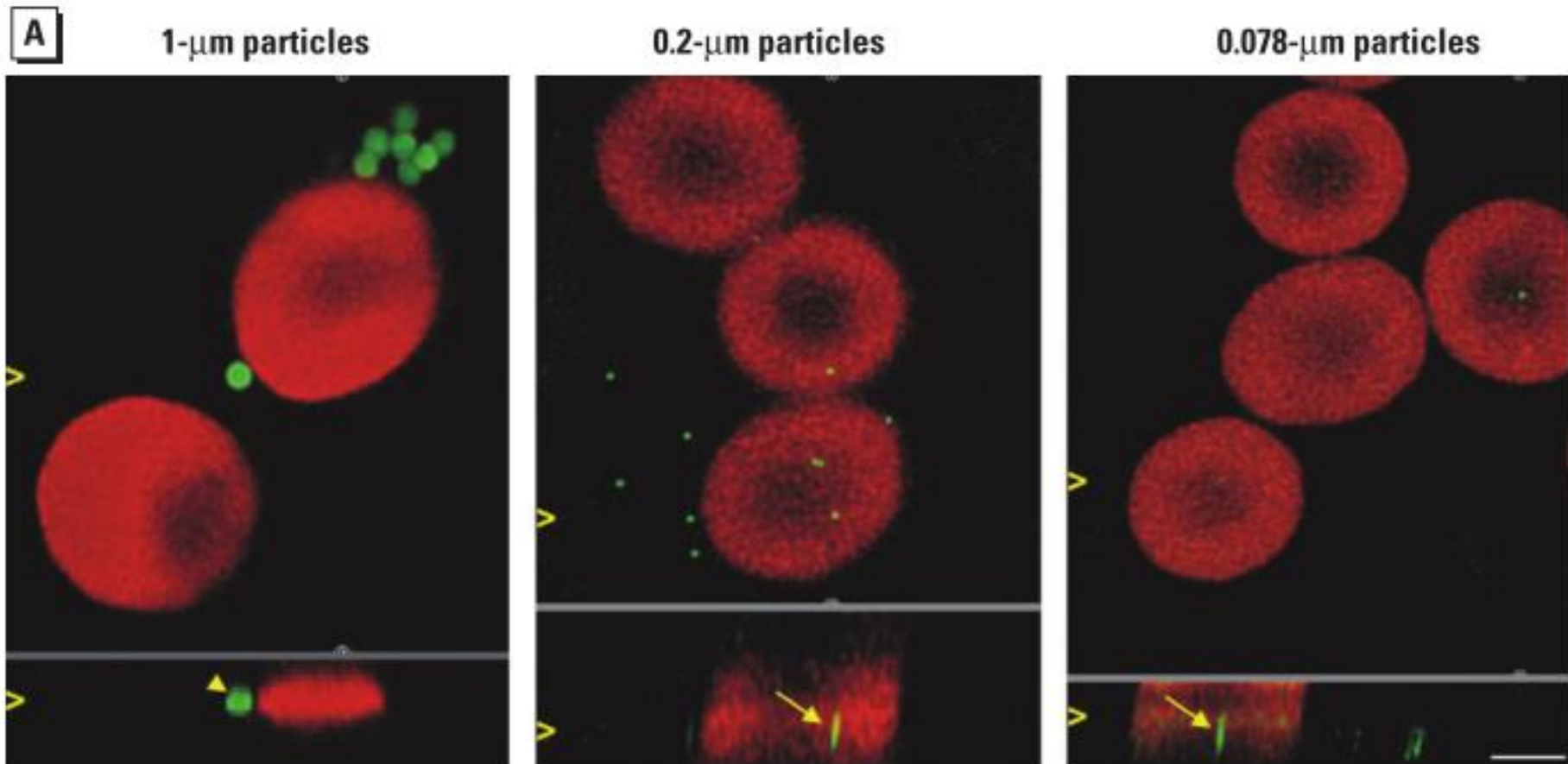


# Translocation to other organ

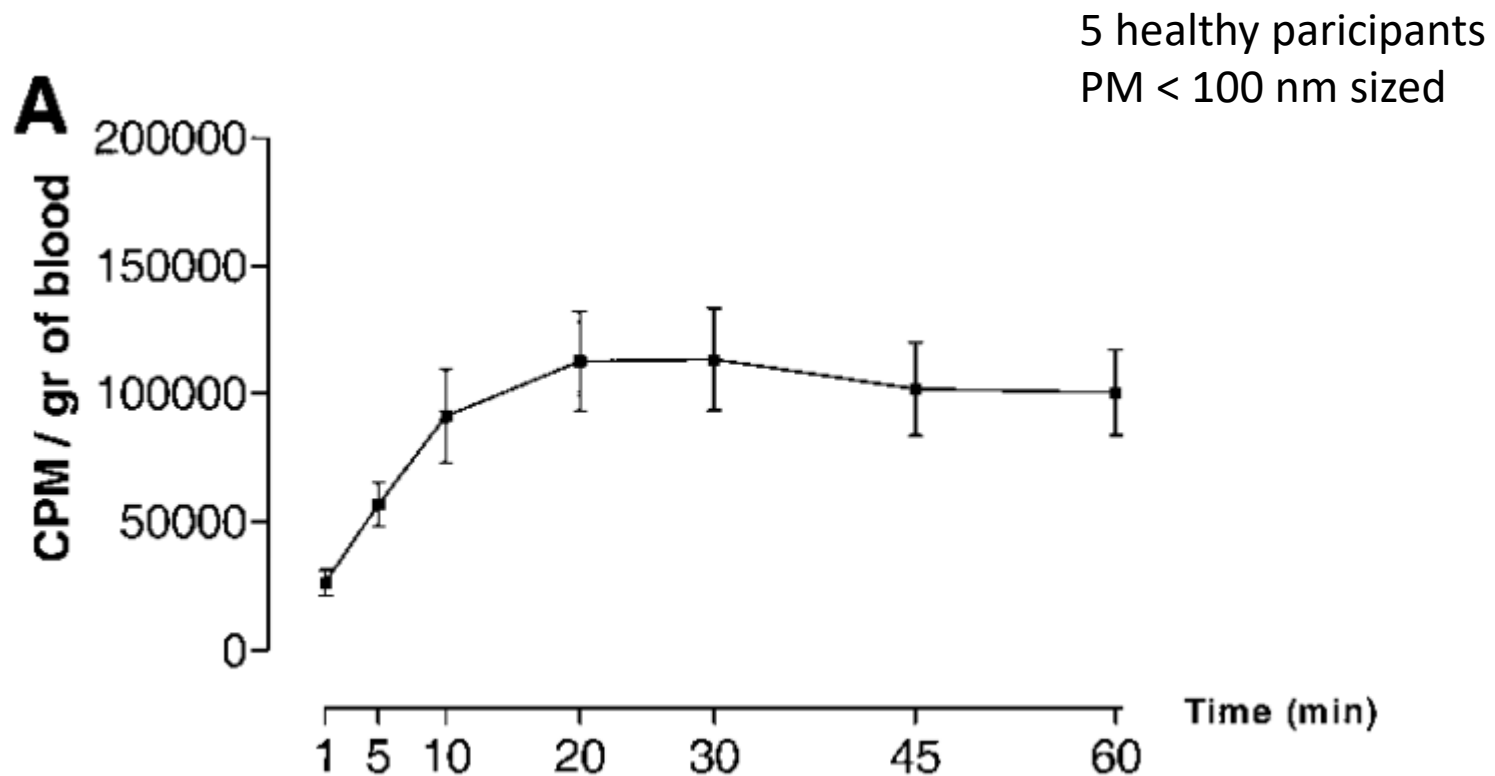


**Figure 2.** Relative distribution of particles localized in the different lung compartments at 1 hr and 24 hr after inhalation. Volume densities ( $V_v$ ) for lung tissue compartments from Burri et al. (1973), Pinkerton et al. (1992), and Tschanz et al. (1995, 2003).

# Fluorescent polystyrene spheres taken up by RBC

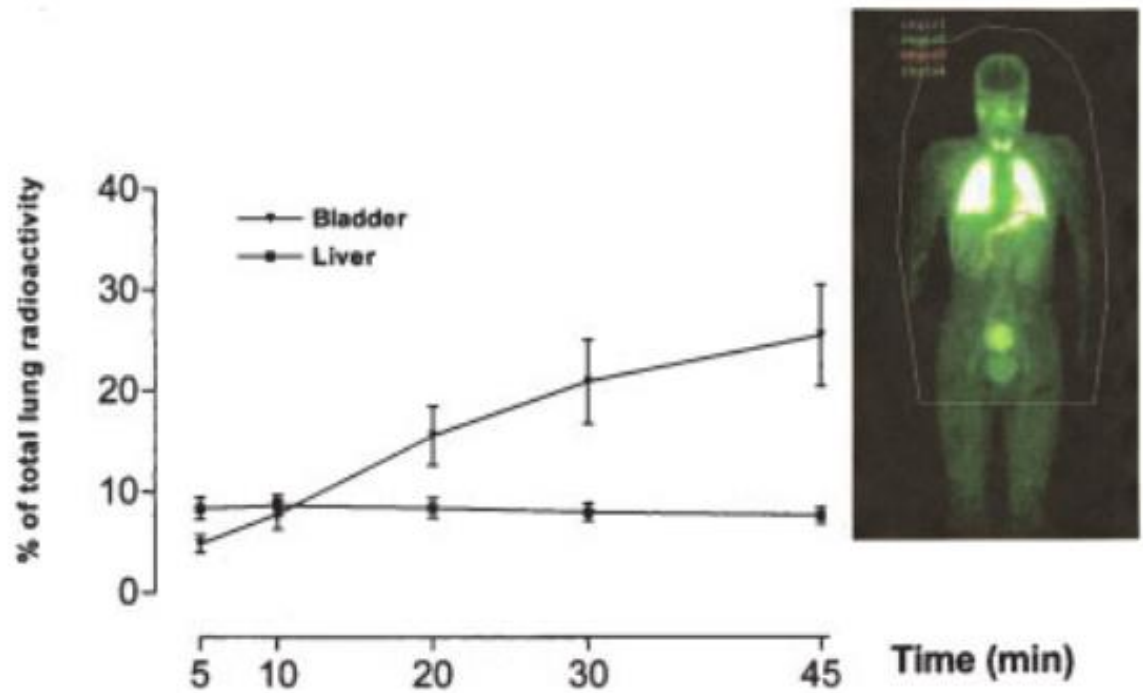


# Counts per minute of radioactive particulate matter



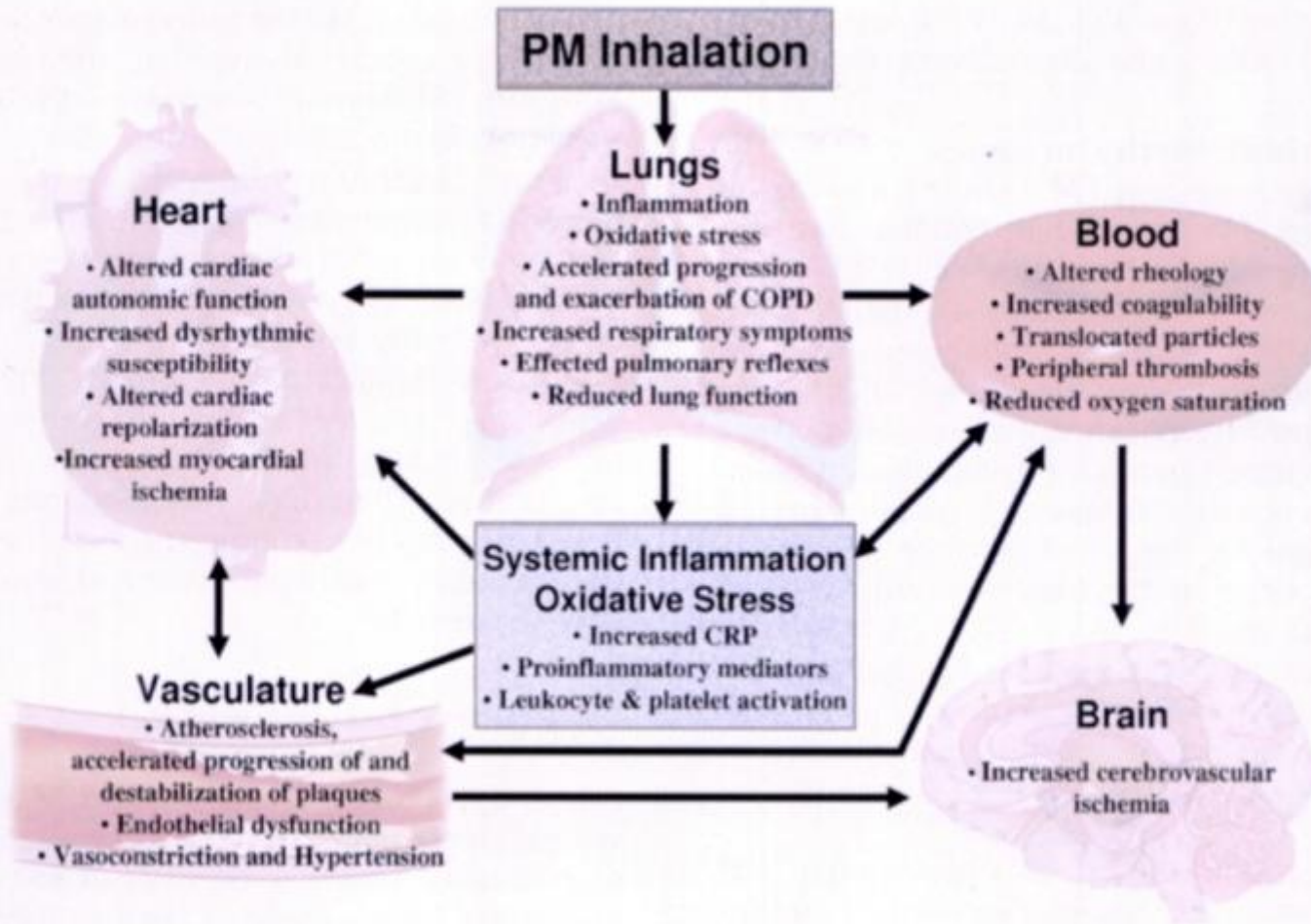
(*Circulation*. 2002;105:411-414.)

- Time-activity curve over liver and bladder expressed as percent of intimal lung radioactivity



(*Circulation*. 2002;105:411-414.)

# Health Effects



**Figure 4.** Potential general pathophysiological pathways linking PM exposure with cardiopulmonary morbidity and mortality.

# Asbestos related disease







중국산 제품으로써 중동까지도  
단열할 수 있는 충분한 고성능=

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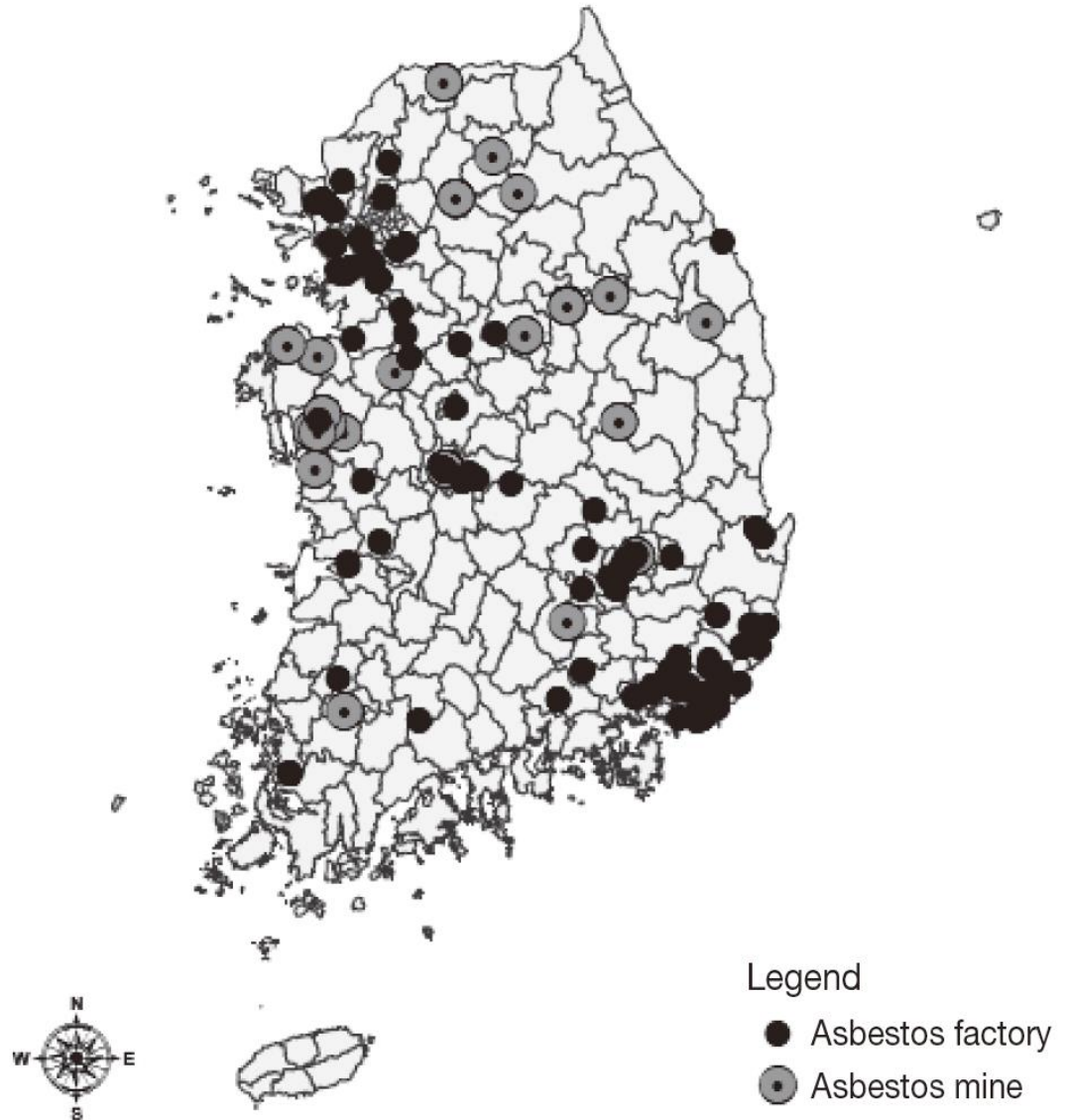
5cm \* 30m 충분한 길이의 석면테이프

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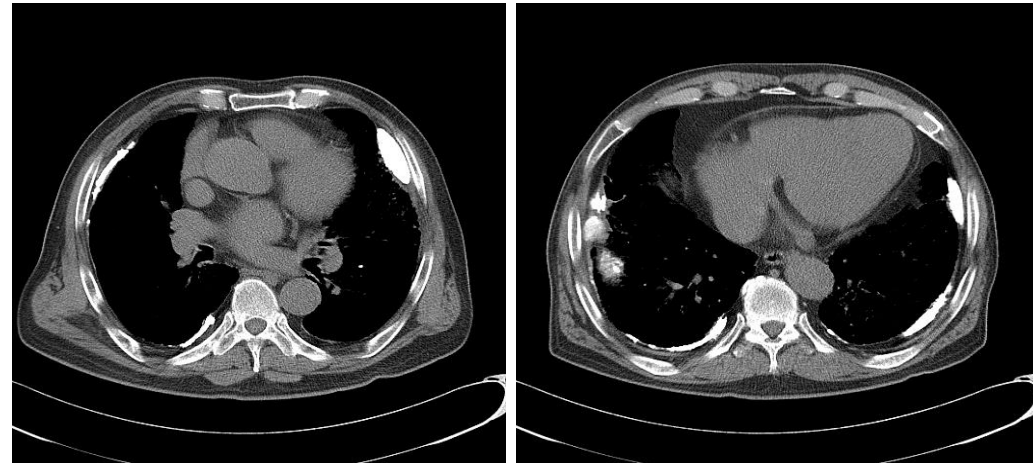
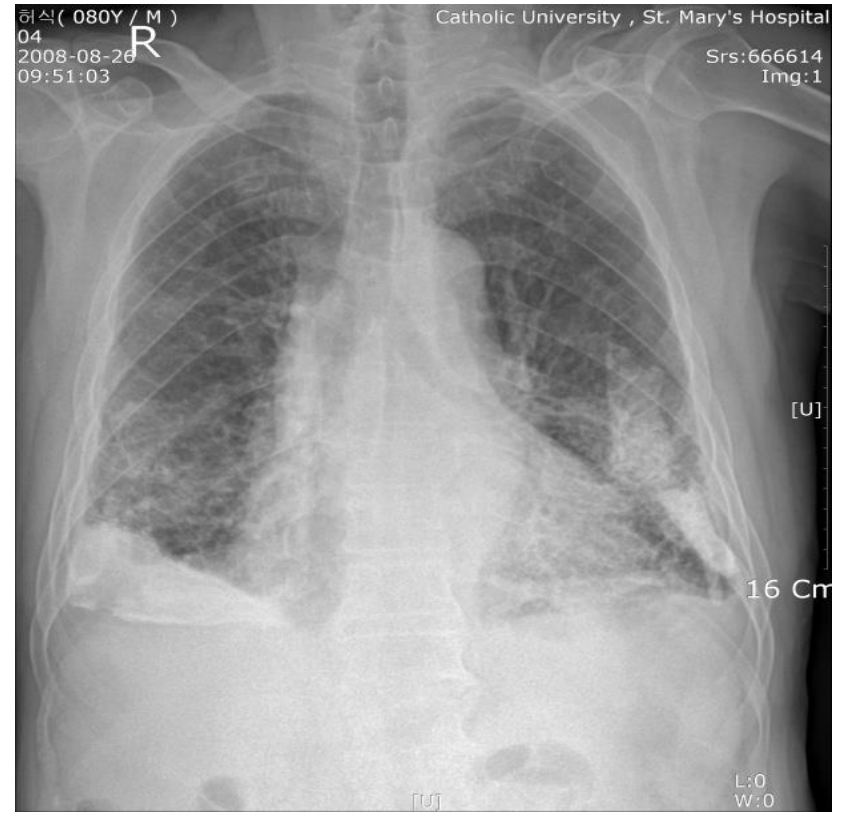


# Major exposure sources

- Mine
- Manufacture
- Construction w
- Slate
- Etc.







# Baby powder



## 베이비 파우더 12종서 석면 검출

2009.04.02 01:02

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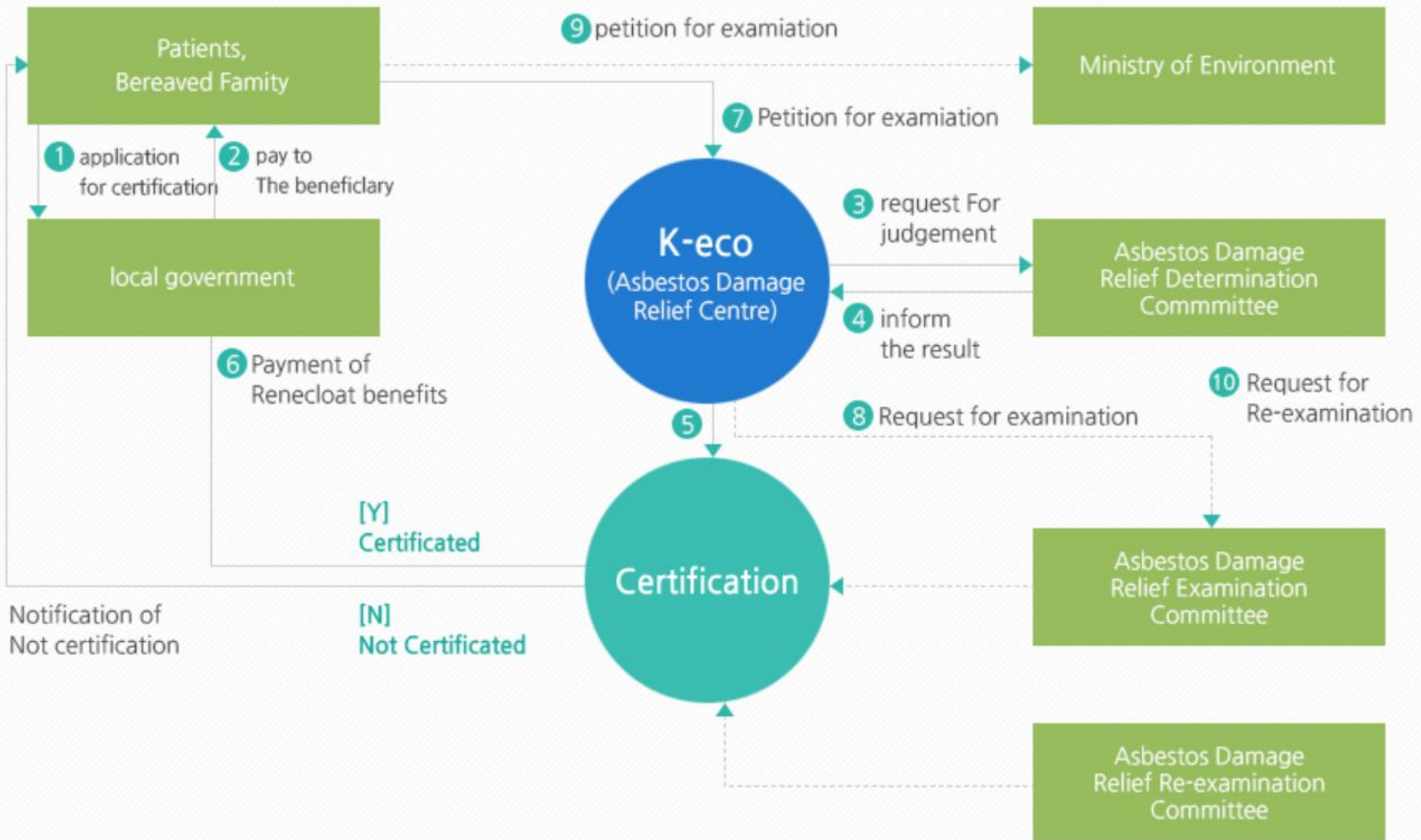
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### 석면 검출된 베이비파우더 품목

업체	제품 이름
보령메디앙스	보령 누크 베이비파우더
"	보령 누크 베이비칼라컴팩트파우더
"	보령 누크 베이비컴팩트파우더 화이트
"	보령 누크 크리닉베이비파우더 분말
유씨엘	베비라 베이비컴팩트파우더
"	베비라 베이비파우더
한국콜마	라구베 베이비파우더
성광제약	큐티 마망 베이비파우더
락희제약	락희 베이비파우더
대동엘에스	일로앤루 베이비컴팩트파우더
한국모니카제약	모니카 베이비파우더
덕양약품공업	덕산탈크(원료)

# Asbestos-caused diseases under the Asbestos Injury Relief Act

- **Type of Remedial benefits and Recipients**
  - **Medical benefits**
  - **Allowance for medical care and living costs**
  - **Funeral expenses**
  - **Special condolence and Special funeral expense**
  - **Remedial benefit adjustment**
  - **Examination expense for Certificated patients**





Humidifier disinfectants and lung injury

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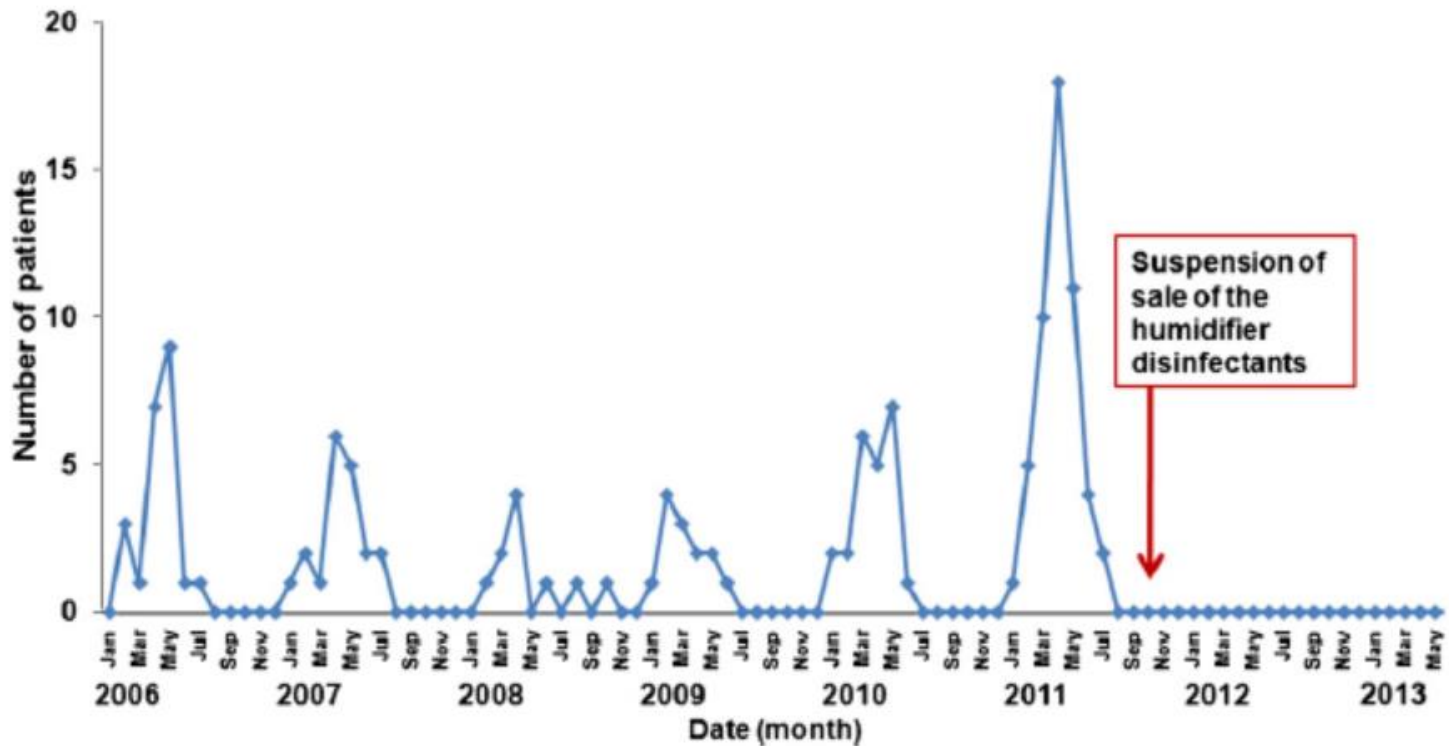
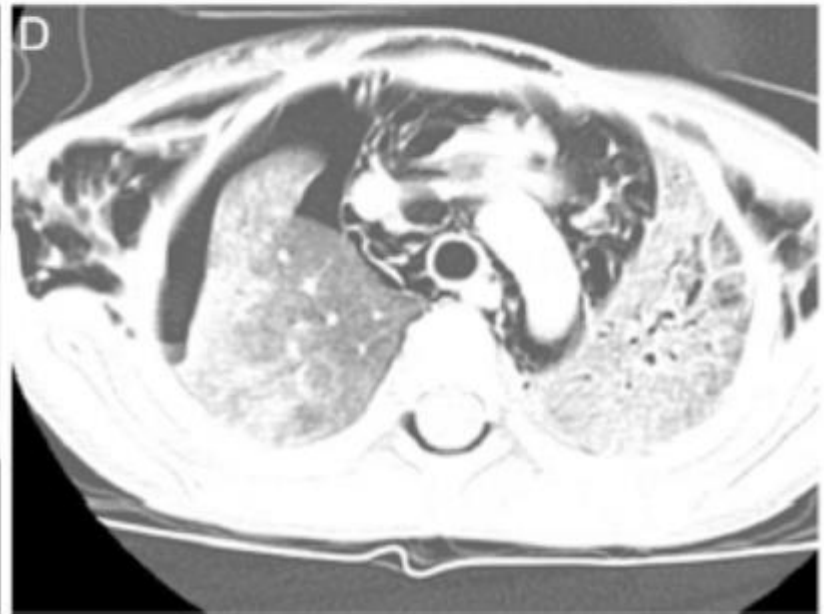
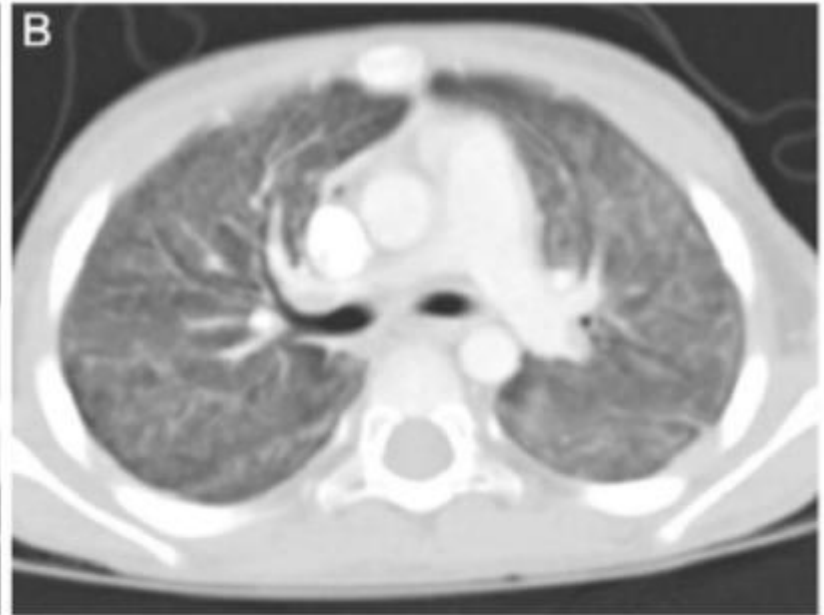
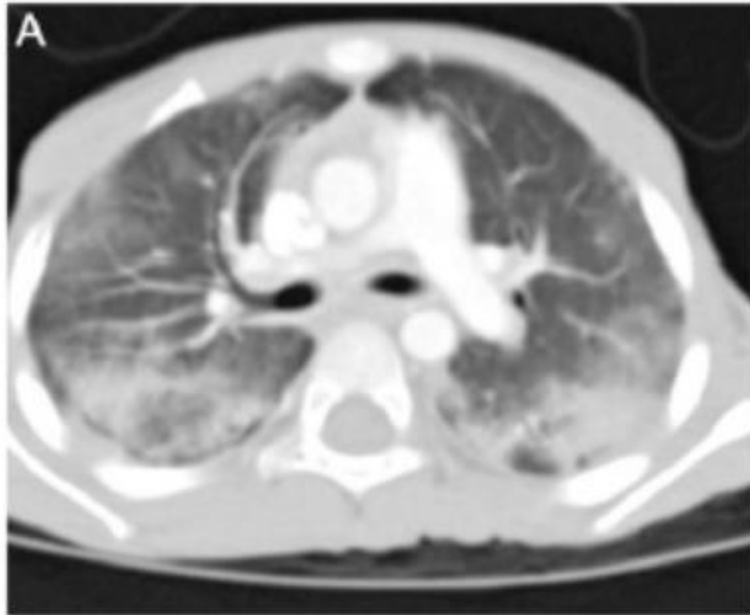


Figure 1. Monthly distribution of the occurrence of humidifier disinfectant-associated children's interstitial lung disease between 2006 and 2013. It should be noted that new cases were not detected after humidifier disinfectant sales were suspended.



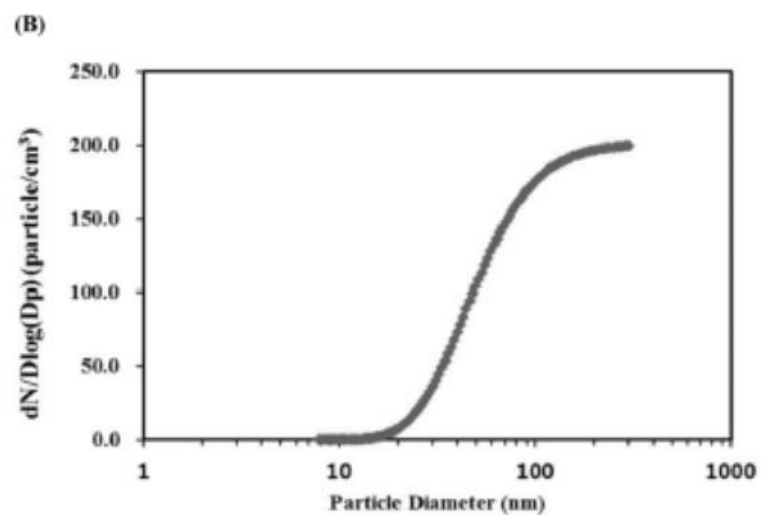
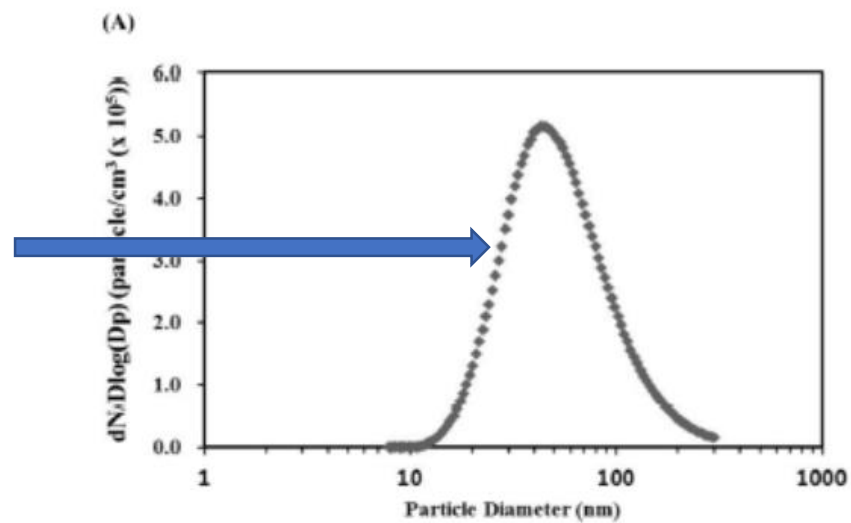
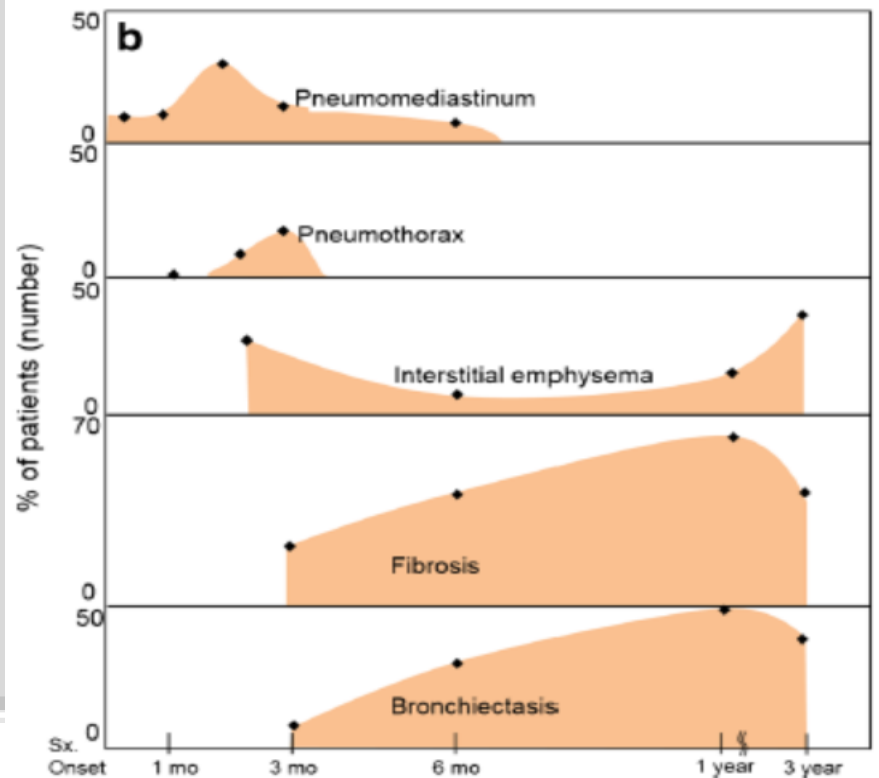
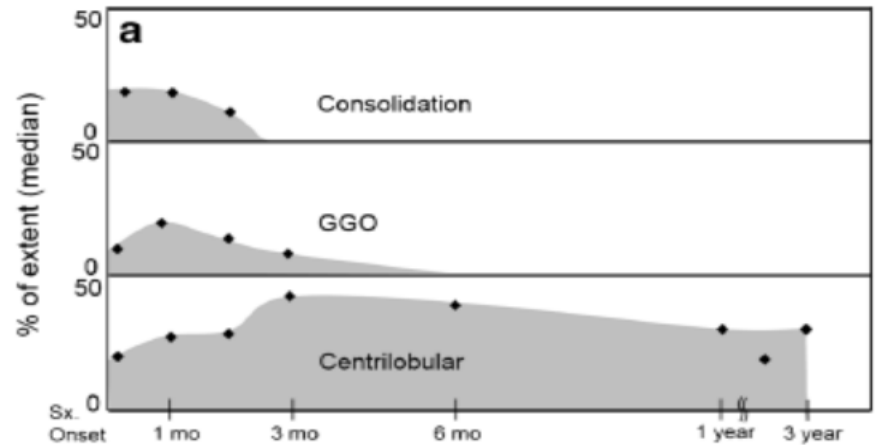


Fig. 1. Representative images of particle size distribution of PHMG phosphate. (A) Particle Concentration, (B) Cumulative Concentration.

# Radioloci features

- Short term prognosis : n= 59
- Radiologic finding
  - Consolidation
  - GGO
  - Centrilobular
  - Pneumomediastium/pneumothorax
  - fibrosis



# Epidemiologic researches

Author (publication year) [Ref]	Study subjects	Use of disinfectant vs. no use of disinfectant OR (95% CI)	Dose-response relationship OR, RR	Others
<b>Case-control study</b>				
Kim et al. (2014) [12]	No. of subjects (age range, yr) Patients: 18 (35.3, 44.0) Control: 121 (35.4, 42.9)	47.3 (6.1, 369.7)		Hospital control group Age, sex-matched Logistic regression model (no adjustment)
Yang et al. (2013) [13]	No. of subjects (age range, mo): Patients: 16 (18.25, 36.25; median, 26) Control: 47 (26.0, 29.5)	2.73 (1.41, 5.90)		Hospital control group Age, sex, first diagnosis-date matched Conditional logistic regression model
Park et al. (2016) [14]	No. of subjects (age range, yr) Patients: 16 (28.0, 49.0; median, 36.0) Control: 60 (27.0, 51.0; median, 35.0)	116.1 (6.5, 2,063.7)	According to 5-year cumulative exposure (L) OR: reference (< 0.5) -> 76.0 (0.5, 2.5) -> 272.9 (2.5+). According to daily exposure (mL/d) OR: reference (< 10) -> 95.4 -> (10, 20) -> 133.5 (20+). According to 5-year exposure period (mo) OR: reference (< 5) -> 9.5 (5, 10) -> 52.9 (10+)	Community control group Age, sex, resident area, pregnancy history-matched Conditional logistic regression analysis
Park et al. (2015) [15]	No. of subjects (age range) Patients: 169 Control: 303 (≤ 6 yr and ≥ 35 yr, pregnant females included)		According to daily mean sleep time in a room with a humidifier containing disinfectants (hr/d) OR: reference (< 10) -> 1.7 (10.1, 11.0) -> 2.0 (11.1, 12.0) OR per the mean distance (m) between a humidifier and the patient's bed (> 1) -> 2.7 (0.5, 1.0) -> 13.2 (< 0.5). According to disinfectant concentration in the air (quartile, µg/m <sup>3</sup> ) OR: reference (< 317.1) -> 1.0 (317.2, 508.5) -> 1.2 (508.6, 942.5) -> 2.6 (942.6, 4946.9)	Family control group No pairing Age, sex, factory within 1 km of resident area, number of chemical substances used at home Multivariate unconditional logistic regression analysis
<b>Retrospective cohort study</b>				
Paek et al. (2015) [16]	1,002 people, 273 families (death: 107) Age range: 0 to adult the exposed/the unexposed (549/408)	By age (vs. > 20 yr) 0-4: 3.84 (2.55, 5.79) 4-20: 1.89 (1.09, 3.27) Age-sex (vs. male adult) Female infants 17.14 (2.14, 137.59) Male infants 10.04 (1.23, 82.32) Female adults 6.02 (0.74, 49.10)	≥ 11 hr exposure/d (vs. < 11 hr) 1.41 (0.90, 2.12) ≥ 7 d exposure/wk (vs. < 7 d/wk) 4.07 (1.28, 12.91) ≥ 800 µg/m <sup>3</sup> exposure (vs. < 800 µg/m <sup>3</sup> ) 1.61 (1.08, 2.40) Survival possibility according to exposure type: high-concentration constant exposure < low-concentration constant exposure < intermittent exposure	Survival analysis using Cox proportional hazards model

Ref, reference number; OR, odds ratio; CI, confidence interval; RR, risk ratio.

## ✔ 가습기살균제 피해구제 제도란?

「가습기살균제 피해구제를 위한 특별법」에 따라 독성이 판명된 화학물질을 함유한 가습기살균제의 사용으로 인하여 생명 또는 건강상 피해를 입은 피해자 및 그 유족을 신속하고 공정하게 구제하기 위한 제도입니다

## 근거법령

▶ 「가습기살균제 피해구제를 위한 특별법」 [다운로드](#) ▶

## 주요내용

### ● 건강피해 인정

▶ 환경부장관은 가습기살균제 건강피해를 인정받으려는 사람(이하 ‘인정신청자’)에 대하여 가습기살균제 피해구제위원회의 심의를 거쳐 가습기살균제 건강피해 인정 여부 및 피해등급 등을 결정합니다.

### ● 구제급여

▶ 가습기살균제 피해자\*를 구제하기 위하여 가습기살균제 피해자 또는 유족에게 손해배상청구권 대위를 전제로 요양급여, 요양생활수당, 장의비, 간병비, 특별유족조위금, 특별장의비, 구제급여조정금을 지원합니다.

\* 독성 화학물질을 함유한 가습기살균제에 의하여 사망하거나 건강상 피해를 입은 사람으로서 특별법 제10조제2항에 따라 환경부장관에게 가습기살균제 건강피해를 인정받은 사람

### ● 특별구제계정

▶ 특별법 제32조에 따라 가습기살균제 피해 특별구제계정으로부터 구제급여에 상당하는 금액 또는 구제계정운용위원회로부터 필요하다고 인정받은 금액을 지원하는 제도입니다. 아래의 어느 하나에 해당되는 경우 구제계정운용위원회의 심의·의결을 거쳐 지원받으실 수 있습니다.

- 가습기살균제 사업자를 알 수 없거나 가습기살균제 사업자가 자력이 없는 경우의 가습기살균제 피해자
- 구제계정운용위원회가 구제급여에 상당하는 지원이 필요하다고 인정한 인정신청자
- 긴급의료지원이 필요한 인정신청자
- 특별법 제32조제1호에 따라 지급받은 급여와 다른 가습기살균제 피해자가 가습기살균제 사업자로부터 배상받은 금액이 현저하게 차이가 나는 경우

# Other sources

<표 1> 평가 대상 제품 분류 체계

제품군	용도	제형
방향제	실내공기 정화용	액상
		스프레이
		트리거
		자동분사형
		겔형
		훈증
		향초
탈취제	실내공기 정화용	액상
		스프레이
		트리거
	섬유 탈취용	액상
		스프레이
물티슈	영유아용	티슈형
	일반용	

<표 3> 방향제 및 탈취제, 물티슈의 MIT 및 CMIT의 HPLC-UV 함량 분석 결과

(단위: mg/kg)

분류	제형	시료 ID	MIT	CMIT
방향제	액상	방향제-15	31.46	
탈취제	스프레이	탈취제-24	29.74,	23.22
		탈취제-20	163.31	-

MDL: MIT=4 mg/kg, CMIT=20 mg/kg

<표 6> 방향제 및 탈취제의 안전기준(안) 제시

물질	제품	제형	경로	NOAEL	안전기준(안) MOE = 1,00	최소 안전기준(안)
MIT/ CMIT	방향제	스프레이	전신 (피부+흡입)	0.104 mg/kg/day	30 mg/kg	30 mg/kg (0.003%)
			흡입	0.34 mg/m <sup>3</sup>	30 mg/kg	
		트리거	전신 (피부+흡입)	0.104 mg/kg/day	60 mg/kg	50 mg/kg (0.005%)
			흡입	0.34 mg/m <sup>3</sup>	50 mg/kg	
	탈취제	스프레이	전신 (피부+흡입)	0.104 mg/kg/day	30 mg/kg	30 mg/kg (0.003%)
			흡입	0.34 mg/m <sup>3</sup>	30 mg/kg	
		트리거	전신	0.104 mg/kg/day	30 mg/kg	20 mg/kg

# Next following?



- Flavoring-induced lung disease
    - Diacetyl induced Bronchiolitis obliterans
      - the buttery-flavored chemical in foods like popcorn, caramel and dairy products
- Flavoring in E-cigarette

〈표 2-1〉 독성물질들에 의하여 발생한 말단기관지 및 폐포 독성 사례 가습기 살균제 건강피해 사건 백서

보건복지부 질병관리본부 폐손상조사위원회

	녹는점	물 용해도	공정	입자 크기	독성 표적
디아세틸 (diacetyl)	2.4℃	20%	용액 섞기	가스 (?)	폐쇄성 세기관지염
기모 - 나일론, 폴리프로필렌	250℃		작두로 자르기		문제 없음
			회전칼로 자르기	0.8~5.6 μm	림프성 세기관지염과 폐렴
아크라민 페인트 스프레이 - 폴리아미드아민			에어 스프레이		문제 없음
			유기용제 에어 스프레이		세기관지염과 기질화 폐렴
폴리에틸렌 폴리프로필렌			Laskin 분무기	1.1 μm	호흡기 출혈성 부종
폴리아크릴산			유체화 평면 (Fluidized-bed) 에어로졸 발생기	3.6 μm	정상에서부터 가벼운 가역적 염증
폴리아크릴 에스테르 나노입자			나노크기 풀(paste) 에어 스프레이	30 nm	폐렴 흉막 확산
방수 스프레이 - 불화탄소 중합체			스프레이		폐렴
가습기 살균제 - PHMG	79~ 136℃	41% w/w	초음파식 에어로졸화	75~ 118 nm	세기관지염과 폐렴

Thank you for attention!