

RAQM-5 Hong Kong Forum

Opportunities in the Greater Bay Area –
Regional Collaboration & Exposure
Management Breakthrough



Air Pollution & Lung Health

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2017 Lancet Commission on pollution and health

The Lancet Commissions

The Lancet Commission on pollution and health



Philip J Landrigan, Richard Fuller, Nereus J R Acosta, Olusoji Adeyi, Robert Arnold, Niladri (Nil) Basu, Abdoulaye Bibi Baldé, Roberto Bertollini, Stephan Bose-O'Reilly, Jo Ivey Boufford, Patrick N Breyse, Thomas Chiles, Chulabhorn Mahidol, Awa M Coll-Seck, Maureen L Cropper, Julius Fobil, Valentin Fuster, Michael Greenstone, Andy Haines, David Hanrahan, David Hunter, Mukesh Khare, Alan Krupnick, Bruce Lanphear, Bindu Lohani, Keith Martin, Karen V Mathiasen, Maureen A McTeer, Christopher J L Murray, Johanita D Ndahimananjara, Frederica Perera, Janez Potočnik, Alexander S Preker, Jairam Ramesh, Johan Rockström, Carlos Salinas, Leona D Samson, Karti Sandilya, Peter D Sly, Kirk R Smith, Achim Steiner, Richard B Stewart, William A Suk, Onno C P van Schayck, Gautam N Yadama, Kandeh Yumkella, Ma Zhong

Executive summary

Pollution is the largest environmental cause of disease and premature death in the world today. Diseases caused by pollution were responsible for an estimated 9 million premature deaths in 2015—16% of all deaths worldwide—three times more deaths than from AIDS, tuberculosis, and malaria combined and 15 times more than from all wars and other forms of violence. In the most severely affected countries, pollution-related disease is responsible for more than one death in four.

Pollution disproportionately kills the poor and the vulnerable. Nearly 92% of pollution-related deaths occur in low-income and middle-income countries and, in countries at every income level, disease caused by

Pollution endangers planetary health, destroys ecosystems, and is intimately linked to global climate change. Fuel combustion—fossil fuel combustion in high-income and middle-income countries and burning of biomass in low-income countries—accounts for 85% of airborne particulate pollution and for almost all pollution by oxides of sulphur and nitrogen. Fuel combustion is also a major source of the greenhouse gases and short-lived climate pollutants that drive climate change. Key emitters of carbon dioxide, such as electricity-generating plants, chemical manufacturing facilities, mining operations, deforestation, and petroleum-powered vehicles, are also major sources of pollution. Coal is the world's most polluting fossil fuel, and coal combustion is an important

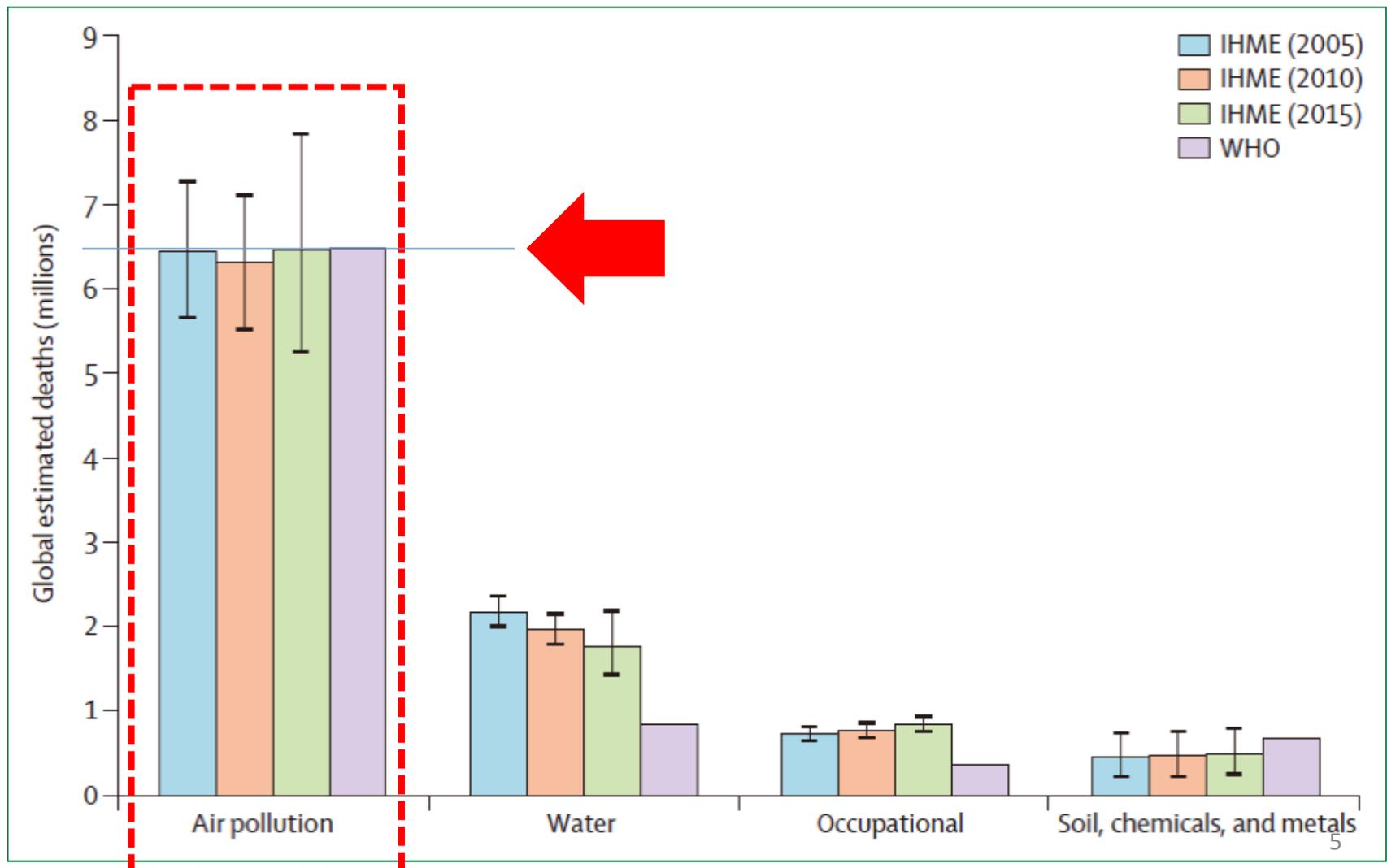
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Arnhold Institute for Global Health (Prof P J Landrigan MD), Mount Sinai Heart

Global estimated deaths (millions) by pollution risk factor, 2005–15



Air Pollution & Mortality

– WHO findings



centre

Publications

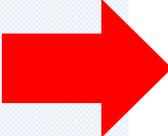
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About WHO

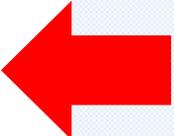
Media centre



7 million premature deaths annually linked to air pollution

News release

25 MARCH 2014 | GENEVA - In new estimates released today, WHO reports that in 2012 around 7 million people died - one in eight of total global deaths – as a result of air pollution exposure. This finding more than doubles previous estimates and confirms that **air pollution is now the world's largest single environmental health risk.** Reducing air pollution could save millions of lives.



Air Pollution & Mortality

– WHO findings

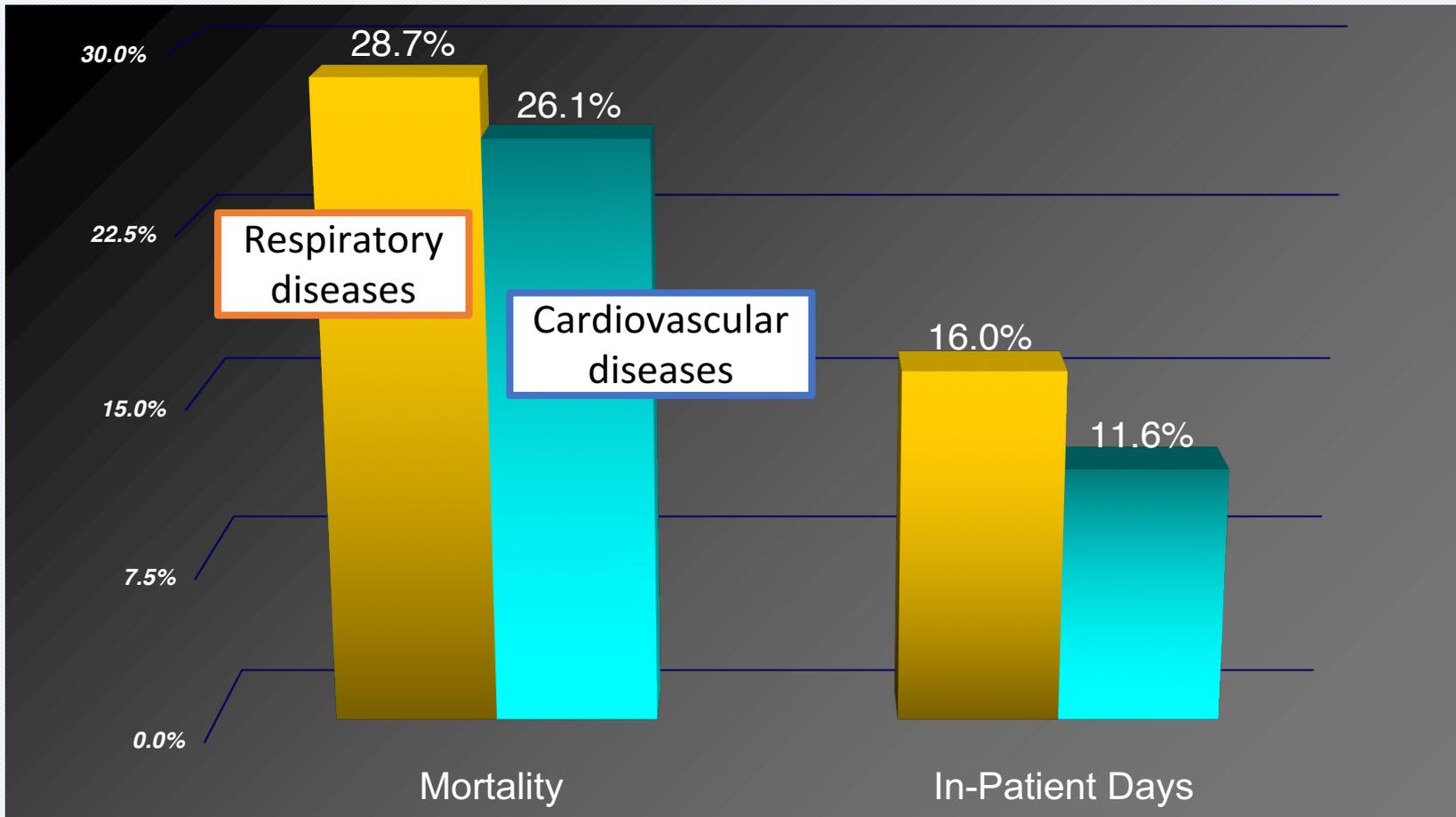
- **Outdoor air pollution-caused deaths**
 - **breakdown by disease:**
 - 40% – ischaemic heart disease;
 - 40% – stroke;
 - 11% – chronic obstructive pulmonary disease (COPD);
 - 6% – lung cancer; and
 - 3% – acute lower respiratory infections in children.

Air Pollution & Mortality

– Hong Kong findings

- **Time series analysis of hospital admissions in 1994-1995** (Wong TW et al, 1999)
 - Increased mortality in non-accidental deaths, cardiac, respiratory causes
 - NO₂, SO₂, O₃, PM₁₀
- **Data from HKU in 2013**
 - 3,000 premature deaths
 - 150,000 hospitalizations for pollution related illnesses
 - Economic burden of \$3.9 billion collars

Hong Kong: Mortality & In-Patient Days



Mortality of Respiratory Diseases

In 2005, 11,099 deaths due to Respiratory Diseases
(163/100 000)

	Overall	Male	Female
Respiratory Infection	39.0	33.2	48.5
Respiratory Cancer	33.2	36.3	28.2
COPD	17.9	21.6	11.7

Air Pollution & Asthma

- **Increased prevalence for 10 ug/m³ increase in PM₁₀**
(Wong TW et al 1999)
 - 1.6% in all respiratory admissions
 - 1.5% in asthma admissions
 - 1% in A&E attendances for acute asthmas exacerbation (esp. with O₃)
 - 0.6% in cardiovascular diseases
- **Increase in asthma admissions in 1993-1994**
(Wong CM et al 2001)
 - NO₂, SO₂, PM₁₀
- **Increase prevalence of atopy, asthma**
 - Diesels, SO₂, O₃ act as adjuvants for allergens

Air Pollution & Allergy

- **Increase prevalence of atopy or allergic diatheses**
 - Diesels, SO_2 , O_3 act as adjuvants for allergens
- **Early exposure to Traffic Related Air Pollutants (TRAP)**
(Deng et al, 2016)
 - 2,598 school children 3-6 years in Changsha, China
 - PM_{10} , NO_2 , SO_2
 - 11-15 $\mu\text{g}/\text{m}^3$ increase in NO_2 increased odds of Allergic Rhinitis
 - 1.4 in third trimester
 - 1.34 in first year of life
 - 12 $\mu\text{g}/\text{m}^3$ increased in PM_{10} increased odds of Allergic Rhinitis
 - 1.54 in first year of life
 - risk factors - male, family history of atopy

Air Pollution & Lung Cancer

- **Diesel particles of 5-23 $\mu\text{g}/\text{m}^3$**
 - Increase of 1-2.6 per 100,000 persons per year
- **Sulphates of 20 $\mu\text{g}/\text{m}^3$**
 - Increase mortality risk of 1.36
- **Confounding factors, e.g. smoking**
- **Individual susceptibility**

Air Pollution & Children

- **Children are more vulnerable to effects of air pollution**
 - shorter airways
 - higher levels of physical activities
 - spend more time outdoor
- **Observed effects**
 - increased respiratory symptoms and disease
 - aggravation of asthma
 - school absenteeism
 - decrease in lung function

Air Pollution & Respiratory Symptoms in Children

- **Kwai Tsing vs Southern District in 1989** (Ong et al 1991)
 - Increase in sore throat, wheeze, cough in industrialized district
 - Increase in bronchial hyperresponsiveness (Tam et al 1994)
- **6 districts in Liaoning, China** (Pan et al 2010)
 - 11860 school children aged 3-12 years
 - Increase in persistent cough, persistent phlegm, current asthma
- **6 cities study, Harvard**
 - Increase in cough, bronchitis, wheeze, lower respiratory tract illnesses

Air Pollution & Lung Growth in Children

- **3 districts with different levels of air pollution in Guangzhou** (He et al 2010)
 - 1983 grade 3-4 children followed for 6 months in 2006-7
 - PM₁₀, NO₂, SO₂
 - Reduced annual growth rate in FEV1 (large & small airway), FEV 25-75 (small airway) in both boys and girls
 - FEV1 negatively associated with air pollution level
- **Children's Health Study in Southern California** (Gaudeman et al 2004)
 - 1759 children followed from 10 years to 18 years
 - PM_{2.5}, NO₂, acid vapor
 - Reduced growth rate in FVC, FEV1, FEV 25-75

Air Pollution Trend in China & Hong Kong

- **Hong Kong 1998**

- amongst 36 major cities in the world
- ranked 9th and 15th for worst RSP and NO₂
- diesels vehicles responsible for 79% of total mileage on the roads

- **Hong Kong 1999-2015**

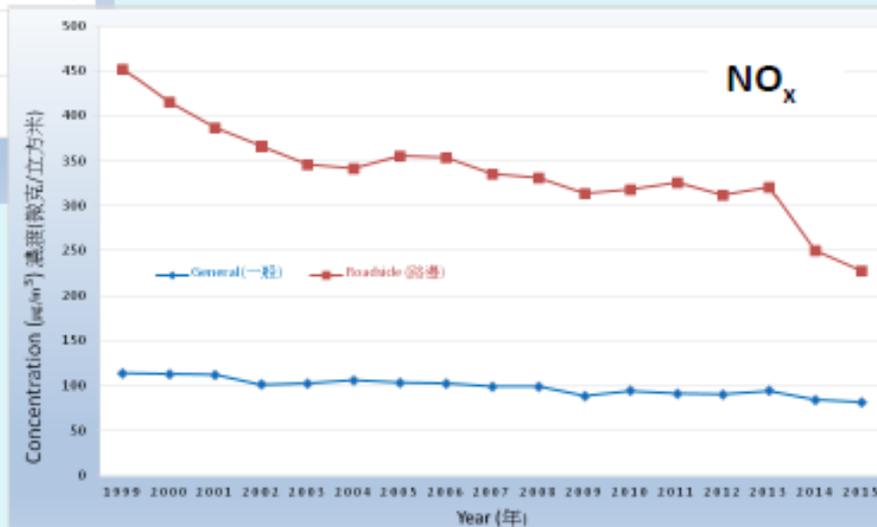
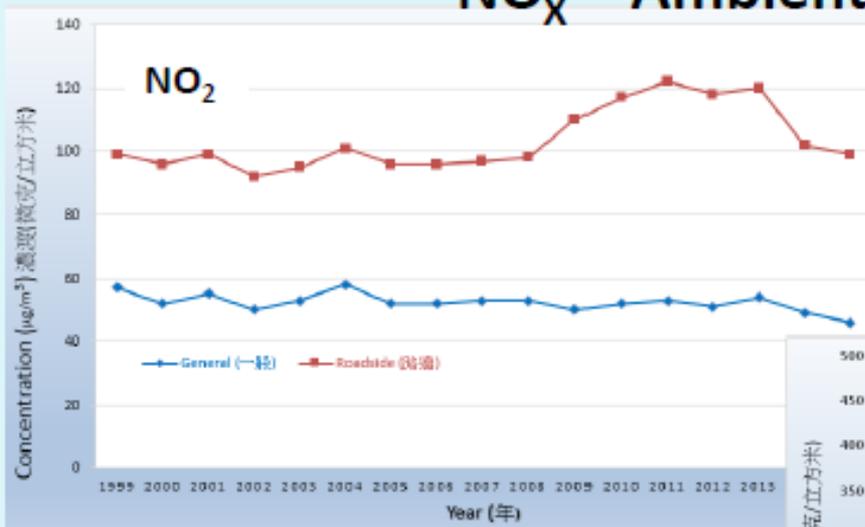
- decrease in ambient and roadside SO₂ by 44% and 70%
- decrease in ambient and roadside NO₂ by 29% and 50%
- decrease in ambient and roadside PM₁₀ by 24% and 44%

- **Pearl River Delta 2006-2015**

- decrease in ambient NO₂ by 28%
- decrease in ambient PM₁₀ by 34%

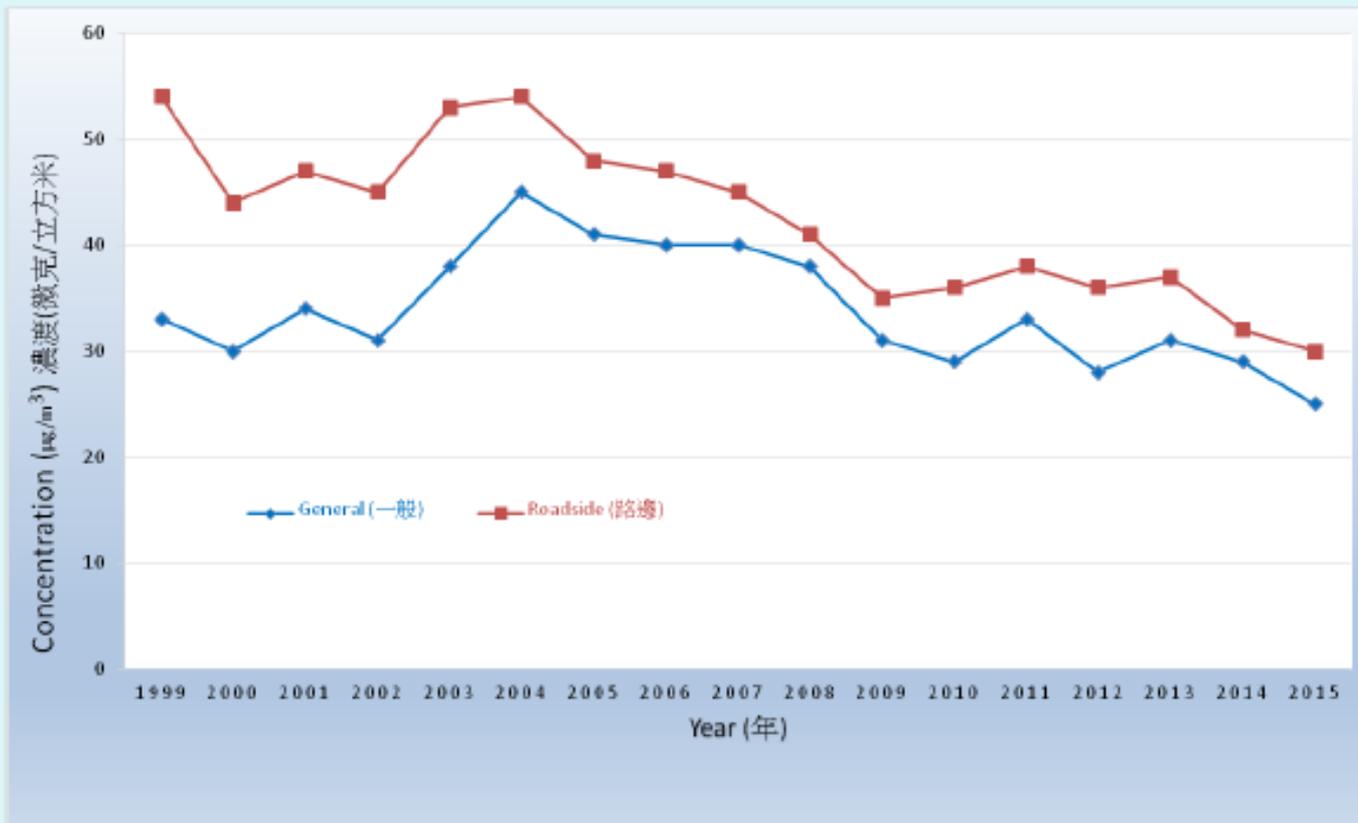
Air Quality Trends – Hong Kong

1999 to 2015: NO₂ – Ambient ↓ 14%; Roadside no change
NO_x – Ambient ↓ 29%; Roadside ↓ 50%



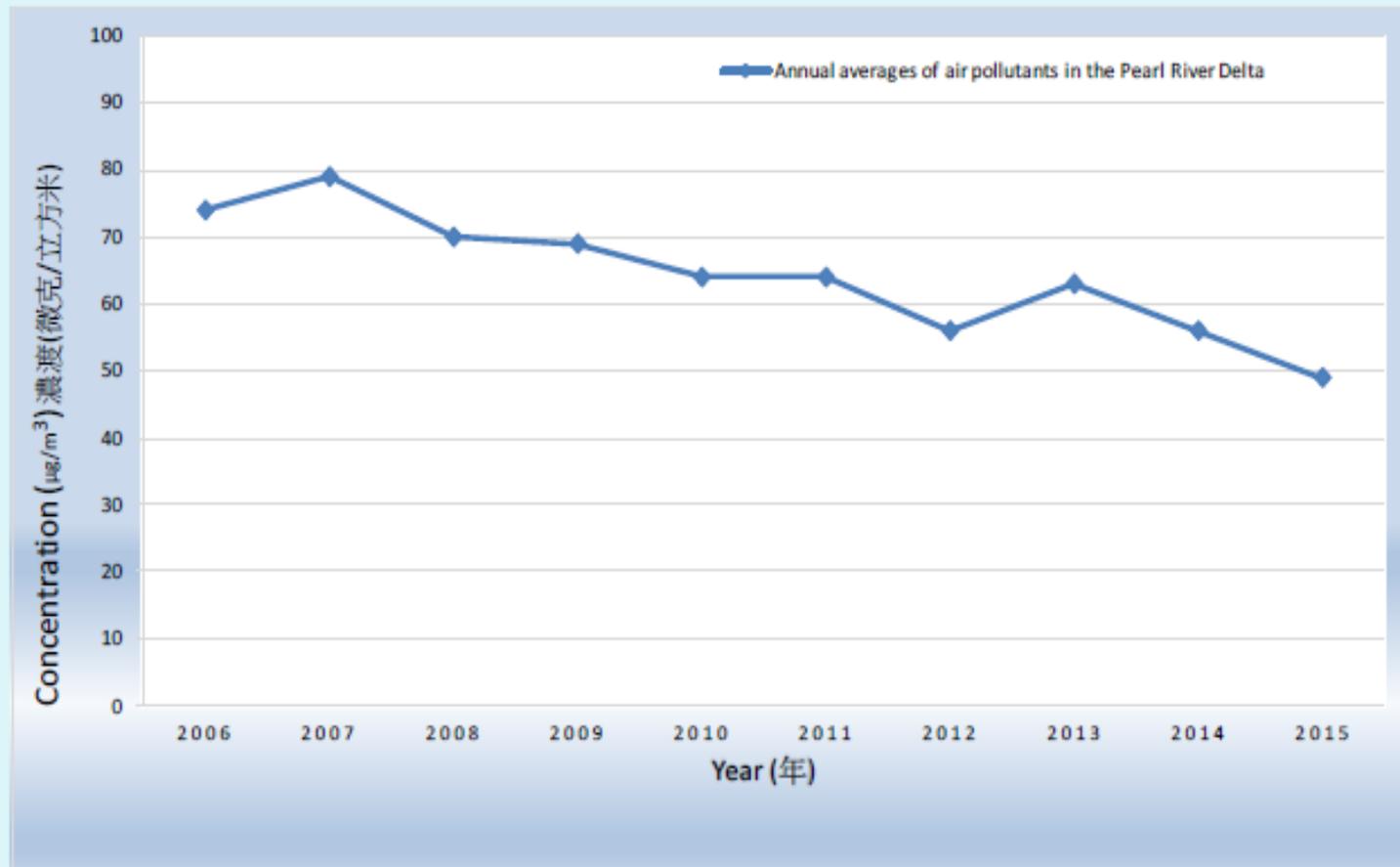
Air Quality Trends – Hong Kong

1999 to 2015 : PM_{2.5} – Ambient ↓ 24%; Roadside ↓ 44%



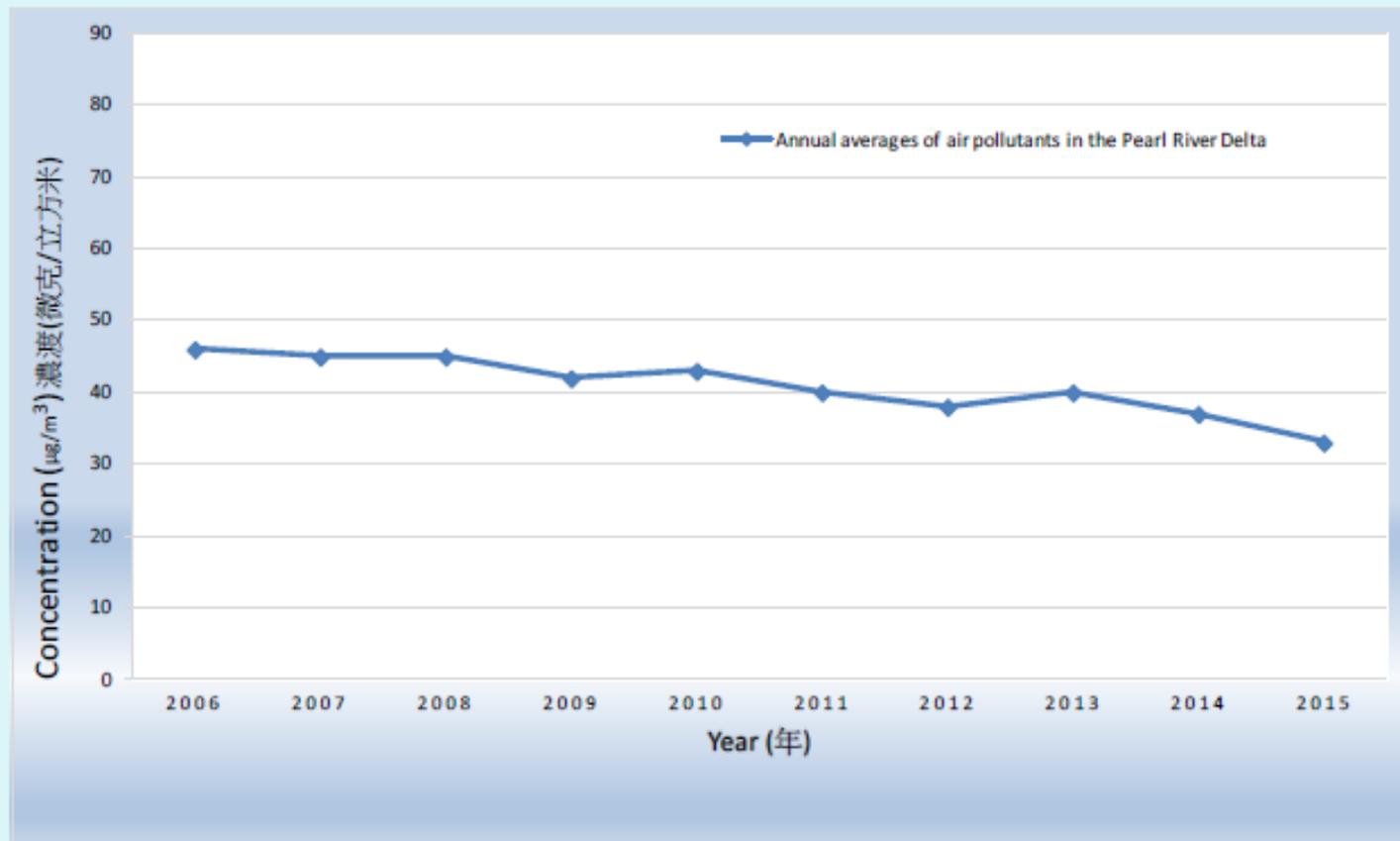
Air Quality Trends – PRD network

2006 to 2015 : PM₁₀ ↓ 34%



Air Quality Trends – PRD network

2006 to 2015 : NO₂ ↓ 28%



Air Pollution Trend in China & Hong Kong

- **Shift of polluted cities in China from East to West**
 - decrease in ambient $PM_{2.5}$ by 23% in first Q 2016 in Beijing-Tianjin-Hebei
 - increase in ambient $PM_{2.5}$ by 20% in Central and Western provinces
 - 6 of the 10 most polluted cities in China are now in Xinjiang
 - shift of polluting factories to the West, cf One Belt One Road
 - more stringent environmental control and slow down in coal and steel industry in major Eastern cities
- **Parallel decrease in health effects???**
- **Change in epidemiology of asthma and allergic diseases???**

2017 Lancet Commission on pollution and health

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The Burden of Lung Diseases in Hong Kong

- In 2005, respiratory disease was ranked as the top cause of mortality and hospitalization in Hong Kong.
- Respiratory diseases accounted for 16% of all inpatient bed-days.
- Although there has been a slow decline in respiratory mortality rate in the past decade, there has been no change in respiratory hospitalization rates.
- **Respiratory diseases, therefore, have accounted for the largest share of the health-care burden locally.**

Respiratory Diseases in 2005

% of Respiratory Diseases	Mortality	Hospitalization	In-patient bed days
Respiratory infection	39.0	41.3	37.2
Lung Cancer	33.2	5.7	9.2
COPD	17.9	14.6	20.5
Tuberculosis	2.4	3.9	7.1
Bronchiectasis	1.7	1.7	1.7
Asthma	0.9	5.7	2.6
Pneumoconiosis	0.4	0.2	0.2
OSA	0	5.5	0.7
Others	4.5	21.5	20.7

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4. Air Pollution Trend in China & Hong Kong

Global estimated deaths (millions)

	GBD study best estimate (95% CI)	WHO best estimate (95% CI)
Air (total)	6.5 (5.7–7.3)	6.5 (5.4–7.4)
Household air	2.9 (2.2–3.6)	4.3 (3.7–4.8)
Ambient particulate	4.2 (3.7–4.8)	3.0 (3.7–4.8)
Ambient ozone	0.3 (0.1–0.4)	..
Water (total)	1.8 (1.4–2.2)	0.8 (0.7–1.0)
Unsafe sanitation	0.8 (0.7–0.9)	0.3 (0.1–0.4)
Unsafe source	1.3 (1.0–1.4)	0.5 (0.2–0.7)
Occupational	0.8 (0.8–0.9)	0.4 (0.3–0.4)
Carcinogens	0.5 (0.5–0.5)	0.1 (0.1–0.1)
Particulates	0.4 (0.3–0.4)	0.2 (0.2–0.3)
Soil, heavy metals, and chemicals	0.5 (0.2–0.8)	0.7 (0.2–0.8)
Lead	0.5 (0.2–0.8)	0.7 (0.2–0.8)
Total	9.0	8.4

Note that the totals for air pollution, water pollution, and all pollution are less than the arithmetic sum of the individual risk factors within each of these categories because these have overlapping contributions—eg, household air pollution also contributes to ambient air pollution and vice versa.

Table 1: Global estimated deaths (millions) due to pollution risk factors from the Global Burden of Disease study (GBD; 2015)⁴² versus WHO data (2012)^{99,101}

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