



# Our working lungs over time

Have they really changed and what are the challenges to keeping them healthy?

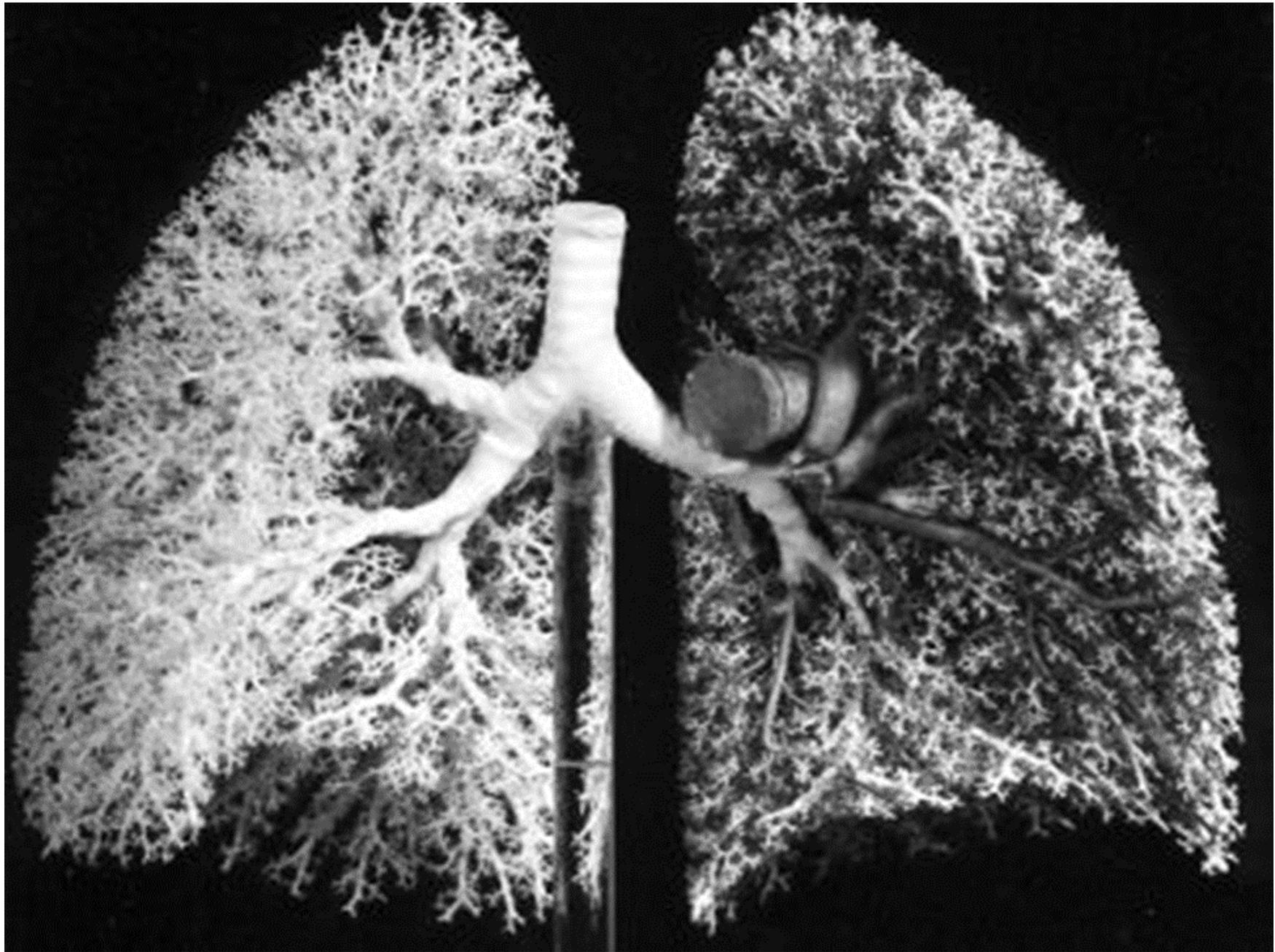
**Professor David Fishwick**

Centre for Workplace Health

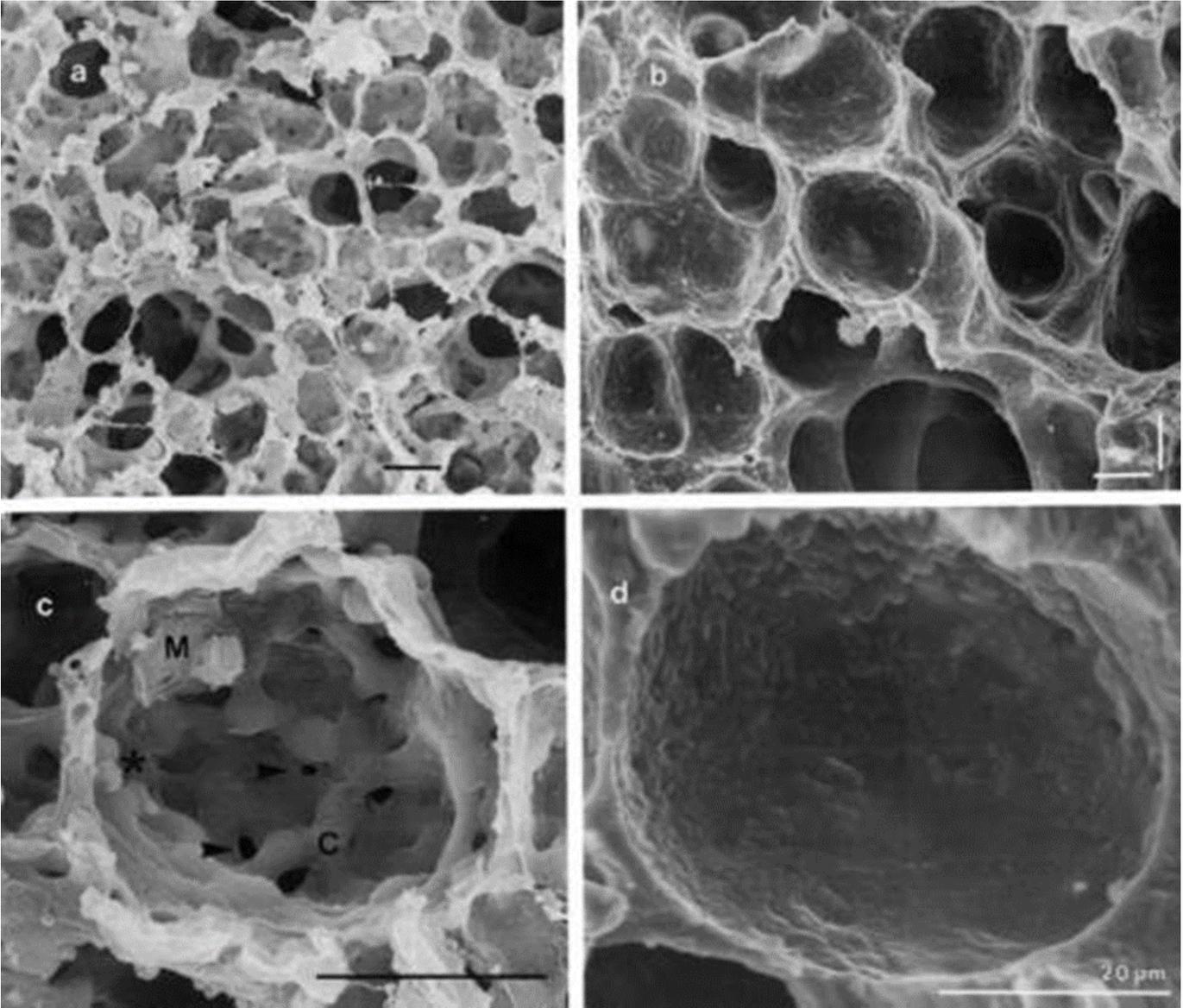
University of Sheffield and Emeritus Sheffield

Teaching Hospitals NHS FT

Chief Medical Adviser HSE GB and HSE NI



# Gas Exchange Units



# Life at 0.33 atm (33KPa)



# Life at 21 atm (2100KPa)



# How many normal breaths in a lifetime?

14,120,000



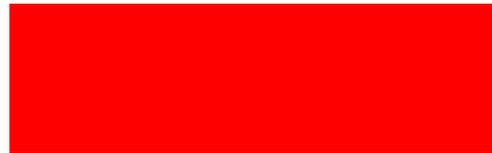
85,500,000



327,234,786



441,504,000



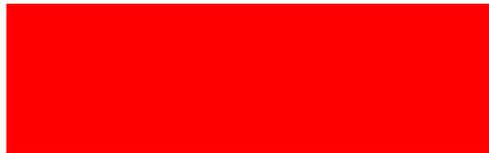
# How many normal breaths in a lifetime?

14,120,000

85,500,000

327,234,786

441,504,000 (minus 1)

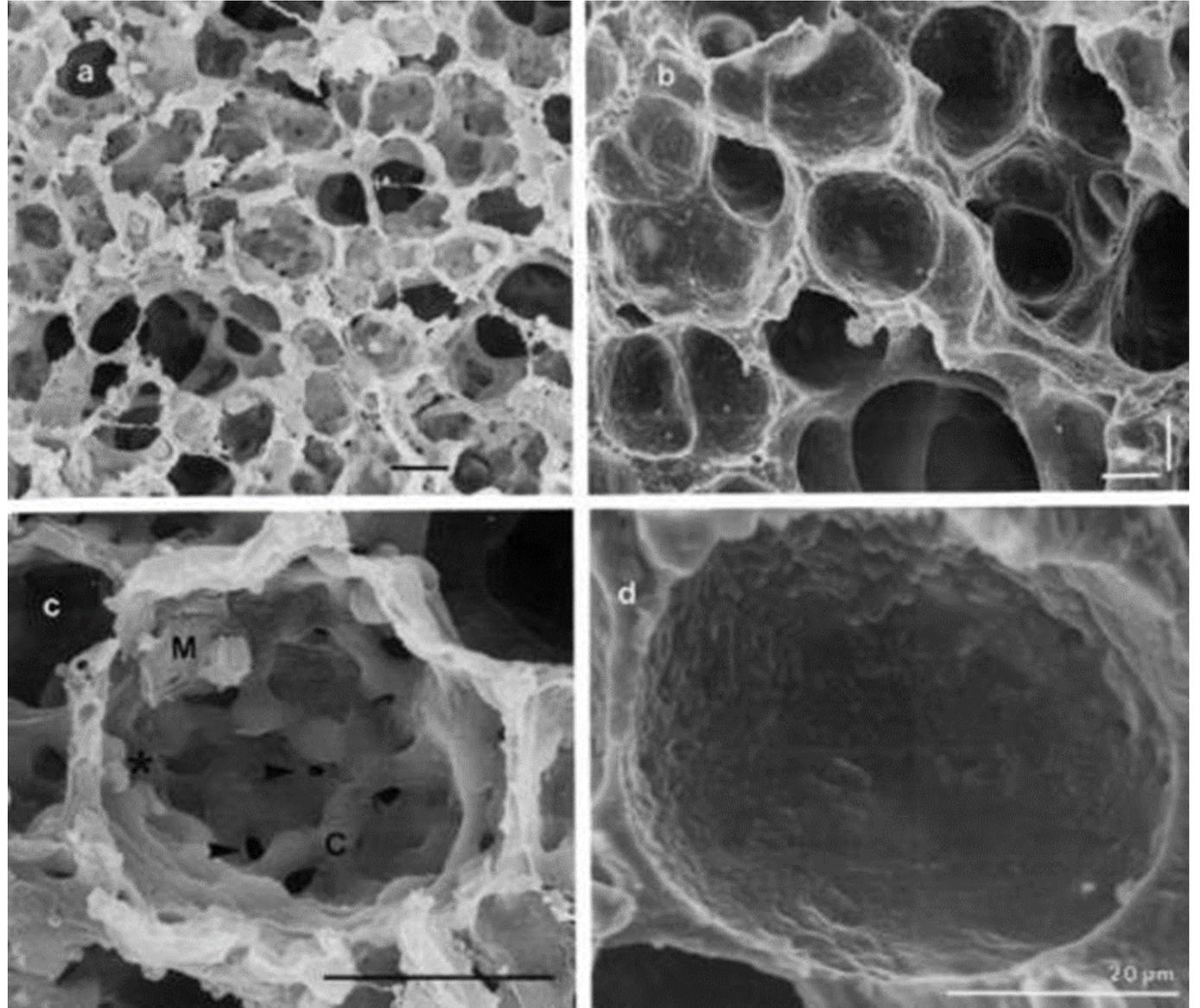


# Lifetime ventilation

441,504,000 breaths

Tidal volume = 500mls  
(or 0.5 litre) of inspired gas  
[matched to 5l/min of cardiac  
output]

= **220,752,000 litres** of  
inspired gas over a lifetime



Have Our Lungs Really  
Changed Much?

**No, Not Really:** At least for 200,000 years..

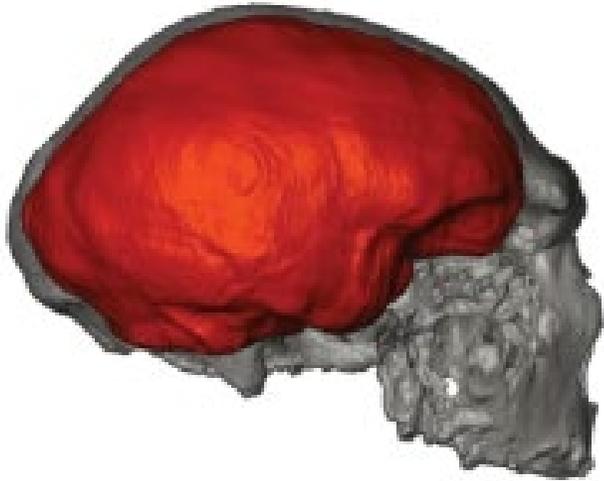


Neanderthals  
Male Lung Capacity 9.0 litres  
[Kebara and Guattari]

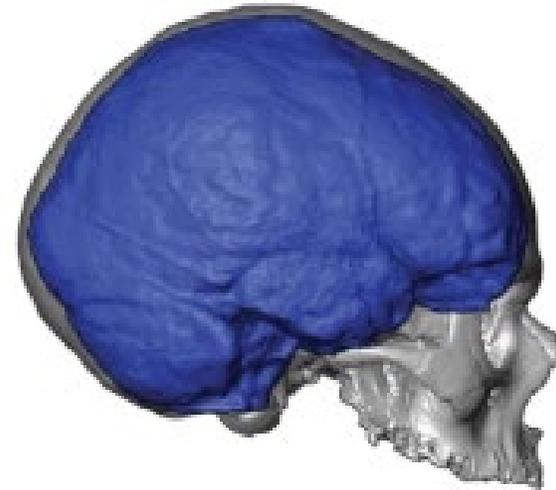


Modern Humans  
Male Lung Capacity 7.5 litres

# By Comparison, Our Brains Have Changed



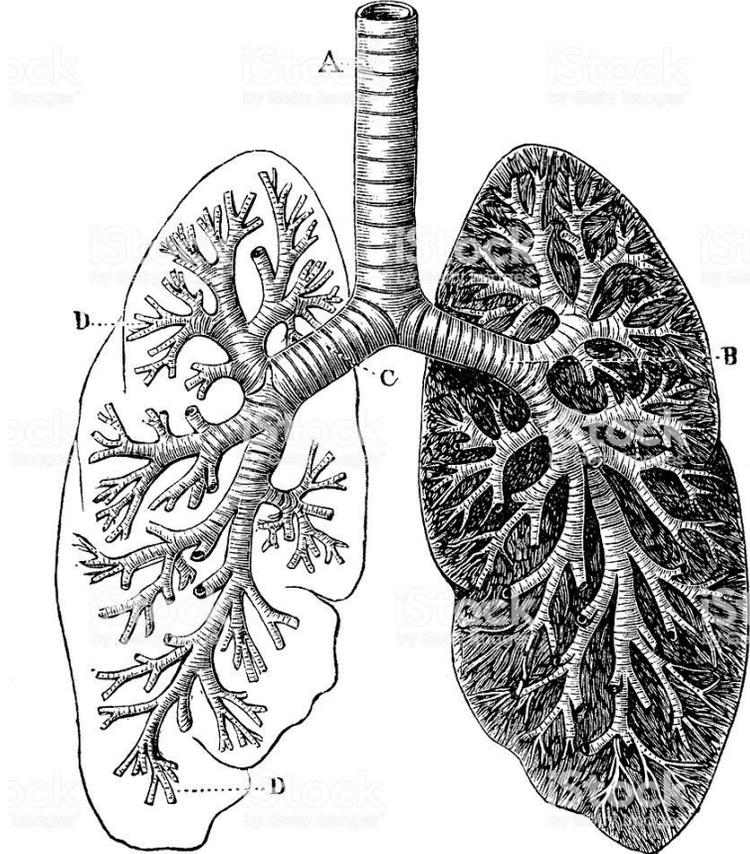
Neanderthals  
[Kebara and Guattari]



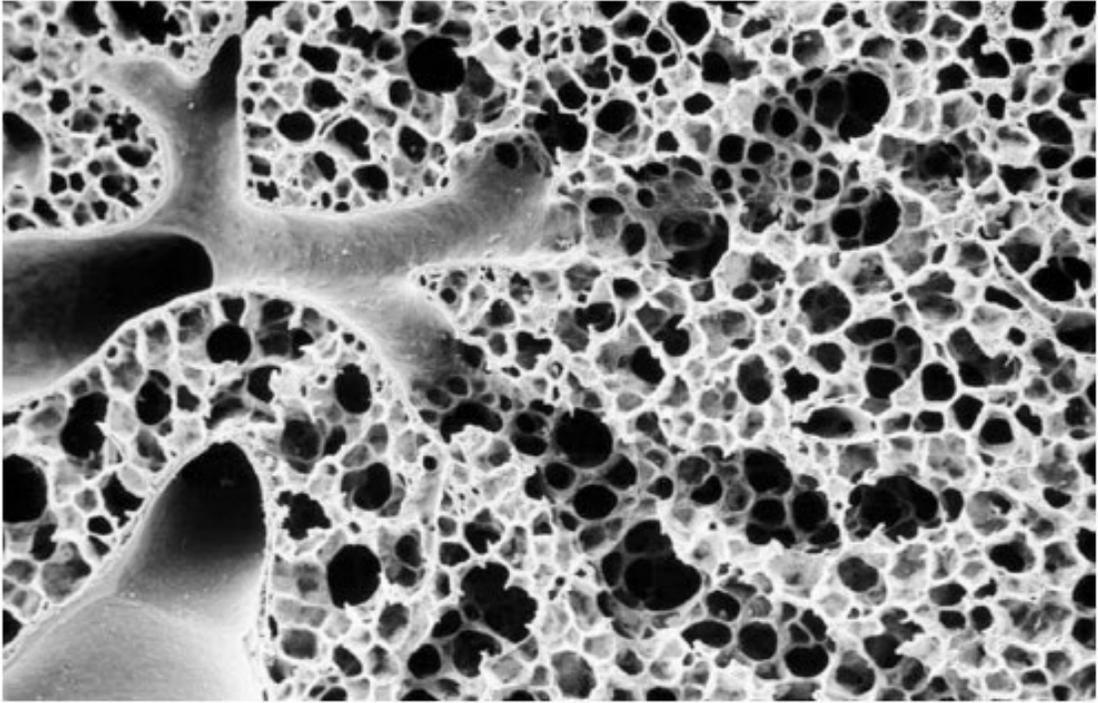
Modern Humans

# Your Lungs

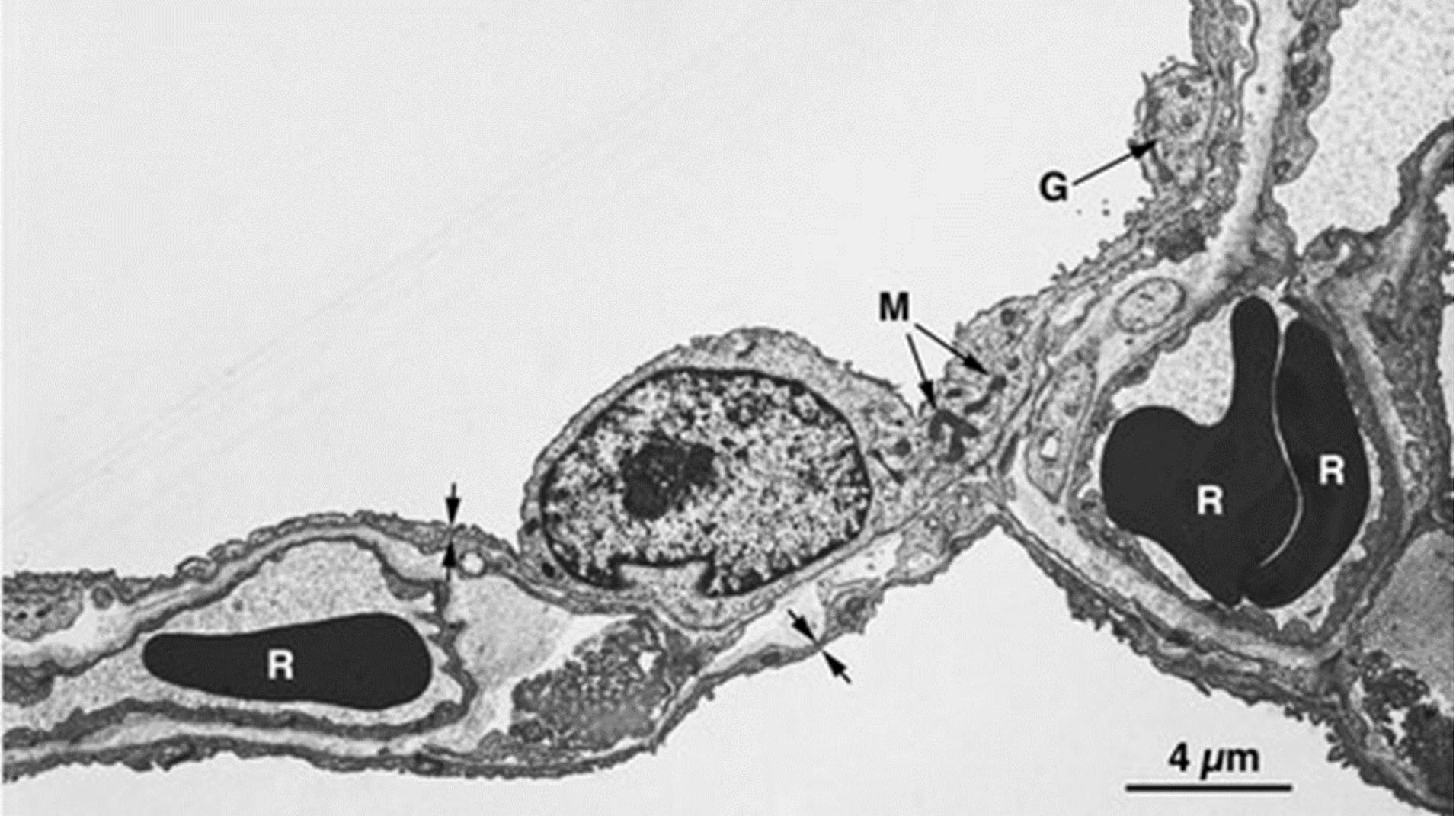
Breathing tubes (the airways)



Lung Tissue



# Gas blood interface



# So, What Has Changed?

Imaging

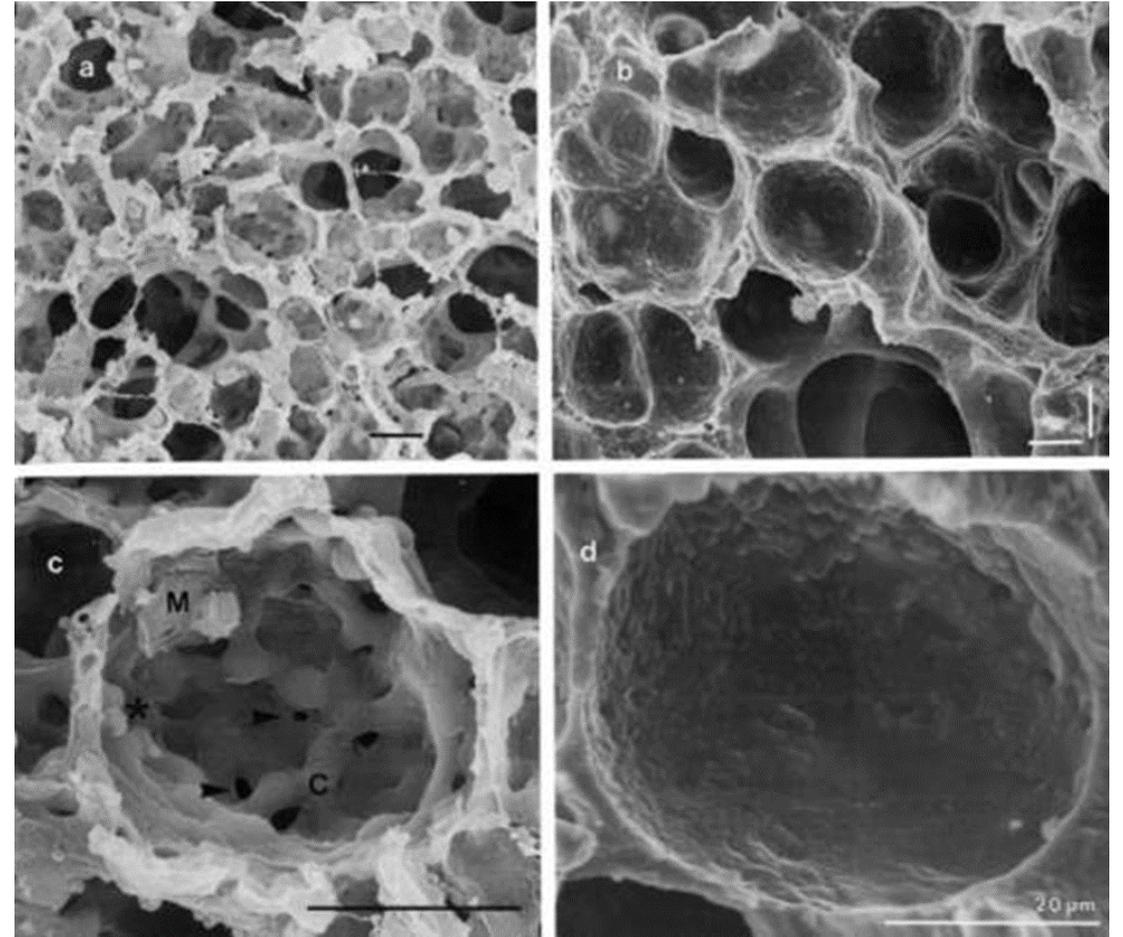
How the lungs work

How the lungs fail

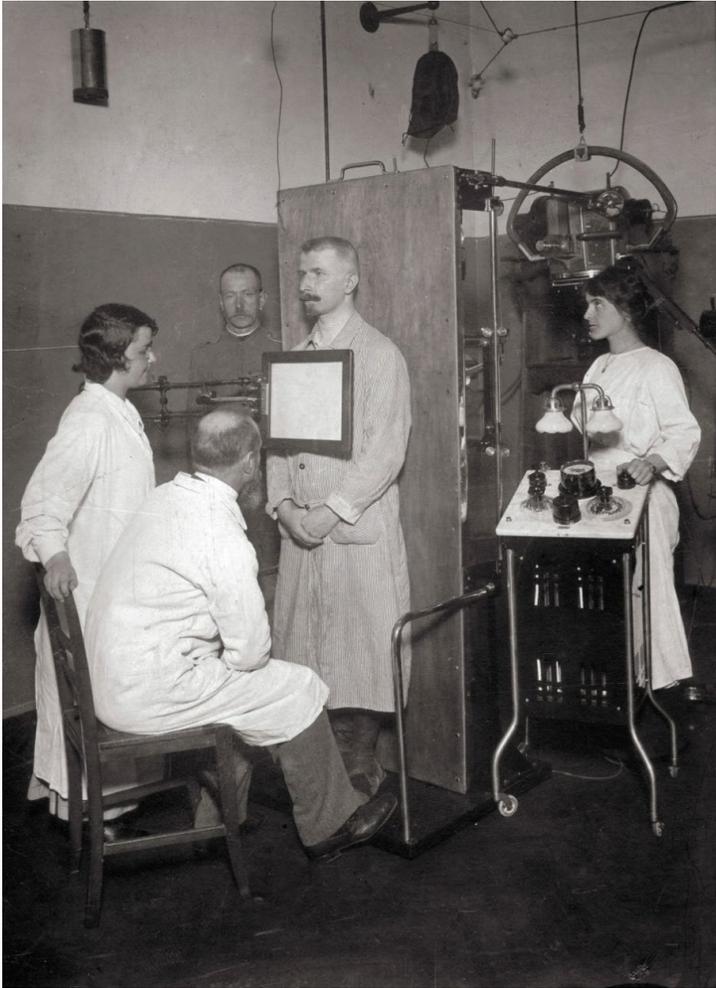
Workplace contributions to individual lung conditions

Newer population data

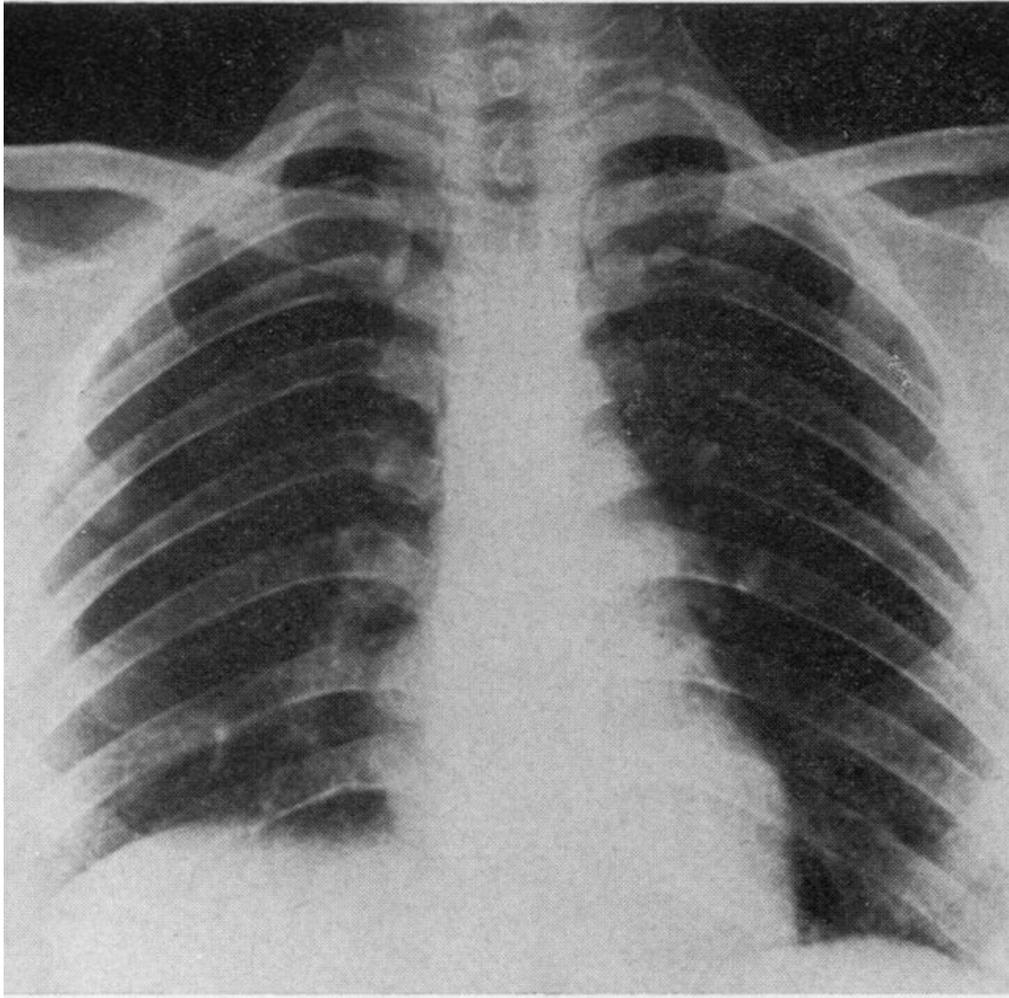
Newer techniques at work to identify early breathing problems?



# Historic Imaging

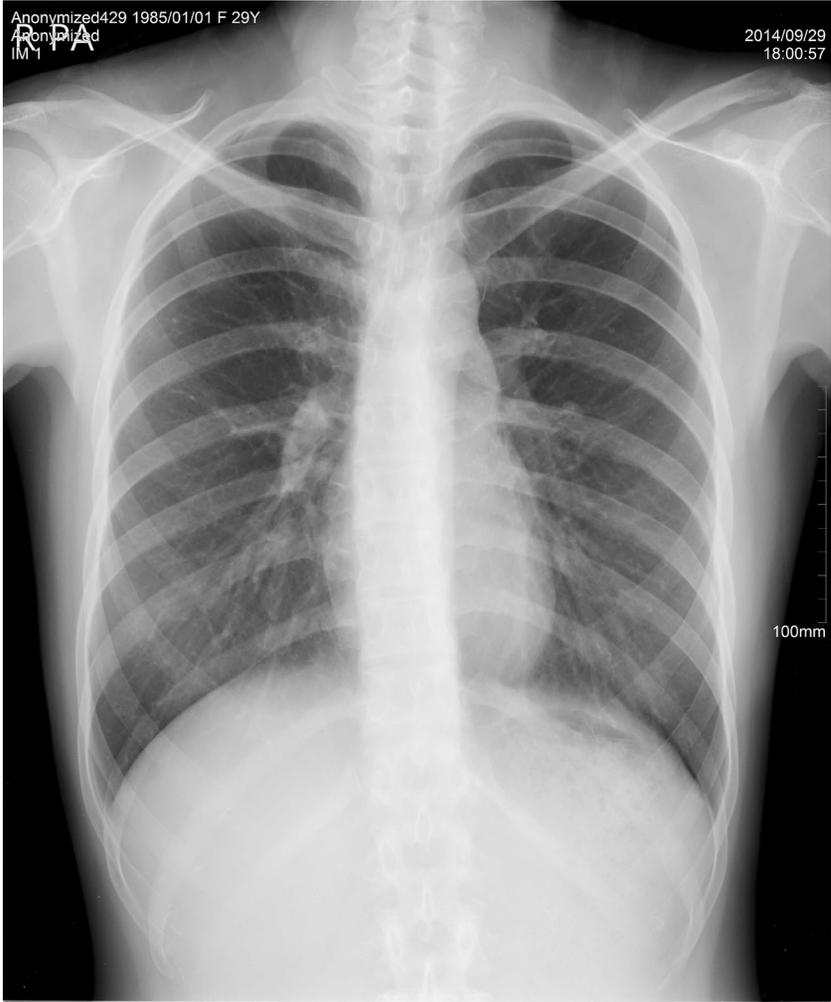


A man receiving an x-ray in Austria, circa 1910. [Imagno—Getty Images](#)



Human Chest X Ray 1971

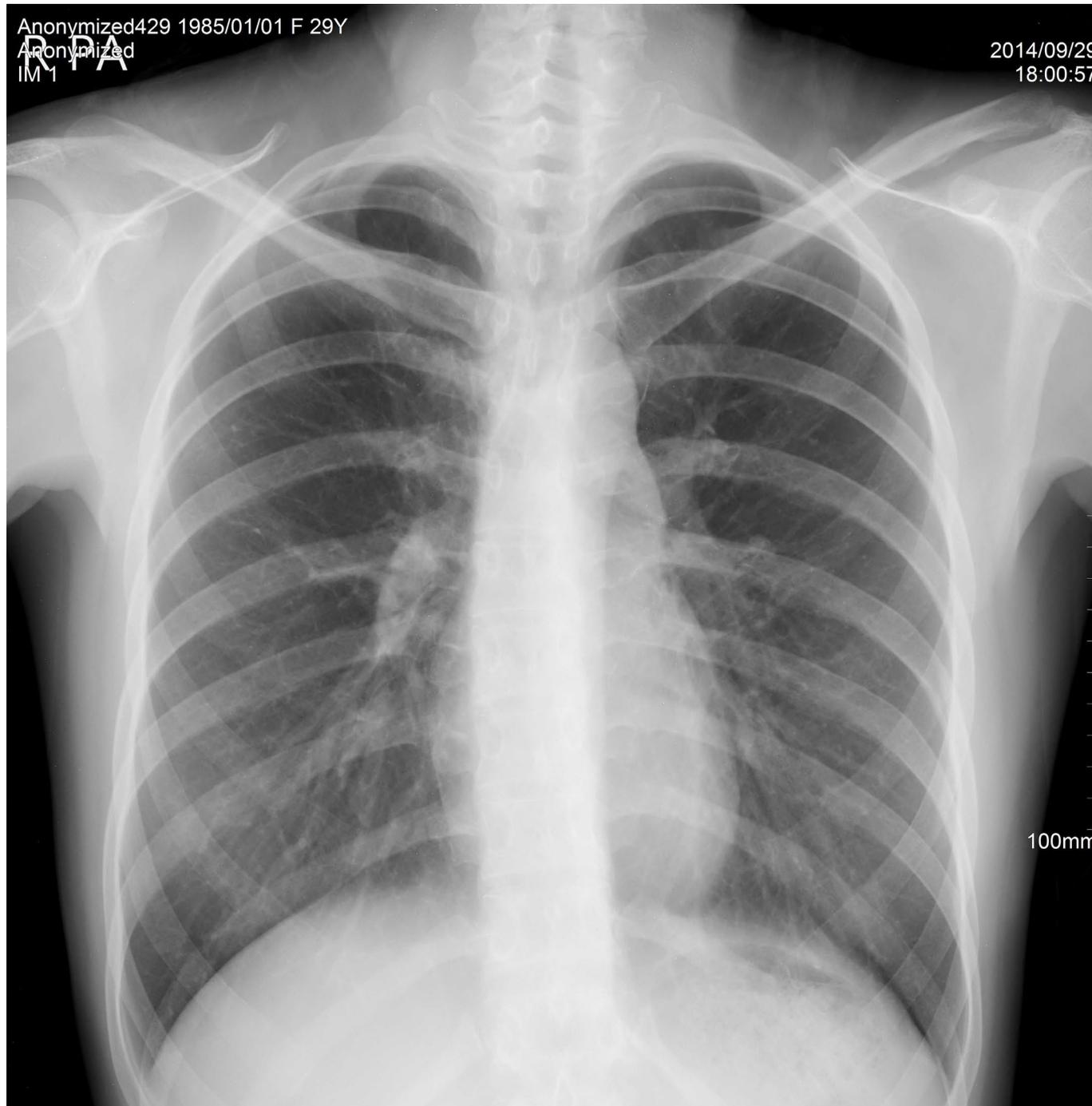
# Modern Imaging



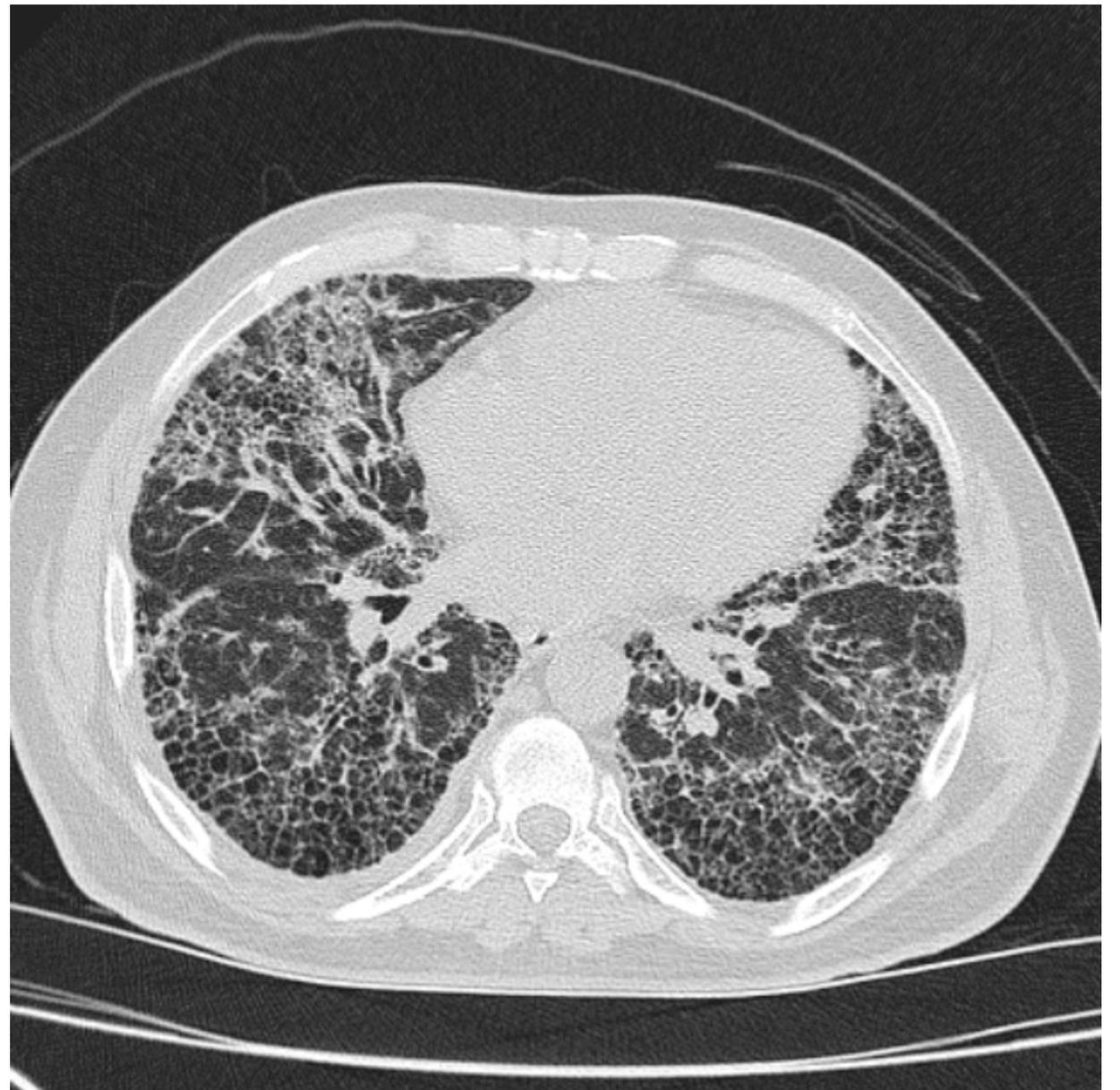
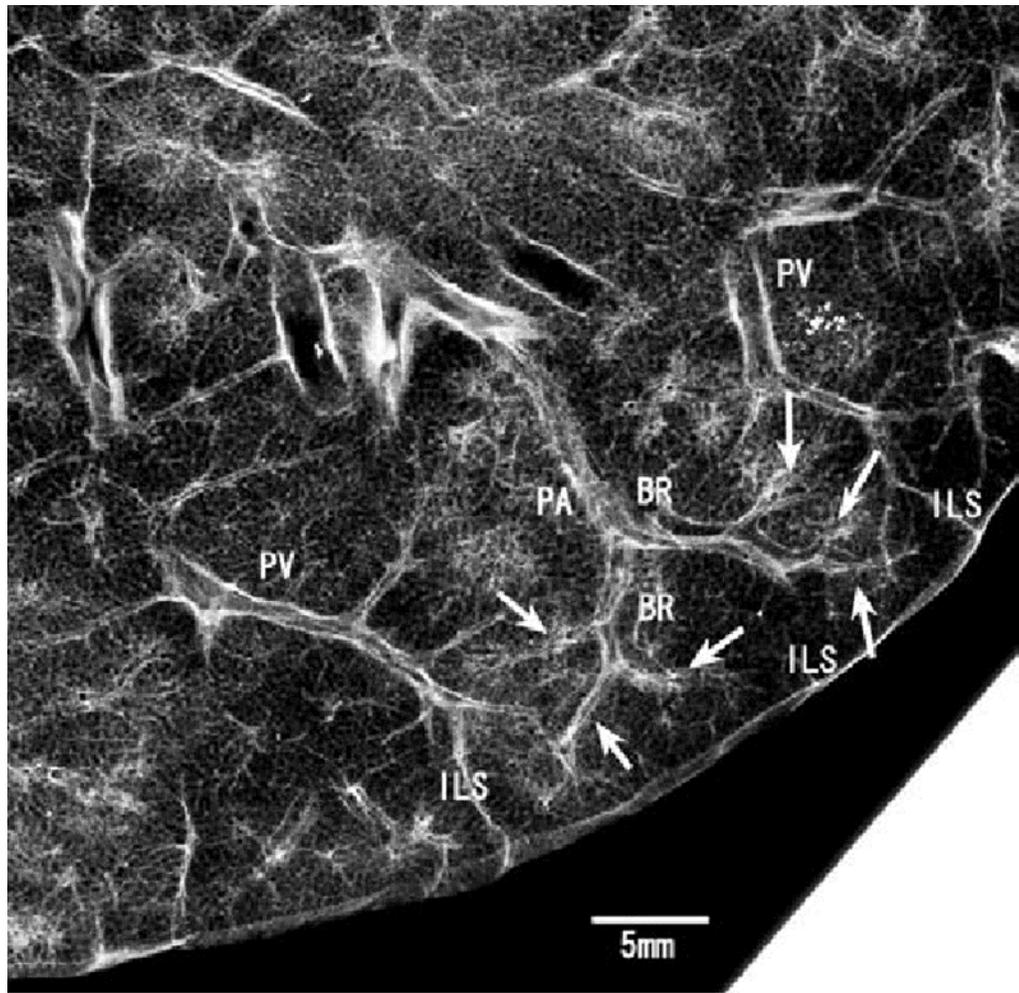
Human Chest X Ray Digital Modern

Anonymized429 1985/01/01 F 29Y  
R PA  
Anonymized  
IM 1

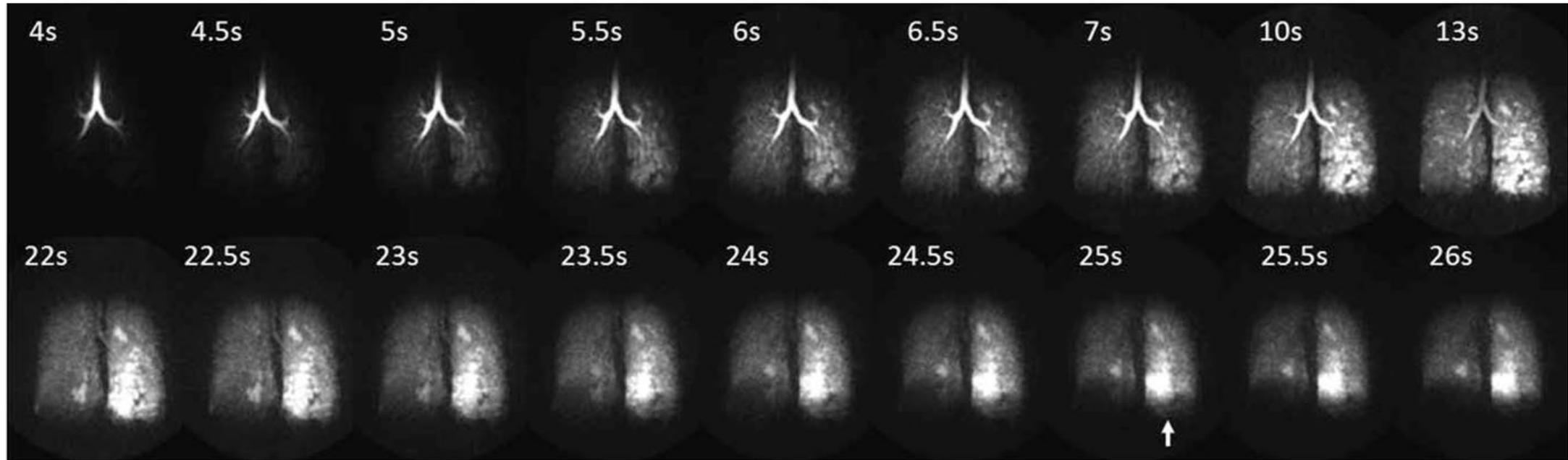
2014/09/29  
18:00:57



100mm

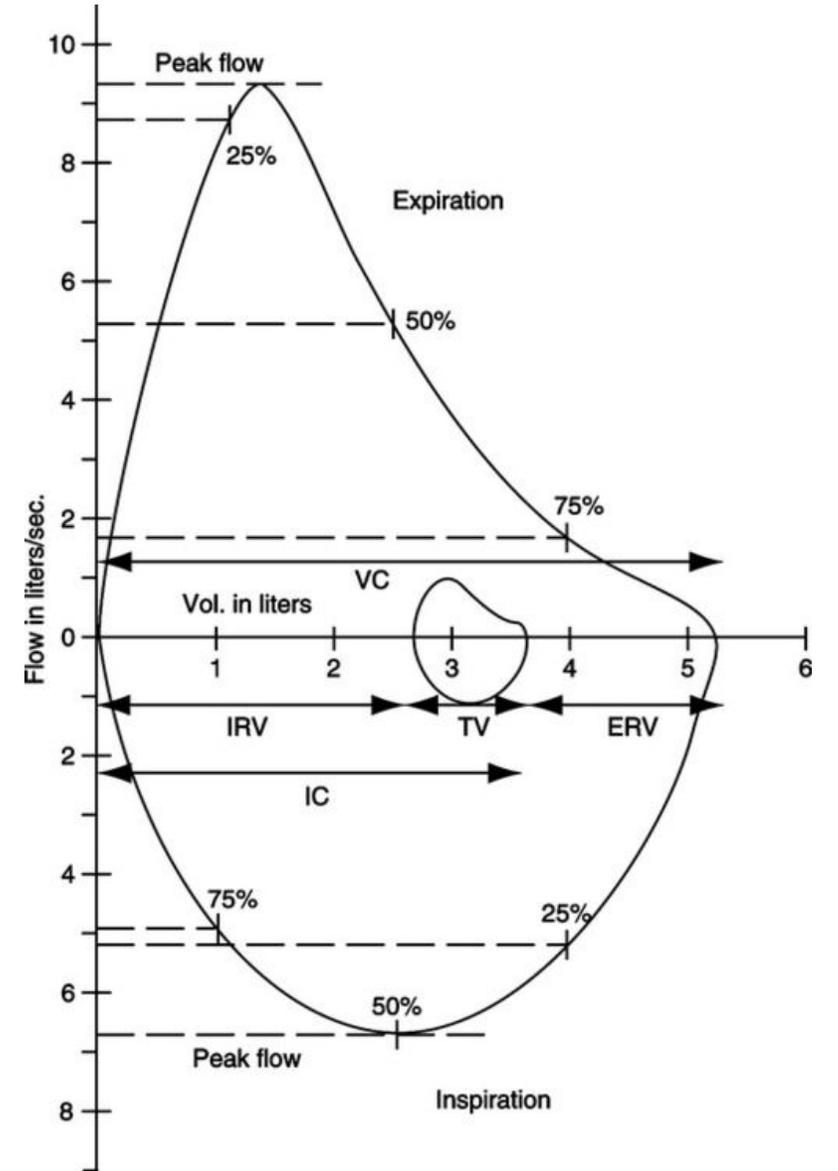
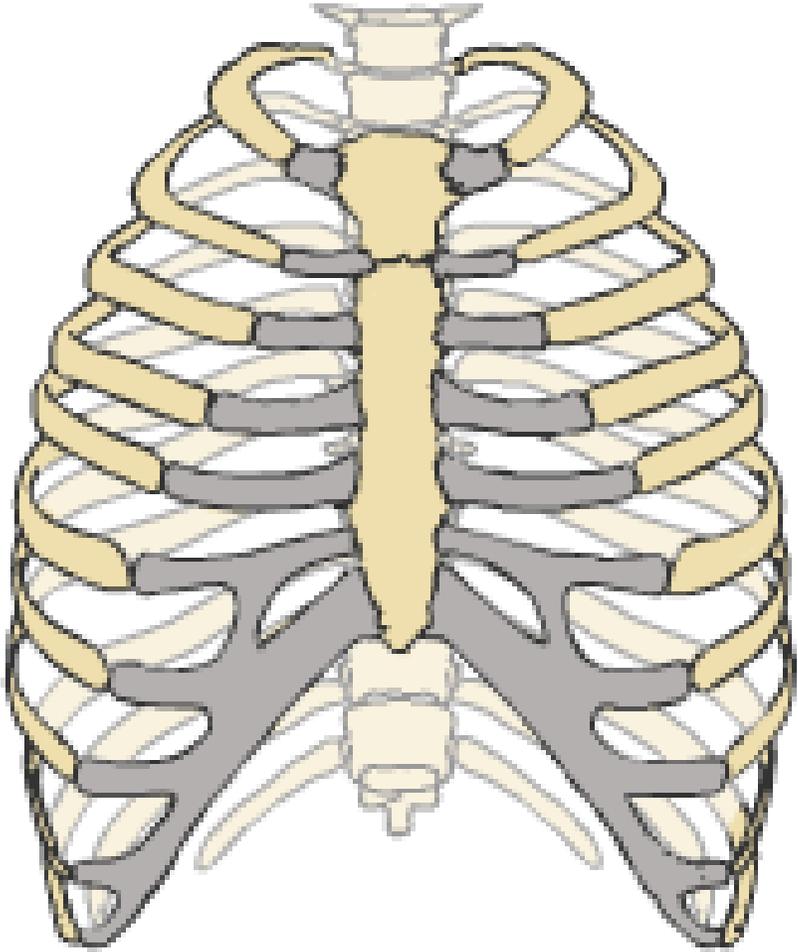


# Modern Imaging

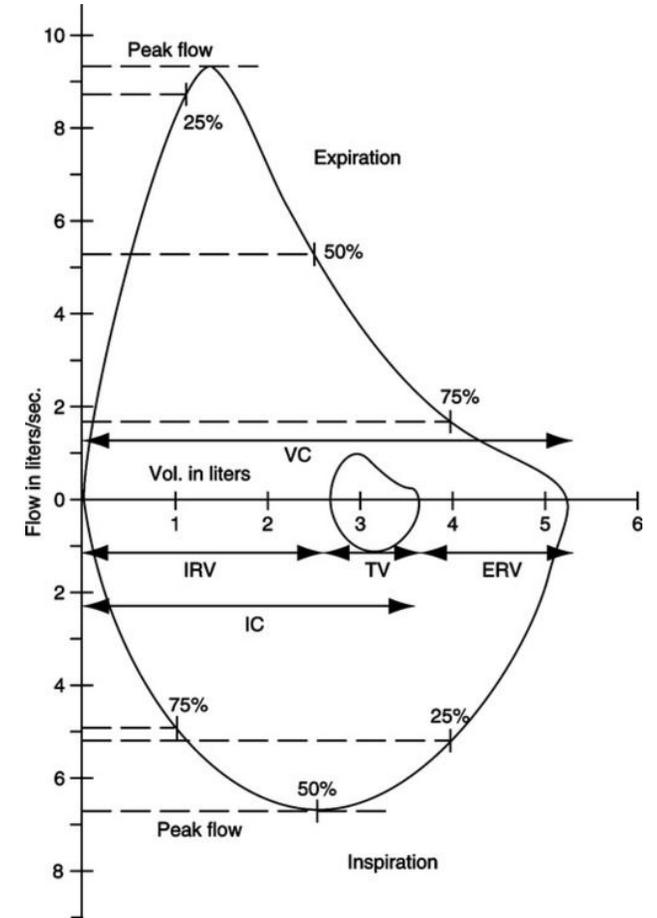


Hyperpolarised helium scanning

# How the Lungs Work



# How the Lungs Work



# How the Lungs Fail

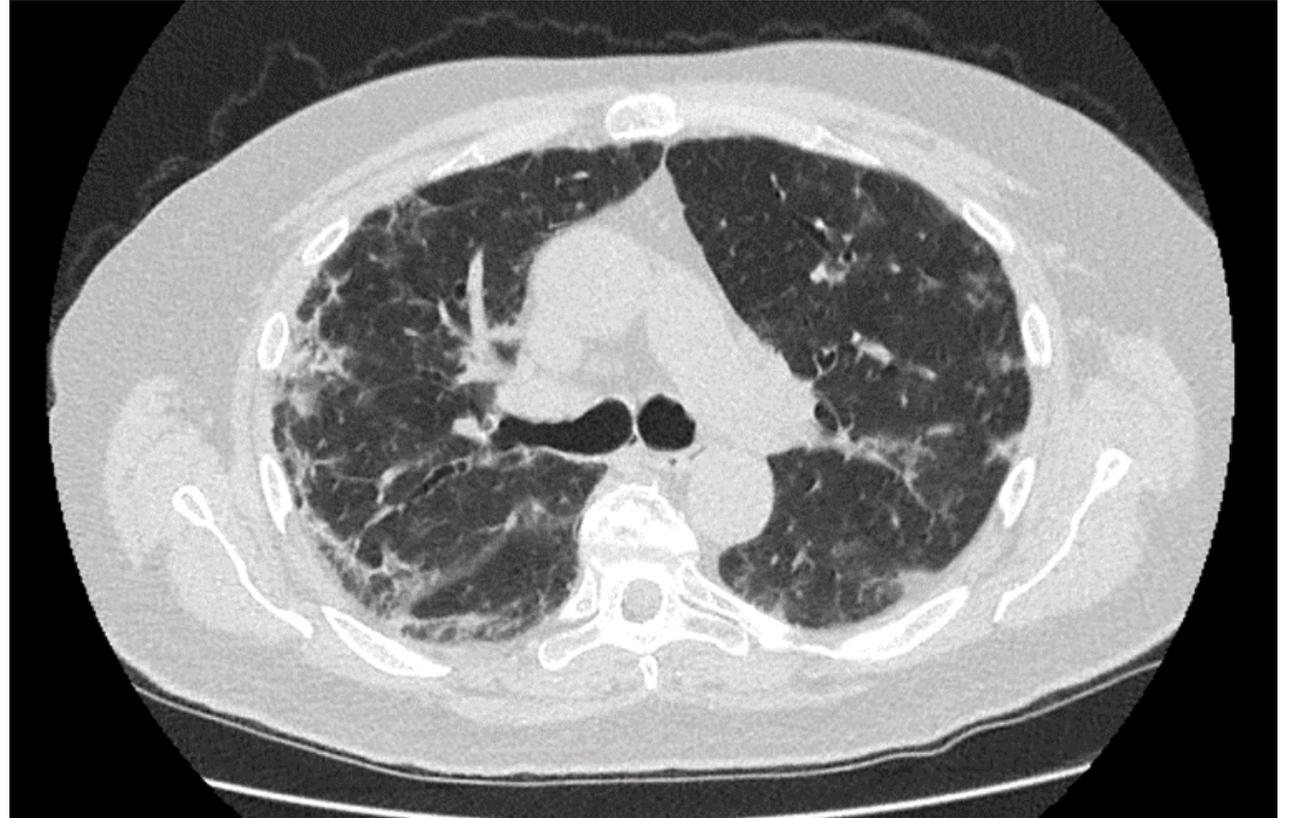
63-year-old male

Never smoker

No birds, pets, drugs, medications,  
connective tissue disorder

Recently unwell and short of breath

4 months heavy, 4 years possible  
asbestos exposure



Asthma

# [Occupational] Asthma History

Bernardino Ramazzini, 1700s; baking and grain handling

Hippocrates; farm hands and metal workers

Symptoms

No understanding of the causes or treatments



# [Occupational] Asthma Now

Highly prevalent ( $\approx 7\%$  adults)

Genetic and environmental components

Inflammatory [FeNO, breath condensate, lavage]

Lymphocyte mediated [CD4 CD25]

Multiple phenotypes

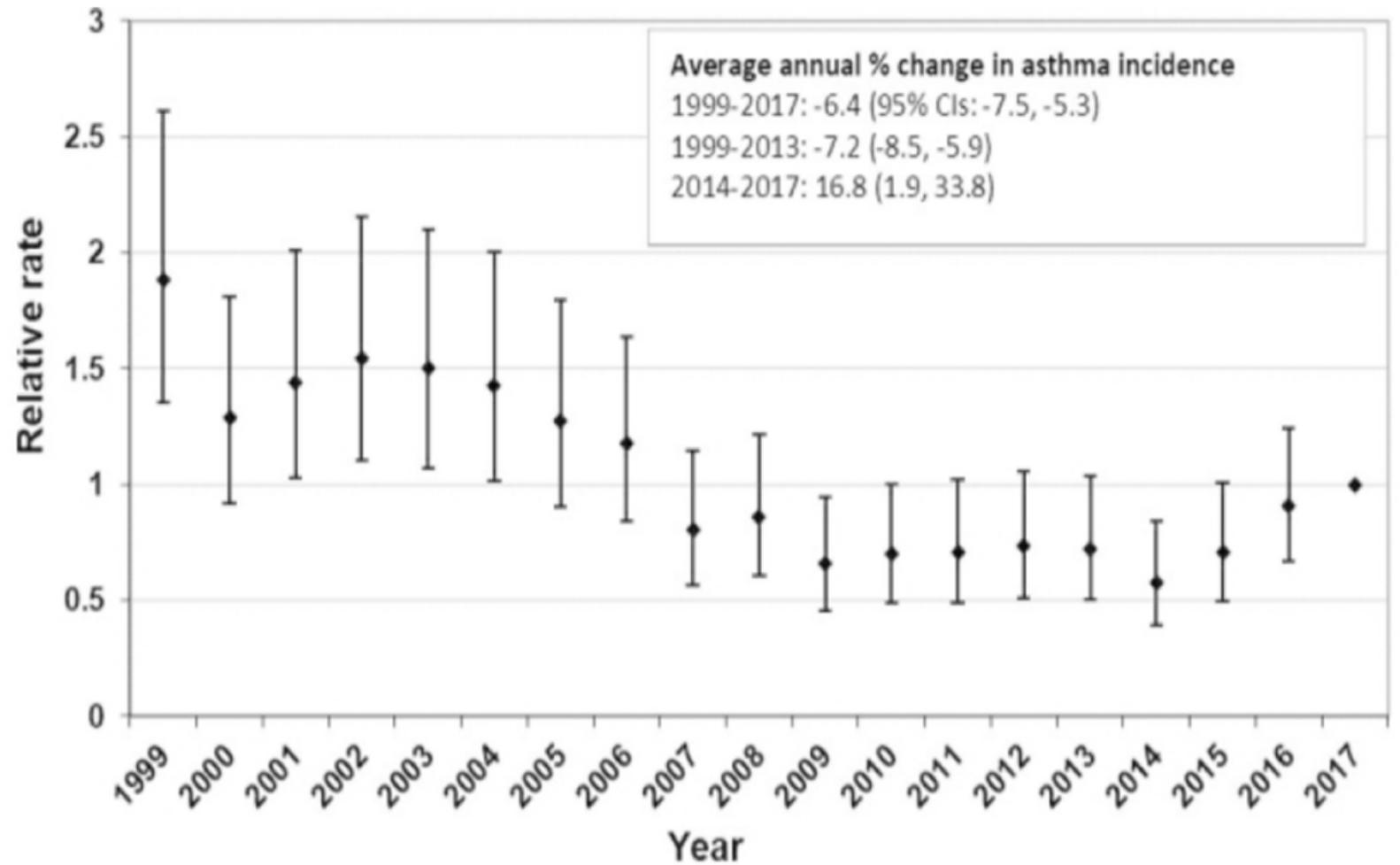
Linked to many individual work exposures

Excellent, highly effective, treatment strategies

[Incidence flat ? Increasing]



# [Occupational] Asthma Now

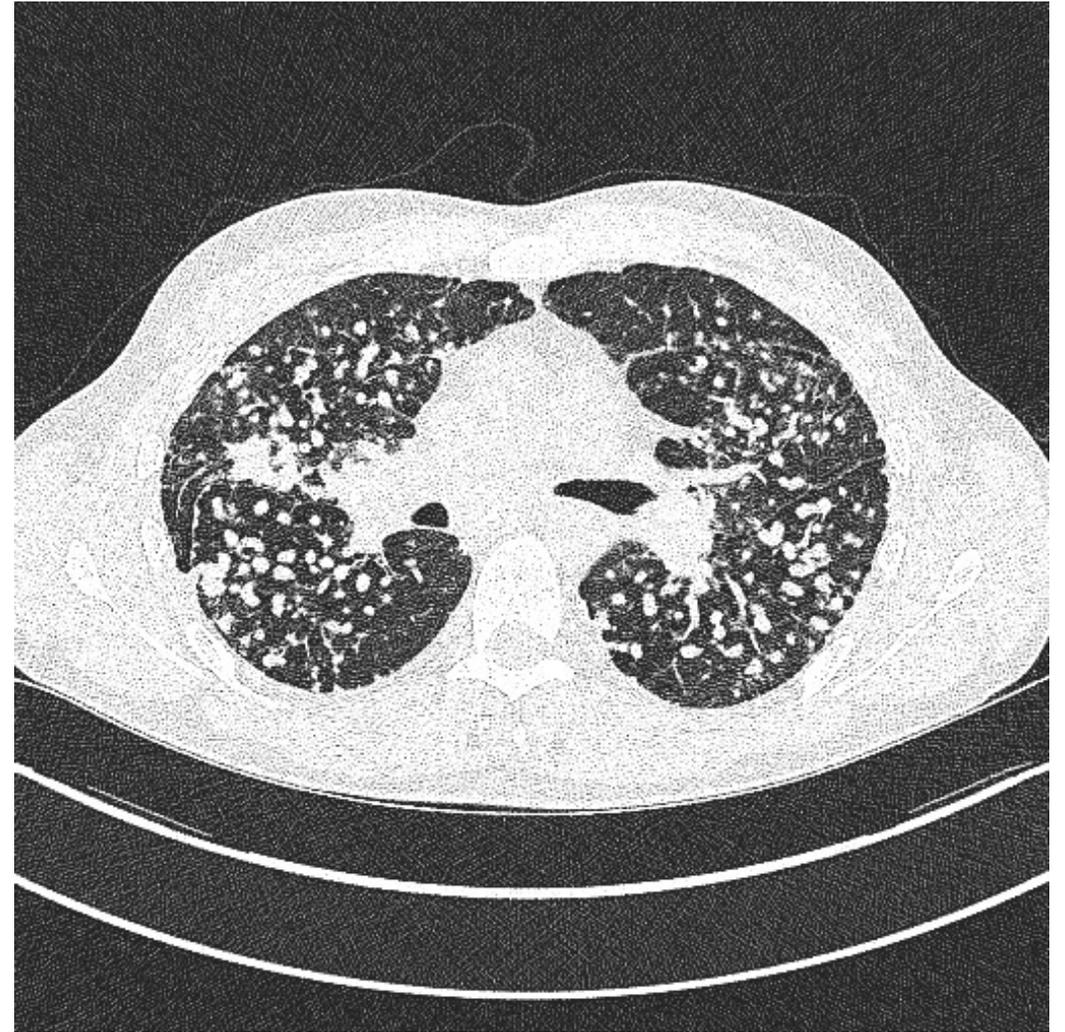


Silicosis

# Silicosis History

Agricola, 1556: described high death rate from lung diseases amongst metal miners in the Carpathian mountains. Wives could have many husbands.

Ramazzini, 1700s: Metal diggings and ill health



# Silicosis Now

Unfortunately, globally prevalent

Genetic and environmental components

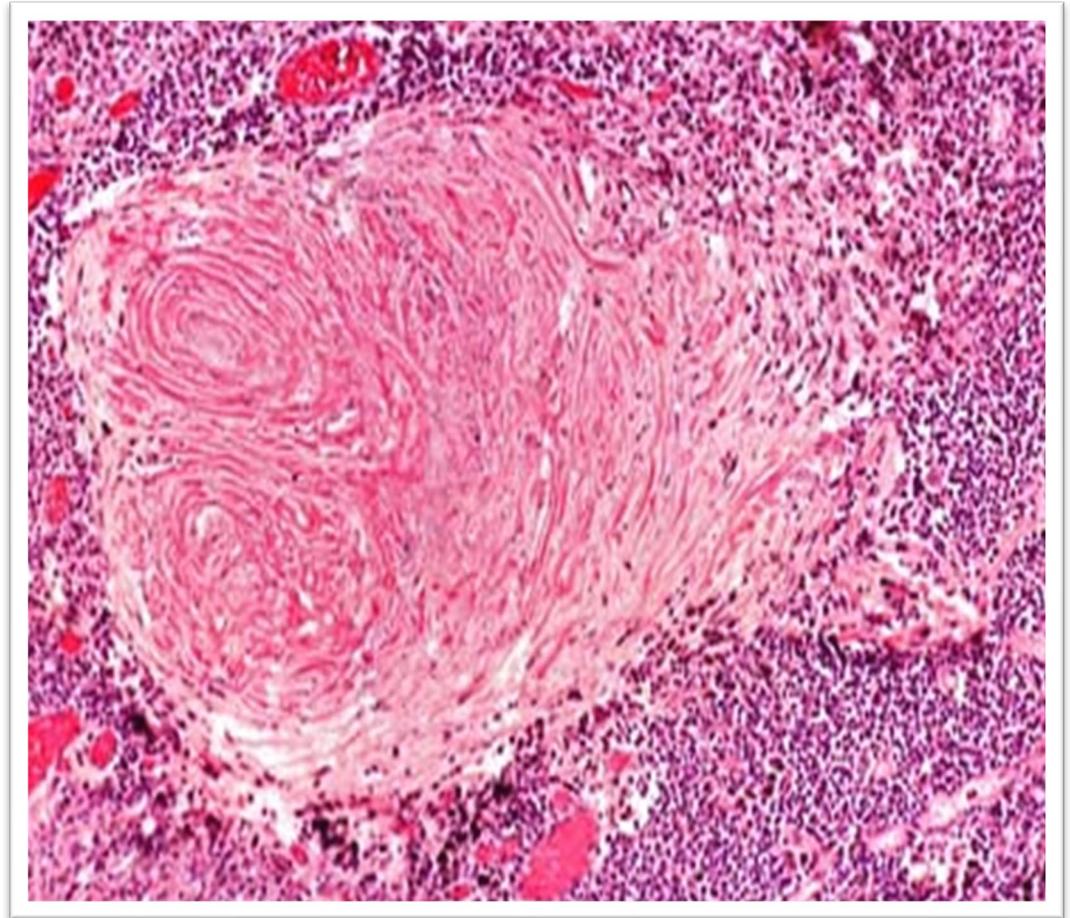
Inflammatory with lung fibrosis

Acute, accelerated and chronic types

Linked to many individual work tasks where RCS exposure is likely

No effective treatment strategies?

[country by country differences in incidence and prevalence]



# Artificial Stone Silicosis



Used with permission 2019; Dr Ryan Hoy, Sydney, Australia

# Whats wrong with this chest scan?

Lungs too white



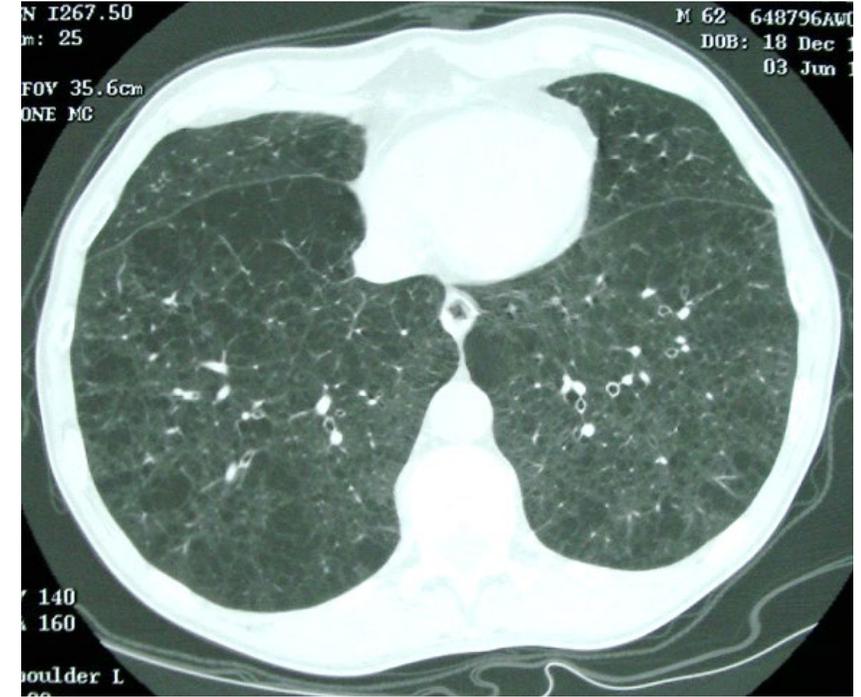
Lungs too black



Lungs have fluid



Lungs have holes



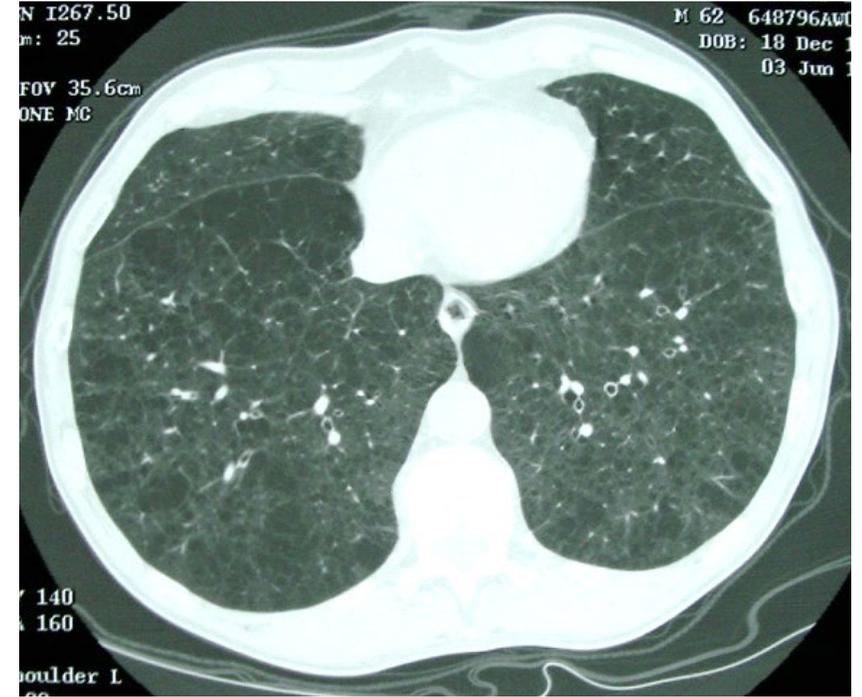
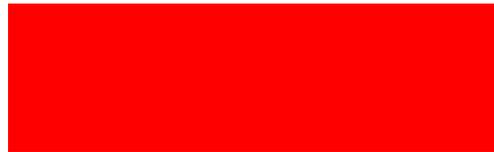
# Whats wrong with this chest scan?

Lungs too white

Lungs too black

Lungs have fluid

Lungs have holes



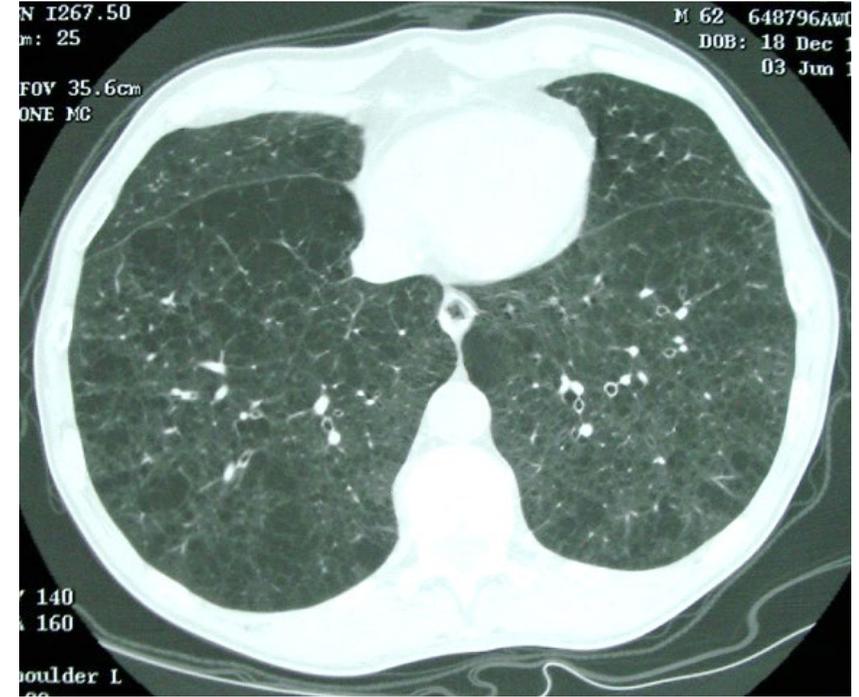
COPD

# [Occupational] COPD History

A long evolution

Pre-dates tobacco smoking

Considered as bronchitis and emphysema



# A Chest X Ray



# [Occupational] COPD Now

Unfortunately, globally highly prevalent

14-15% of the entire COPD burden is attributed to occupational exposures

Tobacco and other causes and risks

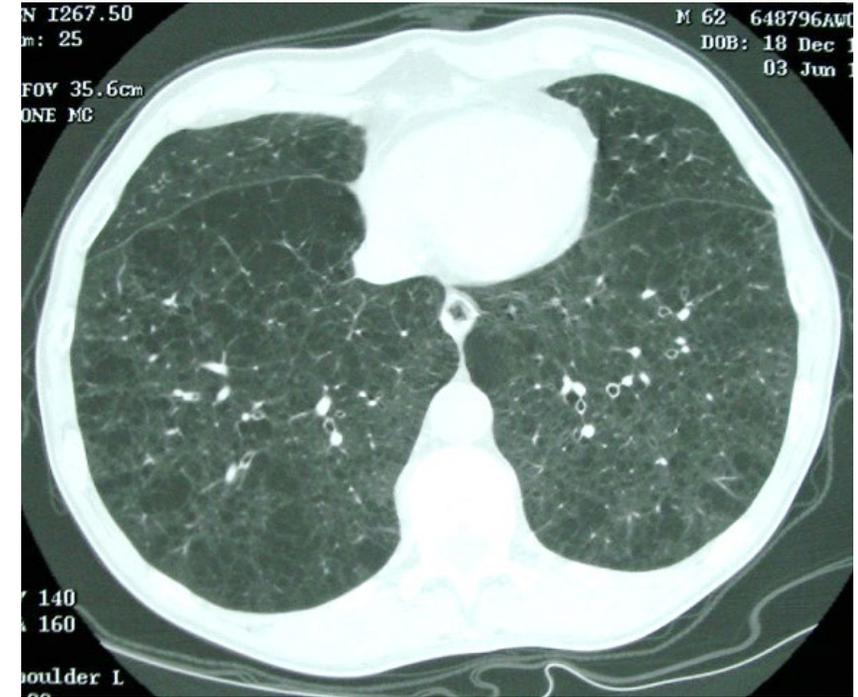
Genetic and environmental risk factors [dust=emphysema]

Occupational risk factors [silica, cadmium, cotton, dust]

At least in part inflammatory

Multiple treatment approaches: variably successful

[incidence increasing]



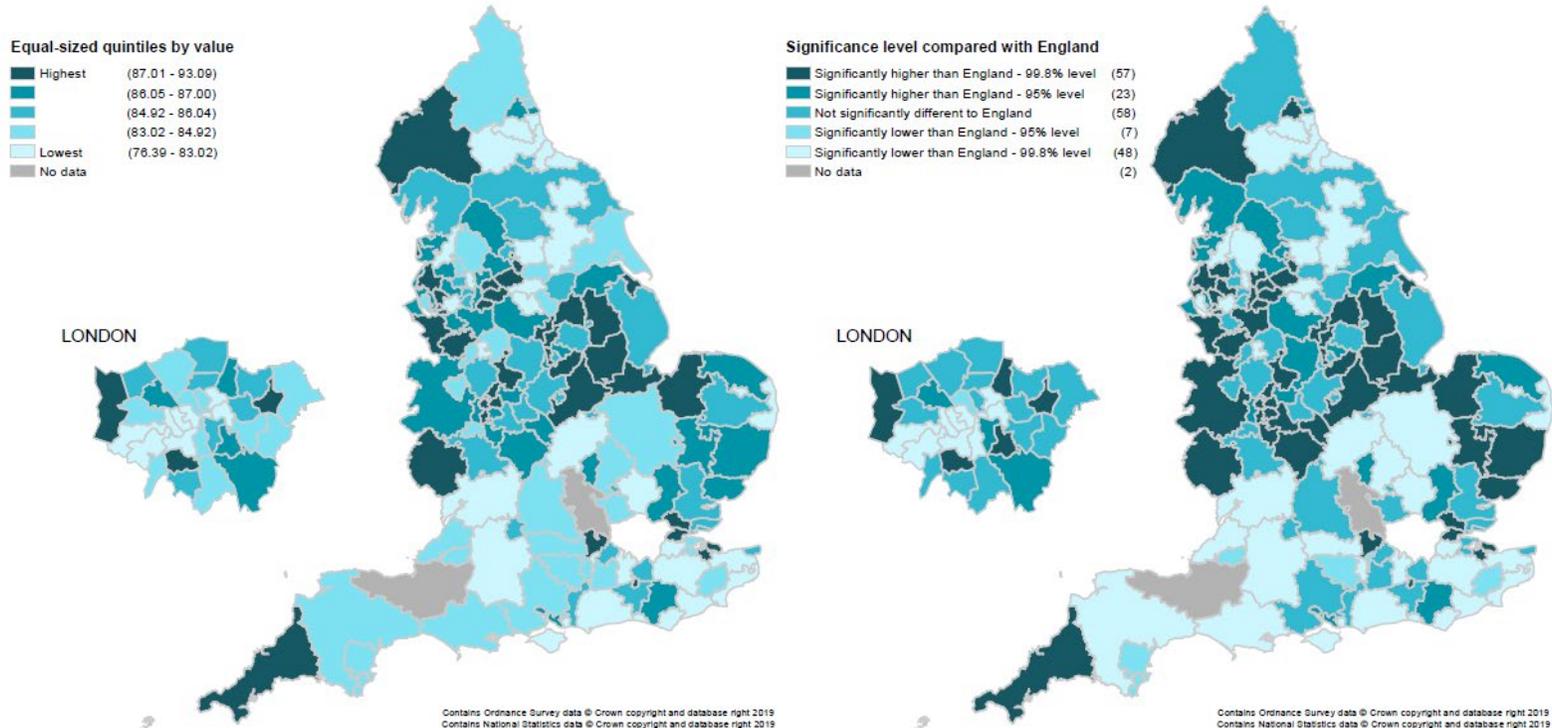
# Newer Population Data

# Asthma; GP registers 2017-2018

Asthma – Primary care - Diagnosis

**Map 13b:** Variation in percentage of patients with asthma on GP registers aged 8 years or over, in whom measures of variability or reversibility are recorded (including exceptions) by CCG (2017/18)

Optimum value: High

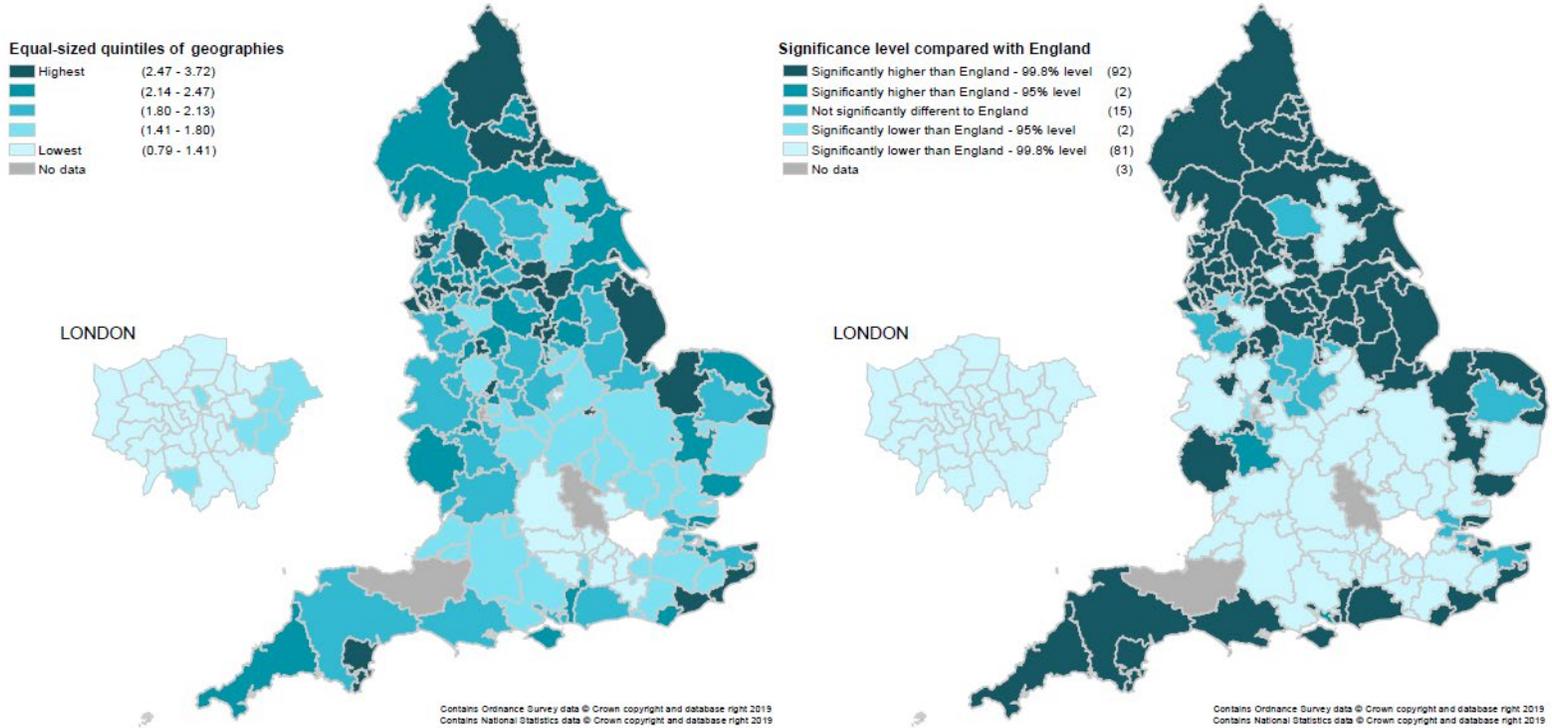


# COPD; GP registers 2017-2018

COPD – Disease burden

**Map 7c: Variation in percentage of patients with COPD on GP registers by CCG (2017/18)**

Optimum value: Requires local interpretation



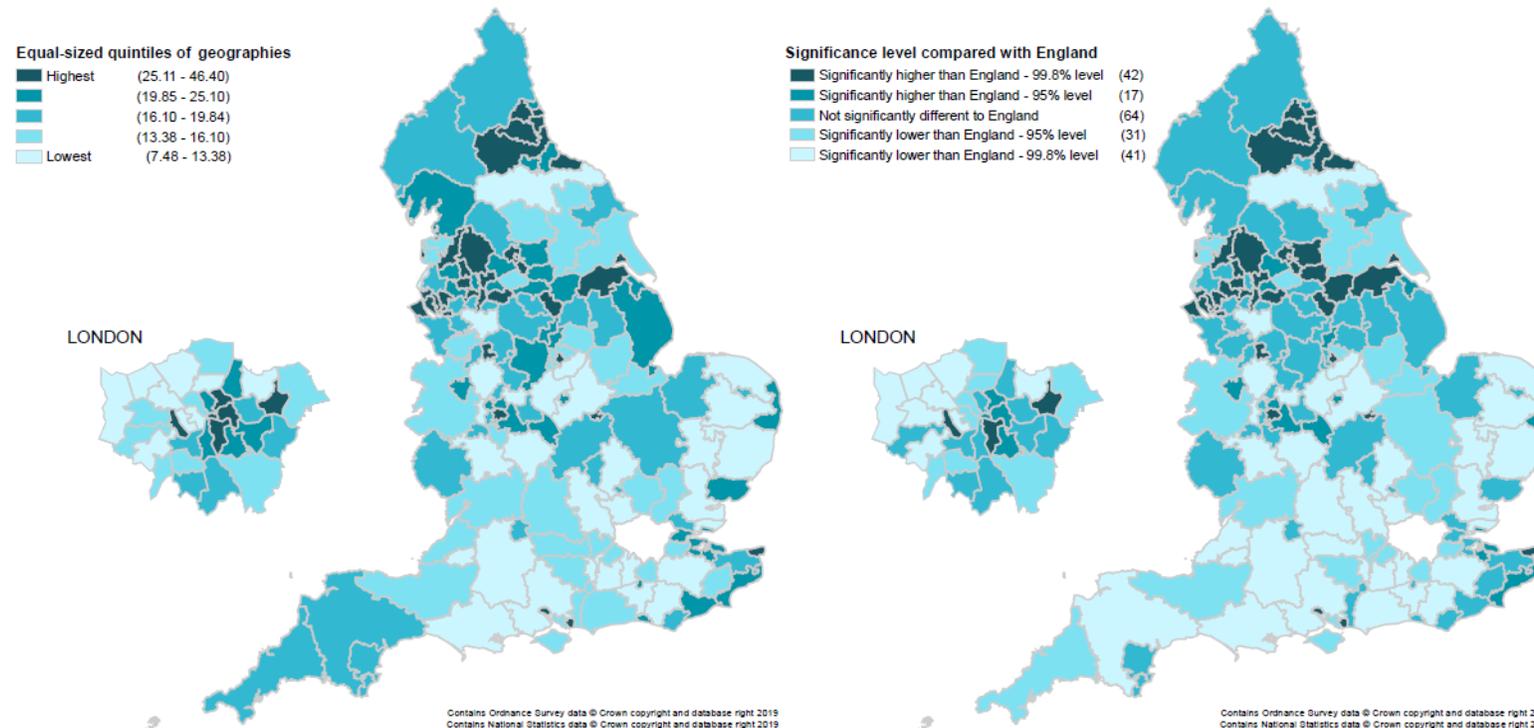
# Preventable Respiratory Disease 2015-2017

All respiratory disease – Disease burden

**Map 21b:** Variation in mortality rate from respiratory disease considered preventable in persons aged under 75 years per population by CCG (2015-2017)

Directly standardised rate per 100,000

Optimum value: Low



# Mesothelioma SMRs 1981-2021

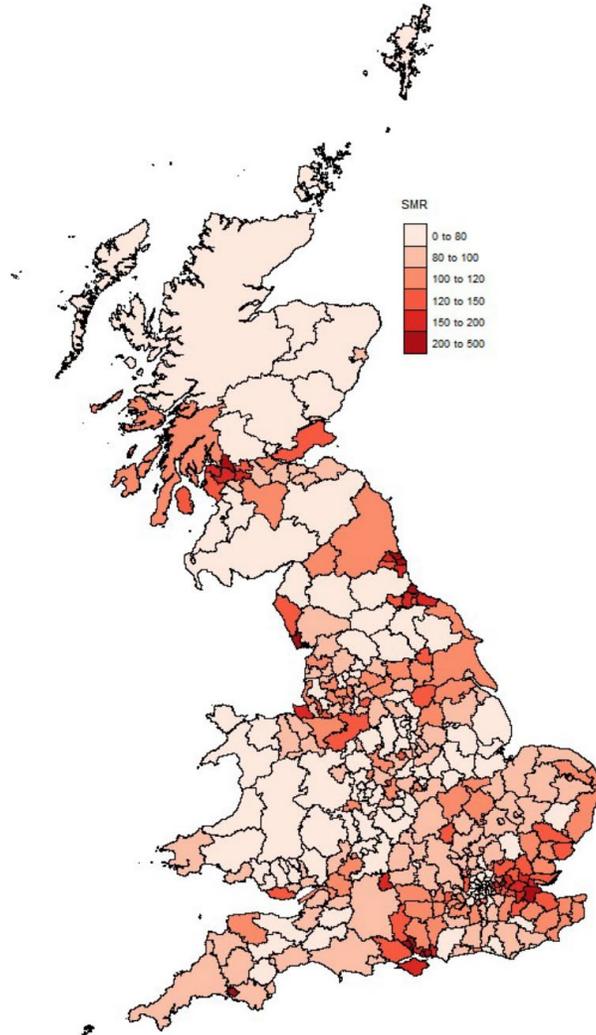


Figure 2 – Mesothelioma SMRs for males by geographical area for the period 1981-2021

# Mesothelioma SMRs 1981-2021

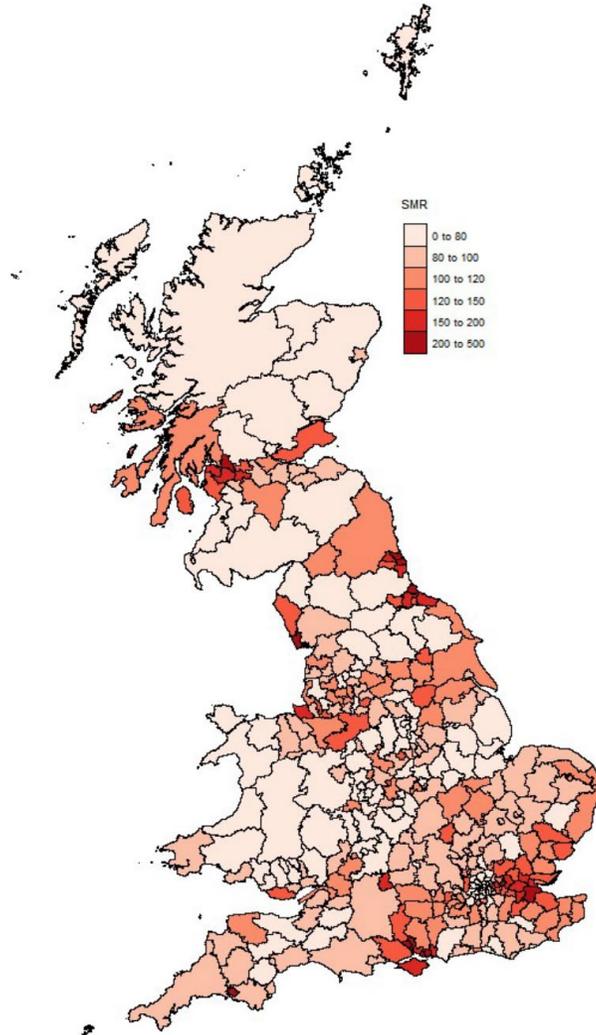
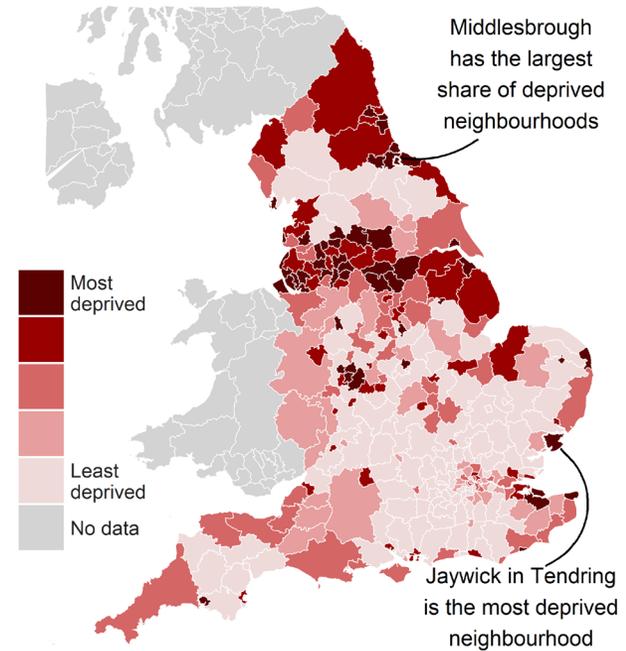


Figure 2 – Mesothelioma SMRs for males by geographical area for the period 1981-2021

## Deprivation across England

Indices of multiple deprivation 2019



Source: MHCLG

BBC

# Mesothelioma SMRs 1981-2021

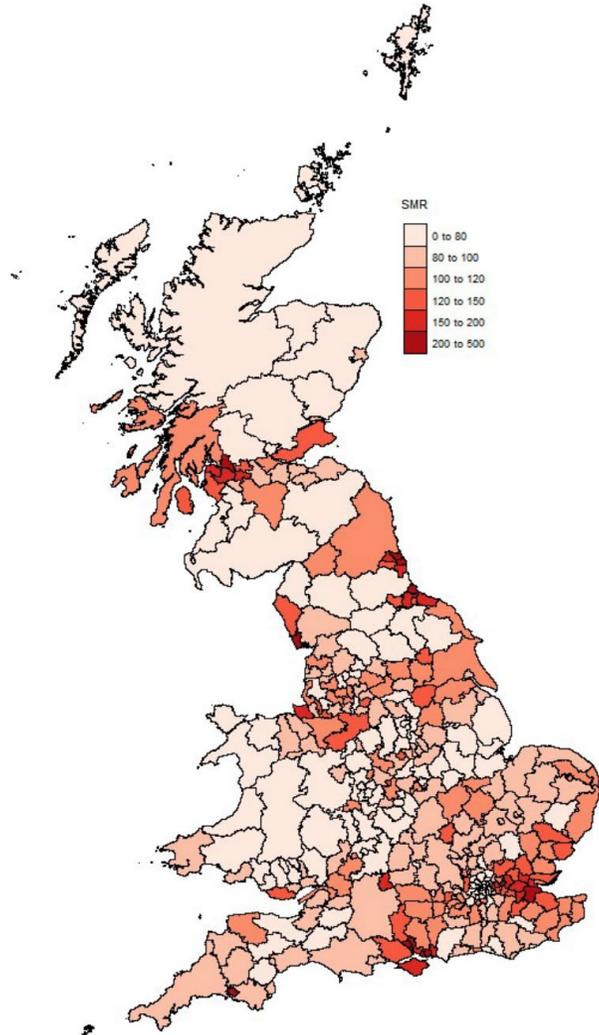


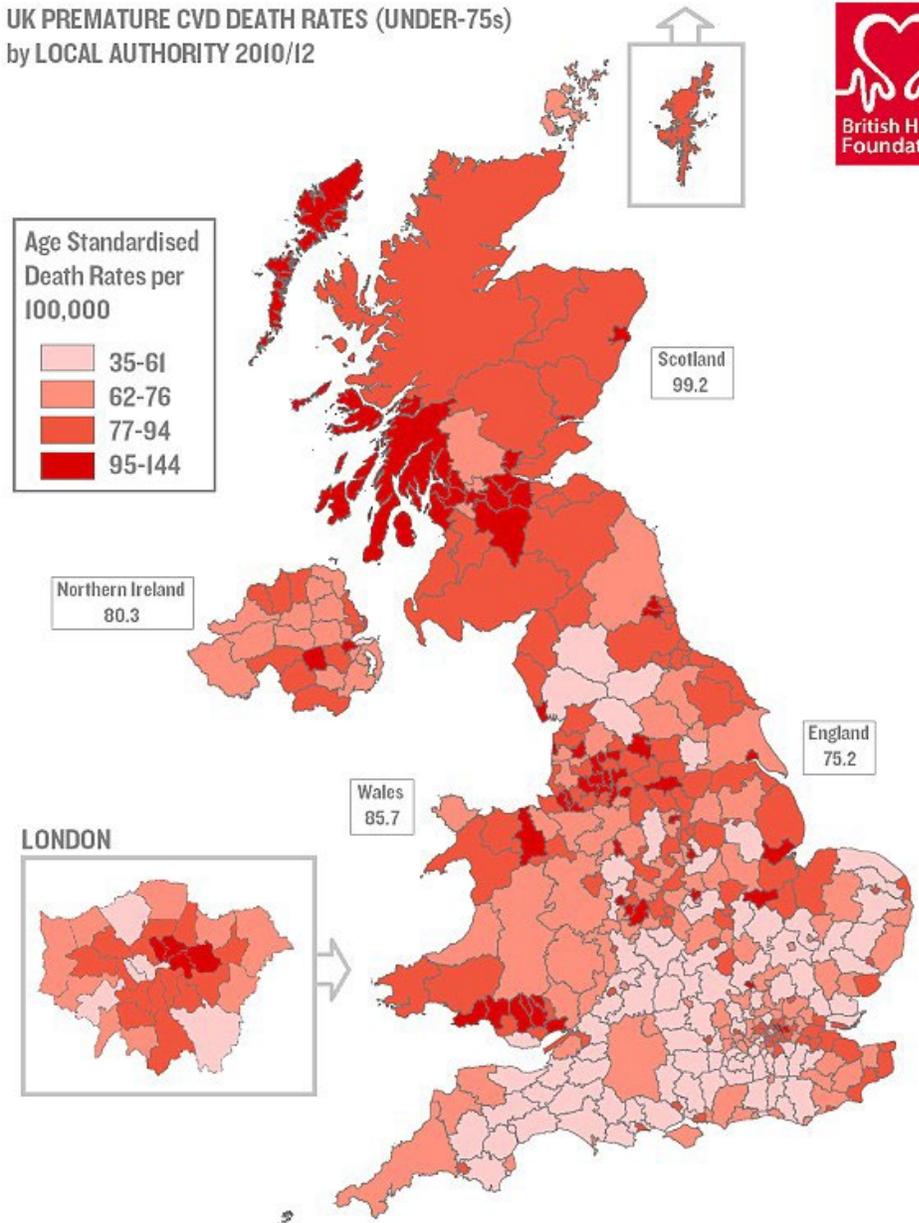
Figure 2 – Mesothelioma SMRs for males by geographical area for the period 1981-2021

UK PREMATURE CVD DEATH RATES (UNDER-75s)  
by LOCAL AUTHORITY 2010/12



Age Standardised  
Death Rates per  
100,000

- 35-61
- 62-76
- 77-94
- 95-144



Newer techniques at work  
to identify early breathing problems?

# Newer Techniques @ work

Questionnaires

Lung Function

Blood tests

Exhaled breath nitric oxide [ $FE_{NO}$ ]

Measures airway inflammation

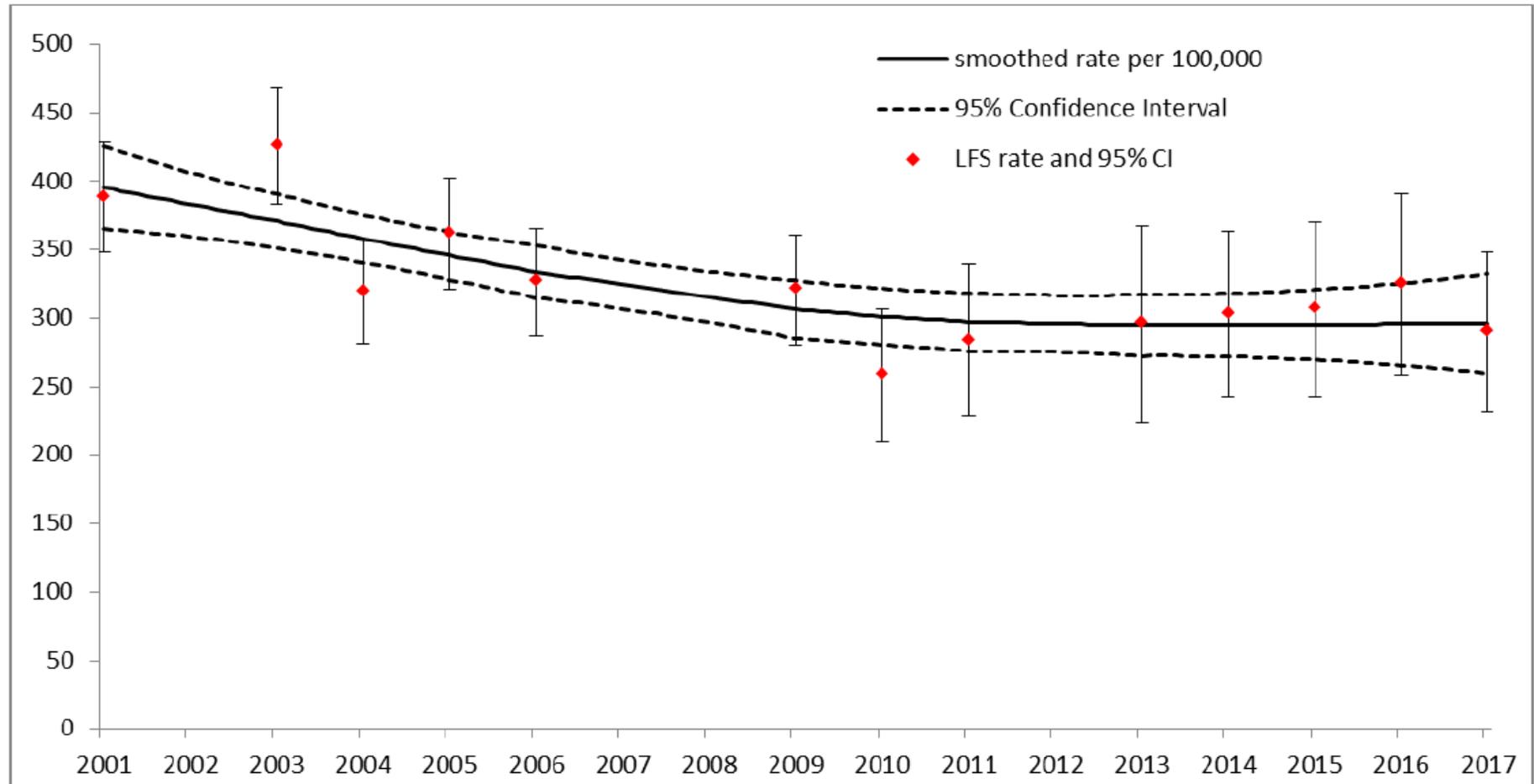
Exhaled breath condensate

Collects water vapour and can be analysed e.g. pH, fibre counts

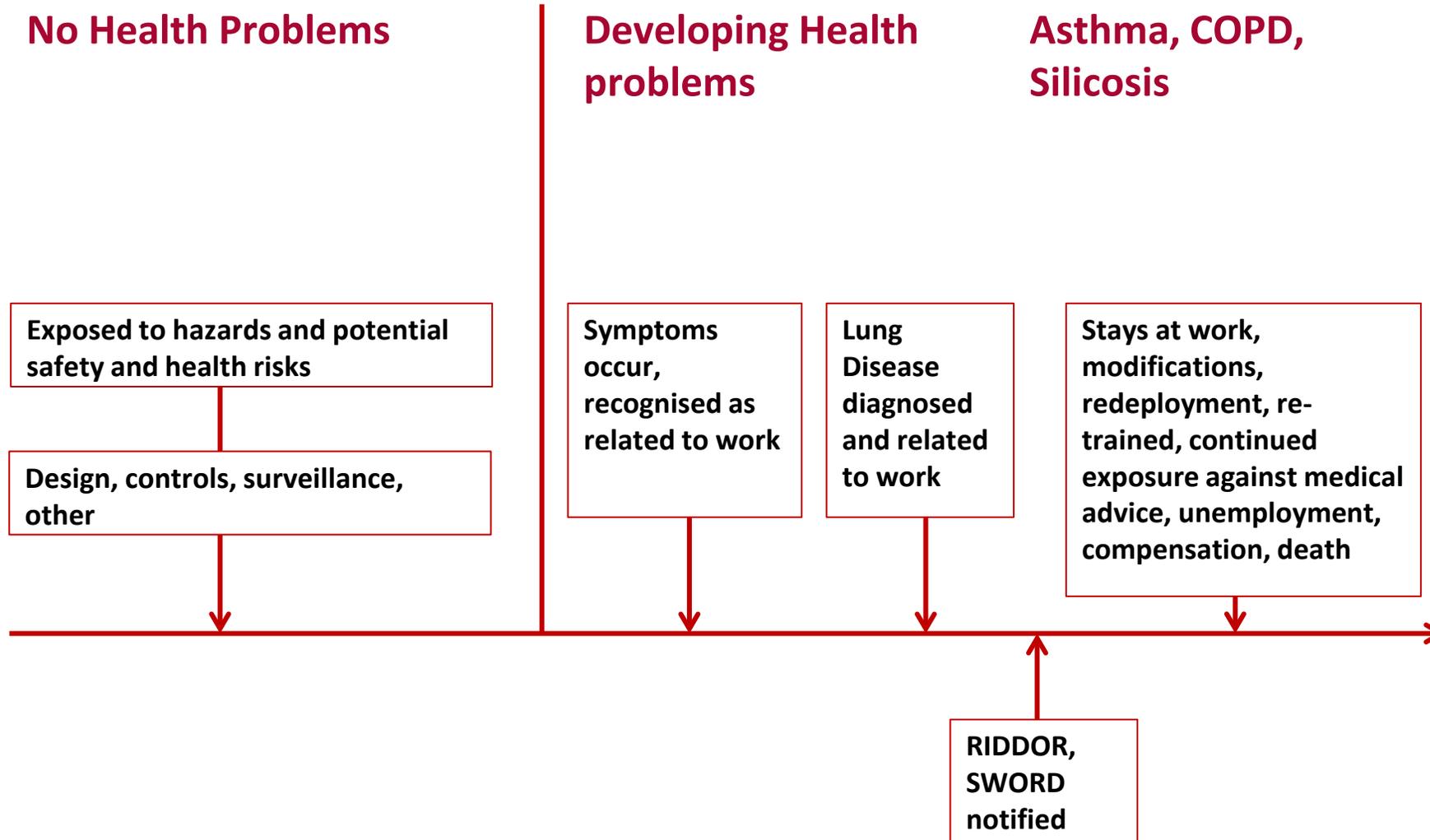


# Recent Flat Trend

**Figure 2: Self-reported work-related breathing or lung problems for those who ever worked**



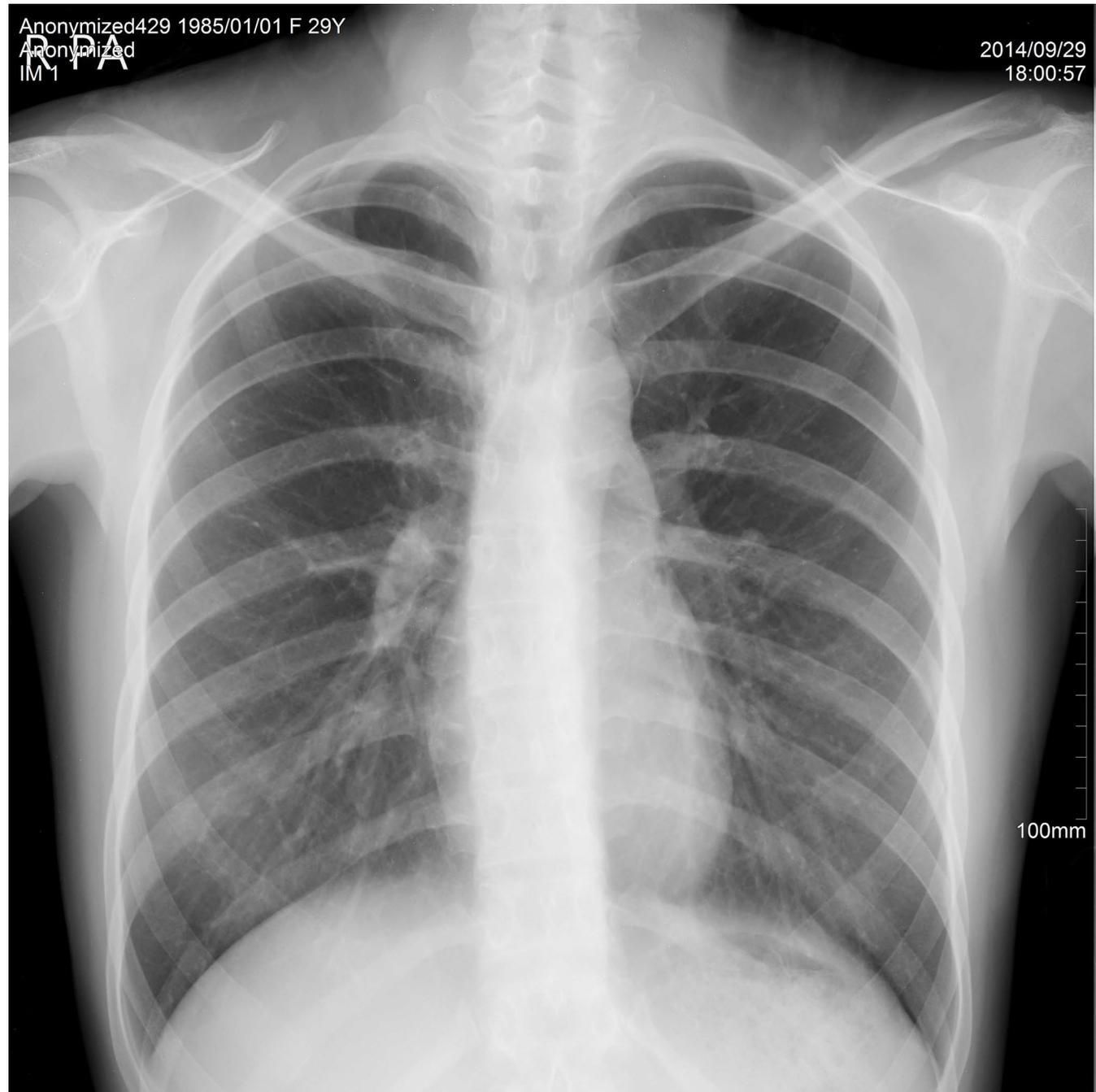
# Early Identification of Respiratory Diseases is key



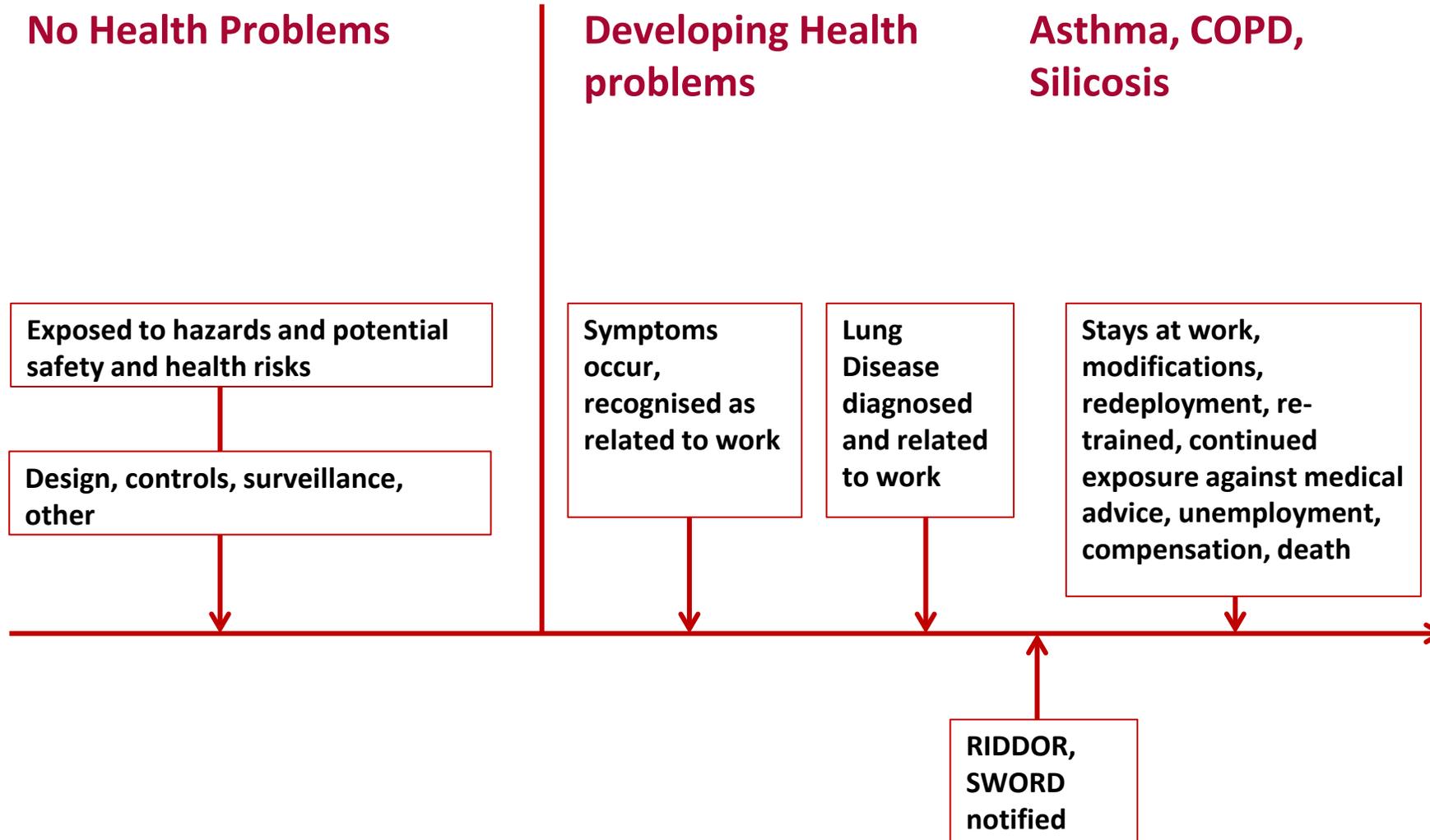
# Advanced Silicosis



# Early Silicosis?



# Early Identification of Respiratory Diseases is key





# Hawk's Nest [Tragedy]





# Our working lungs over time

Have they really changed and what are the challenges to keeping them healthy?

**Professor David Fishwick**

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