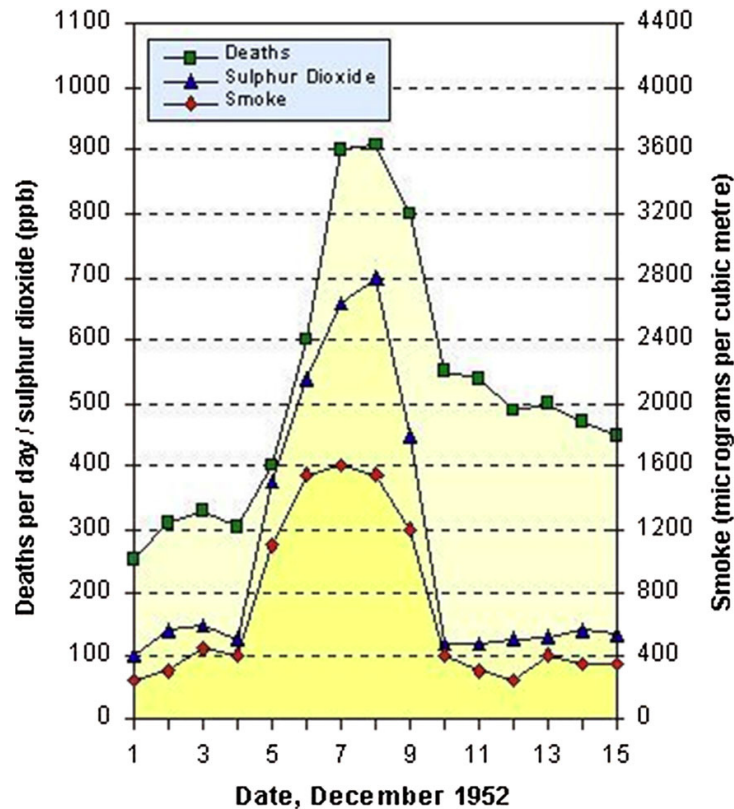


Health Effects of Air Pollution in Birmingham

Historical Air Pollution

- Typified by acute increases in smoke and SO₂
- 1952 London smog
 - Worst air pollution disaster in UK history
 - Enormous increase in respiratory and cardiovascular complications
 - 4000–12,000 deaths





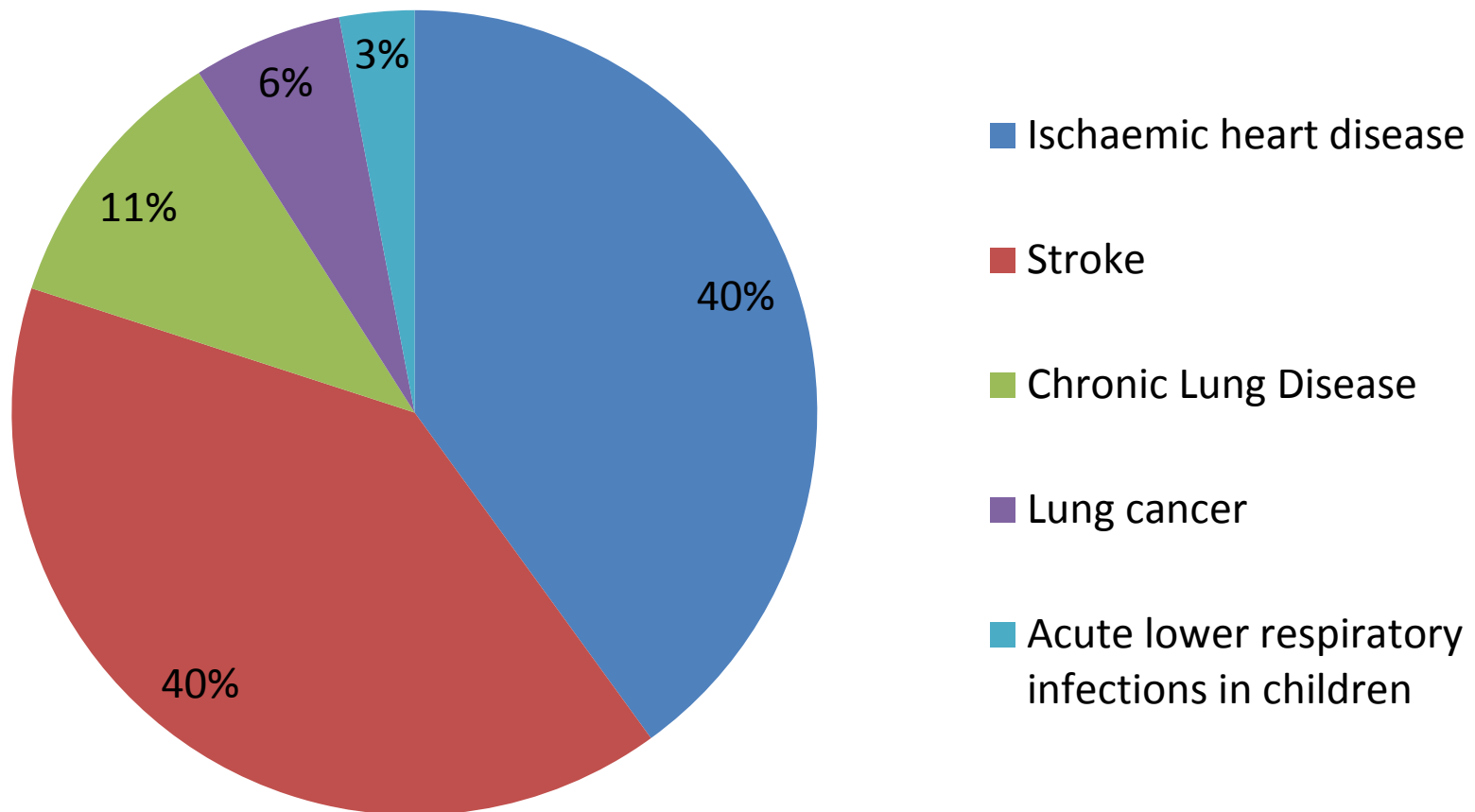
Modern-day Air Pollution

- Acute smog events can still occur
 - Exacerbate chronic conditions
- Concern now is invisible pollutants, indiscernible at ground level. Those with most evidence of health harm are:
 - Nitrogen oxides
 - Ozone (O₃)
 - Exceptionally small particulate matter (PM₁₀ and the more abundant PM_{2.5})
- Outdoor air pollution largely due to road traffic
 - UK road traffic 10 times higher in 2012 than 1949
 - Increased use of diesel vehicles from 14% to 50% between 2000 – 2014 in the UK
- Smaller particles are more complicated! (temperature, micro-climate, etc..)

Global Impact of Air Pollution

- Air pollution has overtaken poor sanitation and a lack of drinking water to become the main environmental cause of premature death
- In 2012, approximately 3.7 million people died from outdoor air pollution (WHO 2014)
- In Europe, air pollution is the biggest environment risk factor behind premature death (EEA 2014)
- Indonesia fires – 100,000 XS deaths in 2015!

Air Pollution Deaths



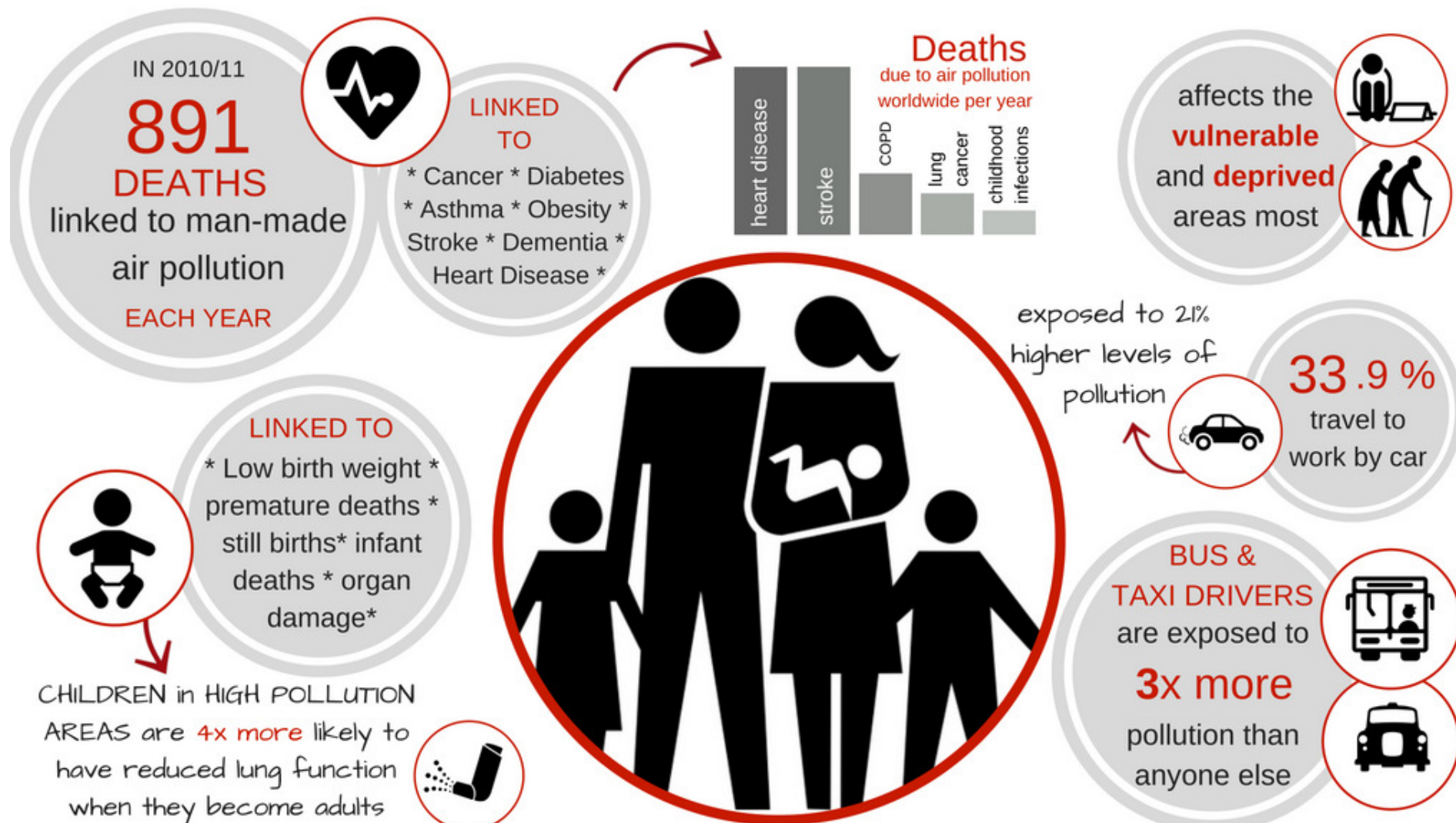
Air Quality Standards

- There are standards set for a number of pollutants
 - SO_2 , NO_x , PM, Pb, CO, Benzene, Ozone
- The main focus is on:
 - NO_2 – basis of the Clean Air Zone
 - $\text{PM}_{2.5}$ – linked to mortality in the Public Health Outcomes framework
- Vehicle emissions are the major source of both NO_2 and $\text{PM}_{2.5}$
- Both are linked to a range of health effects

Impact on Health

- In the UK PM_{2.5} air pollution by itself is responsible for at least 29,000 premature deaths
- UK wide estimated some 23,500 deaths annually on the basis of NO₂ concentrations
- A 10 µg/m³ reduction in ambient PM_{2.5} pollution would have a larger impact on life expectancy in England and Wales than eliminating road traffic accidents or passive smoking (IOM 2006).

EFFECTS OF AIR POLLUTION



Cardiovascular & Respiratory Disease

Strong evidence for impact of short and long-term exposure to PM_{2.5} on cardiovascular health:

- Reduced lung function
- Heightened severity of symptoms in individuals with:
 - Asthma
 - COPD
 - Ischaemic heart disease
 - Stroke
- **Remarkably similar to harm caused by tobacco smoke**

Emerging evidence for PM_{2.5}

- Exposure in pregnancy
 - Airway inflammation
 - Increased susceptibility to respiratory infections
- Exposure in childhood
 - Increase in asthma symptoms
 - Low lung function
 - Vulnerability to COPD in adulthood

New Health Outcomes

- Emerging evidence linking long-term exposure to PM_{2.5} with:
 - Adverse birth outcomes
 - Low birth weight at term
 - Small for gestational age
 - Preterm birth
 - Neurodevelopmental harm
 - Miscarriage
 - Diabetes
 - Obesity
 - Cognitive function (?Dementia)
 - Social isolation

NO₂ Health Outcomes

An independent effect of NO₂ has also been found that is additional to PM_{2.5} effects and has both immediate and long term effects:

- Acute exposure:
 - respiratory morbidity,
 - hospital admissions and emergency visits for cardiovascular and/or cardiac diagnoses,
 - mortality due to the effect of associated compounds
- Chronic exposure;
 - Reduced lung function in children and adults
 - Respiratory infections in early childhood including bronchitis
 - Cancer incidence
 - Adverse birth outcomes

Potential Vulnerable Groups

Some groups are at higher risk of exposure to outdoor air pollution:

- Certain professional groups:
 - Taxi and bus drivers are exposed to 3x more pollution than anyone else
 - Urban based traffic police
 - Street cleaners
- Deprivation

Potential Susceptible Groups

Some groups are more susceptible to adverse outcomes following exposure:

- Pregnant women and the unborn child
- Children in high pollution areas are 4x more likely to have reduced lung function when they become adults
- Older adults: risk of death from PM₁₀ exposure twice that of younger populations
- Adults with pre-existing medical conditions
 - Aggravate asthma
 - Increase risk of adverse health events

Safe Levels

- There are none
 - There is no threshold below which there would be no impact on mortality
- Every $10\mu\text{g}/\text{m}^3$ increase in NO_x is associated with 2.5% increase in all cause attributable mortality
- Every $10\mu\text{g}/\text{m}^3$ increase in PM_{10} is associated with 6% increase in all cause attributable mortality

Estimated Direct Health Effects of Current Air Pollution in Birmingham

- PM_{2.5}: **520** deaths in 2010
 - 6.4% deaths attributable to this form of anthropogenic air pollution
 - 5,707 years of life lost
- NO₂: **371** deaths in 2011
 - Range of 2.9% to 8.7% deaths attributable to NO₂ alone (independent of effect with PM_{2.5})
- Combined effect **891 deaths per year**, over half that due to tobacco

Potential Benefits of Reducing Air Pollution

Strong evidence for:

- Increased life expectancy
- Reduced health inequalities
- Reduced morbidity for people living with respiratory and cardiovascular conditions

Potential Benefits of Reducing Air Pollution

Evidence for:

- **Increased productivity** (GDP, workforce productivity)
- **Improved school attainment** (through reduced school absence, improved concentration, reduced behavioural disorders)
- **Reduced use of health care** (most research looked at hospital admissions)
- **Reduced obesity and sedentary behaviour; increase in physical activity** (evidence for children living with asthma and evidence regarding obesity in adults)

EFFECTS OF AIR POLLUTION

