



Wildfire Smoke Exposure and Population Health

Collaborative on Health and the Environment Webinar

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Emissions from Wildfires with Health Concerns

Primary air pollutants

- CO
- NO₂
- PAHs – polycyclic aromatic hydrocarbons
- VOCs – volatile organic compounds
- Particulate Matter (PM)

Secondary air pollutants

- Particulate Matter (PM)
- Ozone



Image courtesy of the U.S. EPA

Epidemiological Difficulties

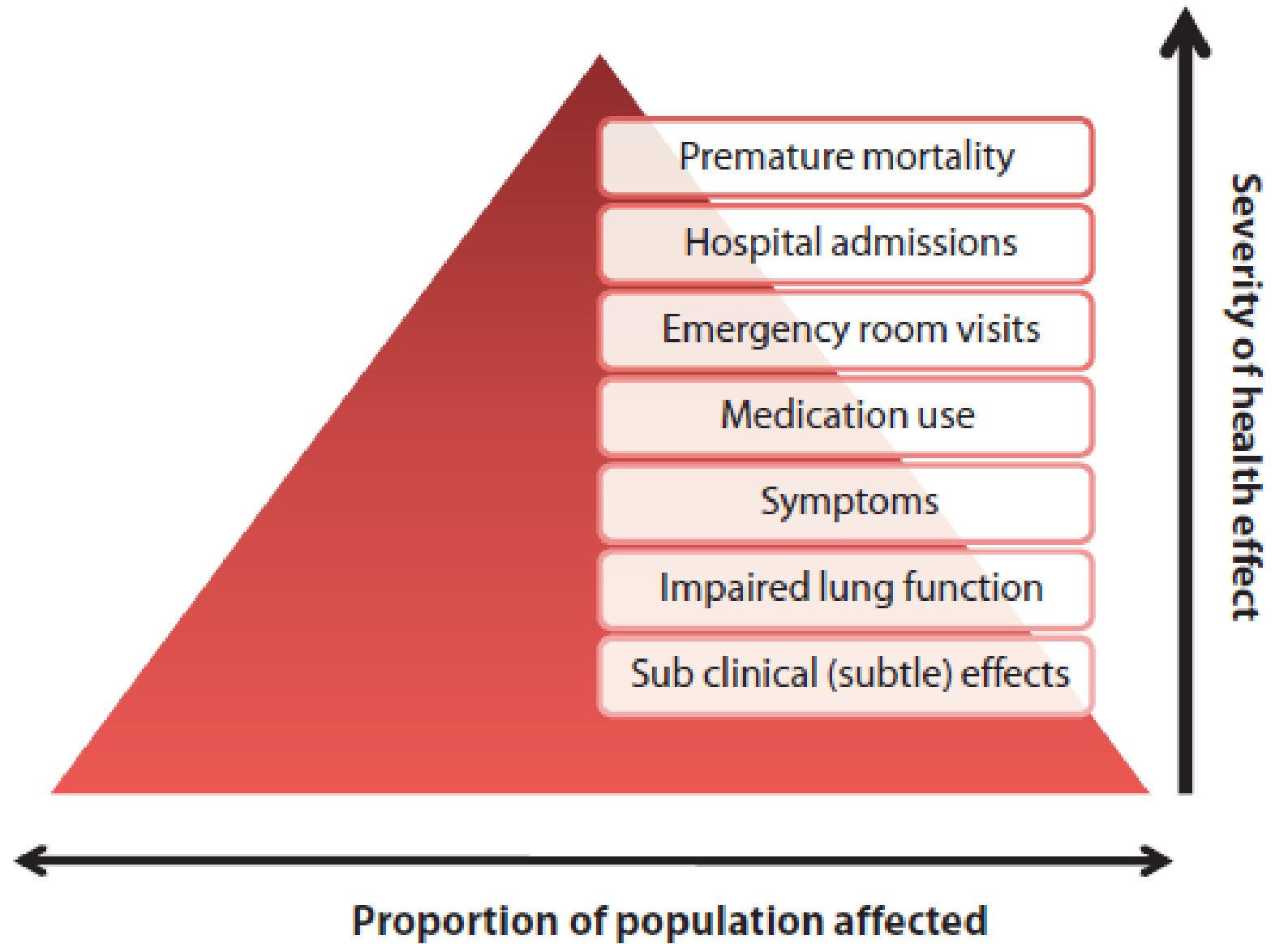
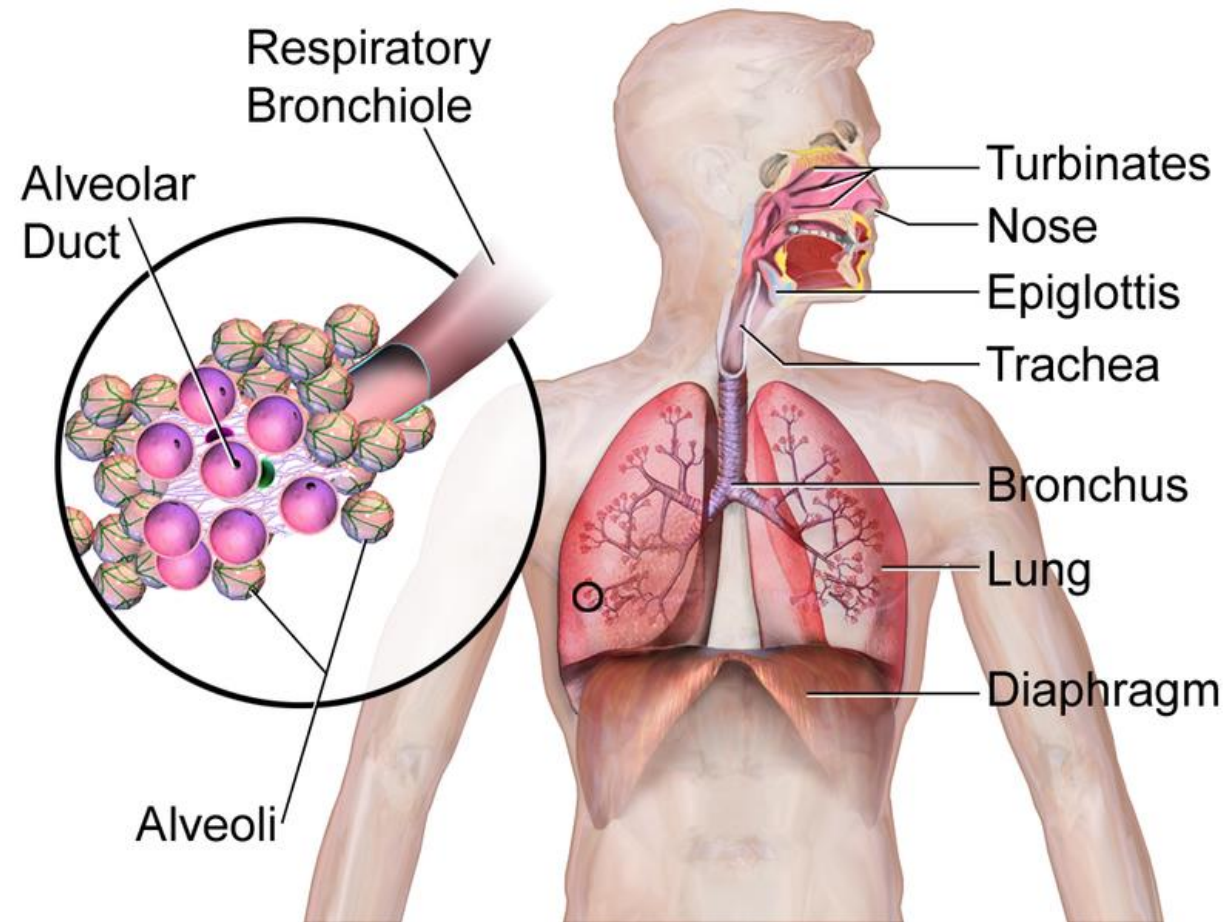
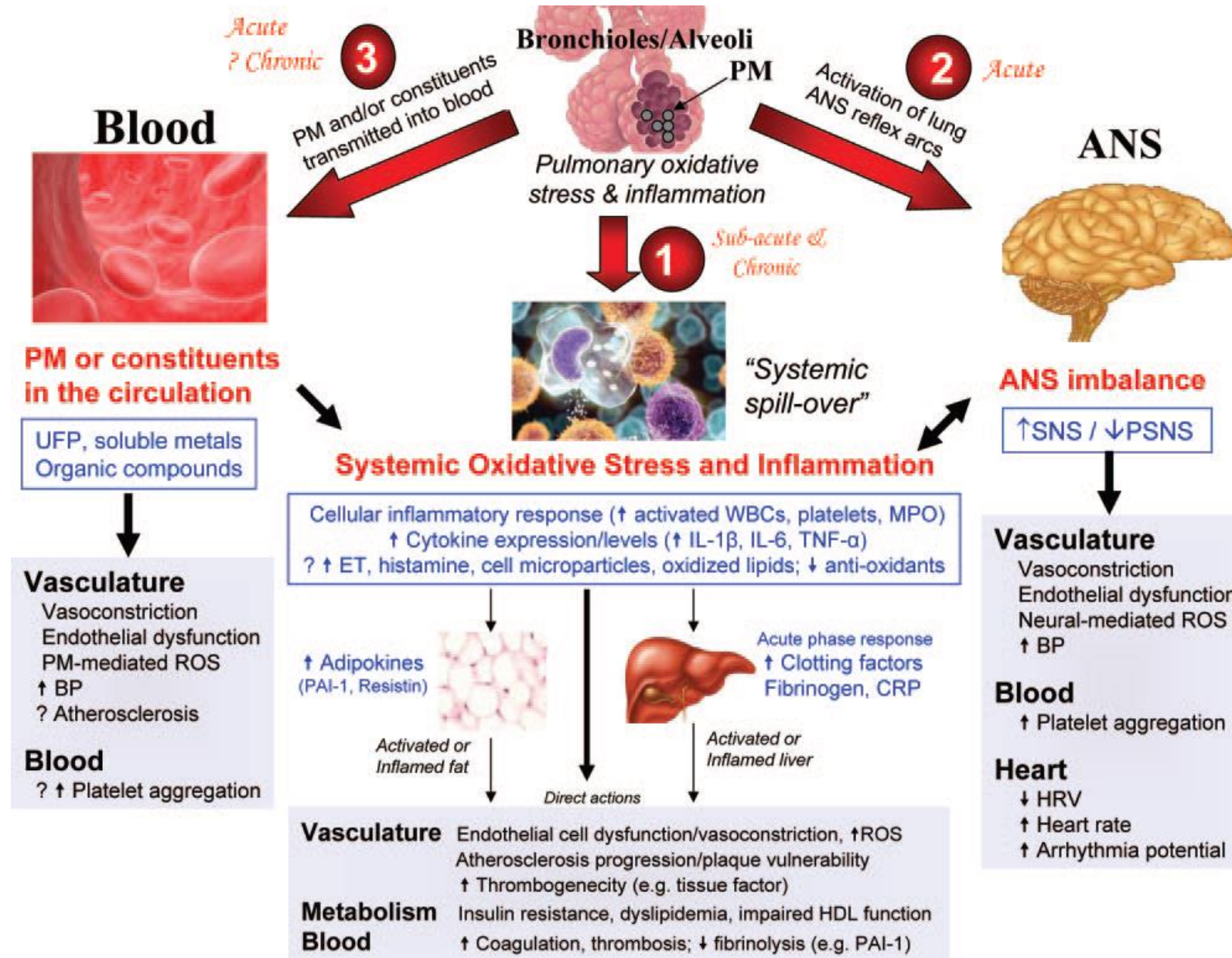


Figure 2 The air pollution health effects pyramid (adapted from American Thoracic Society 2000).⁴³

Clear evidence of an association between wildfire smoke and respiratory health

- Asthma exacerbations significantly associated with higher wildfire smoke *in nearly every study*
- Exacerbations of chronic obstructive pulmonary disease (COPD) significantly associated with higher wildfire smoke in most studies
- Growing evidence of a link between wildfire smoke and respiratory infections (pneumonia, bronchitis)





Wildfire smoke and cardiovascular disease

- Most studies to date have been null
- A few **recent studies** have found significant results
 - ED visits for all-cause cardiac symptoms in California (Wettstein et al. 2018)
 - Out-of-hospital cardiac arrests in Victoria, Australia (Haikerwal et al. 2015) and in Sydney, Australia (Salimi et al. 2016)
 - ED visits for congestive heart failure in North Carolina (Rappold et al. 2011)
- Some borderline significant
 - ED visits for hypertension (Tinling et al. 2016)
- Unsure as to the cause of these differences across studies

Wildfire Smoke and Mortality

- Clear evidence of wildfire smoke impacts on all-cause mortality
 - But no clear evidence for specific causes of mortality such as respiratory or cardiovascular deaths

Fires effect on birth weight

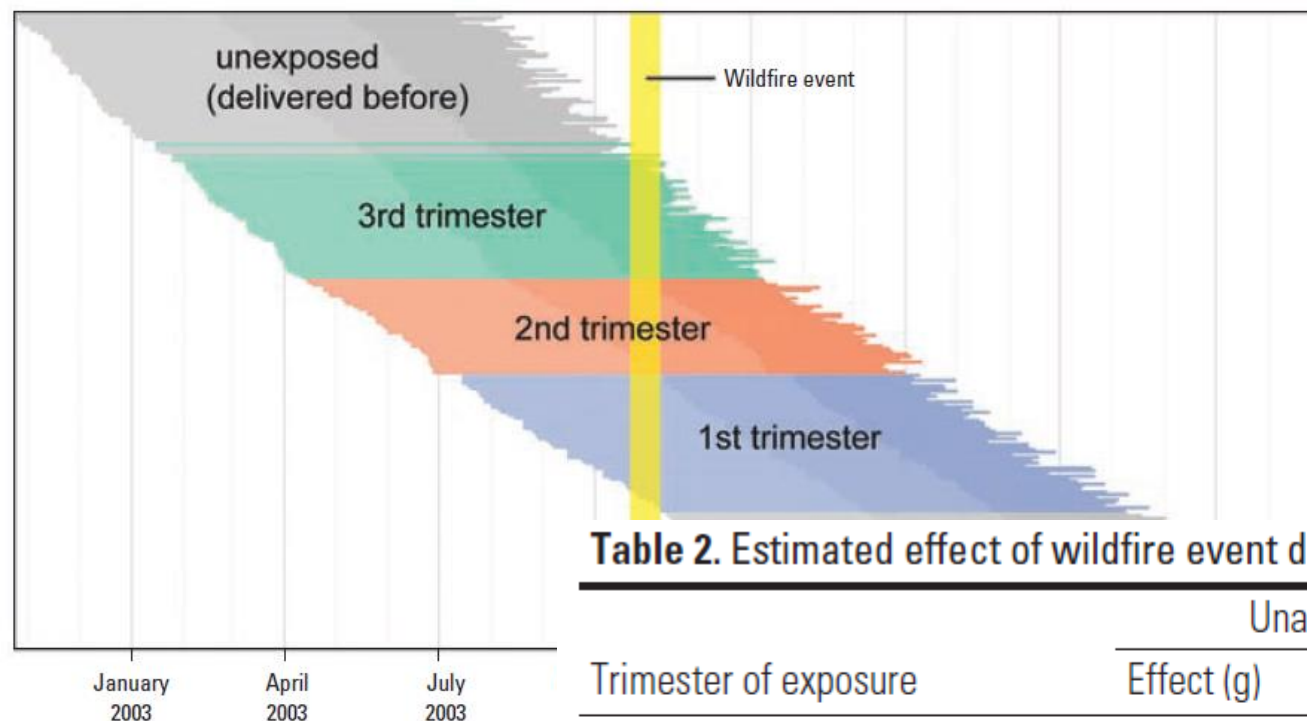


Figure 2. Schematic illustrating exposure as a lap between the wildfire event (yellow) and clarity, gestational intervals are shown order from 2002–2004 is shown. Dates on the x-axis seasonality.

Table 2. Estimated effect of wildfire event during gestation on birth weight (g), by trimester.

Trimester of exposure	Unadjusted model		Adjusted model	
	Effect (g)	95% CI	Effect (g)	95% CI
Third (≥ 29 weeks)	-7.9	(-12.8, -3.1)	-7.0	(-11.8, -2.2)
Second (17–28 weeks)	-17.1	(-21.9, -12.3)	-9.7	(-14.5, -4.8)
First (1–16 weeks)	-3.9	(-7.8, 0.0)	-3.3	(-7.2, 0.6)
Any trimester	-8.8	(-11.5, -6.1)	-6.1	(-8.7, -3.5)

Adjusted model includes terms for fetal sex, gestational age, parity, maternal age, maternal education, maternal race/ethnicity, secular trend, and season.

Who is most vulnerable?

- Age
 - Some studies find older adults are more vulnerable
 - Some studies find younger adults are more vulnerable
- Pre-existing conditions
 - Only a few studies have looked at this with mixed results
 - But exacerbations of asthma and COPD are the clearest health findings for wildfire smoke



Who is most vulnerable?

- Socio-economic status
 - No differential effects by SES in British Columbia (Henderson et al. 2011)
 - More vulnerable in lower income areas found in studies in North Carolina (Rappold et al. 2012), California (Reid et al. 2016), and the western US (Liu et al. 2017)
- Race-ethnicity
 - Elderly Blacks had higher respiratory admissions associated with wildfires than elderly Whites in western US (Liu et al. 2017)
 - Indigenous Australians (Johnston et al. 2007; Hanigan et al. 2008)

What do we still not know?

- Why we have different findings for CVD
- Need more research into vulnerable populations
- There are likely other health endpoints related to smoke that have not been studied
- The health impacts of repeated exposures to wildfires
- Need more research into the effectiveness of public health interventions
- Health impacts of other air pollutants from wildfires not just PM
- Whether smoke from different types of fires affect health differently

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