Health impact of Fairbanks Air Quality

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BIG DATA
vs
our experience
Why do we get ill?

Big Data tells us:

• Genes: 20%
• Environment: 80%
Environmental exposure:

• Excess sun exposure turns young skin old
• Eating grease makes young arteries old
• Excess noise makes young ears deaf
• But one of your biggest exposure is:
Breathing

• You eat 3-4x in 24 hours; you breathe every 5 seconds.
• If the food was not safe, you could go a month without eating. How long can you live without breathing?
• You breathe: 5-10 liters a minute at rest; 100-150 liters/minute during exercise.
• 10,000 liters/day reach alveoli of lungs.
Lung is a filter

- 10 micron particles removed in upper airway.
- 2.5-10 microns: trachea, bronchi, bronchioles
- <2.5 micron reach alveoli ("PM 2.5")
- <0.1 micron pass through cell membranes
- Particles carry chemicals that dissolve in alveolar moisture (Think Lipton teabag).
Where does most of PM 2.5 come from in Fairbanks?
Major source:
Wood smoke is toxic because

- Incomplete combustion produces huge numbers of particles carrying chemicals
What are these chemicals?

- formaldehyde
- dioxin
- toluene
- lead and other heavy metals
- Polycyclic aromatic hydrocarbons (PAH)
- 100s more proven toxins in woodsmoke
Where do these chemicals go?

- airway
- blood
- cells (brain, organs, placenta)
What do these chemicals do?

• Carcinogens
• DNA damagers
• Clot provokers
• Inflammation provokers
• cytotoxins (eg neurotoxins)
What is a safe amount of these chemicals to inhale?
How many cigarettes is it safe for your kid to smoke?
Setting limits for PM 2.5

- USA (EPA): 35
- Australia: 25
- WHO: 25
- EU: 20

- These are “regulatory limits” not “safety standards”!
- Levels of 5 are proven hazardous to health!
At PM 2.5 levels of 35 we inhale 100,000,000 particles in 24 hours.
Particle shape matters
Particle size matters

• surface area
• removal mechanisms
• cancer locations in smokers
Particle composition matters

• Particle as a vehicle
• PM 2.5 is a dangerous vehicle
• wood smoke 12x potential of 2nd hand cigarette smoke to cause lung cancer
What are the health hazards?

- Air pollution contributes to 4 of 5 leading causes of deaths:
  - Heart attacks
  - Strokes
  - Cancer
  - Respiratory illnesses
How large is the health effect?

• In the US, the annual deaths due to:
  • Air pollution: >100,000
  • Breast cancer: 40,000
  • Prostate cancer: 29,000
  • gun-related deaths: 32,351
  • motor vehicle deaths: 35,543
Which deaths are most easily preventable?
PM2.5’s Larger Health Impact

- DVT increases 70% for each 10 mcg increase in PM 2.5
- spikes in pollution cause BP to rise within 30 minutes
- heart rhythms become irregular (AF)
- Alzheimer’s occurs earlier in life (a 10 mcg increase in long term PM 2.5 exposure increases cognitive aging 2 yrs)
Many pregnant women in Fairbanks will spend several weeks of critical fetal development breathing air proven to be toxic to their baby
Toxins cross the placenta

- increased miscarriage
- increase still births
- increased birth defects
- low birth weight
childhood development

• 5 year old children whose mothers breathed >2.26 nanograms/m3 of PAH showed IQ loss of 5 points (fetal BBB not fully developed)

• The neurotoxins in wood smoke are particularly harmful for developing brains

• These children become adults with more health problems/costs
Air pollution limits freedom to play

- In healthy kids, lung function will be impaired for a week after a brief spike in air pollution. Why?
- Exercise in polluted air will deliver 10-30 times more pollutants to the lungs.
lung development

• Only 20% of alveoli are present at birth

• Children who grow up with air pollution are less likely to develop full lung capacity.
What should we do?