Contribution of household biomass burning to ambient air pollution in low- and middle-income countries: knowns and unknowns
Household Air Pollution (HAP)

- ~3 billion people cook using polluting open fires or stoves fueled by biomass fuels (e.g. wood, dung), kerosene, or coal.
- Associated with ~2.6 - 3.8 million premature deaths annually.
- HAP is a complex mixture, but particulate matter (e.g. PM$_{2.5}$) is a major deleterious component.
Proportion of population directly exposed to household air pollution from burning of solid fuels in 2016

HEI, State of Global Air 2018
Two main areas:

1. Health effects
   - Mechanisms; interventions

2. Implementation Science
   - “IS...is about trying to use research strategies to gain a better understanding of the complex array of structural and human factors that can determine whether new programmes or interventions will work as intended.”
A stereotypical rural village...

Focus of research on exposure to HAP is typically at the household level (where exposures to cooking smoke are highest)

BUT: the smoke also goes outside (and what’s outside comes inside) – and health effects are understood to respond to cumulative exposure.

India:

“One of the most surprising sources of Delhi’s air pollution is the smoke coming from the millions of cooking and space heating fires outside of the city limits. HAP: not just a rural problem”

Dr. Sarath Guttikunda, Director of UrbanEmissions
Prior work quantifying the HAP-to-ambient contribution

According to Chowdury et al. 2019, only seven studies, three focused on India

% contribution of HAP to ambient PM2.5

India
- Conibear 2018
- MAPS 2018
- urbanemissions.info 2016

Global
- Silva 2016
- Butt 2016
- Lelieveld 2015
- Chafe 2014

Contribution of HAP to Ambient PM$_{2.5}$ up to 52%

Adapted from Chowdury et al. 2019
Why is this important to quantify?

1. For scientific reasons: e.g. evaluation of potential effects of HAP interventions in different settings.
2. Getting urban folks interested in what is otherwise largely a “rural” problem
3. Potential policy lever to improve both household and ambient in one effort?
   (Would require government-relevant – i.e. national and regional – estimates)
What is standing in our way?

• “Residential and commercial” category is broad - lack of detailed national emission inventories hampers refining it further (Chafe et al., others)
• Lack of observational data, i.e. detailed characterization of the chemical, physical, and optical properties of aerosol in regions impacted by residential emissions, particularly in the developing world (Butt et al.)
• Difficult to distinguish rural from urban contexts due to coarse resolution of models, e.g. (Butt et al.).
• To date, poor understanding of how HAP from one home affects local/neighborhood air pollution – only limited understanding from computational fluid dynamics models (e.g. Ruiz Garcia et al).
• Etc.

But can anything better be done now with available data and models?
Thank you!

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