Environmental Health in Israel: A Global Perspective

Focus on India

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Panel Discussion—1/31/17
National Center for Env. Health/Agency for Toxic Substances & Disease Registry
H Falk--Israel Background

- Lead Poisoning - Egypt, Israel, Jordan, Gaza, West Bank
- Public Health proposal: CDC, Emory/ Hebrew U/ Al Quds SPHs
- Disaster Prep/Response
- Visiting Committee: Recommended creation of EHF
- Consultant to EHF
H Falk—India Engagement

• Bhopal chemical plant accident—1984-6
• Workshops/Conferences: lead, heavy metals, air pollution, disaster preparedness—1997-2001
• Indo-US Collaboration: Environmental and Occupational Health, & Injury Prevention—2002...
• Current issues: ambient air pollution; cookstoves and household air pollution; burn injuries-- working with ICMR, NCDC, DGHS of MOHFW
• Chair RAC for new Center for Environmental Health at Public Health Foundation of India—2016...
Delhi the most polluted city in the world today

Source: WAQI.Info
MOHFW Report of Steering Committee on Air Pollution and Health--2015

- Air pollution recognized as world’s largest single environmental risk

- GBD 2010 ranked air pollution as leading cause of death and disability in India

- ~1.6 million premature deaths and 49 million DALYs can be attributed to fine particulate matter ≤ 2.5 µm in diameter

- HAP and AAP together account for 9% of the national disease burden, making it the single largest risk factor of over 60 risk factors examined in the study

- WHO AAP database – 13 of the top 20 cities in the world with highest levels of PM$_{2.5}$ are now in India
Annual ambient concentrations of PM10 recorded across NAMP monitors (2004-2011)

Source: Ghosh, Balakrishnan et al 2014
The world's most polluted cities are in India

PM 2.5 (micrograms per cubic meter) in the most polluted cities worldwide in 2014

- Delhi: 153
- Patna: 149
- Gwalior: 144
- Raipur: 134
- Karachi: 117
- Peshawar: 111
- Rawalpindi: 107
- Khormabad: 102
- Ahmedabad: 100
- Lucknow: 96
- Firozabad: 96
- Doha: 93
- Kanpur: 93
- Amritsar: 92
- Ludhiana: 91
Sources of Air Pollution---Guttikunda, 2016

- Industries
- Road Dust
- Power Plants
- Construction
- Garbage Burning
- Vehicle Exhaust
- Domestic Fuels
Sources of Air Pollution in India

THE URBAN JUNGLE

Average contributions of major sources to PM10 pollution in cities

- **PUNE** (4%)
  - Road dust: 57%
  - Domestic: 11%
  - DG Sets: 7%
  - Transport: 16%
  - Brick kilns: 5%
  - Waste burning: 11%
  - Bakeries: 17%
  - Others: 14%
  - Industries: 11%
  - SIA: 4%
  - Marine: 4%
  - Secondary: 7%

- **CHENNAI** (43%)
  - Road dust: 14%
  - Domestic: 11%
  - DG Sets: 17%
  - Transport: 11%
  - Brick kilns: 11%
  - Waste burning: 14%
  - Bakeries: 17%
  - Others: 14%
  - Industries: 19%
  - SIA: 4%
  - Marine: 4%
  - Secondary: 7%

- **KANPUR** (26%)
  - Road dust: 15%
  - Domestic: 7%
  - DG Sets: 19%
  - Transport: 11%
  - Brick kilns: 17%
  - Waste burning: 8%
  - Bakeries: 17%
  - Others: 14%
  - Industries: 8%
  - SIA: 4%
  - Marine: 4%
  - Secondary: 7%

- **DELHI** (45%)
  - Road dust: 14%
  - Domestic: 15%
  - DG Sets: 7%
  - Transport: 17%
  - Brick kilns: 8%
  - Waste burning: 11%
  - Bakeries: 17%
  - Others: 14%
  - Industries: 11%
  - SIA: 4%
  - Marine: 4%
  - Secondary: 7%

- **MUMBAI** (16%)
  - Road dust: 15%
  - Domestic: 17%
  - DG Sets: 13%
  - Transport: 13%
  - Brick kilns: 4%
  - Waste burning: 17%
  - Bakeries: 17%
  - Others: 4%
  - Industries: 11%
  - SIA: 9%
  - Marine: 9%
  - Secondary: 8%

- **BENGALURU** (50%)
  - Road dust: 11%
  - Domestic: 18%
  - DG Sets: 9%
  - Transport: 18%
  - Brick kilns: 8%
  - Waste burning: 14%
  - Bakeries: 17%
  - Others: 11%
  - Industries: 8%
  - SIA: 4%
  - Marine: 4%
  - Secondary: 7%

Source: CPCB, 2010
<table>
<thead>
<tr>
<th>Source Category</th>
<th>Types of Sources</th>
<th>Nature of pollutants</th>
</tr>
</thead>
</table>
| **Area Sources** | • Domestic cooking: Fossil fuel combustion  
• Bakeries  
• Crematoria  
• Hotels & Restaurants  
• Open eat outs  
• Open burning (refuse/biomass/tyre etc. burning)  
• Paved & unpaved roads  
• Construction/Demolition/Alteration activities  
• Roads, flyovers  
• Waste Incinerators  
• DG Sets  
• Brick kilns (Fossil fuel combustion) | Fine particles (PM2.5), coarse particles (PM10), black carbon/soot, Gaseous pollutants (Sulphur dioxide-SO2, Nitrogen dioxide-NO2, Ammonia-NH3, Carbon monoxide-CO, Ozone-O3 etc.) and organic and inorganic toxics. Organic toxics include Benzopyrene-B(a)P, Benzene-C6H6, Aldehydes and other Polycyclic aromatic hydrocarbon-PAHs, inorganic toxics include mostly the heavy metals such as Arsenic-As, Lead-Pb, Nickel-Ni |
| **Point Sources** | • Large scale industries and Power plants  
• Medium scale industries; Fossil fuel combustion  
• Small scale industries (28 industrial estates) | |
| **Line Sources** | • 2 Wheelers (Scooters, Motor Cycles, Mopeds)  
• 3 Wheelers (CNG)  
• 4 Wheelers (Gasoline, Diesel, CNG)  
• LCVs (Light Commercial Vehicles)  
• Heavy duty commercial vehicles such as Trucks (Trucks, min-trucks, multi-axle trucks)  
• Buses (Diesel, CNG) | Variety of fossil fuel (combustion) has been taken place in fuel specifications/types in all above categories. |

Nature of pollutants: Fine particles (PM2.5), coarse particles (PM10), black carbon/soot, Gaseous pollutants (Sulphur dioxide-SO2, Nitrogen dioxide-NO2, Ammonia-NH3, Carbon monoxide-CO, Ozone-O3 etc.) and organic and inorganic toxics. Organic toxics include Benzopyrene-B(a)P, Benzene-C6H6, Aldehydes and other Polycyclic aromatic hydrocarbon-PAHs, inorganic toxics include mostly the heavy metals such as Arsenic-As, Lead-Pb, Nickel-Ni.
Share of HH fuel consumption to outdoor PM2.5 pollution

District wise reports @ http://www.urbanemissions.info
Air pollution health effects

**Respiratory**
- Coughing, wheezing, reduced lung function
- Exacerbation of asthma, COPD
- Lung cancer
- Respiratory mortality

**Central Nervous**
- Cerebrovascular impairment
- ↑ Stroke/Dementia (?)

**Cardiovascular**
- ↑ Systemic inflammation
- Autonomic system disorder (HRV reduction, HR increase dysrhythmias)
- ↑ Atherosclerosis
- ↑ Myocardial infarctions
- CV mortality

**Reproductive**
- Low birth weight
- Preterm births and intrauterine growth retardation (?)
- ↑ Birth defects (?)
Recommendations: Specific role of MoHFW-1

- **Strengthening AP&H policies** (and policy capacity)
  - Better integration of AP&H in all policy (“Health in All Policies”)
  - AP&H policy unit? Standing Expert Committee on AP&H?

- **Programs aimed at controlling AP&H**
  - Public campaigns, esp. for HAP (since users and key affected communities same)

- **Data collection & Research**
  - Air pollution – coordinate with MOEF&CC
  - Exposure and health impact – start with surveillance sites; monitor emergency cases
  - Economic analysis of AP&H
  - Increase investments in AP&H research

- **Awareness Building**
  - Health-based risk communication systems (esp. for vulnerable populations), e.g., AQI-based systems
  - Health Advisories at key episodic events (e.g. Diwali)
Recommendations: Specific role of MOHFW-2

• **Dissemination of information**
  – Training health workers (doctors, nurses, ASHA workers)...
  – Incorporate into medical education

• **Linkages to other domestic actors/programs**
  – Inter-ministry working group to implement multi-sectoral approach – MOHFW should coordinate
  – Require Health Impact Assessments to be part of major projects
  – Sensitize and guide state agencies
  – Link to programs like Swacch Bharat and Clean Cities

• **International Linkages and Agenda-Setting**
  – *Synergies with other national and international programs*
  – Disseminate success stories
  – Major international meeting to disseminate the approach and analysis of this report for international agenda-setting
Urgent Threats & Urgent Realities—Ambient Air Pollution, India

- Air pollution in India/Delhi is an urgent reality
- Leading cause of morbidity/mortality
- An economic and social albatross
- Health is a critical partner in a multi-sectoral problem
- Define health role and detail programs, goals, resources, and benefits of action
- Develop and implement short- and long-term goals (while all eyes are riveted on the acute crisis)
- New and existing environmental health centers such as NCDC, ICMR, PHFI, SRU can be critical for promoting solutions
Need for Improved Exposure and Health Data in India

• Need for more complete and more sophisticated air monitoring data over very wide geographic areas.
• Acute health surveillance/studies can help determine the scope of air pollution crises, evaluate the response, better plan for future events, and assure services to the most vulnerable populations and places.
• Now is the time to strategically plan the long-term registries, cohorts, studies that will be needed to evaluate the full scope of the long-term health impact in India, assure an effective long term plan to eliminate this severe health hazard, identify the burden and unique features of air pollution risk in India, and develop appropriate programs and services.
• In above, need to consider all of the special features of the air pollution/weather/health complex in India.
Question: What happens when the population is still experiencing excess morbidity and mortality at low levels?
The Problem

3 billion people dependent on traditional stoves

2 billion tons of biomass burned each year

Exposure to air pollution typically up to 100 times more than recommended as healthy by WHO

4 million people die annually

Up to 40% of household income spent on fuel

Up to 5 hours a day spent on collecting fuel

Women and children disproportionately impacted
The Global Alliance for Clean Cookstoves

The Global Alliance for Clean Cookstoves is an innovative public-private partnership to create a thriving global market for clean and efficient cookstoves and fuels.

Save Lives

Empower Women

Improve Livelihoods

Combat Climate Change
Leading cause of disease burden in 2010 by country

Population Cooking with Solid Fuels in 2010 (%)
Good vs. Poor Air Quality
(\(PM_{2.5}\) as an indicator)

Some Pollutants in Indoor Smoke
Criteria Pollutants: \(PM_{2.5}\), CO, NO\(_2\),
Toxics: formaldehyde, benzene, 1-3 butadiene, benzo[\(\alpha]\)pyrene
For Coal: \(SO_2\), As, Pb, Hg, & F

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Annual EPA Standard</th>
<th>Annual WHO Guideline</th>
<th>24-hour EPA Standard</th>
<th>24-hour WHO Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PM_{2.5})</td>
<td>15.0 µg/m(^3)</td>
<td>10.0 µg/m(^3)</td>
<td>35 µg/m(^3)</td>
<td>25.0 µg/m(^3)</td>
</tr>
</tbody>
</table>
### Current State of Cooking Technology

<table>
<thead>
<tr>
<th>Performance</th>
<th>Subtier 0</th>
<th>Subtier 1</th>
<th>Subtier 2</th>
<th>Subtier 3</th>
<th>Subtier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM2.5 (mg/min)</td>
<td>&gt;40</td>
<td>17-40</td>
<td>8-17</td>
<td>2-8</td>
<td>0-2</td>
</tr>
<tr>
<td>PM2.5 (μg/m³)</td>
<td>&gt;600</td>
<td>6-300</td>
<td>300-100</td>
<td>100-35</td>
<td>&lt;35</td>
</tr>
</tbody>
</table>

- **Performance varies along a continuum and can vary widely within stove type**

**Stoves**
- TSF
- Traditional
- Rocket
- Charcoal
- Gasifiers/TLUDs
- Ethanol
- LPG/Biogas
- Electric/Induction
- Solar

**Models**
- Chulhas
- Chulika
- AgniStar
- Biolite
- Oorja
- ACE
- Mimi Moto
- LPG
- TTK Prestige

**Fuels**
- Unprocessed Biomass
- Processed Biomass
- Clean Fuels
Global Burden of Disease from Household Solid Fuel Use

• Most important environmental risk factor identified in recent global burden of disease study (Lim et al, Lancet 2012)
• ~3.5 million deaths from household air pollution
• ~0.5 million deaths from outdoor air pollution caused by cooking with solid fuels

• Recent estimates include impacts on: child acute respiratory illness, chronic respiratory illness (COPD, lung cancer), cardiovascular disease, and cataracts
• Estimates do NOT include (due to insufficient evidence or lack of data) impacts on: low birth weight, cognitive/developmental effects, adult respiratory illness, other cancers, tuberculosis, severe burns and injuries
Toxic Pollutants in Wood Smoke from Simple (poor) Combustion

• Small particles, CO, NO₂
• Hydrocarbons
  – 25+ saturated hydrocarbons such as *n*-hexane
  – 40+ unsaturated hydrocarbons such as 1,3 *butadiene*
  – 28+ mono-aromatics such as *benzene* & *styrene*
  – 20+ polycyclic aromatics such as *benzo*(α)*pyrene*
• Oxygenated organics
  – 20+ aldehydes including *formaldehyde* & *acrolein*
  – 25+ alcohols and acids such as *methanol*
  – 33+ phenols such as *catechol* & *cresol*
  – Many quinones such as *hydroquinone*
  – Semi-quinone-type and other radicals
• Chlorinated organics such as *methylene chloride* and *dioxin*
Toxic Pollutants in Wood Smoke from Simple (poor) Combustion

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• Oxygenated organics
  – 20% aldehydes including formaldehyde & acrolein
  – 25% alcohols and acids such as methanol
  – 33% phenols such as catechol & cresol
  – Many quinones such as hydroquinone
    – Semi-quinone-type and other radicals
• Chlorinated organics such as methylene chloride and dioxin

Typical chulha releases 400 cigarettes per hour worth of smoke

Source: Naeher et al, J Inhal Tox, 2007
Household air pollution

Distribution of 24-hr average kitchen area PM2.5 concentrations in solid fuel using households across states

(Source: Balakrishnan et al. 2013)
1990: 85%: 700 million people using solid fuels

2010: 60%: 700 million people

~1980 700 million people in entire country

Fig. 1. Distribution by state of households using biomass or coal as their main cooking fuel in 2005. From (IIPS, 2007).
1990: 85%: 700 million people using solid fuels
2010: 60%: 700 million people

700 million people in the Chulha Trap
Challenges to Eliminating Household Air Pollution

- Move to more advanced stoves
- Move to improved fuels such as LPG
- Stoves/fuels don’t always work as well in field as in laboratory tests
- Conditions vary across Africa/India/LA
- Need for exposure and health investigations
- Behavioral/social factors
- Economic factors: where is the funding
- Need for monitoring and evaluation
Burn Injuries and Cookstoves
Territories are sized in proportion to the absolute number of people who died from fires in one year.
Liquid Petroleum Gas (LPG)

In 2011, “33.6 million (28.5%) Indian households used LPG as cooking fuel”

2011 Indian National Census
Photos from: http://www.globalsources.com/
Burn Injuries and Cookstoves

- LPG will not be fully accepted and adopted unless safety issues resolved.
- Poorly fitting or improperly maintained LPG cannisters may lead to severe explosions.
  - Photo at right from Dr Mahmoud el-Oteify, Assuit, Egypt
Future Plans for Burn Registries

- **WHO Geneva** developing Global Burn Registry (GBR)
- **DGHS/MOHFW/India** developing a plan for an India national burn registry as part of a national program for burn prevention and treatment/coordinate with WHO
- **International Society for Burn Injuries (ISBI)** could promote a WHO/GBR focused particularly in LMIC
- **GACC** and health/medical communities eager to utilize surveillance data for driving prevention of burn injuries
- **CDC** provides technical support
- Currently, an informal working group of above organizations is guiding development of GBR and prevention programs
Examples of How to Link Prevention to Registry Data

• Track newly introduced cookstoves/fuels and distribution approaches in relation to registry data to assure they are safe as well as clean

• Investigate all major LPG burns/explosions identified in registry to determine cause and how to correct

• Use incidence data, trends, location, etc of burn injuries to most effectively apply prevention activities, educational messaging, policies, rehabilitation services, etc
Global Challenges/Opportunities

• Global Challenges
  – Israel environmental health programs are relatively new
  – Focus at present has been on building national capacity

• Global Opportunities
  – Israel government, business, and academic links are growing in Asia (China, India, Japan, etc) and Africa
  – Potential collaborative opportunities exist in research, training, technical assistance, and exchange programs
Potential for Collaboration in Environmental Health with India

• India and Israel have established collaborative efforts recently with scientific, diplomatic, and business exchanges, and in areas such as defense, agriculture, and water quality

• Israel has greatly enhanced environmental health capacity (eg, COEs, faculty, training) in past 10 years

• India has striking environmental health needs not only in AAP/HAP, but in drinking water, sanitation, toxic chemicals, rural health, hazardous wastes......

• India is in an early phase of capacity building for environmental health

• Collaborative approaches could be very beneficial