Weather, Climate, Pollen, & Health: Stakeholder Perspectives and Preliminary Results

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Overview

• Primer on pollen and health
• Review of project objectives
• Stakeholder priorities
• Preliminary results
Pollen and Health: General

- Pollen exposure produces allergic disease (rhinitis, sinusitis, asthma, others) in sensitized individuals
- Risk factors include:
  - Family history of atopy
  - Male sex
  - Birth during pollen season
  - Firstborn status
  - Early use of antibiotics
  - Maternal smoking exposure
  - Indoor allergen exposure, e.g. dust mite allergen

- Sensitization age 2; 9% by age 8; 15% by age 12; lifetime incidence 10-30%
- Significant morbidity but low mortality
  - 2.5 % of all clinician visits
  - 2 million lost school days
  - 6 million lost work days
  - 28 million restricted work days per year
- Burden is increasing; allergic rhinitis spending went from $6.2b in 2000 to $11.2b in 2005
- Mediated primarily by IgE antibodies
Etiology

Diagnosis

- Diagnosis primarily by clinical syndrome in association with allergic (e.g. pollen) exposure(s)
- Self-diagnosis (and management) are common
- Formal testing
  - More severe or complicated cases
  - Blood testing for specific IgEs
  - Skin prick testing with allergens
- Wide spectrum of symptoms, variable exposure patterns, variable presentation, all complicate recognition, diagnosis, and management
Therapy

- Prevention difficult
- Acute rhinosinusitis
  - Symptomatic therapy with antihistamines, local and systemic steroids, decongestants, irrigation
- Acute asthma
  - Bronchodilators, systemic steroids, preventive therapy with inhaled steroids
- Complicated disease
  - Escalation of therapy as necessary with systemic steroids, antibiotics, epinephrine injections, ventilatory assistance, hospitalization
- Immune modulation therapy
  - Moderately effective
  - Subcutaneous
  - Sublingual
  - Years of treatment
Stakeholders and Their Needs

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Prevention, Therapy</td>
</tr>
<tr>
<td>Providers</td>
<td>Exposures, Therapy</td>
</tr>
<tr>
<td>Public Health</td>
<td>Prevention, Projection</td>
</tr>
<tr>
<td>Researchers</td>
<td>Data, Relationships</td>
</tr>
</tbody>
</table>

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Project Goals

1. Determine the climate factors that influence the timing and severity of the allergenic pollen season at a national scale
2. Identify the weather patterns during the pollen season that are related to high pollen count days
3. Determine links between pollen season parameters (e.g. onset, peak, duration) and health outcomes
4. Integrate this information to forecast pollen concentrations and health burden under future climate scenarios
PRELIMINARY RESULTS: ESTIMATING POLLEN SEASON ONSET
1. MODIS Global Land Cover Dynamics (Phenology)

- Identifies timing of key seasonal changes in vegetation (phenophases) using Enhanced Vegetation Index (EVI)
- 2001-2014
- 500m resolution
Phenophases based on logistic functions fit to time series of EVI:

1. Onset of EVI increase (greenup)
2. Onset of EVI maximum (maturity)
3. Onset of EVI decrease (senescence)
4. Onset of EVI minimum (dormancy)

Zhang et al., 2002
2. NOAA Climate Data Record

- AVHRR daily $0.05^\circ \times 0.05^\circ$ grid, 1981-present
- Leaf Area Index (LAI) = one-sided green leaf area per unit ground surface area
- Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) = fraction of the incoming solar radiation in the photosynthetically active radiation spectral region that is absorbed by the plants
- FAPAR is directly related to primary productivity of photosynthesis
Atlanta Pollen Count Data

- Data from CDC Climate and Health Program and Atlanta Allergy and Asthma
- Daily counts, 1991-2011
Pollen Season Onset: Phenology, LAI and Pollen Count (Atlanta, 2011)
Pollination Season Onset: Phenology, FAPAR and Pollen Count (Atlanta, 2011)
Google Trend Search Data as Proxy for Health Effects
Google Trend Search Data

Limitations of publicly available data:
- Normalized over time period
- Daily data only available for time periods of 90 days or less
- Random subsample of the total data

Atlanta, 2011
Summary

• Onset of pollen season: LAI, FAPAR and MODIS Phenology Product seem to agree with observed pollen count
• Google Trend search queries coincide with observed pollen count data
Questions?