

Climate Change and the Increase in Allergic Diseases

Rosalyn Baker, M.D., M.H.S.
Board Certified Allergist
and Immunologist

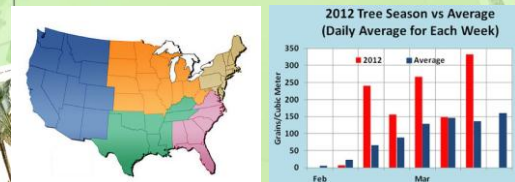
Speaker Disclosure Declaration: None



Climate Change Objectives

- **Increased carbon dioxide emissions**
 - Increased heat
 - Increase pollen counts
 - Longer pollen season
- Increased Rainfall/ indoor humidity
- Clinical cases of allergic patients
- Increased healthcare/economy costs
- Recommendations for healthcare providers

Pollen map and count



Increased Pollen Counts

- Fossil fuels, coal, oil cause an increased atmospheric carbon dioxide (CO₂) emissions
- Increased CO₂ causes increased plant growth
 - 5 to 10 gram per plant (CO₂ 280→370 ppm) from 1990 to 2000
- Plants exhibit enhanced photosynthesis and reproductive effects and produce more pollen
- Moreover, the plants flower earlier in urban areas than in corresponding rural areas with earlier pollination of about 2–4 days.

D'Amato et al. World Allergy Organization Journal (2015) 8:25

Change in length (day of year, days) of ragweed pollen season as a function of latitude for National Allergy Bureau and Aerobiology Research Laboratories sites along a south–north latitudinal gradient

- Northern climates, warmer temperature compared from 1995 to 2009
- 16 days increased Ragweed season in (Minneapolis, MN)
- 27 days increased Ragweed season in Saskatoon, Canada
- 1 day increased Ragweed season in Oklahoma City

Ziska L, Knowlton K, Rogers C, et al. *Proceedings of the National Academy*. 2011;108(10):4248–4251. doi:10.1073/pnas.1014107108.

Increased Allergen Sensitization

- Increased Allergic rhinitis, conjunctivitis
- 1 out of 12 individuals have asthma
- Allergic Asthma
 - 60% Pediatric Asthma is allergen related
 - 40% Adult Asthma is allergen related
- Allergic Asthma exacerbations
 - Declining FEV1 or FVC during season
 - Declined Lung Function
- Increased Adult onset asthma at an older age
- Younger onset allergic diseases in children

Case 1- Severe Pollen Allergy

24 y.o. WF with severe Grass Pollen allergy unable to tolerate allergen injections (anaphylaxis). Moved to my Maryland for college.

- Antihistamine, Montelukast, and Daily maintenance asthma inhaler

Mowing grass May 2014 and developed SOB, throat closing sensation, hives, and blurred vision.

- JHU Eye clinic, optical nerve inflammation secondly to anaphylaxis
- Initiated monoclonal immunotherapy, Omalizumab
 - Add-on Allergen Immunotherapy Injections,
 - Then will discontinue Omalizumab once stable.

Other Effects of Climate Change that impact Allergic Patients

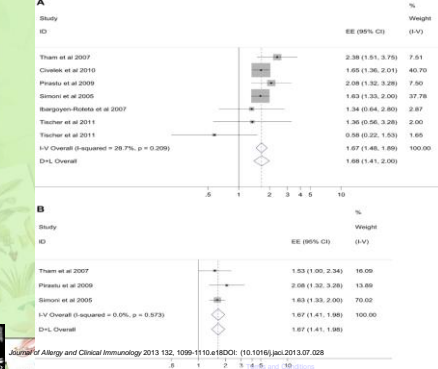
- Poor air quality (heat, wildfires, drought, ozone)
 - Wildfire smoke produces large amounts CO, CO₂, NO_x, O₃(ozone), PM (particulate matter), and VOCs (volatile organic compounds)
- Asthma morbidity/mortality
 - Ozone also demonstrates an adjuvant effect, because individuals exposed to ozone at levels of 0.16 to 0.25 ppm demonstrate an increased level of response to inhaled allergen.
 - Ozone cause increase in airway inflammation markers
- Increased rainfall/humidity
 - Allergic rhinitis molds
 - Increased VOCs

- SHEA ET AL, J ALLERGY CLIN IMMUNOL VOLUME 122,

Increased Rainfall cause increase indoor humidity

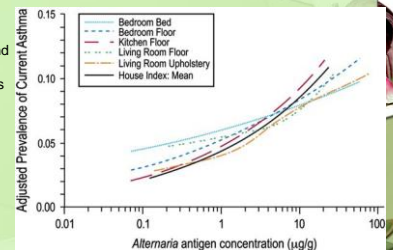
- Increased humidity (>50%)
 - Mold spores and Dust Mites growth
 - Increased allergic rhinitis allergen sensitization & asthma exacerbation
- Building damage
 - Susceptible to Rodents
 - Cockroaches, Mice, Rats (Allergens)
- Increased economical and emotional stressors linked to sick building syndrome
 - Work absenteeism due to respiratory illness
 - Increased anxiety due to lack of control of building water repairs at work/home
 - Unemployment, increased basement inhabitants

Indoor dampness (A) Visible mold (B) and rhinoconjunctivitis



Exposure to *A alternata* in US Homes is Associated with Active Asthma

The National Survey of Lead and Allergens in Housing (831 units from 75 locations) found increasing *Alternaria* mold levels correlated with asthma.



Salo PM et al. J Allergy Clin Immunol. 2005; 116:623-629.
Salo PM et al. J Allergy Clin Immunol. 2006; 118: 892-898.

Increased Dust Mites Exposure

- Some important household mites:
 - *Dermatophagoides pteronyssinus*
 - *Dermatophagoides farinae*
 - *Blomia tropicalis*
- Live in bedding, upholstered furniture, stuffed animals and carpet.
- Feed on human skin scales.
- Grow best in relative humidity above 50-70%.



Climate Change impacts on allergic diseases

- Increased CO2 emissions
 - Increased Heat
 - Increased pollen counts
 - Increased pollen season
- Increased Rainfall/Flooding
 - Increased humidity
 - Increased mold
 - Poor living conditions
- **Increased healthcare costs and economic costs**

Healthcare costs of allergic diseases

- Allergic disease affects more than 50 million people in USA
- Fifth leading chronic disease
- Annual cost \$14.4 billion, medications and physician visits.
- 16.7 million office visits each year
- 2 million ER visits for asthma
- 465,000 asthma-related hospitalizations (USA)
- \$8 million - indirect costs from asthma
- Major reason for adult employee sick leave

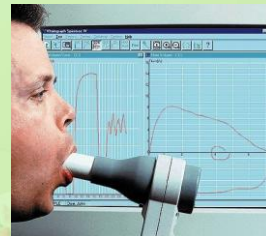
Increased Healthcare Costs

- Medications costs
 - Overuse , tolerance, ineffectiveness
 - Asthma inhalers
- Allergen Immunotherapy injections (costs, risks)
 - Allergy injections (Co-pays, Allergen Serum)
 - Less insurance coverage
- Monoclonal Immunotherapy Omalizumab (coverage by insurance, annual \$10,000)

Case 2- Medication Overuse

- 62 y.o. WM experiences hives, eyelid swelling, sneezing after outdoor exposure in Spring & Summer season
- Benadryl 50mg (2 tabs) every 4hours while awake (8 tabs daily)
- Medication tolerance
- Fluticasone/salmeterol 250/50 mcg BID inhaler
- Allergen immunotherapy injections x 3.5 years
- Benadryl 25-50mg tabs QD PRN and Albuterol PRN

Pulmonary Function Tests (PFT or Spirometry)



Healthcare Recommendations for allergic rhinitis patients

1. Environmental Controls
 1. Pollens (avoid exposure)
 2. Molds, Dust Mites (indoor controls)
2. Identify your allergens
 1. Skin Prick Testing or in-vitro immunoassay (CAP RAST) lab testing
3. Allergen treatment
 1. Medications
 2. Allergen Immunotherapy (SCIT, SLIT)
 3. Monoclonal antibodies
4. Prevention/Control (asthma, chronic sinusitis)
5. Early intervention

Skin Prick Testing



Subcutaneous Allergen immunotherapy injections (SCIT)



Subcutaneous Allergen immunotherapy injections (SCIT)

- Decrease episodes of sinusitis
 - Missed work/school days
- Decrease risk of asthma attacks
- Decrease risk of developing asthma
- Decrease risk of chronic sinusitis/ nasal polyps
 - Headaches
 - Sinus Surgery
- Cost effectiveness of medications
 - Lower long-term medication cost

Subcutaneous Allergen immunotherapy injections (SCIT) Side effects

- Injection site reaction
 - Redness, Swelling, Itching
- Low risk of severe systemic reaction, immunotherapy should be administered only in a physician's office equipped to handle anaphylaxis

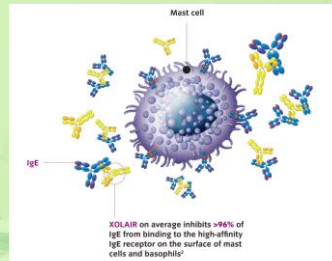
Sublingual immunotherapy (SLIT)



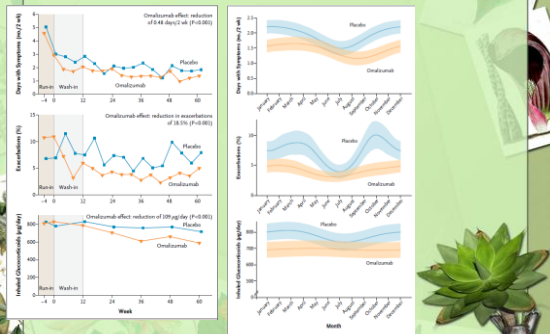
Omalizumab

- Monoclonal Anti- IgE Antibody
- Reduction of free serum IgE
- Uncontrolled Moderate – Severe Persistent Asthma
- Perennial allergen documented
- 0.2% incidence of systemic reactions

Omalizumab : Binds Free IgE



Omalizumab Therapy in Inner-city Children



Allergic Rhinitis Co-morbidities Poor quality of life

Primary Effects

- ASTHMA
- Atopic Dermatitis
- Conjunctivitis
- Sinusitis/ URI
- Nasal and Sinus Polyps
- Bronchitis
- Otitis Media

Secondary Effects

- ❖ Decreased Quality of Life
- ❖ Sleeping Disorders
- ❖ Learning and Attention Impairment
- ❖ Mouth Breathing
- ❖ Dental Malocclusion

Case 3- Older population

- 60 y.o. AAF with minimal allergic rhinitis requires occasional Zyrtec
- Chronic Cough, itching throat and Postnasal drainage
- Diagnosed with Asthma
- Initiated Allergen immunotherapy injections
- Caution:
 - Older population
 - May not be a candidate for allergy injections
 - Due to underlying cardiac disease
 - Earlier intervention is recommended

In Conclusion

- Increased carbon dioxide levels
 - Increase heat with longer growing season over larger geographic area
 - Increase pollen production
 - Increase rain/floods/humidity in some areas creates more mold, poorer living conditions
- Leads to more numerous patients with more severe allergies
- Creates more health care demand, expense and poorer quality of life

