PM10 & Childhood Asthma in Maricopa County

- EPA challenge grant 2006

- The impact of air pollution on children’s health: the latest medical research
Asthma in Arizona

• Asthma prevalence above national average
• Up from 11% in 2000 to 15% in 2009
• 700,000+ Arizonans have been told by their doctor they have asthma
• Ambulatory-sensitive disease: with good primary care & avoidance of triggers, ER & hospital visits can be prevented
Asthma in Arizona

- AHCCCS paid 50% of all asthma ER visits, Medicare 6.7% = 56.7% public $$

- Total cost: $44.5 million

- AHCCCS paid 39.1% & Medicare paid 23.8% of the hospital bills = 62.9% public $$
Goals of the Study

• Exchange quality-assured hospital & ER admissions data & air quality data with partners
• Examine the correlations between data sets
Goals of the Study, cont.

• Develop a predictive model for asthma episodes & air quality thresholds in Maricopa County

• Investigate possibility of creating an alert system on the potential health effects of poor air
Partners

- ADEQ – provided air monitor data
- ADHS – provided data on ER visits & hospitalizations for asthma as a primary diagnosis
- ASU – analyzed the data & provided predictive modeling for weather & pollution
Study Design

• Area: 168 census tracts in Metro Phoenix
• Boundary: Dunlap Rd., 52nd St., Eliot Rd & 75th Ave.
• Each census tract in area was located within 5 miles of a permanent PM$_{10}$ monitor
• Mapped PM$_{10}$ concentrations via monitoring & modeling
Central Phoenix Continuous PM10 Monitoring Sites

Area: 168 census tracts in Metro Phoenix
Boundary: Dunlap Rd., 52nd St., Eliot Rd & 75th Ave.
Each census tract in area was located within 5 miles of a permanent PM10 monitor
Mapped PM10 concentrations via monitoring & modeling

Monitors
Permanent:
CP - Central Phoenix
DC - Durango Complex
WF - West 43rd Avenue
WP - West Phoenix
GR - Greenwood
SP - South Phoenix
SS1 - Supersite

Temporary:
MRV - Maryvale
VGC - Valley Garden Center
WVR - Weaver’s Auto Service
CSA - Community Service

Photo courtesy of azdeq.gov

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Study Design

• Analyzed 5,000+ hospitalizations & ER visits for asthma as the 1st diagnosis
• Population: children age 5-18
• Duration: 21 months, from January 1, 2005 to September 30, 2006
• Controls: reviewed 24-hour avg. PM$_{10}$ from 1-7 days before the health event in each case
• Modeled weather & pollution predictions for potential new warning systems
Results

Positive correlations between elevated PM$_{10}$ & high asthma incidence in Metro Phoenix

Photo courtesy of niehs.nih.gov
• 13.7% increase in asthma events when PM$_{10}$ rose by 36.4 µg/m3 (in range of 30-56 µg/m3)

• This is a change in the daily average PM$_{10}$ from the 25th percentile to the 75th percentile

• Statistically significant at 95% confidence level
Asthma ER & hospital visits linked to elevated PM10

13% increase with rise of 36.7 ug/m3 in the range of 30-56 ug/m3

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Conclusions

• This is a stronger effect than seen in other studies where such site-specific health and air quality data may not have been available

• Significant increase in the likelihood that children may have an asthma event with a relatively small increase in PM$_{10}$
Study Conclusions

- The at-risk population is greater than previously observed.
- Sensitive populations need greater protections than the current systems in place.
- The study design can be used to model other pollutants such as PM$_{2.5}$, ozone, or a combination of pollutants.

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Photo courtesy of coyoteblog.com
Research on air pollution and asthma

• PM$_{2.5}$: Utah Valley Steel Mill closed for 13 mo. & reopened (1980s)
  – 89% increase in childhood hospital admissions during months mill was open

• Ozone: 1996 Atlanta Olympic Games, city traffic curtailed for 3 weeks
  – Peak ozone fell by 28%, Medicaid claims for asthma dropped 48%
Traffic-generated air pollution

• CA: longitudinal study in 12 communities—urban, suburban & rural
  – Showed reduced lung function growth linked to PM$_{10}$ concentration near urban highways
  – Long term exposure associated with changes in lung function in teens and adults
  – Forced respiratory volume (FEV) was lower in people who live in polluted areas

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**Traffic-generated pollution**

- NJ & PA study of pregnant mothers who lived near highway toll plazas
  - After E-Z pass system introduced, traffic passed through tolls faster, no idling
  - Lower pollution associated with 10.8% reduced prematurity and
  - Low birthweight reduced by 11.8%

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Effects of Inhaled PM:

- **Lungs**: inflammation, oxidative stress, alters pulmonary reflexes, reduces lung function

- **Blood vessels**: inflammation of lining, accelerates atherosclerosis, vasoconstriction & hypertension
Effects of Inhaled PM:

- **Heart**: abnormal rhythm, increases ischemia, exacerbates heart failure

- **Blood**: activates white blood cells, alters flow, increases coagulation, reduces oxygen saturation

- **Brain**: reduces blood flow (ischemia)
**Long term effects of pollution**

- Asthma incidence may be related to air pollution exposure in utero and early life.
- 1st trimester exposure to PM$_{10}$ and 2nd trimester NO$_2$ exposures associated with lower lung function in children age 6-11.
- Ozone, PM$_{2.5}$ & CO are harmful to infants at levels below the EPA thresholds.
Do cities with bigger improvements in air quality have bigger improvements in health, measured by life expectancy?

• Studied 51 metro areas from 1980-2000

• YES: a 10 mcg/m$^3$ reduction in PM$_{2.5}$ is associated with 1 year increase in life expectancy
Policy implications

- Air pollution is recognized as a serious public health hazard
- Adverse effects on respiratory system occur at levels below the current ambient standards
- Focus control strategies on specific sources & constituents that are damaging to health
Policy implications

- Change zoning for schools & homes to increase distance from busy roadways
- Develop alert systems so at-risk people can decrease exposure on bad air days
- Study children’s environmental health long-term
- Current regulations could be more stringent
Sources


Sources


• Arizona Asthma Coalition: Barbara Burkholder  barbburk5@msn.com