Optimizing the Respiratory Health of Soldiers During Pasture Burning

Erica McGinley, BSN, RN
MPH Field Experience Report
Kansas State University
November 12, 2015
Introduction

Missouri Western State University
Saint Joseph, Missouri
Bachelor in the Science of Nursing
Spring 2009
Master of Public Health
Infectious and Zoonotic Diseases

Fall 2013:
Fundamental Methods of Biostatistics: MPH 701 (3 credit hours)
Global Health Issues: DMP 844 (3 credit hours)
Introduction to Epidemiology: MPH 754 (3 credit hours)

Summer 2014:
Globalization, Cooperation & the Food Trade: DMP 888 (1 credit hour)
Fundamental Concepts in Emerging Pathogenic Disease: DMP 770 (3 credit hours)

Spring 2014:
Environmental Toxicology: DMP 806 (2 credit hours)
Administration of Health Care Organizations: MPH 720 (3 credit hours)
Social and Behavioral Bases of Public Health: MPH 818 (3 credit hours)

Fall 2014:
Principles of Animal Disease Control: ASI 540 (3 credit hours)
Genetics of Microorganisms: BIOL 675 (3 credit hours)
Multidisciplinary Thought and Presentation: DMP 815 (3 credit hours)

Spring 2015:
Principles of Veterinary Immunology: DMP 705 (3 credit hours)
Intermediate Epidemiology: DMP 854 (3 credit hours)

Summer 2015:
Capstone: MPH 840 (6 credit hours)
Completed 240 contact hours with the Department of Public Health, Fort Riley, KS

Total program hours: 42
Field Experience

Department of Public Health
7665 Normandy Drive
Fort Riley, KS
To promote health and wellness, and to prevent disease and injury of Soldiers and military retirees, their families, and Army Civilian employees at Fort Riley through Environmental Health, Industrial Hygiene, Occupational Health, Army Hearing Program, and Army Public Health Nursing services.

-Mission Statement

Fort Riley Department of Public Health
Departments:

- **Industrial Hygiene**: ergonomic assessments, noise dosimetry testing, indoor air quality surveys, personal protective equipment, storage of sterile products

- **Environmental Health**: vector-borne diseases, hazardous waste disposal, chemical labeling and storage, food inspections at Child Development Centers (CDC) and Dining Facilities, infestation investigation, storm shelter structures, water sampling

- **Army Public Health Nursing**: CDC inspections, sexually transmitted infection (STI) counseling, disease outbreak investigations, tobacco cessation program, community partnerships

- **Army Wellness Center**: metabolic testing, stress management, nutrition education, body composition, physical fitness testing
Departments

- **Army Hearing Program**: hearing tests, fitting for hearing protection, visiting sites such as the air field

- **Occupational Health**: immunizations, tuberculosis (TB) screening, EKGs, pulmonary functions tests (PFTs), vision screening, hearing tests, vital signs

- **Veterinary Services**: food inspections, routine exams of pets, collaboration with bite incidents

- **Health Promotion Officer**: maintaining and developing programs and policies to improve the health of the military population, evaluating the effectiveness of current health promotion policies and projects, and engaging the community in wellness promotion
Field Experience

Presenting to Army Public Health Nursing Department
June 4, 2015
Field Experience

Irwin Army Community Hospital Safety Day
May 21, 2015
Field Experience Project

• Fort Riley has a population of approximately 53,000
  • This includes active duty members, their family members, retirees, and contracted civilian workers

• Fort Riley is located within a unique region known as the Flint Hills

• Every spring (March, April, and May) some degree of pasture burning occurs in this region
  • The by-products are known to cause injury to human health
ARE YOU SURE THIS IS THE OFFICIAL WAY TO REPORT POLLUTION STATISTICS?

THAT ONE LOOKS LIKE A .043 PPM.
The Flint Hills

Map courtesy of eoearth.org
“Prairie fire is as fundamental to the Great Plains as the sun, soil, wind, grazers, and grass. It influences grass composition; allows for more nutritious growth on which cattle can graze; and, when applied regularly, prevents trees from intruding into native prairie grasses.”

-Prairie Fire: A Great Plains History
Prairie Plants

• The lengthy root systems of prairie plants are adapted for adverse conditions
  • Prairie fires affect the plant above ground
  • The grass roots below remain intact and ready to produce new plants

• This is an endangered ecosystem; approximately 4% of original prairie grasslands remain in existence today
Prescribed Fire

Photo courtesy of kidsconewandsgras.com
Cattle Gains

Effect of time of burning on steer gains

Graphic courtesy of Kansas State University
An Exceptional Event

• Environmental Protection Agency’s (EPA) Exceptional Event Rule
  • 72 FR 13560, March 22, 2007
  • An exceptional event is defined 40 CFR 50.14 (c)(3)(iv) as an event that:
    • affects air quality
    • is not reasonably controllable or preventable
    • is caused by human activity that is unlikely to recur at a particular location or is a natural event

• April 6, 12, and 13, 2011 ozone exceeded the National Ambient Air Quality Standard (NAAQS) for 8-hour ozone at several air quality monitors

• April 29, 2011 ozone exceedances for 8-hour ozone were recorded in the Wichita area
Kansas monitors with 8-hour ozone concentrations exceeding 0.075 ppm in April 2011

<table>
<thead>
<tr>
<th>Monitor</th>
<th>AQS Site Code</th>
<th>Date in 2011</th>
<th>Observed 8-Hour Ozone Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine Creek</td>
<td>201070002</td>
<td>April 6</td>
<td>0.076</td>
</tr>
<tr>
<td>Peck</td>
<td>201910002</td>
<td>April 6</td>
<td>0.082</td>
</tr>
<tr>
<td>Wichita Health</td>
<td>201730010</td>
<td>April 6</td>
<td>0.079</td>
</tr>
<tr>
<td>Department</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNI-Topeka</td>
<td>201770013</td>
<td>April 12</td>
<td>0.084</td>
</tr>
<tr>
<td>Konza Prairie</td>
<td>201619991</td>
<td>April 12</td>
<td>0.078</td>
</tr>
<tr>
<td>Konza Prairie</td>
<td>201619991</td>
<td>April 13</td>
<td>0.079</td>
</tr>
<tr>
<td>Peck</td>
<td>201910002</td>
<td>April 29</td>
<td>0.077</td>
</tr>
<tr>
<td>Sedwick</td>
<td>201730018</td>
<td>April 29</td>
<td>0.082</td>
</tr>
</tbody>
</table>

Chart courtesy of KDHE Exceptional Events Report
Smoke Management Plan (SMP)

- The EPA has the authority to exclude data from use in exceedance determinations regarding NAAQS violations.
- This may be applied to the use of prescribed fire if the state has met certain criteria.
  - Part of the criteria requires the state to adopt and implement a smoke management plan.
- The Kansas Department of Health and Environment (KDHE) formally adopted its SMP on December 2010.
Monitoring at Konza Prairie

- KDHE and owners of the Konza requested the EPA stop monitoring air quality at the site
  - Debate about data use for research vs. regulatory purposes
  - Concern for negative impact on the local economy vs. public health

- Director of the Konza Prairie biological station noted that there is a concern about exceedances in ozone during burn season but the real source is material carried in by the wind from other regions
Respiratory Health

• Ozone
  - Develops when oxides of nitrogen react with hydrocarbons and other volatile compounds with sunlight present

  • Can exacerbate allergies, asthma, and emphysema

  • Has the ability to decrease lung function in seemingly healthy people

  • Demonstrates the capability of causing illness in large numbers of the general public

Ozone and PM – Health Effects

Respiratory:
- Coughing, wheezing, reduced lung function
- Reduced resistance to infection
- Aggravation of asthma, emphysema and bronchitis

Cardiovascular:
- Inflammation
- Heart failure
- Cardiac arrhythmia
- Hardening of the arteries
- Stroke
- Heart attack

Image courtesy of KDHE
Respiratory Health

• Particulate Matter (PM)
  - A mixture of solid, liquid, or solid and liquid particles of organic or inorganic substances suspended in the air
  
  PM 10: diameter <10 µm (course fraction)
  PM 2.5: diameter <2.5 µm (fine fraction)
  Diameter <0.1 µm (ultra-fine fraction)

• Exposure leads to a wide range of acute and chronic conditions

• Long-term exposure to moderate amounts of PM leads to a reduction in life expectancy by several months
Implications for Soldiers

• Many of their duties are performed outdoors

• Pasture burning poses a unique public health concern

  • Is there a correlation between hospital admissions for respiratory-related illness in this population and pasture burning?

  • If so, what rules and regulations can be implemented to optimize respiratory health?
Konza Monitoring Station
Air Quality Sites
### ICD-9 Codes

<table>
<thead>
<tr>
<th>Medical Code</th>
<th>Respiratory Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>460-466, 477, 480-487</td>
<td>Respiratory infection (including upper)</td>
</tr>
<tr>
<td>466</td>
<td>For children (as it may be difficult to distinguish from asthma): acute bronchitis and bronchiolitis</td>
</tr>
<tr>
<td>480-486</td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>481</td>
<td>Viral pneumonia</td>
</tr>
<tr>
<td>482</td>
<td>Pneumococcal pneumonia</td>
</tr>
<tr>
<td>483</td>
<td>Other bacterial pneumonia</td>
</tr>
<tr>
<td>484</td>
<td></td>
</tr>
<tr>
<td>485</td>
<td>Pneumonia due to other unspecified organism</td>
</tr>
<tr>
<td>486</td>
<td>Bronchopneumonia organism unspecified</td>
</tr>
<tr>
<td>490-492, 494-496</td>
<td>Chronic Obstructive Pulmonary Disease (COPD)</td>
</tr>
<tr>
<td>491</td>
<td>Bronchitis</td>
</tr>
<tr>
<td>492</td>
<td>Emphysema</td>
</tr>
<tr>
<td>493</td>
<td>Asthma</td>
</tr>
<tr>
<td>508</td>
<td>Respiratory conditions due to other and unspecified external agents</td>
</tr>
<tr>
<td>786</td>
<td>Other respiratory symptoms</td>
</tr>
<tr>
<td>786.05</td>
<td>Shortness of breath</td>
</tr>
<tr>
<td>786.07</td>
<td>Wheeze</td>
</tr>
<tr>
<td>786.1</td>
<td>Stridor (whistling)</td>
</tr>
<tr>
<td>786.2</td>
<td>Cough</td>
</tr>
<tr>
<td>786.5</td>
<td>Chest Pain</td>
</tr>
</tbody>
</table>
Average Cases with Ozone

*Average ozone in PPB*
Average Cases with PM 2.5

<table>
<thead>
<tr>
<th>Month</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb</td>
<td>4.44</td>
<td>8.24</td>
<td>11.38</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average PM 2.5

<table>
<thead>
<tr>
<th>Year</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Average Cases with PM 10

<table>
<thead>
<tr>
<th>Month</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>9.39</td>
<td>23.86</td>
<td>39.91</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average PM 10

<table>
<thead>
<tr>
<th>Month</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Linear Mixed Model Analysis

| Effect  | Year | Estimate | Standard Error | DF | t Value | Pr > |t| |
|---------|------|----------|----------------|----|---------|------|---|
| Intercept |      | 4.0193   | 0.1811         | 3  | 22.19   | 0.0002 |
| Year     | 2008 | -2.8881  | 0.1251         | 6  | -23.09  | <.0001 |
| Year     | 2009 | -1.9406  | 0.3098         | 6  | -6.26   | 0.0008 |
| Year     | 2010 | -1.3228  | 0.1640         | 6  | -8.07   | 0.0002 |
| Year     | 2011 | 0        |                | .  | .       | .     |
| Ozone    |      | 0.03191  | 0.007937       | 6  | 4.02    | 0.0070 |
| PM 2.5   |      | 0.04616  | 0.02121        | 6  | 2.18    | 0.0724 |
| PM 10.0  |      | 0.009947 | 0.02465        | 6  | 0.40    | 0.7005 |
Total Flint Hills acres burned over years
2000-2015
Discussion

- Average acres burned and increase in respiratory illness did not coincide
  - Investigate other potential respiratory irritants

- Population at Fort Riley is demographically unique

- Missing demographic data

- Air quality data from separate locations
Discussion

• Pollen allergy forecast
  • Allergy and burn seasons occur simultaneously
    • Consider Eastern Red Cedar

• Future study for comparison
  • Fort Riley respiratory counts with Fort Carson

• Air quality data from February, March, April, and May
  • More inclusive study with year-round data
Conclusions

• Air quality data used in this report did not contain any exceedances or violations by Environmental Protection Agency (EPA) standards

• Exceptional event from EPA
  • No other violations in the state of Kansas

• Kansas Department of Health and Environment (KDHE) Smoke Management Plan (SMP)
Conclusions

• Education for the public on small engine use and emissions
  • Lawn mowers
  • Personal vehicles

• Alternate plans for soldiers on visibly hazy days

• Flint Hills Smoke Management website
  • http://www.ksfire.org
    • Tools for land managers
    • Education for burn decisions
Core Courses

• Environmental health sciences: established connections between the environment and human health as well as potential solutions when problems arise

• Social and behavioral sciences: provided an in-depth understanding of the complexities of human behavior

• Biostatistics: laid the foundation for understanding the basic principles of analyzing data

• Epidemiology: cultivated a process for critically thinking about complex public health issues and interpreting data appropriately

• Health services administration: directly related to my field experience and the collaborative health care efforts made in the local community
Questions?
Acknowledgments

• Dr. Robert Larson
• Dr. Wei-Wen Hsu
• Dr. Deborah Canter
• Dr. John Blair
• Rosemary Ramundo
• Dr. Carol Blocksome
• Dr. Paul Benne
• Fort Riley Public Health Department Staff
References


