EVIDENCE AND ANALYSIS
DEBUNK SPECULATIONS
ABOUT RAW MILK RISKS

Peg Coleman and Nick Azzolina

Society for Risk Analysis (SRA) 2019 – Risk Analysis in the Data Analytics Era

11 December 2019
OUTLINE

• Some history on disparate positions for raw and pasteurized milk in the US

• Testing a hypothesis based on US data reported by CDC

• Graphical analysis and multivariate Poisson regression

• Results

• Conclusion and next steps
EMERGENCE OF MICROBIAL ECOLOGY AS SCIENCE

North and Coleman (2017) SRA Webinar Series on Microbiota of Milks Project
New Ecological Insights

• *Homo sapiens* incomplete without microbial partners

• All animals and plants SUPERORGANISMS

• Mammalian milks superfoods with dense and diverse microbiota essential to ‘seed and feed’ healthy superorganisms
BACK TO 1840S:
URBANIZATION OF US DAIRY INDUSTRY

North and Coleman (2017) SRA Webinar Series on Microbiota of Milks Project

COMMUNICATIONS FROM EARLY HISTORY
NY CITY METROPOLITAN AREA (1890s)

Nathan Straus

➢ New York City Philanthropist
➢ Son died from contaminated milk
➢ Had no medical or scientific training
➢ Founded Straus Pasteurized Milk Laboratory (1892) that provided milk to urban children

“Raw Milk Kills”

Henry L. Coit

➢ New Jersey Pediatrician
➢ Son died from contaminated milk
➢ Had physicians who were trained in dairy microbiology and sanitation supervise farm dairies
➢ Founded the Association of American Medical Milk Commission (1893)

“Dirty Milk Kills”

North and Coleman, 2017 SRA Webinar Series on Microbiota of Milks Project
SPECULATION FROM CDC MOTIVATES RE-ANALYSIS

• “Legalization of the sale of unpasteurized {raw} milk in additional states would probably lead to more outbreaks and illnesses.”
  • Mungai et al (2015, pg. 121) Emerging Infectious Diseases (CDC outbreak data from 2007 to 2012)
  • Statement widely cited in media and various journals as proven fact, not speculation

• Whitehead and Lake (2018) study analyzed CDC data from 2005 to 2016

• Epidemiologist’s critique of this study motivated the Raw Milk Institute to fund an independent re-analysis of the CDC data

• Dr. Nick Azzolina conducted re-analysis of the CDC data (graphical, Poisson regression)
  • Mungai’s speculation tested as hypothesis for significance of effects by formal statistical methods
STATISTICAL RE-ANALYSIS OF CDC DATA

• Graphical analysis of incidences rates and legal status over time

• Multivariate Poisson regression, controlling for population and evaluating the potential effects of the legal availability of raw milk on rates of outbreaks, illnesses, or hospitalizations.

  • Conducted the entire analysis in the open-source statistical package, R

  • Evaluated both fixed-effects and multilevel models

    Model.01 = glm(Outbreaks ~ Legal + State, offset=LPopulation) [1]

    Model.02 = glm(Outbreaks ~ NLlicense + State, offset=LPopulation) [2]

    Model.03 = glmer(Outbreaks ~ Legal + (1|State), offset=LPopulation) [3]

    Model.04 = glmer(Outbreaks ~ NLlicense + (1|State), offset=LPopulation) [4]

Azzolina and Coleman (2019) manuscript submitted for publication
STATE-LEVEL SCATTERPLOTS: NO INCREASING TREND FOR OUTBREAKS
POISSON REGRESSION: LEGAL STATUS/NUMBER OF LICENSES NOT SIGNIFICANT

Equation 3
- Full dataset
- 151 outbreaks from 39 states
- Legal status not significant from zero
- \( (p\text{-value} = 0.92) \)

Equation 4
- Reduced dataset
- 56 outbreaks from 9 states
- No. licenses not significant from zero
- \( (p\text{-value} = 0.96) \)

| Parameter   | Estimate | Std. Error | z value | Pr(>|z|) | Significance |
|-------------|----------|------------|---------|----------|--------------|
| (Intercept) | -16.862  | 0.341      | -49.413 | < 0.01   | *            |
| Legal       | 0.036    | 0.355      | 0.101   | 0.92     |              |

Significance code: \( p\text{-value} \leq 0.05 \) ‘*’

Groups

<table>
<thead>
<tr>
<th>Variance</th>
<th>Std. Dev.</th>
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<tbody>
<tr>
<td>State (Intercept)</td>
<td>0.8183</td>
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</table>

| Parameter   | Estimate | Std. Error | z value | Pr(>|z|) | Significance |
|-------------|----------|------------|---------|----------|--------------|
| (Intercept) | -16.860  | 0.484      | -34.832 | < 0.01   | *            |
| NLicense    | 0.001    | 0.011      | 0.052   | 0.96     |              |

Significance code: \( p\text{-value} \leq 0.05 \) ‘*’

Groups

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<thead>
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<th>Std. Dev.</th>
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STATE-LEVEL SCATTERPLOTS: NO INCREASING TREND FOR ILLNESSES
STATE-LEVEL SCATTERPLOTS: NO INCREASING TREND FOR HOSPITALIZATIONS
RATES OF OUTBREAKS, ILLNESSES, HOSPITALIZATIONS FOR CALIFORNIA NOT INCREASING WITH PRODUCTION

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Volume (gallons)</th>
<th>Illness Rate</th>
<th>Hospitalization Rate</th>
<th>Outbreak Rate</th>
<th>Change in Rate</th>
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<tbody>
<tr>
<td>2000</td>
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<tr>
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<tr>
<td>2016</td>
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</table>
Controlling for state and population, NO SIGNIFICANT RELATIONSHIPS between either LEGAL STATUS of raw milk or NUMBER OF LICENSES/PERMITS for raw milk and increasing rates of outbreaks, illnesses, or hospitalizations
NEXT STEPS

• Azzolina and Coleman (2019) manuscript on this work prepared with funding from the WHOLE TRUTH, WHOLE MILK CAMPAIGN through Upstate NY SRA

• Another manuscript on BENEFITS AND RISKS of RAW AND PASTEURIZED MILKS (?breastmilk? and bovine milk) in preparation from this campaign

• Upstate NY SRA SEEKING PARTNERS for organizing international workshop(s) to begin more formal analytic-deliberative process of the structured body of evidence on the microbiota of milks

ACKNOWLEDGMENTS

• Donors to the SRA Whole Truth, Whole Milk crowdfunding campaign

• Raw Milk Institute and the Board of Directors

• Upstate NY SRA members and webmaster Michele Stephenson