

**Case Study on Benefits: The Mainly
Microbial Human as the Target for Health
Risk Assessment**

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Additional Background and COI

Prior Consultant/COI: Immune safety contract lab testing; National Toxicology Program (NIEHS); EPA Air Quality Criteria; **Seed (CA)**

Present COI: Tiny Health (Austin TX)

Author/Co-author/Editor: Strategies for Protecting Your Child's Immune System; **Immunotoxicity Testing; Immunotoxicity, Immune Dysfunction and Chronic Disease; The Human Superorganism;**

Peer-reviewed papers: immune development; immune and microbiome safety evaluation; **chronic and infectious diseases; colonization resistance in early life**

Invited lectures: U.S. National Academy of Sciences, NIH, FDA, EPA, USDA, WHO projects

OUTLINE

1. Orientation to Evidence Maps

(See: **Wiedemann et al. (2011)** Evidence Maps: Communicating Risk Assessments in Societal Controversies: The Case of Engineered Nanoparticles. *Risk Analysis*, 31: 1770-1783.)

2. The Fundamental Nature of the Microbial Human

3. Health Risk Assessment in the Era of the Microbiome

4. Consumable Microbes, Immune Balance, and Colonization Resistance (CR) against Pathogens

5. Degraded Microbiomes and Predictable Chronic Diseases: Asthma and Beyond

Evidence Map Components Relevant to Case Study

Pro Supplemental Studies on Mechanisms

- **Vertical and Horizontal (Environmental) Transfer of Microbes** from foods to infants
 - Study_A
 - Study_B
 - Study_C
- **Microbial Ecology** of infant foods
 - Study_A
 - Study_B
 - Study_C
- **Microbiome: Immune System Crosstalk**, indirect colonization resistance for infants
 - Study_A
 - Study_B
 - Study_C

Contra Supplemental Studies on Mechanisms

- **Foodborne pathogen susceptibility to innate defenses including microbiota**, direct colonization resistance
 - Study_A
 - Study_B
 - Study_C

supporting

- Evidence attributing benefits to specific foods or microbial consortia
- Other

Pro-Argument on Health Benefits

1. Extent and consistency of the evidence for dose-dependent protective effects against incidence and severity of infectious diseases
2. Extent and consistency of the evidence for dose-dependent protective effects against incidence and severity of non-communicable diseases

attenuating

- Evidence attributing benefits to specific foods or microbial consortia
- Other

supporting

- Evidence on infectious disease causation, dose-dependency
- History of use of foods
- Other

Contra-Argument on Risks of Enteric Infections

Extent and consistency of the evidence for dose-dependent effects linked to infectious (and/or non-communicable) diseases

attenuating

- Assessment of predictive value of pathogen presence/absence and levels in foods for illnesses in infants
- History of use of foods
- Other

Evidence Basis

- Numbers of benefit-risk, systematic review, meta-analysis, and clinical studies in the body of evidence
- Number of other supporting or attenuating studies
- Number of Supplemental Studies with evidence on plausible mechanisms

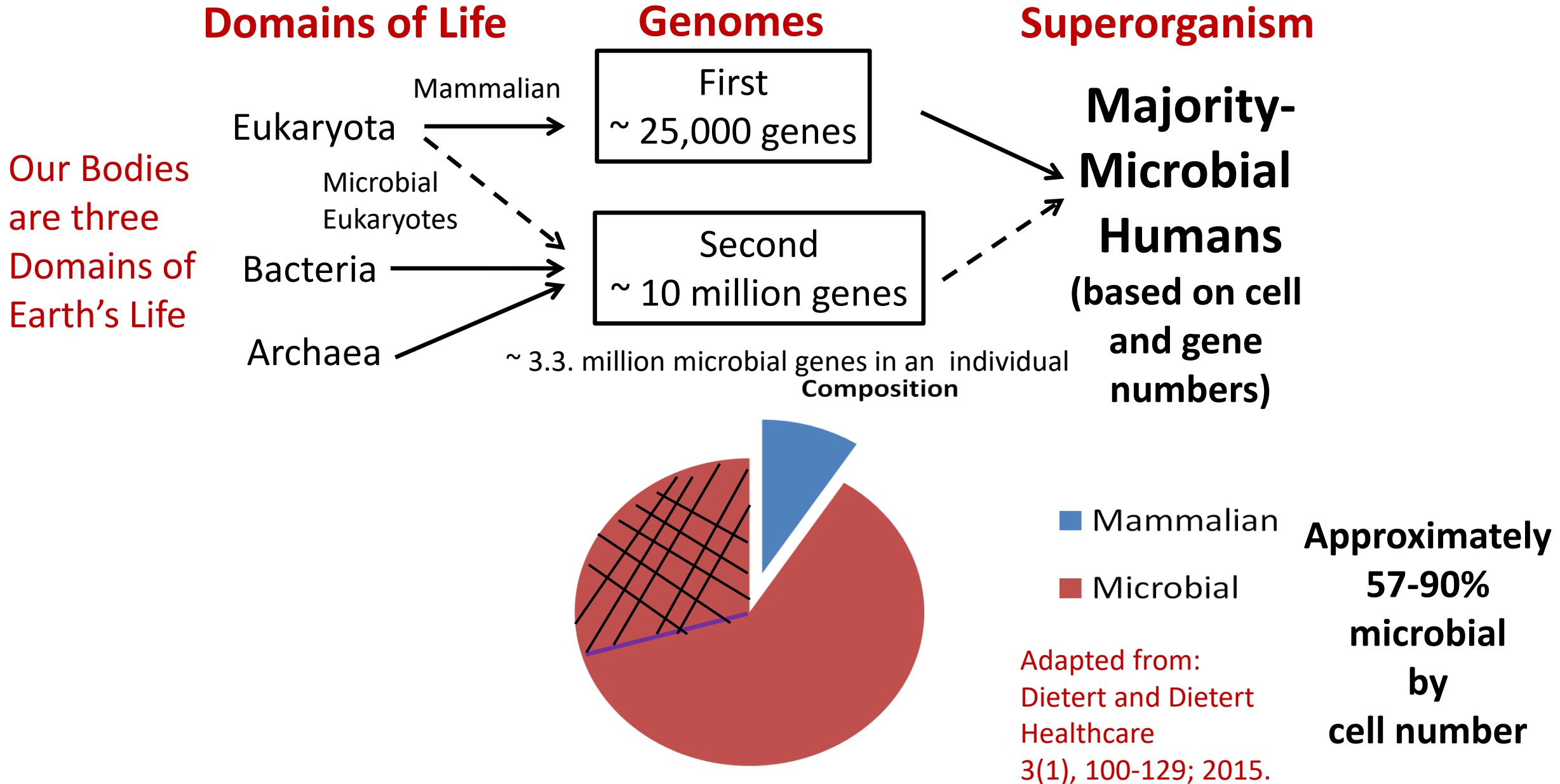
Conclusions

1. Overall biological benefits with assessment of limitations and strengths, clarity, consistency, and cohesion of the body of evidence, with supplemental studies on plausible mechanisms
2. Overall biological risks with assessment of limitations and strengths, clarity, consistency, and cohesion of the body of evidence, with supplemental studies on plausible mechanisms

Remaining Uncertainties

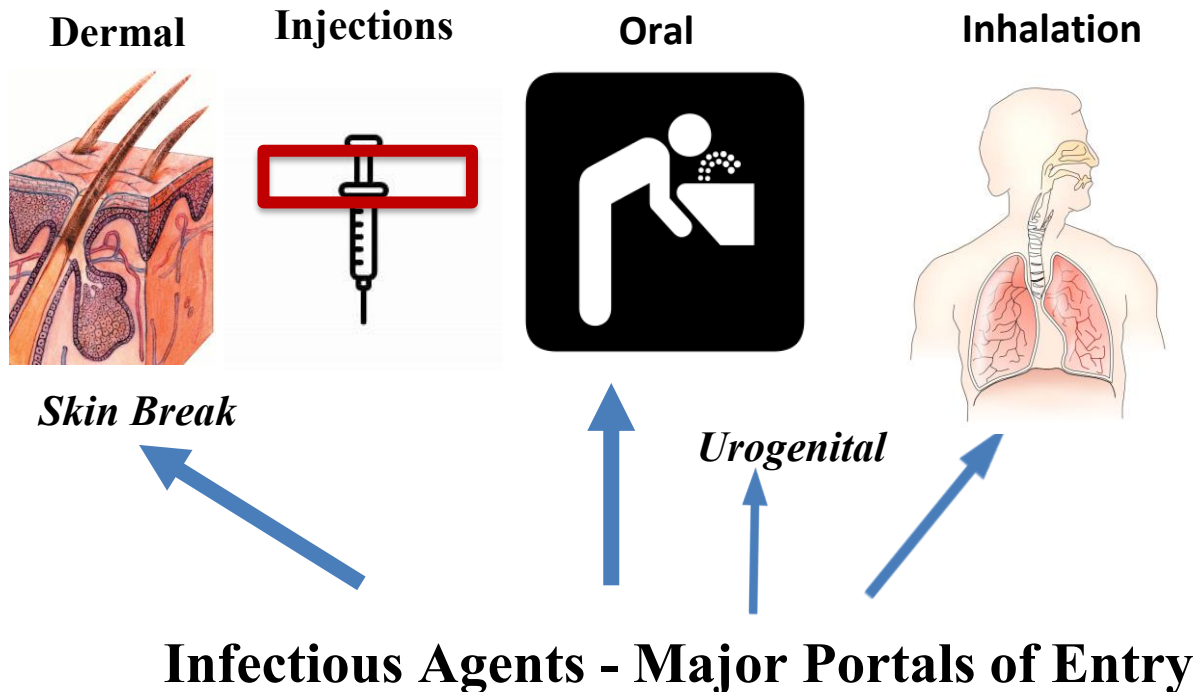
- How do food microbiota function in protection against infectious and non-communicable diseases in infancy and later in life?
- Are presence or levels of potential pathogens in foods predictive of illness in infants?
- Are there health benefits to thermal treatments of foods for infants?

The Mainly-Microbial Human

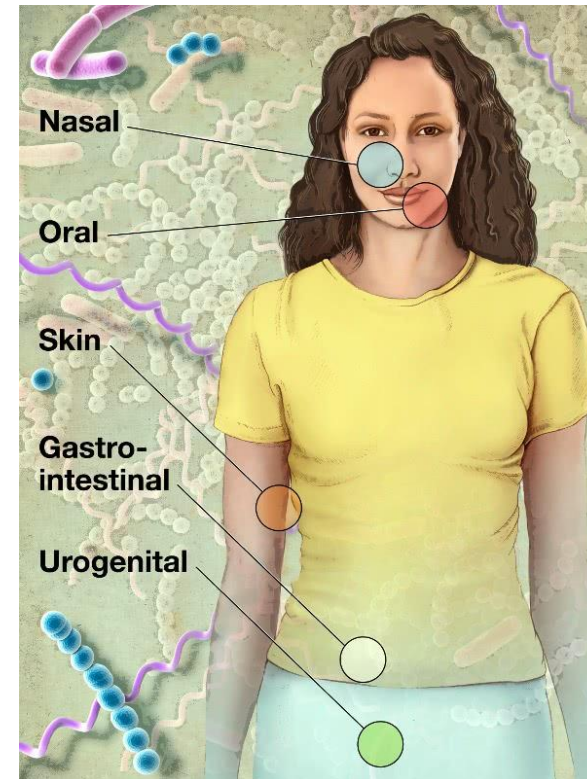


The Microbiome is Our Gatekeeper and Front-Line of Defense

Main Toxicological Routes of Exposure



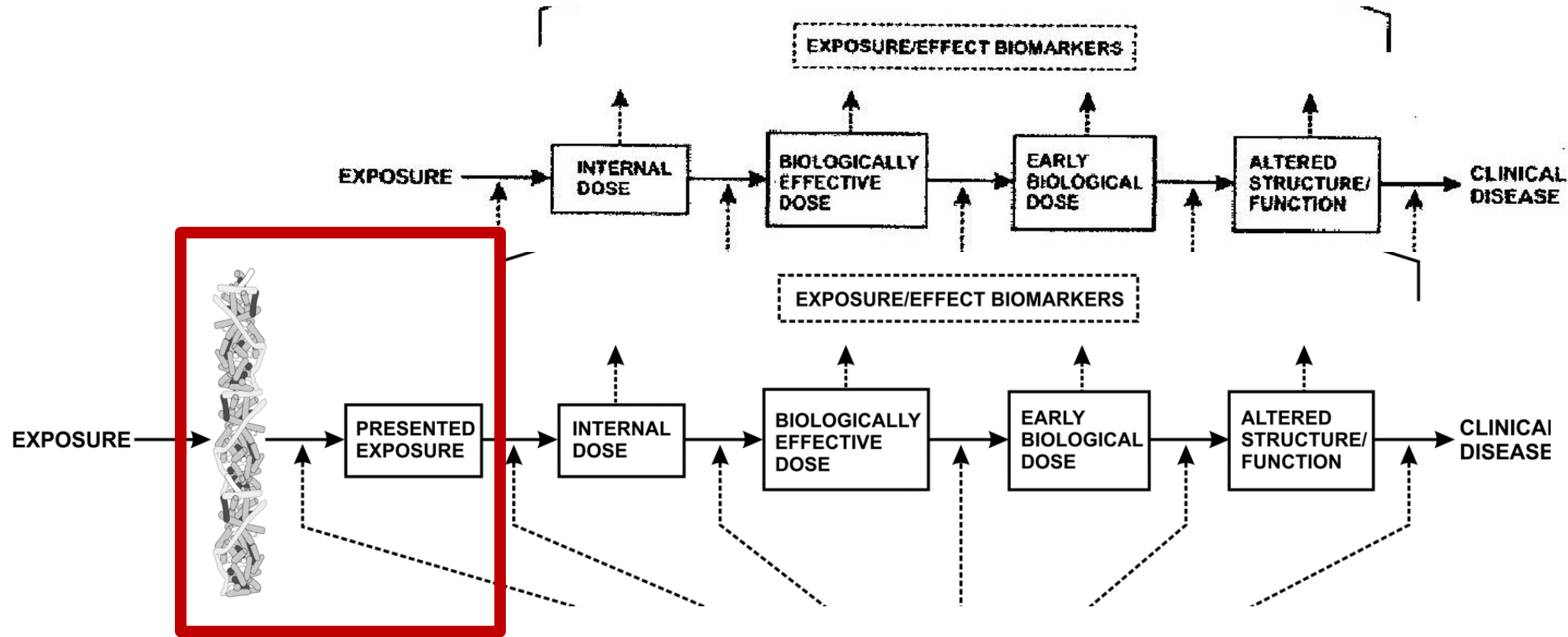
Major Body Sites for the Microbiome



See: Damalas and Koutroubas,
Toxics 2016, 4(1), 1; doi:10.3390/toxics4010001; and also,
Dietert and Dietert, Am J Biomed Sci & Res. 2023 20(3) AJBSR.MS.ID.002708,
DOI: 10.34297/AJBSR.2023.20.002708
Angrand et al. Environ. Toxicol. Pharmacol. (2025) 119, 104812. <https://doi.org/10.1016/j.etap.2025.104812>

3. Health Risk Assessment in the Era of the Microbiome

2015 Recommendation in *Toxicological Sciences*



From: Dietert, R and Silbergeld, E. (2015)

Biomarkers for the 21st Century: Listening to the Microbiome. *Toxicol. Sci.* 144 (2): 208-216. <https://doi.org/10.1093/toxsci/kfv013>

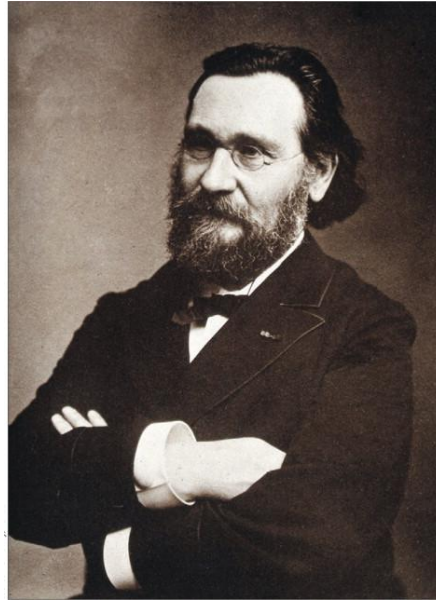
4. Consumable Microbes, Immune Balance and and Colonization Resistance (CR) Against Pathogens

1908 Nobel Prize in Physiology or Medicine for the discovery in 1882 of macrophage phagocytosis to kill bacteria
Known as the Father of Innate Immunity

Metchnikoff advocated
the consumption of lactic acid
bacteria such as

*Lactobacillus delbrueckii subsp.
bulgaricus*

*to blunt the effects of toxic gut
bacteria that could sicken and
shorten life.*



Elie Metchnikoff (1845–1916)

*The Prolongation of Life:
Optimistic Studies* (1907)

Metchnikoff E. In: Mitchell PC editor. *The Prolongation of Life. Optimistic Studies*. New York: G P Putnam's Sons (1910). 96 p;

Podolsky SH. Metchnikoff and the microbiome. *Lancet* (2012) 380:1810–1.10.1016/S0140-6736(12)62018-2;

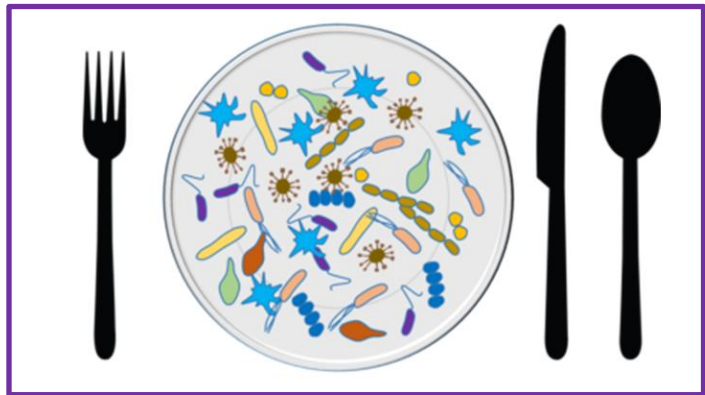
Anukam KC, Reid G. Probiotics: 100 years (1907–2007) after Elie Metchnikoff's observation. Communicating current research and educational topics and trends in applied microbiology. 2007;1:466-74.

Mackowiak, Philip A. (2013). Recycling Metchnikoff: Probiotics, the Intestinal Microbiome and the Quest for Long Life. *Frontiers in Public Health*. 1: 52. Bibcode:2013FrPH....1...52M. doi:10.3389/fpubh.2013.00052.

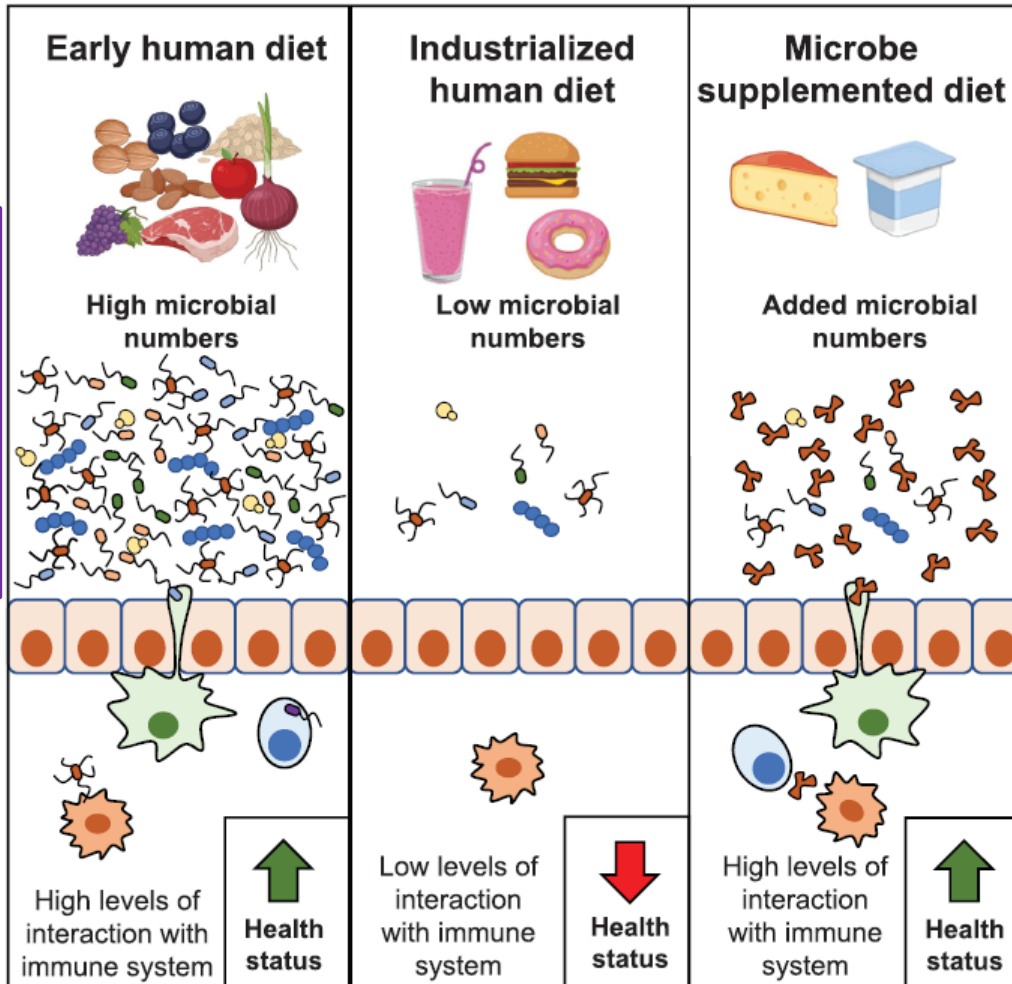
Petrova, P., Ivanov, I., Tsigoriyna, L., et al. (2021). Traditional Bulgarian Dairy Products: Ethnic Foods with Health Benefits. *Microorganisms*, 9(3), 480. <https://doi.org/10.3390/microorganisms9030480>

Consider Protective Effects of Foods Enriched in Microbes

Recommended Daily Allowances for Microbes

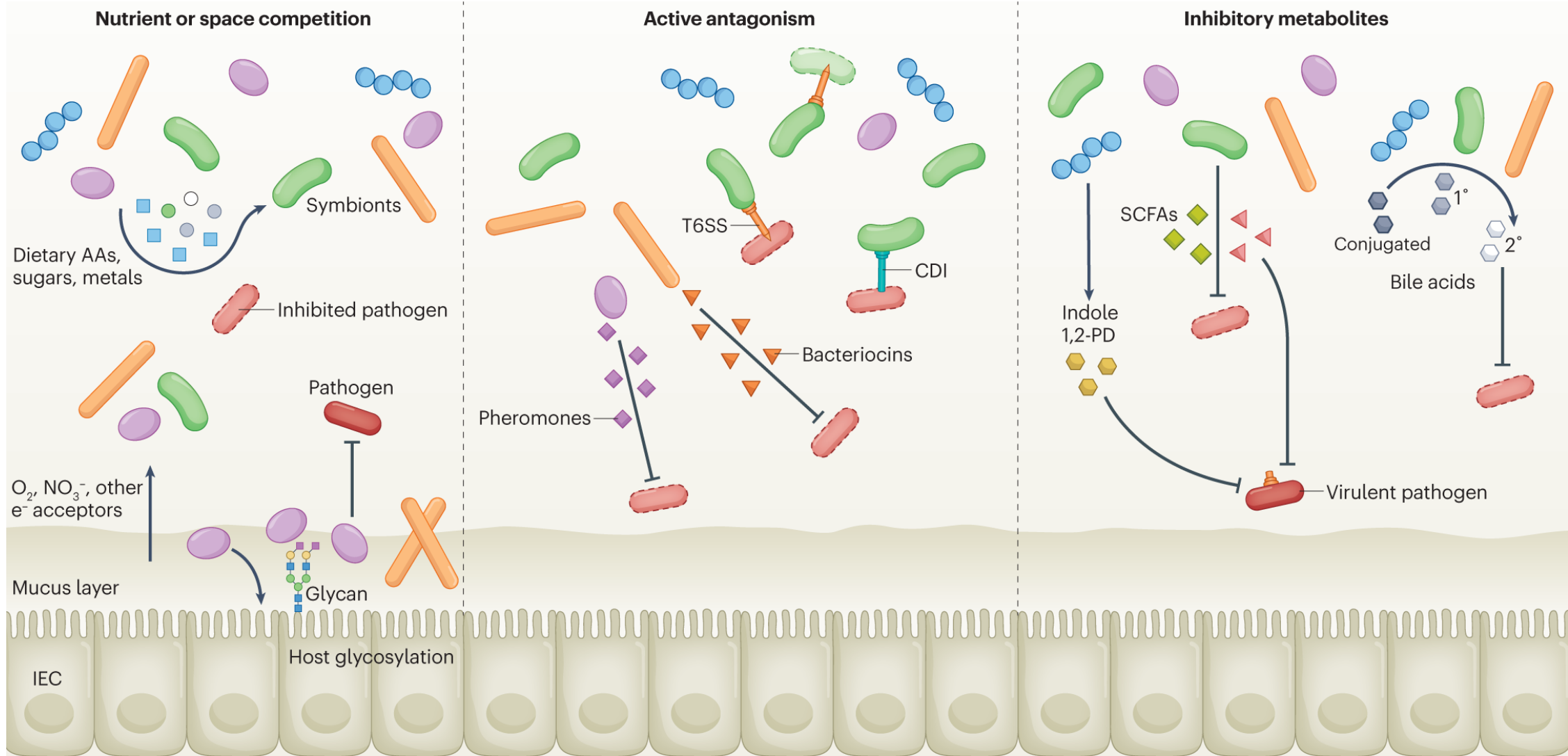


UC Davis Prof Maria Marco:
(2020-2026) work on synergy between microbes and milk matrix for improving gut health and reducing NCDs, leading cause of mortality globally

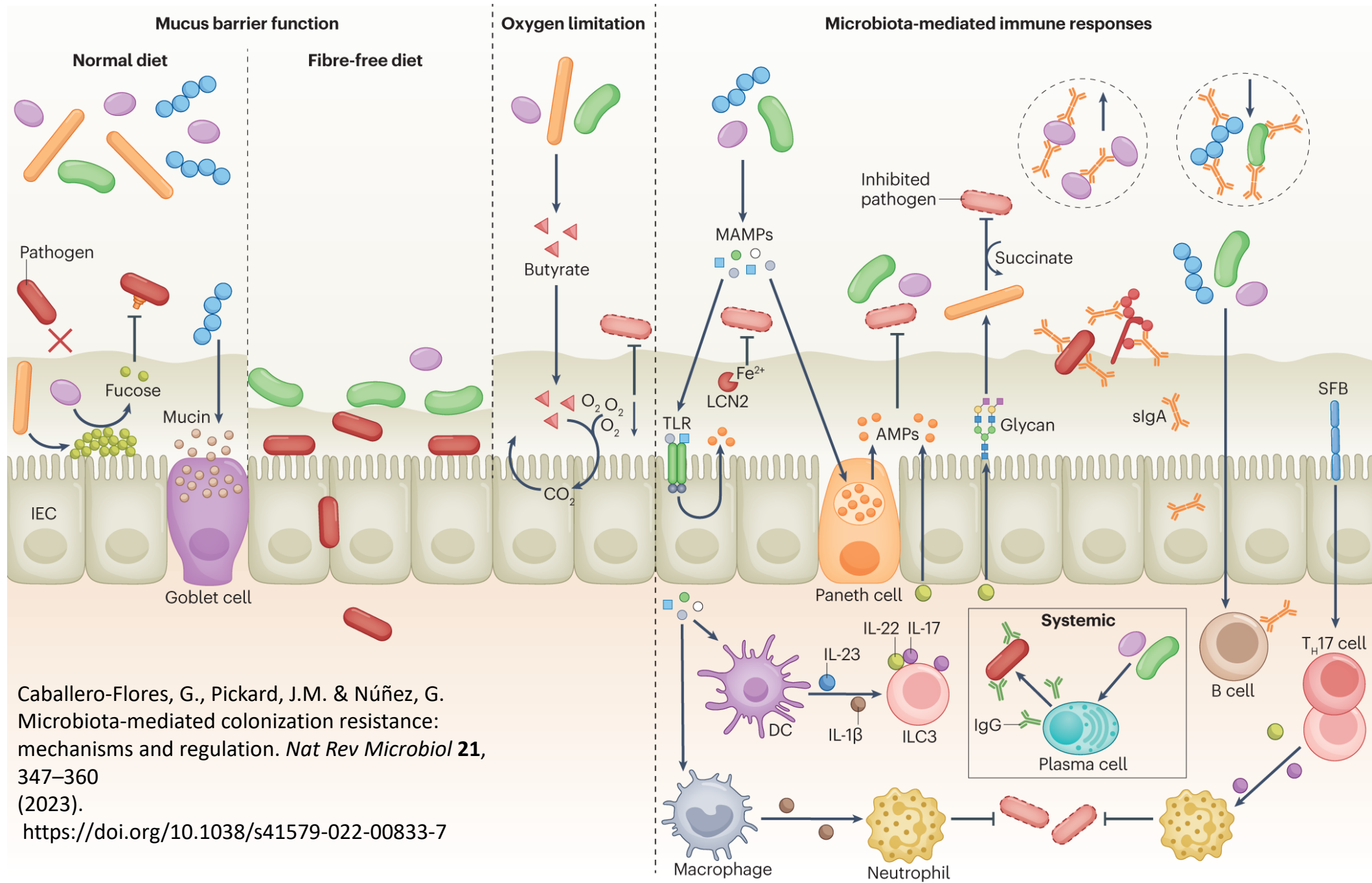


Whole Foods Contribute More than Nutrients for Human Cells

Three Direct Mechanisms of Colonization Resistance



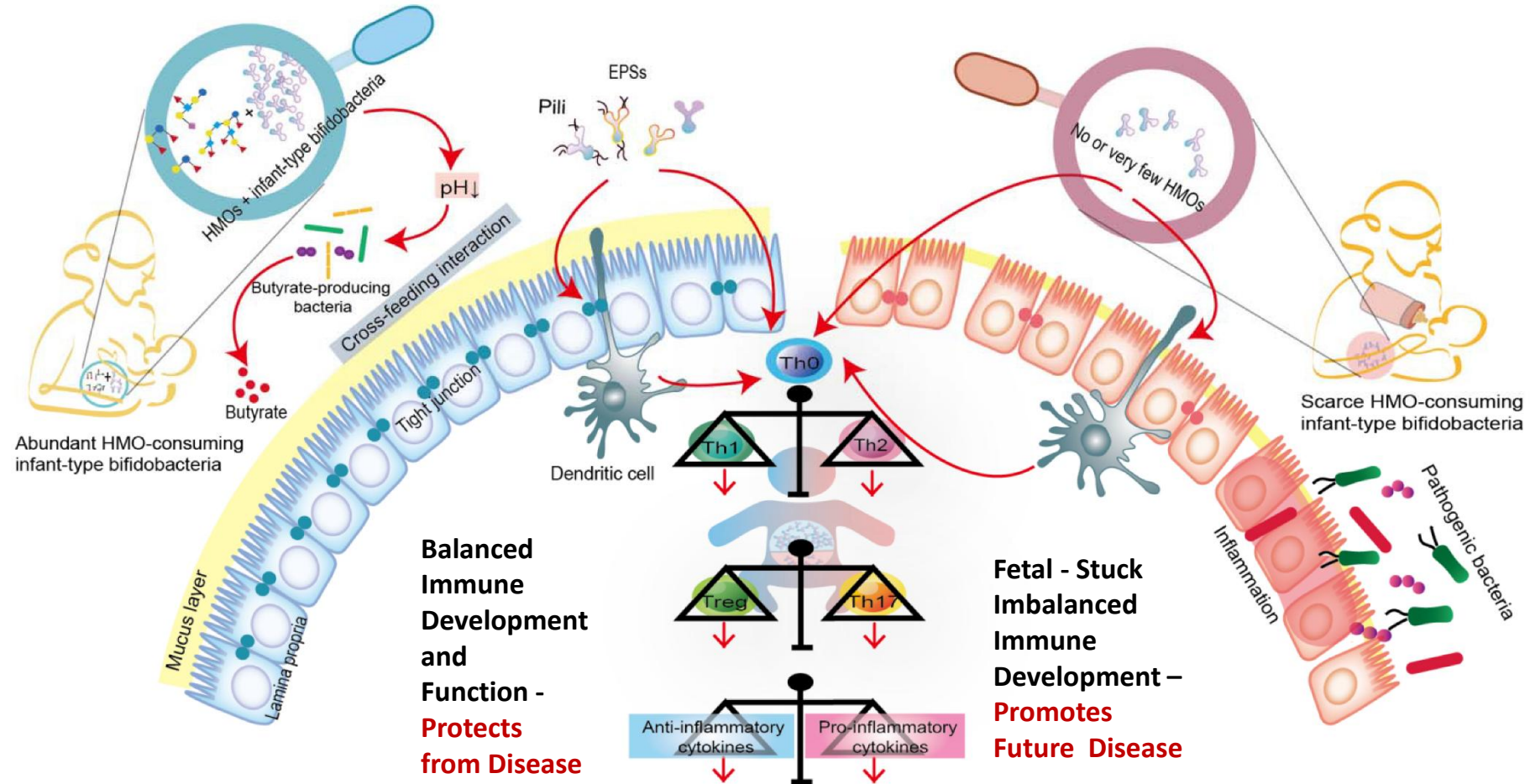
Caballero-Flores, G., Pickard, J.M. & Núñez, G. Microbiota-mediated colonization resistance: mechanisms and regulation. *Nat Rev Microbiol* **21**, 347–360 (2023). <https://doi.org/10.1038/s41579-022-00833-7>



Three Indirect Mechanisms of CR

Caballero-Flores, G., Pickard, J.M. & Núñez, G. Microbiota-mediated colonization resistance: mechanisms and regulation. *Nat Rev Microbiol* **21**, 347–360 (2023).
<https://doi.org/10.1038/s41579-022-00833-7>

Bifidobacteria, Postnatal Immune Development and Immune Balance



Controlled Inflammation vs. Misregulated Inflammation

Adapted from: Lin et al. Nutrients 2022, 14(7), 1498; <https://doi.org/10.3390/nu14071498>

Raw Cow's Milk: An Example of Colonization Resistance Against Antibiotic Resistant E. Coli by a Transmissible Raw Milk Bifidobacterium

Calved Cows transmitted a specialized isolate of *Bifidobacteria longum ssp. longum* via raw milk to the intestines of both a calf and a child.

The isolate demonstrated significant antibacterial activities against *Escherichia coli* strains producing extended-spectrum beta-lactamases.

Reference:

Machulin AV, Abramov VM, Kosarev IV et al. A Novel Bifidobacterium longum Subsp. longum T1 Strain from Cow's Milk: Homeostatic and Antibacterial Activity against ESBL-Producing Escherichia coli. Antibiotics. 2024; 13(10):924.

Raw Cow's Milk and Evidence of Protection Against Allergy: "A Farm Effect" (See Table 1)

Bartosik et al. 2022 is a double blind, placebo-controlled proof of concept study showing that heat denaturing of cow's milk whey protein increases its allergenicity. In contrast, reformulated whole whey protein simulating the raw milk form reduced allergic symptoms.

The Bartosik et al. study built upon the Abbring et al., 2019 findings, and both studies followed the Loss et al. 2011 study on risk of asthma and allergy.

The Loss et al. 2011 large epidemiologic study across southern Germany, Switzerland, Austria, and Poland found a significant inverse relationship between raw milk consumption and asthma, atopy and hayfever while boiled milk was not protective. Evidence that raw milk whey proteins was involved in protection was also reported.

References: See Table 1

Bartosik, T., Jensen, S.A., Afify, S.M et al. 2022. Ameliorating atopy by compensating micronutritional deficiencies in immune cells: a double-blind placebo-controlled pilot study. *J. Allergy Clin. Immunol.: In Practice*, 10(7), pp.1889-1902.

Abbring, S., Kusche, D., Roos, T.C et al. 2019. Milk processing increases the allergenicity of cow's milk—Preclinical evidence supported by a human proof-of-concept provocation pilot. *Clin. Exp. Allergy*, 49(7), 1013-1025.

Foundational reference:

Loss, G., S. Apprich, S., M. Waser, M. et al. 2011. The protective effect of farm milk consumption on childhood asthma and atopy: the GABRIELA study *J Allergy Clin. Immunol.* 128 (2011), pp. 766-773.e4

5. Degraded Microbiomes and Predictable Chronic Diseases: Asthma and Beyond

Allergic rhinitis
Atopic dermatitis
Food allergies
Chronic obstructive pulmonary disease (COPD)
Chronic sinusitis
Obesity
Depression
Anxiety
Mood swings
Attention Deficit Disorder
Fatigue
Gastro-esophageal reflux disease (GERD)
Osteoarthritis
Vocal cord dysfunction
Stomach ulcers
Nasal polyps
Frailty
Hypertension

36 Comorbid Chronic Diseases for Asthma



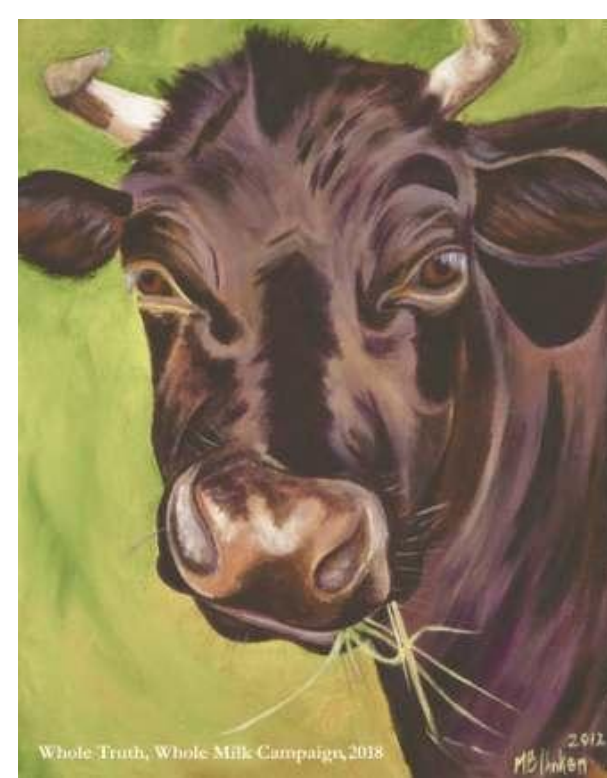
Asthma

Adapted from: Dietert, R. Microbiome
First Medicine in Health and Safety.
Biomedicines 2021, 9(9), 1099;
<https://doi.org/10.3390/biomedicines9091099>

Skeletal muscle wasting/Sarcopenia
Mast cell activation syndrome
Hormone imbalances/disorders
Type 2 diabetes
Obstructive sleep apnea
Insomnia/sleep disorders
Ischemic heart disease
Hypoxia
Stroke
Acute myocardial infarction
Posttraumatic Stress Disorder (PTSD)
Myasthenia gravis
Lung cancer
Allergic bronchopulmonary aspergillosis (ABPA)
Type 1 diabetes
Metastasized breast cancer
Eosinophilic granulomatosis with polyangiitis (vasculitis)
Coronary heart disease



Risks Associated with Raw Milks: Countering Misinformation



Presenter Disclosures: Medical Microbiologist, Risk Analyst, and Fellow of Society for Risk Analysis; Unpaid Advisor to Breastfeeding Foundation, Canadian Artisan Dairy Alliance, and the Raw Milk Institute



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Presentation to ARA Panel, 26 October 2026

Case for Worrying about Raw Milks

Credit to Risk Communication Scholar Peter Sandman on Worrying

Supporting

- Raw milks inherently dangerous, severe and fatal effects, especially for children
- Risks of adverse effects exceed benefits
- No downsides to pasteurizing donor breastmilk or cow milk

Refuting

- Natural bioactives in raw milk, including microbiota, protect against
 - Infectious diseases
 - Non-communicable diseases
- Raw milk contributes to healthy gut, immune, neural, and respiratory systems
- No food is risk-free and merits systematic consideration of both benefits and risks

Building on the Breastmilk Evidence Map: Diarrheal and Other Risks

supporting

Case for worry: raw milk associated with gastrointestinal (GI) disease burden

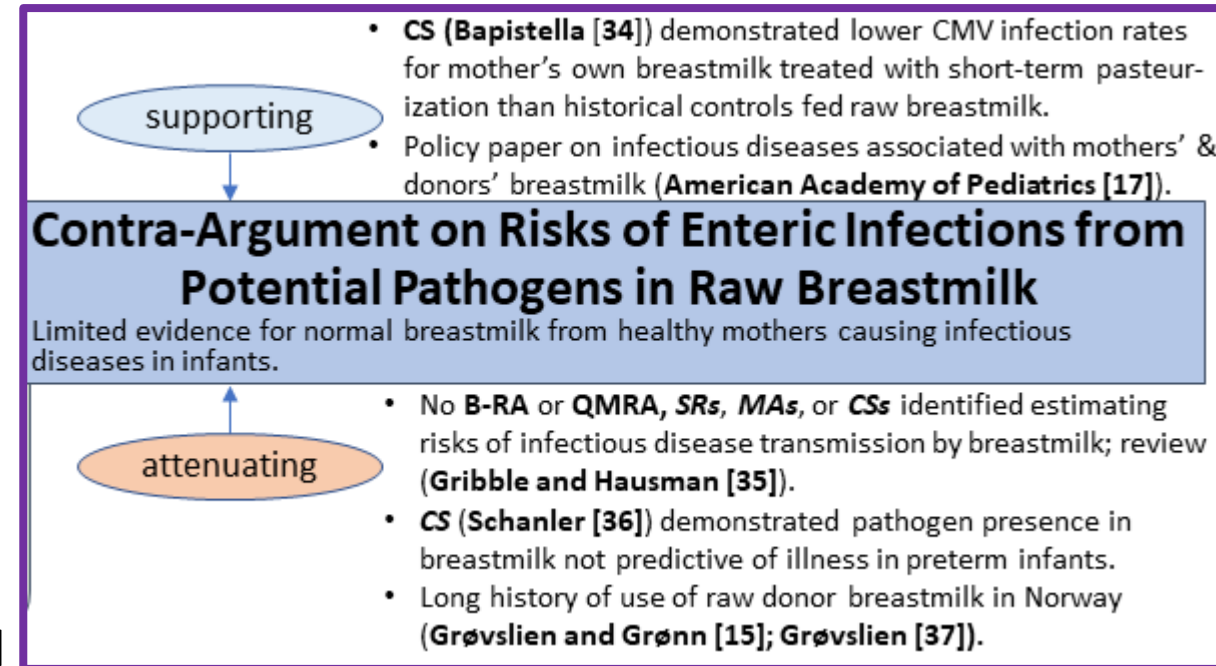
Diarrhea occurs in small cohort studies of exclusive breastfeeding over first 6 months of life

- 18% full-term exclusively breastfed infants ill (Nass et al., 2022)
- 10% preterm infants fed raw milk severely ill (Huang et al., 2023)

attenuating

Case NOT to worry: higher pasteurized milk burdens

- 53% infants NOT exclusively breastfed ill
- 16% preterm infants fed pasteurized milk severely ill



Subsequent studies, notably systematic review of Patnode et al. 2025, strengthen Evidence Map conclusions, providing strong evidence for clear, convincing, conclusive **risk reductions** for many infant diseases with access to raw breastmilk.

Decision Question: benefit of Norway's model providing raw donor milk?

Building on the Cow Milk Evidence Map: Risks

supporting

Case for worry: raw milk associated with GI disease burden

- see Hazard ID slides for CDC outbreak data from 2005-2020 (Stephenson et al., 2024)
- raw dairy reportedly associated with 29, 75, and 14-fold greater risks of illness, hospitalization, and death than pasteurized dairy (Hsu and Wu, 2026)
- policy paper calling for ban of raw milk in US (American Academy of Pediatrics, 2026; see backup slides)

attenuating

Case NOT to worry: both pasteurized, raw associated with disease burdens

- see Hazard ID slides for CDC, 2005-2020
- **diarrhea not associated** with raw milk feeding, infant cohort studies (Loss et al., 2015; Järvinen et al., 2022)
- **Sebastianski** systematic review (2022) pasteurized dairy significant outbreaks, hospitalizations, deaths
- **non-communicable disease burden for pasteurized milk** estimated 15 million milk allergy/intolerance cases, 11 of 15 deaths children aged 3-17 (2005-2025)

supporting

- QMRAs (FDA/FSIS 2003; EFSA 2015; Giacometti 2015a,b, 2017) Estimate risks for raw milk associated with *Campylobacter*, enteropathogenic *E. coli*, *Listeria monocytogenes*, *Salmonella*
- Ois (Jaros 2008; Whitehead & Lake, 2018) Raw milks associated with outbreaks, illnesses, deaths
- Exp studies from Canada, Finland, Germany, Poland, US, UK (Table 1)

Contra-Argument on Risks of Infectious Diseases with Raw Bovine Milk

One early systematic review and recent QMRA reassessments and outbreak investigations

attenuating

- QMRAs (FDA/FSIS 2003; reassessments Latorre 2011, Stasiewicz 2014, Buchanan 2017) and Rev (EFSA 2015; Berge and Baars 2020) Limited evidence, pathogen levels, growth in milks, dose-response
- QMRA (FDA/FSIS 2003) Oi (Whitehead & Lake, 2018) CS (Loss 2015) Illness, mortality rates for raw milk not higher than pasteurized or boiled milks
- Ois (Jaros 2008; Whitehead & Lake, 2018; Hanson 2019) Pasteurized milk associated with outbreaks, illnesses and deaths

HAZARD ID: Burden of Infectious Diseases for Cow Milk

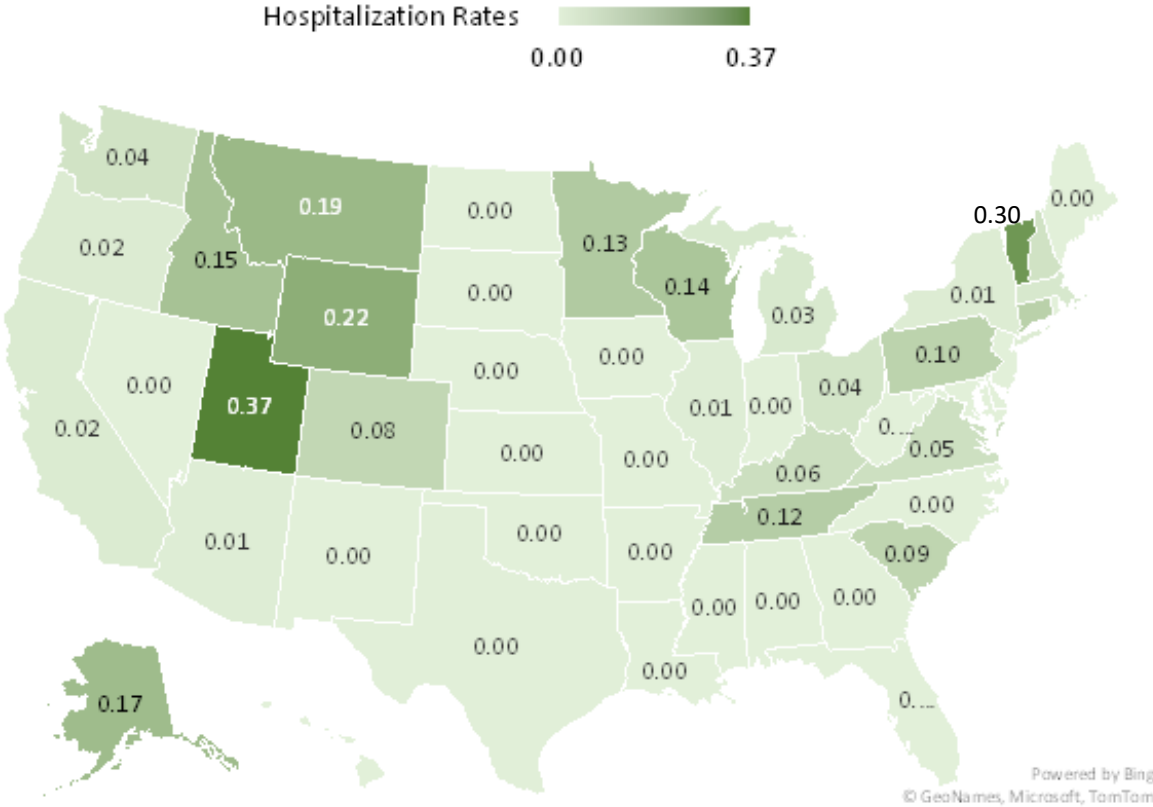
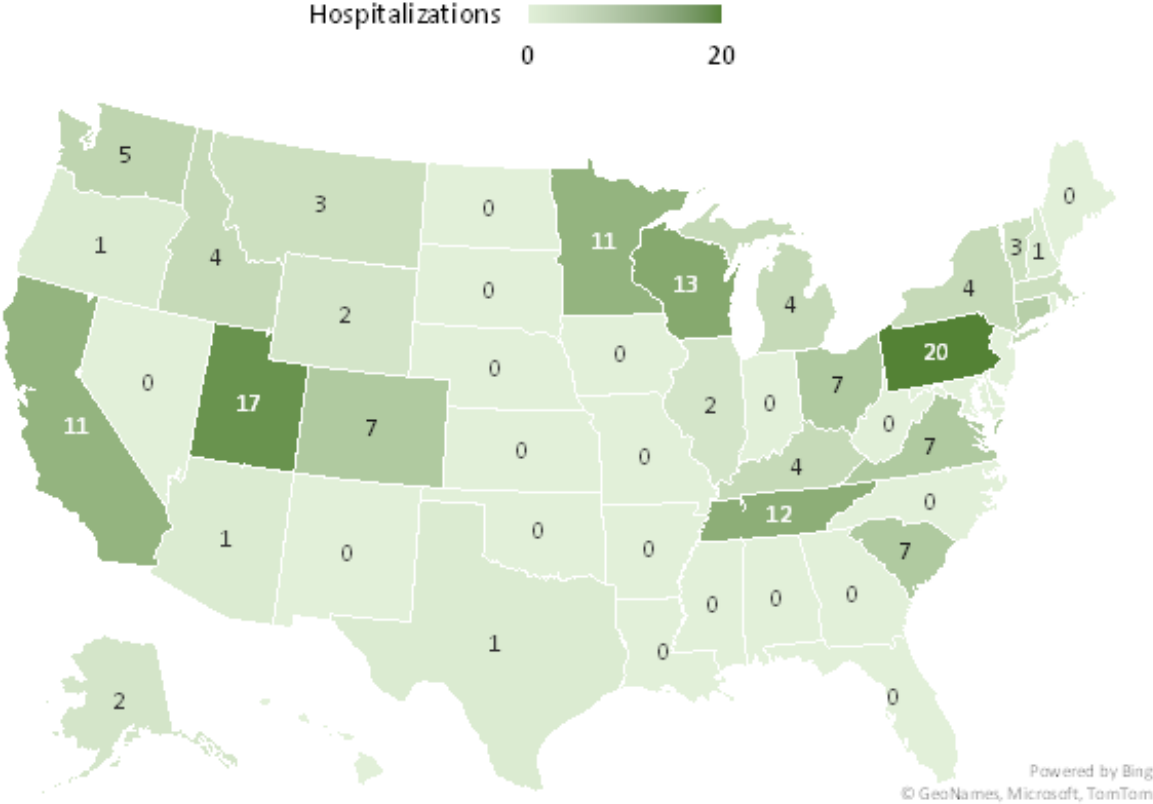
US CDC Dataset for 2005-2020; Stephenson et al., 2024

Food	Pathogens (numbers ill by pathogen)	Illnesses	Deaths
Pasteurized Milk	<i>Campylobacter</i> (1,873), <i>Yersinia</i> (125), <i>Norovirus</i> (33), <i>Salmonella</i> (24), <i>L. monocytogenes</i> (5), <i>E. coli</i> STEC (3), other hazards (48)	2,111	4
Raw Milk	<i>Campylobacter</i> (1,570), <i>E. coli</i> STEC (267), <i>Salmonella</i> (162), <i>Cryptosporidium</i> (35)	1,696	1 confirmed

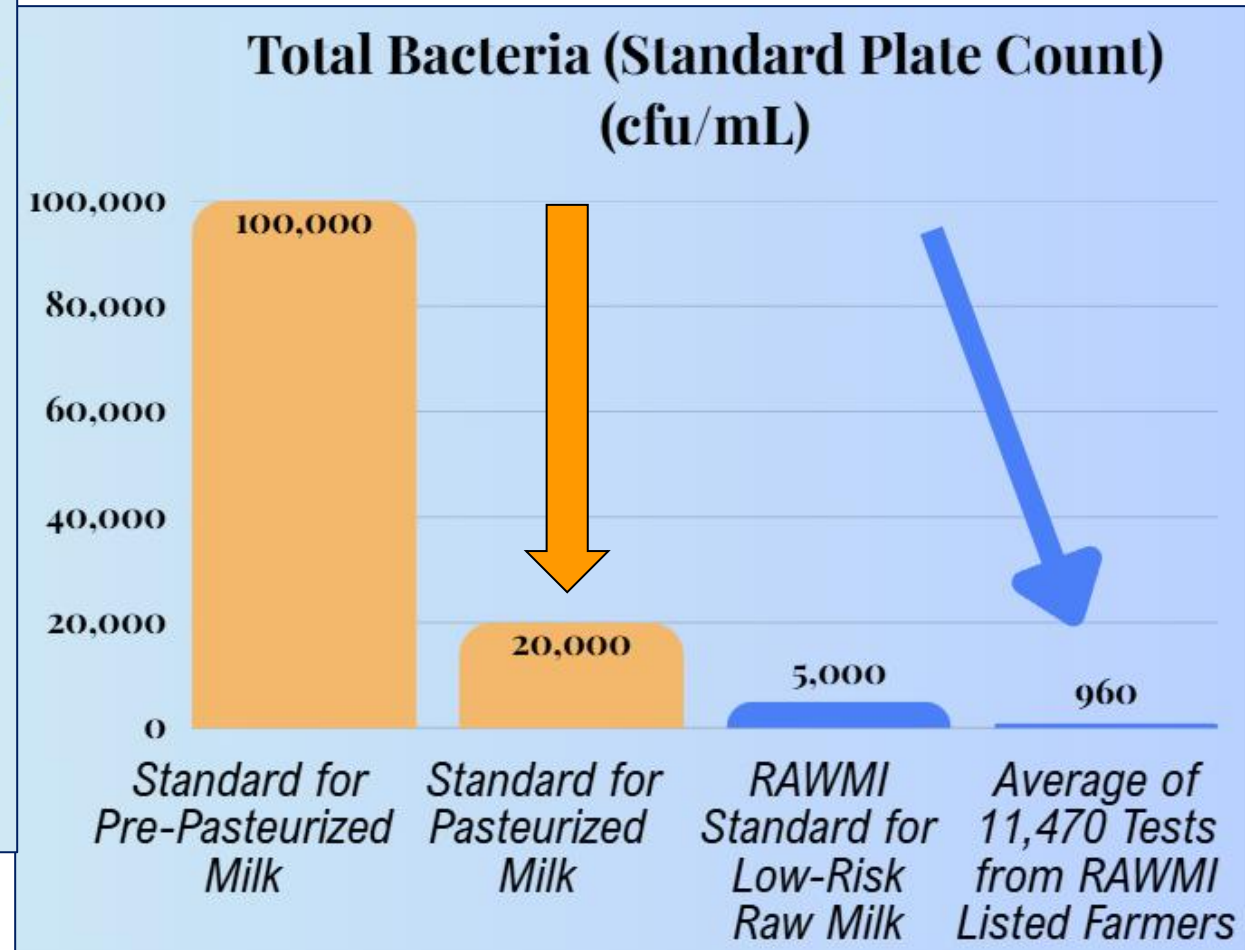
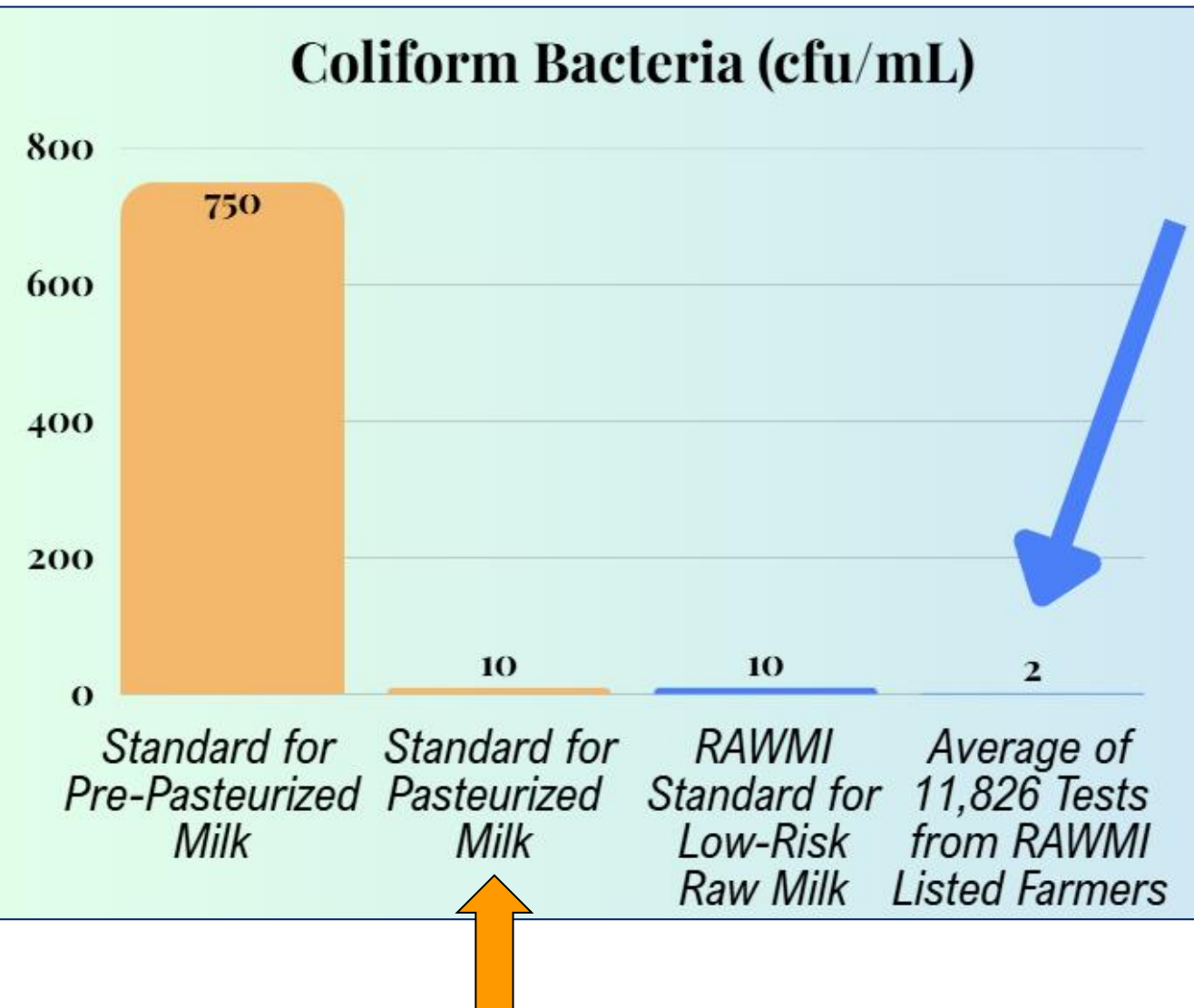
Systematic Review for US, Canada: reported significantly **higher likelihood, severity** of disease (including premature delivery, stillbirth, miscarriage) from **pasteurized** than raw dairy (Sebastianski et al., 2022)

HAZARD ID: State-Level Hospitalizations Associated with Raw Milk over 16-year Period

(CDC NORS 2005-2020)

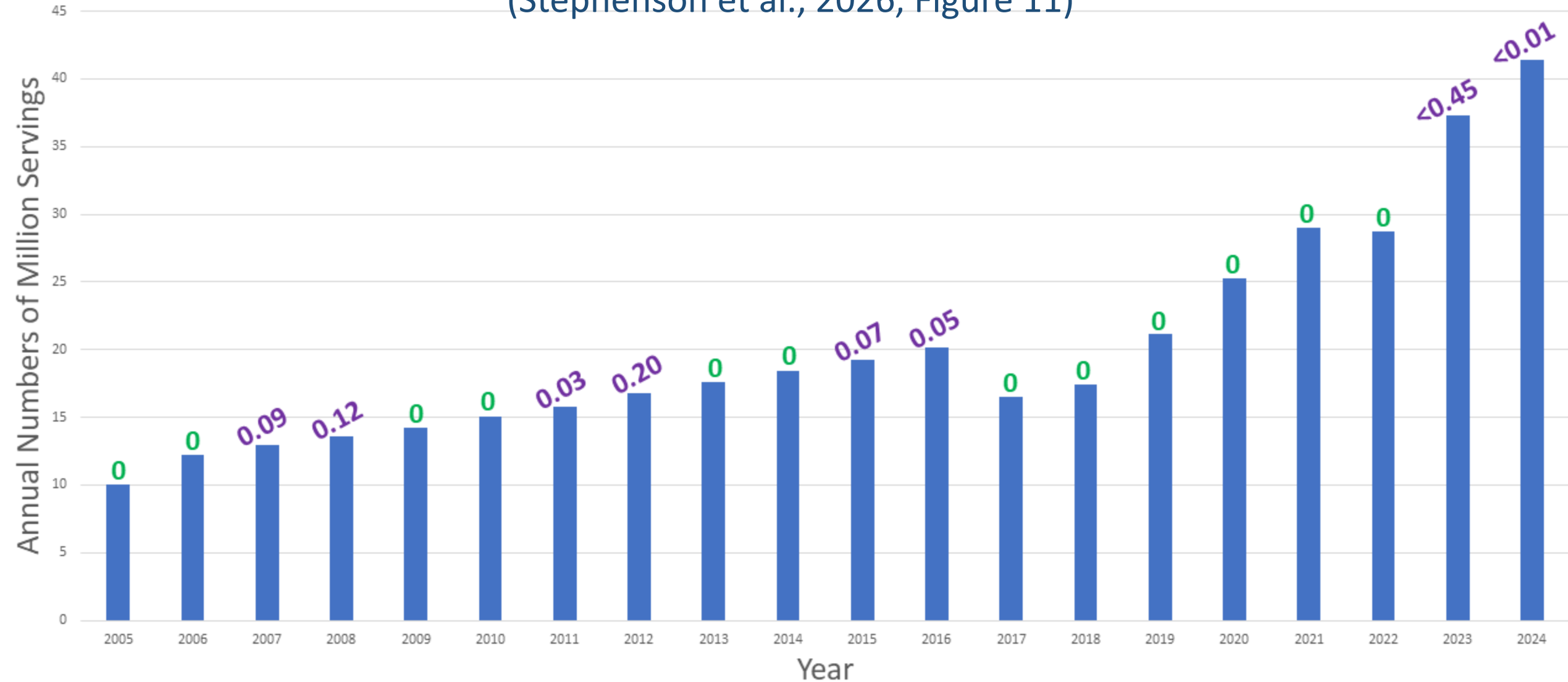


EXPOSURE ASSESSMENT: Microbial Monitoring Results for Raw Milk Institute (RAWMI)-Trained Farmers Meet Standards for PASTEURIZED MILK



RISK CHARACTERIZATION: Low Estimated Annual Rates/100,000 servings for CA Retail Raw Milk

(Stephenson et al., 2026, Figure 11)



0 represents years with zero reported illnesses associated with raw milk

Questioning Assumptions:

Overkill for Pasteurization Policies?



Prof. Dallas questioned need for **5-log kill pasteurization policies**

- Target 99.999% or 100,000-fold pathogen decrease
- But destroys bioactive components including milk microbiota, causing loss of benefits

Evidence basis **1957 challenge study by Enright**

- High-dose inoculated, **>10⁵ pathogen cells/mL** versus **1-10 pathogens/mL** observed in raw milk
- No adjustment for highly heat-resistant pathogen (*Coxiella burnetii*; Q-fever agent) compared to those associated with disease in US

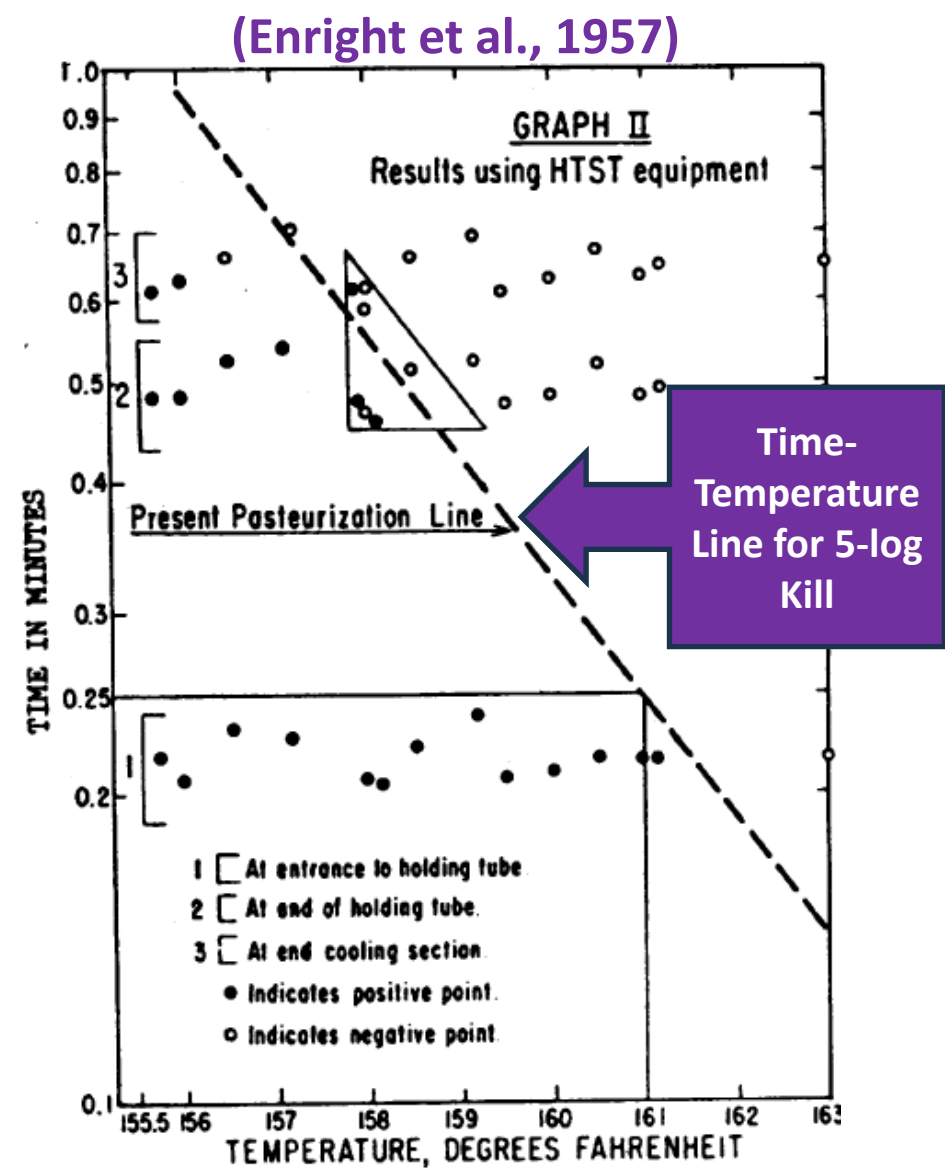
Overkill for Pasteurization Policies Ignores Loss of Bioactives

5-log kill policy

- *exposure-based or hazard-based*
- invokes multiple conservative assumptions
- worst- case scenario for eradication
- design for eradicating infeasible pathogen doses
- heat-tolerant pathogen not contributing to US burden of milkborne illness
- heating contributes to allergenicity and chronic disease
- wastes food without a link to public health protection
- *ignores dose-response assessment*

Subsequent studies provided evidence of non-communicable and infectious diseases associated with pasteurized milk and infectious diseases associated with raw milk.

Decision Question: do benefits exceed risks for raw or pasteurized milks?





Easy Reads on Relevant History



Email: peg@colemanscientific.org

Where To Go from Here

D. Warner North

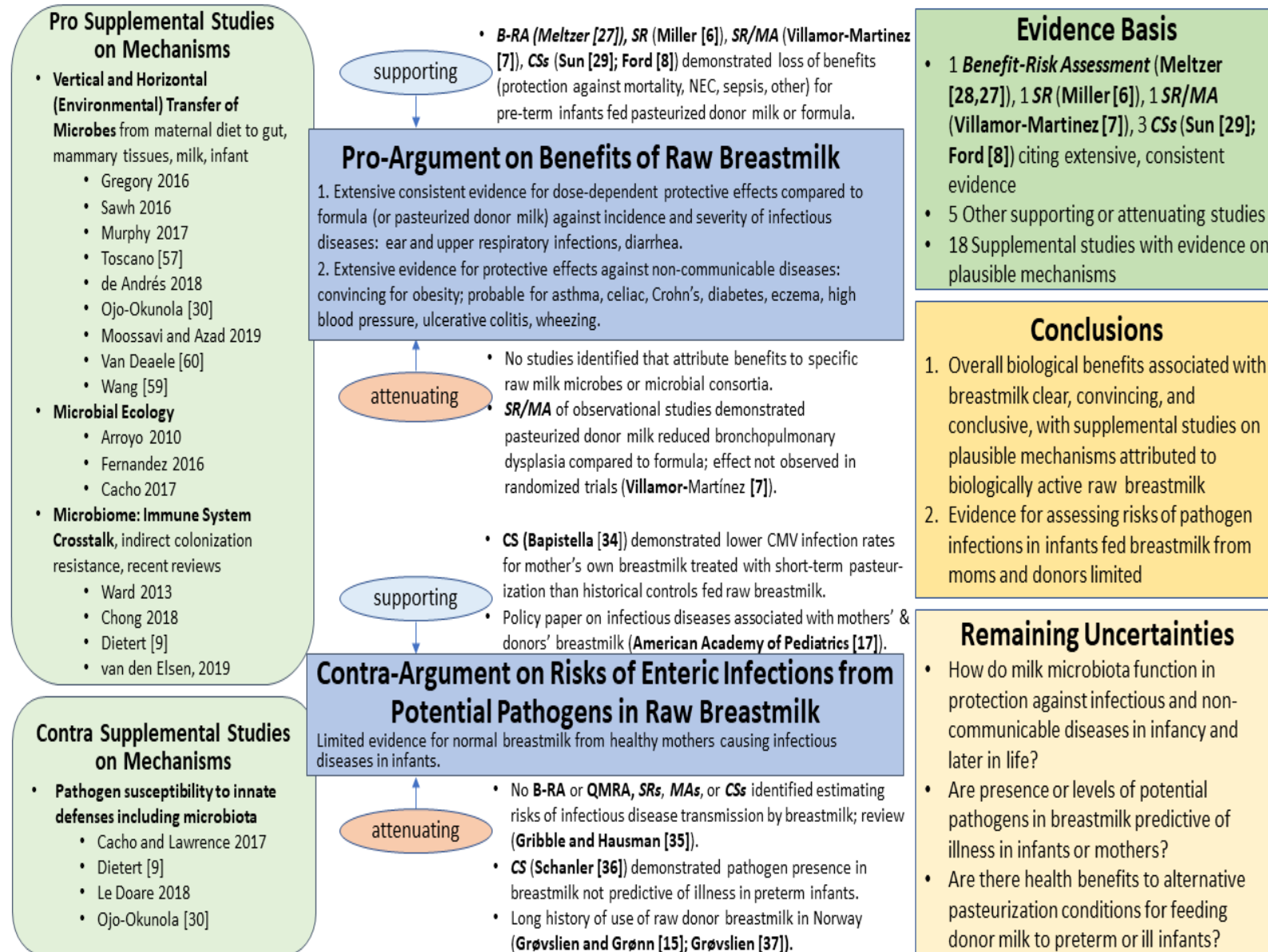
NorthWorks

San Francisco, CA

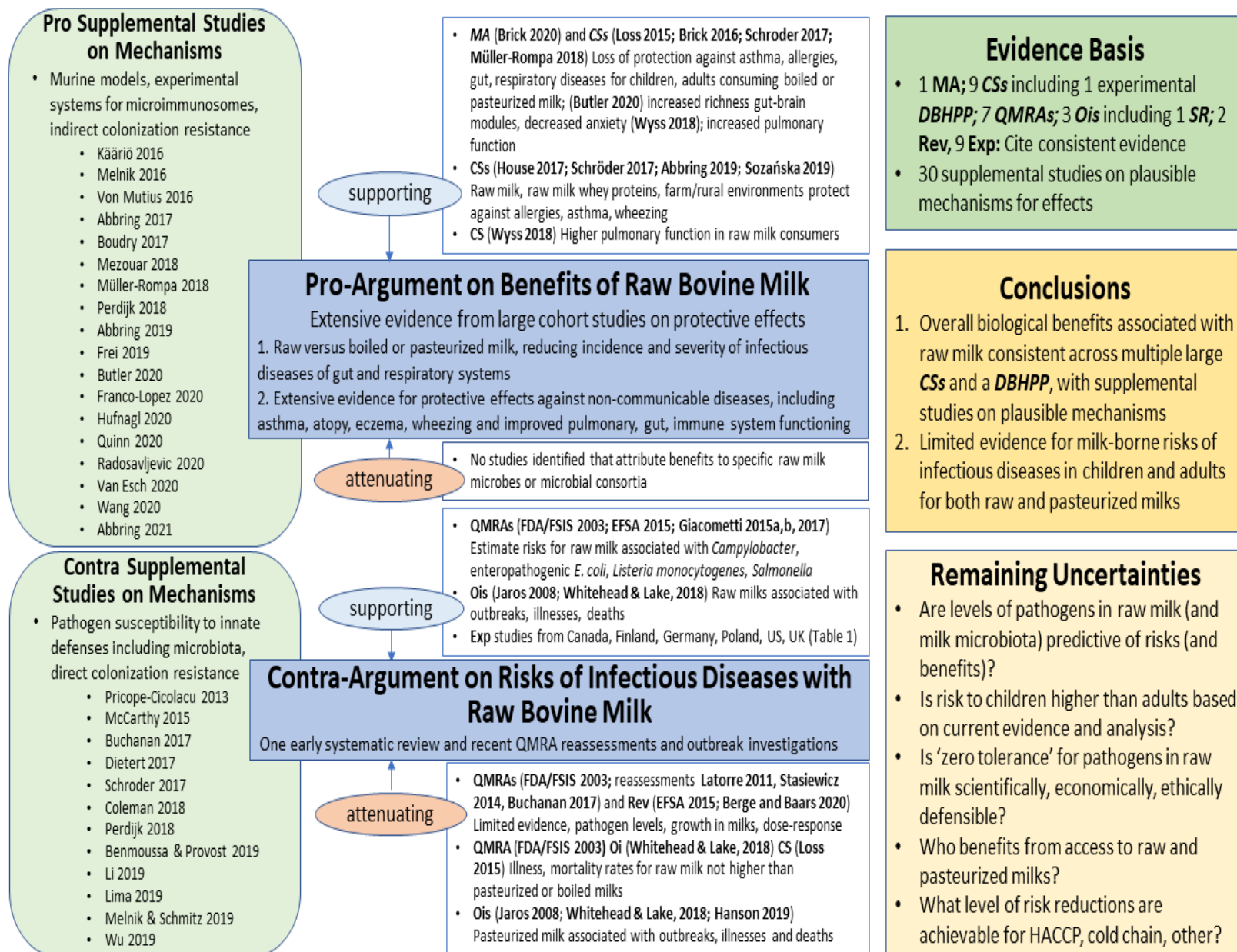
northworks@mindspring.com

October 26, 2026

Breastmilk Evidence Map



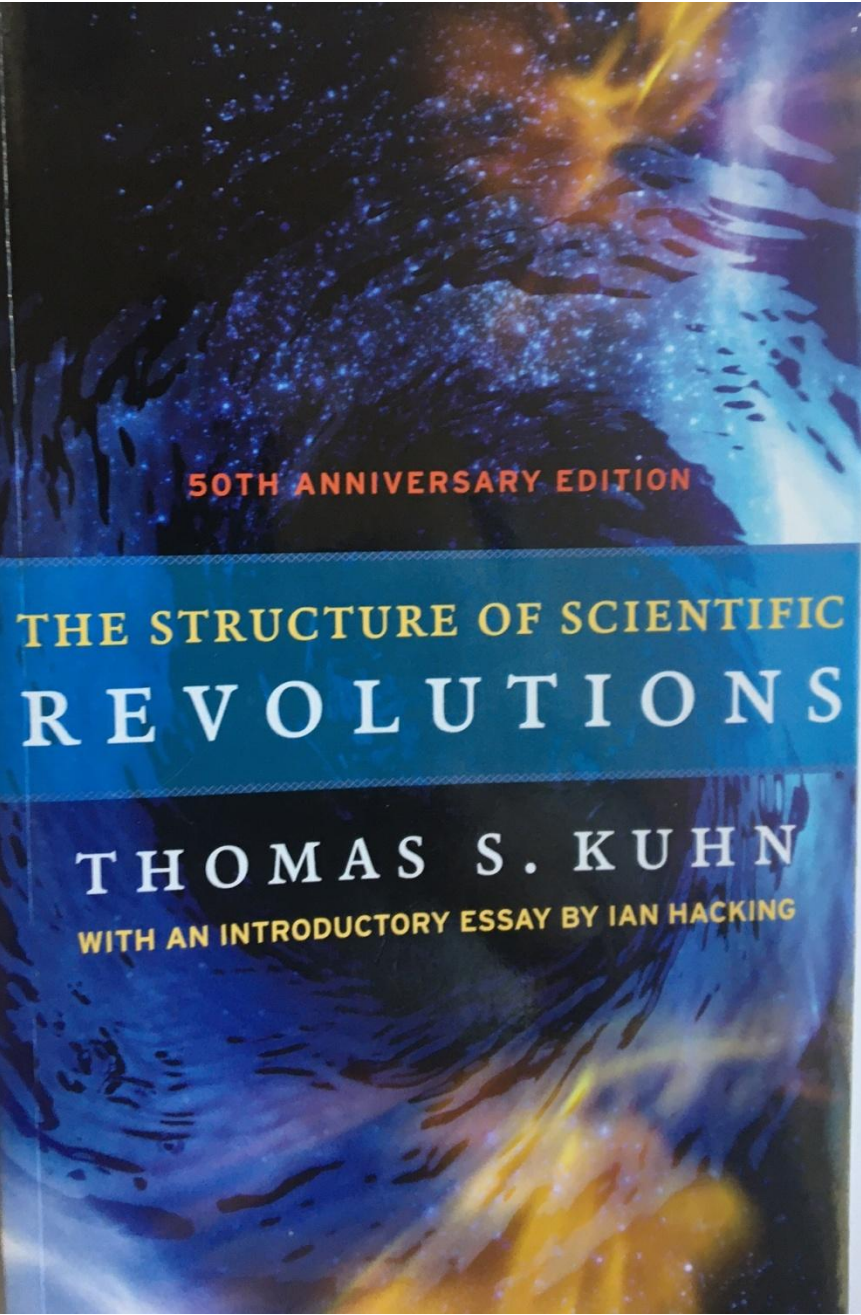
Bovine Milk Evidence Map



Evidence Maps

For our case study Evidence Maps have been used as a framework for summarizing scientific publications with evidence for risks and benefits from pasteurizing or not pasteurizing milk.

They provide organization and make obvious what evidence has been included, for both risks and benefits. Omissions can be rectified. And those unfamiliar with items of evidence can access them and learn.

The background of the book cover is a vibrant cosmic scene. It features a dark, star-filled space with a prominent spiral galaxy in shades of blue and white. Bright, glowing nebulae in orange and yellow are scattered throughout, particularly in the upper right and lower right corners. The overall effect is one of deep space and celestial wonder.

50TH ANNIVERSARY EDITION

THE STRUCTURE OF SCIENTIFIC
REVOLUTIONS

THOMAS S. KUHN

WITH AN INTRODUCTORY ESSAY BY IAN HACKING

Messages from Thomas S. Kuhn's 1962 Book

- Changes in belief systems do not happen quickly. The process can be slow and contentious.
- Newly available evidence should be reviewed and evaluated.
- Dialogue in the scientific community and with stakeholders is needed, with a willingness to question “accepted wisdom” and enable its revision to new “accepted wisdom.”

Past Examples

- Many in Kuhn's book
- Extraction of natural gas through fracking
 - Simona Perry, 2012
 - ES&T Special Issue following National Academies workshops
- Importation of Mexican Haas Avocados
- Cause of the Extinction of Dinosaurs.

The Path Forward

- We hope this case study presentation with its evaluation in this ARA meeting is an important milestone in rethinking the risks and benefits of pasteurizing milk.
- Further dialogue, and further supporting research, may enable the conclusions we have presented to become widely accepted.

BACKUP SLIDES

References

- *The Structure of Scientific Revolutions*, 50th Anniversary (Fourth) Edition, Thomas S. Kuhn, Chicago IL, University of Chicago Press, 1962, 2012. ISBN-13: 978-0-226-45812-0.
- "Societal Costs of Unconventional Oil and Gas Exploration and Production," Simona L. Perry, *Environmental Practice*, Published online by Cambridge University Press: 13 December 2012, pp. 352-365. DOI:10.1017/S1466046612000336.
- "Public and Stakeholder Participation for Managing and Reducing the Risks of Shale Gas Development," (with Paul C. Stern Thomas Webler, and Patrick Field), **Environmental Science and Technology** **48**(15): 8388-8396, Special Issue on Shale Gas Development, August 5, 2014, Web Publication Date: April 29, 2014 (Policy Analysis), DOI: 10.1021/es405170k.
- "Risks and Risk Governance in Unconventional Shale Gas Development," (with Mitchell J. Small and 17 other co-authors), **Environmental Science and Technology** **48**(15): 8289-8297, Special Issue on Shale Gas Development, August 5, 2014, Web Publication Date: July 1, 2014 (Feature) DOI: 10.1021/es502111u.
- *T.rex and the Crater of Doom*, Walter Alvarez, Princeton NJ, Princeton University Press, 1997. ISBN-13: 9780691016306

Evidence Maps from Case Study

- EM diagrams from our Case Study are on earlier slides. There is lots of detail in fine print!
- We have done our best to have it all that detail on risks and benefits there for you to see – on one page for Human Breastmilk and one page for Bovine Milk.

Rebuttal of False Claims about Raw Milk

Coleman and North, 2026; Rebuttal of Previous Commentary from American Council on Science and Health (ACSH)



Comments Below from ACSH Editor Describing
Rebuttal of the Previous Commentary

[Revealing Raw Truths About Milk: Scientific Advances in Understanding the Health Impacts of the Milk Microbiota](#)

Raw milk has long been at the center of passionate debate, with public health concerns often clashing against emerging research on its microbial complexity and potential benefits. A recent ACSH commentary appears to overlook a growing body of peer-reviewed evidence. This review highlights key scientific advances that challenge outdated assumptions and call for a more balanced, evidence-based conversation.

Beliefs, Claims, Risk Perceptions

Government scientists, State Public Health officials voice **Fear of Deaths**

- *2014 Society for Risk Analysis meeting conversation after Disagreements About Risks of Raw and Pasteurized Milks talk*
Despite increasing access to raw milk since 2014, only 1 death was reported through 2025, in an adult with chronic underlying disease, with contaminated raw milk reportedly contributing to his death
- *2024 Louisiana Department of Health demanded millions of dollars of extra funding if bill was passed to increase access to raw milk for expansion of hospital and ICU facilities to process imminent serious and fatal cases from consuming raw milk*

Some Outdated Claims on Government Websites:

- *There are no beneficial bacteria in raw milk for gastrointestinal health*
Cited studies from **1999-2005**, **NOT** advances since 2013 on characterizing presence, abundance, and functionality of milk microbiota
- *Raw milk is not an immune system building food and is particularly unsafe for children*
Cited studies from **2006-2010**, **NOT** extensive body of evidence since 2015 on epidemiologic, medical microbiologic, immunologic, and clinical studies on cohorts of adults and children
- *Raw milk is not nutritionally superior to pasteurized milk*
Cited studies from **1972-2008**, **NOT** advances in detecting and quantifying bioactive components of milk denatured or destroyed by pasteurization

AAP Claims Challenged by Studies Cited in Case Study (1)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

Page 1:

- *Efforts to limit the sale of unpasteurized milk products have been met with opposition from proponents of unpasteurized milk's alleged health benefits. These **purported benefits** have **no evidence base** and **do not outweigh the risks of unpasteurized milk consumption**.*
- ***Substantial data SUGGEST** that **pasteurized milk confers equivalent health benefits** compared with unpasteurized milk, **without the additional risk of infection**.*
- *The **PURPOSE OF THIS POLICY STATEMENT** is to **provide evidence** for the **risk of infection** from unpasteurized milk consumption ...*

No risk assessment or risk-benefit assessment for raw milk was conducted by AAP consistent with **consensus principles and guidelines for microbial risk analysis (Codex Alimentarius Commission, 1999)**.

None of the evidence provided in the **Case Study** undergoing independent panel peer-review through the **Alliance for Risk Assessment** on October 26, 2026, was cited by AAP. Studies on heat damage that contributes to allergenicity, loss of benefits were **excluded**.

AAP Claims Challenged by Studies Cited in Case Study (2)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

Page 2:

- *Reasons for the continued burden of disease related to unpasteurized milk or milk products are primarily related to **MISINFORMATION** regarding **purported benefits** and **underestimation of risk**.*
 - **No benefit-risk analysis for raw milk exists in the peer-reviewed literature consistent with international principles and guidelines of microbial risk analysis (Codex Alimentarius Commission, 1999).**
- *Evidence demonstrates the **overwhelming benefits to food safety** conferred by standardized **pasteurization and consumption of pasteurized dairy products**.*
 - **Pasteurizing milk did not prevent 4,313 acute illnesses, 343 hospitalizations, and 26 deaths for dairy-borne infectious disease over 16 years (CDC, 2005-2020).**
- *This technique [pasteurization] eliminates pathogens with an effectiveness **beyond that which can be achieved by sanitation practices or filtering alone**.*
 - **See slide 21: raw milk from farms trained by the Raw Milk Institute exceed pasteurized milk standards**
 - **average coliform count from 11,826 samples is 2 counts, <10 count standard for pasteurized milk**
 - **average total bacteria (standard plate count) from 11,470 samples is 960, <20,000 count pasteurized standard**

Older epidemiologic studies cited by AAP are inconsistent with Stephenson et al. (2024), published in the ***Journal of Epidemiology and Global Health***. See slides 4-7, 24, 34.

AAP Claims Challenged by Studies Cited in Case Study (3)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

Page 3:

Text box on right lists **redline strikeout** for potential milkborne hazards **NOT** associated with CDC raw milk cases **since 2005**, some for **decades**.

BOX. Organisms Detected in Unpasteurized (Raw) Milk or Milk Products

Bacteria

~~Brucella species~~, including *Brucella abortus* RB51 vaccine strain

~~Campylobacter jejuni~~

~~Clostridium perfringens~~

~~Coxiella burnetii~~

~~Cryptosporidium species~~

~~Enterotoxigenic Staphylococcus aureus~~

~~Escherichia coli~~, including Shiga toxin-producing (STEC [e.g., *E coli* 0157])

~~Listeria monocytogenes~~

~~Mycobacterium bovis~~

~~Salmonella species~~

~~Shigella species~~

~~Streptococcus species~~

~~Vibrio species~~

~~Yersinia enterocolitica~~

Parasites

~~Giardia species~~

~~Toxoplasma gondii~~

Viruses

~~Highly pathogenic avian influenza A(H5N1)~~

~~Norovirus~~

~~Rabies~~

~~Tickborne encephalitis virus~~

~~Vaccinia~~

AAP Claims Challenged by Studies Cited in Case Study (4)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

Page 3:

- *Close contact through breastfeeding should be avoided during the infectious period of disease attributable to **M. bovis**.*
 - CDC has **not documented tuberculosis** cases caused by *M. bovis* in association with milkborne illness in the US in **recent decades**. See also [hypertext link to rebuttal regarding tuberculosis](#) on slide 13.
- *No human cases from unpasteurized milk consumption have been identified to date, but HPAI(**H5N1**) in **unpasteurized milk and milk products MAY REPRESENT A THREAT TO CHILDREN AND PREGNANT PEOPLE...***
*The **risk of HPAI A(H5N1) TRANSMISSION** through **human milk feeding** is **unknown**.*
 - **No evidence links influenza H5N1 to disease transmission by the oral route in primates including humans** (Coleman, 2025).

AAP Claims Challenged by Studies Cited in Case Study (5)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

Page 4:

- The paragraph of text on **equivalency of raw and pasteurized milks** and **effects of heat on allergenicity** is **inaccurate** and **does not cite key studies** documented in the **Case Study**, including the following listed in order of citation in the text.

- | | | | |
|------------------------------|----------------------------------|---------------------------------|-------------------------|
| • Quigley et al., 2013 | • Nocerino et al., 2025 | • Stephenson et al., 2024 | • Mangalea et al., 2024 |
| • Abbring et al., 2017, 2019 | • Blaser 2014 | | • Shao et al., 2024 |
| • Davis et al., 2025 | • Dietert 2016, 2018, 2021; 2023 | • Bartosik et al., 2022 | • Woelfel et al., 2024 |
| • Evrendilek & Güven, 2026 | • Loss et al., 2015 | • Sebastianski et al., 2022 | • Chen et al., 2025 |
| • Lin et al., 2022 | • Järvinen et al. 2022 | • Pechlivanis et al., 2023 | • Dinleyici, 2025 |
| • Warren et al., 2022, 2024 | • Whitehead & Lake, 2018 | • Caballero-Flores et al., 2023 | |

AAP Claims Challenged by Studies Cited in Case Study (6)

Unsubstantiated Claims by American Academy of Pediatrics (AAP, 2026):

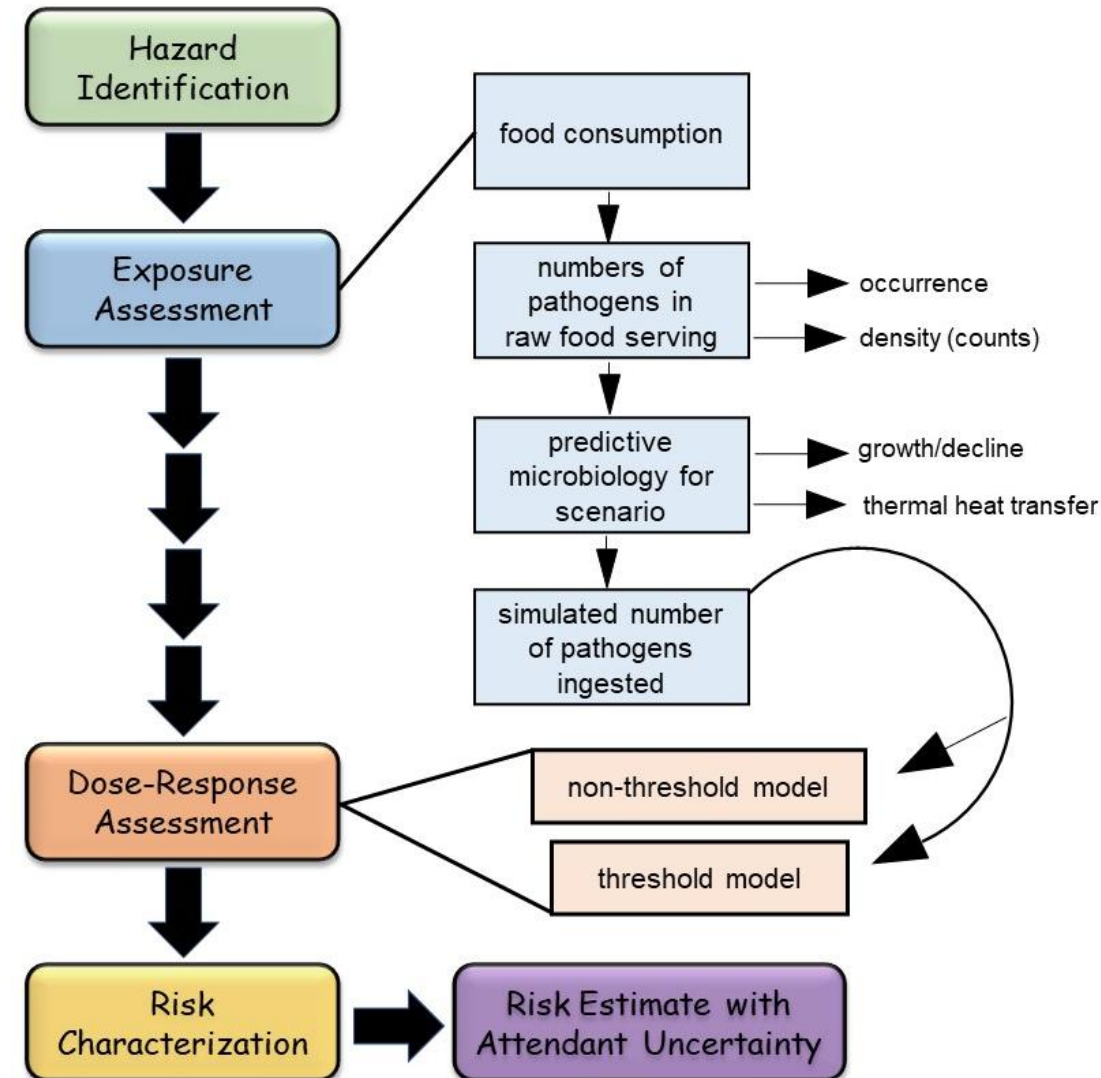
Conclusions:

- *The **AAP endorses a ban** on the sale or distribution of unpasteurized milk and milk products **throughout the United States**... This recommendation is **BASED ON THE MULTIPLICITY OF DATA** regarding the **burden of illness** associated with consumption of unpasteurized milk and milk products, especially among pregnant people, **fetuses and neonates**, and infants and young children, as well as the **STRONG SCIENTIFIC EVIDENCE** that **pasteurization** does **not alter** the nutritional value of milk.*
- **None of the evidence** cited in the **Case Study** including peer-reviewed studies listed on the previous slide is **acknowledged** by the AAP. **Exclusion** of this **extensive body of evidence** and the **lack of a peer-reviewed benefit-risk analysis** render the recommendations **misinformation at best**, perhaps intentionally misleading **misinformation** or ‘**weaponized disinformation**’ intentionally crafted and disseminated to deceive, manipulate, and **cause harm to populations or industries**.

More Detailed Evidence for Risk Assessors

Considering Evidence and Transparency in the Risk Assessment Framework

- Hazard Identification
- Exposure Assessment
- Dose-Response Assessment
- Risk Characterization and Reassessment



HAZARD ID for Milkborne Disease Since ~2000

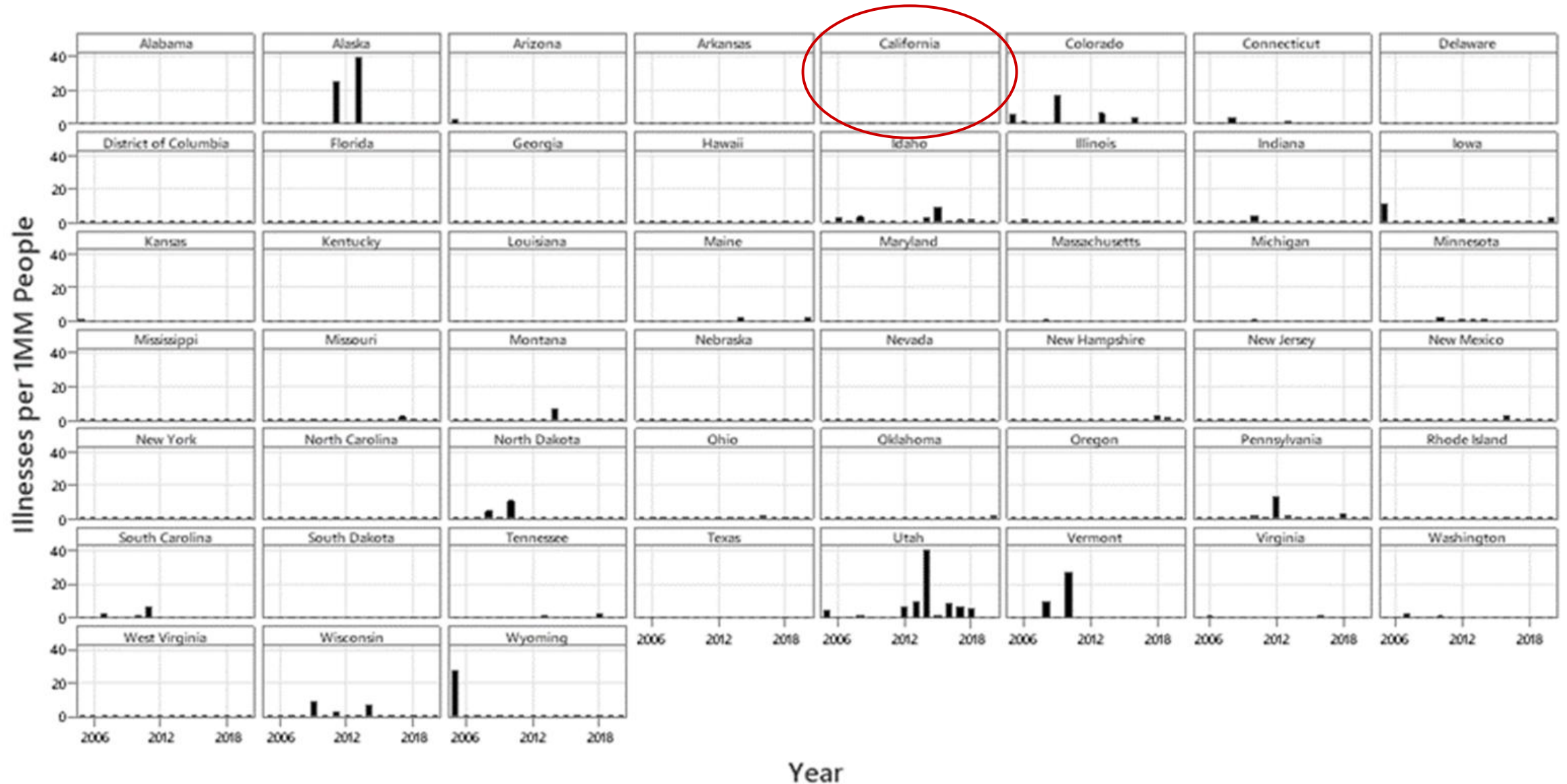
References in Speaker Notes; NR Not Reported

Burdens of Disease For:	Infectious Disease (INF) Burden	Non-Communicable Disease (NCD) Burden	Recent Fatalities	
			INF	NCDs
Raw Breastmilk	Negligible Norway, 4 US, 13 global cases	NR	2	NR
Pasteurized Donor Milk & Formula	18 global cases US, 23 global cases	NR	5	NR
			5	NR
Raw Cow Milk	1,696 US cases	NR	1	NR
Pasteurized Cow Milk	2,111 US cases	~15 million US cases	4	15

HAZARD ID Breastmilk

- Cases of disease transmission rarely reported, clinical studies consistently document protection from diarrheal and other diseases
- Detection of bacteria in breastmilk not predictive of neonatal infection and disease transmission (Schanler et al., 2011)
- Decades of safe delivery of carefully screened raw donor milk to infants in Norway and other countries
- Primary cause of infant mortality in preterm infants:
 - necrotizing enterocolitis (NEC) and other diseases of prematurity
 - immature GI and immune systems
 - NICU equipment and environments
- Some pathogens linked to cases of neonatal infection that may be associated with contaminated milk or formula or environment

HAZARD ID: Rates of Illness by State Not Increasing



EXPOSURE ASSESSMENT: TWO Types of Milks

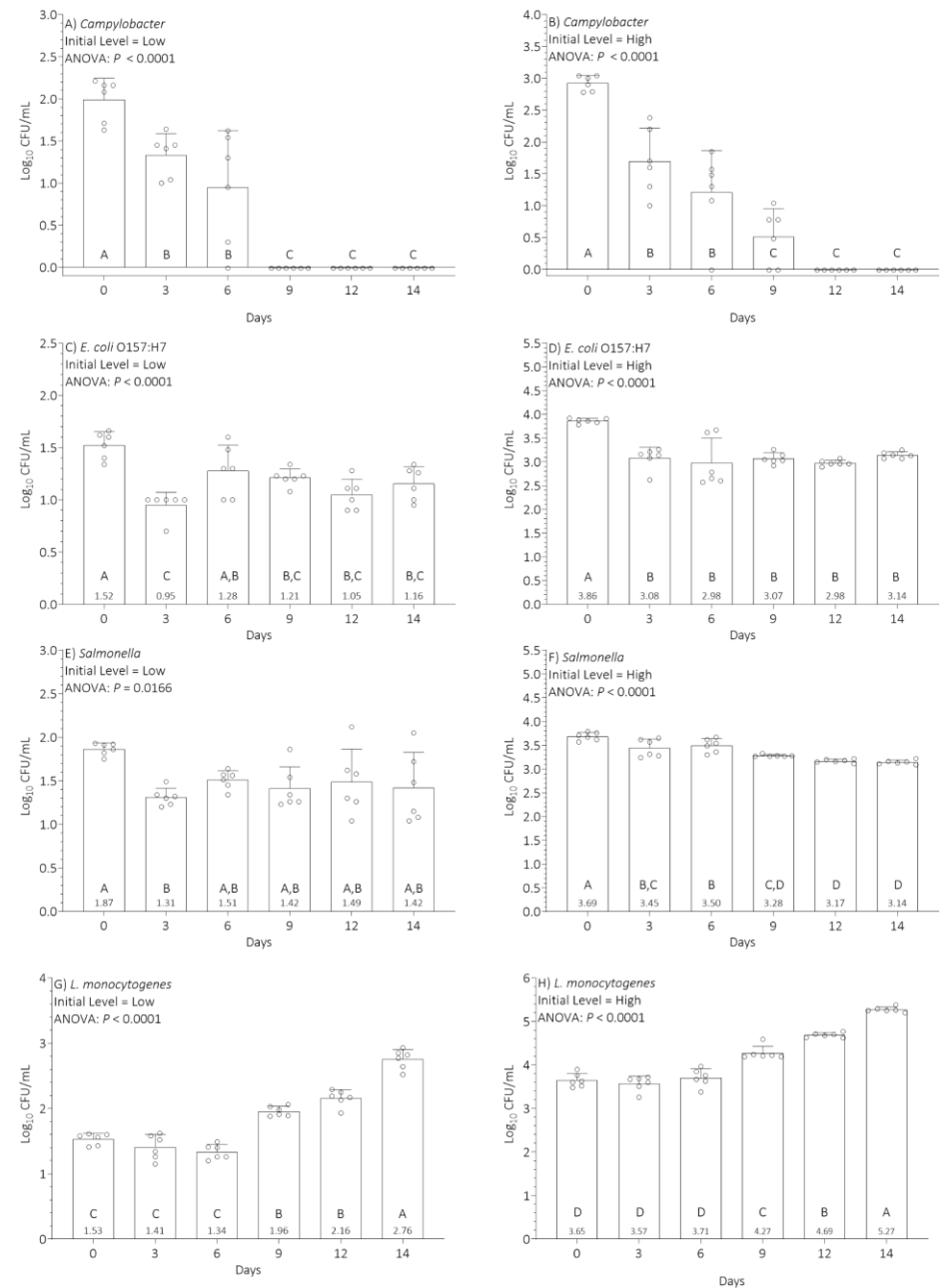
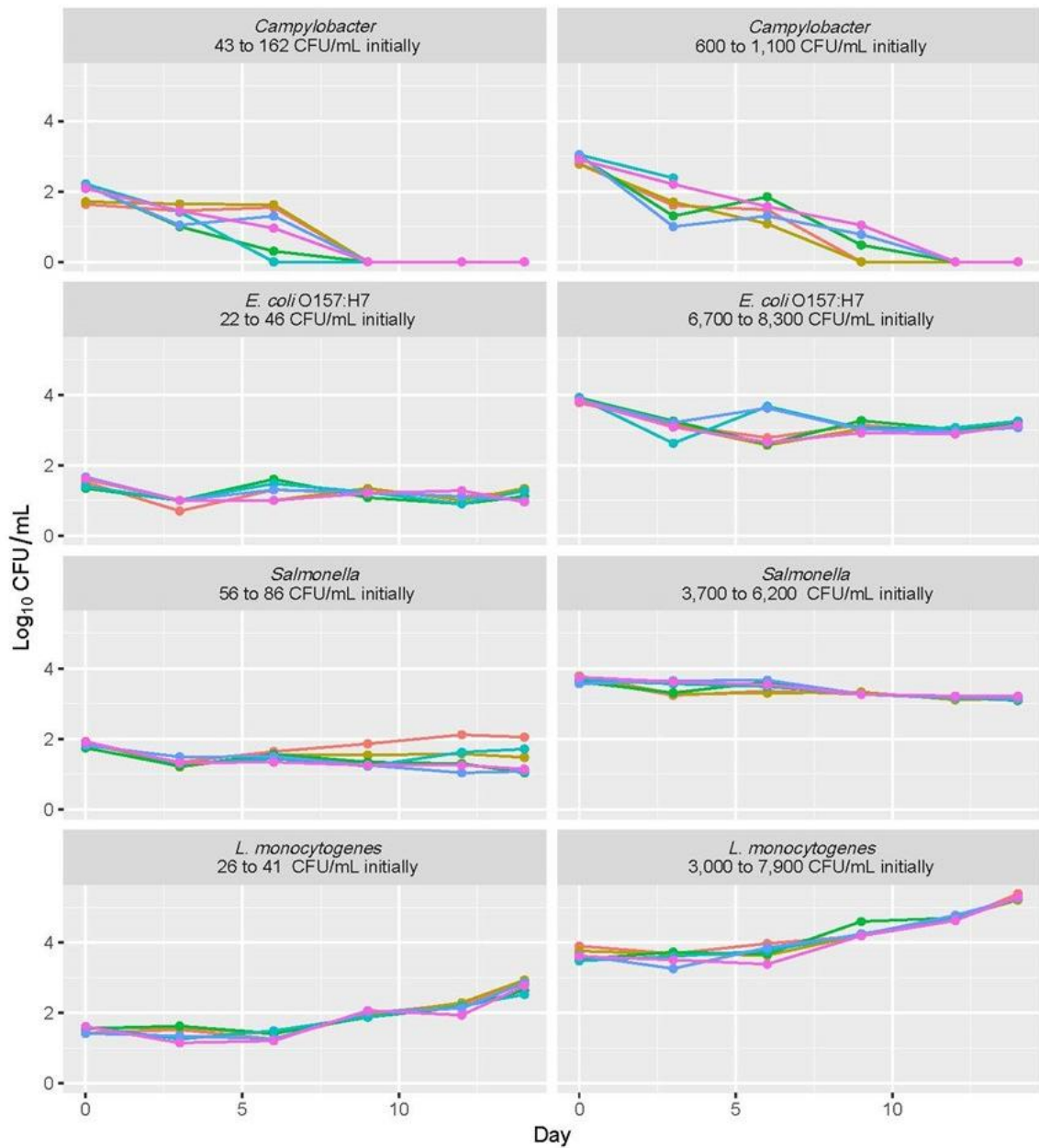
... with Different Percentages of Pathogen Positive

OVERALL PERCENTAGES PATHOGEN-POSITIVE	<i>L. monocytogenes</i>	<i>Campylobacter</i>	<i>E. coli</i> O157:H7 (EHEC/STEC/ VTEC)	<i>Salmonella</i>
1. Raw Milk Produced for Direct Human Consumption	0.44% (40/9,118)	0.95% (93/9,740)	0.23% (26/10,934)	0.18% (14/7,976)
2. Pre-Pasteurized Milk from Concentrated Animal Feeding Operations (CAFOs), Comingled Silos	~50%	3.2-10.9%	3.8-9%	21-57.9%

Raw Milk Monitoring: Canada, Finland, Germany, Poland, UK, US (Berge & Baars, 2020; Dietert et al., 2022); **Pre-pasteurized Monitoring:** US (Williams et al., 2023)

EXPOSURE ASSESSMENT: Raw Milk Microbes Suppress Pathogens under Refrigeration

Coleman et al., 2023, PLOS ONE



EXPOSURE ASSESSMENT: Dense, Diverse Natural Milk Microbiota

Human

Ralstonia
Roseburia
Clostridium
Corynebacterium
Faecalibacterium
Lactobacillus
Bifidobacterium
propionibacterium
pseudomonas
staphylococcus
streptococcus
Bacteroides
Acinetobacter
Veillonella
Lachnospiraceae
Ruminococcaceae
Enterococcus
Prevotella
Weissella
Leuconostoc
Lactococcus
Citrobacter
Serratia

Cow

Microbacterium
pediococcus
Fusobacterium
propionibacterium
Acinetobacter
Bifidobacterium
pseudomonas
staphylococcus
streptococcus
Lachnospiraceae
Corynebacterium
Bacteroides
Enterococcus
Ruminococcaceae
Aerococcus
Jeotgalicoccus
Psychrobacter
Enterobacter

Water buffalo

Micrococcus
5-7N15
solibacillus
propionibacterium
pseudomonas
staphylococcus
Aerococcus
Clostridium
Facklamia
Trichococcus
Turicibacter
Acinetobacter
Psychrobacter

Goat

Micrococcus
Rhodococcus
Arthrobacter
stenotrophomonas
Pseudomonas
Staphylococcus
Streptococcus
Phyllobacterium
Rhizobium
Agrobacterium
Bacillus

Sheep

Enterococcus
Bifidobacterium
Lactobacillus
pseudomonas
staphylococcus
Streptococcus
Corynebacterium
Bacillus
Methylobacterium
Escherichia

Oikonomou et al., 2020, Figure 2,

<https://www.frontiersin.org/articles/10.3389/fmicb.2020.00060/full>

DOSE-RESPONSE ASSESSMENT: General Population Resistant to Extremely High *Listeria monocytogenes* Numbers Observed in Blue Bell Ice Cream Outbreak (Pasteurized Milk)

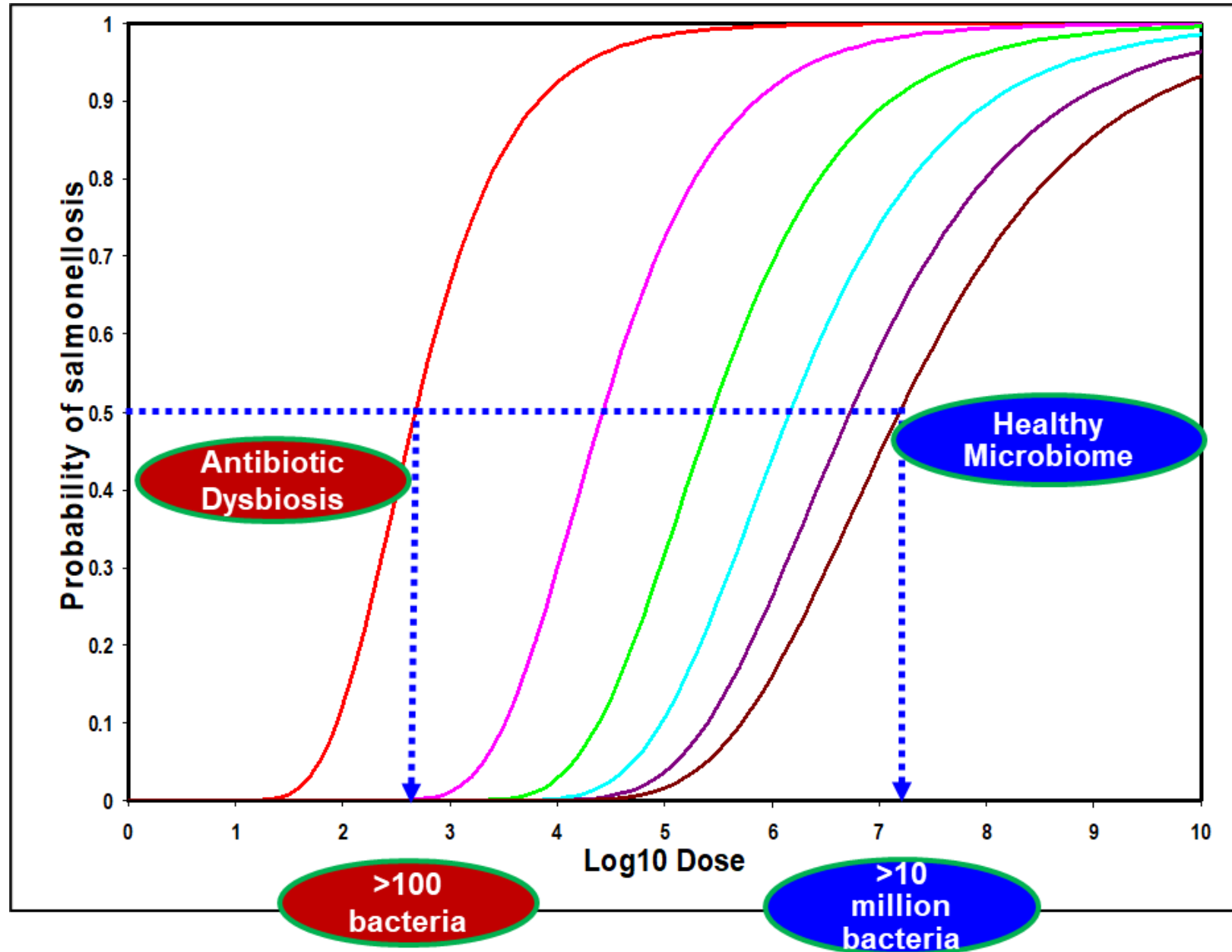
Pouillot et al., 2016	General Population Resistant Asymptomatic (No Illness)	Immunocompromised Institutionalized Susceptible Fatal Illness
Estimated Ingested Doses	10^{9-10} 10,000,000,000 pathogens	10^{6-7} 10,000,000 pathogens

DOSE-RESPONSE ASSESSMENT: Model Uncertainty for Salmonellosis

Applying intentionally conservative or oversimplified models **overestimate risk** and **underestimate uncertainties**, particularly for dose-response relationships (complex, dynamic, and multi-factorial)

**Marks et al. (1998),
Coleman et al. (2018):**

- family of curves based on human and murine data
- **conservative non-threshold, low-dose linear models** ignore innate & adaptive immunity, microbial ecology of healthy GI ecosystem



Overkill? Eradicating 10^{5-8} *Coxiella burnetii*

Enright et al., 1957

Pasteurization Process	Temperature	Time
Holder	63°C (145°F)	30 minutes
Thermization	57°C to 68°C (135°F to 154°F)	15 minutes
Batch pasteurization (low-temperature long time, LTLT)	63°C (145°F)	30 minutes
High-temperature short time (HTST)	72°C (161°F)	15 seconds
Ultra-high temperature (UHT)	135°C to 140°C (275°F to 284°F)	2 to 4 seconds

- **Cerf & Condron (2006)** reevaluated: up to 8-log kill (overkill)
- **Wittwer et al. (2022)** reducing temperature-time profiles feasible

RISK CHARACTERIZATION: Recent CDC Data Support Lower Risk for Milks than Estimated by FDA/FSIS in 2003

CDC Dataset for 2005-2020; Stephenson et al., 2024

- Pasteurized milk accounted for 3 listeriosis deaths over 16 years
not ~91 per annum estimated in 2003 (1,453 deaths over 16 years)
- Raw milk accounted for no confirmed listeriosis deaths over 16 years,
not ~3 per annum estimated in 2003 (50 deaths over 16 years)

Per Annum Basis ^b		
	Food	Cases
Very High	Deli Meats	1598.7
High Risk	Pasteurized Fluid Milk	90.8
	High Fat and Other Dairy Products	56.4
	Frankfurters, not reheated	30.5
Moderate Risk	Soft Unripened Cheese	7.7
	Pâté and Meat Spreads	3.8
	Unpasteurized Fluid Milk	3.1
	Cooked Ready-to-Eat Crustaceans	2.8
	Smoked Seafood	1.3
Low Risk	Fruits	0.9
	Frankfurters, reheated	0.4
	Vegetables	0.2
	Dry/Semi-dry Fermented Sausages	<0.1
	Fresh Soft Cheese	<0.1
	Semi-soft Cheese	<0.1
	Soft Ripened Cheese	<0.1
	Deli-type Salads	<0.1
	Raw Seafood	<0.1
	Preserved Fish	<0.1
	Ice Cream and Other Frozen Dairy Products	<0.1
	Processed Cheese	<0.1
	Cultured Milk Products	<0.1
	Hard Cheese	<0.1

Quantitative Assessment of Relative Risk to Public Health From Foodborne *Listeria monocytogenes* Among Selected Categories of Ready-to-Eat Foods

Center for Food Safety and Applied Nutrition
Food and Drug Administration
U.S. Department of Health and Human Services

Food Safety and Inspection Service
U.S. Department of Agriculture

September 2003



RISK CHARACTERIZATION: Multiple Conservative Assumptions Drove High Risk Estimates

Independent Re-Assessment for Severe Listeriosis Risk

FDA/FSIS (2003) versus re-assessment by academics (Latorre et al., 2011)

Pasteurized Milk

- 90.8 deaths per year (**high** risk)
- 10^{-9} per serving or 1 fatal case in 1,000,000,000 exposures at selected doses (**moderate** risk)

Unpasteurized Milk

- 3.1 deaths per year (**moderate** risk)
- 7×10^{-9} per serving or 7 fatal cases in 1,000,000,000 exposures at selected doses (**high** risk)
- $\sim 2 \times 10^{-15}$ per serving or 2 cases in 1,000,000,000,000,000 exposures (**very low** risk)

FDA/FSIS

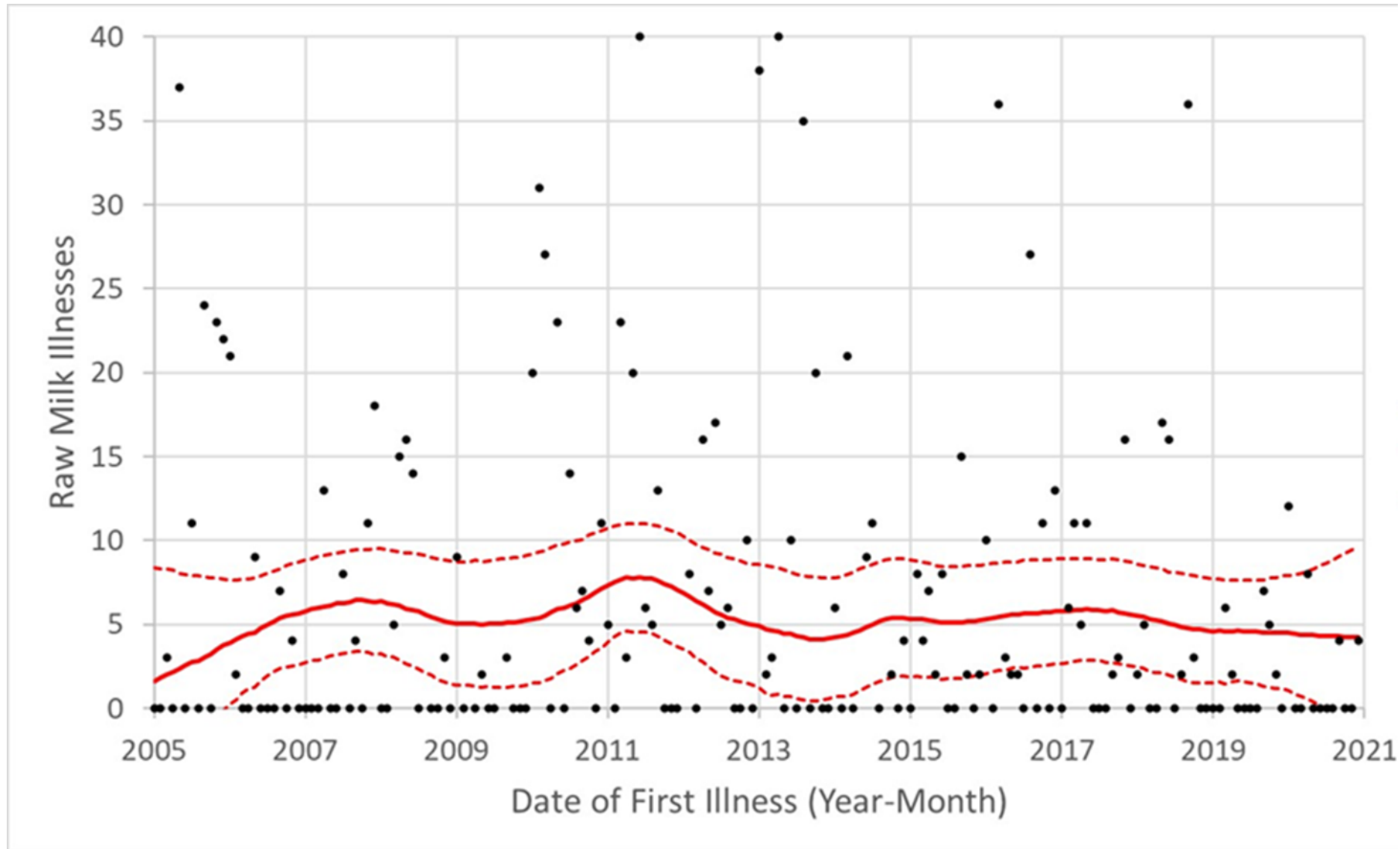
Latorre

Claims from Same CDC Data Source Differ!

	Selected Data Range	Key Results	Data on Rates by State	Data and Analysis Quality
Stephenson et al., 2024	2005-2020	Illness and outbreak trends NOT increasing ; No evidence increasing illness or outbreaks with increasing access	✓	Transparency of data and statistical procedures including formal trend analysis; consideration of microbial risk assessment framework
Koski et al., 2022	1998-2018	Illness trend not increasing; Outbreak trend increasing; Increasing access associated with more outbreaks and illnesses in conclusions	No: States Pooled without Adjustment	Improper comparisons: bias for including 1998 data from older surveillance system; invalid comparisons for states without adjustment; outbreaks incorrect measure for burden of illness
Costard et al., 2017	2009-2014	840x higher illnesses for raw dairy compared with pasteurized dairy	No	Improper comparisons: pooling all dairy products prevents inferences about fluid milks; Excluded 2006 outbreak with 1,644 illnesses in pasteurized milk
Mungai et al., 2015	2007-2012	States legalizing raw milk associated with increasing numbers of outbreaks	No: Pooled without proper adjustment	Improper comparisons: number of outbreaks incorrect measure for burden of illness; Insufficient statistical analysis; Excluded 2006 outbreak with 1,644 illnesses in pasteurized milk
Langer et al., 2011	1993-2006	150x higher raw outbreaks than pasteurized outbreaks	No: Pooled without proper adjustment	Improper comparisons: number of outbreaks incorrect measure for burden of illness; Outdated, NOT representative of current training and risk management practices

No Increasing Trends in Raw Milk Illness

CDC Dataset for 2005-2020; Stephenson et al., 2024



Clusters of Clinical Strains from PulseNet Not Causally Linked by Known Sources of Disease Transmission Inconsistent with Hypothesis Generation for Outbreak Investigations (White et al., 2021)

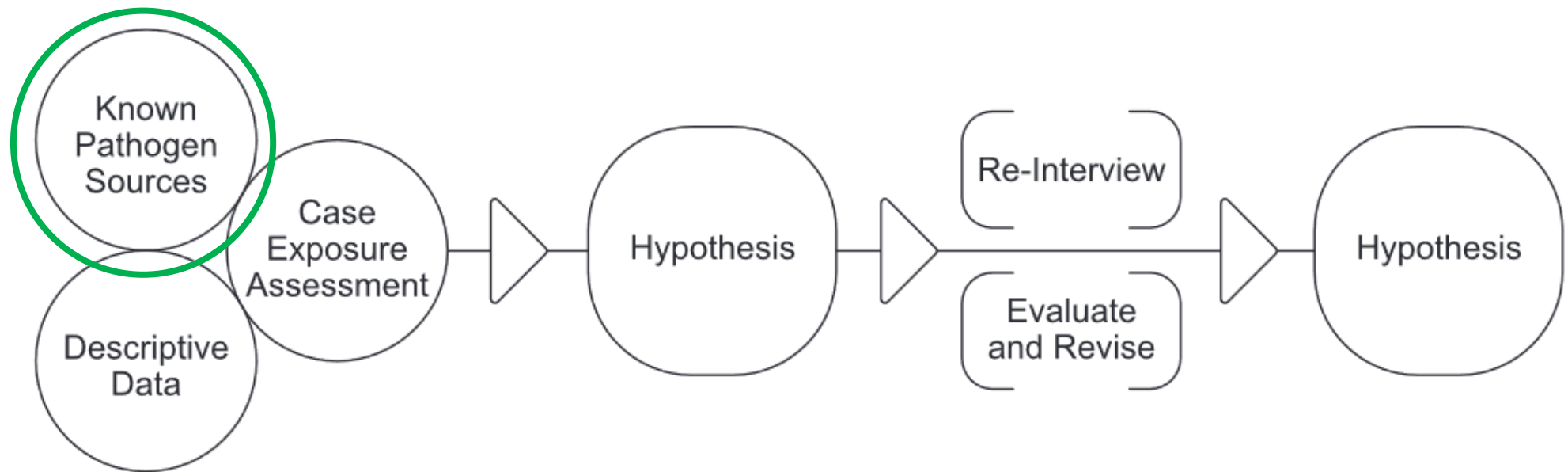


Figure 1. A model framework for hypothesis generation during a foodborne-illness outbreak investigation.

Weinstein et al (2025) targeted raw milk, despite accounting for <1% of salmonellosis burden of illness for years 2005-2020