Capturing Change: A Focus on Innovation that Advances the Public Good

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Charge to the National Academies' Panel

OVERVIEW

Charge to the Panel

- What are the Key National STI Indicators that NCSES should produce in the next 5-10 years?
  - Policy relevant
  - Internationally comparable
- What are the types of data necessary for capturing change in STI activities over time?
- What is the best framework for setting priorities for developing indicators representing the system of STI activities?

Changing Environment

- Rapid technological changes
- More open and collaborative innovation
- Shortened user timelines for data access
- Evolving methods of gathering data
- More complex privacy and confidentiality issues
- Heightened interest in subnational geographic scales, distributed social returns, open innovation
- Augmented NCSES mission and tightening budgets

Questions Addressed by STI Indicators

1. What are the **social returns to public and private expenditures** on STI activities? What are the innovation, economic health, and employment outcomes related to federal expenditures on R&D?
2. How is the contribution of STI to productivity, **employment**, and growth in the broader U.S. economy changing in a world of economic globalization?
3. What are the **drivers of innovation** that benefit the economy and society? What is the uptake of ideas for **innovation from consumers**?

- Appendix B of the report has the full list of questions from users of STI indicators or the underlying data.

Key Questions

Social Returns on Public and Private Expenditures on STI

Impact on Economic Growth, Competitiveness, and Jobs

STI Indicators

Drivers, Trends, Advances, Vulnerabilities, Culture/Climate, and Distributions

Actors	Activities	Linkages	Outcomes
• Individuals • Collectives - Teams - Governments - Education and research institutions - Businesses - Private nonprofit organizations	• Research • Invention • Development • Engineering/ design • Innovation • Diffusion • Education • Training • Capital investment • Job mobility • Firm dynamics • Policy, regulation & governance	• Grants • Contracts • Collaboration • Partnerships • Co-development • Copublication • Social networks • Media/com-munications	• Knowledge stocks • Social capital • Intangibles • Products and services • Productivity • Product life cycles • Trade in S&T products • Trade in R&D services • Job mobility • Firm dynamics • **Socioeconomic impacts/well-being**

Systems, Firm Dynamics & Business-practice Data

MEASURING INNOVATION

Measuring Innovation

- Broader measures of **outputs of R&D other than patents** (R4-1)
- **Organizational and marketing innovations** (R4-2)
- Link innovation to business characteristics, including the **balance of payments of R&D services** (R5-2)
- Research on precisely **what companies mean by "innovation"** (R4-2)
- Track **unmarketed innovations**, illuminating why stalled commercialization (R4-2)
- Track innovation-related expenditures, e.g., **training and design** (R4-2)
- Track activities by **high-growth firms, births and deaths** of businesses linked to innovation outputs, and other indicators of firm dynamics (R4-4)
- Create indicators of **innovative firms' demand for skills** (R6-7)
- **Use business practice data** to track R&D spending and innovation-related jobs, more detailed geographic scales and occupational levels (R4-5)
- **Improve access** to the data for NCSES staff who develop the R&D and innovation statistics (R4-3)

[R#-# is Recommendation #-# from the *Capturing Change* report]

Public Investments, Public and Private Returns

EXAMPLE

The Project

Assessing the *Public Value* of Government-funded University-based Research on Food Safety

USDA/NIFA AWARD #: 2014-67023-21809; USDA CRIS #: 1002375

Research Team:

- **Kaye Husbands Fealing**, Georgia Institute of Technology
- **Sandra Hoffmann**, U.S. Department of Agriculture
- **Stan Johnson**, National Center for Food and Agricultural Policy
- **John King**, University of California—Davis
- **Julia Lane**, New York University
- **Christina Jones**, American institutes for Research
- **Evgeny Klochikhin**, American Institutes for Research
- **Yeong Jae Kim**, Georgia Institute of Technology

In a typical year…

- 48 million cases (29-71 million)
- 128,000 hospitalizations (63,000 to 216,000)
- 3,000 deaths (1,500-5,000)

Source: CDC 2011

And conservatively **$14.1 billion ($2010)** in economic burden from foodborne infectious illnesses alone.

Source: CDC 2011

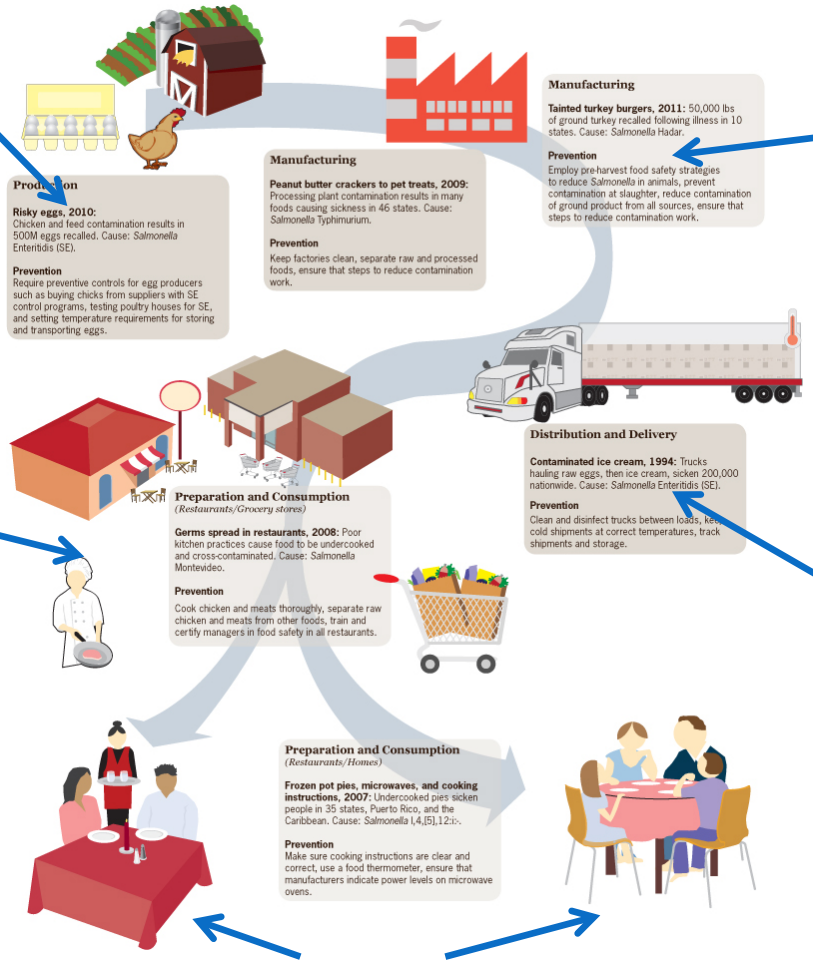
Research Is Needed Farm-to-Table

Production: Animal husbandry, pathogen survival in crops, breeding, veterinary epidemiology, storage technology

Processing: pathogen and chemical detection, equipment engineering, food chemistry, management processes,

Preparation: impacts of new preparation technologies on safety, personnel management and training

Shipping and distribution: storage and refrigeration technology, pathogen detection, temperature abuse detection, information systems



Consumption: consumer food handling practices, information technology and communication, illness reporting systems, “restaurant” regulation, and epidemiology

Focus

- **Develop frameworks and techniques for measuring outcomes from federally funded research targeted at the agricultural sector in general and food safety in particular.**

Key Questions on Food Safety

1. What **expenditures** have been made and how have these expenditures changed over time?
2. Who is **doing the research** (principal investigators, graduate students, postdoctoral fellows, and staff scientists)?
3. What kinds of work is done in the first jobs of graduates trained in food safety? How do these early career activities relate to graduates' **career paths**? What is the role of food safety research funding in graduate student training?
4. What are the **outputs** of federally sponsored academic research? How are the results transmitted to the scientific and private sector, commercialized, and effective for the **social good**?
5. What is **best method** for funding research leading to the most significant breakthroughs?

Approach

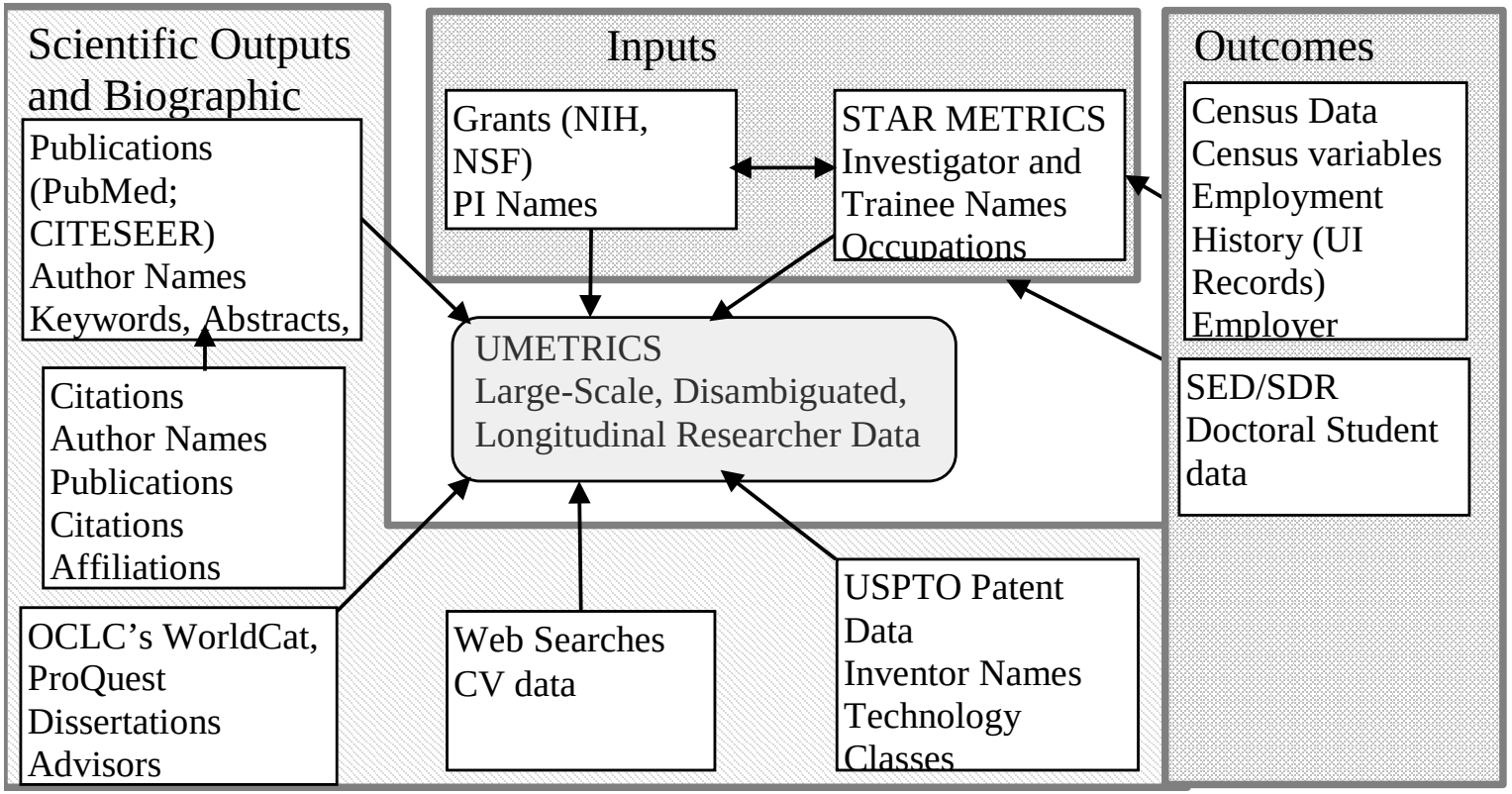
- **What**: The text analysis approach
- **Who**: Workforce composition/ team structure
- **What results**:
  - Human capital (earnings and placements)
  - Publications/patents/governance
  - Commercialization
  - Safer food supply

Approach

- **Project**-level data, payroll records
- **Taxonomy**—natural language text analysis to identify food-safety research
- **Linkages** between researchers, students, postdocs, patents, publications, dissertations, employment, enterprises—tech transfer
- **Deliverables**
  - Data platform
  - Impacts of research to social returns
  - Policy options

Data Structure

The Emerging Large-Scale, Disambiguated, Longitudinal Researcher database



Source: Julia Lane et al.

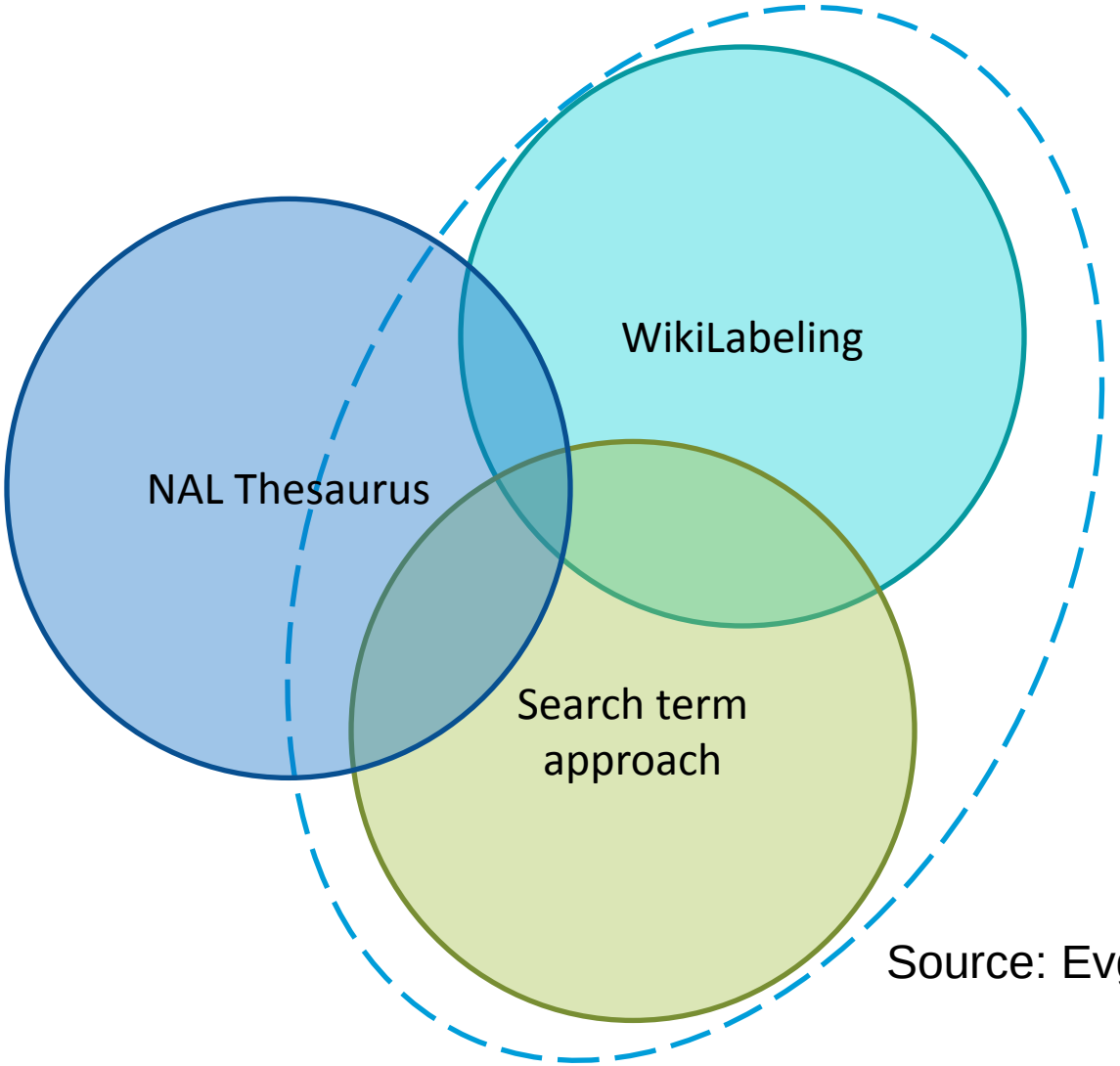
The problem

- Scientific awards and dissertations are typically not labelled as food safety
- Limited resources on the definition and scope of food safety research (e.g. USDA FSRIO office)

How to identify food safety-related research and funding streams?

Source: Evgeny Klochikhin

Approach



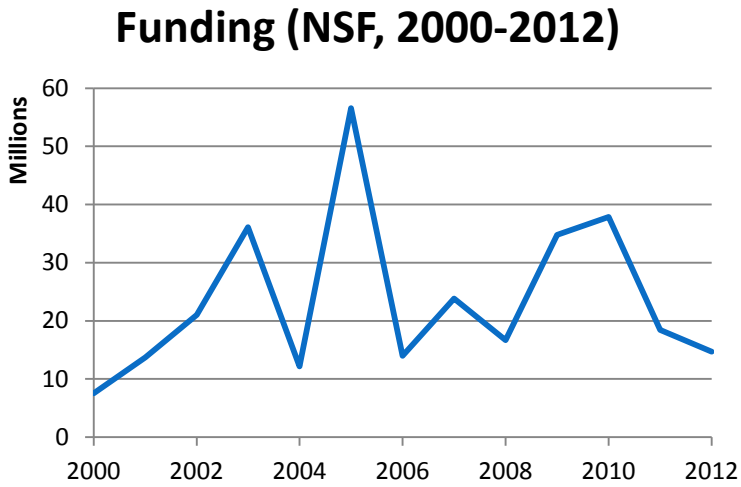
Source: Evgeny Klochikhin

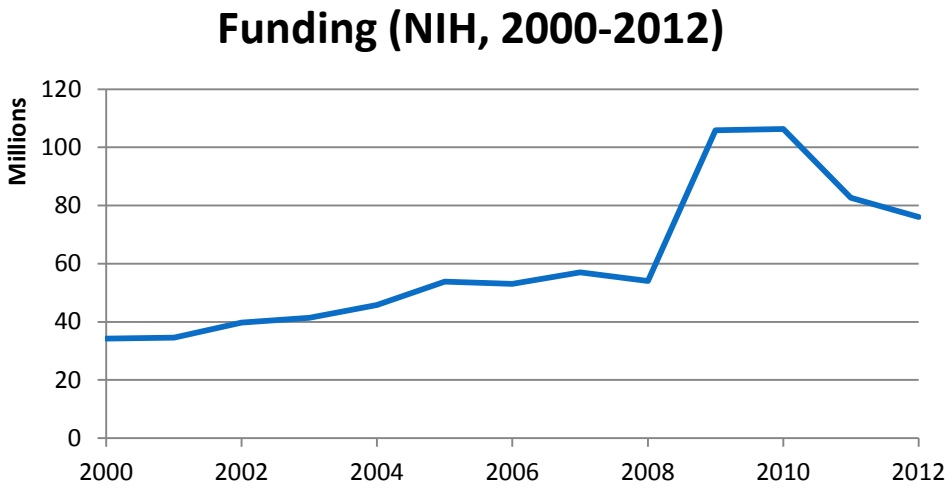
Food safety awards

	# of grants	Share of total	Funding amount	Share of total
National Science Foundation (incl. CIC institutions)	595 (84)	0.4%	$313 m ($55.4 m)	0.48%
National Institutes of Health (incl. CIC institutions)	2,337 (365)	0.26%	$743 m ($101.6 m)	0.26%
USDA (incl. CIC institutions)	3,654 (776)	0.6%	-	-

Source: Evgeny Klochikhin

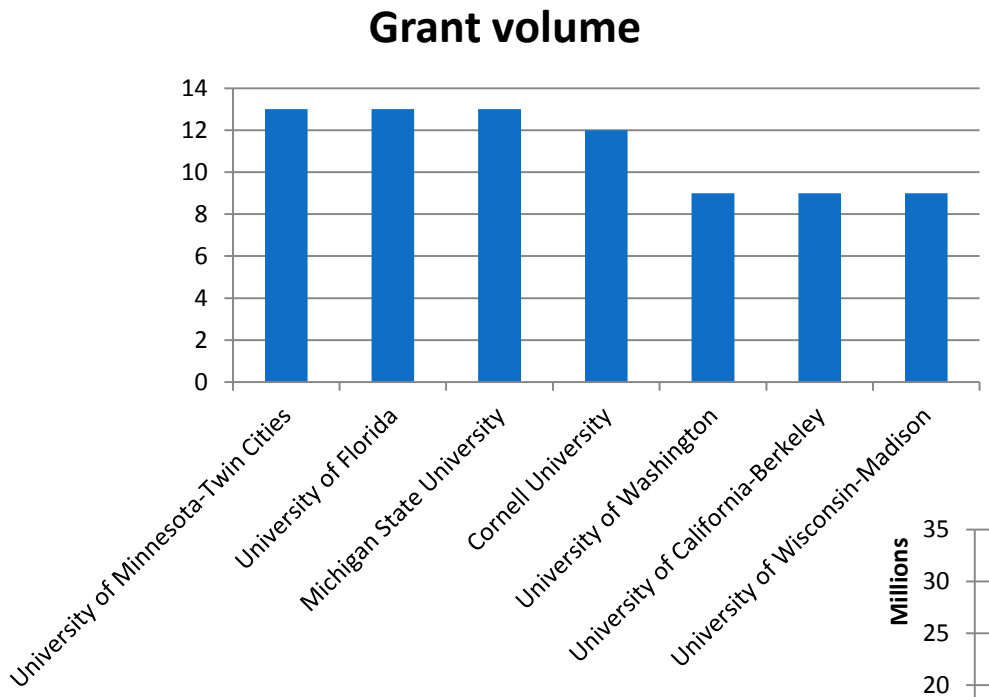
Yearly trends (funding, 2000-2012)

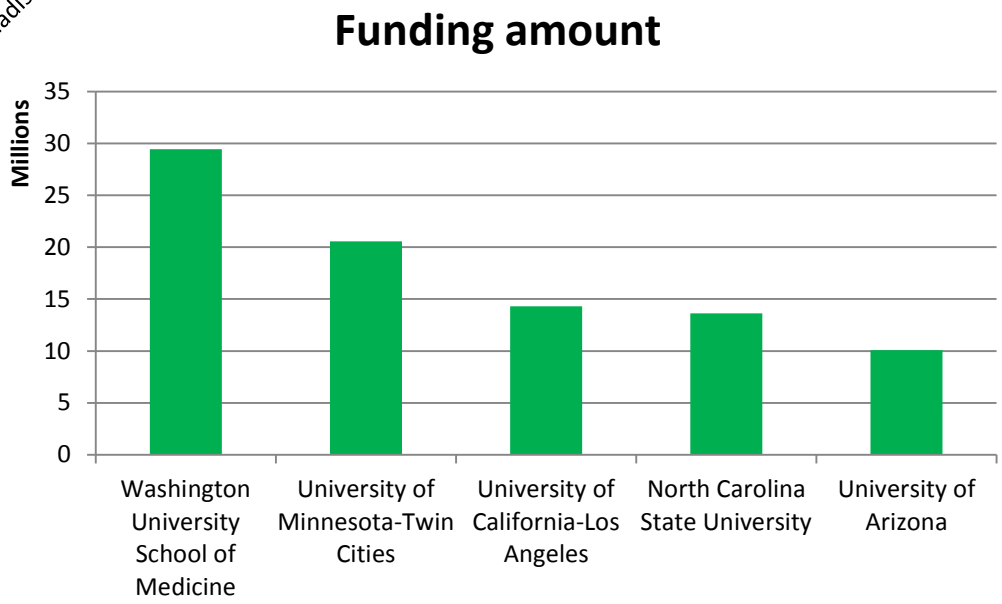




Source: Evgeny Klochikhin

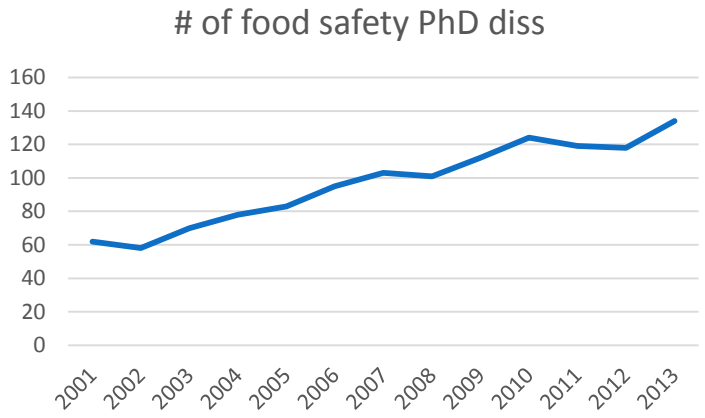
Top-5 institutions (NSF)

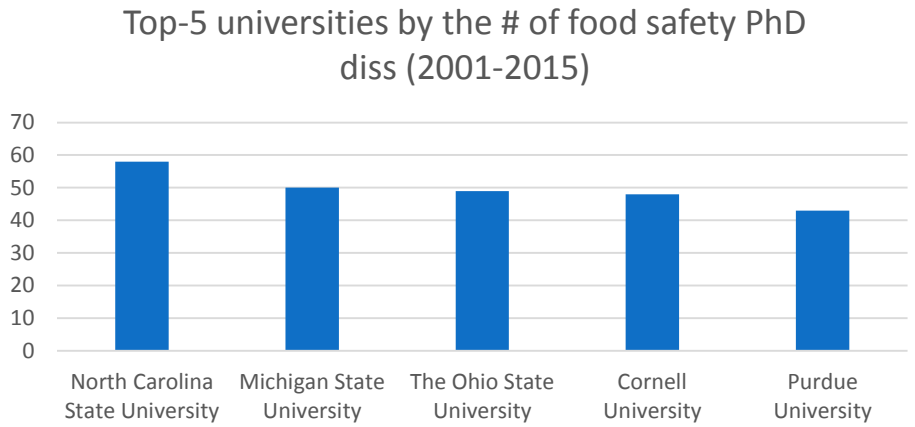


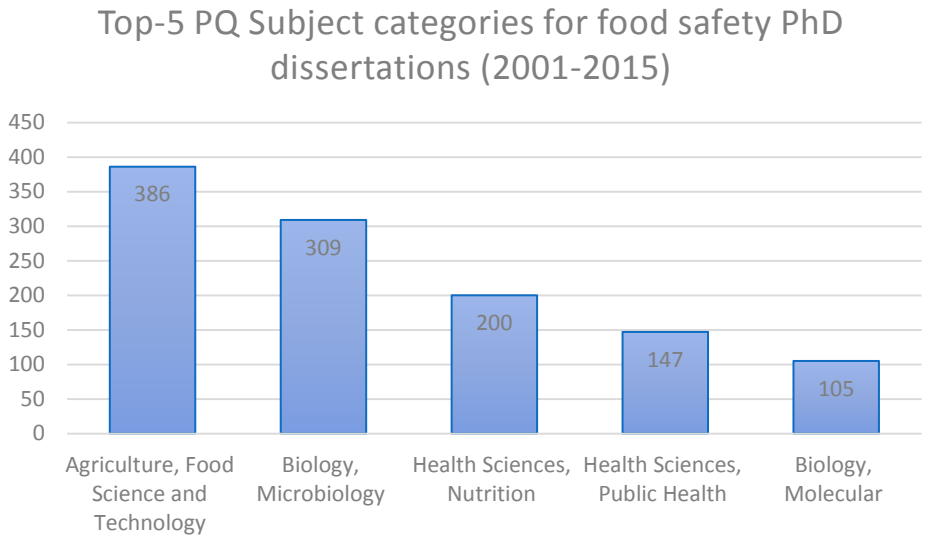


Source: Evgeny Klochikhin

ProQuest dissertations







Source: Evgeny Klochikhin

Concluding remarks

- Computational techniques help identify food safety research
- Human validation is critical for rigor
- USDA is the top food safety funder while NIH is mostly focused on health/nutrition aspects and NSF funds both biological sciences and technology programs (via STTR and SBIR)
- North Carolina State, Michigan State, Ohio State, Cornell and Purdue are top-5 producers of food safety PhD graduates

Source: Evgeny Klochikhin

Capturing Policy Impacts

Source/Group	*Academic Citation Status*
Code of Federal Regulations	Yes, mainly other government agencies or organizations
Federal Register	Yes, footnotes in PDF and on individual webpages
FDA	Under CFR Title 21, it appears to be mainly other government agencies or organizations
USDA Food Safety Inspection Service	Yes, spread throughout various reports and risk assessments
Codex Alimentarius	Limited to one section of the Codex itself; see committees below for citations
Codex: JECFA - Joint FAO/WHO Expert Committee on Food Additives	Yes, various reports
Codex: JMPR - Joint FAO/WHO Meetings on Pesticide Residues	Yes, various reports
Codex: JEMRA - Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment	Yes, both FAO and WHO have document repository pages, in addition to extensive report pages
SPS agreement (WTO)	No, for the agreement itself
Sanitary and Phytosanitary Measures (SPS Report)	No
Model Code for Produce Safety (AFDO)	Don't know; access requires purchase
Minnesota Dept of Health	No
Pew Charitable Trust	Limited, in select reports
Grocery Manufacturers Association	Limited, in select reports
American Meat Institute	Very limited
Center for Science in the Public Interest	Limited, in comment letters and one report
Environmental Working Group	Limited, in various reports
International Life Science Institute	No
FoodRisk.org (Joint Institute for Food Safety and Applied Nutrition)	Yes, in tools, databases, and datasets

For more information and to download the report:

http://www.nap.edu/catalog.php?record_id=18606

THANK YOU!