The Food Safety Universe Database: A Risk Assessment and Risk Ranking Tool

Dr. Mike Cassidy
Coordinator, Food Safety Science Unit
Ontario Ministry of Agriculture and Food (OMAF)

"From the Farm Gate to the Dinner Plate"
November 3, 2003

Presentation Outline

- 1) Evolution of Food Safety Risk Assessment
- 2) Intent of Food Safety Universe DataBase
- 3) Structure - Food / Hazard / Location
- 4) Structure - Probability and Impact
- 5) Risk Per Serving vs. Societal Risk
- 6) Final Outcome

Objectives of food safety programs

- Optimizing the use of finite resources
- Maximize (and equalize) return on investment across hazards and food types, in terms of reductions to food safety risks
  - Systematically assessing and ranking food safety risks is an essential step to achieving this objective.
  - Not easily achieved given complexity of food system

Prioritizing Risks

- What is the bigger risk to consumers?
  - *Salmonella* in pork or *E. coli* in beef?
  - Pesticides in vegetables or acrylamide in fried foods?
  - Listeria in RTE foods or dioxin in milk?

Food safety risk assessment

- Involves systematically determining or estimating the likelihood and consequences of failures to food safety

- Qualitative - rank as high, medium or low risk
- Quantitative -very detailed, complex determination of risk
  - e.g., US - *E.coli* in ground beef
    - *Listeria* in RTE foods

Qualitative Text Risk Assessment vs. Quantitative Risk Assessment

- Text Based Qualitative RAs great but….
  - Repetitive
  - Tedious to change (transposition errors)
  - Limited determination within high, med, or low
  - Difficult to effectively rank
- Quantitative Risk Assessments
  - Detailed, but time and resource heavy
  - Rating changes easy (computer transposes)
  - Generally only have risk on one hazard, not comparative with other risks

Scope and Complexity of the Problem

- Different foods may be contaminated with various biological, chemical or physical hazards at different locations along the food chain, from production to consumption, to ultimately cause harm to the health of consumers.

- In theory, every possible combination of food-hazard-location-of-entry could be defined and assessed in terms of its likelihood and consequence.

The Problem

- A systematic method of assigning, recording and comparing scores for the likelihood and consequence components of risks from various hazards, in various foods, was needed to semi-quantitatively assess and rank risks to food safety

Solution

- A database program was developed in Microsoft Access™ by Dr. Bruce McNab, Epidemiologist, OMAF

- A "middle ground" risk assessment tool that facilitates systematic ranking of many risks, without the detail and resources required to develop full mathematical models, to help optimize the allocation of food safety resources under the influence of OMAF

Food Safety Universe DataBase (FSUDB)

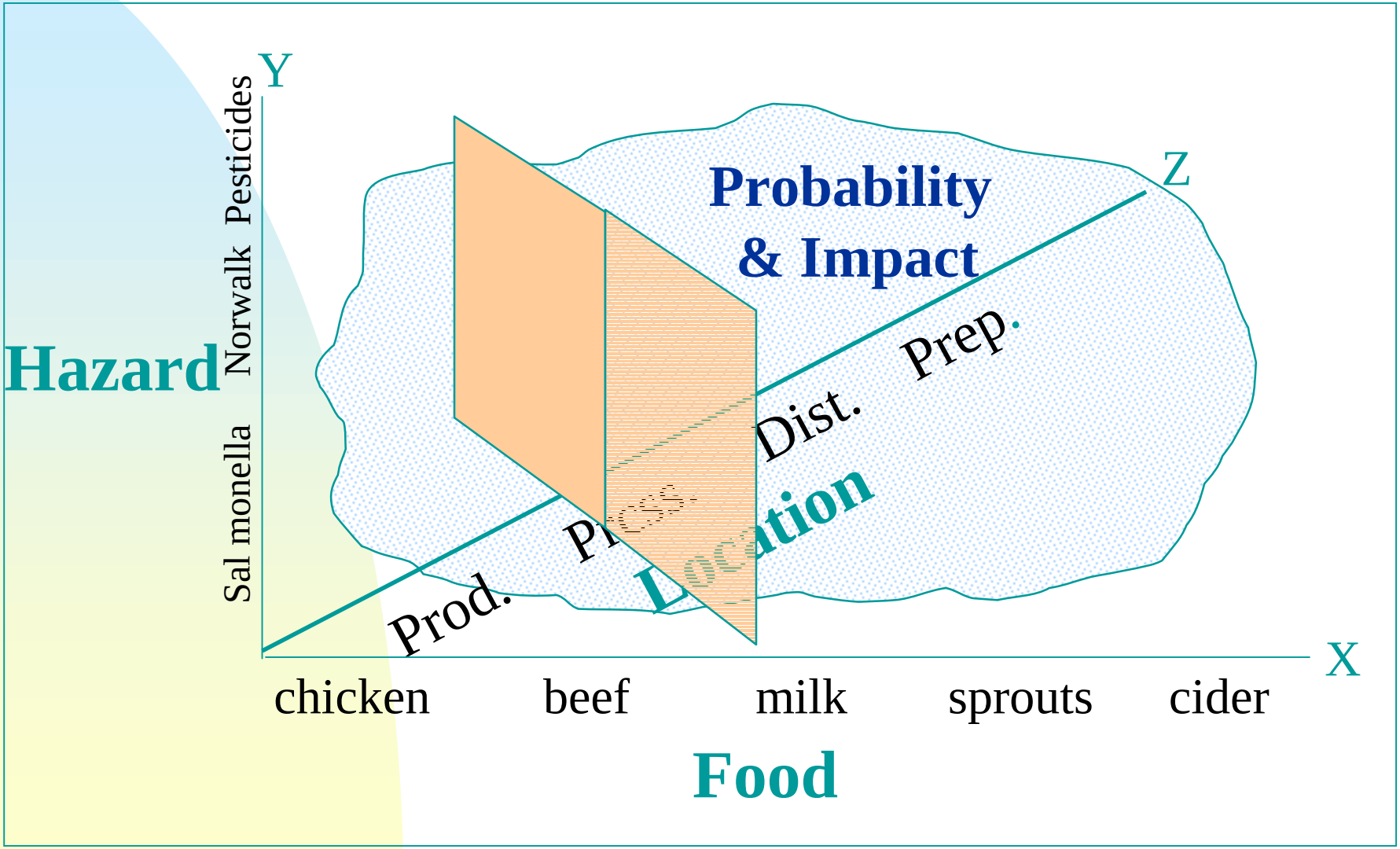
- This theoretical complete data set of all possible combinations could be thought of as the "universe" of food safety data. The database was designed to capture and analyze these data.

- The Food Safety Universe Database is a semi-quantitative Risk Assessment tool

Food / Hazard / “Location” Risk

- Food / Hazard / “Chain Location” - triplet
- Probability & Impact components of risk

FS Universe
"Multi-Dimensional" Database



The Three Dimensions

- "X" Axis
- **Food Dimension**
  - chicken
  - beef
  - milk
  - sprouts
  - cider
  - cheese
  - etc.

- "Y" Axis
- **Hazard Dimension**
  - Salmonella
  - E. coli
  - Norwalk Virus
  - Pesticides
  - Antibiotics
  - etc.

- "Z" Axis
- **Location in Chain Dimension**
  - production
  - processing
  - distribution
  - final preparation
  - etc.

Probability Components

- The probability (P) component of risk is broken down into three sub-scores of 1 to 10 as follows:

- Pa) scale of consumption is scored from 1 to 10 based on the amount of food consumed
- Pb) the "proportion" of that food contaminated with that hazard at that location is scored from 1 to10
- Pc) if contamination occurs then the "proportion" of that contaminated food that would lead to consumers being exposed to that hazard is scored 1 to 10

Impact Components

- The impact (I) component of the risk is also broken down into three sub-scores of 1 to 10 as follows:

- Ia) if exposure occurs then of those consumers exposed to the hazard, the "proportion" that become ill is scored 1 to 10
- Ib) if consumers become ill then of those consumers that get sick, how sick they become is scored 1 to 10
- Ic) difficulty to reduce or limit the impact; scored 1 to 10

Food/Hazard/Location Probability & Impact

i) Food: meat, chicken, fresh

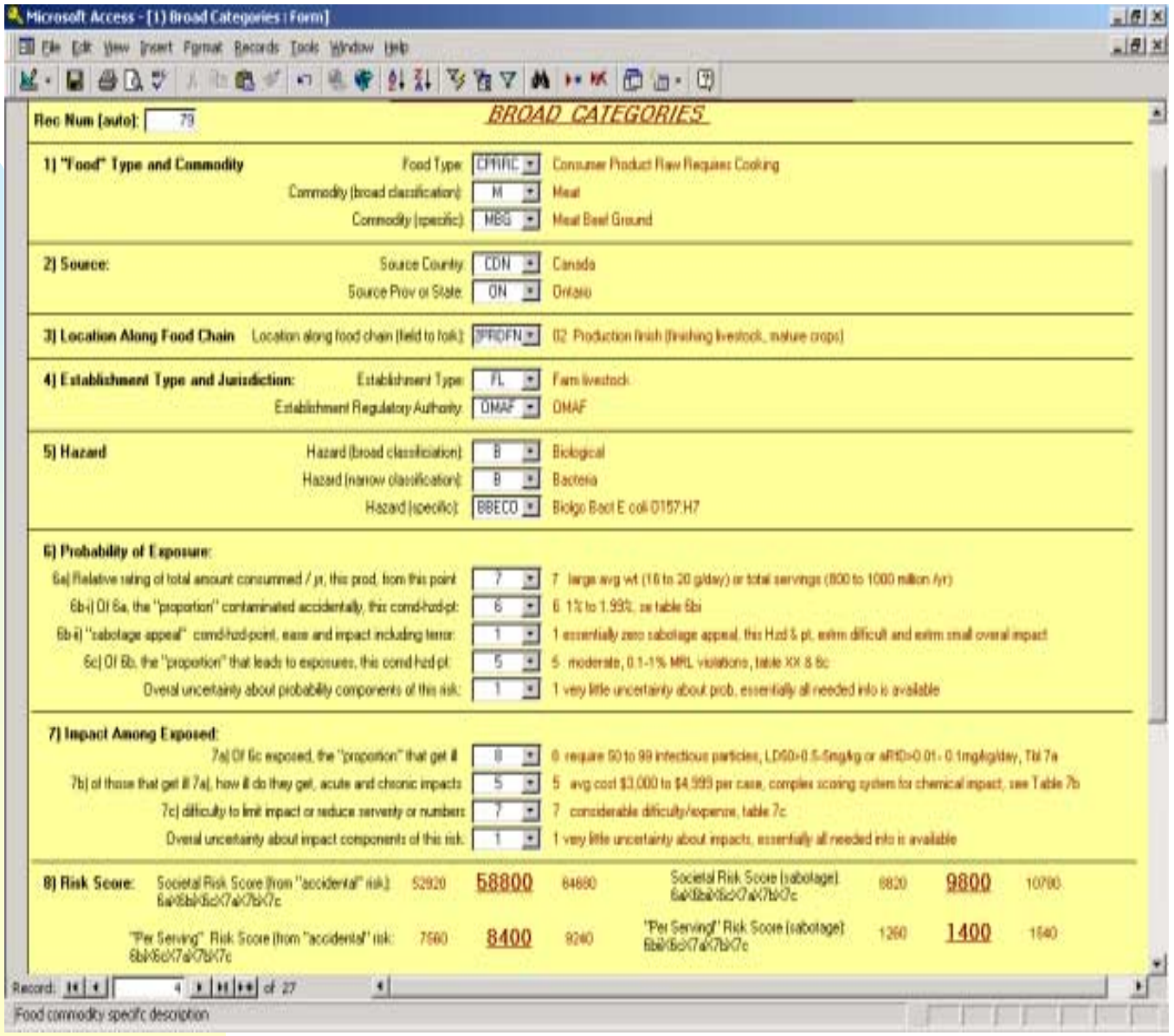
ii) Hazard: biological, bacteria, pathogenic Salmonella

iii) Location: production

iv) Probability: **a**) scale consumption 1-10
b) of a), the "proportion" contaminated 1-10
c) of b), the "proportion" leading to exposure 1-10

v) Impact: **d**) of c), the "proportion" that get sick 1-10
e) of d), how sick (acute & chronic) 1-10
f) difficulty to reduce impact 1-10
ax**b**x**c**x**d**x**e**x**f**= 1 to 1,000,000

FSUDB Primary Screen



Societal vs Per Serving Risk

- Which are we concerned about ?
  - High risk per serving (*Salmonella* in sprouts ?)
  - “High” total # exposures (*Salmonella* in chicken ?)
  - “High” days lost (GE, arthritis, cancer ?)
  - all three ?

Demonstration of Possible Risk Scores for Some Chemical Hazards in Various Commodities

Rank	Commodity	Location of hazard entry	Specific hazard	Consum-ption of food, 6a	Accidental contamina-tion 6bi	Exposure, 6c	Acute toxicity, 7a	Chronic toxicity, 7b	Reduce impact, 7c	Risk score
1	Milk	on farm prod.	Dioxin	10	5	10	10	10	7	350000
2	Chicken	on farm prod.	Dioxin	8	5	10	10	10	8	320000
3	Beef (ground)	on farm prod.	Dioxin	8	5	10	10	10	8	320000
4	Pork	on farm prod.	Dioxin	8	5	10	10	10	8	320000
5	Carrots	on farm prod.	Lead	6	6	10	8	8	7	161280
6	Milk	on farm prod.	Aflatoxin	10	3	10	8	8	7	134400
7	Potatoes	on farm prod.	Cadmium	10	6	10	5	6	7	126000
8	Fish	on farm prod.	Dioxin	6	5	6	10	10	7	126000
9	Maple syrup	harvest	Lead	4	7	7	8	8	7	87808
10	Chicken	on farm prod.	Arsenic	8	6	6	8	8	4	73728
11	Lettuce	on farm prod.	Cadmium	5	6	7	4	6	7	35280
12	Milk	harvest	Aflatoxin	10	2	6	5	8	7	33600
13	Lettuce	on farm prod.	Endosulfan	5	5	7	6	6	4	25200
14	Maple syrup	on farm prod.	Lead	4	2	7	8	8	7	25088
15	Lettuce	on farm prod.	Cypermethrin	5	4	6	5	5	6	18000
16	Lettuce	on farm prod.	EBDC	5	6	6	2	5	6	10800
17	Apples	on farm prod.	EBDC	9	10	6	1	5	4	10800
18	Apples	on farm prod.	Captan	9	9	4	2	4	4	10368
19	Peppers	on farm prod.	Endosulfan	2	5	6	6	6	4	8640
20	Celery	on farm prod.	Nitrate	4	10	6	2	2	6	5760
21	Peppers	on farm prod.	EBDC	2	6	7	1	5	6	2520
22	Peppers	harvest	Endosulfan	2	2	4	4	6	4	1536
23	Peppers	on farm prod.	Cypermethrin	2	1	6	4	5	6	1440
24	Celery	harvest	Nitrate	4	2	6	2	2	6	1152
25	Lettuce	on farm prod.	Captan	5	1	5	2	4	5	1000
26	Milk	harvest	Dioxin	10	0.01	10	10	10	7	700
27	Chicken	harvest	Dioxin	8	0.01	10	10	10	8	640
28	Beef (ground)	harvest	Dioxin	8	0.01	10	10	10	8	640
29	Pork	harvest	Dioxin	8	0.01	10	10	10	8	640
30	Peppers	harvest	EBDC	2	2	4	1	5	6	480
31	Peppers	on farm prod.	Captan	2	1	4	2	4	5	320
32	Fish	harvest	Dioxin	6	0.01	6	10	10	7	252
33	Beef (ground)	on farm prod.	Cyanide	8	0.01	10	9	8	4	230
34	Beef (ground)	harvest	Cyanide	8	0.01	10	9	8	4	230
35	Potatoes	harvest	Cadmium	10	0.01	10	5	6	7	210
36	Carrots	harvest	Lead	6	0.01	7	6	8	7	141
37	Chicken	harvest	Arsenic	8	0.01	5	6	8	4	76.8
38	Lettuce	harvest	Cypermethrin	5	0.01	8	5	5	6	60.0
39	Lettuce	harvest	Cadmium	5	0.01	7	4	6	7	58.8
40	Lettuce	harvest	EBDC	5	0.01	6	2	5	6	18.0
41	Lettuce	harvest	Endosulfan	5	0.01	3	4	6	4	14.4
42	Peppers	harvest	Cypermethrin	2	0.01	4	3	5	6	7.2
43	Lettuce	harvest	Captan	5	0.01	3	2	4	5	6.0
44	Apples	harvest	Captan	9	0.01	2	2	4	4	5.8
45	Apples	harvest	EBDC	9	0.01	3	1	5	4	5.4
46	Peppers	harvest	Captan	2	0.01	3	2	4	5	2.4

Just One Tool of Many

- Just one tool to help decision makers
- Help relative ranking across commodities, foods, hazards and food-chain location
- Systematically capture, organize, summarize information across all programs
- Demonstrate needs, logic, and priorities
  (operations & research)

For more information...

- To obtain a detailed description of the FSUDB system please contact:

Bruce.McNab@omaf.gov.on.ca