Food Safety in the 21st Century:

Challenges and solutions to improve the safety of the food we eat

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The burden of foodborne diseases is substantial

Every year foodborne diseases cause:

- almost in 10 people to fall ill
- 33 million healthy life years lost

Foodborne diseases can be deadly, especially in children <5

- 420,000 deaths
- Children account for 1/3 of deaths from foodborne diseases

Foodborne Illness in North America

**Canadian Statistics:**
- 4 million human cases,
- 11,600 hospitalizations,
- 238 deaths.

(Government of Canada, 2016)
([Link](https://www.canada.ca/en/public-health/services/food-borne-illness-canada/yearly-food-borne-illness-estimates-canada.html))

1 in 8 people get sick annually from a foodborne illness

**American Statistics:**
- 48 million illnesses,
- 128,000 hospitalizations,
- 3,000 deaths.

(Centers for Disease Control and Prevention 2016)
([Link](https://www.cdc.gov/foodborneburden/index.html))

1 in 6 people get sick annually from a foodborne illness
Major causes of foodborne illnesses

- E. coli
- Listeria
- Salmonella

Recent Foodborne Outbreaks

836 REPORTED CASES

Public Health Notice: Outbreak of E. coli infections linked to Fresh Express brand Sunflower Crisp Chopped Salad Kits

January 16, 2020 - Final update

This notice has been updated to advise that the outbreak appears to be over and the outbreak investigation has been closed.

Public Health Notice - Outbreak of norovirus and gastrointestinal illnesses linked to raw oysters

May 17, 2018 - Update

This notice has been updated to advise that the outbreak appears to be over. The outbreak investigation remains active to allow patients to continue submitting and exchanging information about the possible source of the outbreak. Information on the latest and initial reported food items.

Public Health Notice - Outbreak of Salmonella infections linked to raw chicken, including frozen raw breaded chicken products

May 23, 2019 - Update

This notice has been updated to reflect a new outbreak of Salmonella infections linked to frozen raw breaded chicken products, and a new food item existing that is related to illnesses reported in this active outbreak investigation.
Foodborne illness is more than just 2 or 3 days of discomfort. It can also mean years of suffering and the difference between life or death.
Food Safety and Climate Change

• Foodborne disease is a major concern in Canada and represents a significant climate change-related threat to public health
• Climate variables, including temperature and precipitation patterns, extreme weather events and ocean warming and acidification, are known to exert significant effects along the entire length of the food chain
Food Safety and Climate Change

• Foodborne diseases are caused by a range of bacteria, fungi, parasites and viruses, and the prevalence of these diseases is modified by climate change through:
  – Alterations in the abundance, growth, range and survival of many pathogens
  – Alterations in human behaviours
  – Alterations in transmission factors such as wildlife vectors
  – As climate change continues and/or intensifies, it will increase the risk of an adverse effect on food safety in Canada
Food Safety and Climate Change

• There are three main ways that climate change can increase foodborne illnesses
  – Extreme weather events
  – Rising ocean temperatures
  – Rising air temperatures
Food Safety and Climate Change

- Extreme rainfall events such as hurricanes can impact food safety
  - Animal manure containing *E. coli*, *Salmonella*, *Listeria* and other pathogenic bacteria can wash onto crops
  - Extreme rainfall events can lead to power outages, which impact food safety because there is a lack of potable water and refrigeration

Source: Rodrigo Gutierrez/Reuters
Food Safety and Climate Change

- Temperature increases in the ocean have been linked to hundreds of foodborne illnesses in British Columbia.
- As the ocean warms, it's easier for *Vibrio* bacteria to grow and accumulate in shellfish.
- That's led to an increase in foodborne illness due to consumption of raw or undercooked shellfish.
Large outbreak
- 73 cases in BC Jun 15-Sep 9
  - 60 associated with raw BC oysters
  - 13 associated with ocean water contact
- 24 cases in rest of Canada

n=82 confirmed

Source: BCCDC Communicable Disease, Prevention and Control Services
Food Safety and Climate Change

Sea Surface Temperature
Halibut Bank ODAS Buoy C46146
Central Strait of Georgia

Blue areas represent temperatures that are below normal;
Red areas represent temperatures that are above normal.
Normal means an average (blue line) of all observations over 22 years,
the dashed blue lines show one standard deviation from the average.
The black dots show the maximum and minimum temperature observed
for each day of the year over 22 years.

Map courtesy of Peter Chandler, Institute of Ocean Sciences
Food Safety and Climate Change

• Bacteria grow better at higher temperatures, which is why we refrigerate our food
• One study showed that for every 1 degree rise in air temperature, 6% more people became sick with *E. coli*
• Warming weather will lead to an increase in houseflies
• They fly onto manure or feces, and then onto food
Current approach to food safety is **reactive**: to react to events or situations rather than acting first to change or prevent something
- Foodborne outbreaks of disease
- Recalls of contaminated food

Future approaches need to be **proactive**: taking action by causing change and not only reacting to change when it happens
- Anticipating foodborne outbreaks before they happen
- Identifying contaminated food before it goes to retail
Defining the food safety problem

Pyramid of Foodborne Surveillance

- Exposures in the general population
- Person becomes ill
- Person seeks care
- Specimen obtained
- Lab tests for organism
- Laboratory confirmed case
- Reported to Health Dept.

Surveillance

Laboratory Survey

Physician Survey

Three to Five weeks

Proactive Interventions

1 in 20 E. coli
1 in 26 Salmonella
1 in 27 Campylobacter
Precision Food Safety

• The use of data-intensive tools to develop tailored responses to food safety problems

• Examples:
  – The use of social media data mining to identify foodborne outbreaks earlier than the current Pyramid of Surveillance approach
  – Sewage analysis to identify foodborne pathogens before human symptoms occur
Internet Biosurveillance

- Internet biosurveillance emerged in the mid-1990s
- It is a globally recognized technique for providing early warning of, and situational awareness for, public health threats
- Research studies show that social media may be valuable tools in the disease surveillance toolkit
- Can be used to improve the ability of public health professionals to detect disease outbreaks faster than traditional methods
Got food poisoning?

**STEP 1**

I got sick from...

Where did you get the food? e.g. Moe's Tavern

What are your symptoms?

- [ ] Diarrhea
- [ ] Fever
- [ ] Nausea
- [ ] Vomiting

**STEP 2**

Rate the Business ★★★★★

- [ ] Make my report private

Description

Tell your story: Please include when you ate, what you ate, and when the symptoms started. The more details, the better.

**FINISH REPORT**

Send My Report To:

- [ ] Public Health
- [ ] The Business
- [ ] Detect Outbreaks

Get Alerts

- [ ] Get notified if we receive other reports for your case

[REPORT IT NOW]
Five Guys, Ralston Rd, Arvada, CO, USA

Report Type: Food Poisoning
Symptoms: Vomiting  Diarrhea  Nausea

Apr 3 2019 at 8:46 AM

“Burger fries milkshake, 2 hours after stomach cramps. Then vomited about 3 times a few hours later. And diarrhea all through the night. Stomach cramping all through the night. Unable to sleep”

— Reported By Iwaspoisoned.com User

Leo's Coney Island, Highland Road, Waterford Township, MI, USA

Report Type: Food Poisoning
Symptoms: Diarrhea  Nausea

Apr 3 2019 at 8:24 AM

“I ordered a chicken finger salad with romaine lettuce and 20 minutes into eating it had severe stomach cramps which turned into diarrhea. A coworker also had the same thing and about 2 hours later suffered from the same symptoms.”

— Reported By Iwaspoisoned.com User

Leo's Coney Island, Highland Road, Waterford Township, MI, USA

Report Type: Food Poisoning
Symptoms: Diarrhea

Apr 3 2019 at 8:23 AM

“I had a fried chicken salad with ranch dressing on 4/2/19 and severe cramping and diarrhea started 3 hours later.”

— Reported By Iwaspoisoned.com User
FoodBorne Chicago

• On March 23, 2013, the Chicago Department of Public Health (CDPH) and its civic partners launched FoodBorne Chicago
• It is a website (https://www.foodbornechicago.org) aimed at improving food safety in Chicago by identifying and responding to complaints on Twitter about possible foodborne illnesses
FoodBorne Chicago

- FoodBorne Chicago tracked Twitter messages using artificial intelligence
- The algorithm identified tweets originating from Chicago that included “food poisoning” to identify specific instances of persons with complaints of foodborne illness
- Identified Tweets were reviewed by project staff members for indications of foodborne illness (e.g., stomach cramps, diarrhea, or vomiting) from food prepared outside the home
- Project staff members provided feedback on whether each tweet fit the criteria, enabling the tweet identification algorithm to learn and become more effective over time
FoodBorne Chicago

- In 10 months, project staff members responded to 270 Twitter messages (tweets) and provided links to the FoodBorne Chicago complaint form.
- A total of 193 complaints of possible foodborne illness were submitted through FoodBorne Chicago, and 133 restaurants in the city were inspected.
- Inspection reports indicated 21 (15.8%) restaurants failed inspection, and 33 (24.8%) passed with conditions indicating critical or serious violations.
If you think you have food poisoning in Chicago, please complete this form. The info will be sent to the Chicago Department of Public Health so they can take any necessary action.

Here's more information about what happens next:

1. We will use the City's Open311 system to directly submit your information. [Here's more info on the 311 process.]

2. You will then get an e-mail from CityServices@cityofchicago.org letting you know that the information was received as well as a link to the City's 311 Service Tracker tool.

3. There will also be a link in this email [example] that goes directly to the City's Service Tracker website. This is your key to finding out what comes of the service request. If you don't get the email, check your Spam folder. Otherwise, contact 311 with questions.

If we were to reply on Twitter? Here's why.

We use computers & code to search Twitter for tweets related to food poisoning in Chicago. We do as much as we can to automatically zero-in on the tweets we think are about a possible food poisoning case and really coming from Chicago. Then real humans review the tweets and reply back to people with a link back to this page. [More details here.]

Questions? We've got answers.

What happened?

Please be as descriptive as possible, letting us know what food items you consumed, what time of day, what was your first symptom, and for how long you were sick.

* What restaurant was it?

* What was its address?

* What happened?

* When did it happen?

How can the Chicago Department of Public Health reach you?

We use the City's Open311 system to directly submit your information to make a request about your food poisoning incident. The Chicago Department of Public Health requires some info for a possible follow-up.

* First name

* Last name

* Email

Phone

Questions about privacy? [Read our policy.]

[Submit your report]
Canadian Network for Public Health Intelligence (CNPHI)

- The CNPHI is a web-based biosurveillance platform for public health information resources for use by local, regional and national decision makers.
- CNPHI developed the “on the go” app to generate geoaware biosurveillance related to human, animal, and environmental public health issues of concern.
• We are collaborating with Advanced Symbolics Inc. to develop a social media approach to detect foodborne outbreaks earlier than the current approach.
2018 Norovirus Outbreak

- The Public Health Agency of Canada and provincial partners investigated a norovirus outbreak in three provinces linked to raw oysters from British Columbia.
- A total of 176 cases of gastrointestinal illness linked to oyster consumption were reported in three provinces: British Columbia (137), Alberta (14), and Ontario (25).
- Individuals became sick between mid-March and mid-April 2018.
- Most individuals who became sick reported eating raw oysters from the south and central parts of Baynes Sound, British Columbia before the onset of their illness.
2018 national norovirus outbreak

• In mid-March an estimated 341 people were describing norovirus symptoms on Twitter
• potentially 873 affected individuals — nearly seven times the cases reported through hospitals

Social media chatter
March 16

First PHAC notification
April 16
Improving food safety through sewage

http://underworlds.mit.edu/

UNIVERSITY OF GUELPH
ONTARIO AGRICULTURAL COLLEGE
DEPARTMENT OF FOOD SCIENCE
Summary

• Each year in Canada, foodborne illnesses cause 4 million illnesses, 11,600 hospitalizations, and 238 deaths
• Climate change is expected to increase foodborne outbreaks and illnesses due to increased rainfall (flooding), and increased air and ocean temperatures, leading to more contamination of food plants, increased numbers of pests, and bacterial growth
• Newer approaches are needed to more rapidly identify foodborne contamination and outbreaks
• Social media and sewage analysis are two approaches that could allow us to identify outbreaks faster, and make our food supply safer
Questions?

It’s definitely food poisoning. But what did you expect? After all, they were green. In the future, I would not eat them here nor there... I wouldn’t eat them anywhere.

When potato salad goes bad

Mathematician Food Fights