

Lessons Learned from Gallatin County's Morel Mushroom Outbreak

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DEPARTMENT OF
**PUBLIC HEALTH &
HUMAN SERVICES**



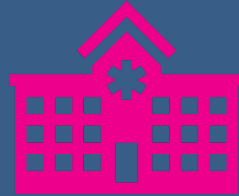
**Gallatin City-County Health
Department (GCCHD)**

A map of Montana showing its 56 counties, each with a unique color and name. Major cities are marked with red dots. The Yellowstone National Park is indicated by a green arrow pointing to the border between Yellowstone and Teton counties.

County	Major City
Lincoln	Libby
Flathead	Kalispell
Glacier	Cut Bank
Toole	Shelby
Liberty	Chester
Hill	Havre
Blaine	Chinook
Phillips	Malta
Valley	Glasgow
Daniels	Scobey
Sheridan	Plentywood
Roosevelt	Wolf Point
Richland	Sidney
McCona	Circle
Dawson	Glendive
Prairie	Terry
Wibaux	Wibaux
Fallon	Baker
Carter	Ekalaka
Powder River	Broadus
Big Horn	Hardin
Carbon	Red Lodge
Stillwater	Columbus
Sweet Grass	Big Timber
Park	Livingston
Gallatin	Bozeman
Madison	Virginia City
Beaverhead	Dillon
Silver Bow	Butte
Jefferson	Boulder
Deer Lodge	Anaconda
Granite	Philipsburg
Ravalli	Hamilton
Missoula	Missoula
Lake	Polson
Sanders	Thompson Falls
Mineral	Superior
Powell	Deer Lodge
Lewis and Clark	Helena
Cascade	Great Falls
Teton	Choteau
Pondera	Conrad
Chouteau	Fort Benton
Judith Basin	Stanford
Fergus	Lewistown
Petroleum	Winnett
Garfield	Jordan
Rosebud	Forsyth
Musselshell	Roundup
Golden Valley	Ryegate
Wheatland	Harlowton
Meagher	White Sulphur Springs
Broadwater	Townsend
Hysham	Treasure
Yellowstone	Billings
Custer	Miles City

- Decentralized public health system
- 59 county or tribal health departments
- This outbreak was jointly investigated by the GCCHD and MTDPHHS

SETTING THE SCENE



Two individual cases were reported to public health on 4/18: both experienced severe vomiting and diarrhea after eating at a sushi restaurant in Bozeman, Montana the day before

RESTAURANT INVESTIGATION



- Cases consumed the 'special roll' – morels and raw salmon
- Restaurant was inspected
- Salmon and morel specimens were collected for testing
 - Only morel shakes were available for collection
- Restaurant temporarily closed due to potential ongoing risk to the public

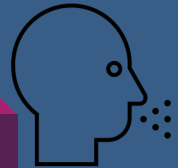
EARLY HYPOTHESES



Onset of symptoms was rapid



Symptoms ranged from short term and mild to severe illness requiring hospitalization and resulting in death



Mostly gastrointestinal symptoms

raw fish c. perfringens
false morels histamine poisoning
morels poison control staph aureus
b. cereus
paralytic shellfish poisoning

Summary of Cases

- The initial investigation identified a total of 51 cases, 3 hospitalizations, and 2 deaths associated with the outbreak
- Onset of symptoms was rapid: median onset of 1 hour after the restaurant meal, range from 15 minutes to 20 hours
- Diarrhea, nausea, and abdominal pain were the most commonly reported symptoms



Morel Mushrooms



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Morel Mushrooms: what do we know?

- Morels: type of edible mushroom commonly foraged from the wild; sometimes cultivated
- Morchella genus of mushrooms
- Morels can sometimes be confused with similar-looking species of mushrooms that can cause illness or death in humans (including 'false morels' – Gyromitra species)



Morel Mushrooms: what do we (not) know?

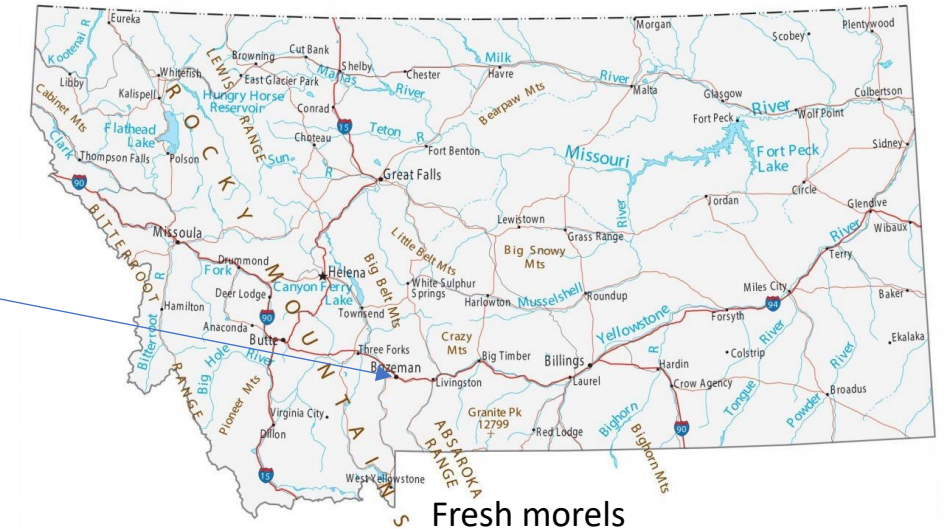
- Limited information available from scientific or medical literature
 - News articles and journal articles mentioning gastrointestinal illness and sometimes death after eating morels
- The toxins in morels that may cause illness are not fully understood, but cooking them properly is thought to reduce toxin levels

episode that took place in Vancouver, British Columbia on June 8, 1991, stands out; 77 adults fell ill at a banquet where they were served raw morels (and other mushrooms) in a salad (Lindgren, 1997). All presented with mild digestive disorders, nausea, and vomiting.

morels — but they have happened infrequently abroad. In 2019, a morel food poisoning outbreak at a Michelin-star-rated restaurant in Spain sickened about 30 customers. One woman who ate the morels died, but her death was determined to be from natural causes. Raw morels were served on a pasta

Carlos de Bariloche (Río Negro province, Argentina). It was about a family that purchased and consumed dried morels native to the area, then prepared them in tomato sauce. The family consisted of a 47-year-old man, along with his wife and daughter. The man, who was the one who ingested the greatest amount of mushrooms (about 10 specimens approximately), suffered from vomiting and diarrhea 30 minutes after ingestion. A few hours later, he presented with muscle weakness in the lower and upper limbs, loss of consciousness, seizures, and cardiorespiratory arrest. He was admitted to a nearby hospital and died within 36 hours. The wife suffered only vomiting and diarrhea;

Morel Mushroom Traceback Information



FDA Traceback

- ▶ Other states also received morel mushrooms from the same importer in the same timeframe as the Montana restaurant
- ▶ An FDA investigation, in collaboration with a state health department where 12 facilities received the morels, sought to determine whether other restaurants had similar illnesses related to consumption of the morels
- ▶ Six facilities responded, and reported receiving no illness complaints from patrons who ate morels prepared and served by them. All facilities reported cooking, sauteing, or otherwise thoroughly heating the morel mushrooms prior to consumption.

Case Control Study



Case-Control Study

- Interviewed cases (people who ate at the restaurant and got sick) and controls (dining partners of cases; ate at the restaurant and did not get sick)
 - 41 cases and 22 controls were interviewed
- Case = someone who experienced diarrhea, nausea, vomiting, or abdominal pain after eating at the restaurant between March 27 and April 18
- Asked about consumption, amount, and modifications for every menu and off-menu item

Case-Control Study Key Findings

- The odds of eating morel mushrooms (in either the special roll or a chef's choice roll) among cases were **10.77** times higher than the odds of eating morel mushrooms among controls
- Other case control analyses were also suggestive of a dose-response relationship
 - The more pieces of the sushi roll with morels someone ate, the higher the odds of them getting sick

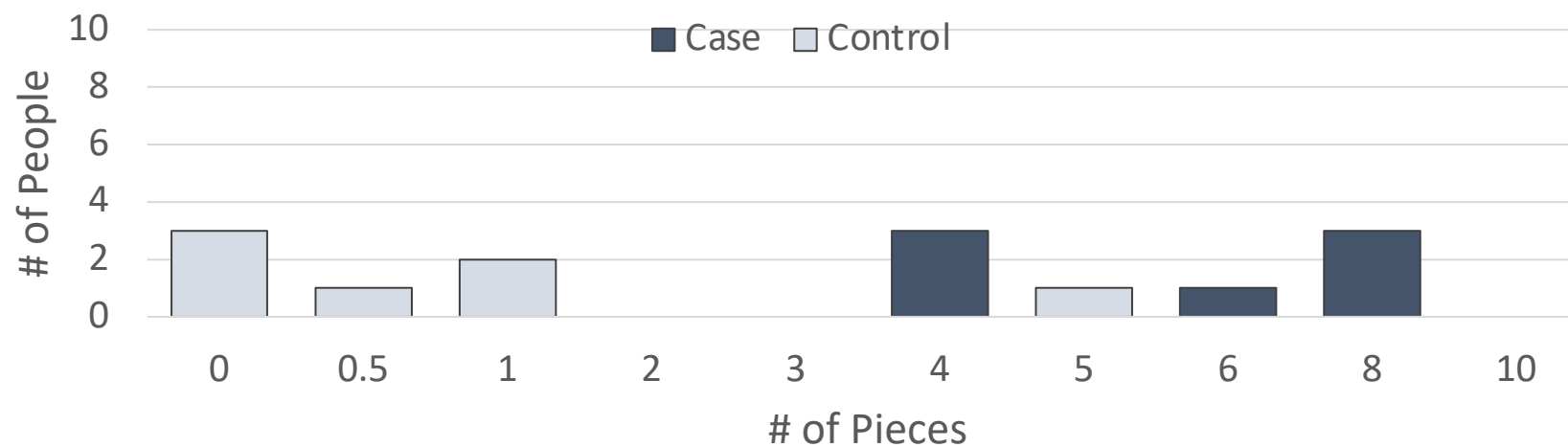
Impact of Cooking on Illness

- **April 8:** a sauce was boiled and poured over raw morels, which marinated for 75 minutes, before adding to the special roll
- **April 17:** the morels were served completely raw as part of the special roll

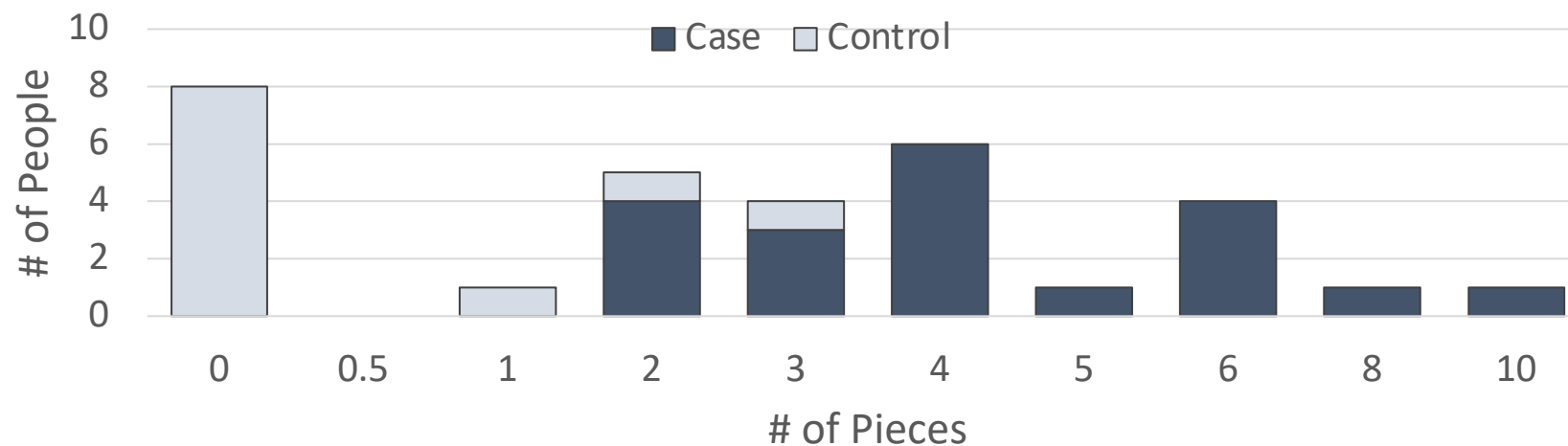
Consumption of the special roll with morel mushrooms was more strongly associated with gastrointestinal illness on the day when the morels were served completely raw, compared to the day they were partially cooked



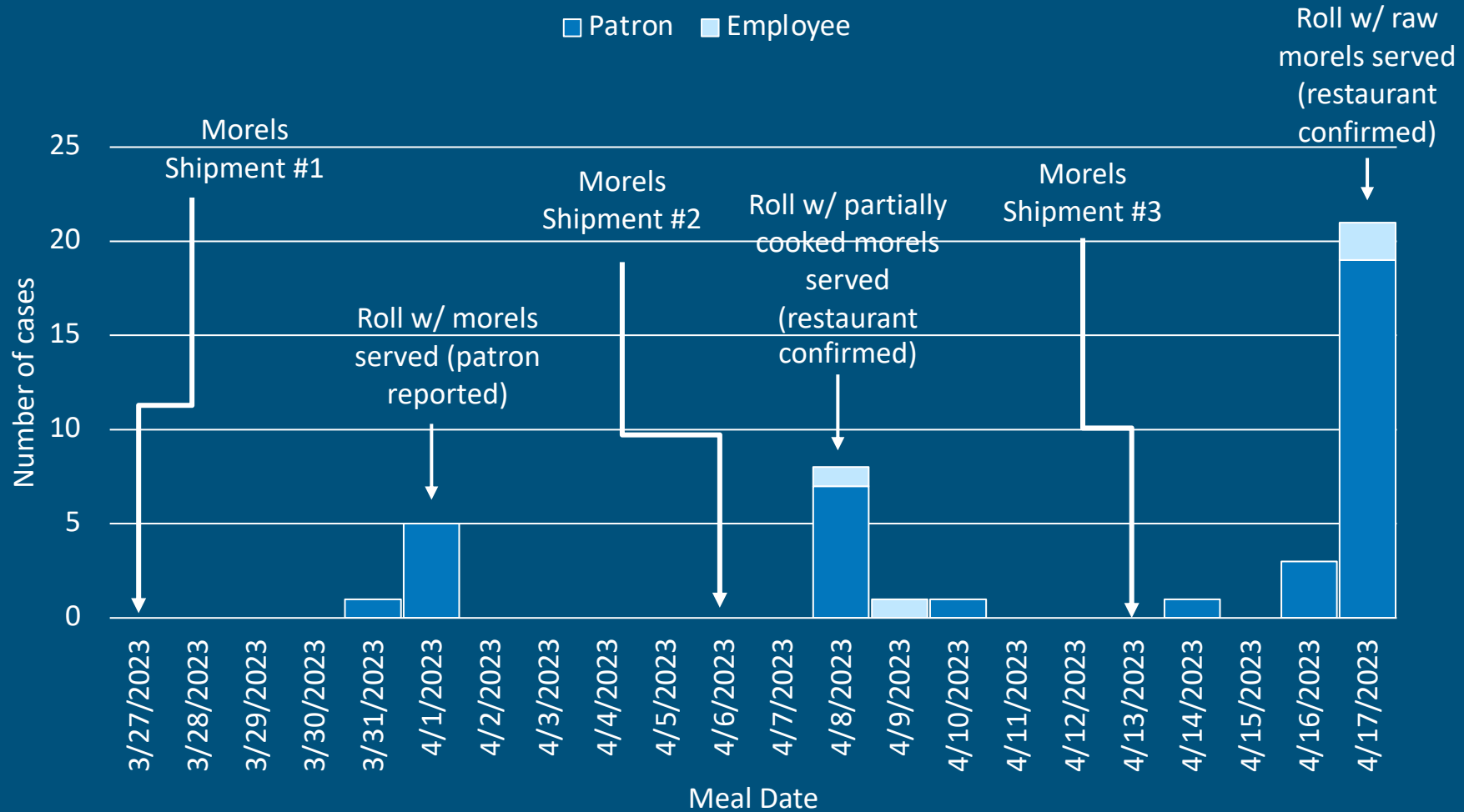
Number of Pieces of Special Roll Consumed on April 8, 2023 by Case Status



Number of Pieces of Special Roll Consumed on April 17, 2023 by Case Status



Meal Date for Suspected Cases of Morel-Related Gastrointestinal Illness



Public Messaging

Public Messaging: state and local partners

April 26	May 3	May 19	July 19
<p>An Epi-X call for cases was sent out, but no additional states reported any related illnesses</p>	<p>Joint press release between DPHHS and GCCHD goes out, describing the outbreak and the mitigated risk to the public</p>	<p>FDA releases information on the investigation of illnesses linked to morel mushrooms, as well as general guidance on morels and other wild-type mushrooms</p>	<p>DPHHS and GCCHD release a press release closing the outbreak and sharing guidance on proper preparation for morel mushrooms. FDA releases an outbreak update the same day.</p>

Media Coverage

- The outbreak gained much attention in the local news and on social media (reddit page, facebook comments, etc.)
- May have contributed to high level of engagement in case control interviews

Food Safety News

Raw morel mushrooms found to be most likely cause behind deadly outbreak

Bozeman Daily Chronicle

 food poisoning outbreak sickens 30; morel mushrooms possible culprit



Outbreak Testing

Clinical Testing

- Clinical testing
 - No causative agent was identified through clinical testing, which included urine amatoxin testing, random total urine arsenic level, gastrointestinal panel and culture on stool specimen, and standard clinical labs used for medical management

Food Testing

- Food testing
 - Salmon and morel specimens were tested and negative for various toxins, heavy metals, pesticides, volatile and nonvolatile organic substances, and pathogens (including *C. perfringens*, *B. cereus*, and *Staph enterotoxin*)
 - DNA sequencing exclusively identified the mushroom specimen as *Morchella sexteleta*, a species of true morel

Engagement with Federal Partners

CDC Involvement

- ▶ CDC provided technical assistance to Montana health departments during this outbreak, including medical toxicology expertise and epidemiological assistance
- ▶ Met multiple times a week (via Teams calls) with the CDC toxicology and epidemiology team to discuss new developments in the outbreak, plans for clinical testing, and for general guidance on morel mushroom toxicity
- ▶ The CDC epidemiology team performed the analysis for the case control study



FDA Involvement and Advisory

- ▶ Met with the FDA CORE team on a weekly/biweekly basis to discuss updates to the investigation, traceback information for the morels, food testing updates, and communications plan
- ▶ FDA advisories were posted on May 19 and July 19, describing the outbreak and warning of the risks of consuming morel mushrooms
 - ▶ Shared guidance that cooking can help reduce toxicity of the morels

Investigation of Illnesses: Morel Mushrooms (May 2023)

FDA assisted Montana state partners with an investigation of multiple illnesses at a single restaurant. FDA's investigation is complete.

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Product

Morel mushrooms are a type of edible mushroom that are commonly foraged from the wild and are sometimes cultivated for commercial sale. Morel mushrooms are generally considered safe to eat, but they may contain some toxins that can cause health problems. The toxins in morel mushrooms that may cause illness are not fully understood; however, using proper preparation procedures, such as cooking can help to reduce toxin levels.



The US Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) assisted [Gallatin City-County Health Department \(GCCHD\)](#) and the [Montana Department of Public Health and Human Services \(DPHHS\)](#) with an investigation of illnesses at a single restaurant in Montana. Available epidemiological evidence indicated that imported cultivated morel mushrooms, consumed at a single Montana restaurant, were the likely source of illnesses.

Summary of Investigation



Cooking morels seems to reduce the toxin levels and make them safer for human consumption



Illness from consuming morels likely occurs more often than public health is aware of



Need further research to better understand how morel mushrooms affect human health, in order to prevent outbreaks, hospitalizations, and deaths

A Year of Morels in Review

- Nine presentations about this outbreak in four different states, with audience members from across the country
 - Epidemiologists, sanitarians, food safety experts, and public health professionals
- [MMWR](#) released in March 2024 summarizing this outbreak
- DPHHS social media posts and new webpage
- DPHHS press release planned for mid-April release
- Morel mushroom guidance infographic



Acknowledgements – thank you!

- Lauren Parri, Gallatin City-County Health Department
- Dr. Maggie Cook-Shimanek, Montana Department of Public Health and Human Services
- DPHHS and GCCHD Environmental Health Teams
- DPHHS Laboratory Team
- CDC and FDA partners



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Questions?