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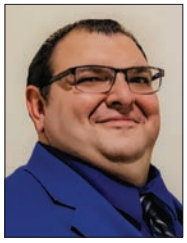
Beth Wittry, MPH, REHS, CP-FS
Centers for Disease Control and Prevention



David Nicholas, MPH
New York State Department of Health

Modernizing the Foodborne Outbreak Contributing Factors: The Key to Prevention

Editor's Note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, the National Environmental Health Association (NEHA) features this column on environmental health services from the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, authors from CDC's Water, Food, and Environmental Health Services Branch, as well as guest authors, will share insights and information about environmental health programs, trends, issues, and resources. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

David Nicholas is a chief epidemiologist with the New York State Department of Health. Beth Wittry is an environmental health officer with the Water, Food, and Environmental Health Services Branch within CDC.

Foodborne outbreak investigations can be complex, involving investigators from epidemiology, environmental health, and laboratory disciplines. Typically, one role of environmental health investigators is identifying the conditions that enabled or amplified the outbreak (i.e., the factors that contributed to the outbreak). These contributing factors fall into three categories: contamination, proliferation, and survival (Figure 1). For example, if a restaurant worker with norovirus contaminates food with norovirus while preparing it and causes an outbreak, this contamination by the worker is a contributing factor to the outbreak.

Contributing Factor Data Critical to Understanding and Preventing Foodborne Illness Outbreaks

High quality data on outbreak contributing factors help identify food safety failures in the outbreak environment. These data can be used to develop and implement immediate interventions to prevent further illness. When aggregated across all outbreaks in the U.S., these data can help inform new policies to prevent more outbreaks. For example, in 2014, the Centers for Disease Control and Prevention (CDC) analyzed data from investigations of foodborne norovirus outbreaks. These data showed that infected food workers and bare-hand contact with ready-to-eat foods were primary contributing factors to norovirus outbreaks. CDC then developed and released specific recommendations for state and local governments and the restaurant industry on preventing these contributing factors and the outbreaks they cause (CDC, 2014; Hall, Wikswo, Pringle, Gould, & Parashar, 2014).

Contributing Factors List Based on Review of Outbreak Data

Since 1966, CDC has produced summaries of data obtained from foodborne outbreak investigations conducted by state health departments and reported to CDC (www.cdc.gov/fdoss/annual-reports). These summaries for outbreaks occurring from 1972–1997 included data on five contributing factor categories: improper storage or holding temperatures, inadequate cooking, contaminated equipment or working surfaces, food from unsafe sources, and poor personal hygiene. In 1998, CDC started including data on an expanded list of contributing factors in its outbreak summaries to include 15 contamination factors, 12 proliferation factors, and 5 survival factors. This expanded list was developed by federal and state food safety experts after analyses of data from hundreds of outbreak investigations (Bryan, 1978, 1988; Lynch, Painter, Woodruff, & Braden, 2006; Weingold, Guzewich, & Fudala, 1994). CDC reported on these contributing factors through 2008. Food safety experts again revised the list at that time,

FIGURE **1**

Portion of the Centers for Disease Control and Prevention's Contributing Factors Infographic

WHAT ARE CONTRIBUTING FACTORS?

Contributing factors are behaviors, practices, and environmental conditions that lead to outbreaks. Knowing the contributing factors can help us stop outbreaks and prevent future ones.

THERE ARE 3 TYPES OF CONTRIBUTING FACTORS	FOOD PREPARATION PRACTICES THAT CONTRIBUTE TO...	FOR EXAMPLE...
Contamination	Pathogens and other hazards getting into food	A sick food worker handles food with their bare hands
Proliferation	Pathogens in food growing faster	Food is held in a refrigerator that is too warm
Survival	Pathogens surviving a process to kill or reduce them	Food is not cooked long enough or to a hot enough temperature

The full infographic is available at www.cdc.gov/nceh/ehs/publications/cf-infographic.html.

albeit minimally, and that list has been in place since 2009.

Recent Revisions to Contributing Factors List Provide Better Data From Outbreak Investigations

In 2018, CDC and New York State Department of Health spearheaded a workgroup to revise and improve the contributing factor list. This workgroup was expanded in 2019, prompted by emerging trends in food preparation and by feedback from investigators on needed changes and inconsistencies across states in interpretation and reporting of contributing factors.

The workgroup was comprised of federal and state food safety experts in both epidemiology and environmental health from CDC, Minnesota, New Hampshire, New York, Tennessee, and Wisconsin. Representatives came from CDC's Foodborne Disease Outbreak Surveillance System (FDOSS) and National Environmental Assessment Reporting System (NEARS) that collect epidemiological data and environmental health data on foodborne outbreaks, respectively.

The workgroup collaborated through a data-driven and science-based process to identify and develop needed revisions (Table 1) that can be categorized into four themes:

1. **Consideration of food supply chain:** Since most outbreaks occur in restaurants, many of the contributing factor definitions were specific to restaurant-related outbreaks and referenced retail federal food safety provisions. Contributing factors, however, can apply throughout the food chain—farms, manufacturers, processors, distributors, and point of preparation, including the home and point of sale. The emerging technique of whole genome sequencing, used to identify foodborne pathogens in specimens from people and in samples from food and the environment, provides the power to identify and confirm the point of contamination in foodborne outbreaks more precisely than ever before. Thus, the contributing factors were revised to allow investigators to specifically indicate the point of contamination, proliferation, and survival, and retail references were removed.
2. **Review of emerging trends:** The workgroup consulted with food scientists and reviewed trends in food processes and in foods and processes associated with outbreaks. These reviews led the workgroup to add, remove, and revise contributing factors to be more comprehensive. For example, because of the rise in the sale of unpasteurized products and in outbreaks caused by them, the workgroup added a survival contributing factor (i.e., no attempt made to inactivate the contaminant).
3. **Review of data:** Through review of contributing factor data, the workgroup identified situations in which a reported contributing factor was scientifically or practically inapplicable to the outbreak. Thus, the workgroup revised multiple contributing factor definitions to improve their clarity and reduce confusion. The data review also identified several overlapping contributing factors. For example, there were two factors focused on proliferation caused by food being held at improper temperatures for a prolonged time period. Thus, the workgroup dropped these two factors and cre-

Quick Links

- Foodborne Disease Outbreak Surveillance System (FDOSS): www.cdc.gov/fdoss/index.html
- National Environmental Assessment Reporting System (NEARS): www.cdc.gov/nceh/ehs/nears/index.htm
- Environmental Assessment Training Series (EATS): www.cdc.gov/nceh/ehs/elearn/eats/index.html

ated a new one that encompassed the two scenarios (i.e., allowing foods to remain out of temperature control for a prolonged period during food service or display).

4. **Feedback from investigators:** The workgroup solicited feedback from outbreak investigators who reported that contributing factor definitions were unclear, challenging to classify, and inconsistent. They also expressed the need for additional guidance. Thus, the workgroup revised the contributing factor definitions and guidance, as well as added clarifying examples for each factor.

Revised Contributing Factors List Implementation in 2021

CDC will ask state and local investigators to begin using the new definitions and guidance in 2021 (National Outbreak Reporting System/NEARS Guidance for Contributing Factors in Foodborne Outbreak Reports). CDC's Environmental Assessment Training Series shows users how to identify outbreak contributing factors and provides practice in an interactive, virtual outbreak environment. In response to requests from investigators, CDC will also provide additional training on contributing factor identification. NEARS is another tool that can help environmental health investigators identify contributing factors.

The described revisions have improved and modernized the contributing factors, enabling investigators to identify contributing factors more easily during investigations. This progress will ultimately lead to higher quality foodborne outbreak and contributing factor data, prevention of future outbreaks, and improved food safety.

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- Rachel Klos, Wisconsin Department of Health Services; and
- Zachary McCormick, New Hampshire Department of Health and Human Services.

TABLE **1**

Updated List of Contributing Factors That Will Be Implemented in January 2021

#	Description
Contamination Factors	
C1	Toxin or chemical agent naturally part of tissue in food
C2	Poisonous substance or infectious agent intentionally added to food to cause illness (does not include injury)
C3	Poisonous substance accidentally/inadvertently added to food
C4	Ingredients toxic in large amounts accidentally added to food
C5	Container or equipment used to hold or convey food was made with toxic substances
C6	(New) Food contaminated by animal or environmental source at point of final preparation/sale
C7	(New) Food contaminated by animal or environmental source before arriving at point of final preparation (pre- or post-harvest)
C8	Cross-contamination of foods, excluding infectious food workers/handlers
C9	Contamination from infectious food worker/handler through bare-hand contact with food
C10	Contamination from infectious food worker/handler through glove-hand contact with food
C11	Contamination from infectious food worker/handler through unknown type of hand contact with food or indirect contact with food
C12	Contamination from infectious nonfood worker/handler through direct or indirect contact with food
C13	Other source of contamination (specify)
Proliferation Factors (Bacterial and Fungal Outbreaks Only)	
P1	(Revised) Allowing foods to remain out of temperature control for a prolonged period during preparation
P2	(Revised) Allowing foods to remain out of temperature control for a prolonged period during food service or display
P3	Inadequate cold holding temperature due to malfunctioning refrigeration equipment
P4	Inadequate cold holding temperature due to an improper practice
P5	Inadequate hot holding temperature due to malfunctioning equipment
P6	Inadequate hot holding temperature due to an improper practice
P7	Improper cooling of food
P8	Extended refrigeration of food for an unsafe amount of time, relative to the food product and pathogen
P9	Inadequate reduced oxygen packaging (ROP) of food
P10	(Revised) Inadequate nontemperature dependent processes (e.g., acidification, water activity, fermentation) applied to a food to prevent pathogens from multiplying
P11	Other situations that promoted or allowed microbial growth or toxic production (specify)
Survival Factors (Bacterial, Viral, Parasitic, or Fungal Outbreaks Only)	
S1	Inadequate time and temperature control during initial cooking/thermal processing of food
S2	Inadequate time and temperature during reheating of food
S3	Inadequate time and temperature control during freezing of food designed for pathogen destruction
S4	(Revised) Inadequate nontemperature dependent processes (e.g., acidification, water activity, fermentation) applied to a food to prevent pathogens from surviving
S5	(New) No attempt was made to inactivate the contaminant through initial cooking/thermal processing, freezing, or chemical processes
S6	Other process failures that permit pathogen survival (specify)

Note. New and revised factors have been labeled.

Corresponding Author: Beth Wittry, Water, Food, and Environmental Health Services Branch, National Center for Environmental Health, Centers for Disease Control and Prevention, 4700 Buford Highway NE, Atlanta, GA 30341. E-mail: xks5@cdc.gov.

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