

# THE ROLE OF TRAINING STRATEGIES IN FOOD SAFETY PERFORMANCE: KNOWLEDGE, BEHAVIOR, AND MANAGEMENT

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## 1 INTRODUCTION

The food handler is a diamond, unique, and multifaceted that we need to know.

Food safety is a critical component of sustainable development, and problems that occur in one country may put others at risk. To make credible and sustainable legal and policy decisions, the decision-making process must be based on strong evidence. Considering the growing complexity of the food safety field, innovative approaches are required to improve prioritization, accounting for the overall available knowledge, and the need to integrate new scientific developments quickly ([World Health Organization, 2013](#)).

Foodborne diseases (FBD) are important health problems ([Kafertein et al., 1997](#); [Soares et al., 2013](#)). The social and health impacts of FBD have been described and documented on all continents ([World Health Organization, 2013](#)). Every individual is threatened by FBD. This problem significantly contributes to mortality by diarrhea, with approximately 2.2 million deaths per year, mostly in children from developing countries ([World Health Organization, 2008](#)).

The Centers for Disease Control and Prevention (CDC) estimate that 31 of the most important known agents of FBD found in foods consumed in the United States cause 9.4 million illnesses, 55,961 hospitalizations, and 1351 deaths ([Centers for Disease Control and Prevention, 2011](#)) each year. In 2013, the CDC confirmed a total of 19,056 infections, 4200 hospitalizations, and 80 deaths by FBD in the United States ([Crims et al., 2014](#)). Data from FoodNet show that nearly 45% of the imported foods that caused outbreaks in the United States in 2010 came from Asia ([Centers for Disease Control and Prevention, 2012](#)). A total of 5648 foodborne outbreaks, including outbreaks for which there was both weak and strong evidence, were reported in Europe. In 2011 by the 25 reporting European Union member states. This finding represents an increase of 7.1% relative to 2010 ([European Food Safety Authority, 2013](#)).

In Latin America, studies show that the relative frequency of diarrheal diseases that are attributable to foodborne pathogens varies from 26% to 36% (Pan-American Health Organization, 2013). From 1993 to 2010, reports by the regional system of the Pan American Health Organization noted 9180 outbreaks for 22 countries in the region (Pan-American Health Organization, 2013). Among these countries, the Health Surveillance Office of Brazil indicated that there were 3351 FBD outbreaks from 2010 to September 2014 involving 64,936 individuals (Brazil Health Ministry, 2014).

In Africa, an unprecedented number of FBD outbreaks have been reported recently (World Health Organization, 2012). In the continent of Oceania, the OzFoodNet site reported 30,035 notifications of diseases or conditions that are commonly transmitted by food in Australia in 2010, which represents an increase relative to the average of 26,190 notifications per year for the last 5 years (2005–2009) (OzFoodNet, 2012). In New Zealand, there was a decrease in the number of reported outbreaks and associated cases in 2013 (652 outbreaks involving 7137 cases) compared with 2012 (719 outbreaks and 10,500 cases). A total of 113 outbreak-associated cases required hospitalization and there were four deaths (Public Health Surveillance, 2014).

These data show the magnitude of FBD even in countries with a complete monitoring system within their health surveillance programs.

However, there are no quantitative data for all FBD spectra on a global basis, primarily because foodborne illness is normally underreported (World Health Organization, 2013). For example, an estimated 38.4 million episodes of FBD occur annually in the United States, resulting in the death of approximately 1686 (90% confidence interval 369; 3338) individuals per year (Scallan et al., 2011), which is higher than reported by the CDC.

Reliable and science-based estimates of these diseases are necessary to support policy makers in their decisions and to mobilize resources at all levels; namely, local, national, and international (World Health Organization, 2013). Kafertein et al. (1997) concluded that epidemiological data provide a common field for meeting an international consensus on food safety questions.

In Brazil, the costs of hospitalization cases caused by FBD were approximately US\$97 million from 1999 to 2004, with an average of US\$16 million per year (Carmo et al., 2005). Hoffmann et al. (2012) estimated the annual cost of FBD (medical costs, productivity loss, and the valuation of premature mortality) at US\$14.0 billion (ranging from US\$4.4 billion to US\$33.0 billion) in the United States. These costs demonstrate the negative economic impact caused by FBD.

The implementation of prerequisite programs (good manufacturing practices) improved food safety (Cenci-Goga et al., 2005). However, FBD outbreaks still occur (Soares et al., 2013). The *Codex Alimentarius* (2013) conceptualizes the food employee/food handler as “an individual working with unpackaged food, food equipment or utensils, or food-contact surfaces.” In Brazil, the National Health Surveillance Agency (Brazil Health Ministry, 2004) recognizes food handlers as “anyone in the food service that comes into direct or indirect contact with food.”

Among the negative behaviors of food handlers, who are often associated with outbreaks, are inadequate hand hygiene practices, inadequate hygiene of equipment and utensils, maintenance of ready-to-eat food at room temperature, preparation of meals in advance, insufficient cooking temperature, and inadequate thawing (Greig et al., 2007; Chan and Chan, 2008; Food and Drug Administration, 2009). Therefore, it has been suggested that these professionals may be responsible for up to 97% of FBD outbreaks (Egan et al., 2007).

Training food handlers in safe food handling is one of the most critical interventions in the prevention of FBD ([World Health Organization, 2013](#)). Food handlers can help to reduce FBD by either preventing food contamination or by preventing the growth or survival of bacteria ([Clayton et al., 2002](#)). Increasing the food safety standards implies food safety education ([Kafertein et al., 1997](#)).

Recommendations such as the Codex Alimentarius ([Codex Alimentarius, 2013](#)) and food safety laws and standards have been published to guide professionals and owners of foodservices, experts, and primarily food handlers on appropriate procedures to reduce the risk of FBD outbreaks. Individuals engaged in food operations that come directly or indirectly into contact with food should be trained ([Codex Alimentarius, 2013](#)). Resolution no. 216 of the Brazilian National Health Surveillance Agency ([Brazil Health Ministry, 2004](#)) establishes technical regulations for good manufacturing practices in food services. This legislation states that all food handlers should be periodically trained in food handling. The training program must be described and determined according to its hourly load and program content.

[Karaman et al. \(2012\)](#) studied food handler knowledge of dairy products from differently sized companies (small, medium, and large) in Turkey. He found that sites that had mandatory training were more effective in relation to good food-handling practices in comparison with companies that had a voluntary program.

According to ISO 22000:2005, the food security team and other people who perform activities that have an impact on food safety should be competent and have adequate education, training, skills, and experience. It is the responsibility of the organization to identify these necessary skills, provide training, or take actions to ensure that the staff has these competencies. The organization should also ensure that the people responsible for the monitoring, correction, and corrective action of the food safety management system are trained ([International Organization for Standardization, 2005](#)).

The [Codex Alimentarius \(2013\)](#) recommends that all people involved with food must be aware of their role and responsibility in food safety. Food handlers must have the necessary knowledge and skills to handle food hygienically. Organizations should establish a training program. This program should provide periodic evaluations of the effectiveness of the training, instructions that direct handlers, the supervision of work routines, and checks to ensure that the procedures are performed effectively.

Food operation managers and supervisors must have knowledge of food hygiene practices to assess the potential risks of FBD, and they should make decisions to prevent its occurrence. Training programs should be reviewed and updated regularly ([Codex Alimentarius, 2013](#)).

To support a credible system and build confidence with consumers and trading partners, food safety laws and regulations should be relevant and enforceable. In addition, the regulations should clearly define the mandate of the food safety authority and other relevant agencies to prevent and manage food safety issues. To the extent possible, modern food safety laws should not only confer the necessary legal powers, but also should allow them to build preventive approaches into the national food safety system ([World Health Organization, 2013](#)).

Food safety, food control systems, and the food safety education and training of workers must move their focus gradually from end product tests to process control throughout the food chain ([World Health Organization, 2013](#)).

This chapter is intended to discuss different strategies for diagnostics and for the training given to handlers in food chain production.

## 2 FOOD HANDLER BEHAVIOR, FEELINGS, AND PERCEPTIONS

*Food Safety Management Systems* highlights the importance of managing people to achieve their goals (International Organization for Standardization, 2005, 2009). The manager should, among other things, assess the effectiveness of the people management processes and training activities in relation to food safety and associated risks.

At present, ISO 31000:2009 (International Organization for Standardization, 2009) defines risk as the “effect of uncertainty on objectives, often expressed in terms of a combination of consequences of an event and the probability of expected occurrence.” It is universally understood that the notion of risk involves some type of loss or damage. Yoe (2012) defines risk in a simplified manner by using the following equation:

$$\text{Risk} = \text{probability} \times \text{consequence} \quad (1)$$

The uncertainty addressed in the definition of ISO 31000:2009 is the possibility of an error, which may be caused by an erroneous measurement or calculation, a lack of available scientific data for decision making, and a measure of variability (Pan-American Health Organization, 2008).

The risk may be faced through three fundamental approaches: that is, as a risk analysis as defined in *Food Safety Management Systems*, which involves reason, science, and logic to address hazards; the second is risk as a feeling, which addresses our quick, intuitive, and instinctive responses to danger; and the third is of risk as a policy, which is based on the meeting perceptions/feelings with risk analysis (Slovic et al., 2004).

In addition to the evaluation of microbiological risks in food (Sant’ana and Franco, 2009), scientific research has been applied to a detailed study of risk as feeling. When risk is a feeling, the individual tends to consider his or her decision intuitively based on the risk that a decision or action leads to or aggravates a negative event, which is also called perceived risk (Slovic, 1987). By using heuristics as its basis, the risk perceptions (or perceptions of benefit) define human behaviors and lifestyles (Frewer et al., 1994). Risk judgments involve what people think and how they feel about this risk.

If the feelings are favorable, the risk is judged to be low; otherwise, there is a tendency to make the opposite judgment (Slovic et al., 2004; Dijk et al., 2011). Several factors, such as knowledge, experience, attitudes, and emotions, can influence thinking and individual judgment regarding the seriousness and acceptability of risk (Sjoberg, 2000; Wachinger et al., 2013).

When the perceived risk is high, individuals tend to take protective actions to prevent or reduce the risk (Brewer et al., 2007). There is a tendency to underestimate dangers, especially those involving personal risks such as those related to food or FBD (Weinstein, 1987).

When the individuals exercise (or identify) low control over the phenomenon, they tend to identify such situations as having a high risk to themselves and society. However, in the case of contamination of food by microorganisms, the risk is generally identified as low because the individual feels he or she has (real or illusory) control over these situations (Frewer et al., 1994).

Weinstein (1989) explains that the individual has the need to exert control over situations, but the belief that he or she has control leads to underestimating hazards, identifying them as low risk. In food handling, for example, the use of gloves generates feelings of comfort and safety in the handler, making him or her believe that the food will not be contaminated, because of the use of these gloves, regardless of other procedures or the proper hygiene of the gloves (Frewer et al., 1994; Weinstein, 1984).

This illusion leads the individual to believe that he or she is less susceptible to contamination than others, or that the food that he or she manipulates has lower risk than the food handled by others, under similar conditions or not. This phenomenon is called the optimism bias. The illusion of control is one concept that is intended to explain this phenomenon (Weinstein, 1989).

Another motivator of the optimism bias is a comparison with stereotypes risk (Weinstein, 1989). In considering that a person is more skilled or will have more luck than average, individuals believe that risk prevention campaigns are targeted at people who are less fortunate or those who exhibit clearly risky behavior (Horswill and McKenna, 1999; Weinstein, 1989).

The optimism bias is also related to individual experiences about each hazard, in which the handler ponders the personal risk by considering the occurrence referred to him or her from a negative event in the past or something that happened in his or her family and those close to him or her (Weinstein, 1987). In association with his or her knowledge, he or she can use heuristic methods to avoid risks. In terms of food safety, individuals who had had salmonellosis (or someone in their family had had salmonellosis) perceived themselves to be more susceptible to foodborne illness than individuals who had not had the illness (Parry et al., 2004).

Da Cunha et al. (2014a) observed that food handlers in different food businesses presented an optimistic bias (OB) toward the risk of being responsible for handling foods that can spread FBD to consumers, friends, and family members. The authors concluded that this positive outlook can emerge from environmental characteristics because food handlers from schools and hospitals presented higher OB levels than food handlers from street food vendors and restaurants.

It has also been shown that risk perception can directly interfere with the conduct of the individual (Janz and Becker, 1984) in that optimism bias can reduce the individual's precaution to minimize his or her own risk (Horswill and McKenna, 1999; Weinstein, 1984, 1987), and then engage in inadequate conduct. This assumption indicates that food handlers with a positive outlook on their (real or illusory) practices may neglect food protection attitudes.

Risk perception can establish an attitudinal ambivalence, mitigating the application of knowledge in the practices and attitudes of protection (Janz and Becker, 1984). Knowledge is an important attribute in the description of a risk. Determining the perception of risk is fundamental for determining the degree to which the individual knows that he or she is exposed to risk, how much the individual knows about the nature of the risk, and how much science he or she knows about the risk. When given some knowledge of the danger, the precision for estimating the risk of occurrence increases (Frewer et al., 1994). However, popular interpretations of a health threat are primarily based on the beliefs and convictions, not on the facts and scientific data (Slovic, 1987).

Risk perception is subjective and based on the experience, and understanding it is important to the success of food safety communication and the absorption of new technologies (Knox, 2000; Behrens et al., 2010).

Among tutors for food safety programs, there is the belief that only knowledge of microbiological hazards in foods can ensure safe practices. This understanding has a direct implication for internal risk communication, because food handlers can perceive low risks associated with other dangers and consequently neglect control measures applied in the best practices for food safety. One goal of risk communication is to promote the exchange of information among knowledge, attitudes, values, practices, and perceptions about risks to food safety (Food and Agriculture Organization of the United Nations, World Health Organization, 1999, 2006).

Evaluating risk perception may be an important diagnostic tool to improve understanding of food handler behavior at work and enable the use of different training strategies and interventions in this context (Nauta et al., 2008).

Knowledge is necessary, but it is not a condition for behavioral change (Ehiri et al., 1997; Askarian et al., 2004), and alone it has little direct effect on the intention of food handlers to engage in safe behavior. However, this behavior is compensated by social cognitive factors (Mullan et al., 2010).

It is important to determine gaps in the knowledge of food handlers to guide effective educational and behavioral interventions (Pichler et al., 2014). Accordingly, Jianu and Golet (2014) observed that, although results indicated a good level of knowledge and practice among meat handlers, some aspects, such as the identification of risks to food safety and hand hygiene, continued as problems that must be articulated in training programs.

This knowledge allied to attitudes is a precursor to behavioral change (Gilling et al., 2001; Mullan et al., 2010). Positive behavior in food handlers in terms of good manufacturing practices is the result of motivation; thus, people work to develop actions (Ellis et al., 2010).

To adapt this motivation to the workplace, Yiannas (2009) identifies some relevant actions, such as valuing people, recognizing the improvement of attitudes, encouraging initiatives, delegating authority, and conducting evaluations.

Lin (2007) emphasizes, “Efforts to foster the targeted reciprocal relationships and interpersonal interactions of employees are necessary for creating and maintaining a positive knowledge sharing culture in organizations.”

Ellis et al. (2010) indicated that to increase in the probability that employees will be motivated to perform safe food-handling practices, supervisors should improve communication with employees and provide resources to them. All these functions can be controlled, implemented, and influenced by the supervisors, who need the required management skills to fulfill these roles in a way that influences the employees positively.

Food safety education, training, and motivation are factors that impact safe food preparation practices by food workers and managers (Green et al., 2005).

The psychosocial aspects of food safety, namely the beliefs, self-efficacy, locus of control, and stage of change, have been studied in the food safety field (Byrd-Bredbenner et al., 2007a,b).

In considering the above, researchers have studied ways to identify the nuances of behavior and their theories and to propose diagnostic strategies and training to improve food handler practices, in addition to the attending health legislation. From this perspective, carefully considering the pedagogical approach to adopt is fundamental. This approach allows for the guidance and development of a training program and assesses its impact. All educational activity is thought to obey the purposes of social, cultural, political, and economic development. Consequently, this activity responds to certain interests. It is therefore maintained by a philosophy of education in space and time (Bezerra et al., 2014).

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### 3 THEORIES AND MODELS OF BEHAVIORAL CHANGE

Among the studies to evaluate food hygiene training, few used explicit theoretical models as their basis (Bezerra et al., 2014). Given the plurality of psychology theories, there is a question as to what would be the best model or theory to use in a training program for food handlers. The value of a psychological theory is not only judged by its explanatory and predictive power, but by its practical power to promote

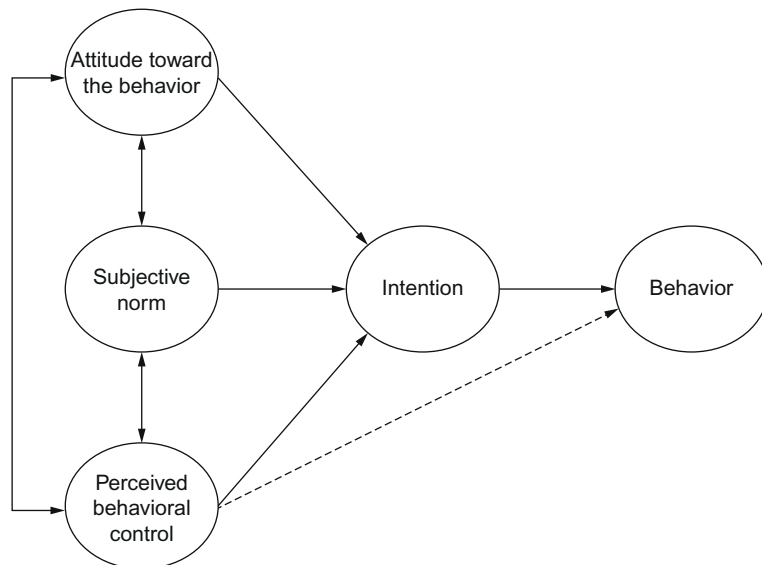
changes in human behavior (Bandura, 2004). Some theories and models that will be cited in diagnostic strategies and training are discussed below.

### 3.1 THE THEORY OF REASONED ACTION AND THE THEORY OF PLANNED BEHAVIOR

The theory of reasoned action (TRA) and its extension known as the theory of planned behavior (TPB) (Ajzen, 1991) include perceptions of control. These strategies have been successfully used in studies on food hygiene and food handler behavior (Clayton et al., 2002; Mari et al., 2012). In TRA/TPB, individual intentions are the primary factor in achieving certain behaviors (Figure 1) (Ajzen, 1991).

People's intentions and beliefs about food safety are influenced by two key factors: (1) the level of people's intent is greater if they have a positive attitude toward the behavior and (2) the level of intent will be greater if they are motivated to act in accordance with social norms (Yiannas, 2009).

The attitude toward a given behavior in the TPB and the perception of control are associated with the influence of subjective norms, also called social pressure or peer pressure. Peer pressure is often used to describe instances in which an individual feels indirectly pressured into changing his or her behavior to match that of his or her peers (Albarracín et al., 2001). In a study by Seaman and Eves (2010), it was noted that peer pressure was the factor that most influenced the intention to change hygiene and sanitation practices. Coworkers can positively or negatively influence the behavior of others quickly, underscoring the importance of involving all intervention strategies.



**FIGURE 1**

The theory of planned behavior model (TPB) (Ajzen, 1991).

### 3.2 THE HEALTH BELIEF MODEL

The health belief model (HBM) is intended to reveal the relations between what a person believes and how he or she acts. A person's health beliefs are the results of his or her ideas, beliefs, and attitudes about health and illness. These beliefs may be based on the information and misinformation, common ideas in a given community or family, or myths, lived realities, or misconceptions. Therefore, beliefs can both promote health and influence it negatively (Rosenstock, 1974).

The HBM is shown in Figure 2. Its application to the food safety field is presented in Tones' Health Action Model (THAM).

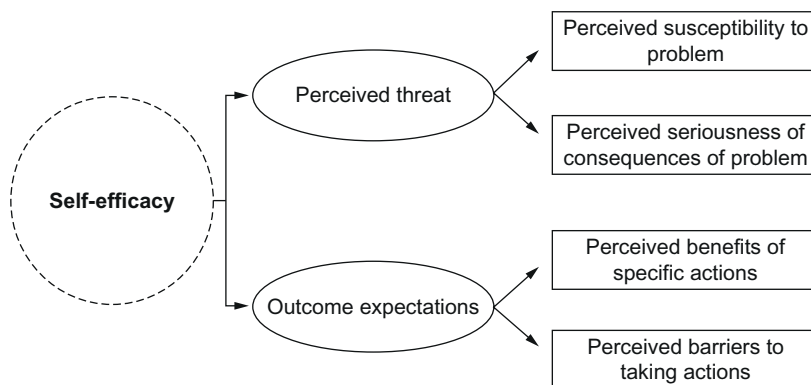
### 3.3 TONES' HEALTH ACTION MODEL

The THAM (Figure 3) is a combination of two other models: namely, the HBM and the TRA (Rennie, 1995) and contains several key points of the TRA/TPB such as the influence of norms and motivation to change behaviors.

The Tones' Health Model is divided into five constructs or systems as follows: (1) the knowledge system, initial knowledge about food safety; (2) the legal system, the laws and rules of the service; (3) the motivational system, the motivation elements of the service; (4) the belief system, the values and beliefs of the target audience; and (5) the environmental conditions of service (Nieto-Montenegro et al., 2008; Rennie, 1995). In this model, interventions that address all constructs/proposed systems are developed because all these factors are thought to affect the behavior of the food handler directly and not just knowledge.

### 3.4 SOCIAL COGNITIVE THEORY

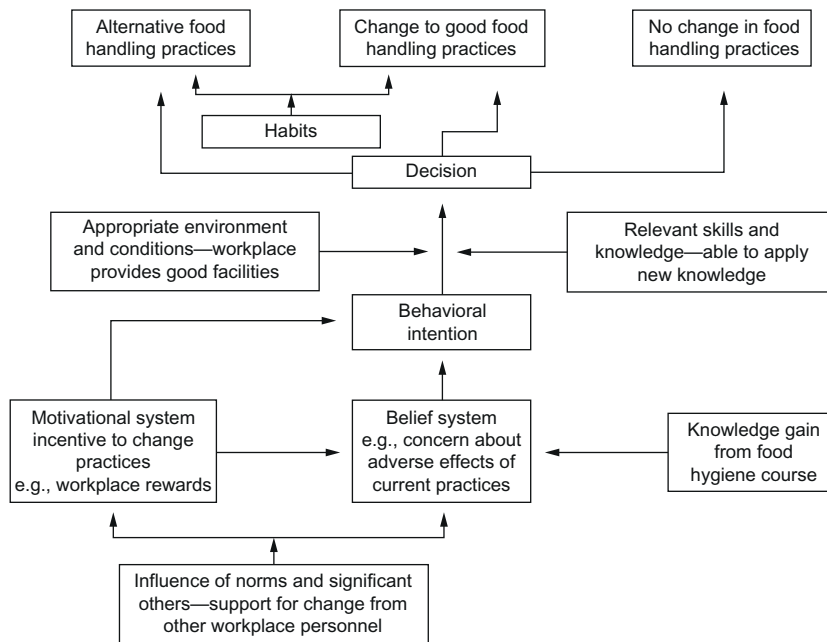
Social cognitive theory (SCT), created in 1971 by Albert Bandura, a Canadian psychologist, argues that the individual's behavior, personal factors, and the environment mutually influence each other in a relation called triadic reciprocity. In this theory, self-development and change of human behavior are explained from the perspective of the agency. In a simplified way, being an agent means being able to



**FIGURE 2**

The health belief model (HBM).





**FIGURE 3**

Tone's Health Action Model as applied to food safety (Rennie, 1995).

develop mechanisms of self-regulation that may determine the path to be followed. The individual can influence the course of events according to his or her interest. He is an active participant of the direction that his or her life will take, as he or she sets goals that will be reached through trajectories chosen by himself or herself (Bandura, 1977).

SCT emphasizes that behaviors are influenced by the environment and personal factors (Yiannas, 2009).

People are ambitious and proactive, not just reactive. The ability to predict allows people to exert control in advance, rather than simply react to the effects of their efforts. They are motivated and guided by predicting goals, not only by a retrospective view of limitations. SCT has been applied in studies about educational focuses on health promotion (Bandura, 2004).

### 3.5 THE TRANSTHEORETICAL MODEL

In the transtheoretical model (TM), behavioral change is conceptualized as “a process that unfolds over time and involves progression through a series of six stages: precontemplation, contemplation, preparation, action, maintenance, and termination. At each stage of change, different processes of change optimally produce progress” (Prochaska et al., 2002).

Based in this theory, specific interventions to influence behavioral change should correspond to the stage where an individual is or the degree of his or her willingness to change (Yiannas, 2009).

These models and theories should be seen as a way to understand the factors that influence decisions and individual behavior.

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## 4 DIAGNOSTIC STRATEGIES

Diagnostic strategies are intended to support the development of training programs that are more appropriate to the specific needs of food handlers (Kaliyaperumal, 2004). Some diagnostic strategies will be presented and discussed below.

### 4.1 FOOD SAFETY KNOWLEDGE, ATTITUDES, AND PRACTICES

To introduce a discussion about knowledge, attitude, and practice, the following terms are defined:

**Knowledge:** “These are facts, information, and skills acquired by an individual through experience or education; it is the theoretical or practical understanding of a topic” (Pearsall, 2001).

**Attitude:** “A psychological tendency expressed in degree of favor or disfavor upon a particular entity” (Eagly and Chaiken, 2007); “an established way of thinking or feeling about something or someone, usually reflected in individual behavior” (Pearsall, 2001).

**Practice:** “Run or perform an activity or a particular method of habitual or regular manner” (Pearsall, 2001).

In relation to foods, practice can be defined as “Attitudes observed in an individual that can affect his nutrition or that of others, such as: eating, feeding, hand hygiene, cooking, and food choice” (Macías and Glasauer, 2014).

These definitions are simplified translations of what is generally understood to be knowledge, attitudes, and practices in food handling. The practice can be divided into self-reported and observed categories. The self-reported practice may be a bias in the research in that it considers the response of the manipulator, and the observed practice is a result of the researcher’s observation.

Several studies have been devoted to assessing the knowledge, attitudes, and practices of food handlers (Angelillo et al., 2000; Ansari-Lari et al., 2010; Bas et al., 2006; McIntyre et al., 2013; Soares et al., 2012). Older and more recent studies indicate that the provision of knowledge is not enough to engender attitudinal change and the adoption of appropriate practices (Da Cunha et al., 2014b; Ansari-Lari et al., 2010; Ehiri and Morris, 1996; Ehiri et al., 1997; Iiu et al., 2015; Park et al., 2012; Rennie, 1995). This insufficiency occurs because individuals have attitudinal ambivalence (Newby-Clark et al., 2002) in several respects. This attitudinal ambivalence is defined by a concomitant degree of favor (positive attitude) and disfavor (negative attitude) toward a practice (Newby-Clark et al., 2002). Food handling researchers hypothesize some factors as generators of ambivalence; namely, OB (Miles et al., 1999), a low perception of risk in food handling activities (Da Cunha et al., 2012; Parry et al., 2004), an illusion of control (Horswill and McKenna, 1999), knowledge provision with low application in a practical context (Rennie, 1995), a lack of intention to change on the part of individuals (Ajzen, 1991), motivation (Kelly et al., 1991), and several behavioral aspects. It is noteworthy that attitudinal ambivalence has not yet been investigated in food handlers, and it is only a hypothesis of associate factors.

Attitude is an important factor in the application of knowledge, and it can influence behavior and practice, reducing the risk of FBD (Bas et al., 2006; Ko, 2013; Sani and Siow, 2014); thus, it is

important that all food handlers have positive attitudes toward food safety. However, negative attitudes toward hand hygiene, the practice of safe storage, and the control of cross-contamination are observed among food handlers (Tan et al., 2013; Sani and Siow, 2014).

A way to evaluate knowledge, attitudes, and self-reported practices (KAP) is by using a structured questionnaire that can be created by using the method described by Bas et al. (2006) and Da Cunha et al. (2014b) and then administering it to food handlers.

The first part of the KAP questionnaire has the objective of evaluating food handler knowledge about food safety. Questions related to the daily practices of food handling are presented, and they address different aspects of food handling (e.g., personal hygiene, food hygiene, cross-contamination, temperature control, food thawing, and environmental hygiene). The response is generally given as one of three possible answers; that is, “yes,” “no,” and “I don’t know.” The order of “yes” and “no” as correct answers can be shuffled and should not follow a pattern. One point is assigned for each correct answer, and zero points are assigned for wrong or “I don’t know” answers.

The second part of the KAP questionnaire includes affirmatives to assess food handler attitudes toward food safety, including affirmatives about the importance of hygienic procedures, their responsibility as food handlers in preventing FBD, and the importance of learning more about food safety. Food handlers can indicate their level of agreement by using a three-point rating scale of “agree,” “not sure,” and “disagree.”

Self-reported practices are generally evaluated in the last part of the KAP questionnaire. Questions about daily practices can be included and preferably address the same topics as in the knowledge-related part. A five-point rating scale ranging from 1 = never to 5 = always can be used to evaluate each practice.

A checklist can be used to evaluate the observed food handler practices. The questions were retrieved from a food safety evaluation instrument that was created to consider the characteristics of food services and to evaluate the compliance and noncompliance resulting in a percentage of adequacy (Da Cunha et al., 2014b).

## 4.2 RISK PERCEPTION

Risk perception is a diagnostic strategy that can also be assessed by a questionnaire; for example, a structured questionnaire was designed to evaluate the risk perception of FBD as developed by Da Cunha et al. (2012). This instrument was based on a questionnaire used by Frewer et al. (1994). It contains seven questions about food storage and personal environmental food hygiene. Responses were given through a 10-cm structured scale that was anchored with the intensity descriptors ranging from “no risk” to “high risk.” Risk perception can also be assessed by different scales such as a structured 7-point scale (with three descriptors; e.g., much less than most people, same as most people, much more than most people) (Sparks and Shepherd, 1994), a structured 9-point scale (1 = extremely unlikely to 9 = extremely likely) (Raats et al., 1999); a numeral scale from 0 (as defined as the certainty that the event will not happen) to 100 (certainty that it will happen) (Hoorens and Buunk, 1993); and others.

Thus, it is possible to evaluate different perceptions of risk as the perceived risk of specific practices (e.g., what is the risk of FBD for the consumer if you thaw food at room temperature?); the perceived risk of general practices (e.g., what is the risk of FBD for the consumer after eating a meal prepared by you?); or even to evaluate food handler willingness to change their practices (e.g., what is the risk of FBD for the consumer in the future if you don’t change your food-handling practices?).

In food handling, the risk perception of food handlers may be the barrier between adopting and not adopting proper hygienic practices. If the food handler believes that a FBD will never occur during his

or her work or after mishandling food, it may be more difficult to get him or her to adopt preventive measures, such as good handling practices. Perceived risk assessment can be used as a diagnostic tool and information can be used to demystify food-handling aspects perceived as low risk.

Other aspects of perceived risk assessment are described further in the next section.

### 4.3 OPTIMISTIC BIAS

OB, as described before, is defined as a “positive outlook regarding future events in which individuals consider themselves less likely than others to experience negative events” (Weinstein, 1987). OB can be identified by using risk perception with a direct or an indirect method. In the direct method, respondents are required to make a likelihood judgment form by themselves in relation to others on the same scale (Miles and Scaife, 2003) (e.g., compared with the average food handler of my sex and age, what is the likelihood of me being responsible for giving a FBD to the consumer?). In the indirect method, individuals separately indicate their own risk and their peers’ risk of causing an FBD (Chock, 2011) (e.g., (a) What is the likelihood of me being responsible for causing a FBD in the consumer? (b) What is the likelihood of a food handler who is similar to me (same age and sex) being responsible for causing a FBD in the consumer?). The direct method tends to reveal a greater degree of OB, which may hinder the analysis of potential factors that influence this phenomenon (Helweg-Larsen and Shepperd, 2001; Miles and Scaife, 2003).

An average positive rating (when using a direct method) or a rating significantly greater than zero (when using an indirect method) is taken as evidence of an OB (Chock, 2011; Helweg-Larsen and Shepperd, 2001). Da Cunha et al. (2014a) assessed the OB of food handlers from different food businesses. In their assessment, the indirect method was used and significant differences between ratings were considered OB tendencies.

Food handlers can be asked the following questions as adjusted by Da Cunha et al. (2014a):

Question 1—“What is the consumers’ likelihood of exhibiting abdominal pain and/or vomiting (FBD) after eating a meal or food in a restaurant (other than the one where you are working)?”

Question 2—“What is the consumers’ likelihood of exhibiting abdominal pain and/or vomiting (FBD) after eating a meal or food prepared by you?”

Question 3—“What is the consumers’ likelihood of exhibiting abdominal pain and/or vomiting (FBD) after eating a meal or food from another foodservice that is not a restaurant (such as hospitals, beach kiosks, street food kiosks, or school meal services)?”

Question 4—“What is the likelihood of your friends and family members exhibiting abdominal pain and/or vomiting (FBD) after eating a meal or food prepared by you?”

Question 5—“What is the likelihood of your friends and family members exhibiting abdominal pain and/or vomiting (FBD) after eating a meal or food prepared by a food handler other than you?”

The questions must be adjusted for each food business. Responses can be given on a scale similar the one used to assess risk perceptions, because OB is a phenomenon based on perceived risk.

To assess the food handlers’ degree of OB, the score assigned to each perceived risk question must be compared with the scores assigned to the other questions. Five OB constructs were established, as follows: 1—consumer’s risk (questions 1 and 2); 2—friend and family member risks (questions 4 and 5); 3—food business risk (questions 1 and 3); 4—consumer food business risk (questions 2 and 3); and

5—consumer family member risk (questions 2 and 4). Positive and statistically significant results indicated the presence of OB, and higher scores indicated a greater magnitude of OB (Chock, 2011; Da Cunha et al., 2014a; Helweg-Larsen and Shepperd, 2001).

#### 4.4 BELIEFS

To reduce foodborne illness, it is crucial to gain an understanding about the interactions of prevailing food safety beliefs, knowledge, and practices of food handlers (World Health Organization, 1988).

Clayton et al. (2002) used elements of SCT to examine the beliefs of food handlers in relation to food safety, and they used a questionnaire to determine the self-reported practices of food handlers. The questionnaire first collected open-ended responses from the participants that were related to their beliefs about food safety, as follows:

- What are the important things that you can do, when preparing or handling food at work, in order to prevent food poisoning? (Please list as many things as you can.)
- Salient consequences: Please list any advantages or good things that would happen if you carried out these behaviors at every appropriate occasion during your working day. Please list any disadvantages or bad things that would happen if you carried out these behaviors at every appropriate occasion during your working day.
- Salient facilitators or barriers: What, if anything, might encourage you or make it easier for you to carry out these behaviors at every appropriate occasion during your working day? What, if anything, makes it difficult or prevents you from carrying out these behaviors at every appropriate occasion during your working day?

This questionnaire was based on the theory of planned behavior and the HBM. Both models require a pilot research stage in which remarkable beliefs of the target population about the specified behavior are determined by using open-ended questions. The questionnaire begins by asking participants to describe which behaviors could be performed to prevent food poisoning in their workplace. The specification of this food safety behavior allowed participants to answer the other questions based on their own definition of food safety behaviors.

The remaining open questions were designed to identify the primary consequences, meaning the advantages and disadvantages of performing food safety actions and to determine potential facilitators and barriers to engaging in food safety actions.

Consequences help to increase or decrease behaviors, meaning that they can be used to improve food safety performance. Positive and negative reinforcements are two behavioral consequences that increase the probability that a behavior occurs again. Historically, managers have focused excessively on creating negative consequences for performance below the ideal. To improve performance and results, consequences, or positive reinforcements should be used much more than negative consequences (Yiannas, 2009).

The second part of this questionnaire was designed to collect quantitative data in the form of closed questions. Self-reported practices by food handlers for food safety were verified by asking the respondents to designate which of four statements applied to themselves.

Statement A: I carry out all the food safety behaviors, which I know I should do, at every appropriate occasion during my working day.

Statement B: I carry out many of the food safety behaviors, which I know I should do, but sometimes I do not carry out all these food safety behaviors at every appropriate occasion during my working day.

Statement C: I carry out a few of the food safety behaviors, which I know I should do, but often I do not carry out all these food safety behaviors at every appropriate occasion during my working day.

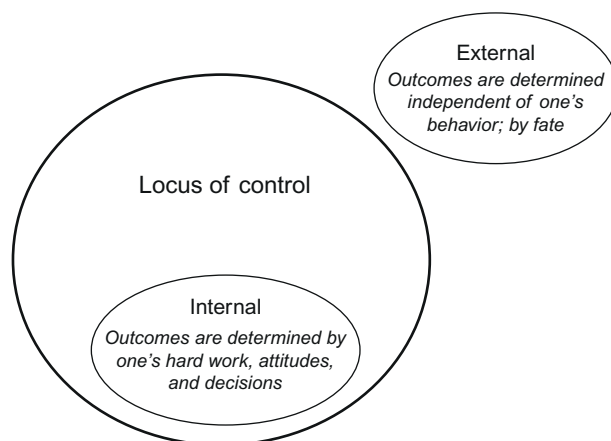
Statement D: I do not carry out any of the food safety behaviors, which I know I should do, at the appropriate occasions during my working day.

To determine the level of the perceived control that food handlers had over performing food safety actions, closed questions were also used to assess their risk perceptions of someone who would contract food poisoning from their workplace, other businesses, and their home and to establish the type of food hygiene training participants had received.

#### 4.4.1 *The locus of control and self-efficacy*

In personality psychology, the locus of control refers “to the extent to which individuals believe they can control events affecting them. A person’s ‘locus’ (Latin for ‘place’ or ‘location’) is conceptualized as either internal (the person believes they can control their life) or external (meaning they believe their decisions and life are controlled by environmental factors which they cannot influence, or by chance or fate) (Figure 4).”

Self-efficacy is “the belief in one’s capabilities to organize and execute the courses of action required to manage prospective situations.” In 1977, Bandura developed a very important and influential publication that demonstrated how self-efficacy can impact everything from psychological states to behavior to motivation. Self-efficacy and skills are core concepts of SCT. For example, if a person perceives an incentive related to a specific behavior, it is important that he or she believes that he or she may be able to accomplish it (self-efficacy). Success in realizing this performance increases the likelihood that it will be performed again (Yiannas, 2009).



**FIGURE 4**

The locus of control.

The locus of control and generalized self-efficacy are significant predictors of both worker satisfaction and worker performance. Clayton and Griffith (2008) observed that self-efficacy was an important predictor of adequate food safety practices.

To initiate a study about the locus of control, we recommend Wallston et al. (1978) and Wallston (2005). With regards to self-efficacy, we recommend Abbot et al. (2009).

#### 4.5 MOTIVATION

Motivation is “the driving force which gives purpose or direction to human and animal behaviors which operate at a conscious and subconscious level.” Without motivation those behaviors would simply not occur. Another definition for motivation explains that, “it is a person’s willingness to exert physical or mental effort in order to complete a goal or set aim.”

Arendt and Sneed (2008) proposed a model for employee motivations to follow food safety practices. The motivators for this group included all external motivators that were controlled by the food-service supervisor-leader.

Four motivation factors are part of the model. Factor 1 is communication. This extrinsic motivator refers to the verbal and nonverbal communication between the supervisor and foodservice worker in addition to communication by supervisors to employees through their role-modeling behaviors. Factor 2 is rewards and punishment. This extrinsic motivator refers to rewards (increased pay, “thank you,” and time off) and punishments (reprimands) that are typically administered by the supervisor. Factor 3 is internal motivators. This category encompasses all intrinsic motivators that are not reliant on an external source. Examples in this area included pride and satisfaction when following safe food-handling practices and seeing benefits to the self. Factor 4 is resources. This extrinsic motivator included resources that were typically provided by the foodservice supervisor such as supplies and food safety training.

#### 4.6 CHANGE STAGE

Garcia et al. (2013) developed a questionnaire known as The Scale of Attitude Change for Food Handlers (EMAMA) based on the TM by Prochaska.

The EMAMA was validated by judges and includes a semantic analysis of 31 statements that were prepared so that the food handler could choose an answer suited to his or her reality; in other words, what he or she performed at the restaurant in relation to good handling practices.

Responses were described on the basis of a Likert five-point scale, as follows: the answer “I do not think about it” or “I do not do it” was designated grade 1 and was classified as Precontemplation; the answer “I have been thinking in this way” was given grade 2 and was classified as Contemplation; the answer “I am determined to do it” was designated grade 3 and was classified as Decision; the answer “I have started doing it recently” was given grade 4 and was classified as Action; and the answer “I have been doing it for a long time” was designated grade 5 and was classified as Maintenance.

#### 4.7 FOCUS GROUP

The perceived barriers to performing food safety practices were determined by Howells et al. (2008) by using the following three practices: (1) time/temperature control; (2) personal hygiene; and (3) cross-contamination. The investigators assessed restaurant employee perceptions of barriers to implementing

the three food safety practices at work by using the following two series of focus groups: Group A, which was composed of restaurant employees who had not completed a food safety class prior to the focus groups; and Group B, which included employees who participated in focus group discussions immediately following a food safety class. After the focus groups, the researcher reviewed the data and developed barrier categories for each behavior. These data were managed by placing similar responses into categories.

The foodservice interventions were planned by using the results. Food safety posters were developed including phrases such as “how to” and “did you know.”

Arendt et al. (2012) engaged in qualitative research that addressed the challenges encountered in foodservice processes and discussed strategies to overcome the identified challenges.

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## 5 TRAINING STRATEGIES

Training is the primary strategy used to educate food handlers to perform the procedures established by the health legislation properly (Medeiros et al., 2011). Training, capacity building, and formation are generally treated as synonyms but have different definitions, as follows:

Training: “Making skillful, dexterous, able, by instruction, discipline or exercise; enable, train; perform (an activity) regularly; exercise, practice” (Pearsall, 2001).

Capacity building: “Becoming able to; empower yourself; make understand or comprehend; persuade; have understanding; understand, finding out; be sure; convince yourself; persuade yourself” (Houaiss, 2001).

Formation: “Act, effect or mode of forming; constitution, character; way by which constituted a mindset, a character or a professional knowledge. It is continuous and involves the knowledge and previous experiences” (Ferreira, 1986).

The purpose of these definitions is not to discuss the etymology of the three terms, although the term “training” has a connotation related to the reproduction of techniques by using regular practice. The term “capacity building” makes individuals capable, persuading them and making them understand something. In this sense, the term presents the individual as an object that must “be able,” leaving aside the discussion of abilities and disabilities.

The term “formation” has a broader meaning linked to the gradual process of education. Formation is a term that best defines the actions (effective) of safe handling. It is derived from a bilateral action in the education process between educator and student, and it is based on exchange and continuity. In this text, the term training as used in the original quote was retained, and the term was used in the discussions among the authors.

Before the training, performance expectations should be created to achieve performance excellence in food safety. These expectations should be clear, achievable, and understood by all, based on risk. Without them, the actions and desired outcomes will not occur consistently (Yiannas, 2009).

Certainly, when creating performance expectations for food safety, they should be determined beyond adaptation to regulatory standards. The manager should think about all the things that food handlers should know about the risks associated with the food and clearly define what he or she wants them to do. The expectations should be documented so that they can be communicated consistently. When the manager relies excessively on negative effects, this demonstrates a lack of a comprehensive



understanding of how to use expectations to generate improvements in performance. Food handlers will not be motivated to perform at full potential for fear of being punished or suffer a negative consequence. A work environment dominated by the fear of negative consequences is not a good working environment. Although negative consequences have their space in the food safety arena, they are not the ones that should be used (Yiannas, 2009).

Training has been established to promote an increased knowledge of food hygiene in food handlers (Hislop and Shaw, 2009; McIntyre et al., 2013; Osaili et al., 2013). The use of training is therefore motivated by the thought that knowledge can change attitudes and practices, for compliance with sanitary regulations and the low cost of this intervention.

The relation of training and adequate practice is complex. As mentioned, several authors have reported that training was not enough to change practices; however, other authors showed positive results in their research indicating that training can be transformative (Choudhury et al., 2011; McIntyre et al., 2013). In this sense, Nieto-Montenegro et al. (2008) reported that it is necessary to plan and use appropriate methods for the training to be effective.

Most food hygiene training uses a method of providing the information, following the KAP model, which has been widely criticized and has perceived limitations (Ehiri and Morris, 1996). A major flaw in this model is the fact that it is founded on the assumption that the information received by the workers is translated into behavior.

Therefore, there are variables/situations that were researched and considered as factors that affect training, such as the strategy used for intervention (Egan et al., 2007), the place where training is conducted (Rennie, 1995), the lowering of acquired knowledge applicability, mandatory participation against voluntary participation (Cotterchio et al., 1998), and factors that involve concepts of food safety culture such as leadership, communication, commitment, environment, perceptions of risk, and motivation (Ehiri et al., 1997; Ko, 2013).

Placing all bets on lectures is not associated with best practices by the food handler (Da Cunha et al., 2014b) because it ignores the perceptions of these professionals. A positive attitude is an important factor in the adoption of appropriate practices (Ko, 2013); thus, the handler must be motivated to learn and apply the acquired knowledge.

Food training programs based on practical activities and theoretical instruction have been shown to be important tools in which food handlers can translate information into practice (Soares et al., 2012). Soares et al. (2013) verified that the association of strategies based on practices enabled the food handler to translate the knowledge acquired in the theoretical lessons to practice and to reduce microbiological contamination successfully. Therefore, practical training should be implemented (Tan et al., 2013).

In 2010, Seaman proposed the food hygiene training model (Seaman, 2010). In this strategy, the following three evaluation stages are proposed: (1) the documented analysis of training needs, which consists of an assessment of the training needs of the food handler, why and when food handlers should be trained, analysis and previous records and controls, and established criteria for the success or failure of the training; (2) a knowledge test and/or evaluation of practical skill, which is a step to perform after training to carefully monitor and ensure the translation of knowledge into practice and to correct deficiencies in the practices of food handlers; and (3) an evaluation of the food handler training program, which is an assessment of the perceptions and reactions of food handlers in training, providing the opportunity to approve or disapprove certain aspects of training (Seaman, 2010).

After the evaluations, the food hygiene training model employs methods to increase knowledge and improve food-handling practices. These methods should be performed along with motivational strategies, adequate infrastructure, and the effects of social pressure, among others (Figure 5).

Training programs must be evaluated to ensure their effectiveness (Zain and Naing, 2002).

Based on the food hygiene training model and the concepts of knowledge, attitudes, and practices, an intervention model for food handlers in a school environment was tested (Da Cunha et al., 2013). This model uses different strategies to promote increases in knowledge and changes in practice and motivation (Figure 6). This model, which was created and tested in Brazil, adds points that are

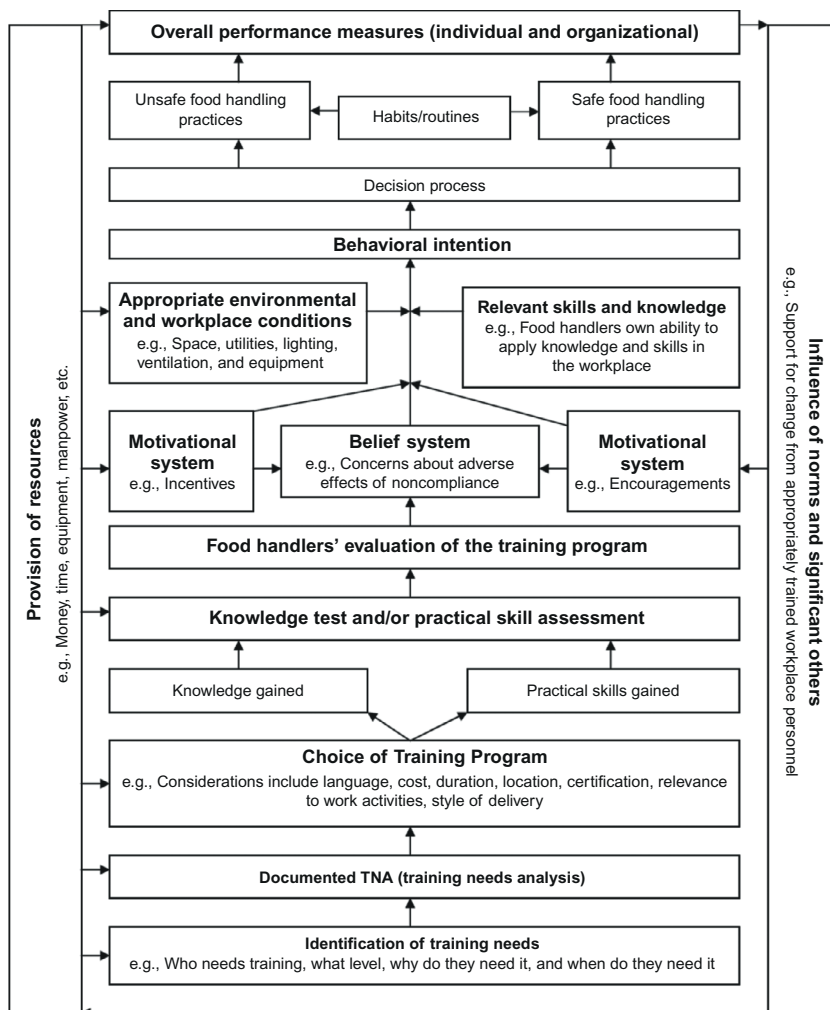
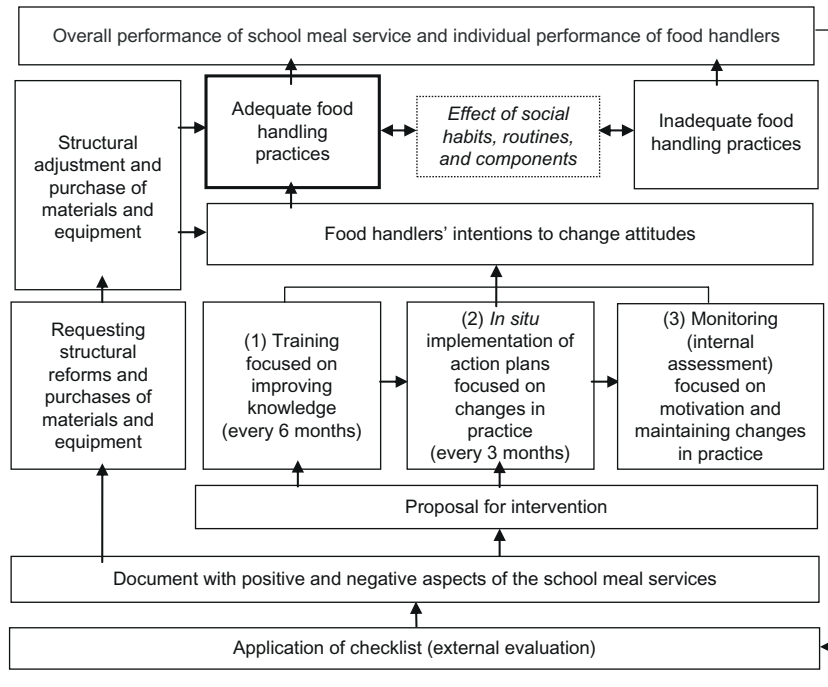


FIGURE 5

The food hygiene training model as proposed by Seaman (2010).



**FIGURE 6**

A systematic intervention model based on triad knowledge, attitude, and practice for school food services (Da Cunha et al., 2013).

infrequently discussed for intervention strategies with food handlers as a combination of internal and external evaluators, adequate infrastructure, and monitoring. When tested longitudinally, the proposed intervention improved school compliance with the health laws (Da Cunha et al., 2013).

Soares et al. (2013) assessed the influence of theoretical-practical food safety training based on the microbiological counts of food-contact surfaces, food equipment surfaces, food tools, and hand washing by handlers in canteens and cafes at a university campus in northern Portugal. A food safety training program was specially developed for all of the food establishment's handlers on the campus. Training was performed by only one trainer. The food safety training consisted in 9 h (three sessions of 3 h each) per group, and each session was divided into three parts as follows: (1) general concepts of hygiene and food safety, (2) practice, and (3) application of the acquired knowledge *in situ*.

The first part consisted of presenting food safety concepts in a theoretical approach. Training sessions were given to small groups with four food handlers belonging to canteens and groups and with two food handlers belonging to cafes to achieve a strict interaction between food handlers and trainers. The theoretical portion consisted of in-depth explanations of food safety practices.

The second part included practical training to translate the knowledge acquired in the first section. During the practical training, the practical aspect of each Hazard Analysis and Critical Control Points (HACCP) prerequisite was demonstrated to reinforce the food safety concepts that were previously discussed. Finally, the application of the previously acquired knowledge *in situ* included an audit by the

food safety trainer to verify the procedures performed by the food handlers during the workday. After that, corrective measures were applied in cases of inadequate practices.

The results demonstrated that food handler training was essential to increasing the hygienic conditions of the food establishments in this study. After the food safety training program, the overall microbiological counts decreased and several differences related to the specific characteristics of the two categories of establishments were found. Thus, differences in the layout, hygienic design, equipment, foodservices, and food handlers in these establishments implied that the food safety training programs had been specially developed for each food sector and/or establishment size. Moreover, this study showed that food safety training is also important for ensuring safe foodstuffs, and for preventing the involvement of food handlers in FBD.

Gomes et al. (2014) evaluated a methodology for food handler training by using didactic material (booklet) developed for hotel sector training sessions and for evaluating microbiological variables. The microbiological analyses result in the need for constant vigilance to ensure safe food, in addition to providing examples to insert into teaching materials, with a focus on hotel food handlers, with the advantage of approaching examples of the routine in these establishments.

Food handler education in hotels should be a compulsory part of any food safety program. Gomes et al. (2014) demonstrated the development of a methodology that employs practical examples from the daily activities of the workers and the results of laboratory analysis. Improvements were observed after the implementation of the method and easy understanding was noted among all the food handlers. The methodology can be adopted without any extra cost, by any hotel foodservice.

Studies describing the effectiveness of the models/interventions mentioned here highlight the important points for understanding food handler behavior. However, all studies note that several factors were not investigated, because the behavioral context influenced the adoption of appropriate practices in food handling and few authors were motivated to identify these factors.

The training sessions, which focused on monitoring food safety practices, cause positive behavior to happen naturally (Da Cunha et al., 2013). According to Soon and Baines (2012), the recycling of training and the recurrent emphasis on the behavior of good handling practices has a positive effect on the hand-washing practice of handlers.

The effectiveness of food hygiene training is improved if the training is based on a more appropriate approach, and if it is designed on the basis of health education theories (Ehiri et al., 1997). Chapman et al. (2011) reasoned that the use of interactive media has a positive influence on food safety training.

Behavioral strategies open new ways of diagnosis and training; however, when applied in isolation, they become trapped or bound to the researcher. When greater involvement is intended, the approach of the research action can facilitate a diagnosis and a background in shared construction.

The goals of action research are represented in the following two ways: practical and theoretical. It is important that research addresses the proper relation and balance of both approaches. Good knowledge helps to achieve good practice. The purpose of knowledge is more focused on research and the willingness to expand the level of food handler awareness and produce knowledge. The practical goal is focused on the action itself, occurring as a concrete action, and an investigation of the situation and/or practices in food safety with an interaction between the researchers and workers.

When hosting all diagnostic strategies and training, this model also accepts others that may be created from the action research process. The meeting between the researcher and the handler can bring new solutions to food safety. It is important to know that reflective practice can be a useful precursor to action research. Reflective practice can lead to strategic action (McMahon, 1999).

The techniques used in training should be reviewed by minimizing theoretical concepts, a widely used feature (Medeiros et al., 2011). Studies conducted on this topic provide suggestions that may be fruitful for practical improvement or that can maximize the following intervention strategies:

- (1) Train food handlers in the workplace to improve their understanding of procedures. In the workplace, a tutor can reinforce theoretical ideas in a practical manner (Da Cunha et al., 2013; Rennie, 1995).
- (2) Involve the owner of the property or manager/supervisor in interventions regarding good practices. A supervisor with knowledge can assist in monitoring and correcting improper practices (Egan et al., 2007; Seaman and Eves, 2006).
- (3) Provide a suitable environment, with the necessary resources, equipment, and utensils for the implementation of good manufacturing practices (Tannenbaum and Yukl, 1992; Tracey et al., 1995).
- (4) Provide motivation. Feelings such as motivation and self-efficacy play important roles in enhancing training and the adoption of adequate practices (Seaman and Eves, 2006).
- (5) Establish goals and present them to the group. A goal, when feasible, may motivate the fulfillment of tasks (Ray et al., 1997).
- (6) Evaluate the impact of the acquired knowledge. The evaluation of results allows for the development of their own training methodologies (Garayoa et al., 2011; Soares et al., 2012).
- (7) Select the content of the training. Irrelevant information reduces the interest of the handler (Abdul-Mutalib et al., 2012).

Some factors can negatively affect the impact of training and interventions performed in food services, such as hiring employees with a low socioeconomic status and low education, a high employee turnover, the cost of interventions for food safety, and dissatisfaction with pay (Mortlock et al., 2000; Seaman and Eves, 2006). Therefore, these factors must be evaluated with the intention to cause changes; for example, improving the socioeconomic situation and decreasing worker turnover.

In a study by Da Cunha et al. (2014b), the number of meals prepared per handler also had a negative effect on appropriate practices. The higher the workload is (i.e., the greater the number of meals produced by a food handler) the lower will be the number of correct food safety practices. The overloaded food handler may neglect correct practices, favoring practices that facilitate or accelerate the production of meals. In this study, the experience of food handlers positively affected the observed practices, independent of knowledge. The experienced food handler may be accustomed to techniques and procedures and know how to reproduce them. However, it is not possible to say whether the years of work that food handlers perform can change their attitudes and make them adopt appropriate practices in a voluntary manner.

Adequate buildings and facilities were also positively associated with the observed practices. Another significant factor associated with the observed practices was the presence of food safety leadership working in foodservice. With a specific curriculum addressing hygiene, food safety, and food microbiology, the nutritionist can perform the management and maintenance of good manufacturing practices in food services in Brazil (Da Cunha et al., 2013). In this sense, the nutritionist, and other professionals with the aforementioned knowledge, can monitor internal activities by acting as a food safety leader, which was already shown to influence food safety adequacy in a positive fashion (Tannenbaum and Yukl, 1992; Seaman and Eves, 2006; Egan et al., 2007; Da Cunha et al., 2013). For Griffith et al. (2010), food safety leadership is the ability of a leader to engage staff in hygiene/safety performance and encourage compliance in meeting goals and standards. In addition to monitoring, this professional

can perform frequent evaluations. The assessment of food safety practices is itself a factor that enhances food safety in food handling (Bader et al., 1978).

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## 6 VIRTUAL ENVIRONMENTS

Some countries such as Brazil and the United Kingdom are investing in training courses for food handlers via the Internet as a strategy to improve the knowledge of people interested in safe food handling.

In Brazil, ANVISA (National Health Surveillance Agency) launched a completely virtual 12-h course for food handlers with motivational and educational strategies in 2014. Videos and exercises were used for the assimilation of knowledge and for a dynamic, easy-to-understand presentation with a review of the content. The Brazilian course is divided into eight modules, and the participants can print a booklet with all the content and a certificate of participation. In the end, the course is assessed by the participants, facilitating the improvement of future versions.

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## 7 CONSUMERS

A strategy that resonates with positive results for food establishments is the education of the population itself in matters related to proper food-handling practices.

This practice generates more critical and demanding consumers because they may also be food handlers. In a study performed by Deon et al. (2014), educational activities in the form of good practice programs for food preparation in households are of fundamental importance.

Such programs should be developed with consistent methodologies to meet their objectives, and they should consider the possible causes of failure. In addition, schools are the ideal environment for early interventions in hygiene education, assuming that childhood is the best time for learning. The dissemination of knowledge as early as possible in schools is a concrete method of risk communication because it builds trust and credibility.

In this sense, the U.S. Department of Agriculture (USDA) has directed its efforts to promote and educate the population about issues related to food safety, and it includes among its actions those related to the virtual environment. The USDA hotline responded to over 80,000 inquiries (calls, chats, and webmail) in fiscal year 2013. The USDA is also a major contributor of food safety consumer content for the site [FoodSafety.gov](http://FoodSafety.gov), the primary initiative of the Working Group on Food Security. To engage consumers further on the importance of food safety at home, the USDA joined with the Ad Council to develop Families Safe Food Campaign, a national public education campaign (Fight BAC). The campaign encourages consumers to take four simple steps to protect themselves and their families from FBD. This program, which is in its fourth year, has been seen or heard by more than 1 billion people since its launch in June 2011 (United States Department of Agriculture, 2014).

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## 8 FINAL CONSIDERATIONS

Scientific research has been directed at improving food-handling practices throughout the entire food chain, from primary production to the consumer's table. The legislation and regulations mention that

the training of food handlers is critical for preventing FBD, and they recommend the need for continuous education actions for all involved, with records kept of these activities. Continuing training should be planned and enhanced to emphasize content directed at health risks and for improving the knowledge, attitudes, and practices of food handlers.

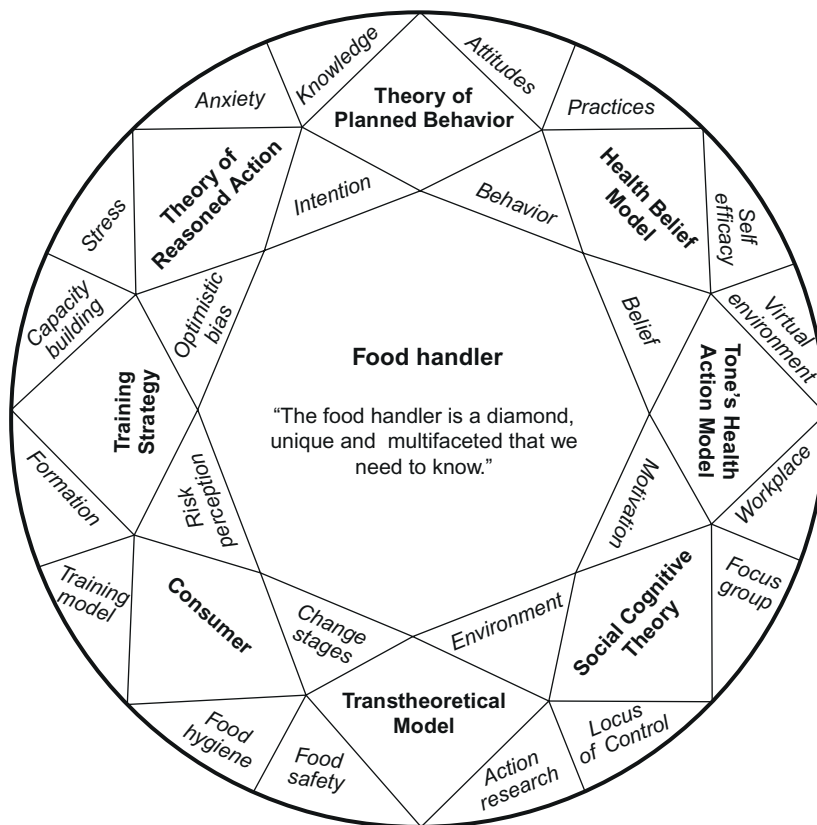
There is an observable scientific basis for improving food handler training in pursuit of updated theoretical and traditional models, and more studies are needed. In this context, the management steps used in the training of food handlers include a diagnosis of the demand, planning, and implementation of intervention activities and continuous assessment of the effectiveness of the program or training plan. This program should be documented, and all actions should be recorded to ensure execution.

Inspection practices remain important for the reduction of foodborne outbreaks. However, inspections alone do not reduce the risk of FBD. A combination of inspection results, mandatory training programs, and certifications can minimize this type of risk. Current evidence for the effectiveness of food hygiene training is limited. Studies with meaningful performance indicators are needed to elucidate the relations between training and adequate food-handling practices.

Educational programs, and not necessarily training in its traditional format or function, can be developed more effectively by considering the different variables related to food handlers. These variables can be observed in [Figure 7](#).

Highlights for effective training in food safety:

- To establish performance expectations.
- To facilitate communication among employees, managers, and employers.
- To enroll people with skills in human resource management and give them knowledge of strategies.
- To provide encouragement for employers.
- To provide leadership for food safety.
- To elicit motivation, by stimulating feelings such as self-empowerment and self-efficacy.
- To enroll professionals with a curriculum including hygiene, food safety, and food microbiology disciplines.
- To establish and respect an adequate workload.
- To use languages according to food handler ethnicity.
- To train food handlers in their workplace.
- To provide an adequate infrastructure.
- To have similar workplace values.
- To provide a suitable environment, with the necessary resources, equipment, and utensils.
- To illustrate theoretical concepts with practical activities.
- To use a variety of diagnostic tools.
- To apply health educational theories.
- To achieve a consensus on food safety.
- To embody the concept of risk.
- To apply an action research approach.
- To establish goals and present them to the group.
- To work with consequences and incentives.
- To provide compelling, rapid, relevant, reliable, and repeated messages.
- To use interactive media.



**FIGURE 7**

Different variables related to food handlers.

- To develop specific legislation.
- To perform continuous evaluation.
- To work toward purposes of social, cultural, economic, and political development.

The implementation of food safety practice requires adequate resources and an appropriate management culture. Food safety may be a field in which education and training can be organized to integrate the behavioral sciences with public health.

The creation of food safety within a business means supporting an environment in which food employees know about risks and risk management, and how to value consumer health. A food safety culture requires an application of the science with the best management and communication systems. This oversight includes compelling, relevant, rapid, reliable, and repeated messages.

Frank Yiannas proposed a systems approach entirely based on the scientific knowledge of human behavior, organizational culture, and food safety, called the Behavior-Based Food Safety Management System.



We have deconstructed the meaning of “to train” and “to intervene” here, by redirecting it into “to form.” Punctual strategies tend to be forgotten quickly. To increase effectiveness, it is necessary to address the food handler as a whole person, in all his multifactorial integrality. The educational approach must contemplate, beyond formal training, the social relationships, personal perceptions, feelings, and experiences that shape their behavior. To ally such an understanding to a permanent work program valuation and food safety practice improvement could be the way to minimize inadequate practices and negligence.

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