



## Food safety and healthcare professionals: The need for education and research

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### A B S T R A C T

For the healthy population, a foodborne infection is troublesome; however, for people with a weakened immune system, it might cause serious illness, hospitalization and even death. Healthcare professionals, comprising dietitians, doctors, epidemiologists, hygiene technicians, midwives, nurses amongst others, are often expected to inform patients about food safety to reduce the risk of foodborne diseases.

Our aim was to investigate what is known from the existing scientific literature about healthcare professional's food safety knowledge, attitudes and practices and to summarize the results.

A scoping review was carried out through a broad search conducted in the largest international database in medicine using the keywords health care staff, attitude/knowledge/practice and food safety. Only ten scientific publications were selected, guided by the research question and the inclusion criteria.

Limited food safety knowledge indicated the need for education, including food related issues, during the healthcare professional's working life. Future food safety research might focus on the issue of "responsibility" in multi-professional health care settings, and the "grey zone" between the settings regulated by the food safety legislation and conditions in domestic settings.

An extensive research gap was revealed in the subject of healthcare professional's food safety knowledge, attitudes and practices. This applies globally and, from our perspective, is a matter of concern in the Nordic countries, including Sweden.

### 1. Background

Even for most of the healthy population, food poisoning is a troublesome condition. However, for children under five, older people, pregnant women and those with a weakened immune system, it can cause serious and possibly life-threatening illness, leading to hospitalization and even death (Gerba et al., 1996; Lund & O'Brien, 2011; Lund, 2015; Choi et al., 2018). Every year, almost one in ten people worldwide fall ill after eating contaminated food and 420,000 die because of food safety related diseases (WHO, 2024). In Europe, 48,605 human cases of foodborne infections were reported in 2022 (EFSA, 2023) and there were 64 deaths, mainly caused by *L. monocytogenes*. Norovirus was the agent associated with the highest number of human outbreaks in Europe. Deaths have also been associated with norovirus infection in sensitive populations due to severe dehydration (Mattison, 2011). The Swedish Food Agency estimates that about half a million individuals in Sweden are affected every year by food poisoning; however, the number of undisclosed cases is probably much higher (Swedish Food Agency, 2024).

#### 1.1. Vulnerable groups and pathogens

Some pathogens can cause serious health problems, such as sepsis or paralysis (Koopmans et al., 2022; Rawson et al., 2023). Diseases that affect the immune system, for example leukemia, reduce the immune system's ability to resist infection, as does chemotherapy, radiation therapy, and transplantation requiring immunosuppressive medication. Listeriosis can lead to sepsis or encephalitis, which can be life-threatening (Schlech & Acheson, 2000). The risk of becoming ill from a food-borne pathogen among persons having a weakened immune system varies between patient groups. For example, the relative risk of a patient with a transplant becoming infected with *Listeria monocytogenes* is over 2500 times higher compared to a person from the general healthy population (Rocourt et al., 2003). For people aged over 65 years, the risk is 7.5 times higher compared to a younger person. Children under the age of five are sensitive to infections because their immune system is not yet fully developed (Lund & O'Brien, 2011). Those under one year are more susceptible to bacterial spores of *Clostridium botulinum*. Since the young child's intestinal flora have not yet developed sufficiently to counteract the growth, *Clostridium botulinum* can multiply and grow in the child's intestine and form toxins. Older people have an increased

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vulnerability to foodborne pathogens for various reasons, such as stomach acid production decreasing with age, and the effect of certain medications (King et al., 2000). A lower concentration of pathogens is required to cause infection in people with reduced stomach acid production and a compromised immune system. Limited space in nursing homes and hospitals also contributes to an increased risk of the infection spreading, especially among older people (King et al., 2000).

Listeriosis is severe and has a high case fatality rate (20–30%) (Rocourt et al., 2003). Many groups have a higher risk of infection, such as older people, neonates, or those with an underlying condition, such as cancer, immunosuppressive therapy, or AIDS. The main complications include spontaneous miscarriage in pregnant women, meningitis, or bacteremia in neonates and adults. A fifth of cases of listeriosis during pregnancy result in miscarriage or stillbirth (Swedish Food Agency, 2017). Although *Listeria* has been found in a wide variety of food items, such as unpasteurized milk or soft cheese, the highest risk foods are often ready-to-eat (RTE) foods that have been cold stored for a long period. With the aim of reducing the risk of listeriosis, the Swedish Food Agency has produced advice for at-risk groups concerning safe food selection and handling (Swedish Food Agency, 2023a). During 2013–2017, *Listeria* has been identified as one of the pathogens increasing in Sweden and, in 2022, it caused one death (Swedish Food Agency, 2019, 2023b).

In industrialized countries generally, the proportion of vulnerable groups in society is around 15–20 percent, and is expected to increase with the growing number of older people (Finnish Food Authority, 2023; Lund, 2015; Statistics Sweden [SCB], 2015). Food poisoning incurs costs for society through sick leave, the need for care, and reduced production (Scharff, 2012). For individuals, it also reduces the number of quality-adjusted life years (QALY) and disability-adjusted life years (DALY) (Swedish Food Agency, 2019).

## 1.2. Healthcare professionals and food safety

When it comes to food safety communication, patients place a high degree of trust in healthcare professionals (Shepherd & Saghaian, 2008). The term “healthcare professionals” has been defined on an international level to include dietitians, doctors, epidemiologists, hygiene technicians, midwives, nurses amongst others (WHO, 2013; WHO, 2019). Frenk et al. (2010) identified emerging challenges to healthcare systems in almost all countries and that the education of healthcare professionals has failed to respond adequately because of, amongst other things, curricula rigidities. Meanwhile, healthcare professionals are in a position to detect, treat, and reduce the risk of foodborne diseases, both for the healthy population and for those belonging to risk groups (Kosa et al., 2011). In the USA, as part of a transplant team, the registered dietitian is the recognized expert providing food safety education in the context of medical nutrition therapy to organ transplant patients, carers and other healthcare providers (Obayashi, 2012). Since pathogens in food pose a considerable risk for patients with a weakened immune system, it is of great importance that vulnerable groups receive advice about which foods have a lower risk of containing pathogens, and which foods should be avoided (Lund, 2014, 2015). According to Hoffman et al. (2005), both registered nurses and registered dietitians are viewed as reliable sources of food safety information, although these professions have received different training in food safety (Hoffman et al., 2005); registered dietitians have received far more than registered nurses (Buffer et al., 2013).

Lindup et al., (2020) examined how well transplant patients followed recommendations from healthcare professionals about safe food handling. Where cases could be traced to patients not following food safety advice, the incidence of food poisoning was 18 percent of the study group. This suggests that food safety communication provided by healthcare professionals has the potential to limit the incidence of foodborne illness in transplant patient populations. However, according to Evans and Redmond (2017), not all patients in at-risk groups receive information about the importance of food safety from healthcare professionals. Consumers, more generally, have been shown to have varying

levels of knowledge about food hygiene (Redmond & Griffith, 2003a). It may, therefore, be particularly important to inform patients because of uncertainty about their pre-existing knowledge. In order to reduce the incidence of foodborne diseases both healthy people, and those at increased risk of serious illness or death, should receive information about food safety (Evans & Redmond, 2017; Kosa et al., 2011). Furthermore, there is the question of *what* is known because, according to Djekic et al. (2022), consumers may be aware of foodborne pathogen risks, but the food groups that consumers perceive to be most unsafe have not caused the largest outbreaks of food poisoning in recent years.

Studies have shown that patients who belong to risk groups can receive either inconsistent information, no information at all or, in the worst case, incorrect information about food safety from healthcare professionals (Evans & Redmond, 2017; Kosa et al., 2011). Evans and Redmond (2017) interviewed patients who had undergone chemotherapy and found that the majority of patients and their family members could not confirm having been informed about food risks. The patients were aware of their increased susceptibility to infection, but not that food could be a possible source. Patients and relatives stated that they had more important concerns during ongoing chemotherapy treatment, although they had appreciated learning about the risks of foodborne diseases to those with a weakened immune system. Kosa et al. (2011) reported that patients undergoing a liver transplant had limited knowledge about food safety and had not received adequate advice from healthcare professionals regarding food-borne diseases. To ensure the delivery of appropriate food safety information and advice to vulnerable groups, it would seem appropriate and relevant to investigate food safety knowledge, attitudes, and practices among healthcare professionals. More information is needed about what motivates healthcare professionals to teach safe food handling (Buffer et al., 2013).

In summary, previous studies indicate that there is a need for more research into healthcare professionals and food safety. As far as the authors are aware, there is no overall picture of research on healthcare professionals’ knowledge, attitudes and practices in the area of food safety. This makes it highly relevant to compile and examine previous research on the subject through a scoping review. The aim is to investigate what is known from the existing scientific literature about healthcare professionals’ food safety knowledge, attitudes and practices, and to summarize the results.

## 2. Material and methods

### 2.1. Method

A scoping review was carried out in accordance with the procedures outlined by Arksey and O’Malley (2005). The following five steps were applied: (1) identification of research question, (2) identification of relevant studies, (3) selection of studies, (4) compilation of data and analysis, and (5) writing a summary and reporting the results. Arksey and O’Malley (2005) argue that the aim of a scoping review is not to assess the quality of the included studies. Further, in the present scoping review the term “healthcare professional” includes dietitians, doctors, epidemiologists, hygiene technicians, midwives, nurses amongst others (WHO, 2019).

The identified research question is to investigate what is known from the existing literature about healthcare professionals’ food safety knowledge, attitudes and practices and to summarize the results (step 1).

Steps 2 and 3 are described in a flow-chart (Fig. 1). In step 2, an advanced search was conducted in the largest database in medicine, PubMed, on November 20, 2023. Swedish MeSH (The Swedish Medical Subject Headings) were used to find the most relevant search terms and to identify English synonyms. The selected keywords were: *health care staff, attitude/knowledge/practice and food safety*. The selected terms and synonyms were then entered into a search table to create three search blocks, including the selected keywords, the relevant MeSH terms, and identified English synonyms. A filter was used to include publications

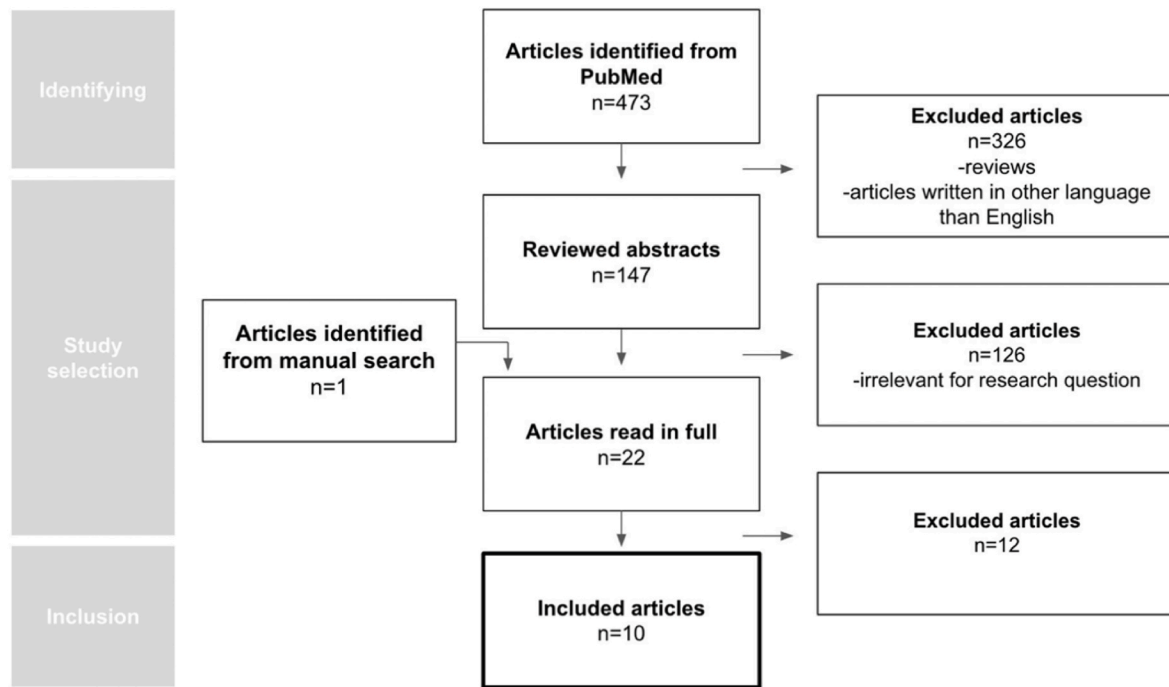


Fig. 1. Flow chart showing article identification and selection stages.

Table 1

The inclusion and exclusion criteria applied in step 3 of the scoping review selection process Arksey and O'Malley (2005).

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>Articles in English</li> <li>Ethically approved</li> <li>Peer-reviewed</li> <li>Access in full text via Uppsala University Library</li> <li>Quantitative and qualitative studies</li> <li>Studies on bacteria and viruses</li> <li>Studies that examine knowledge and/or attitudes and/or practices</li> <li>Studies on healthcare personnel</li> <li>Articles published in 2007–2023</li> </ul>	<ul style="list-style-type: none"> <li>Reviews</li> <li>Studies involving animals</li> <li>Studies dealing with toxins</li> <li>Studies dealing with parasites</li> <li>Studies dealing with the diagnosis of food poisoning</li> <li>Studies dealing with breast milk</li> <li>Studies dealing with kitchen hygiene</li> </ul>

from 2000 to 2023 and that the articles should be written in English. The search first included articles published between 2000 and 2023. After filtering abstracts in English from this period, the 546 original hits resulted in 473 articles for further examination (Fig. 1).

Step 3 began with a review of the abstracts written in English identified in PubMed ( $n = 473$ ) (Fig. 1). Two of the authors performed the search for articles, reading the abstracts. Some articles had English-language abstracts but were otherwise in another language. After excluding these, 326 articles were excluded and 147 articles remained. From the remaining 147 articles further exclusions were made. The selection was performed manually by two of the authors based on the research results, topics in connection with the keywords, and the inclusion and exclusion criteria presented in Table 1. Studies concerning healthcare professionals were included whereas those concerning patients, relatives, and veterinarians were excluded. Both quantitative and qualitative surveys were included. During the selection process, it was also decided to just include the articles published between the years 2007–2023 for the reason that this time span of 16 years can be considered to represent the most up-to-date research on healthcare personnel's knowledge, attitudes and practices regarding food safety. The articles thought to answer the identified research question were then selected in order to be read in full. Two of the authors were reading

the articles both individually and in dialogue with each other. Thereafter, 126 articles that were irrelevant to the research question were excluded. After that, 21 publications remained and one additional publication was identified from a study reference in a manual search. Subsequently, 22 articles were read in full for the analysis. After reading the publications in full text a further exclusion of 12 articles was performed. The rationale for that was also due to that they were irrelevant to the research question and to the inclusion and exclusion criteria that was set up (Table 1). Finally, ten articles were chosen to be presented in the results here.

Step 4 in Arksey and O'Malley's (2005) framework deals with data mapping where the essential information was extracted from the ten included studies. In step 5, the results were collated, summarized, and reported. The results were compiled and presented in an overview with general variables, where results and variables were discussed generally and in relation to Swedish context in particular.

## 2.2. Ethical considerations

All included studies had either been ethically approved or had received confirmation that no ethical approval was required to due to the nature of the study (Table 1).

## 3. Results

The scoping review resulted in ten scientific articles that matched the identified research question, *i.e.*, to investigate what is known from the existing scientific literature about healthcare professionals' food safety knowledge, attitudes and practices, according to the inclusion criteria used (Table 1). A short summary of the ten publications, including the locations of the studies, sample size, target populations, the duration of the investigations, and whether they examined knowledge, attitudes and practices or just one or two of these variables, is presented in Table 2. The investigations had been performed in Africa (2), Asia (2), Europe (1), North America (4) and Oceania (1).

Several studies examined all three factors (knowledge, attitudes, and practices) while others examined only one; all studies addressing any one of the three factors were included. Four of the studies investigated

**Table 2**

Description and key findings of the results from the ten selected publications.

Studies	Authors	Location	Methods	Target- populations	Aim	Duration (months)	Results		
							Knowledge	Attitude	Practice
Food safety in a hospital: knowledge, attitudes and practices of nursing staff of two hospitals in Sicily, Italy.	<a href="#">Buccheri et al. (2007)</a>	Italy	Quantitative survey	N = 401 nurses	To assess the knowledge, attitudes and practice of nurses routinely involved in food service events.	9	Limited food safety knowledge. Education improved knowledge	Positive attitudes were shown towards food safety issues	Safe and unsafe practices
Knowledge and Food Handling Practices of Nurses in a Tertiary Health Care Hospital in Nigeria.	<a href="#">Oludare et al. (2016)</a>	Nigeria	Quantitative survey	N = 340 nurses	To investigate nurses' knowledge and attitudes about food handling for hospitalized patients.	3	Good hygiene knowledge, however limited food safety knowledge	Positive and negative attitude. A relationship between attitudes and knowledge of food safety routines.	Safe and unsafe practices
Knowledge and Practices of Food Safety among Health Care Professionals and Food Handlers Working in the Kitchen of a Moroccan University Hospital.	<a href="#">Guenouni et al. (2022)</a>	Morocco	Quantitative survey	N = 72 (32 doctors, 10 dietitians and hygiene technicians and 30 kitchen staff)	To assess the food safety knowledge and practices of healthcare staff and employees at a university hospital in Morocco.	3	More food safety knowledge among dietitians and hygiene technicians than doctors and kitchen staff. Varying food safety knowledge depending on profession	The study did not deal with attitudes	Safe and unsafe practices
Food safety knowledge attitude and practices of oncology nurses, in Lebanese Hospitals.	<a href="#">Mallah et al. (2023)</a>	Lebanon	Quantitative survey	N = 134 nurses specialized in oncology	To assess oncology nurses' knowledge, attitudes & practices related to food safety	No information	Limited food safety knowledge	Positive attitude towards food safety issues	Food safety conferences improved food safety practices
Health Professionals' Knowledge and Understanding about <i>Listeria monocytogenes</i> Indicates a Need for Improved Professional Training.	<a href="#">Buffer et al. (2012)</a>	USA	Quantitative survey	N = 499 (232 nurses and 267 dietitians)	To assess whether healthcare professionals have knowledge of <i>L. monocytogenes</i> and are aware of what information should be given to patients to avoid listeriosis.	No information	Limited food safety knowledge. More food safety knowledge among dietitians and hygiene technicians than doctors and kitchen staff. Varying food safety knowledge depending on profession	The study did not deal with attitudes	The study did not deal with practices
Investigation of Listeriosis-Related Knowledge, Attitudes, and Practices Among Medical Staff in Fangshan, Beijing, China.	<a href="#">Zhao et al. (2019)</a>	China	Quantitative survey	N = 397 (317 doctors, 80 nurses)	To investigate healthcare professionals' knowledge, attitudes and practical experience of <i>L. monocytogenes</i> .	3	Limited food safety knowledge	Positive attitude	Safe and unsafe practices
Listeriosis in pregnancy. Survey of British Columbia practitioners' knowledge of risk factors, counseling practices, and learning needs.	<a href="#">Kirkham and Berkowitz (2010)</a>	Canada	Quantitative survey	N = 340 (235 doctors, 37 midwives, 68 general practitioners in specialist training)	Assess doctors' and midwives' knowledge, counseling practices and need for training concerning listeriosis in pregnancy.	No information	Limited food safety knowledge. Varying food safety knowledge depending on profession	The study did not deal with attitudes	Varying counseling practices depending on profession

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Table 2 (continued)

Studies	Authors	Location	Methods	Target- populations	Aim	Results			
						Duration (months)	Knowledge	Attitude	Practice
A qualitative study of Australian midwives' approaches to <i>Listeria</i> education as a food-related risk during pregnancy.	Bondarianzadeh et al. (2011)	Australia	Qualitative interview survey	N = 10 midwives	Investigate midwives' perceptions of the risk of <i>L. monocytogenes</i> and how they informed pregnant women about it.	No information	Limited food safety knowledge	Low priority given to food safety advice and that it was the pregnant women's responsibility rather than their own job	Varying counseling practices within the same profession Lack of time and lack of information material The study did not deal with practices
Knowledge about norovirus prevention and control among infection preventionists	Kosa et al. (2014a)	USA	Quantitative survey	N = 941 (647 infection control doctors, 202 nurses, 65 epidemiologists, 26 other professions)	To investigate infection preventionists' knowledge and awareness of norovirus.	4	Limited food safety knowledge	The study did not deal with attitudes	The study did not deal with practices
Gaps in Food Safety Professionals' Knowledge about Noroviruses.	Kosa et al. (2014b)	USA	Quantitative survey	N = 1255 (37% environmental and health protection inspectors, 17% food safety officers or food safety staff, 11% dietitians, 10% quality control officers, 8% extension agents, 7% food safety trainers, 11% other professions)	Explore food safety knowledge of food safety professionals and identify knowledge gaps.	4	Limited food safety knowledge	The study did not deal with attitudes	The study did not deal with practices

knowledge, attitudes, and practices regarding basic food safety (Buccheri et al., 2007; Mallah et al., 2023; Oludare et al., 2016; Zhao et al., 2019; Guennouni et al., 2022; Kirkham & Berkowitz, 2010) concentrated on knowledge and practices, while Bondarianzadeh et al. (2011); Buffer et al. (2012), Kosa et al. (2014a; 2014b) focused on knowledge. Four specifically examined *Listeria monocytogenes* and listeriosis (Bondarianzadeh et al., 2011; Buffer et al., 2012; Kirkham & Berkowitz, 2010; Zhao et al., 2019). Two of the studies examined knowledge about norovirus (Kosa et al., 2014a; 2014b). The healthcare professionals investigated were mostly nurses (6 cases), but also dietitians (3 cases), doctors (4 cases), midwives (2 cases), hygiene technicians (1 case), epidemiologists (1 case) and other professions (Kosa et al., 2014b). None of the investigations dealing with attitudes used a Likert scale, which is considered an optimal method for determining the strength of agreement, the frequency of action, or for example, stated certainty about knowledge (Byrd-Bredbenner & Shear, 1982).

The articles concerned any or all of the factors - knowledge, attitudes, and practices - for healthcare professionals, and related to food safety in general, or to a single pathogen. The broad search covered the last 16 years, and from all parts of the world, although non-English language papers were excluded. The fact that only ten articles could be identified, revealed an extensive research gap in the area of healthcare professionals' food safety knowledge, attitudes and practices.

### 3.1. Food safety knowledge and healthcare professionals

Our analysis showed varying levels of food safety knowledge among healthcare professionals (Table 2). More than 80 percent of the 401 responding nurses in Italy had not attended any educational course on food hygiene (Buccheri et al., 2007). Study participants gave an average of 53 percent correct answers on the knowledge questions. Those who reported having taken a food safety course had better knowledge of the risks of preparing food in advance, and the correct temperature to keep food at in a refrigerator. Some of the 340 nurses investigated in Nigeria showed limited knowledge about basic hygiene routines, which could entail a risk for patients during their period of care (Oludare et al., 2016). Four of the studies investigated the knowledge of doctors, dietitians, midwives and nurses in the USA, China, Canada and Australia regarding *Listeria monocytogenes*. These showed that some participants had never heard of this bacterium, or felt that they did not have enough information about it (Bondarianzadeh et al., 2011; Buffer et al., 2012; Kirkham & Berkowitz, 2010; Zhao et al., 2019). Dietitians in the USA and Morocco performed better than other professions on most of the food safety knowledge questions (Buffer et al., 2012; Guennouni et al., 2022). Dietitians had better knowledge than nurses on how to prevent the growth of *Listeria monocytogenes* in food (Buffer et al., 2012). For questions concerning the practice of food safety communication, the results indicated that dietitians communicated food safety advice to patients in risk groups more often than nurses. Among 397 doctors and nurses in China, 66 percent answered the general knowledge questions about *L. monocytogenes* correctly (Zhao et al., 2019). However, only 62 percent could identify unsafe foods. Among 235 doctors and 37 midwives in Canada, 88 percent had heard of *L. monocytogenes* but only 18 percent were aware that listeriosis is more common during pregnancy (Kirkham & Berkowitz, 2010). Midwives had heard of listeriosis more often than doctors, and were more likely to talk about the risk of listeriosis and risk foods for *Listeria monocytogenes* than the doctors. In a qualitative study, 10 Australian midwives reported not having enough information about *Listeria monocytogenes* to advise patients (Bondarianzadeh et al., 2011), and felt that most of their patients knew more about *Listeria monocytogenes* than they did. Other reasons for not discussing *Listeria monocytogenes* included lack of time and lack of information material. Two publications focused on norovirus (Kosa et al., 2014a; 2014b). The majority (73%) of the 941 doctors, nurses, epidemiologists and other professions in the USA were able to



correctly answer 11 of 15 knowledge questions about noroviruses (Kosa et al., 14a). Among 1255 different healthcare professionals in the USA, of whom 11 percent were dietitians, only 35 percent could identify that the second most common environments for the spread of norovirus were restaurants and parties (Kosa, Cates, Hall, Brophy, & Fraser, 2014). Notably, 65 percent of participants believed that cruise ships were one of the top three environments for the spread of norovirus although less than 1 percent of cases actually originate from cruise ships.

### 3.2. Food safety attitudes and healthcare professionals

Of the ten published investigations, only five dealt with attitudes (Table 2), and none of these investigations applied Likert scales, regarded as optimal for this research focus (Byrd-Bredbenner & Shear, 1982). Attitudes about informing patients about food poisoning risks were poor among some professionals. In a qualitative study, five out of ten Australian midwives felt that food safety advice was of low priority compared to other advice to pregnant women (Bondarianzadeh et al., 2011). For example, some Australian midwives thought that it was not their job, that it was the patient's own responsibility to find out about this, or that another healthcare professional should have informed the patient (Bondarianzadeh et al., 2011). Specifically, seven out of ten midwives felt that it was not their responsibility to inform pregnant women about the risks of *Listeria monocytogenes* and believed that this responsibility lay with the pregnant women themselves.

Positive attitudes were shown towards correct temperature control and the use of gloves; more questionable attitudes were shown towards, e.g., contamination (Bucherl et al., 2007). Based on the composite score of the questions, 57 percent of Nigerian nurses had a positive attitude towards food safety and hygiene, while 43 percent had a more negative attitude (Oludare et al., 2016). In Canada, the average score by oncology nurses for the attitude questions was 95 percent, which indicates a very positive attitude towards food safety among these study participants (Mallah et al., 2023). Of 397 doctors and nurses in China, 98 percent had a positive attitude towards listeriosis prevention and 52 percent had attended a course on listeriosis; the majority (92%) were positive about their listeriosis course participation (Zhao et al., 2019).

#### 3.2.1. Food safety practices and healthcare professionals

Seven out of ten publications dealt with the issue of practice (Table 2). Nurses in Nigeria generally had worse results for questions concerning practice (Oludare et al., 2016). More than half (54%) of the nurses reported safe routines around food handling and hygiene, while 46% reported routines that were unsafe; a relationship between attitudes and knowledge of food safety routines was shown (Oludare et al., 2016). In Morocco, the average percentage of correct answers on practices was 46 percent among doctors, dietitians, hygiene technicians and kitchen staff (Guennouni et al., 2022). However, more positively, 74 percent of participants removed jewelry before cooking. In Lebanon, nurses who attended food safety conferences had better food safety practices than those who did not (Mallah et al., 2023). In a qualitative study of ten midwives in Australia, it was revealed that they gave advice on unsafe foods but not on safe food handling (Bondarianzadeh et al., 2011). Counseling practices also varied greatly between the midwives. Participants in the studies performed in the USA by Kosa et al. (2014a; 2014b) showed knowledge gaps regarding the prevention and control of norovirus, especially in the handling of food.

## 4. Discussion

In summary, this scoping review, including a broad search of articles from all parts of the world and aiming to investigate what is known from the existing scientific literature about healthcare professionals' food safety knowledge, attitudes and practices, resulted in ten international publications. In general, the results showed a limited level of food safety knowledge among healthcare professionals, with food safety knowledge

and counseling practices varying both between and within professions. Both positive and negative attitudes were assessed, including low priority for food safety advice and a feeling of having no professional responsibility. All ten studies indicate the need for further education and training about food safety. An interesting result in terms of education seems to be the difference between basic hygiene knowledge and food safety knowledge, including food-related issues. While the general situation revealed is concerning, specific research questions varied across the included studies, and research designs differed in their complexity, the results cannot be generalized across healthcare professionals.

### 4.1. The food safety research gap

Of the ten publications identified, only one was performed in Europe; but similar research related to healthcare professionals in the Nordic countries and Sweden was lacking. The research gap that was revealed makes Swedish food safety problems, and the training needs they generates, unclear. There is a crucial question about the size and importance of the problem globally, in Europe and specifically in the Nordic countries, including Sweden. Sweden complies with European Union (EU) legislation regarding food and carries out extensive controls on food and drinking water (Swedish Food Agency, 2022). Healthcare professionals in Sweden are covered by the National Board of Health and Welfare's regulations on basic hygiene in health and social care, which means that Swedish healthcare professionals are obliged to adopt good hygiene routines in their work (National Board of Health and Welfare, 2015). However, as far as the authors know, there has been no investigation in Sweden regarding healthcare professionals' actual food safety knowledge, attitudes and practices.

In general, there are significantly more studies that examine hospital kitchen staff's knowledge, attitudes and practices regarding food safety, including those by Angelillo et al. (2000), Ercan and Kiziltan (2014) and Teffo and Tabit (2020). Kitchen staff must follow routines for good food hygiene to avoid the risk of patients getting food poisoning. This profession is possibly more explored because there is a clear responsibility relationship; a hospital can be held responsible for food poisoning if the kitchen staff have not followed the rules regarding food safety. However, when discharged from hospital, the responsibility for food safety at home lies with the patients or their family members. Advice on food safety can help patients establish good routines at home, but their behavior is ultimately not the responsibility of healthcare professionals, which may explain the scarcity of studies concerning these professions. According to the European food legislation, there is no requirement that the legislation should be applied in individual households (EC178/2002). An interesting result from the present scoping review was also the issue of designating "the responsibility of others". For example, qualitative interviews revealed that midwives did not consider it their job to give food safety advice, instead it was the patient's responsibility to find this out, or another healthcare professional should have informed the patient (Bondarianzadeh et al., 2011). This may be due to limited food safety knowledge and underestimating the food safety risk, as highlighted by Evans and Redmond (2017). It may also be supported by the narrative on failed education of healthcare professionals raised by Frenk et al. (2010). Future food safety research might usefully focus on "responsibility" and target healthcare professionals and the "grey zone" between the settings regulated by the food safety legislation and the conditions in domestic settings.

Only five of the ten publications dealt with attitudes, one of which used a qualitative method. Further, the methods for collecting this information were all inadequate. According to Arksey and O'Malley (2005), the aim of a scoping review is not to assess the quality of the included studies but this cannot pass without comment. It has been noted that Likert scales would have been optimal in the collection of data regarding attitudes (Byrd-Bredbenner & Shear, 1982). Among some professionals, the attitudes towards informing patients about the risks of food poisoning were poor. The need for more research regarding

attitudes is obvious, since attitudes have been shown to have a higher impact on behavior than knowledge (Marklinder et al., 2022). Food safety attitudes might, therefore, be crucial when it comes to food safety behavior. Baser et al. (2017) demonstrated a positive relationship between knowledge and attitudes, as well as between attitudes and behavior. Results from a Structural Equation Model demonstrated a full mediation effect of knowledge on behavior by attitudes (Sanlier & Baser, 2019). Seven of the ten publications in this present scoping review dealt with food safety practice. Oludare et al. (2016) could see a relationship between attitudes and knowledge of food safety routines. There is no opposition between practice and behavior. Thus, more research is needed to investigate the interrelationship of knowledge, attitudes and practice.

#### 4.2. The need for more food safety education for healthcare professionals

Healthcare professionals' knowledge, attitudes and practices in different parts of the world vary. The present scoping review points to results from studies that showed differences between professions and the level of food safety education. It has been shown that some healthcare professionals lack knowledge about the most basic hygiene routines or cannot identify foods that may pose a risk to a patient with a weakened immune system; however, some can answer all questions correctly.

Generally, there was limited food safety knowledge and this, along with counseling practices, varied by profession, and within the same profession. Frenk et al. (2010) highlighted the challenges regarding the education of healthcare professionals and the need for redesigning health education from a multi-professional perspective to meet the demands of working in the healthcare system. Results from the present scoping review found that registered dietitians in the USA were more likely to provide information about specific foods and food storage behaviors to prevent a *Listeria* infection than were registered nurses (Buffer et al., 2012). A possible explanation for the better performance of dietitians regarding most of the food safety knowledge questions might be that food safety is part of the dietitian's training (Buffer et al., 2012; Gould et al., 2019; Guennouni et al., 2022). Healthcare professionals are trusted by patients and have the opportunity to inform them about food safety, an opportunity they should take advantage of because there are implications for their patients. Thus, food safety communication skills are needed. Even though they do not handle food themselves they should have sufficient food safety knowledge to be able to transfer information to vulnerable groups (Gould et al., 2019). In some of the publications in the scoping review it was stated that continuing professional education is an important part of maintaining a good level of food safety knowledge, attitudes and practice (Buccheri, 2007; Mallah et al., 2023). Epidemiologists also collect and analyze data to investigate health issues in order to communicate to the public. By informing patients and consumers about risks, unnecessary cases of serious food poisoning could be avoided.

Dietitians seemed to have better knowledge than nurses about the foods that are linked to *Listeria monocytogenes*, while both groups had good knowledge concerning the risk groups. However, knowledge about preventing the growth of *Listeria monocytogenes* in foods differed. This can be partly explained by *Listeria monocytogenes* being a relatively new pathogen that first caused outbreaks in the late 1970s, with the first outbreak in humans directly linked to *Listeria* in contaminated coleslaw being reported in 1983 (Magalhães et al., 2014; Rocourt et al., 2003). An interesting question is to what extent hygiene education concerns food issues and what impact it has on food safety when delivering food safety messages to vulnerable groups. A need for food safety education among consumers, including the topic of cold food storage, has been highlighted in earlier research (Langiano et al., 2012; Marklinder et al., 2020).

In Sweden, and in Europe generally, norovirus is the most common agent of foodborne outbreaks (EFSA, 2023; Swedish Food Agency, 2019). In the present scoping review, two publications focused on norovirus (Kosa et al., 2014a; 2014b). However, only a few subjects in the studies

could identify the most common environments for spreading the virus and there was a lack of knowledge regarding food handling. This is a weakness since, in vulnerable populations, deaths are associated with norovirus infection (Mattison, 2011).

Counseling practices varied greatly between the midwives. Results from the present scoping review found that dietitians, even though they were found to have the best level of food safety knowledge compared to other professionals, still had knowledge deficiencies regarding food safety. The public have also identified dietitians as being the healthcare professionals they trust to provide food safety advice (Gould et al., 2019). To enable the correct delivery of food safety messages, education should target food-related safety issues. Promoting food safety education among healthcare professionals may be a relevant strategy. In a healthcare setting, a food safety culture could be cultivated, with daily food safety management routines, including effective leadership communication of food safety issues (Griffith et al., 2010).

#### 4.3. Methodological reflections and limitations

One weakness of this scoping review is that relevant articles might have been found on other databases. However, since there is limited research in the area, and PubMed is the largest international database in medicine (Karolinska Institutet, n.d.), it can be assumed that most studies in the field are available on PubMed. MeSH is a vocabulary of medical terms used to index and search for articles in the PubMed database. It is produced and maintained by the U.S. National Library of Medicine (NLM) and contains over 30,000 terms. It was used in order to find the most relevant MeSH terms for the search and to identify English synonyms. Thus, the authors could be confident that the ten articles corresponded to the identified research question, i.e., to investigate what is known from the existing literature about healthcare professionals' food safety knowledge, attitudes and practices, and to summarize the results.

Some consideration is required as to the reliability of the results of studies investigating the food safety practices of healthcare professionals. One of the publications reflected that answers were self-reported and therefore influenced by the participants' subjective perceptions, which do not necessarily correspond to reality. Self-reported data should be interpreted with caution (Buffer et al., 2012; Redmond & Griffith, 2003b). Investigations using an observational approach were lacking.

Further, in most of the reviewed studies, a random selection had not been made, i.e., a non-probability sample had been used (Bryman, 2018). This makes it difficult to generalize the results to all professions in the hospitals involved since it is likely that those who chose to participate had a greater interest in food safety and, probably, more knowledge about the subject. Several studies highlighted this as a weakness (Buccheri et al., 2007; Buffer et al., 2012).

In general, a strength of a scoping review is the possibility of including several different study types, potentially contributing to a broader understanding of the subject (Levac et al., 2010; Munn et al., 2018). However, summarizing and reporting the results with any uniformity can be challenging. The results from the ten publications identified were presented in different ways. Some of the studies had more comprehensive questionnaires, the results of which are presented in summary, while others used a few single questions that are presented separately in the article. Some of the studies summarize the results as percentages and others report the number of points the participants received for correct answers to the questions. In addition, the type of questions, the number of questions, and the degree of complexity varied between the studies in the publications. Finally, the study by Bondarianzadeh et al. (2011) is unlike the others and included a qualitative study where the authors have, to the best of their ability, reported the varying results as narrative in a consistent manner.

## 5. Conclusions

The present scoping review resulting in ten international, scientific publications clearly revealed a significant, and concerning, research gap in the subject of healthcare professional's food safety knowledge, attitudes and practices. The results indicate the need for food safety education, including on food-related issues, and continuous training during the healthcare professional's working life. Future food safety research might focus on the issue of "responsibility" in multi-professional healthcare settings, and on the "grey zone" between the settings regulated by the food safety legislation and the conditions in domestic settings. The limited number of articles reveals the need for more food safety research on the subject of healthcare professional's knowledge, attitudes and practices regarding food safety. This applies globally and, from our perspective, is a matter of concern in the Nordic countries, including Sweden.

## CRedit authorship contribution statement

**Ingela Marklinder:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization. **Vera Wersén:** Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Kaisa James:** Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Data availability

No data was used for the research described in the article.

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