

# **Does food handler training improve food safety? A Critical Appraisal of the Literature**

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## **Key Messages**

*The question:* Is the provision of food safety training effective at improving food safety practices of food handlers working in commercial food establishments?

- There is insufficient research evidence that food handler training, whether mandatory or not, improves food safety practices of food handlers working in food premises.
- There is limited evidence that it may enhance knowledge and behaviour.
- There is evidence that regular inspections versus complaint-based inspections reduce the number of food safety infractions.
- There is evidence that various methods of delivering training are equally effective at enhancing knowledge.
- It is recommended that Peel Public Health:
  - Not adopt a mandatory food handler training program in Peel at this time.
  - Send copies of this report to the Ministry of Health and Long-Term Care (MOHLTC) and the Ontario Agency for Health Protection and Promotion with a recommendation that further research be conducted.
  - Continue to monitor the food safety training activities of surrounding health units and the MOHLTC.
  - Revisit the literature at an appropriate time.
  - Consider participating in further research as appropriate.

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## **Executive Summary**

### **Purpose**

The result of this critical review will guide the decision of whether to implement a mandatory food handler training program in Peel Region.

### **Research Question**

“Is the provision of food safety training effective at improving food safety practices of food handlers working in commercial food establishments?”

### **Context**

An estimated one in every ten Peel residents fall victim to a food-borne illness every year (1). Food-borne illness is significantly under-reported in Peel, as in other jurisdictions across Canada (1, 2). Food handler training is seen as one strategy that can improve food safety. In Ontario, Toronto, Hamilton and London, and the Town of Brantford have implemented mandatory food handler programs. Peel Public Health has run a voluntary food handler training program since 1982 but it has never been formally evaluated.

### **Methods**

Different sources of published and unpublished research literature were searched in 2010. Literature was included if it was English, had a control group, was based in a commercial food premise and had a mandatory or certification-based food handler training program. Other studies were found by hand searching journals and references to publications in retrieved papers. Some

authors were contacted and interviews conducted with public health staff involved in developing mandatory programs in Ontario. Further papers were identified at an Ontario public health meeting.

### **Synthesis of Key Findings**

Three single studies (Cates, 2009; Noble, 2009; Kassa 2010) (3-5) and one systematic review (Mann, 2001) (2), from 41 articles found, met the inclusion criteria and were assessed for quality. Mann, 2001 and Cates, 2009 were accepted as being of sufficiently strong or moderate quality to include in this review. The review found insufficient research evidence that food handler training programs improve food safety practices among trained food handlers and limited evidence that it enhances knowledge or behaviour. Various methods of delivering training (live lecture, taped instruction, or computer system) are equally effective at enhancing knowledge. Mandatory training of managers, whose premises have been closed because of a threat to public health, decreases certain types of infractions. Despite general support for a mandatory program among staff, food operators and related professional associations, research and fiscal constraints has led Peel Public Health to recommend not proceeding with a mandatory food handler program at this time.

### **Conclusions**

There is insufficient research evidence to determine if food handler training, whether mandatory or not, improves food safety practices of food handlers working in food premises, and limited evidence that it enhances knowledge or behaviour.

## **Recommendations**

That Peel Public Health:

- Not adopt a mandatory food handler training program in Peel at this time.
- Send copies of this report to the MOHLTC and the Ontario Agency for Health Protection and Promotion with a recommendation that further research be conducted.
- Continue to monitor the food safety training activities of surrounding health units and the MOHLTC.
- Revisit the literature at an appropriate time.
- Consider participating in further research as appropriate.

# **1 Full Report**

## **1.1 Background**

### **Issue**

A March 3, 2010 Report to Peel Regional Council recommended that the Medical Officer of Health explore the implementation of a mandatory food handler training program in Peel Region and report back to Council.

Food handler training courses are intended to improve the food safety practices of food handlers working in food premises. Though these courses have been delivered by Peel Public Health since 1982, there is little evidence as to whether such training improves food safety within premises.

### **Context**

#### **a) Anecdote**

During the process of this review, staff from Peel Health and other Ontario health units were invited to a food safety workshop hosted by the MOHLTC on August 16, 2010. The meeting was held to discuss issues related to food handler training and food disclosure programs. Peel presented the preliminary results of this review and was alone in suggesting that there is limited evidence regarding the effectiveness of mandatory food safety training. Following Peel's presentation to the Ministry, various representatives from health units provided additional references. These articles were assessed for quality as part of this review after being tested for

relevancy. The majority did not meet the criteria for inclusion in this report. (See Appendix D for the list of excluded articles).

### **Food-Borne Illness in Peel**

For a variety of reasons, food-borne illness is significantly under-reported in Peel, as in other jurisdictions across Canada (1, 2). An estimated one in every ten Peel residents falls victim to a food-borne illness every year (1). Between 2004 and 2009, Peel Public Health received a total of approximately 7,000 individual reports of illness associated with food or water (7). According to a 2003 Peel Public Health report on food-borne disease, there was a general decline in the incidence of the most common food-borne diseases between 1993 and 2002 (1).

#### **b) Reasons behind the push for mandatory food handler training in Ontario**

The Canadian Institute of Public Health Inspectors, Ontario Chapter (CIPHI) has been calling on the Ontario Government for a number of years to amend the O. Reg. 562 (Food Premises) to make food handler certification training mandatory(8). CIPHI has based this request on public health inspector's observations that certified food handlers with training increase their food safety awareness and improve their food handling practices (9).

CIPHI's main reason for advocating for mandatory food handler training likely stems from a desire to provide health units with more power to enforce the existing standards. Some public health inspectors (PHI's) consulted said that if the province mandated it, there would be more funds made available to health units to conduct food handler training (10).

Justice Haines' 2004 Report, entitled "Report of the Meat Regulatory and Inspection Review: Farm to Fork – A Strategy for Meat Safety in Ontario", recommended that the *Health Protection and Promotion Act* be amended to require "each operator of a food premises to have at least one staff member who is a certified safe food handler present at a food premises during all hours of operation" (11).

Due to the variability in food safety training programs across the country, in 2004 the Canadian Restaurant and Food Services Association advocated for the introduction of a National Food Safety Training Program (NFSTP), but this has never come into effect (12).

### **c) Overview of Mandatory Food Safety Training in Canada**

#### **Federal**

Health Canada administers the Canadian Food Retail and Food Services Regulation (1999) and Code (2004) which specifies that at least one food service employee hold a food handler certificate. Ontario has not signed off on the Code with respect to this requirement (12).

#### **Provincial**

Many Canadian provinces have implemented mandatory food handler training programs including, British Columbia, Saskatchewan, Nova Scotia, Alberta and Quebec.

The Ontario Public Health Standards and Protocols (2008) states that the Board of Health shall ensure that a food safety education program is available to food handlers of all food premises

(13). However, O Reg. 562 (Food Premises) does not require mandatory food handler training, making it very difficult for health units to enforce (8).

## **Municipal**

Toronto, Hamilton, and London and the Town of Brantford have passed local bylaws allowing them to implement a mandatory program. With the exception of Toronto, these by-laws have not been evaluated to determine whether they are effective in improving food safety. Toronto's program evaluation was published and included as one of the single studies assessed in this review (Noble, 2009).

## **Peel's Food Handler Training and Certification Program**

Peel Public Health has run a voluntary food handler training program since 1982 but has never formally evaluated it's effectiveness in improving food safety. Of the people attending the course in 2009, the majority (71%) were women, and over half (57%) identified themselves as not working in the food service industry.

## **1.2 Literature Review**

A conceptual model (see Appendix A) was designed with Peel public health inspectors to show what interventions (food safety training, inspections, etc) the health department can use to prevent food-borne illness within the context of the entire food safety system.

## **Research Question**

The question that was used to guide this literature review was:

“Is the provision of food safety training effective at improving food safety practices of food handlers working in commercial food establishments?”

P - Food handlers employed in commercial food establishments.

I - Provision of mandatory or certification based food safety training.

C - Food handlers with vs. without training.

O - Enhanced food safety outcomes (knowledge, behaviour, inspection outcomes).

### **a) Search Strategy**

The searches were done using commercially available electronic databases including PsycINFO, Medline, ERIC, CINAHL, Social Science Citation Index, Science Direct, Web of Science and the Cochrane Database of Systematic Reviews.

The searches covered the years 1950 to June 1, 2010. Only English language studies were included. (See Appendix B for details on the search strategy).

The following search terms were used:

Database: Ovid MEDLINE (R) <1950 TO June Week 3 2010>

- 
- 1 food handling/ (13152)
  - 2 (food adj (handling or handler\* or preparation or process\* or serving)).tw. (3289)
  - 3 1 or 2 (15379)
  - 4 training.tw. (168405)
  - 5 exp education/ (515988)
  - 6 4 or 5 (620020)
  - 7 3 and 6 (589)
  - 8 (mandatory or obligatory).tw. (33147)
  - 9 exp Certification/ (12668)
  - 10 8 or 9 (45697)
  - 11 7 and 10 (14)
  - 12 from 11 keep 1-14 (14)
  - 13 from 12 keep 1-14 (14)

Further studies were identified through hand searching journals and references to publications in retrieved papers. Some corresponding authors were contacted for additional information. Key

informant interviews were done with public health staff involved in developing mandatory food handler programs in Ontario.

#### **b) Inclusion and exclusion criteria**

Guidelines, reviews and single studies were included if they had the following characteristics;

1. the populations included food handlers employed in commercial food establishments.
2. the intervention included mandatory or certification based food safety training programs.
3. studies measured changes to knowledge, behaviour, practices or inspection results.
4. study designs included control groups.
5. they were rated of moderate methodological quality or greater.

#### **c) Screening process for relevance**

Of 41 articles found from the initial search, 37 did not meet the inclusion criteria and were excluded. (See Appendix D for details on the excluded studies.) Four articles met the inclusion criteria and were critically appraised for quality.

#### **d) Critical Appraisal & Synthesis of Findings:**

##### **Methods of critical appraisal**

One systematic review (Mann, 2001) and three single studies not included in Mann's review published after 1999 (Noble, Cates, and Kassa) were critically appraised using appraisal tools from the Critical Appraisal Skills Programme (CASP) (14, 15).

## **Results**

Quality assessment of four articles (Mann, Cates, Kassa, and Noble), found one systematic review (Mann, 2001) and one single study (Cates, 2009) of moderate quality or better. See Appendix C - Summary of Included Articles of Food Handler Training Programs, for details on the included studies.

Kassa (4) and Noble (5) were rated as being of poor methodological quality and excluded.

Kassa's cohort study lacked detailed information about the type of training intervention provided or the population studied. Noble's case control study introduced selection bias by comparing National Pizza Chains (NPCs) employing staff trained in food safety, to randomly selected pizza establishments (RSPs) without trained staff. The issue in comparing these two types of establishments was that NPC's have enhanced capacity to address food safety issues because of their corporate affiliation, while RSPs lack external support.

Five Peel Health appraisers rated Mann's systematic review of high methodological quality.

Four Peel Health appraisers rated Cates' single study to be of moderate methodological quality.

### **Summary of Mann's review:**

Mann et al's., Canadian-based 2001 systematic review summarized the evidence on the effectiveness of food safety interventions. It was an update to a 1998 systematic review done by Campbell et al.. Besides food safety training/certification, Mann included other interventions (inspection frequency and community based education) in the review.

Mann's review found that most of the relevant evaluation studies of food safety interventions (41/55) focused on food handler training/certification. The majority (48/55) of all captured articles were of "weak" methodological quality. Mann found that rigorous evaluation research (7/55) on the effectiveness of food safety interventions is "remarkably scarce."

Three of five moderate quality studies (Cotterchio et al., 1998; Rinke et al., 1975; Waddell & Rinke, 1985) found food handler training to be effective in enhancing food safety knowledge and behaviour among food handlers. Two of these three studies (Rinke et al., 1975; Waddell & Rinke, 1985) based their findings of improved knowledge by comparing pre-post test results from different training methods (live lecture, taped instruction, or computer system). Rinke conducted the training in a classroom setting with 60 food handlers employed in university residence halls. Waddell and Rinke held the training in a classroom with 230 hospital food service staff.

Cotterchio et al., based their finding of improved behaviour on the results of inspection records from 26 restaurants run by managers whose licences were suspended due to serious food safety infractions. The study author's themselves acknowledged that "the improvement in the mandatory group's scores may have resulted from the combined effect of the training program and a perceived threat of closure" (16).

There was a lack of evidence in two studies (Kirshner, 1990; Ehiri et al., 1997) to support food handler training / certification. Kirshner randomly assigned 330 restaurants in Peel Region to two groups, one with on-site education and one without, and then within the two groups,

randomly assigned restaurants to receive two, four or six inspections a year. Inspection scores between restaurants with and without training did not differ in the number of infractions found. There was also no difference in infractions between groups receiving two, four or six inspections per year.

Ehiri et al., compared pre- and post-test scores of 188 people who received food handler training in Scotland to 204 city council employees without training from the same locality. No significant differences were found between the pre/post or intervention/control groups knowledge on a number of crucial aspects of food safety.

Mann concluded that food handler training/certification is effective in enhancing food safety knowledge and behaviour among food handlers (3/5).

Mann found one study (Bader, 1978) which showed that regular inspections decrease the number of food safety infractions compared to complaint inspections. Optimal inspection frequencies were not noted. This study randomly assigned two pairs of 158 similar restaurants in Seattle to be inspected four times per year or only upon public complaint.

**The appraisal of Mann's review found:**

- There is limited evidence that food handler training improves knowledge or behaviour.
- Various methods of delivering training, whether through live lecture, taped instruction, or computer system, are equally effective at enhancing knowledge.

- Mandatory training of managers, whose premises have been closed because of a threat to public health, resulted in improved inspection scores.
- Regular inspections decrease the number of infractions compared to complaint based inspections.

### **Summary of Cates study**

Cates 2009 retrospective cohort study examined whether the presence of certified kitchen managers (CKM) improved the result of routine inspections of restaurants with and without liquor. Using inspection scores of 8,338 routine inspections covering 4,461 establishments, Cates found that restaurants with a certified kitchen manager (CKM) had fewer infractions for food source, handling and equipment compared with those without a CKM. However, there was no difference for other issues including temperature abuse and other time control infractions.

### **The appraisal of Cates review found:**

Reviewers found issues with the sample selection, and with the lack of information on training. Records on premise type were missing for 416 of 4,461 establishments, and the inspection information was missing for 857 of 8,338 records. Both types of missing data were manually assigned. There was limited information on the type of training provided to certify kitchen managers beyond the fact that the exams be accredited by the American National Standards Institute.

## **2 Adaptability and Transferability**

A facilitated discussion took place on January 13, 2011 with staff involved in Peel Public Health's food handler training program to determine how to apply the research evidence in Peel. Participants recognized that there is general support for a mandatory program by program staff, the Ontario Restaurant, Hotel, and Motel Association (ORHMA), the Canadian Institute of Public Health Inspectors (CIPHI), the Ontario Public Health Association (OPHA), and the majority of food operators. Despite this, participants recommended that a mandatory program should not be adopted at this time due to the lack of research evidence, but that further research is considered at a later date.

A number of key themes emerged during the discussion including; concern over funding, the importance of ethno-cultural diversity, current activities to enhance the existing program and questions regarding how to measure the success of the current food handler training program.

With regards to funding, Ontario is experiencing a tight fiscal situation. Consequently, there is reluctance to initiate new programs without a solid evidence base. At the same time, there is support among regional Council for programs that demonstrate cost effectiveness. Therefore, food safety training programs need to be designed to have the greatest impact for the money.

With regards to diversity, approximately 50% of Peel's population are visible minorities and over a third speak a non-official language at home (17). Therefore, ethno-cultural diversity issues should be integrated within food safety training programs in Peel.

With regards to program enhancements, research evidence found that various methods of delivering training are equally effective at enhancing knowledge. Therefore, Peel Public Health could explore the feasibility of developing an online training course.

On the question of evaluation, the current program is not evaluating whether the food handler training impacts food safety outcomes. Therefore, an evaluation plan could be designed that measures whether food safety training results in improved food handler practices in the premises they work.

### **3 Recommended Action Items for PHWD for Peel Public Health**

That Peel Public Health:

- Not adopt a mandatory food handler training program in Peel at this time.
- Send copies of this report to the MOHLTC and the Ontario Agency for Health Protection and Promotion with a recommendation that further research be conducted.
- Continue to monitor the food safety training activities of surrounding health units and the MOHLTC.
- Revisit the literature at an appropriate time.
- Consider participating in further research as appropriate.

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- (1) Peel Public Health. State of the Region's Health - Food borne Disease. 2003:<http://www.peelregion.ca/health/health-status-report/foodborne-disease/food-hsr-2003-index.htm>.
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- (3) Cates SC, Muth MK, Karns SA, Penne MA, Stone CN, Harrison JE, et al. Certified kitchen managers: do they improve restaurant inspection outcomes?. *J.Food Prot.* 2009 Feb;72(2):384-391.
- (4) Kassa H, Silverman G, Baroud K. Effect of a Manager Training and Certification Program on Food Safety and Hygiene in Food Service Operations. *Environmental Health Insights* 2010; 4:13-20.
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## **Appendices**

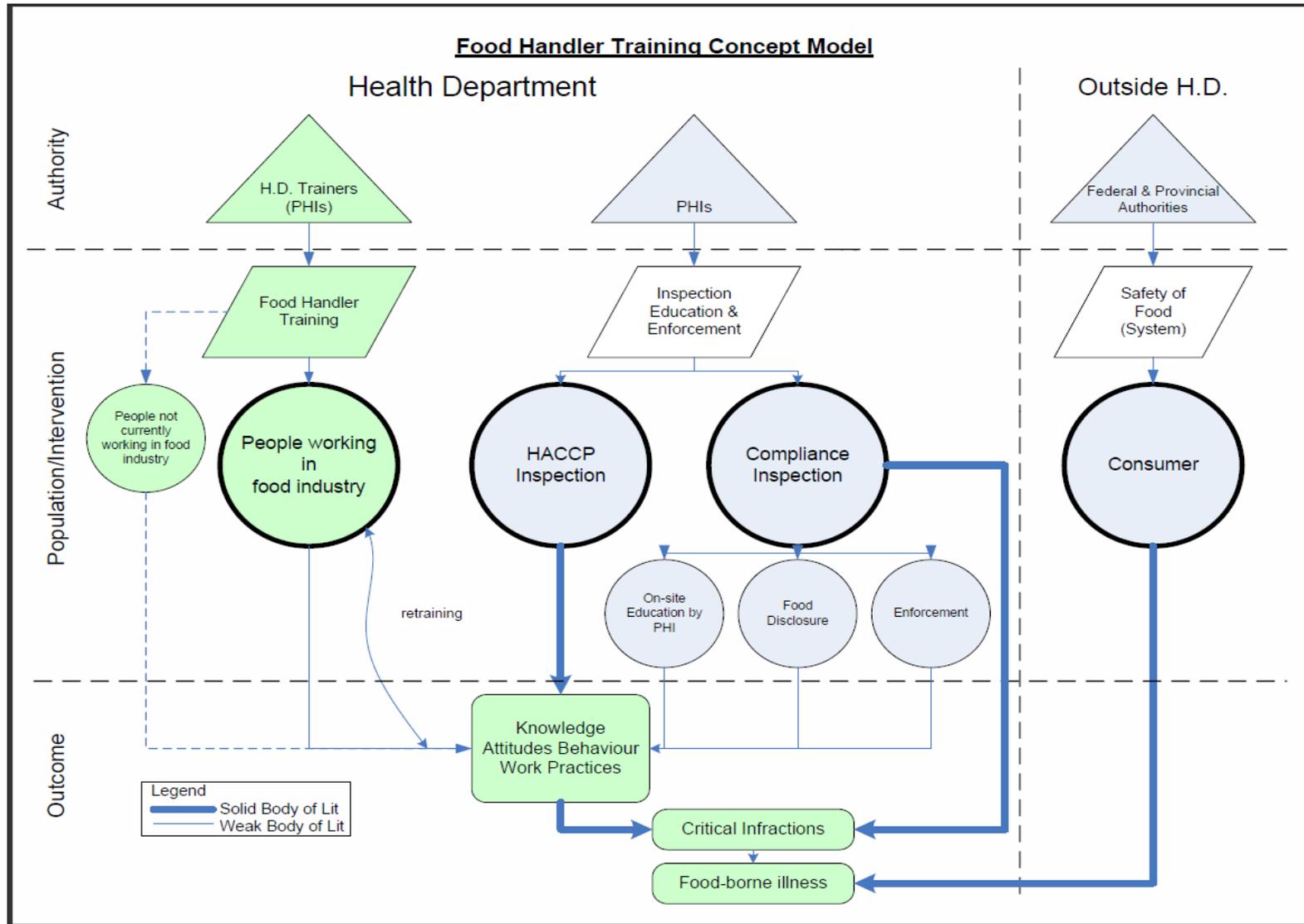
**Appendix A: Food Handler Training Concept Model**

**Appendix B: Chart 1 – Overview of Search Process**

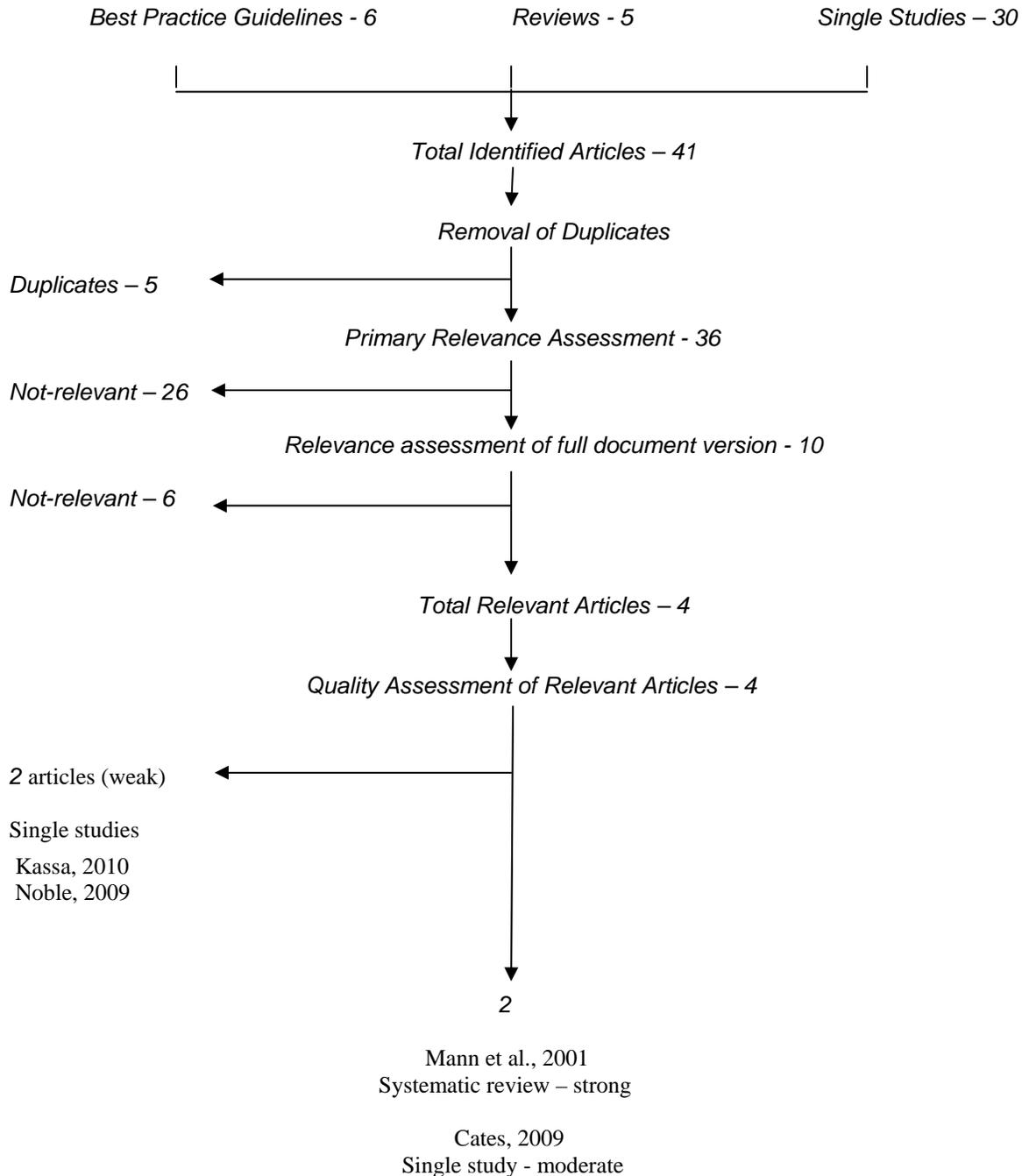
**Appendix C: Table 1 – Summary of Included Articles of Food Handler Training Programs**

**Appendix D: Table 2 – Summary of Excluded Articles of Food Handler Training Programs**

## Appendix A: Food Handler Training Concept Model



## Appendix B: Chart 1 – Overview of Search Process



### Search Strategy:

Database: Ovid MEDLINE (R) <1950 TO June Week 3 2010>

- 
- 1 food handling/ (13152)
  - 2 (food adj (handling or handler\* or preparation or process\* or serving)).tw. (3289)
  - 3 1 or 2 (15379)
  - 4 training.tw. (168405)
  - 5 exp education/ (515988)
  - 6 4 or 5 (620020)
  - 7 3 and 6 (589)
  - 8 (mandatory or obligatory).tw. (33147)
  - 9 exp Certification/ (12668)
  - 10 8 or 9 (45697)
  - 11 7 and 10 (14)
  - 12 from 11 keep 1-14 (14)
  - 13 from 12 keep 1-14 (14)

**In Clear Language:**

food handling or handler or preparation or processing or serving  
and  
training or education  
and  
mandatory or certification

Found 14 Articles

## Appendix C: Table 1–Summary of Included Articles of Food Handler Training Programs

Study, (country)	Design (Quality Assessment)	Participants (number)	Intervention	Outcome (knowledge, attitude, behaviour and / or work practices)	Findings	Relevance Decision	Comments
1. Mann, 2001 (Canada)  An update of Campbell et al.'s 1998 review.	Systematic Review (strong)  Searched for english and french language primary studies and reviews.  Hand searched journals and unpublished studies for the period 1975–1999.  Conducted relevance assessment and quality assessment.	Various  55 relevant studies captured. Of these, five food handler training studies (Kirsher, 1990; Cotterchio et al., 1998; Rinke et al., 1975; Waddell & Ehiri, 1997) were rated as being of good enough quality (moderate) to be critically appraised.	Various including: Formal courses for Managers / Staff, Lecture, Home study, CD ROM Audio tape Manuals Workshops.	Changes to inspection scores (Kirsher, 1990; Cotterchio et al., 1998)  Changes in knowledge (Rinke et al, 1975; Waddell & Rinke, 1985; Ehiri, 1997)	Of 55 relevant articles captured through the search, 48 were rated as being weak. Three of five studies (of moderate quality) (Cotterchio et al., 1998; Rinke et al., 1975; Waddell & Rinke, 1985) found food handler training to be effective in enhancing food safety knowledge and behaviour among food handlers.  There was a lack of evidence in two studies (Kirshner, 1990; Ehiri et al., 1997) to support food handler training / certification.	INCLUDED  Inclusion criteria met: Single studies included based in a commercial setting, and included food handler certification programs.  It was the best, most current review found on the subject.	Sound methodology and transparency.  Multiple interventions examined beyond food handler training.  Problems with quality assessment methodology.  Lack of rigour in the design of included single studies resulting in conclusions that could be overstated.  NOTE: Mann rated many of the moderate and strong studies (10/14) from the Campbell review as weak.
2. Cates, S. et al., 2009 (USA)	Cohort Retrospective (moderate)	4,461 establishments	Certified kitchen manager (CKM)	Inspection scores based on 8,338 routine inspection results.  Premises broken down into three categories (with liquor, without liquor, and taverns with food)	Restaurants with a CKM present during inspection were less likely to have a critical violation (CV) for certain issues (food source or handling (OR=0.80, P<0.01), facility or equipment requirements OR=0.85, P<0.05.) but equally likely to have a CV for other issues (hot holding, temperature abuse)	INCLUDED  It was too recent to be included in Mann's review.  Inclusion criteria met: Included control group, study was based in a commercial setting, and included food handler certification or mandatory programs.	Lack of adequate information on the training of CKM's.  There was no explanation about why the types of premises were selected for the study.  Some missing data on premise types and inspections were manually assigned.  The fact that a manager is certified does not necessarily mean that the certification alone causes a reduction in certain violations. Having a manager present may have an effect on improving certain conditions. Not stated in the limitations.

## Appendix D: Table 2 - Summary of Excluded Articles of Food Handler Training Programs

#	Author	Year	Title	Relevance Decision / Comments
<b>Guidelines</b>				
1	Royal College of Physicians of London	2008	Infected Food Handlers. Occupational aspects of management: A national guideline: Methods for the prevention of transmission of infection from infected food handlers	Population not food handlers in commercial food service. Intervention not food handler training.
2	Health Canada.	2006	National Guidelines for Food Safety Training Programs in the Food Retail and Food Service Sectors	Poor quality. Written to harmonize approaches to food safety training across Canada.
3	Food Safety Authority of Ireland.	2003	Guide to Food Safety Training - Food Safety Skills for Management.	Poor quality. Written to harmonize approaches to food safety training across Ireland.
4	Food Safety Authority, Australia and New Zealand	2002	Food Safety: Skills and knowledge for food businesses	Legal document for Operators to meet regulatory requirements. Not guidelines for practitioners.
5	World Health Organization (WHO)	2003	Assuring Food Safety and Quality: Guidelines for Strengthening National Food Control Systems	Food safety system related. No training intervention identified.
6	CODEX Food and Agriculture Organization of the United Nations	2006	Recommended International Code of Practice General Principles of Food Hygiene	Standards for food manufacturing.
<b>Reviews</b>				
1	Egan, MB.	2007	A review of food safety and food hygiene training studies in the commercial sector	Poor quality. Not a systematic review. Descriptive design.
2	Campbell*	1998	Effectiveness of public health interventions in food safety: a systematic review. Canadian Journal of Public Health	Duplicate. Mann is an update of this review.
3	Riben	1994	The evaluation of the effectiveness of routine restaurant inspections and education of food handlers: Critical appraisal of the literature.	Not as current as Mann. Rated poorer quality than Mann and Campbell on health-evidence.ca
4	DARE	2000	Effectiveness of public health interventions in food safety: a systematic review	Duplicate. Summary of Campbell's review

#	Author	Year	Title	Relevance Decision / Comments
Single Studies / Articles				
1	Almanza, BA.	2004	Food safety certification regulations in the United States.	Descriptive report of regulations.
2	Bassoff, BZ.	1991	Requiring formal training in preventive health practices for child day care providers.	Population not food handlers in commercial setting. Training not food safety based.
3	Chapman, B	2010	Assessment of food safety practices of food service food handlers (risk assessment data): testing a communication intervention (evaluation of tools).	Observational design. No control.
4	DeBess, E.	2009	Food handler assessment in Oregon.	Study design did not include control groups. Cross-sectional study.
5	Donaldson, RJ., et al.	1995	Essential food hygiene on CD-ROM. A new dimension in food hygiene training.	Training tool. No intervention
6	Donaldson, RJ et al.,	1994	Essential food hygiene certificate examination: examination papers reviewed.	Wrong intervention. Looked at the impact of changes to course design on test results.
7	El Derea, H	2008	Safety of patient meals in 2 hospitals in Alexandria, Egypt before and after training of food handlers.	Not English. Wrong setting (hospital)
8	Frash, R.	2006	Transfer of training efficacy in US food safety accreditation.	Study design did not include a control group. Cross-sectional design. Lack of information on the intervention.
9	Henroid, D Jr., et al.	2004	Readiness to implement Hazard Analysis and Critical Control Point (HACCP) systems in Iowa schools	Intervention is not food safety training related. Setting not commercially based. Evaluation of HACCP not food safety training.
10	Hislop N, Shaw K.	2009	Food safety knowledge retention study.	Cross-sectional design. No control.
11	Holley, RA.	2010	Smarter inspection will improve food safety in Canada.	Editorial
12	Jenkins-McLean	2004	Engaging food service workers in behavioural-change partnerships.	Observational design. No control. Based on behaviour change theory
13	Kassa, H,	2010	Effect of a Manager Training and Certification Program on Food Safety and Hygiene in Food Service Operations	Weak methodological quality. Problems with selection bias (convenience sample), not enough information on populations or training.

#	Author	Year	Title	Relevance Decision / Comments
14	Kassa, H.	2001	An outbreak of Norwalk-like viral gastroenteritis in a frequently penalized food service operation: a case for mandatory training of food handlers in safety and hygiene.	Retrospective study. No control.
15	Lynch, RA,	2003	A comparison of food safety knowledge among restaurant managers, by source of training and experience, in Oklahoma County, Oklahoma.	Observational study / cross-sectional design. No control
16	Mathias, RG., et al.*	1994	The evaluation of the effectiveness of routine restaurant inspections and education of food handlers: restaurant inspection survey.	Observational study / cross-sectional design. No control. Duplicate. Reviewed by Mann
17	Mitchell, RE	2007	Preventing food-borne illness in food service establishments: Broadening the framework for intervention and research on safe food handling behaviours.	Theoretical article
18	Noble, S.	2009	Frequency and Type of Food Safety Infractions in Food Establishments with and without Certified Food Handlers	Weak methodological quality. Problems with selection bias (convenience sample), not enough information on populations or training. No description on the methods of allocation. Limited sample size.
19	Paez Jimenez A, et al	2004	Waterborne outbreak among Spanish tourists in a holiday resort in the Dominican Republic, August 2002.	Outcome not food related. Focus on waterborne disease. Retrospective study. No control.
20	Park, SH,	2010	Evaluation of the food safety training for food handlers in restaurant operations.	Pre-post design. No control.
21	Pham, MT.	2010	A qualitative exploration of the perceptions and information needs of public health inspectors responsible for food safety	Qualitative study. No control.
22	Pilling, VK,	2008	Identifying specific beliefs to target to improve restaurant employees' intentions for performing three important food safety behaviours.	Cross-sectional design. No Control.
23	Reicks, et al.*	1994	Effectiveness of a food safety teaching strategy promoting critical thinking.	Population not food handlers working in commercial setting. Duplicate. Reviewed by Mann
24	Seaman, P	2008	Food hygiene training in small to medium-sized care settings.	Observational design. No control.

#	Author	Year	Title	Relevance Decision / Comments
25	Soneff, R*	1994	Effectiveness of two training methods to improve the quality of foodservice in small facilities for adult care	Duplicate. Reviewed by Mann
26	Sneed, J. et al.	2004	Food safety practices and readiness to implement HACCP programs in assisted-living facilities in Iowa.	Interventions not food handler training related. Focused on HACCP.
27	Tymoszewicz, Nikolas T.	2009	An examination of regulatory compliance in High and Moderate-risk Food premises with the presence of a certified food handler.	No control. Limited information on population studied. Limited information on training provided.
28	Viedma, Gil de	2000	Assessment of the effectiveness of health training courses offered for food handlers in a health care district of Gandía, Valencia	Not English. Spanish
29	Zain, MM.	2002	Sociodemographic characteristics of food handlers and their knowledge, attitude and practice towards food sanitation: a preliminary report.	No intervention. Looked at demographic profiles of food handlers in Malaysia
* Articles included in Mann's review and therefore considered duplicate.				