A review of food safety and food hygiene training studies in the commercial sector


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Abstract

This review summarises the methods and results of studies conducted worldwide on the effectiveness of food safety and food hygiene training in the commercial sector of the food industry. In particular it focuses on those studies that have tried to evaluate the effectiveness of such training. Forty-six studies of food hygiene training are included which used some outcome measure to assess the effectiveness of training. The short-term nature and variety of measures used limited the majority of studies. The need for the development of evaluation criteria of effectiveness of food hygiene training is discussed.

Keywords: Food safety; Training; Evaluation; HACCP

1. Introduction

Food safety remains a critical issue with outbreaks of foodborne illness resulting in substantial costs to individuals, the food industry and the economy (Kaferstein, Motarjemi, & Bettcher, 1997). Within England and Wales the number of food poisoning notifications rose steadily from approximately 15,000 cases in the early 1980s to a peak of over 60,000 cases in 1996 (Wheeler et al., 1999). This may be partly attributed to improved surveillance (Griffith, Mullan, & Price, 1995; Kaferstein & Abdussalam, 1999) but may equally reflect increased global trade and travel, changes in modern food production, the impact of modern lifestyles, changes in food consumption and the emergence of new pathogens (Collins, 1997; Tauxe, 1997). Recent years have seen a reversal in this trend but food poisoning remains a high priority for the public and government (Parliamentary Office of Science & Technology, 2003).

Mishandling of food plays a significant role in the occurrence of foodborne illness. Improper food handling may be implicated in 97% of all foodborne illness associated with catering outlets (Howes, McEwan, Griffiths, & Harris, 1996). In two studies of general outbreaks of infectious intestinal disease (IID) in England and Wales the primary causes were related to poor food-handling practices (Djuretic, Ryan, & Wall, 1996; Evans et al., 1998). Improper practices responsible for microbial foodborne illnesses have been well documented (Bryan, 1988) and typically involve cross-contamination of raw and cooked foodstuffs, inadequate cooking and storage at inappropriate temperatures. Food handlers may also be asymptomatic carriers of food poisoning organisms (Cruckshank, 1990).

Food handler training is seen as one strategy whereby food safety can be increased, offering long-term benefits to the food industry (Smith, 1994). A postal survey of manufacturing, retail and catering food businesses by Mortlock, Peters, and Griffith (2000) revealed that less than 10% had failed to provide some food hygiene training for staff. Less encouraging was the fact that less than 20% of managers...
were trained to supervisory level. This lack of training for food managers may restrict their ability to assess risks in their business and to assign appropriate hygiene training for their staff.

The aim of this review is to analyse studies of food hygiene training; in particular studies that have attempted to evaluate the effectiveness of training. The studies will be evaluated principally on the outcome measures used in each study and their limitations for evaluating training effectiveness discussed.

2. Background

2.1. Food hygiene legislation in the United Kingdom

New food hygiene legislation has applied throughout the UK from 1st January 2006. Regulation 852/2004 (EC) of the European Parliament and Council on the Hygiene of Food Stuff now applies to all food businesses. The Food Hygiene (England) Regulations (2006); also come into force and separate but similar legislation will apply in Scotland, Wales and Northern Ireland. Article 5 states that: Food businesses operators shall put into place, implement and maintain a permanent procedure based on the principles of hazard analysis critical control points (HACCP). With regard to training Chapter XII states that food business operators are to ensure that: “food handlers are supervised and instructed and/or trained in food hygiene matters commensurate with their work activity; that those responsible for the development and maintenance of the procedure referred to in Article 5 (1) of the Regulation or for the operation of the relevant guides have received adequate training in the application of HACCP principles, and compliance with any requirement of national law concerning training programmes for persons working in certain food sectors”. Managers responsible for maintaining a food safety management system will require adequate training to enable them to carry out the statutory requirement. Accordingly a new set of food safety qualifications will be launched in 2006 to help train managers and other staff in the essentials of food safety management systems. Furthermore Article 7 of Regulation (EC) 852/2004 on the hygiene of foodstuffs provides for the development of national Guides to Good Hygiene Practice and the Application of HACCP principles (known as Good Practice Guides). These guides are being developed by individual food sectors, in consultation with interested parties. Butchers’ shop licensing has been withdrawn across the UK from the end of 2005. Since 1st January 2006, all retail butchers are subject to the new EC hygiene regulations that apply to all other retail and catering businesses.

2.2. Hazard analysis and critical control points (HACCP)

HACCP is an internationally recognised food safety assurance system that concentrates prevention strategies on known hazards; it focuses on process control, and the steps within that, rather than structure and layout of premises (Kirby, 1994; Worsfold & Griffith, 1995). HACCP establishes procedures whereby these hazards can be reduced or eliminated and requires documentation and verification of these control procedures (Codex, 1997). Whilst HACCP has been widely adopted by the food manufacturing industry and the larger companies in the hospitality and catering sector, there have been concerns about implementation by smaller businesses. Barriers to the implementation of HACCP in small businesses have been identified which include lack of expertise, absence of legal requirements, financial constraints and attitudes (Ehiri, Morris, & McEwen, 1995; Taylor, 2001; Walker, Pritchard, & Forsythe, 2003; WHO, 1999).

2.3. Training and evaluation of training effectiveness

The Manpower Services Commission (1981) defined training as ‘a planned process to modify attitude or skill behaviour through learning experience to achieve effective performance in an activity or range of activities’. Evaluation is integral to the cycle of training, providing feedback on the effectiveness of the methods used, checking the achievement of the objectives set by both the trainer and trainee and in assessing whether the needs originally identified have been met (Bramley, 1996). Criteria that may be used for evaluating the effectiveness of a training programme include reaction to training, knowledge acquisition, changes in job-related behaviour and performance and improvements in organisational-level results (Kirkpatrick, 1967). Research on training effectiveness has focused primarily on factors that are directly related to training content, design and implementation (Tannenbaum & Yuki, 1992). However other factors outside the training environment may influence the effectiveness of any programme (Tracey, Tannenbaum, & Kavanagh, 1995).

Despite general acceptance that training efforts must be systematically evaluated, few studies have tried to identify the benefits food hygiene training brings to the industry. This is illustrated by a survey of the US lodging industry where fewer than 10% of the hospitality companies conducted formal evaluations of their training programmes (Conrade, Woods, & Ninemeir, 1994).

2.4. Transfer of knowledge into practice

To be effective food hygiene training needs to target changing those behaviours most likely to result in foodborne illness. Most food hygiene training courses rely heavily on the provision of information. There is an implied assumption that such training leads to changes in behaviour, based on the Knowledge, Attitudes and Practices (KAP) model. This model has been criticised for its limitations (Ehiri, Morris, & McEwen, 1997b; Griffith, 2000). It is accepted that knowledge alone is insufficient to trigger preventive practices and that some mechanism is needed to motivate action and generate positive attitudes.
Included studies are given in Tables 1–5. The earliest study retained and included in this review was undertaken in 1969 and the most recent in 2005. Twenty-nine studies (63%) measured knowledge (Tables 1 and 3–5). Most studies addressed attitude, behaviour and work practices concerning food safety and food hygiene in some form, however the methods varied greatly. Only four of the studies (Ehiri et al., 1997b; Laverack, 1989; Reicks et al., 1994; Tracey & Cardenas, 1996) make reference to a social cognition theoretical model as a basis for their study.

3. Overview of studies

3.1. Mapping exercise

The aim of the review was to identify criteria used by previous studies to evaluate the effectiveness of food safety and hygiene training. Reports referring to training in the context of food safety training or food hygiene training in the commercial sector were considered relevant. Only those studies written in the English language were included.

Different sources of published and unpublished research literature were searched to locate relevant papers. Searches were conducted on commercially available electronic databases including PsycINFO, Medline, ERIC, CINAHL, Social Science Citation Index, Science Direct, etc. These searches covered the full range of publication years available in each database at the time of searching. For all the databases the following search strategy was used: [{Food safety} or {Food hygiene}] and [{train*} or {teach*} or {educat*}]. All citations identified by these searches were downloaded and when possible captured and compiled as a Reference Manager database. Further studies were identified through hand searching journals and references to publications in retrieved papers.

3.2. General characteristics of relevant studies included in review

Studies were included in the review if they met two criteria:

• The study used some outcome measures to assess the effectiveness of food hygiene training.
• The study was based in a commercial setting.

A total of forty-six studies of food hygiene training were retained and included in this review. Full details of the included studies are given in Tables 1–5. The earliest study in this review was undertaken in 1969 and the most recent in 2003. Fifteen studies (32%) were from the UK, twenty (43%) from the USA, two (4%) each from Canada, Italy and Malaysia and one (2%) each from Australia, Bahrain, New Zealand, Nigeria and Saudi Arabia.

Thirty studies (65%) involved food handlers, 11 (24%) focused on food managers and one study involved both (Burch & Sawyer, 1991). The level of training was not specified in the majority of the studies, the UK studies generally used standard basic food hygiene courses. Twenty-two studies (48%) included a training intervention (Tables 1 and 3–5). Twenty-nine studies (63%) measured knowledge (Tables 1 and 3–5). Most studies addressed attitude, behaviour and work practices concerning food safety and food hygiene in some form, however the methods varied greatly. Only four of the studies (Ehiri et al., 1997b; Laverack, 1989; Reicks et al., 1994; Tracey & Cardenas, 1996) make reference to a social cognition theoretical model as a basis for their study.

3.3. Training interventions

Of the 22 studies involving a training intervention, 15 were from North America, five from the UK and one from Bahrain. North American training included courses for food handlers and food service managers. It also encompassed different types of training such as home study, workshops and more formal courses. A number of those studies also compared the results of using different methods of delivering training. Seventeen of the 22 studies used a knowledge measure to evaluate the effectiveness of the intervention, most commonly a pre- and post-test.

3.4. Study design and theoretical models

Few of the reports specified their study design. For clarity we have attributed each to one of the five evaluation designs detailed by Ovretveit (1998). A brief description of each of the designs is given here:

(i) **Descriptive**: Evaluator observes and selects features of the intervention, which he or she describes. Twenty-six of the 46 studies reviewed fell into this category (Table 1).

(ii) **Audit**: Evaluator compares what the service does with what it should or was intended to do, according to written standards or procedures. Three (Audit Commission, 1990; Holt & Henson, 2000; Morrison, Caffin, & Wallace, 1998) of the 46 reviewed fell into this category (Table 2).

(iii) **Before–after**: Evaluator compares a group of participants before and after an intervention. Seven of the 46 studies reviewed fell into this category (Table 3).

(iv) **Comparative-experimentalist**: Evaluator compares the outcomes of two groups undergoing different interventions. Five (Costello, Gaddis, Tamplin, & Morris, 1997; Howes et al., 1996; Kirby & Gardiner, 1997; Nabali, Bryan, Ibrahim, & Atrash, 1986; Rinke, Brown, & McKinley, 1975) of the 46 studies reviewed fell into this category (Table 4).

(v) **Randomised controlled experimental**: Evaluator compares one group that receives an intervention with another group that does not, but that is in all other possible respects the same. Five (Ehiri et al., 1997b; Reicks et al., 1994; Sonoff, McGechay, Davison, McCargar, & Therien, 1994; Waddell & Rinke, 1985; Wright & Feun, 1986) studies fell into this category (Table 5).
### Food hygiene training evaluation studies using a descriptive design

<table>
<thead>
<tr>
<th>Study and year</th>
<th>Country</th>
<th>Participants (number)</th>
<th>Training intervention</th>
<th>Knowledge</th>
<th>Attitude, behaviour and working practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Dagal (2003)</td>
<td>Saudi Arabia</td>
<td>Sanitarians (n = 82) Managers (n = 13) and employees (n = 27) of 13 convenience stores</td>
<td>None</td>
<td>Questionnaire</td>
<td>Self-reported practices</td>
</tr>
<tr>
<td>Burch and Sawyer (1991)</td>
<td>USA</td>
<td>Food handlers (n = 411)</td>
<td>None</td>
<td>None</td>
<td>Researcher survey</td>
</tr>
<tr>
<td>Angellilo et al. (2000)</td>
<td>Italy</td>
<td>Food handlers (n = 290) in hospitals (n = 36)</td>
<td>None</td>
<td>Face-to-face interviews using structured questionnaire</td>
<td>Self-reported hygiene practices</td>
</tr>
<tr>
<td>Angellilo et al. (2001)</td>
<td>Italy</td>
<td>Food handlers (n = 290) in hospitals (n = 36)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>Clayton et al. (2002)</td>
<td>UK</td>
<td>Food handlers (n = 137) from 52 food SMEs</td>
<td>None</td>
<td>Not assessed</td>
<td>Questionnaire, self-reported practices</td>
</tr>
<tr>
<td>Cook and Casey (1979)</td>
<td>USA</td>
<td>Food service managers</td>
<td>NIFI course, over a 5-week period</td>
<td>Written examination</td>
<td>Comparison of post-course sanitation inspection scores</td>
</tr>
<tr>
<td>Hart et al. (1996)</td>
<td>USA</td>
<td>Beef demonstrators (n = 93)</td>
<td>Pre and post-training questionnaires</td>
<td></td>
<td>Pre- and post-training questionnaires</td>
</tr>
<tr>
<td>Hennum et al. (1983)</td>
<td>USA</td>
<td>Restaurants (n = 16)</td>
<td>None</td>
<td>Interview</td>
<td>Interview and observation</td>
</tr>
<tr>
<td>Hine et al. (2003)</td>
<td>USA</td>
<td>Restaurant managers (n = 500)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>Johnston et al. (1992)</td>
<td>New Zealand</td>
<td>Managers of food service outlets (n = 300)</td>
<td>None</td>
<td>Not assessed</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>Little et al. (2002)</td>
<td>UK</td>
<td>Take-away restaurants and sandwich bars</td>
<td>None</td>
<td>Not assessed</td>
<td>Microbiological study</td>
</tr>
<tr>
<td>Manning and Snider (1993)</td>
<td>USA</td>
<td>Food handlers (n = 64)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Questionnaire, observation checklist</td>
</tr>
<tr>
<td>McElroy and Cutter (2004)</td>
<td>USA</td>
<td>Participants (n = 1,448) in Statewide Food Safety Certification program (SFSCP)</td>
<td>None</td>
<td>Not assessed</td>
<td>Self-reported changes in food safety behaviours assessed by questionnaire</td>
</tr>
<tr>
<td>Oteri and Ekanem (1989)</td>
<td>Nigeria</td>
<td>Hospital food handlers (n = 161)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Structured interview, observation of some practices</td>
</tr>
<tr>
<td>Powell et al. (1997)</td>
<td>UK</td>
<td>Staff in 30 food premises</td>
<td>CIEH basic certificate in food hygiene</td>
<td>Basic food hygiene certificate examination</td>
<td>Frequency inspection ratings</td>
</tr>
<tr>
<td>Sumbingco et al. (1969)</td>
<td>USA</td>
<td>Food service employees (n = 11) of university residence halls</td>
<td>Programmed texts for two food service tasks</td>
<td>Oral test</td>
<td>Quality of work assessed, time for doing tasks measured</td>
</tr>
<tr>
<td>Tebbutt (1986)</td>
<td>UK</td>
<td>Premises selling sliced cooked meats (n = 160)</td>
<td>None</td>
<td>Not assessed</td>
<td>Microbiological sampling, questionnaire on cleaning and disinfection</td>
</tr>
<tr>
<td>Tebbutt (1991)</td>
<td>UK</td>
<td>Staff in 89 restaurants</td>
<td>None</td>
<td>Multiple choice questions</td>
<td>Premises assessed</td>
</tr>
<tr>
<td>Tebbutt (1992)</td>
<td>UK</td>
<td>Staff in 75 premises producing high-risk foods</td>
<td>None</td>
<td>Multiple-choice questions</td>
<td>Numerical scores for premises based on 20 variables</td>
</tr>
<tr>
<td>Toh and Birchenough (2000)</td>
<td>Malaysia</td>
<td>Food hawkers (n = 100) from 15 sites</td>
<td>None</td>
<td>Structured on-site interview</td>
<td>Thirteen attitude items using a Likert scale</td>
</tr>
<tr>
<td>Wade (1998)</td>
<td>UK</td>
<td>Hospitality managers (n = 27)</td>
<td>None</td>
<td>Not assessed</td>
<td>Survey of hygiene management</td>
</tr>
<tr>
<td>Walker et al. (2003)</td>
<td>UK</td>
<td>Food handlers (n = 444) from 104 small food businesses</td>
<td>None</td>
<td>Multiple-choice questions</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Worsfold (1993)</td>
<td>UK</td>
<td>Members of the Women’s Royal Voluntary Service (n = 93)</td>
<td>Royal Society of Health Basic Food hygiene course</td>
<td>Pre-course questionnaire</td>
<td>End-of-course evaluation</td>
</tr>
<tr>
<td>Worsfold and Griffith (2003)</td>
<td>UK</td>
<td>Small or medium sized businesses handling high-risk foods (n = 66)</td>
<td>None</td>
<td>Not assessed</td>
<td>Semi-structured interview with manager; observation of hygiene practices</td>
</tr>
<tr>
<td>Wyatt (1979)</td>
<td>USA</td>
<td>Managers or owners of food markets (n = 219)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Questionnaire on attitudes, opinions, experiences and practices</td>
</tr>
<tr>
<td>Zain and Naing (2002)</td>
<td>Malaysia</td>
<td>Food handlers (n = 430)</td>
<td>None</td>
<td>Questionnaire</td>
<td>Questionnaire evaluating attitude and practice</td>
</tr>
</tbody>
</table>
3.5. Outcome measures

One of the aims of the review was to identify criteria for evaluating the effectiveness of food safety and hygiene training. Evaluation of training is complex given the number of variables that may influence the outcome, including who is being trained, the level of training, motivation and cultural dimensions. Unfortunately few of the studies were...
similar enough to allow any direct comparisons. Data were collected using a variety of research methods. These included self-completed questionnaires, face-to-face interviews, premises inspections, observation and microbiological sampling. We identified four outcome measures that could be used to compare the studies: knowledge; attitudes, behaviour and work practices; retraining and duration of effects. Our evaluation is based on these measures.

4. Results

4.1. Knowledge

Assessment of knowledge featured in 29 (63%) of the studies reviewed here (Tables 1 and 3–5). Questionnaires were used as the principal measure of knowledge. Generally these were of multiple-choice format with the number of questions varying from 8 (Tracey & Cardenas, 1996) to 55 (Medeiros et al., 1996), but some (e.g. Wright & Feun, 1986) providing no detail. Few of the studies detailed the questions used, referring only to the general topics covered. These included high-risk foods, foodborne pathogens, cross-contamination, personal hygiene, temperature control and cleaning. A number of the studies (Costello et al., 1997; Hart, Kendall, Smith, & Taylor, 1996; Laverack, 1989; Medeiros et al., 1996; Nabali et al., 1986; Reicks et al., 1994; Taylor, 1996; Tracey & Cardenas, 1996; Wright & Feun, 1986) involved interventions using pre- and post-training tests of knowledge. Nine studies (Costello et al., 1997; Hart et al., 1996; Howes et al., 1996; Medeiros et al., 1996; Nabali et al., 1986; Reicks et al., 1994; Sparkman, Briley, & Gillham, 1984; Tracey & Cardenas, 1996; Waddell & Rinke, 1985) found statistically significant improvements in the test scores of the intervention groups, whilst a further two (Laverack, 1989; Wright & Feun, 1986) measured some improvement. Two studies (Ehiri et al., 1997b; Reicks et al., 1994) found a significant difference between the intervention and control group. Only one intervention (Powell, Attwell, & Massey, 1997) measured no significant difference in post-training scores.

The results from those studies not involving any intervention also varied. These were frequently based on questionnaires and results ranged from good knowledge through to poor knowledge in critical aspects of food safety. Generally there was good awareness of common food pathogens (Al-Dagal, 2003; Angellilo, Viggiani, Greco, Rito, & the Collaborative group, 2001), but poor knowledge of temperature control, especially regarding reheating and cooling (Manning & Snider, 1993; Zain & Naing, 2002).

In summary it is very difficult to make any direct comparisons as the studies were all conducted in different ways, involving different tests. Of the 21 studies where a training intervention was included, four (Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998; Kirby & Gardiner, 1997; Palmer, Hatlen, & Jackson, 1975; Sonoeff et al., 1994) did not use any knowledge tests to evaluate the training.

4.2. Attitudes, behaviour and work practices

Very few of the studies reviewed included any detailed investigation of attitude, a cognitive element that may influence food safety behaviour and practice. Again any direct comparison of results is difficult because of the disparity of the measures used in the reported studies. The means of evaluating attitudes, behaviour and work practices fall into two broad categories, namely surveys or inspections of premises and structured questionnaires. Seventeen of the studies included a premises survey or observation of behaviour, and five studies (Cook & Casey, 1979; Cotterchio et al., 1998; Kneller & Bierma, 1990; Powell et al., 1997; Wright & Feun, 1986) used routine inspection scores. In some instances this was the sole measure of behaviour and hygiene practices. The exact range of the surveys varied but usually included inspection of physical facilities and assessments of cleaning procedures, personal hygiene and

<table>
<thead>
<tr>
<th>Study and year</th>
<th>Country</th>
<th>Participants (number)</th>
<th>Training intervention</th>
<th>Knowledge</th>
<th>Attitude, behaviour and working practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ehiri et al. (1997b)</td>
<td>Scotland</td>
<td>Intervention group (n = 188) and comparison group (n = 204) who receive no training</td>
<td>REHIS elementary food hygiene course</td>
<td>Self-administered test of 20 questions</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Reicks et al. (1994)</td>
<td>USA</td>
<td>Leaders of home study groups (n = 97)</td>
<td>Food safety instruction (2 h lesson)</td>
<td>Thirteen multiple choice questions, pre- and post-instruction</td>
<td>Pre- and post-instruction evaluation of attitudes to food safety, using 5-point Likert scale</td>
</tr>
<tr>
<td>Sonoeff et al. (1994)</td>
<td>Canada</td>
<td>Staff at 46 community based adult care facilities</td>
<td>Training workshop plus manual, manual only or no intervention</td>
<td>Not assessed</td>
<td>Pre- and post-training assessment of staff practices</td>
</tr>
<tr>
<td>Waddell and Rinke (1985)</td>
<td>USA</td>
<td>Food service employees (n = 230) at large military hospital</td>
<td>Computer assisted training (CAI) and lecture method of instruction (LMI)</td>
<td>Pre- and post-test questionnaire, 33 questions</td>
<td>Questionnaire to assess attitude to training using Likert scale</td>
</tr>
<tr>
<td>Wright and Feun (1986)</td>
<td>USA</td>
<td>Food service managers (n = 54); study group (n = 27) and control group (n = 27)</td>
<td>NIFI training programme</td>
<td>Pre- and post-tests used</td>
<td>Pre-inspection of premises; two post-inspections soon after course</td>
</tr>
</tbody>
</table>
temperature control. Quite often premises were assigned an inspection score, most usually when the study involved a pre- and post-training inspection.

Questionnaires or interviews were used to document self-reported food hygiene practices and attitudes to food hygiene and training. Attitudes were measured most commonly using a 5-point Likert scale. Less frequently studies incorporated researcher observation of food safety practices on site. In one study (Howes et al., 1996) 16 practices were observed prior to training but this was reduced to two practices post-training because of inherent difficulties with completing these observations. In three studies (Little, Barnes, & Mitchell, 2002; Tebbutt, 1986; Tebbutt, 1991) microbiological sampling was used as a measure of effectiveness.

A number of interesting results do emerge. The majority of food handlers and managers expressed a positive attitude to food safety but this was not supported by self-reported practices (e.g. Angellilo, Viggiani, Rizzo, & Bianco, 2000). Furthermore some studies have demonstrated the discrepancy between self-reported behaviour and observed or actual behaviour (Clayton, Griffith, Price, & Peters, 2002; Oteri & Ekanem, 1989).

In studies using inspections/surveys of premises four of the five studies using routine inspection scores (Cook & Casey, 1979; Cotterchio et al., 1998; Kneller & Bierna, 1990; Wright & Feun, 1986) found a significant improvement in post-training inspection scores. In the Cook & Casey study however the improved inspection score was not significantly higher than that of control establishments. Other studies using inspections (e.g. Kirby & Gardiner, 1997) reported no significant improvements. Furthermore there seemed to be no correlation between knowledge test scores and hygiene inspection scores (e.g. Cook & Casey, 1979; Powell et al., 1997).

In one UK study (Little et al., 2002) the presence of a trained manager improved food safety procedures and in one US study (Cotterchio et al., 1998) the mandatory attendance of managers resulted in improved inspection scores. A poor correlation emerged between microbiological examinations and visual inspections (Tebbutt, 1986, 1991).

4.3. Retraining and duration of effects

Retraining or refresher training featured in only four studies (Holt & Henson, 2000; Tebbutt, 1991, 1992; Worsfold & Griffith, 2003). Three studies (Holt & Henson, 2000; Tebbutt, 1992; Worsfold & Griffith, 2003) checked on the frequency of refresher training whilst the fourth study (Tebbut, 1991) assessed the management attitude to retraining as part of an interview. In one UK study (Tebbut, 1992), 41% of the businesses involved offered very limited or no retraining whilst a more recent UK study (Worsfold & Griffith, 2003) reported very little refresher training being carried out.

Thirteen studies included some measure of the impact of training over time. The time period used for those studies (Costello et al., 1997; Hart et al., 1996; Laverack, 1989; Medeiros et al., 1996; Soneff et al., 1994; Sparkman et al., 1984; Sumbingco, Middleton, & Konz, 1969; Worsfold, 1993; Wright & Feun, 1986) ranged from one week to six months. When an inspection was the measure, the time period increased up to five years (Cotterchio et al., 1998; Kneller & Bierna, 1990; Wright & Feun, 1986). Two US studies (Cotterchio et al., 1998; Kneller & Bierna, 1990) reported that improvements in inspection scores were sustained for 18–24 months and only began to decline after three years. However another study from the US reported a reduction in post-training performance after only eight weeks (Sparkman et al., 1984) whilst another found reduced inspection scores after six months (Wright & Feun, 1986).

4.4. HACCP training studies

A search of the food safety literature identified only five studies that included some evaluation of HACCP training, these included a HACCP training programme in the Lithuanian dairy industry (Boccas et al., 2001), a survey of HACCP implementation in Glasgow (Ehiri, Morris, & McEwen, 1997a) and an evaluation of a short HACCP course involving representatives from residential care homes (Worsfold, 1998). A lack of food hygiene knowledge by staff was identified as the greatest problem in a study of the application of HACCP in a flight catering establishment (Lambiri, Mavridou, & Papadakis, 1993). Training was seen as critical in order to assess hazards and control food safety in the long-term. In a study of cleaning standards and practices in 1502 food premises in the UK (Sagoo, Little, Griffith, & Mitchell, 2003a), deficiencies were associated with premises that did not have management food hygiene training or hazard analysis. Education and training is crucial in implementing any HACCP system. This has been recognised previously by both the Codex (1997) and NACMCF (1998) and is now more relevant in the UK with the introduction of new hygiene legislation.

5. Discussion and conclusions

This review particularly focused on studies that attempted to evaluate the effectiveness of food safety and hygiene training. Other reviews of effective food safety training support many of the findings from the studies examined here.

A number of reviews (Riben, Mathias, Campbell, & Wiens, 1994; Riben, Mathias, Wiens, et al., 1994; Mathias et al., 1994) undertook critical appraisals of the literature relating to food safety education in Canada, focusing on routine restaurant inspections and education of food handlers. They identified thirteen studies but many were weak, lacking in methodological detail and with poorly defined outcomes. They concluded that training had an impact on examination scores and restaurant inspection scores in the short-term. It was impossible to define a particular educational intervention as most effective due to differences in...
those used and lack of controls. In a follow up study, Mathias, Sizto, Hazelwood, and Cocksdige (1995) examined the effects of inspection frequency and food handler education on restaurant inspection violations. Those restaurants with any staff having food handler education did significantly better on the overall inspection score than those with staff who had no such education.

In a further review of the effectiveness of Canadian public health interventions in food safety 15 studies were examined and three categories of interventions identified (Campbell et al., 1998). These were inspections, food handler training and community-based education. Once again there was some evidence that interventions can result in improved food safety, but the authors emphasize that because of differences in protocols many studies are not useful in establishing guidelines.

This work was recently extended (Mann et al., 2001) and now includes 55 papers of which seven were rated as moderate and 48 rated as weak. The authors concluded that four of the seven studies provided good evidence to support the effectiveness of the food safety interventions with positive results for the main outcome measured. Five of the seven studies included in the review focused on food handler training and or certification, three of which (Cotterchio et al., 1998; Rinke et al., 1975; Waddell & Rinke, 1985) provided evidence for the effectiveness of the intervention.

Several other reviews have attempted to identify the key features of an effective training programme (Sprenger, 1991; Rennie, 1994; Taylor, 1996). Training in the workplace is one such feature. Current training is often conducted away from the workplace and there may be difficulties in translating theory into improved food handling. Rennie (1994) concluded that the need for improvements in food handling practices might be better served by training in the workplace, allowing for practical reinforcement of the hygiene message. Taylor (1996) reiterated this, arguing that the impact of food handler training is minimal and would be more effective if conducted in the workplace, where it can be job specific. She cites the minimal effect of training courses on knowledge, attitudes and behaviour of food handlers as well as their inability to influence operational practices.

Another critical issue is that of effective management training. In an evaluation of a fast food management training programme Jackson, Hatlen, and Palmer (1977), concluded that management training can be effective if it is administered on a continuous basis, supported by the owners and includes frequent follow-up. Nabali et al. (1986), concluded from their study that training of managers was effective in improving hygiene standards. A microbiological study of open, ready-to-eat, prepared salad vegetables from retail or catering premises by Sagoo, Little, and Mitchell (2003b), identified a direct relationship between food hygiene training of management, increased confidence in the food business management and the presence of food safety procedures. In a study of ready-to-eat stuffing from retail premises in the northeast of England, Richardson and Stevens (2003) suggested that poor microbiological quality of product might be related to management food hygiene training and confidence in management scores. Sprenger (1991) argues that prioritising the training of managers may be more important than that of basic food handlers. The numerous benefits of management training include the ability of managers to influence premises hygiene, less turnover of managers and their impact on the training of staff. Whereas training food handlers has had minimal impact, training managers may be more cost effective, premises hygiene is more within their remit and managers can self-inspect and train employees (Taylor, 1996). However a previous study of 300 professionally qualified catering managers does not support many of these assertions (Taylor, 1994). The results suggested that trained managers did not put their theoretical knowledge into practice or alternatively did not possess the knowledge that their qualification should have delivered. Ultimately the training did not result in the implementation of critical food safety practices in the workplace.

A further issue to arise from US studies is that of mandatory training. Penninger and Rodman (1984) addressed this issue by determining the effectiveness of both voluntary and mandatory food service managerial certification training programs in a limited random study. Mandatory programmes were more successful in certifying managers than voluntary programs with 91% of mandatory agencies claiming improvement in inspection scores, compared to 33.3% of voluntary agencies. However these findings were based on a response rate of less than 35% of the agencies surveyed. In an evaluation of the Ohio Food service manager certification course (Clingman, 1976), there was a 5.5% improvement in overall sanitation level for those restaurants whose managers had been certified. This compared to a 3.3% improvement for restaurants whose mangers were not certified. This study also noted that management turnover in non-certified manager establishments was 29.7%, whereas that in certified manager establishments was 19.5% over the study period. Similarly, the voluntary nature of the Minnesota Quality Assurance Programme for the Prevention of Foodborne Illness reduced its effectiveness (Heenan & Synder, 1978). Burch and Sawyer (1991), also recommended mandatory training based on their finding that the sanitary condition of stores was closely associated with the food safety knowledge of management.

The importance of training food handlers is acknowledged by many as critical to effective food hygiene yet there have been limited studies on the effectiveness of such training. Many of the authors recommend approaches that may result in improved food handling practices. Rennie (1995) suggests that behavioural change would be more likely if the settings approach to health promotion were adopted in food premises.

Studies involving an assessment of food hygiene training were included in this review. It is very difficult to make any direct comparisons between studies because of the varied designs and outcome measures used. Within the various
measures there was much variation and incomplete reporting of the details of the intervention methods and outcome measures. For example, few studies reported details of the questionnaires used. The majority of the studies were only short-term and while these can provide useful information, longer-term interventions and evaluations are needed to assess behavioural change. Another limitation of the studies involving interventions was the lack of information on costs or cost-effectiveness, an issue often cited as a barrier to training.

The limitations of measures used to assess training interventions are further discussed by Ehiri and Morris (1996). They found the use of pre- and post-training test scores limited for evaluation purposes as they often measure knowledge of items not reflected in behaviour change. They also highlighted the lack of correlation between examination scores and improvements in food safety by reference to the studies of Luby, Jones, and Horan (1993) and Laverack (1989). The use of food hygiene inspection scores as a means of evaluation is limited by the lack of correlation between training and inspection scores. It is worth noting also that these studies were based solely in the commercial sector. Commercial food safety is very dependent on organisational structures and cannot easily be related to individual behaviour.

Efforts to reduce the incidence of foodborne illness through interventions have had mixed results. The focus of interventions, in the commercial sector, has been on improving food handling practices. A primary aim and therefore a primary criterion for evaluation of any training is a change in behaviour towards less risky food handling practices. A related goal is to improve knowledge about food safety practices such as cross-contamination, temperature control and personal hygiene. Related to these is the issue of measuring outcomes. The principal conclusions of this review of the literature are:

Current evidence for the effectiveness of food hygiene training is limited. This review has shown that many of the studies on food hygiene training are limited both by a lack of methodological detail and of well defined outcomes, Comparisons between studies are restricted and it becomes impossible to define effective interventions due to these differences. There is a need to identify meaningful performance indicators at an individual level that can be used to measure the effectiveness of food hygiene training.

Questionnaires are a convenient measure of knowledge and attitudes but direct observation has limited value. Reliable data from the workplace is essential to develop, implement and evaluate effective food hygiene training, however information on food hygiene behaviours obtained by direct observation has limited value. Such observations are usually restricted to a small number of practices because of the variety and complexity of roles involved in food handling. Staff may also exhibit altered behaviours in the presence of the observer to present what is perceived to be a more desirable image. There are also practical considerations in relation to time and cost involved in such observations.

Evaluation of training is essential and factors other than training content and design are important. It is necessary to look beyond the training context to understand how and why training does or does not work. Issues such as managerial support, the availability of equipment and tools, training and pre-training motivation can all influence the extent to which individuals react to the training experience. Training outcomes will also be influenced by a host of other factors, both organisational and individual. These may include cultural dimensions, legislation, environmental.

Training of managers can be effective in reducing food safety problems. The training of managers is seen by many as a necessary precursor to the implementation of realistic food safety practices within the workplace. If managers were trained to advanced levels they would then provide basic training for food handlers in-house and make training more sector specific. The effectiveness of training is very dependent on both management attitude and their willingness to provide the resources and systems for food handlers to implement good practice.

Evidence from the literature suggests that food hygiene training as a means of improving food safety standards is limited by a lack of understanding of those factors contributing to successful outcomes. There is a need to develop training methods that are proven to change behaviour as well as imparting knowledge. Further research is needed on issues including course content, the site of training, duration of courses and refresher training. Such research needs to be clearly thought out, well designed with good baseline data to achieve worthwhile results.

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References


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