Improvement of food safety in school meal service during a long-term intervention period: a strategy based on the knowledge, attitude and practice triad

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ABSTRACT

The objective of the present study was to evaluate the development of food safety scores in school meal services during the application of a systematic intervention based on the knowledge, attitude and practice triad. A total of 68 public schools were included in the study. School meal services were assessed every three months with a checklist, which resulted in eight evaluations over two years. A program was developed and implemented in all the schools during this period that was comprised of three steps: 1) theoretical training, 2) implementation of action plans in situ and 3) weekly visits to motivate food handlers and monitor good practices. These steps were designed to promote changes in the attitudes and practices of food handlers. An ascending linear function was observed for the school meal services' general adequacy percentage over time. Positive developments were also observed regarding buildings and facilities, processes and procedures, distribution of meals, integrated pest management, water control, controls and records, health and safety of employees and equipment and utensils. Our results suggest that the proposed intervention strategy performs well in making school meal services conform to good practices and that strategies in this context should be permanent and continuous.

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1. Introduction

Foodborne diseases are considered to be an emerging problem and are currently a subject of major concern for the governments of various countries throughout the world. Affecting both developing and developed countries, every individual in the world is at risk of foodborne disease (WHO, 2008).

Food- and water-borne diseases contribute significantly to mortality due to diarrhea, responsible for 2.2 million deaths every year, mainly children in developing countries (WHO, 2008). However, the magnitude of the problem is believed to be even greater due to underreporting and the lack of full health monitoring systems, even in developed countries (Seaman & Eves, 2006).

Several factors contribute to the incidence of foodborne disease, including population growth, growth of highly vulnerable population groups, lack of basic sanitation, increased food production and distribution and changes in consumer behavior toward a preference for high-risk foods (Motarjemi & Kafkerstein, 1999). These factors are associated with human development and society rather than directly associated with food handlers.

Nonetheless, studies report that the inadequate handling of food is considered the main causal mechanism of foodborne disease and is directly related to several outbreak cases (Gregg, Todd, Bartleson, & Michaels, 2007; Howes, McEwan, Griffiths, & Harris, 1996). Outbreaks usually involve cases of inadequate cooking temperatures and storage and cross-contamination between raw foods and ready-to-eat foods. In these cases, food handlers are estimated to be responsible for 97% of foodborne outbreaks (Egan et al., 2007).

Thus, strategies should be employed to ensure that food handlers know good practices for food handling and that they use these
practices in their work environment. The most widely used strategy is training, which is considered to be an important method to increase knowledge and skills (Medeiros, Cavalli, Salay, & Proenca, 2011). However, Ehiri, Morris, and McEwan (1994) reported that Good Hygiene Practice training, which involves only scientific communication, is not an effective strategy for changing practices in the workplace. Rennie (1994) stated that knowledge alone does not result in changes in food hygiene practices. Failure to change behavior following training was also observed in other studies, which indicates that knowledge and practice are not always associated (Cook & Casey, 1979; Park, Kwak, & Chang, 2010). This theory may be even more consistent than is observed in the literature, as scientific bias may cause articles that report negative results or intervention failures to remain unpublished (Dirnagl & Lauritzen, 2010; Schooler, 2011).

Therefore, new methods to promote good practices in food service are needed to guarantee the quality of food provided. This assumption becomes even more important in the context of school meal programs because these programs are meant to provide food to children and young people to encourage their growth and psychosocial development (Oliveira, Brasil, & Taddel, 2008).

One of the most important public policies of the Brazilian federal government to ensure the health of the population is the provision of school meals, through the NSFP (National School Feeding Program). The program began in 1955 and over the years changes have occurred in its management until it was established, in 1979, as the NSFP. Currently this program provides, through transfer of financial resources, the food supply for all students (from day care centers, elementary schools, high schools and general education for youth and adults) enrolled in public and philanthropic schools in Brazil. Approximately 45.6 million of school meals are served every day in Brazil (Pereira, 2013).

Brazil's Good Manufacturing Practices (GMP) law does not specifically address school kitchens, ruled by laws applied to general food services. It must be considered that school kitchens are, generally, adapted rooms or similar to home kitchens, resulting in great difficulty in following GMP laws (Oliveira et al., 2008). Thus, this program deserves special attention in relation to food handling and the risks the ready-to-eat food can pose to students' health if food is mishandled.

The objective of the present study was to evaluate trends in sanitation and hygiene conditions within school meal services during the application of a systematic intervention program based on the knowledge, attitude and practice triad.

2. Methods

The present study included all public schools (n = 68) of a highly developed municipality of São Paulo (Brazil) with a 0.8340 Human Development Index (UNDP, 2000). Schools participating in the study covered all age groups involved in basic education, including kindergarten, preschool, elementary, middle and high schools for young people and adults. A total of 365 food handlers participated in the intervention and were distributed among the school meal services being evaluated.

None of the school meal services had implemented the Hazard Analysis and Critical Control Points (HACCP) program before the intervention.

2.1. Checklist and application

A good practice checklist was developed based on current legislation in Brazil, including CV-18 (São Paulo, 2008), RDC 216 (Brazil, 2004) and CV-6 (São Paulo, 1999), and on the food standards present in the Codex Alimentarius (2003). The checklist contained ninety-five items divided into eleven thematic areas: area one — receipt, containing six questions; area two — storage, containing seventeen questions; area three — processes and procedures, containing twenty questions; area four — distribution of meals, containing four questions; area five — pest control management, containing two questions; area six — controls and records, containing four questions; area seven — waste management, containing six questions; area eight — health and safety of employees, containing three questions; area nine — water control, containing four questions; area ten — equipment and utensils, containing twelve questions and area eleven — structure and buildings, containing fourteen questions. The checklist questions were given a score of one point for compliant conditions and zero for non-compliant conditions.

Trained nutritionists applied the list to all schools participating in the study, thereby providing a diagnosis of the sanitation and hygiene conditions of the school meal services. This diagnosis stage was identified as time zero (0) of the intervention.

After applying the checklist, fitness scores were calculated for each thematic area. The scores were calculated as the number of points achieved in the thematic area divided by the maximum number of points possible for that particular area and then converted into a percentage. The same procedure was followed to generate an overall adequacy score. This variable included all scores obtained across the ninety-five items and corresponded to a mean adequacy for all thematic areas.

After discussing the strengths and weaknesses observed in each school meal service, an intervention program was proposed. This intervention program was monitored by repeated applications of the same checklist used in the diagnostic stage. The checklist was applied every three months, for a total of eight evaluations performed over a two-year period (10, 11, 12, 13, 14, 15, 16 and 17). The purpose of this application was to monitor the behavior of the scores of each thematic area and the total scores of school meal services after the intervention program was implemented.

2.2. Intervention program

The proposed intervention program provides a new form of intervention to promote good practices in food service as it combines strategies and concepts presented in other studies. The knowledge, attitude and practice triad serves as the central axis of the intervention program (Bas, Eser, & Kivanc, 2008; Sharif & Al-Malki, 2010) and the program evaluation uses hybrid models (combination of internal and external evaluation) (Bourgeois, Hart, Townsend, & Gagné, 2011); the program also includes scheduled monitoring of good practices (Bader, Blonder, Henrikson, & Strong, 1978) and motivation of food handlers (Seaman, 2010).

Systematization of the intervention model was adapted from Seaman (2010) (Fig. 1).

The intervention consisted of three stages: 1) theoretical training focused on improving knowledge, which was held every six months; 2) good practices evaluation and implementation of in situ action plans to correct nonconformities and to align practices, every three months and 3) weekly visits to all school kitchens to monitor action plans and motivate food handlers. The first and second stages were conducted by nutritionists outside of the school meal services (external assessment and intervention) and the third stage was conducted by trained tutors and staff from the municipality (internal assessment and intervention).

A total of five 12-h theoretical trainings were performed. Each training included three breaks for meals. These trainings were conducted in classrooms with a maximum of thirty food handlers.
in each group. They included dialogical lectures and projected presentations on the following issues: food contamination, receiving, storage, processes and production, distribution, pest control, waste management, food handlers’ health and safety, environmental hygiene, equipment and utensils, visitor procedures, operation of the milk dispensary, records and controls, quality assurance, procedures for freezing goods, sampling and interpersonal relationships. All training topics were selected based on the results obtained from the assessments carried out with the school meal services. Food handlers were given handouts and materials on the topics covered in training. External evaluating nutritionists provided the instruction at this stage. At the end of the training, all food handlers were given an assessment with questions about the topics covered.

The second stage of the intervention, which corresponds to the action plan, was planned and performed individually and in situ within the school meal services by a team from outside the municipality, during the same week in which the quarterly evaluation was held. The aim of this stage was to correct specific inadequacies observed in each school kitchen. During this stage, inadequacies regarding good practices were noted for all food handlers and targets were drawn up for the next evaluation to be implemented in three months.

The action plan consisted of the following items: identification of inadequacies, determination of corrective actions, individual orientation of the food handlers with the demonstration of correct procedures, observation of the handlers’ practices and goals for the next quarterly review. Order requests were submitted to the school board and the school meal services coordinator when structural problems were noted, equipment and utensils were needed or any other factor regarding management and/or use of resources was identified.

The third stage included an individualized weekly visit to each school meal service performed by tutors. These tutors were food handlers who had been trained to develop monitoring for school meal services and were therefore considered internal evaluators. During this stage, food handlers were invited by the tutors to report any difficulties in the workplace and to make suggestions for improvement of the sanitation practices. This stage was also designed to monitor the progress of action plans by evaluating the adequacy of the procedures performed.

At the end of each quarterly assessment, a report was issued and copies were sent to the municipality’s school food sector for referrals relating to management, procurement and reforms.

2.3. Data analysis

Trend analysis using regression models was chosen for the data analysis. This analysis facilitated evaluation of the behavior of the dependent variable (Y), the good practices adequacy percentage, in relation to the evaluation periods (X). A total of eight evaluations occurred every three months.

First, scatter diagrams were made showing the relationship between the adequacy percentages and the time variables to verify the type of relationship between these variables.

The time variable (X) was centralized, therefore “X-11.5” was used, where 11.5 is the mean time in months of the study period. This procedure prevents collinearity between terms of the regression equation.

First, the simplest linear regression model was tested \( Y = \beta_0 + \beta_1 X \). Based on the function identified in the scatter diagram, models of higher orders were also tested, including second degree \( Y = \beta_0 + \beta_1 X + \beta_2 X^2 \), third degree \( Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3 \) and exponential \( \ln (Y) = \ln (\beta_0) + (\beta_1 X) \) models.

The model that showed greater statistical significance and normal residuals was considered the best-fit. Models with \( p < 0.05 \) were considered significant.
3. Results and discussion

A total of 512 evaluations were performed, corresponding to eight assessment points for each of the sixty-eight school meal service research participants.

3.1. Evaluation of the intervention program

Table 1 shows the regression models for each thematic area evaluated. The first value of the equation is the mean adequacy percentage followed by its increment (positive or negative) after each intervention; the explanatory power (r²) and significance (p) of each model are also listed.

An ascending linear function was identified for the overall adequacy percentage, showing that the intervention strategy used explains 57% of the improvement in good practice scores over the observation period (p < 0.01). Therefore, the intervention strategy tends to bring food services into line with health legislation. Bader et al. (1978) evaluated food service establishments and showed that sites that received four health inspections per year obtained final good practice scores 47% higher than sites that only had one inspection performed. This result shows that systematic and frequent visits help in the motivation and monitoring of food services; therefore, they improve good hygiene practices. Has been recently published a specific good practice checklist for Brazilian school meal services. This tool can be an option to assess and monitor the food safety on this environment (Stedeck, Cunha, Silva Junior, Oliveira, & Silva, 2013).

Fig. 2 shows the regression models of the thematic area variables over the eight ratings. Reduction in the overall adequacy percentage in month ten (fourth assessment) was observed (Fig. 2A). In addition to the overall percentage, small reductions occurred in the following thematic areas: building and utensils, buildings and facilities (Fig. 2A), processes and procedures, controls and record (Fig. 2B) and storage (Fig. 2C). These adequacy percentage reductions coincided with holiday periods for the food handlers. Absence from the workplace most likely led handlers to resume incorrect practices that had previously been corrected. Therefore, interventions should be continued and strengthened especially after holiday periods to avoid inadequacies. Furnari et al. (2002) observed that ongoing training reduced the resistance of food handlers to using food handling knowledge in their practice.

When the thematic areas were analyzed separately, positive increments were observed in the following areas: buildings and facilities (p < 0.01), processes and procedures (p < 0.01), meal distribution (p < 0.01), integrated pest management (p < 0.01), health and safety of employees (p < 0.01), water control (p < 0.01) and equipment and utensils (p < 0.05). In this case, the positive effect was demonstrated with linear and coefficient of determination models above 0.50 for all tests. This indicates that up to 50% of the variation between evaluations can be explained as a function of time, and therefore, of the intervention.

Using a quadratic model, favorable development was observed in the controls and records thematic area (Fig. 2B). This model indicates that despite positive development, in the period between the second and fourth assessment, there was a reduction in correct practices in relation to the completion of temperature control sheets and labels with usage information and food quality. Locks et al. (2011) in a cross-sectional study of school meal services, observed that the filling of records and controls was the third largest inadequacy observed with respect to good practices. These results show that food handlers may exhibit resistance to the completion of records and controls, but the intervention proposed here improved adequacy in this area by 33.4% over two years.

Positive effects of food safety-related interventions in terms of changing practices have been observed in different contexts, such as hospitals (El Derea, Salem, Fawzi, & Abdel Azeem, 2008), street food vending (Choudhury, Mahanta, Goswami, & Mazumder, 2011), small businesses (Bush et al., 2009) and with those responsible for food services (Kassa, Silverman, & Baroudi, 2010). However, these studies have been conducted using strategies with school meal services that demonstrate a positive effect on practices.

The thematic areas of integrated pest management (Fig. 2B) and health and safety of employees (Fig. 2D) reached nearly 100% adequacy, with 98.6% and 95.3% adequacy, respectively. For integrated pest management, the most influential positive factor was adjustment in the frequency of chemical control use and the retrieving of prohibitive documents. About the thematic area of health and safety of employees, the training adequacy, purchasing of utensils and frequency of medical exams contributed to the achieved adequacy.

The waste management thematic area showed a negative increment (p < 0.01), and the receiving and storing blocks did not change significantly between assessments. Handlers most likely failed to prioritize these activities in relation to others because they were identified as low risk for foodborne disease. Internal evaluators may also not have prioritized these steps, failing to monitor them and propose corrections.

Such factors depend on the perception of risk involved. Food handlers were shown to have reasonable perception of foodborne illness risks in a study performed with school meal services (Da Cunha, Stedeck, & De Rosso, 2012). This perception increased with participation in mandatory training. Lower adequacy percentages for waste management have also been reported (Cardoso et al., 2011; Locks et al., 2011) and may be a reflection of the lack of perception of risk for this activity by food handlers in these locations.

3.2. Practical implications

The intervention strategy used combined internal and external evaluation. This combination provides results closer to reality and facilitates the planning of interventions. Internal assessment provides deep insight into the organization and work, facilitating decision-making (Bourgeois et al., 2011). The external evaluator tends to understand cultural and political motivations behind behavior in the service (Conley-Tyler, 2005). Moreover, the evaluator understands well the nature of the results, and thus the results can be used more effectively (Minnett, 1999). The external evaluator has greater access to information because people tend to be more sincere about their problems with people who are not involved in their daily routine (Conley-Tyler, 2005). Additionally, the external evaluator more easily identifies errors inserted into...
work routines, evaluating the service with greater objectivity and reduced bias, which is fundamental, especially with regards to summative assessments (Bourgeois et al., 2011; Conley-Tyler, 2005).

Another important practical implication is that in 2007 Brazil began to work together with the World Food Programme (WFP) of the Food and Agriculture Organization of the United Nations (FAO) in the structuring of school feeding programs in several countries in Latin America, the Caribbean and Africa (Organization of American States, 2008). The development and improvement of materials to ensure food security cannot only benefit the Brazilian school feeding program, but also help other countries that cooperate with Brazil.

4. Conclusion

The systematic intervention strategy proposed by the present study was effective in improving school meal services' adequacy in terms of food service hygiene laws.

The strategy was important for the improvement of sanitation and hygiene conditions regarding structural issues, controls and records and food handling activities, all of which are essential for quality assurance. Activities before and after food handling, such as raw material receiving, storage and waste disposal, were not prioritized by food handlers. Handlers most likely identified such actions as low risk for food contamination. However, this hypothesis needs to be tested.

Another important finding observed in this study was the reduction in the overall adequacy percentage after food handlers' holiday periods. Permanent intervention strategies should be prioritized with emphasis on the period after vacation periods and sick leave.

Importantly, intervention strategies for food handlers' practices, even successful ones, should not be observed as a panacea for problems involving foodborne diseases. Several aspects influence sanitation and hygiene practices in food service units, and those responsible must carry out constant monitoring, food handler motivation, structural reforms and quality assurance of food and raw materials, among other actions.

The performance of this strategy may be observed in other food service areas, such as restaurants, hotels and even the street food.

References


