HYGIENE TRAINING OF FOOD HANDLERS IN HOSPITAL SETTINGS: IMPORTANT FACTOR IN THE PREVENTION OF NOSOCOMIAL INFECTIONS

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SUMMARY

The aim of this study was to evaluate the effects of food hygiene training of food handlers on sanitary-hygienic conditions in hospital kitchens, based on microbiological analysis of smears taken in hospital kitchens.

The study was conducted in the 1995−2009 period at the Clinical Centre Niš, Serbia. The food hygiene training was conducted in February 2005, by an infection control officer.

1,076 smears in the central kitchen and 4,025 smears in distributive kitchens were taken from hands and work clothes, work surfaces, equipment, and kitchen utensils. Microbiological analysis of smears was carried out in an accredited laboratory of the Public Health Institute Niš (Serbia). A significantly lower percentage of smears with isolates of bacteria ($p<0.001$) taken from hands and work clothes, work surfaces, equipment and kitchen utensils in the central and distributive kitchens was observed in the period following the food safety education programme (2005−2009). The most commonly isolated bacteria was: *Enterobacter spp.*, *Acinetobacter spp.*, *Citrobacter spp.*, *and E. coli*. Our results confirmed that food hygiene training improved hygiene and is also an important component for the prevention of nosocomial infection.

Key words: hygiene training, hospital, kitchen, smears

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INTRODUCTION

Nosocomial infections are a common problem that increases the length of hospital stay, hospital cost and often affects patients' quality of life, survival and response to treatment (1, 2).

To prevent nosocomial infection, the maintenance of a high degree of hygiene in hospital settings is necessary. Poor hygiene in the system of preparation and distribution of food, poor personal hygiene of food handlers as well as food safety pose significant risk of the development of food borne infections in hospital settings (3, 4).

Data from the literature indicated that poor hygiene practice in hospital kitchens may be the cause of outbreaks of infections in hospitals, some of them resulting in death of patients (5–8). Almost all of cases (88%) and deaths in outbreaks of listeriosis in Canada were people from the hospital or older people who were living in a long- term care home, because deli meats contaminated with listeria was distributed to hospitals. Listeria was found in niches deep inside two slicing machines (9). The most common reasons of food borne infection in hospitals are: improper holding time or temperature, contaminated equipment, poor personal hygiene, and food from unsafe sources (4).

The Clinical Centre Niš is the second largest hospital in Serbia, with 1,553 beds and 28 departments with a catchment area with around 2 million residents.

The purpose of this paper is to analyze sanitary-hygienic conditions in the Clinical Centre Niš based on the retrospective analysis of microbiological smears taken in hospital kitchens, before and after food safety education of their staff.

MATERIALS AND METHODS

In the period between 1995 and 2009, sanitary-hygienic situation in kitchens of the Clinical Centre Niš was controlled by the bacteriological analysis of smears. Microbiological status of the smears has been analyzed concerning the causes of positive smears and the location of bacteria.

In our hospital, meals are prepared daily and cooked in the central hospital kitchen and distributed to the distributive kitchens in the Clinics.

In the period from 1995–2004 (before the food safety education programme), the smears were taken every fourth month from the central kitchen and every sixth month from distributive kitchens. After the implementation of the food safety programme started in February 2005 in the Clinical Centre Niš, the smears started to be taken more frequently – every month from the central kitchen, and every third month from distributive kitchens.

During both periods of investigation, smears in kitchens were taken from hands and work clothes, work surfaces, equipment, and kitchen utensils.

Microbiological Analysis of Smears

The analysis of the samples has been conducted in an accredited laboratory (ISO 17025) of the Public Health Institute Niš (Serbia).

The food utensils, work surfaces and their contact surfaces as well as hands and work clothes were swabbed using sterile cotton smears moistened with sterile quarter strength Ringer solution.

The samples were transported as soon as possible to the laboratory using an insulated ice box containing an ice pack (10).

The smears were streaked on blood agar supplemented with 5% defibrinated sheep blood (Himedia, India) and Endo agar (Torlak, Beograd). Plates were incubated under aerobic condition at 37°C for 48 h. After the incubation, isolated species were identified using Gram strain, colony morphology and appropriate biochemical tests.

Food Hygiene Training

The food hygiene training was conducted in February 2005 by an infection control officer. Education about food borne disease hazards and appropriate preventive measures in hospitals included:

- how to avoid foods from unsafe sources – to obtain food from safe and approved sources: food produced and processed in institutions with implemented Hazard Analysis and Critical Control Points (HACCP) or ISO 22000 and with food safety certificates complying with the Serbian law on food safety (11), and never use home prepared food in hospitals;
- proper food handling: reception of food, storage (keeping food at a safe temperature), preparation (avoiding cross contamination: raw and ready to eat foods), cooking and serving of food (various times and temperatures required for production and safekeeping of ready to eat meals);
- maintenance of personal hygiene (proper hand washing and hand drying) according to recommendations (12) and methods used for cleaning kitchen.

Results of food hygiene training based on microbiological analysis of smears taken in hospital kitchens were interpreted by a physician (specialist in hygiene) from the Public Health Institute Niš.

RESULTS

In the first ten years (1995–2004) of research, in 101 (25.8%) out of 391 smears taken from the central kitchen – bacteria were isolated (positive smears) pointing to rather poor sanitary-hygienic situation in the facilities investigated. After the food hygiene training (2005–2009), there were only 15 (2.2%) positive smears out of 685 taken and analyzed ones (Table 1).

In the period before the food hygiene training in almost every fifth smear (251 (19.5%) out of 1,285 analyzed smears) from distributive kitchens bacteria had been isolated, and after the food hygiene training only 129 (4.7%) out of 2,740 analyzed smears were positive (Table 2).

Significantly lower percentage of positive smears ($p<0.001$) from hands and work clothes, work surfaces, equipment, and kitchen utensils in the central as well as in distributive kitchens were observed in the period after the food hygiene training compared to the percentage of positive smears in the period preceding the food hygiene training (Table 1 and Table 2).

Fig. 1 and Fig. 2 show linear trends of positive samples from the central and distributive kitchens of CC Niš from 1994−2009.

The results showed a decreasing trend in the proportion of positive smears in the central kitchen and in distributive kitchens as well (Fig. 1 and Fig. 2).

Table 3 shows the most commonly isolated bacteria.

In both periods of investigation, the most commonly isolated bacteria were *Enterobacter spp*., *Citrobacter spp.*, *Acinetobacter spp*. and *E. coli*.

DISCUSSION AND CONCLUSION

The results of most studies showed that food hygiene training of food handlers improved food safety knowledge in respect of personal hygiene, cross-contamination and temperature control (13) and noted that knowledge of food hygiene alone, without motivation for implementation does not lead to the change in behaviour of those concerned (14, 15).

Over the past fifteen years (1995–2009) there were no outbreaks of food borne illnesses reported in our hospital.

The results of the analysis assessing the period preceding the hygiene training (1995–2004) in the Clinical Centre Niš showed inadequate washing and disinfection of working surfaces (in the central kitchen specially) and equipment and kitchen utensils. Inadequately cleaned surfaces promote the spread of microorganisms. The probable cause of these results is the fact that working surfaces, equipment and kitchen utensils in the central and distributive kitchens are very often amply covered by organic materials which can inhibit the effect of disinfectants. So preliminary cleaning with warm water and adequate amount of detergent before the proper application of disinfectants (concentration and time of application) is of the greatest importance.

In most of other studies, food from unsafe sources and inadequate food handling were the most common causes of food borne illness in healthcare settings, or the cause of illness was not identified (4).

Unfortunately, in only few studies the relation between the food hygiene training of food handlers and improvement of hygiene in hospital kitchens and food safety has been considered.

Table 1. *The numbers of analyzed smears (n) taken in the central kitchen from 1995−2009, and the number and percentage of positive smears (n_{pos})*

	Hands and work clothes		Work surfaces		Equipment and kitchen utensils		∑	
	n	n_{pos} (%)	n	n_{pos} (%)	n	n_{pos} (%)	n	n_{pos}(%)
1995−2004	77	19 (24.6)	60	25 (41.7)	254	57 (22.4)	391	101 (25.8)
2005−2009	133	5 (3.8)	82	4 (4.9)	470	6 (1.3)	685	15 (2.2)
p*	<0.001		<0.001		<0.001		<0.001	

*Chi square (χ^2) test

Table 2. The numbers of analyzed smears (n) taken in distributive kitchens from 1995–2009 and the number and percentage of positive smears (n_{pos})

	Hands and work clothes		Work surfaces		Equipment and kitchen utensils		∑	
	n	n_{pos} (%)	n	n_{pos} (%)	n	n_{pos} (%)	n	n_{pos} (%)
1995−2004	167	36 (21.6)	131	28 (21.4)	987	187 (19.0)	1,285	251 (19.5)
2005−2009	638	35 (5.5)	259	23 (8.9)	1,843	71 (3.9)	2,740	129 (4.7)
p*	<0.001		<0.001		<0.001		<0.001	

*Chi square (χ^2) test

Table 3. The most commonly isolated bacteria (%) in positive smears taken in kitchens of the Clinical Centre Niš in the period before (1995–2004) and after food hygiene training (2005–2009)

Bacteria	Central kitchen		Distribution kitchens	
	1995–2004	2005–2009	1995–2004	2005–2009
Enterobacter spp.	28.7	33.3	23.9	34.9
Citrobacter spp.	13.9	26.6	14.7	13.2
E. coli	20.8	6.7	15.5	7.7
Acinetobacter spp.	19.8	6.7	25.1	21.7
Other*	17.8	33.3	25.8	22.4

**Bacillus spp., Pseudomonas spp., Coagulase negative Staphyloccocci, Proteus spp., Staphylococcus aures*, etc

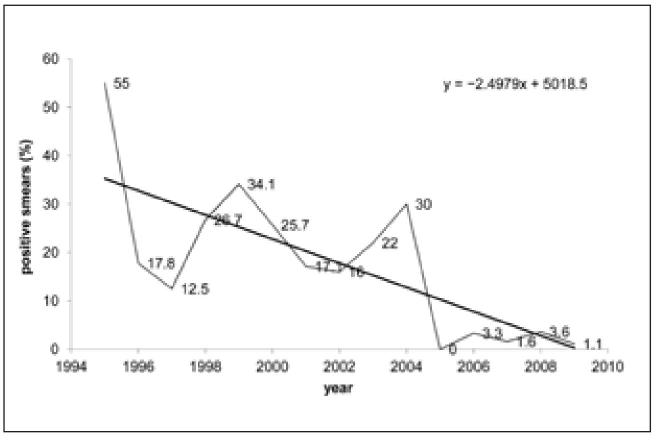

***Fig. 1.** Linear trend of positive smears in the central kitchen of the Clinical Centre Niš from 1995–2009.*

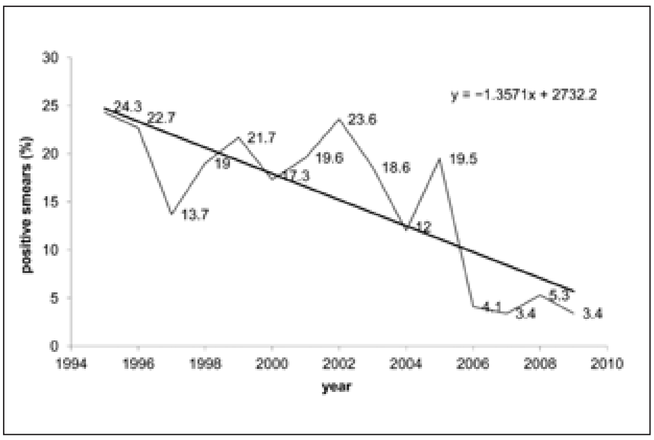

***Fig. 2.** Linear trend of positive smears in distribution kitchens of the Clinical Centre Niš from 1995−2009.*

In two hospitals in Alexandria (Egypt), the bacteriological quality of most of patient meals and working surfaces and utensils in hospital kitchens improved after the hygiene training (16). In a teaching hospital in Spain, *S. enteritidis* infection was identified in 22 inpatients. After the implementation of kitchen hygiene procedures, no more cases were detected (17).

The results of the analysis show that the percentage of positive smears in kitchens of the Clinical Centre Niš from 1995−2004 was high. However, after the food hygiene training the percentage of positive smears from hands and work clothes, work surfaces, equipment, and kitchen utensils significantly decreased in the central as well as in distribution kitchens.

In the 15 years of research, the most common bacteria were *Enterobacter spp.*, *Escherichia coli*, *Citrobacter spp.* and *Acinetobacter spp*. They have been found in more than 60% of the positive smears. The bacteria found indicated the inadequate personal hygiene in observed kitchen employees.

Among the isolates there was *Acinetobacter spp*. one of the common causes of nosocomial infection in Serbia (18, 19). *Acinetobacter spp*. are becoming a problem because of their rapid development of resistance, with high mortality rates of 20 to 60% (20). It is worth to know that the numbers of isolates with *Acinetobacter spp*. in the Clinical Centre Niš were much lower in the period following food hygiene training.

This study has some limitations. During the period of investigation there were no reconstructions of hospital kitchens, nevertheless, more frequent visits of infection control officers (who started to work in the Clinical Centre Niš in February 2005) after the education may be a confounding factor.

This study confirmed the importance of continuous training of food handlers to ensure sanitary hygienic conditions in hospital kitchens settings. Our study also highlights the importance of the infection control team establishment (physician, infection control officer and nurse) to prevent outbreaks of food born diseases in hospitals.

Therefore, simultaneously with the implementation of HACCP in hospital kitchens and in order to reduce the risk of nosocomial infections, continuous food hygiene training is required.

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