

Food safety performance and risk of food services from different natures and the role of nutritionist as food safety leader

Desempenho e risco dos serviços de alimentação em segurança dos alimentos e o papel do nutricionista como líder em boas práticas de manipulação

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Abstract *The objective of this study was to evaluate the food safety performance of food services and its associated factors. The study involved 84 food businesses in the city of Santos as follows: street food kiosks and beach kiosks (street food), commercial restaurants, hospitals and school meal services (institutional food services). A food safety checklist with 81 items was applied. The overall percentage of adequacy was lower in street food kiosk (49.7%) and beach kiosk (62.0%) than in restaurants (69.7%), hospitals (83.9%) and schools (86%). Institutional and commercial restaurants showed higher scores of food safety performance than street food services, mainly regarding riskier practices. The variables positively associated with food safety performance in commercial restaurants were: presence of a nutritionist as leader and adequate structure. These results show that street food services need, in a mediate way, the implementation of new strategies and regulations to improve food safety. A nutritionist acting as food safety leader may improve the food safety performance at commercial restaurants.*

Key words *Food safety, Food service, Risk assessment, Nutritionist*

Resumo *O objetivo desse estudo foi avaliar o desempenho dos serviços de alimentação e seus fatores associados. O estudo envolveu 84 serviços de alimentação na cidade de Santos, sendo estes: ambulantes, quiosques de praia (grupo comida de rua), restaurantes (grupo alimentação comercial), hospitais e escolas (grupo alimentação institucional). Uma lista de verificação com 81 itens foi aplicada. Classificações de risco sanitário foram utilizadas para cada item. O percentual geral de adequação foi menor nos ambulantes (49,7%) e quiosques de praia (62,0%) do que em restaurantes (69,7%), hospitais (83,9%) e escolas (86%). Serviços de alimentação institucionais e comerciais apresentaram escores mais elevados no desempenho em segurança dos alimentos do que os pertencentes ao grupo comida de rua nos quesitos de maior risco sanitário. As variáveis positivamente associadas com o desempenho em restaurantes comerciais foi a presença de nutricionista e estrutura adequada. Esses resultados indicam a necessidade de novas estratégias e políticas para os serviços de comida de rua e que o nutricionista atuando como líder de segurança dos alimentos pode melhorar o desempenho de restaurantes comerciais em relação à segurança dos alimentos.*
Palavras-chave *Segurança dos alimentos, Serviços de alimentação, Avaliação de risco, Nutricionista*

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Introduction

The increase in consumption of food away from home is a reality of the current standard of living. Lin and Guthrie¹ defines food away from home those consumed in restaurants, schools, fast-food, take-out or delivered meal eaten at home and other away-from-home places. In Brazil the consumption of food away from home rose from 22.2% in 2002-2003 to 27.9% in 2008-2009².

In Brazil, the set of establishments that offers/sells food away from home is defined as collective food service (*alimentação coletiva* in Portuguese), which refers to the term catering used in Europe and food service used in the American English standard³. Based on French definitions (*restauration collective* and *restauration commerciale* in French), food services can be classified into two categories in Brazil: institutional and commercial⁴. The first includes restaurants of industries, companies, schools, hospitals, nursing homes, prison and other food services in which the main feature is to have fixed customers. In this category exists the frequent concern that meals are nutritionally balanced, appropriate to the consumer and coordinated by a nutritionist^{3,5}. Microbiology, good manufacturing practices, nutritional and financial management of food services are part of the academic curriculum of the course of nutrition in Brazil⁶. So, it is believed nutritionist (also called dietitian in some countries) is a professional able to unite the knowledge of microbiology and management of food services leading to an improved state of food safety.

In the second group, commercial food services, there is greater concern to attract the consumers based on the concept of quality and consumer satisfaction, offering different and regional meals, culinary specialties, with strong appeal in the taste of meals and not necessarily based on the production of healthy meals. In this group it is included fast food restaurants, restaurants, cafes, hotels and even street food⁴.

The law n. 8234 of 1991 establishes that planning, organization, direction, supervision and evaluation of food services are private activities of nutritionist⁷. However, these assignments refer exclusively to institutional food services. The Brazilian law on hygiene in food services establishes "The person responsible for food handling activities must be the owner or designated employee, properly trained, without prejudice to cases where there is legal provision for technical responsibility"⁸. This second regulation allows

that any person, after training, be responsible for food safety in commercial restaurants and other food services.

Besides the differences in physical structure, the food safety performance (i.e. procedures and behaviors that can avoid food borne diseases - FBD) may be an important factor that differentiates street food, institutional and commercial food services. Food service category may predict food safety compliance and consumers' risk perception, because street food, and with a minor frequency, commercial restaurants can be understood as a stereotype of risk according to common sense⁹ but there are no studies that compare the food safety performance between these type of establishments.

The lack of a full system of food safety management and poor food safety performance associated with several factors (e.g. population growth, growth of highly vulnerable population groups, increased food production and distribution, and changes in consumer behavior towards a preference for high-risk foods) can contribute to the incidence of FBD^{10,11}. Therefore, identify the differences between food services, assessing associated factors to food safety performance, can assist the developing of strategies for food safety management.

The aim of this study was to evaluate the food safety performance of street food, commercial restaurants and institutional and associated factors to food safety performance.

Methods

Sample data

This study was cross-sectional and involved 84 food businesses in the city of Santos, Brazil, as follows: 29 street food kiosks, 23 beach kiosks, 28 commercial restaurants, two hospitals and four school meal services. The number of selected services was proportional to the total number of available services of each food business in the city.

All food services were classified into three subgroups: a) street food kiosks and beach kiosks were classified as street food; b) commercial restaurants; c) hospitals and school meal services as institutional food services.

Only those services that manipulated foods with a high risk of contamination, such as meat products and raw salads¹², were eligible for inclusion.

Evaluation of observed practices of food handlers

To evaluate the food safety performance a checklist was developed in accordance with the Brazilian food safety law⁸. The questions were retrieved from a food safety evaluation instrument created considering the characteristics of Brazilian food services¹³.

The checklist was composed of 81 evaluated items covering different aspects of food handling. The items were divided into twelve categories: 1 - buildings and facilities (i.e. proper size and condition of the physical structure - walls, doors, floors, ceilings; area for hand hygiene) 2 - environmental hygiene (i.e. frequency of sanitization of the facilities, furniture and utensils; type and dilution of hygiene products used); 3 - integrated control of disease vectors and urban pests (i.e. areas free of vectors and urban pests; presence of a set of effective actions that prevent the attraction of vectors and urban pests; chemical control performed by a specialized company); 4 - water supply (i.e. use of drinking and running water; condition and sanitization of water reservoir; sewer facilities); 5 - waste management (i.e. sanitization and use of waste collectors); 6 - food handlers (i.e. use of clean uniforms; hygienic behavior; hand hygiene); 7 - raw materials, ingredients and packaging (i.e. receipt of the raw materials; use of raw materials before their expiration dates; storage); 8 - food preparation (i.e. temperature of cooking; thawing technique; preservation of food under refrigeration; sanitization of raw food; avoidance of cross-contamination); 9 - storage and transportation of prepared food (i.e. temperature and waiting time of ready-to-eat foods that are transported and stored); 10 - display of the prepared food for consumption (i.e. compatibility of equipment, furniture and utensils; avoidance of cross-contamination in the display; hand hygiene, use of utensils and gloves when touching ready-to-eat food); 11 - documentation and records (i.e. presence of a Manual of Good Practices; presence of a spreadsheet with temperature records; written instructions about the hygiene procedures); 12 - responsibility (i.e. presence of a trained worker responsible for the food handling procedures).

The checklist was applied in all food services by trained nutritionists who observed and followed each food handler throughout the process of food handling/preparation during a work day. The food handlers did not know the study objectives and that their practices were being evaluated

during the observations. One point was awarded for each adequate condition/situation and when the condition/situation was not properly executed it received a mark of 0 (zero). When the condition did not apply to that establishment, the option "not applicable" was checked. For each item checked as "not applicable", one point was subtracted from the total points to avoid a bias in score interpretation.

A percentage of adequacy of each category was obtained by the total number of points divided by the possible number of points multiplied by one hundred.

Risk classification

All the checklist items were classified into four groups according to risk factors that can cause outbreaks involving food defined by Da Cunha et al.¹⁴ and Da Cunha et al.¹⁵. The first risk group - Risk A involved questions that dealt with time and temperature aspects; the second risk group - Risk B involved questions that dealt with direct contamination by food handler, equipment and utensils; the third risk group - Risk C involved questions that dealt with contaminated water and improper ingredients and raw food and; the fourth risk group - Risk D involved questions that dealt with indirect contamination like structure and buildings.

Food safety performance was considered as the average adequacy percentage of Risk A and B, since these groups deal with aspects of food handling, food handler behavior, practice and performance. The Risk C and D groups dealt, mainly, with structure or management issues.

The adequacy percentage was calculated for each set of questions based on risk classification.

Statistical analysis

Food business was entered as a categorical variable, and adequacy scores were entered as continuous variables. To compare means among the five food services or the three food service groups (street food, commercial and institutional restaurants), analysis of variance with a fixed factor and Tukey's multiple comparisons were used. To compare proportions the Chi-Square with Yates correction was used.

A generalized linear model was used to determine which variables were associated with food safety performance. The independent variables in the model were those variables that presented a Pearson correlation coefficient greater than 0.30.

The independent variables remained in the model if they were statistically significant ($p < 0.05$). Homoscedasticity and model fit were evaluated by residual analysis. The data analysis was performed using SPSS version 15.0 and OpenEpi 3.01.

Ethical aspects

The project was approved by the Federal University of São Paulo's Ethics Committee through *Plataforma Brasil*. All participants signed an Informed Consent Form.

Results

In total 84 food services were evaluated. Table 1 shows the general characteristics of the food services.

The institutional food services presented higher numbers of food handlers, employees and meals prepared each day than restaurants and street food. It was also observed that 100% of institutional food services had a professional who were responsible for food safety with college degree, in which 100% were nutritionists. In commercial restaurants 87% had a responsible for food safety and in 61.8% of street food, but of these only 13% were professionals with college degree (nutritionists). In the remaining food services the owner, a food handler or manager claimed to be the food safety responsible.

The food safety overall score was lower in street food kiosk and beach kiosk (different su-

perscript letters indicate significant differences) as follows: street food kiosk 49.7% (8.54)^a; beach kiosk 61.0% (9.59)^b; restaurants 69.7% (13.0)^c; hospitals 83.9% (4.27)^c and; school meal service 86.0%(4.98)^c. Figure 1 shows the distribution of food safety adequacy percentage categorized by risk. Street food kiosks presented poorer food safety performance with lower scores in all risk categories.

The institutional food services performed better considering the overall scores and risk categories (Table 2). Institutional food services also presented better scores with the regards of buildings and facilities; environmental hygiene; food handlers; raw materials, ingredients and packaging; food preparation; storage and transportation of prepared food; display of the prepared food for consumption and documentation and records.

It was performed sample power analysis indicating that despite institutional food services group presented a reduced sample size the probability of error of significant differences (alpha error - Type I) is very low.

The main fails observed (and the respective percentage of inadequate establishments) considering all establishments were: incorrect hygienization of cleaning cloths used to clean equipment and utensils (89%), inefficient monitor and maintenance of the temperature of hot (70%) and cold ready-to-eat (RTE) food (62%), food handlers receiving the payment of bills (65%), inappropriate cooling of RTE food (58%), served hot RTE foods do not reach a minimum temperature of 74° C (57%), among others. Important to note that in 100% of institutional food services

Table 1. Characteristics of the 84 evaluated food services and differences between institutional and commercial food services from Santos – Brazil.

	Street food (n=55)	Commercial restaurant (n=23)	Institutional food services (n=6)	P
	Value; SD	Value; SD	Value; SD	
Number of food handlers (mean)	2.5a; 1.6	6.3b; 5.1	13.3c; 10.7	<0.01
Number of employees (mean)*	3.4a; 2.6	12.1b; 7.4	25.1c; 21.7	<0.01
Number of meals prepared each day (mean)	106.0a; 90.7	307.6b; 213.9	474.1c; 280.9	<0.01
Food handlers workload (mean of meals prepared each day by each food handler)	58.0; 67.0	62.4; 66.3	54.0; 45.7	0.94
Food service uptime in years (mean)	11.9; 35.9	11.6; 12.4	28.3; 47.8	0.59
Number of food services who have a food safety responsible (percentage)†	61.8%	87.0%	100%	0.02
Number of food services who have a nutritionist as food safety responsible (percentage) †	0%	30.4%	100%	<0.01

*Food handlers included; † chi-square test; SD = Standard deviation; Bold values indicate statistically significant differences ($p < 0.05$); Different letter indicates statistically significant difference at $p < 0.05$.

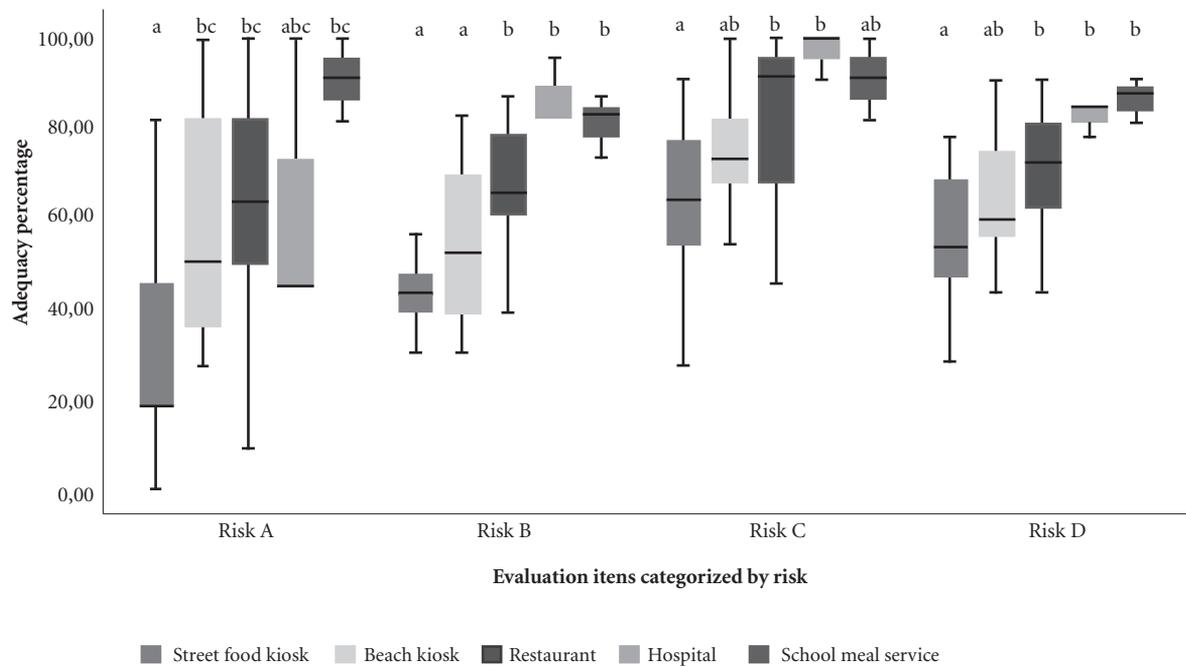


Figure 1. Adequacy percentage of 84 evaluated food services considering risk categories.

Different letters indicate significant differences ($p < 0.05$ Tukey test).

Table 2. Differences of food safety adequacy percentage between street food, commercial restaurants and institutional food services.

	Street food (n=55)		Commercial restaurant (n=23)		Institutional food services (n=6)		P
	Mean (%)	SD	Mean (%)	SD	Mean (%)	SD	
Food safety performance overall score	54.6b	10.5	69.7b	13.0	84.9b	4.3	<0.01
Risk A category	44.2a	29.1	62.0b	25.6	77.2b	25.5	<0.01
Risk B category	48.6a	12.8	67.1b	13.3	84.0c	7.0	<0.01
Risk C category	69.4a	15.3	83.3b	16.5	93.9b	7.4	<0.01
Risk D category	58.9a	13.9	70.9b	14.5	84.3b	4.4	<0.01
Buildings and facilities	62.2a	20.7	73.9b	15.0	86.8b	10.9	0.012
Environmental hygiene	44.6a	18.7	57.9b	19.8	85.1c	11.4	<0.01
Control of vectors and urban pests	70.6a	17.0	58.3b	17.1	71.4a	9.0	0.01
Water supply	88.6a	22.4	90.2a	18.0	100.0a	0.0	0.44
Waste management	54.5a	41.1	78.2b	29.4	83.3b	25.8	0.01
Food Handlers' behavior	55.2a	17.7	73.3b	20.4	79.1b	12.9	<0.01
Raw materials, ingredients and packaging	57.7a	23.5	76.0b	21.9	91.6b	12.9	<0.01
Food preparation	44.6a	23.7	67.6b	19.7	82.2b	16.4	<0.01
Storage and transportation of prepared food	61.8a	40.7	71.7a	29.4	100.0b	0.0	0.04
Display of the prepared food for consumption	33.6a	23.2	73.9b	22.3	86.1b	16.3	<0.01
Documentation and records	30.9a	36.6	45.6a	42.4	91.6b	20.4	<0.01
Responsibility	56.3a	40.8	73.9a	20.4	91.6a	20.4	0.03

SD = Standard deviation; Bold values indicate statistically significant differences ($p < 0.05$); Different letter indicates statistically significant difference at $p < 0.05$.

the item “food handlers receiving the payment of bills” was checked as “not applicable”.

Considering that is stated that institutional food services must have a nutritionist as leader^{16,17}, a generalized linear model was used to study the variables associated with food safety performance (risk category A plus risk category B) of commercial restaurants and street food services. A crude analysis (one-way ANOVA $p < 0.001$) showed differences between commercial restaurants with different types of food safety leaders and between commercial restaurants without food safety leader (different superscript letters indicate significant differences) as follows: nutritionist as food safety leader (Mean; SD = 80.3; 8.1)^a, restaurants with food safety leader with other college degree (Mean; SD = 64.9; 10.2)^{ab} restaurants with food safety leader without college degree (Mean; SD = 59.6; 15.3)^{bc} and restaurants without food safety leader (Mean; SD = 40.3; 4.7)^c. The variables associated with food safety performance in commercial restaurants in the model were: presence of a nutritionist as food safety as leader (coefficient = 0.39, $p < 0.001$) and adequate structure (Coefficient = 0.22; $p = 0.036$). The presence of trained food handlers ($p = 0.92$) and presence food safety leader without college degree or with other college degree ($p = 0.33$) were not significantly associated with food safety performance. None of the independent variables presented significant interaction between them. The model for street food services has not showed significant variables.

Discussion

The aim of this study was to evaluate the food safety performance of food services from different natures discussing the role of food safety management. Institutional food services presented an evolved food safety management when compared to commercial restaurants and street food. Some of the factors observed in institutional food services have been discussed as important factors to improve food safety performance: e.g. presence of trained food handlers^{18,19}; and presence of a qualified manager to supervise food safety^{20,21}.

All the aforementioned factors, among others, are essential part of a food safety management system²². Despite evaluated institutional food services do not presented all necessary characteristics of a developed food safety management system²³, the implementation of some food

safety management system characteristics were sufficient to hospitals and schools perform better than restaurants, beach and street food kiosks regarding food safety performance. The use and benefit of food safety management system have already been extensively discussed²⁴⁻²⁶ as well the difficulties in its implementation^{23,26,27} mainly the excessive costs and the lack of technical skills of managers²⁵.

Whereas many of the commercial restaurants and street food services hires temporary workers, low paid and with low education level²⁸, factors that undermine change in food safety culture²⁹, the use of food safety management systems may be utopian or very difficult with current reality of these services. Another limiting factor in this context is that many food services showed basic flaws in relation to food safety, not attending minimum parameters required by Brazilian law for good manufacturing practices (e.g. fails to maintain the temperature of RTE food, inadequate cleaning of equipment and utensils, high number of food handlers who have never attended a food safety training, etc). Food safety policies in Brazil must ensure that establishments meet minimally the sanitary laws, especially street food services that had presented several failures in procedures associated with FBD outbreaks during this research. Meet the requirements of sanitary legislation has its costs such as: structural adaptations, equipment purchase and investment in training food handlers. However the costs of basic food safety requirements can be feasible^{29,30} and with high cost-benefit for government³¹. Perhaps the Brazilian government can provide and facilitate loans with low interest rates so that food services could enhance their food safety adequacy, somewhat similar of the loans carried out with smallholders farmers³².

In general, food services presented better scores on risk categories C and D, categories with items covering aspects of lower risk for food borne disease^{13,33}. A large number of flaws were observed in all food services regarding aspects of temperature control. Inadequate temperature was one of main factors of FBD in China³⁴, New Zealand³⁵ and Brazil³⁶. This highlights that the consumer may be at high risk for FBD, especially if they consume meals in commercial restaurant and in a street food service.

With the objective of verifying initial solutions to improve the food safety of commercial restaurants, generalized linear models were developed. It was observed that specialist leadership and adequate structure were associated fac-

tors for food safety performance in commercial restaurants.

In all hospitals, schools and in 30.4% of commercial restaurants it was observed the presence of a food safety responsible with college degree, which we call "food safety leader". Leadership is the process of influencing people to create predictable results and accomplishing its goals³⁷. Therefore the food safety leader must ensure the food safety standard compliance combining food safety vision and goals³⁸. The food safety leader can do the synergy between the standards and practices once he/she has the proper knowledge and leadership attributes. In the food services that presented a responsible for food safety activities without specific education, the food safety performance was the same as the performance of restaurants without any leader. The Brazilian law establishes that all food services must have a food safety responsible but do not specify their level of education⁸. In the legislation update, the Brazilian government could recommend supervision, advisory or consulting of an expert in food safety, since it is a factor that positively affects the food safety performance.

The fact of all food handlers are trained to perform correctly practices was not associated with the food safety performance. Some studies reported an increase on food safety performance rate after food handlers' training/certification^{18,19}. However is not completely clear the role of training on food handlers' attitudes and practices³⁹. In previous research we observed that training can improve knowledge but it was not associated with food handlers' attitudes and practices⁴⁰. Several aspects can influence the effectiveness of training in food handlers' knowledge and practices and some of them were not evaluated in this study like mandatory versus voluntary attendance of training²⁰. Therefore, our data are limited only to show that it was observed no association between training and food safety performance.

The better was the physical structure (buildings and facilities) of the food service better was the food safety performance. Adequate physical structure possibly favors the adoption of appropriate practices for two reasons: 1) Certain food safety procedures are dependent on certain structures such as the presence of adequate toilets and sink for hand hygiene etc. 2) an appropriate work structure and environment can fosters job motivation. Proper working conditions are extrinsic characteristics of work motivation, also called maintenance⁴¹. The effects of extrinsic and intrinsic aspects of job motivation of food

handlers can be studied. Perhaps motivational strategies can be used to improve the food safety performance.

Many aspects are directly associated with food safety performance, and many of them has already been presented and discussed in scientific papers. Policy makers and stakeholders in Brazil must condensate all these findings to create a food safety law that states the necessity of these aspects. Food handler, as a human being, has a complex set of attitudes, beliefs and culture. These aspects are hard to change, so, investing in management system strategies, or in an adaptation of the existing strategies, can be used as a mediate solution to improve compliance of food safety laws in commercial restaurants in Brazil. In addition, specific laws could be enacted to street food, increasing the applicability and comprehensiveness.

In this study, it was decided to use a risk classification to assess the food services. Sort the questions into groups, based on the risk of FBD, is a simple and assertive solution to assess food services¹⁴. Health inspectors must be trained to use new methods, reducing the variability between evaluators and evaluations. Therefore, government and health agencies should evaluate their conditions before the deployment of a score system.

Conclusion

Institutional food services and commercial restaurants showed higher scores of food safety performance than street food services, mainly regarding risker practices (i.e. temperature aspects, food handler hygiene, equipment hygiene etc). These results show that street food services need, in a mediate way, the implementation of new strategies and regulation to improve food safety performance. According to common sense, commercial restaurants would present, mainly, worse physical structure than institutional services. However, they were quite similar in this aspect, but commercial restaurants performed worse regarding some aspects of food handler behavior. So, strategies for this type of business must be created, tested and established.

A nutritionist acting as food safety leader and an adequate facility can possibly improve the food safety performance at commercial restaurants and thereby, reduce the risk of FBD.

Finally, the use of scores and / or classifications based on the risk of FBD is promising and

may facilitate evaluation and management of food services.

Collaborations

DT Da Cunha was responsible for: study design, data collection, data analysis, data interpretation and manuscript writing. VV De Rosso and E Stedefeldt were responsible for: study design, data interpretation and critical review of manuscript.

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