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Occupational risks and food contamination: Assessment of the work environment of an industrial kitchen using the GUT matrix

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Abstract

The work environment of a Food and Nutrition Unit (FNU) often exposes employees to occupational risks, which can directly or indirectly, affect food safety. Therefore, identifying environmental risks at an FNU is crucial for ensuring the health of workers, preventing accidents, and, consequently, mitigating any errors that could lead to the contamination of food. This study aimed to develop an individualized GUT matrix to help prioritize the environmental risks in the vegetable pre-preparation area of a university hospital's industrial kitchen, located in Rio de Janeiro, RJ. The study area was defined in view that most accidents happen in this area in industrial kitchens. The vegetable pre-preparation team was observed twice a day for 15 days using daily checklists to detect the team's actual health and safety culture. GUT matrix analysis identified three physical, two chemical, three biological, three ergonomic risks, and five risks of accidents. The use of the GUT matrix proved adequate to identify the main risks, allowing decisions to be made that adjusted the work environment accordingly and helping to improve the work environment, health, and safety of workers while ensuring food safety.

Keywords: food safety; risk analysis; occupational safety; food and nutrition unit.

Practical Application: Customized GUT matrix to prioritize environmental risks in industrial kitchens.

1 INTRODUCTION

Food production environments, such as hospital Food and Nutrition Units (FNUs), can pose several risks to workers in view of the intense pace of production, the temperature of the environment, and the presence of humidity and constant noise. Despite the few reports in the literature, official data indicate that the food sector has accident and illness rates similar to those of industries (Michigan, 2023). Every year, 360 million non-fatal occupational accidents happen around the world, accounting for 19% of deaths worldwide (WHO, 2023). In Brazil, despite the underreporting of accidents at work, in 2019, there was a formal record of 10,659 accidents involving food service workers, ranking sixth among registered work accidents (Cesteh, 2022). According to 2022 data from the Brazilian Ministry of Health's Information System for Notifiable Diseases (Sinan) (Brazil, 2007), which involves the formal and informal sectors of the economy, the number of serious work-related accidents reported grew by about 76% compared with 2021.

The risks related to occupational accidents can be classified as physical, chemical, biological, ergonomic, and psychosocial. In Brazil, the ergonomic and accident risks were included in the annexes of Regulatory Standard 09 published in Ordinance No. 3,124/1978 by means of Ordinance No. 25, of December 29, 1994 (Brazil, 2020b).

The lack of effective preventive measures can generate occupational diseases, work accidents, and food contamination (Nepomuceno, 2004). By focusing only on the worker, and not on food safety, these risks can cause immediate or future/chronic injuries (Epifânio et al., 2020). Thus, the FNU management of high-complexity hospitals adopts measures to prevent and control environmental risks, aiming to ensure the safety and health of workers.

Among the measures that can be adopted to avoid occupational accidents are the implementation of training and capacity building for employees, the use of adequate personal protective equipment, the implementation of breaks for rest and extension, and the adoption of ergonomic techniques to reduce physical overload. In addition, the manager of the UAN performs periodic estimates of the environmental risks present in the work environment, in order to identify possible problems and adopt preventive and corrective measures. Therefore, the minimum level of occupational safety and health is established by regulations and standards that improve working conditions for all workers (OMS, 1995).

Without doubt, a company's organizational culture affects the effectiveness of its occupational promotion, health, and food safety measures. Many times, even with inadequate conduct, a work accident may not happen, but the workers understand the

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sequence that can lead to a work accident. Frank Bird's Pyramid, which was created after statistical treatment with almost two million accidents, from 297 companies in different segments, relates the frequency and severity of accidents, showing that serious accidents are preceded by a series of minor incidents, which, in turn, are preceded by accidents that generate material or physical damage; these are preceded by accidents resulting from unsafe conditions or behavior. It is therefore important that all occurrences are recorded and closely followed up in order to identify the root causes of the problems and take preventive measures. In the absence of such measures, a domino effect can be generated, as one accident occurs under the influence of another, which can generate a serious injury or lead to the death of the worker (Bastos & Resch, 2018).

The safety culture must therefore be encouraged, and promoted, by the company's management, encouraging workers to report incidents and adopt safe conduct in the workplace. In this way, it is possible to reduce the risk of accidents and ensure the safety and health of workers (Yiannas, 2009).

According to Regulatory Standard No. 01 (NR-01) (Brazil, 2022), which deals with the General Provisions and Management of Occupational Risks in Brazil (Brazil, 2020b), it is necessary to assign each risk a level of occupational risk, which is determined by combining the severity of possible injury or damage to health with probability or chance of its occurrence. The risk matrix must be used as a preventive action to assess occupational risks, but the company is responsible for the choice of tools and techniques suitable to assess risks (Brazil, 2020b).

Preliminary risk analysis (PRA) is a very common tool used to detect and prevent potential risks in the work environment. This tool is based on the observation of the activities developed by the employees, as well as the conditions of the work environment, in order to identify the possible risks (Jeronimo et al., 2013).

As PRA does not enable a precise differentiation between risks within the same level, the use of the GUT matrix can be an alternative. The GUT method is a management tool used to prioritize decision-making, considering the gravity (G), urgency (U), and trend (T) of the event. Its great differential is the simplicity of use and the possibility to assign values to each specific case in an objective manner (Kepner & Tregoe, 1981; Meireles, 2001). Gravity should take into account both depth and intensity if the problem is not flagged. Trend should be evaluated to determine the likelihood of worsening over time. Finally, urgency should be analyzed to determine how long it will take for damage, or unwanted, outcomes to occur if no action is taken (Periard, 2011). Each of these criteria is evaluated with a score from 1 to 5. Multiplying these scores results in the GUT score, which indicates the priority of the problem.

Considering that the food sector presents a considerable number of reported accidents and that, when it comes to hospital UANs, these accidents can interfere not only with the workers' health but also with the quality of the service provided, and the safety of the food served in these units is essential, this study aimed to develop a customized GUT matrix to help prioritize the environmental risks in the vegetable pre-preparation area of a university hospital's industrial kitchen located in Rio de Janeiro in order to improve not only the workers' health but also the service provided.

2 MATERIALS AND METHODS

The study was conducted at an FNU of a large university hospital located in Rio de Janeiro/Brazil. For ethical reasons, the name of the hospital will not be revealed. The number of weekly working hours is 44. Observations took place at the vegetable pre-preparation area before lunch and dinner times. The unit has two types of workers: employees on call and day laborers. The workday was 12 h/day, from 7 a.m. to 7 p.m. and 8 a.m. to 8 p.m., with a 12/36-h shift for on-call workers. The day laborers worked from Monday to Friday from 7 a.m. to 4:48 p.m. The night team only included two workers, with shifts of 12/36 hours from 7 p.m. to 7 a.m. At the time of the study, the university hospital employed 161 people, including 75 on-call/shift workers and 11 day workers. Data were gathered using observational analyses, photographic records, and by filling daily checklists while the workers pre-prepared the vegetables to understand the types of risks present in this environment and the team's culture of health and safety (Genta et al., 2005). The analysis was performed twice a day for 15 days, from March 18 to April 1, 2022. The GUT Matrix was used as a tool to prioritize the sources of the risks identified (Kepner & Tregoe, 1981) for subsequent decision-making.

3 RESULTS AND DISCUSSION

Table 1 presents the ranking of the risks identified in the GUT matrix along with the priority levels. Three physical, two chemical, three biological, three ergonomic, and five accidental risks were identified. There was a risk of an accident caused by the constant use of disposable gloves while using a vegetable peeler. While using a vegetable peeler, it can easily pull the tip of the glove, which can cause a severe cut on the fingers along with bleeding and, consequently, lead to food contamination. Hence, this risk received a total score (Tt) of 125.

With a Tt of 100, the second place was shared by biological risks (fungi, mold growth, and rat infestation) and by the risk of accidents (loose parts in the kitchen exhaust hoods). Many species of fungi are harmful to humans due to the presence of toxic substances that cause slight or allergic digestive problems and even serious liver damage, hallucinations, and death. The production of toxins by some fungi and mold species can be harmful and trigger a wide range of diseases classified as waterborne and foodborne diseases (WFD). In addition, mold contamination can cause economic losses due to food spoilage (Gallo et al., 2020). Rat infestation can cause, in addition to WFD, damage to machines, equipment, pipes, and electrical wiring (Grings, 2006). Besides the damages caused by rats, some machines and equipment do not present proper maintenance. In this kitchen, loose exhaust hoods presented a constant danger and required immediate action from the members of the supervisory body overseeing workers' health.

At the third position (Tt = 48) was the presence of insects that often fall in vegetables that are already sanitized,

Table 1. Prioritization of individualized environmental risks obtained from the GUT matrix.

Identified Risks		G	U	T	Tt	P
Physical Risk	Countertop vibrations with unfixed equipment	**2**	**3**	**1**	**6**	**10th**
	Excessive heat due to faulty exhaust	**3**	**4**	**1**	**12**	**8th**
	Noise caused by equipment without maintenance	**3**	**4**	**1**	**12**	**8th**
Chemical Risk	Fumes from the cigarette smoking area near the kitchen	**3**	**3**	**1**	**9**	**9th**
	Incorrectly handled chemicals	**5**	**5**	**1**	**25**	**4th**
Biological Risk	Fungi, molds	**4**	**5**	**5**	**100**	**2nd**
	Rat infestation	**5**	**5**	**4**	**100**	**2nd**
	Contamination from insects	**4**	**4**	**3**	**48**	**3rd**
Ergonomic Risk	Excessive physical exertion	**3**	**5**	**1**	**15**	**7th**
	Lifting and transporting crates and vats	**4**	**5**	**1**	**20**	**5th**
	Extended working hours due to lack of sufficient workers	**3**	**3**	**1**	**9**	**9th**
Risk of Accidents	Lack or misuse of PPE kits	**5**	**5**	**1**	**25**	**4th**
	The use of latex gloves while peeling vegetables	**5**	**5**	**5**	**125**	**1st**
	Inadequate lighting	**5**	**5**	**1**	**25**	**4th**
	Exhaust hoods with loose parts	**5**	**5**	**4**	**100**	**2nd**
	Unprotected equipment	**5**	**5**	**1**	**25**	**4th**

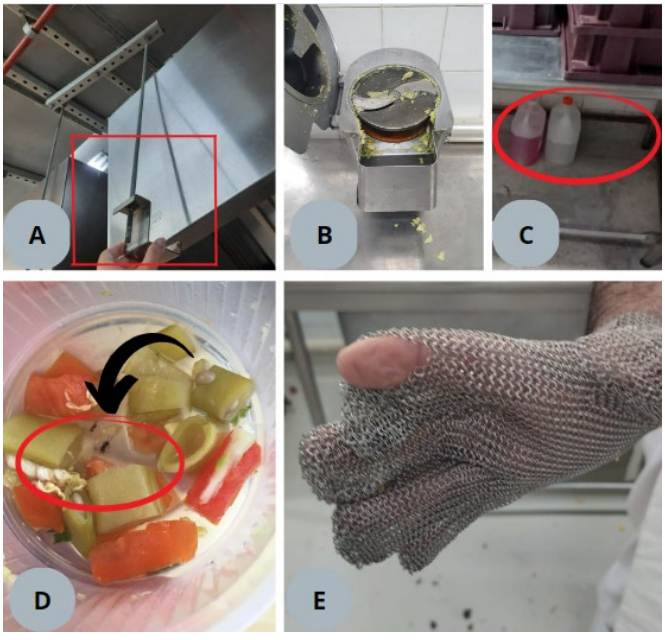
[5]: G (extremely grave or severe), U (immediate action), T (tends to get worse right away); [4]: G (very severe), U (with some urgency), T (will get worse in the short term); [3]: G (severe), U (as soon as possible), T (will get worse in the medium term); [2]: G (little severe), U (can wait a little), T (will get worse in the long run); [1]: G (no gravity), U (no hurry), T (will not get any worse); [Tt]: Total: Result of multiplication of G×U×T factors; [P]: Priority ranking of risk for which actions will be implemented.
Source: adapted from Regulatory Standard 9 (Brasil, 2020b).

fractionated, and ready for further preparation. Insects pose a serious risk to workers' health and food safety as they act as disseminators for microorganisms (Voeller et al., 2008). In addition, the presence of insects can lead to financial losses as the disposal of contaminated ingredients and meals by insects is mandatory (Brasil, 2020a).

The fourth place was shared by chemical (e.g., incorrect handling of chemicals) and physical risks (e.g., the lack of PPE, inadequate lighting, and unprotected equipment), both with a Tt of 25. Among the risks are the incorrect identification and handling of chemical products that may result in residues on equipment and utensils, besides causing skin irritation; inadequate lighting in the work environment that can harm workers' physical and psychological health increases their chances of committing an error (e.g., using the wrong ingredients) and, consequently, affects their job safety. Conversely, the lack of PPE and protective equipment can also lead to work accidents while preparing food (Matos, 2000). Risks with priorities ranked between the 5th and 11th positions, showing a low degree of tendency ($Tt = 1$) compared with all other risks.

As observed in Table 1, all the identified risks can directly affect food safety. The physical risk posed by a poorly lit environment can generate other risks and errors, such as using the wrong ingredients or not detecting an insect or another contaminator falling on the food. Incorrect use of chemical agents can also generate contamination and pose severe health risks.

The results of the photographic report within the vegetable pre-preparation sector of the kitchen are shown in Figure 1. Throughout the observational analysis, part of the exhaust chute system was not correctly fastened (A). Equipment was stored dirty, which attracted insects and rodents (B). Chemicals were poorly identified and stored in inappropriate places, increasing the risk of chemical incidents and chemical contamination of food (C). There were insects that could bite and transmit diseases to employees, as well as fall into ready-to-eat foods, contaminating them (D). The use of personal protective equipment that was in poor condition put the health of the worker and food safety at risk (E).



Source: adapted from (Finelli, 2021).

Figure 1. The photographic report of the FNU industrial kitchen. The images refer to the following risk groups: (A) accident risk, (B) biological risk, (C) chemical risk, (D) biological risk, and (E) accident risk.

Despite the regulations and inspections made by governmental supervisory bodies in Brazil, there is no evidence of a

decrease in work accident rates throughout the years (MPT, 2020). This is interconnected with bad working conditions and a lack of safety in work environments, in addition to deficient supervision. Complying with Regulatory Norms (NRs) is still a major challenge for most companies as many of which focus on improving product quality rather than bettering environmental working conditions (Lacerda et al., 2005). However, it is clear that food safety goes hand in hand with worker health.

4 CONCLUSION

Risks exist in every work environment, and risk assessment and hazard management are designed to lower those workplace risks and can influence the overall safety of the workplace. The results presented here point to the risks that can interfere with the physical and psychological health of kitchen workers.

In order to improve occupational and food safety of the studied FNU, new trainings were added according to service demand. A daily on-call nutrition technician was hired to supervise the unit, following the entire production line, as the organizational culture is the result of a complex learning process by the group. Daily reports were also requested in order to improve the response time for detected problems. This also made issues easier to resolve, as addressing them immediately prevented them from getting worse or causing future problems.

Our results highlight the importance and efficacy of the GUT matrix as a quality assessment tool for improving workers' health and food safety. The use of such an assessment would help organizations devise measures to control risks, improving the work environment, health, and safety of workers while ensuring food safety.

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