

Creation of CBRNE protection system for large area shopping malls



COUNTERMEASURE PROCEDURES

IN CASE OF FOOD CBRN EVENTS



Co-funded by the Internal Security Fund
of the European Union
Grant Agreement No. 861643 - Mall-CBRN

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Stock | #121967743

Title: 5.5 Countermeasure procedures in case of food CBRN events



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Co-funded by the Internal Security Fund
of the European Union
Grant Agreement No. 861643 - Mall-CBRN

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Document description

WP number and title	WP5 – Food defence 5.5 Countermeasure procedures in case of food CBRN events
Lead Beneficiary/ Author(s)	UniLodz
Contributor(s)/ Author(s)	INTA, ATRIUM PROMENADA, ISEMI, HELLENBERG INT, MIHE,
Document type	Report
Last Update	18.04.2024 V.1.0
Dissemination level	Public / Confidential *

* *Confidential – only for members of the consortium & EC Services*

Acknowledgement

This project is funded by the European Union's Internal Security Fund — Police Grant Agreement No. 861643 — Mall-CBRN

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The material for this publication was developed and reviewed by the Mall-CBRN Consortium, Associated Partners and Advisory Board.

TABLE OF CONTENTS:

LIST OF FIGURES	8
ABBREVIATIONS	9
1. INTRODUCTION.....	10
1.1 Mislabelling of food products.....	12
1.2 Misuse of additives.....	12
1.3 Adulteration	13
1.4 Serving expired food (food past use by date)	13
2. SHIELDING THE FOOD	15
3. THE PREPAREDNESS TO FOOD CBRN EVENT	21
4. PRE INCIDENT COUNTERMEASURE PROCEDURES	24
4.1 Hazard Analysis and Critical Control Points.....	24
4.1.2 Cooking.....	25
4.1.3 Serving and Holding.....	25
4.1.4 Transporting and Serving.....	25
4.1.5 Cooling.....	25
4.1.6 Reheating.....	25
5. THREAT ASSESSMENT CRITICAL CONTROL POINT “TACCP”	27
5.1 The TACCP normative approach	27
5.2 TACCP objectives.....	28
5.3 Impact.....	28
5.4 The TACCP team should:	29
5.5 Threat assessment	29
5.5.1 In case of food product:.....	30
5.5.2 In case of the premises:.....	30
5.5.3 In case of the business:.....	30



- 5.6 The threat assessment critical control point (TACCP) 30
 - 5.6.1 Access to premise 30
 - 5.6.2 Access for vehicles 31
 - 5.6.3 Access for people..... 31
 - 5.6.4 Identification of unauthorized people..... 31
 - 5.6.5 Controlling the access to crucial systems 32
 - 5.6.6 Storage of transport vehicles 32
 - 5.6.7 Access to food products 32
 - 5.6.8 Product security..... 32
 - 5.6.9 Quality control during food process..... 35
- 6. FMEA (FAILURE MODE AND EFFECT ANALYSIS) 35
 - 6.1 Introduction and method description..... 35
 - 6.1.1 The FMEA systematically:..... 35
 - 6.2 Food delivery - access to the facility 38
 - 6.2.1 Vehicle access (monitoring, identification of unauthorized access, security) 38
 - 6.2.2 Recommendations..... 39
 - 6.2.3 Human access 39
 - 6.2.4 Recommendations..... 39
 - 6.3 Food transportation inside the facility..... 40
 - 6.3.1 Recommendations..... 41
 - 6.4 Security staff 42
 - 6.4.1 Recommendations..... 42
 - 6.5 Back-office access 42
 - 6.5.1 Recommendations..... 43
 - 6.6 Ready-made gastronomic products sold in an open manner (allowing free access to the product by third parties). 43
 - 6.6.1 Recommendations..... 44
 - 6.7 Preparation of the consumption areas to serve guests eating meals on the spot..... 44



- 6.7.1 Recommendations..... 45
- 6.8 Preparation of food products for distribution..... 45
 - 6.8.1 Recommendations..... 45
- 6.9 Ready-made products service (both eaten on site and take-away). 46
 - 6.9.1 Recommendations..... 46
- 6.10 The probability of inspection carried out by an individual posing as a Public Health Inspector 46
 - 6.10.1 Recommendations..... 46
- 7. POST INCIDENT COUNTERMEASURE PROCEDURES..... 46
 - 7.1 Detection 46
 - 7.2 Containment 47
 - 7.3 Triage 48
 - 7.4 Evacuation..... 49
 - 7.5 Decontamination..... 49
 - 7.6 Epidemiological investigation 49
 - 7.6.1 Epidemic curves..... 49
 - 7.6.2 Purpose of Epidemic Investigations 50
 - 7.6.3 Elements of Epidemic Control 52
 - 7.7 The decision making process..... 52
 - 7.8 Recovery from attack 53
- 8. CONCLUSIONS..... 53
- APPENDIX 1 54
 - EU Food policy and food safety projects..... 54

List of figures

Figure 1: Distribution of food related incidents up to 2008.....	11
Figure 2: Reported food incidents.....	12
Figure 3: The number of food borne illness vs total number of human population.....	13
Figure 4: The global number of foodborne illnesses, deaths, Years Lived with Disability (YLDs),Years of Life Lost (YLLs) and Disability Adjusted Life Years (DALYs).....	14
Figure 5: The causative agents of food borne illness	14
Figure 6: Limitation concerning implementation of food defense/shielding plans/procedures.....	16
Figure 7: The organization responsible for elaboration of food defense/shielding plan – consumers perspective	18
Figure 8: The organization financing the elaboration of food defense/shielding plan – consumers perspective	18
Figure 9: The crucial points in susceptibility analysis of food provider on CBRN events.....	19
Figure 10: Useful technologies in food defense/shielding according to the food operators – on the basis of.....	22
Figure 11: Useful technologies in food defense/shielding according to the authorities – on the basis of	23
Figure 12: A flow diagram illustrating the food product processing within the HACCP guidelines and showing all the critical control points. This chart categorizes every step of the process under the listed headings.....	26
Figure 13: The example of tamper evidence closure	33
Figure 14: . The example of tamper evidence closure	33
Figure 15: The example of sealed cup.....	33
Figure 16: Expiration date	34
Figure 17: Lot (batch) coding facilitates product recall.....	34
Figure 18: The probability of intentional or unintentional contamination of food products.....	37
Figure 19: Inside food product delivery point.....	38
Figure 20: Outside food product delivery point.....	38
Figure 21: Unattended food product	40
Figure 22: Vulnerability of food products in supply chain on CBRN agent contamination– on the basis on inspection visits	41
Figure 23: Open back office access to restaurants/catering points area.....	42
Figure 24: Foods sold ‘open’ for customers.....	43
Figure 25: Foods sold ‘closed’ for customers.....	44
Figure 26: The consumption area.....	45
Figure 27: Biological agent detection method	47
Figure 28: The example of Point source epidemic curve	49
Figure 29: The example of propagated (or progressive source) epidemic curve.....	50
Figure 30: The example of continuous common source epidemic curve	50
Figure 31: The decision making process chart	52

Abbreviations

BWA – The Biological Weapons Convention (The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction)

CBRN – Chemical, Biological, Radiological and Nuclear materials

CCP – Critical Control Points

CCTV – Closed-Circuit Television

CWA – Chemical Warfare Agent

CWC – The Chemical Weapons Convention (The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction)

FPD – Flame Photometric Detector

FM – Facility Management

FTIR – Fourier Transformation Infra-Red

GC – Gas Chromatography

GCMS – Gas Chromatography Mass Spectrometry

GHP – Good Hygienic Practice

GMP – Good Manufacturing Practice

HACCP – Hazard Analysis and Critical Control Points

IMS – Ion Mobility Spectrometry

IR – Infra-red

PPE – Personal Protective Equipment

SM – Shopping Mall

TIC – Toxic Industrial Chemical

TIM – Toxic Industrial Material

UAV – Unmanned Aerial Vehicle

1. Introduction

CBRN agents are unique in their potential ability to inflict large numbers of casualties over a wide area with minimal logistical requirements and by means that can be virtually untraceable. Although wide area delivery may be technically challenging, the ease and low cost of producing an agent, the difficulty in detecting its presence and protecting (and treating) its intended victims, and the possibility to selectively target humans, animals, or plants conspire to make defense against this class of agents particularly difficult. As the economic gaps between nations grow and as some less advantaged nations seek a balance of power, there may be a tendency by these nations to overcome their disadvantage by choosing CBRN agents that can be produced easily and cheaply. The purely financial advantage of employing CBRN agents were clearly illustrated by a 1969 expert United Nations panel which estimated the minimum cost of attacking civilian populations at \$1/km² for biological weapons, versus \$600/km² for chemical, \$800/km² for nuclear, and \$2,000/km² for conventional armaments¹.

Dissemination is the process by which CBRN agents are dispersed to cause disease or intoxication. CBRN agents are most likely to be delivered covertly and by aerosol. The same routes of entry pertinent to natural spread of diseases (that is, through inhalation, ingestion, or percutaneous inoculation) are also relevant when their etiological agents are delivered intentionally. Other routes of entry are thought to be less important than inhalation but are nonetheless potentially significant. CBRN agents can be delivered effectively by a wide range of platforms. The agent can be formulated as either a liquid or dry powder fill. The dissemination can be performed using simple or sophisticated spray devices, by an explosive charge, or simply packaged and delivered in the regular mail. Depending on the efficiency of the delivery system used, some agent may be destroyed at the time of release, larger particles will fall to the ground producing local contamination and respirable particles generated will present predominantly as an inhalation hazard travelling long distances. Direct contamination of consumables, such as drinking water or foodstuffs, could be used as a means to disseminate agents. Some foodstuffs, for example chocolate, can allow organisms to survive for long periods, and significantly reduce the number of organisms required to cause disease in case of biological agent. This method of attack would be most suitable for sabotage activities and might be used against limited targets such as water supplies or food supplies.

The September 11 2001 changed the all global approach in field of whole crisis management and also in management of food CBRN incidents. The largest investigation were initiated by European Commission in frame of SecuFood - Security of European Food supply chain. The results of conducted project up to 2008 pointing that, the in all tested cases (450), the majority of all food incidents cases happened in North America (mainly in USA – over 150 cases) and Asia – see Figure 1. The Figure 1, clearly pointing on the fact that, the food defense incidents appeared globally.

¹ <https://www.reachingcriticalwill.org/resources/fact-sheets/critical-issues/4579-biological-weapons>

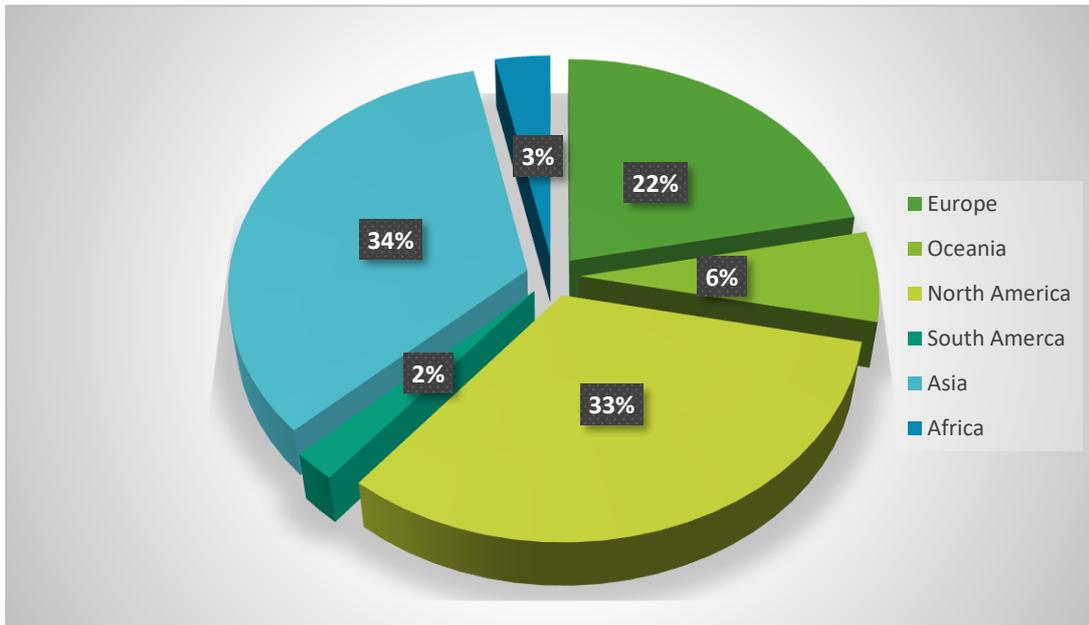


Figure 1: Distribution of food related incidents up to 2008

(Figure 1)²

The increasing risk of CBRN food incidents are mainly due to the changes observed in last decades. Mainly due to expansion and development of food supply chain, diversity of food and food related products, free trade food market, cross border food trading, problems related with global unemployment, human migration and globalization of world economy.

Analyzing the available literature data concerning the food incidents³ - see Fig 2, (averaged mean – developed and developing countries), suggesting that, the main factor responsible for food incidents belongs to the other category.

² “SecuFood - Security of European Food supply chain”. project co-funded by the European Commission in the framework of the European Programme on Critical Infrastructure Protection (CIPs), addressing the program theme “Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks”

³ Zemichael Gizaw. Public health risks related to food safety issues in the food market: a systematic literature review. Environmental Health and Preventive Medicine volume 24, Article number: 68 (2019).

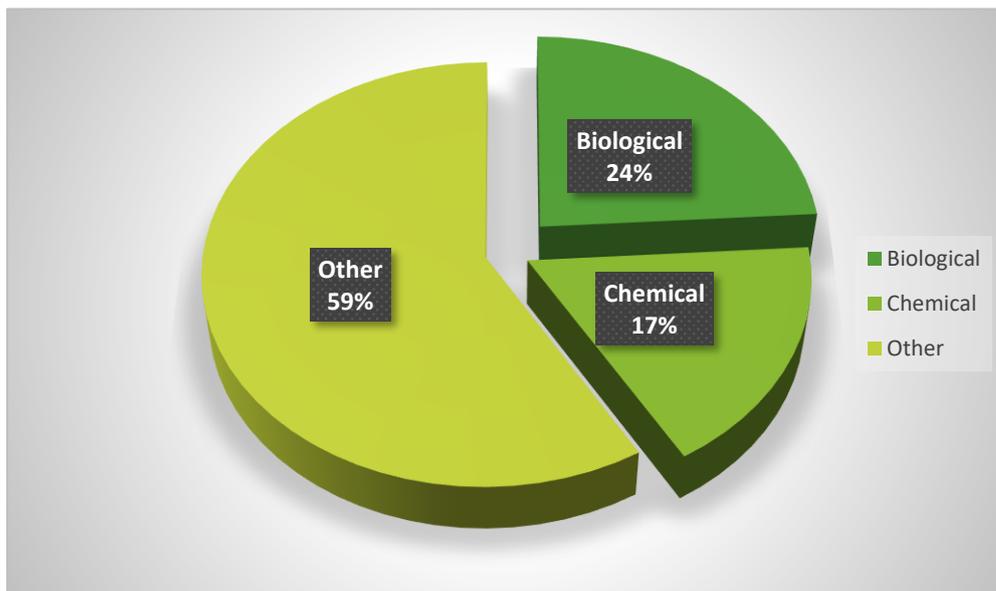


Figure 2: Reported food incidents

The other include: mislabeling, adulteration, misuse of additives and consumption or serving expired food (food past use by date).

Concerning the biological contamination - 6 major pathogens (Norovirus, Clostridium perfringens, Campylobacter spp., Salmonella spp., Bacillus cereus and Listeria) are causing the most incidents. In case of chemical agents: four chemicals (aflatoxin, dioxin, cyanide and peanut allergen)⁴.

1.1 Mislabelling of food products

One of the major risk for public health associated with food product market. The performed studies concerning mislabeling revealed that substantial proportion of food samples collected from food stores, supermarkets, restaurant and catering points, which were genetically tested contained entirely different species from that, which were presented on food product labels. It should be underlined that; the most common mislabeled food product were products contained seafood⁵.

1.2 Misuse of additives

The misuse of food additives also was reported as a serious threat for public health related to food market. Some of food colorants and sweeteners are allowed to use in food industry, however the concentration exceeded the limit. It was also reported of usage of non-permitted colorants and sweeteners⁶.

⁴ https://ccnse.ca/sites/default/files/2015-12-17_EH_Seminar_Foodborne_Chemicals-Afshari.pdf

⁵ Miller DD, Mariani S. Smoke, mirrors, and mislabeled cod: poor transparency in the European seafood industry. *Front Ecol Environ.* 2010;8(10):517–21

⁶ Dixit S, Purshottam S, Khanna S, Das M. Usage pattern of synthetic food colours in different states of India and exposure assessment through commodities preferentially consumed by children. *Food Addit Contam Part A Chem Anal Control Expo Risk Assess.* 2011;28(8):996–1005.

1.3 Adulteration

Food adulteration is also consider as the one of the major threat for public health related to food chain. Most of the food products accessible in the market are adulterated in different degrees. Usage of the chemicals (e.g. hydrogen peroxide, caustic soda) or others, which are not declared food component (e.g. sugar in honey) are commonly used techniques in order to improve food products⁷.

1.4 Serving expired food (food past use by date)

There are substantial data concerning selling/serving outdated food in food stores and restaurants. This action largely contributing not only to threat to public health but also to environment⁸.

World Health Organization estimates that annually approx. 600 million cases of food borne illness appear globally. Among them, 360 million cases are due to the bacterial infections, 125 million cases due to the viral infections and 220 thousand due to the chemical intoxication see Fig 3⁹.

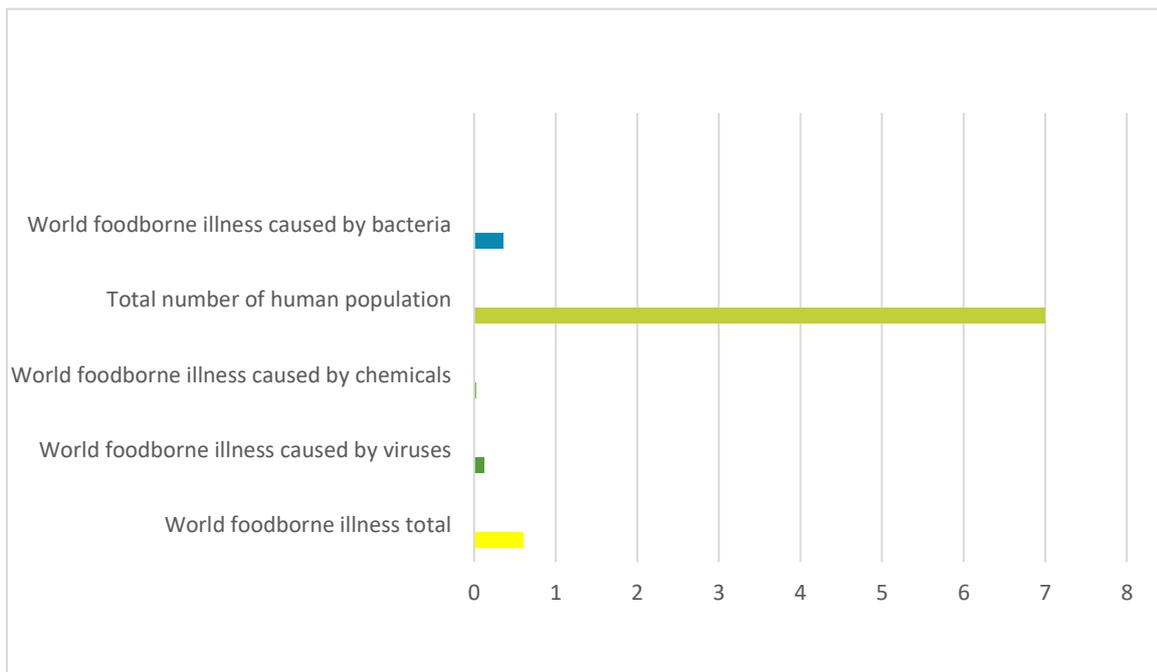


Figure 3: The number of food borne illness vs total number of human population

Furthermore, the food borne illness will cause not only the deaths but also remove the employee from the market and by this influence on the overall economy see Fig. 4

⁷ Peng G-J, Chang M-H, Fang M, Liao C-D, Tsai C-F, Tseng S-H, et al. Incidents of major food adulteration in Taiwan between 2011 and 2015. *Food Control*. 2017;72:145–52.

⁸ Freedman DA, Bell BA. Access to healthful foods among an urban food insecure population: perceptions versus reality. *J Urban Health*. 2009;86(6):825–38.

⁹ https://apps.who.int/iris/bitstream/handle/10665/199350/9789241565165_eng.pdf

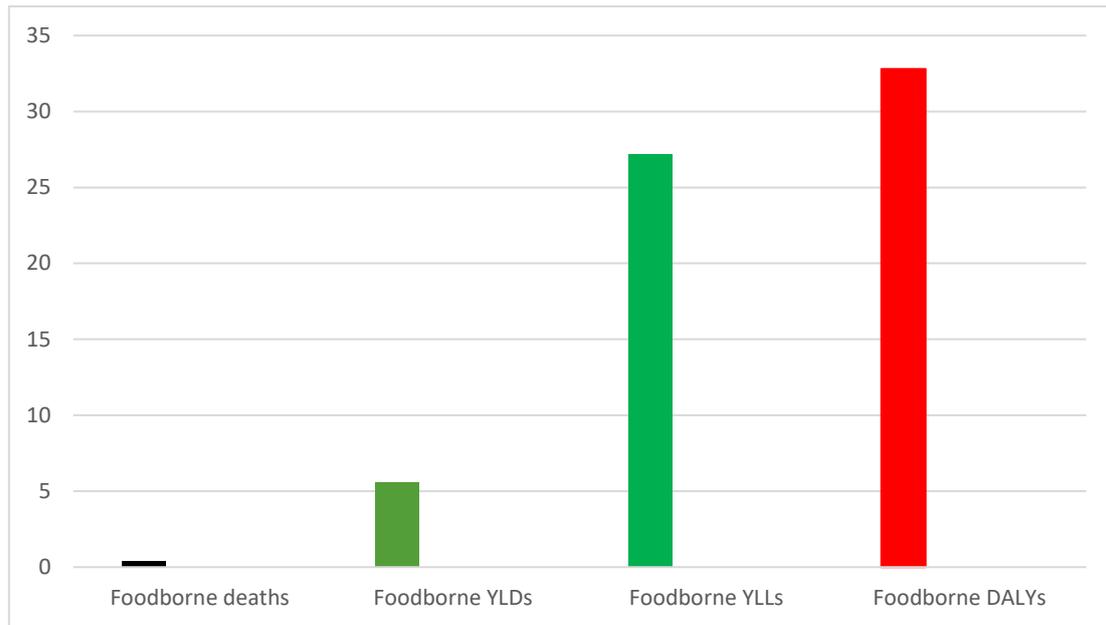


Figure 4: The global number of foodborne illnesses, deaths, Years Lived with Disability (YLDs), Years of Life Lost (YLLs) and Disability Adjusted Life Years (DALYs)

(Figure 4)¹⁰

In most of the cases the responsible agent of food borne illness are bacteria and parasites see Fig 5.

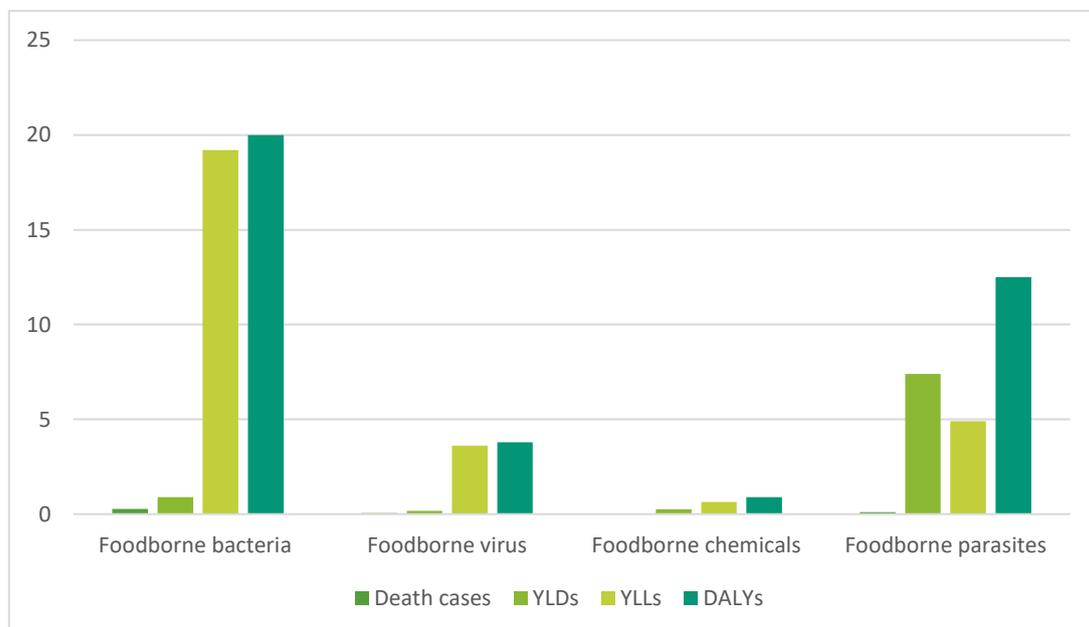


Figure 5: The causative agents of food borne illness

¹⁰ https://apps.who.int/iris/bitstream/handle/10665/199350/9789241565165_eng.pdf

2. Shielding the food

Food terrorism is unpredictable and by the agents features used (as an example biological agents) easy to execute. The incidents mentioned in deliverable 5.4 Bests practices for prevention of food CBRN incidents in paragraph concerning history of CBRN incidents in food defense chain clearly pointing out that, there is a need to elaborate and implement dedicated programs and procedures, which can prepare the food chain in order to protect them. By this reason is indicated two crucial elements: food defense and food shielding. Both of these are identified by various groups of experts on: protection of food and food chain from unintentional or deliberate contamination using CBRN agents. The protection should on the beginning identify critical points in food chain, which are vulnerable and all efforts should be placed in order to minimize threat and effects in case of this attack. All steps are aiming to minimize the threat and effects of attack and should covers Critical Control Points (CCP) in whole food supply chain. Critical Control Points (CCP) are the steps in the production, where taking control measures is essential¹¹.

The efforts should start from controlling the food supplies at the manufacturer premises, ending on restaurants, which provide ready to eat product to the consumer. All these efforts are aiming to create all food chain less attractive for terrorist purposes and less vulnerable in case of unintentional or deliberate food contamination. The rising threat forcing all members of food chain (starting from food producers through delivery and transport companies, through the companies/employees engaged in cleaning services in whole food process) to elaborate food protection/food shielding plans and procedures. However, the members of food supply chain are facing several limitations, which illustrate the Figure 5. These limitations are: imposed by client deadlines concerning the implementation of food defense plans and setting this as condition of further cooperation. Lack or very limited consciousness concerning threats to food arising from food terrorism. Lack of national standards in field of food defense/food shielding observed in most of the countries. Insufficient knowledge concerning the existing and implemented plans/procedures. Very limited and academic literature, mostly known only in the scientific community.

¹¹ C.A. Wallace, S.E. Mortimore. Handbook of Hygiene Control in the Food Industry. doi.org/10.1016/B978-0-08-100155-4.00003-0

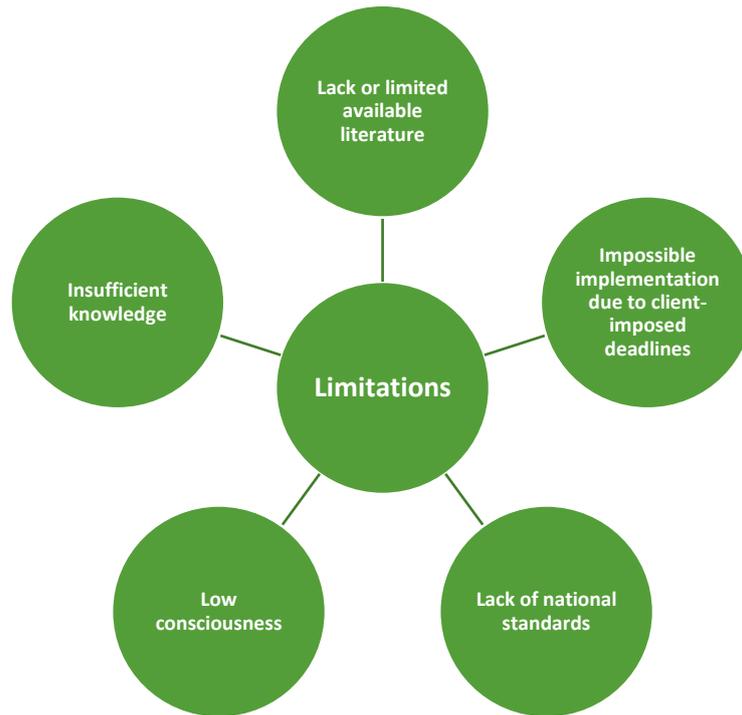


Figure 6: Limitation concerning implementation of food defense/shielding plans/procedures

A plan despite it concerns, it should covers all assets and actions needed to timely fulfill their essential¹². Each plan should be clearly described and contains the following parts: describing the project goals and the pathway how to achieve them, identifying the problems, elaborating the way to resolve the problems and methods, which allow to prevent the future appearance, verification of elaborated solution aiming to introducing plan modification, if needed. Ones elaborating plan isn't a close document. It should be adjusting according to the changes introduced.

Food defense/shielding plan similarly to the statements above, should fulfilled similar conditions. The plan identified as a document describes the control assets undertaken by Shopping Mall and dedicated catering point inside Shopping Mall in order to prevent from unintentional or deliberate food contamination. The plan should be: elaborated in written form, implemented, tested, verified and sustained. The knowledge taken from the USA as a country, which is "experienced" due to the terrorist attacks provides several standards, which can be used in elaborating effective food defense/shielding plan. The first defense CB (chemical, biological agents) plan was created in 2000, before September 11 by US Center of Disease Control¹³. The first elaborated plan contained agents identification, grouping them and pointing the most possible agents, which can be used in case of terrorist attack. The plan

¹² W Wójcicki. Protoeconomics - Elements of Economics in Antiquity. DOI: <https://doi.org/10.2478/ers-2018-0043>

¹³ Biological and Chemical Terrorism: Strategic Plan for Preparedness and Response. <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr4904a1.htm>

covered the following fields: CB preparedness and prevention, CB detection methods, CB characteristics, countermeasures, communications methods.

All subsequent plans, despite the organization, which was elaborated were followed on first CDC plan. The breakthrough moment in field of elaboration of effective food defense plan was releasing in 2002 Public Health Security and Bioterrorism preparedness and Response Act¹⁴. In this document the strict control over the food processing. Directly in Section 306 – Maintenance and Inspection of Records for Food is stated that, the food handler should keep records concerning delivered food products in order to confirm their identity. Followed this, in 2003, appeared the Homeland Security Presidential Directive¹⁵. The Directive appointed all National Services and described their roles in the area of food defense. It should be underlined that, the food defense plans are recommended not required. US Food Safety and Inspection Service recommends the implementation of food defense plans in food industry, whereas United States Department of Agriculture (USDA) propagates food defense plans among farmers, while Food and Drug Administration (FDA) among others food handlers including restaurants and catering points. It should be mentioned that, the above mentioned legislation created environment, which allowed broad cooperation including representative of governmental institution and universities community in field of food defense. As a result of this cooperation, the collection of guidelines and recommendations were elaborated and published. Starting from 2003 and since then updated several times the guidelines concerning food industry appeared¹⁶. Follow the guidelines for food industry, the recommendation concerning the food detailers and processors (including restaurants and catering points) and also for the food transporters and distributors appeared¹⁷. In Europe, exists several organization and institution, which deal with the food safety on the national level, however the main one European Food Safety Authority¹⁸, undertakes work in response to requests for scientific advice from the European Commission, the European Parliament and EU Member States.

The opinions concerning the responsibility of elaborating the food defense plan/shielding vary. The consumer opinion in this field is presented in Fig. 6. While, the organization, which should finance these activities are also vary and the consumer opinion is presented in Fig. 7.

¹⁴ H.R.3448 - Public Health Security and Bioterrorism Preparedness and Response Act of 2002

¹⁵ HSPD 8: National Preparedness (2003)

¹⁶ Guidance for Industry: Food Security Preventive Measures Guidance for Food Producers, Processors, and Transporters. FDA-2020-D-1929.

¹⁷ <https://www.fsis.usda.gov/about-fsis>

¹⁸ <https://www.efsa.europa.eu>

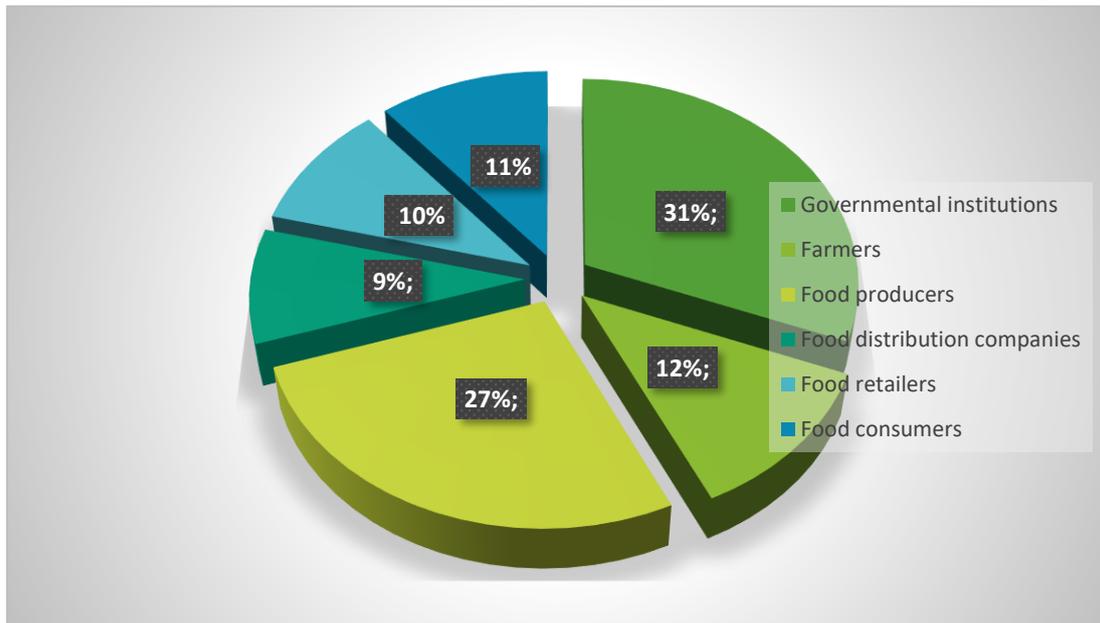


Figure 7: The organization responsible for elaboration of food defense/shielding plan – consumers perspective

(Figure 7)¹⁹

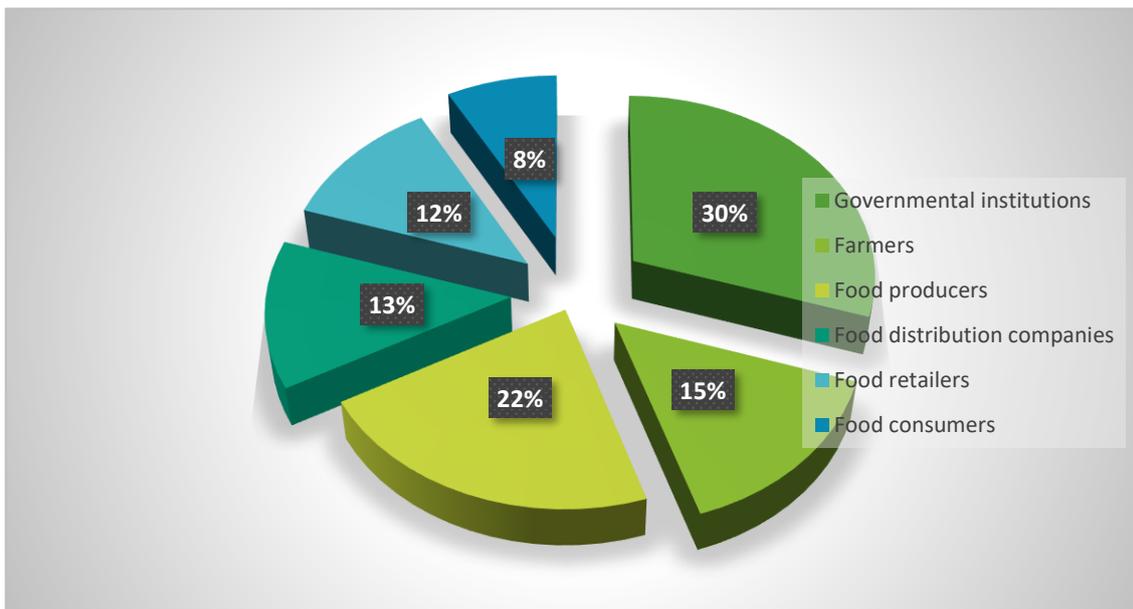


Figure 8: The organization financing the elaboration of food defense/shielding plan – consumers perspective

(Figure 8)²⁰

¹⁹ Thomas F. Stinson, Koel Ghosh, Jean Kinsey and Dennis Degeneffe. Do Household Attitudes about Food Defense and Food Safety Change following Highly Visible National Food Recalls?. American Journal of Agricultural Economics. Vol. 90, No. 5, Proceedings Issue (Dec., 2008), pp. 1272-1278

²⁰ Thomas F. Stinson, Koel Ghosh, Jean Kinsey and Dennis Degeneffe. Do Household Attitudes about Food Defense and Food Safety Change following Highly Visible National Food Recalls?. American Journal of Agricultural Economics. Vol. 90, No. 5, Proceedings Issue (Dec., 2008), pp. 1272-1278

The food countermeasure procedures are based on existing food defense/shielding plans. According to these plans the fundamental procedures aiming to analyze the risk in order to protect the food as follows: assess the risk, risk management, risk reporting and risk communication. The risk analysis follows the risk assessment – vulnerability assessment in case of food terrorism attack (assessment), elaboration of detailed plan of action (preparedness), food defense/shielding management plan (management). In details, assessment – permanent and seasonal food employee behavior assessment (their contacts with other persons, organizations), cleaning personnel, which providing their services in food industry premises (their contacts), employee of food transport companies and other, which are directly and indirectly (e.g. security, technical staff) connected with obtained food and food related products. The assessment may be based on the following: observing their activities in social media by supervisors, observing their behavior at work etc. Any suspicious activities should be reported immediately to the supervisors. Besides the human factor in the assessment, the analysis of food processing process should also be evaluated in order to discover possible vulnerability points (the points, where the food contamination is most probable). The vulnerability assessment is presented on Figure 8.

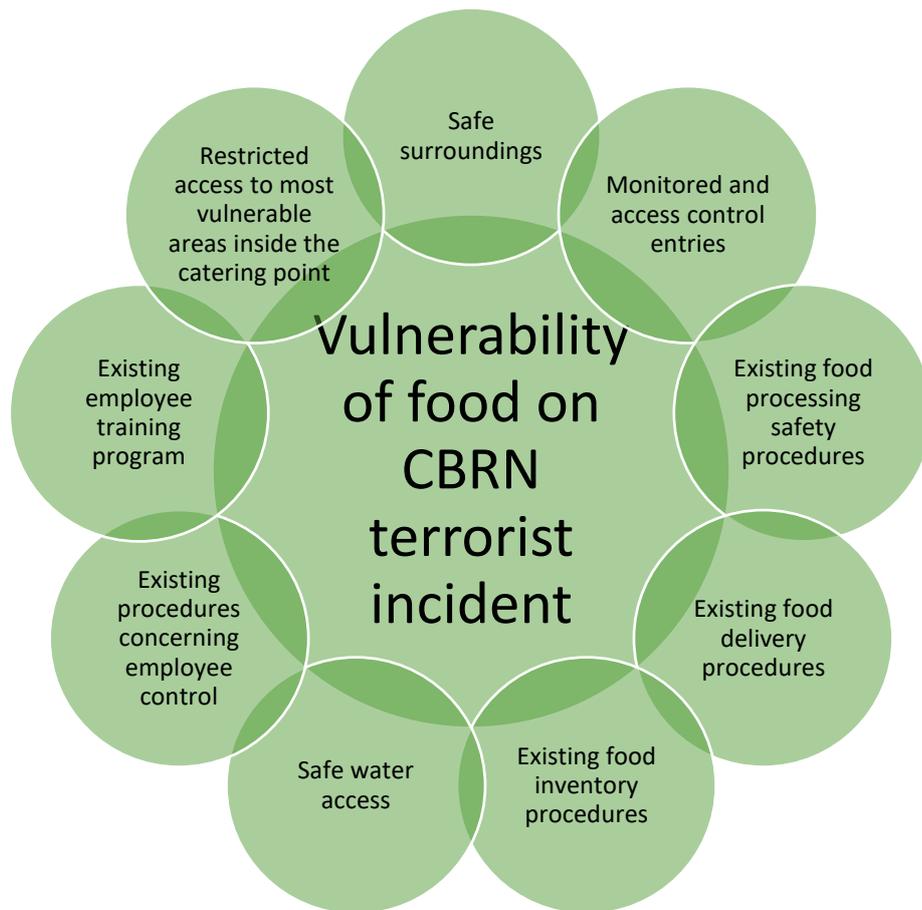


Figure 9: The crucial points in susceptibility analysis of food provider on CBRN events

The vulnerability analysis is one of the crucial elements of food defense/shielding plan. That way should be explained in details. Safe surrounding: access to the premise delivery point, which include fences, gates (in necessary) other barriers aiming to prevent unauthorized access by persons or vehicles. Delivery point and surrounding monitoring, which include presence of security personnel, cameras.

Monitored and control entries, which include the presence of access control entry from delivery point to the premises. The doors should be equipped with security locks, which are opening on the basis of PIN or card reader. The single PIN or card should be given only to dedicated personnel. Furthermore, the entries surrounding should be equipped with cameras, which allow to visualize the entry. The records should be recorded and kept. The same activities and procedures should be placed in the entry points to the restaurants and catering point back stage existing in food court.

Existing food processing safety procedures is aiming to control the following aspects: controlling the food processing technology, verification of food producers, brokers and transport companies focusing on the food delivery, protective clothes rules of conduct (their washing, cleaning, storing etc.), verification of cleaning services personnel (if outsourced), access to household chemicals.

Existing food delivery procedures is aiming to verify access to food delivery areas, rules in case of planned and unplanned food products deliveries, verification of amounts food products deliveries, verification of food cargo securing, controlling activities aiming to verify food delivery vehicles (cleanliness).

Existing food inventory procedures is aiming to verify the rule of storing and inventorying all food products and other items used in food processing and food serving (plates, forks, knives etc.), verification of inventory records.

Safe water access is aiming to verify security of water used in food processing. Verification of existing access control to water source, condition of water installation and verification of equipment, which used water in food processing (e.g. ice machine).

Existing procedures concerning employee control aiming to verify the process of personnel employment (their previous experience and records), their pre - employment and periodical training, which underlined the procedures in case of any observed suspicious behavior among other employee, bystanders and food consumers.

Existing employee training program aiming to verify, if any of CBRN issues are the parts of the pre – employment or periodical trainings.

Restricted access to most vulnerable areas inside the catering point aiming to verify the rules of access to most vulnerable areas inside restaurant or catering point (food and food related items storage pints, rules of wearing protective clothes during food processing and food serving).

3. The preparedness to food CBRN event

The preparedness to food CBRN event consist broad spectrum of activities. The preparedness, that is elaboration plan of action in aces of CBRN incident should be prepared in written form of control sheets. The control sheets should cover all existing or possible/predicted threat and vulnerable areas of all food chain derive from first step of analysis - assessment. As an example, the control sheet should identify: area description, threat analysis, existing control measures, physical countermeasure assets (e.g. physical barriers in delivery area, which prevent unauthorized access), procedural or technical countermeasure assets (e.g. monitoring of personnel entry), personnel responsible for threat monitoring and procedures of actions in case of threat appearance and responsible person to supervise all action. The last step of food defense/shielding is the management. It's based on the elaboration of four crucial step in reaction plan: containment, detection, recall and disposal.

The first step in reaction plan - containment covers the following actions: threat recognition, securing the probable source of the threat (the contaminated food product should be safely secured in designated secured place without possible access by unauthorized persons).

The next step detection covers the following actions: agent detection, if possible and contact with crisis management authorities. The emergency contact list should be prepared and accessible for all staff.

The recall is based on the immediate contact, if possible with all probable food consumers, transporters, distributors. In case of food transporters and distributors, the list of contacts is accessible, so the contact with them should not be problematic. In case of food consumers, the contact with them is very demanding due to the fact that, there are no records available. In this case, the media announcement requesting for contact of food consumer/clients of dedicated restaurant/catering point should be prepared and released mainly by crisis management centers or other possible authorities (regional or national).

The last step is disposal. The main activities are: elaborating control sheets, which allows to undertake all necessary actions aiming to reduce threat (main countermeasure activities). These main activities are as follows: appointing the responsible persons, establishing control and preventive measures, data collection concerning the contacts with employee, transport and distribution companies, food brokers, establishing the evacuation gathering point and other activities necessary in dedicated situation.

The last element in action plan is management. Is based on the following action: appointing the crisis management team, which will supervise all action taken.

Elaborated food defense/shielding plan should be verified and tested at least ones a year. The records of plan verification should be kept. Any changes and adjustments in plan should be tested and verified before implemented. Furthermore, with the plan, the new appointed and permanent employee should be trained at the beginning and then later periodically. The training should aimed on the rising the CBRN threat consciousness and their reaction in case of CBRN incident.

During the project realization, the survey concerning possessing the plan of action in case of CBRN food event was executed. In all companies, the plan of action concerning fire and other crisis exists. However, the plans concerning action taken in case of CBRN food event is not available. It clearly shows that, the issue of food defense not only in food courts but also in other mass catering points need to be introduced and action undertaken. The useful technologies for the purpose of food defense/shielding according to food operators are presented in Fig. 9 are differ from the technologies from these mentioned by the authorities see Fig 10.

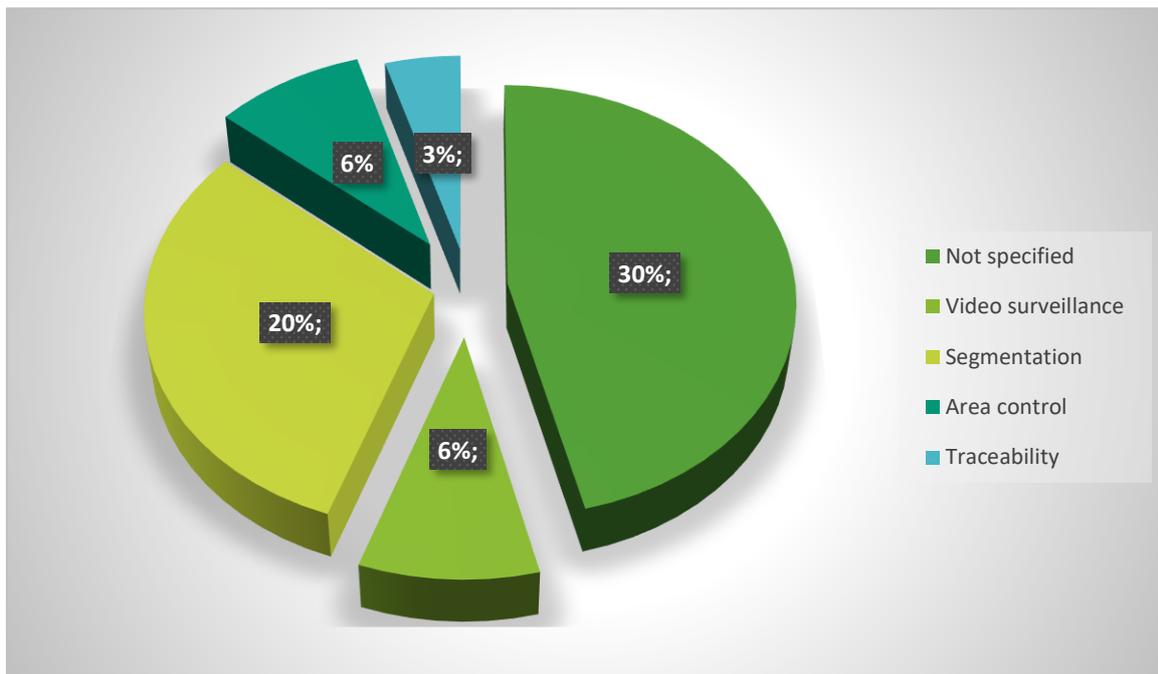


Figure 10: Useful technologies in food defense/shielding according to the food operators – on the basis of

(Figure 10) ²¹

²¹ “SecuFood - Security of European Food supply chain”. project co-funded by the European Commission in the framework of the European Programme on Critical Infrastructure Protection (CIPs), addressing the program theme “Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks”

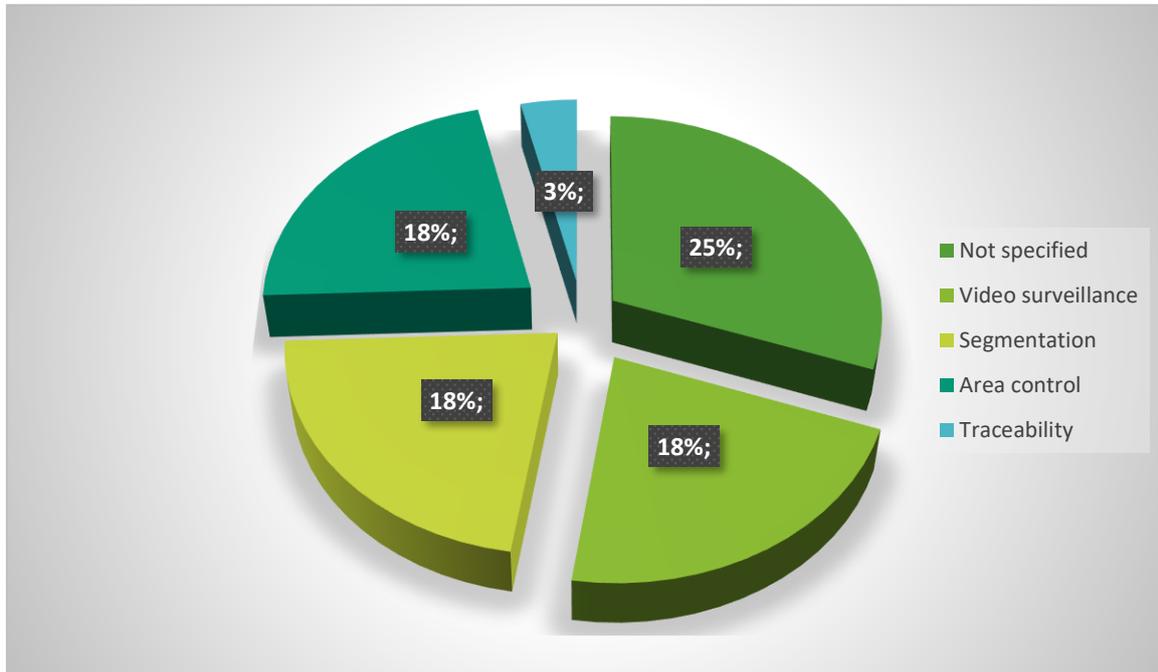


Figure 11: Useful technologies in food defense/shielding according to the authorities – on the basis of

(Figure 11)²²

In order to food defense/shielding the following countermeasure procedure should be understood and implemented.

²² “SecuFood - Security of European Food supply chain”. project co-funded by the European Commission in the framework of the European Programme on Critical Infrastructure Protection (CIPs), addressing the program theme “Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks”

4. Pre Incident Countermeasure procedures

- Hazard Analysis and Critical Control Points - HACCP
- Threat Assessment Critical Control Point - TACCP
- Failure Mode and Effect Analysis - FMEA

4.1 Hazard Analysis and Critical Control Points

HACCP is a scientific system for analyzing any recipe or any kind of food preparation process, in order to determine the “critical control points” (places where there are possibilities of contamination). This was developed by NASA, when they were trying to control for food-borne illnesses among astronauts. NASA has a strong interest in preventing food-borne diseases with their motto “nothing worse than having an astronaut with diarrhea in orbit” This NASA-developed system is so good that it was incorporated into the food code²³.

There are 7 steps in the HACCP system. The first is to analyze for potential hazards (biological, chemical, radiological or physical). Second: identify the critical control points in the process which can be controlled in an effort to avoid contamination. This is followed by the establishment of an optimized procedure to avoid contamination at those points.

4.1.1 Seven Steps of HACCP

1. To analyze potential hazards (know your enemy) – biological, chemical, or physical
2. To identify critical control points (CCPs) – points in a food's chain at which the potential hazard can be controlled or eliminated: e.g. cooking, cooling, serving, transporting, packaging.
3. To establish preventive measures with critical limits for each control point. Example: setting the minimum cooking temperature and time required to ensure the elimination of any microbes
4. To establish procedures to monitor the critical control points in order to establish corrective actions to be taken when a critical limit has not been met. Thus if something goes wrong everybody knows what needs to be done to correct the problem. Example: determining how and by whom cooking time and temperature should be monitored.
5. To establish corrective actions to be taken when a critical limit has not been met. Example: reprocessing or disposing of food if the minimum cooking temperature is not met
6. To establish procedures to verify that the system is working properly. Example: testing time-and-temperature recording devices to verify that a cooking unit is working properly.
7. To establish effective record keeping to document the HACCP system. Records of hazards and their control methods. Monitoring of safety requirements. Action taken to correct potential problems.

²³ <https://safefoodalliance.com/haccp/the-history-of-haccp>

Within the HACCP exist the common critical control points. The points involve:

- Cooking
- Cooling
- Points of cross contamination
- Re-heating
- Holding

4.1.2 Cooking

The critical control point: cook ingredients until an internal product temperature of 60°C or higher is reached. Stir frequently.

4.1.3 Serving and Holding

Serve immediately. The critical control point: hold food at 60°C or above for service. Do not mix new product with old.

4.1.4 Transporting and Serving

The critical control point: hold food at 60°C or higher.

4.1.5 Cooling

The critical control point: cool food to 4°C or lower within 4 hours in shallow pans with a product depth of 5 cm or less. Stir frequently. Store at a product temperature of 4°C or lower in a refrigerated unit.

4.1.6 Reheating

The critical control point: reheat food to a product temperature of 74°C or higher within 2 hours.

Sanitation Instructions:

- Measure all temperatures with a thermocouple.
- Wash hands before handling foods.
- Wash, rinse, and sanitize all equipment before and after use.

The final product of the HACCP system is the creation of a table, so that every step of the cooking process is tabulated with additional columns with the headings shown to include applicable information for each step.

Table created to categorize every step of process with the following headings:

- Possible hazard
- The critical control point
- Operational step
- Type of monitoring
- Corrective action if standard not met
- Standard or criteria applied (verify)
- Applicable records

Below on the Fig.11. The schematic diagram the food processing with HACCP guidelines in order to protect the food product and consumer health is presented.

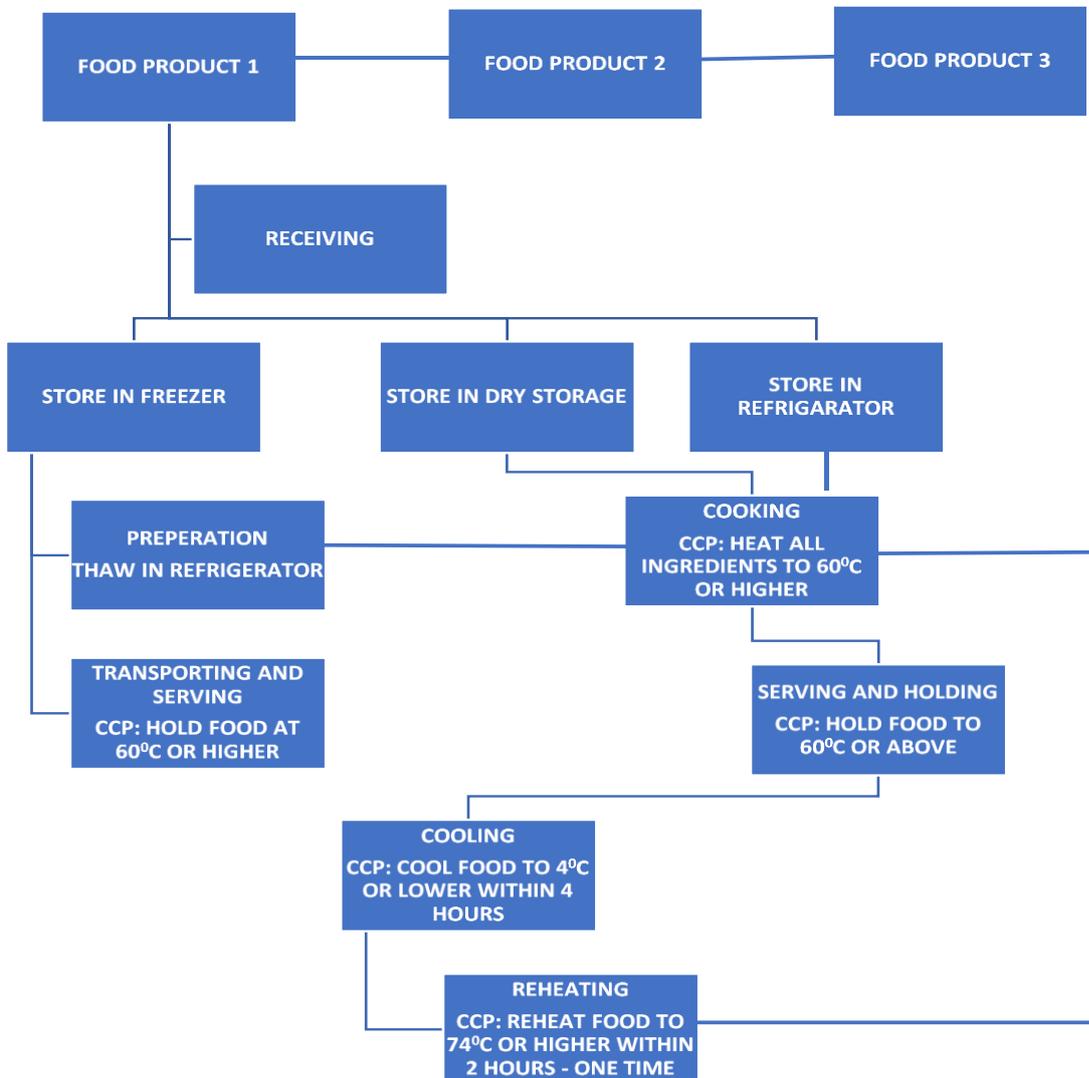


Figure 12: A flow diagram illustrating the food product processing within the HAACP guidelines and showing all the critical control points. This chart categorizes every step of the process under the listed headings.

5. Threat Assessment Critical Control Point “TACCP”

The threat assessment critical control point approach builds business continuity management philosophies. It is the threats methodical evaluation. The aim of this TACCP assessment is to examine the food supply chain (starting at food producers ending in restaurant or catering point) in order to identify vulnerable points, and to implement countermeasure procedures/actions to improve resilience against evil intent attacks by individuals or groups. The TACCP precisely considers that, the evil intentions is likely to involve unanticipated CBRN agent or strategies, which involve usage of CBRN material. The features of CBRN agent used in attack will be influenced by the nature of the food itself: its physical state, chemical composition, packaging, transporting, preparing, servicing of ready to eat product. The TACCP analysis will recognize the key differences based on the following features: the predictable, random nature of hazards (CBRN agent features), the target, threats evil intent nature, which demands imaginative thinking in order to anticipate possible modes of attack and to identify deterrent precautions and countermeasure actions. Threat Assessment Critical Control Point is a one of countermeasure tool. It should be mentioned that, the TACCP may be managed together with other business continuity procedures.

5.1 The TACCP normative approach

- The company shall possess procedures designed to report and effectively manage incidents and possible emergencies in the event of intentional food contamination or sabotage.
- The existing security systems should be able to ensure that food products are protected against theft or intentional contamination on site.
- The company will perform a documented assessment of the safeguards and potential risks to the food products in the event of attempts to intentionally food contamination or damage.
- In company will be applied the procedures limiting access to food processing points (restaurants, catering points and food storage sites) only for authorized persons, and access to the site for employees, contractors and visitors will be limited and controlled.
- The company should possess documented procedures for receiving of food products, which will include requirements for product safety, especially in parked and unattended vehicles during receiving process.

That evil intent in order to contaminate food products needs a person, so the existing procedure should be people-oriented. The person may be an individual or be part of a group or may be an insider. The insider is the employee or contractors (cleaning service, security, others), which possess legitimate access to food processing points (including their backstage). In most of the cases, the attacker want to see a fairly immediate impact, so the agent used for the purpose of food contamination will lead to severe illness or harm. In other cases, when the agents used will cause chronic disease or is not “spectacular”(only limited impact will be observed) will not satisfy attacker himself and the aspirations terrorist groups. It is also

important to underline that, this crime act involving food products can be deterred but cannot be prevented. Furthermore, the expert knowledge in field not only of agents features but also of the vulnerable points is crucial in successful and widespread of executed attack. The undertaken protective measures shall include physical, electronic and personnel security procedures, while the TACCP should be oriented to a specific food product and analyze whole food product cycle (starting on food product production, ending on servicing ready to eat meal).

5.2 TACCP objectives

The TACCP objectives are:

- To identify persons or groups, which might want and are able to target the company, organization, location or food product.
- To assess the probability of contamination of food product in regards to meet the needs of prospective attackers.
- To obtain the consensus within an organization management concerning the key vulnerabilities in the food products supply chain as a whole and also for the dedicated specific food product.
- To provide the estimation of the impact of food product contamination (as a successful attack) on business continuity.
- To create and implement the proportionate control procedures/regulations in order to make a successful attack highly unlikely.

5.3 Impact

The allegation or even gossips of unintentional or intentional food product contamination, which is served in the restaurant or catering point in the Mall premises can alone lead to negative media comment (including social media), aversion and consumer concern with negative picture of company image. A real attack may cause illness, disabilities or even death among customers. Furthermore, the company will face the psychological and economic consequences of this action despite the fact that, the Mall was not directly responsible due to the fact that they are not a food operator but only the landlord.

Food producers and operators are obliged to protect their consumers. They have to comply with food safety legislation/standards. They are need to follow safety regulation and all reasonable precautions in order to avoid unintentional or intentional food product contamination or to minimize the probability should be undertaken.

Use of this TACCP protocol will not prevent the attack or unintentional release of CBRN agent. However, the execution of this attack or unintentional release will be less probable. Any incident will influence on business continuity including media management and public relations strategies. The threat assessment critical control point (TACCP) will not replace existing strategies, but it should complement them.

As a first step in the threat assessment critical control point (TACCP) process is to appoint the TACCP Team. The Team should be formed from individuals with different area of responsibility/expertise:

- Security personnel
- Human resources
- Management
- Cleaning personnel
- Food operators

In case of small organization, the manager may cover all of these roles. The threat assessment critical control point (TACCP) Team would typically be established as a permanent group, able to review its decisions over time.

The Team chosen persons should possess knowledge concerning premise, highly trustworthy, discreet and be aware of the implications of the study.

5.4 The TACCP team should:

- Identify individuals or groups (internal or external) which may cause a threat
- Select an exemplar food product which is representative and trace him from delivery point up to the releasing to the customer.
- Draft a detailed process flow chart
- Carry out a detailed study: amending and validating the flow chart, listing job roles pertinent to each step from delivery point up to the releasing to the customer.
- Establish and assess all vulnerable point during the trace
- Consider the probability on contamination and impact of the CBRN agent on each step.
- Assess the existing procedures in order to detect such agent.
- Attempt to establish the contamination levels needed to achieve a infectious/toxic effect
- Document assessment outcomes
- Identify and implement proportionate preventative action in confidential
- Carry out a security risk assessment for dedicated groups of personnel
- Agree for any further necessary preventative actions and a plan for their implementation.
- Determine review and revise undertaken arrangements

5.5 Threat assessment

The food product or the premises can be the target thus each element in food chain should be assessed separately. The responsible person (from management) should be aware of alienated and former employees, single issue groups, commercial competitors, media representatives, terrorist groups, criminals and influencers. The questions which arise:

5.5.1 In case of food product:

- Does dedicated food product serve in the premises possess any particular religious, ethical or moral significance for some people?
- Are this food product is used as an ingredient or is served in the premises?
- Are this food product contain ingredients or is sourced from overseas?

5.5.2 In case of the premises:

- Are premises located in sensitive area (from political or social field)?
- Are the premises share access or are localized close to 'controversial' neighbors?
- Are the premises adequately protected?
- Are external utilities adequately protected?
- Are any hazardous materials present in the premises and if yes are they are protected?

5.5.3 In case of the business:

- Are the business ownership by nations involved in international or internal conflict?
- Are the business is run by celebrity or highly recognized person?
- Are the business possess the significant links through customers, suppliers with unstable regions of the world?
- Are the business can be foreseen as controversial by some?
- Are the business supply with food products celebrities or high profile customers or events?

The responses to above questions can provide the better understanding of the attack impact and the probability that, the attack will take place.

5.6 The threat assessment critical control point (TACCP)

5.6.1 Access to premise

General access of people, vehicles and materials onto premises food delivery points should be restricted to those associated with business function. By this, it will reduces the possibility for intrusion. As an example, in most of the cases delivery of food product is executed by vehicle, so any pedestrian present in food delivery point should be carefully monitor. Furthermore, any delivery of food products should be appointed, so the presence of delivery out of the scheduled time should be investigated. Visible and comprehensive food delivery point fencing may act as a deterrent to intruders, however in many premises the delivery point is localized inside the building so CCTV monitoring and an associated alarm system can give indication that intrusion take place. Advice on the need of perimeter fencing depends upon operational requirements provided by the threat assessment. Unauthorized access may be monitored and controlled by above mentioned CCTV, security guards and suitable lighting system. Within perimeter control, the threat assessment critical control point (TACCP) team should also consider the site situation. The roads, waterways, other buildings, planning constraints vicinity

as well as technological aspects important in food delivery safety like pest control. The food delivery point controls should be viewed as a whole, so the weakness in one part does not necessary negate strengths in other parts. In case of development of a new site the plans should follow these security considerations and implement it into the design process.

5.6.2 Access for vehicles

Entry to vehicles involved in the food business should be through monitored access points. The approach roads should be equipped with features allowing to minimize the speed of the vehicle. The features should be exercised and maintenance should be performed routinely. Deliveries of food products should be scheduled in advance and unscheduled deliveries should only be accepted in specific situation (the list of this situations should be elaborated with management). Staff responsible for receiving food products should check documentation and the integrity of loads. The record serial numbers from any tamper evident tags should be performed. Deliveries of other goods other than those related to food chain should not be overlooked as potential carriers of hazardous material. The reception staff should be aware of the dangers of the unlawful use of emergency service and other liveried vehicles (e.g. 'Trojan' horse type vehicles) which are not what they seem. Any delivery, which is taken place unscheduled and agreed with the list of situation, should be carefully investigated and reported to supervisors.

5.6.3 Access for people

The entry to people to restricted zones (delivery point, restaurants/catering points back doors, food storage points, routes for food transport etc.) should be granted only to the dedicated personnel. The entry should be secured (e.g. a key or token such as a swipe card) or other methods (e.g. a password or PIN code) or, preferably, of both. In some situation the old fashion key will also be sufficient, if the doors remains closed and zone will be under the CCTV surveillance. Other than dedicated persons (official business, visitors) should have appointments and be under management endorsement and supervision.

Screening the people in food related restricted zone is a general rule with the exception for food delivery company personnel, if necessary. The best option is that, the restaurants/catering points personnel responsible for food product is receiving the food products at delivery point and transporting it's to the dedicated places by himself. In case of casual visits - should be excluded unless from a recognized authority (e.g. health inspectors). Nerveless, all visitors should present reasonable proof of their identity on arrival and a record of their attendance should be maintained. During their visits, a nominated person from management should meet them prior and accompany throughout the visit, controls and inspections. All visitors should agree to cooperate with a security search, if necessary.

5.6.4 Identification of unauthorized people

The positive identification of staff and visitors at all times is recommended. This could be achieved by issuing a pass, which will allow to identify the person. The pass should be worn in visible place allowing to identify throughout CCTV monitoring. Security staff and other

personnel should be trained and encouraged to be vigilant in order to identify, monitor and report intruders and to report hostile surveillance. The police should be contacted immediately if an intruder is found on the premises.

5.6.5 Controlling the access to crucial systems

Attack on the premise services (power, potable water, drainage, cleaning systems, etc.) could lead to contamination of food products. Ventilation systems can be vulnerable to gases or aerosols and may require protection. Managers should identify these areas and restrict the access only to responsible persons. Furthermore, the managers should identify avoidable gaps in security between supplier owned and operator owned infrastructure.

5.6.6 Storage of transport vehicles

The food transporting vehicles should be present only during the unloading in dedicated delivery area. During unloading, the vehicle should be monitored using CCTV.

5.6.7 Access to food products

Secure storage of food products, packaging materials will reduce the chances for intentional contamination. Hazardous materials present in the premise, in particular cleaning and sanitizing chemicals should be handled safely and in locked storage under the control and monitor by CCTV. It is strictly forbidden to leave food products in restaurants/catering point back door area unattended. Any food products with damaged seals should not be used without further investigation and clearance.

Assurance that, the sources of food products are reliable is crucial. The integrity of food products supplied to restaurants/catering point is fundamental to good practice. Casual purchases should be avoid. Casual purchases should be the exception rather than the norm. Moreover, it should be ensured that casual suppliers do not become permanent suppliers without prior appropriate checks and controls.

5.6.8 Product security

Tamper evident consignments.

Product tamper evidence closure provides an important knowledge concerning food product safety and information concerning undamaged external packages, which have not been opened – see Fig. 12

For other food products, protective seals assures integrity and contributes to product traceability see Fig. 13. The protective seal need to be checked for the existing holes or other damages suggesting prior opening or broken integrity see Fig. 14.

In case of any suspicion concerning broken tamper evidence or sealed cup the food product should be placed in quarantine and the investigation prior to use, should be started.



Figure 13: The example of tamper evidence closure



Figure 14: . The example of tamper evidence closure

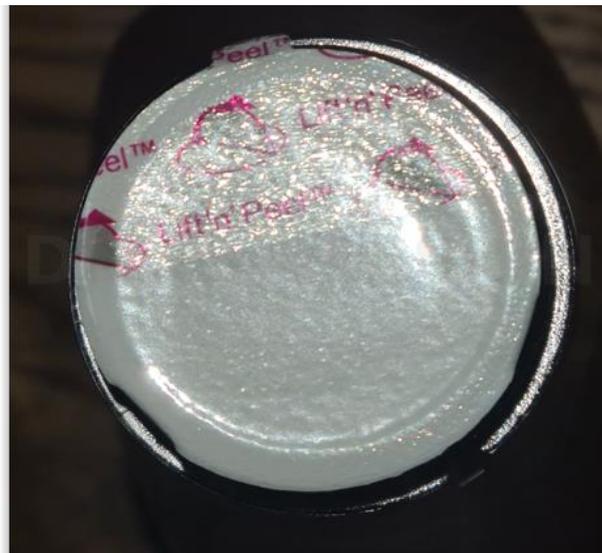


Figure 15: The example of sealed cup

The personnel responsible for food products reception should record vehicle details and tamper-seal numbers, and confirm there are no damaged packs. Furthermore, the food product expiration date should be checked and recorded – see Fig.15. The expiration date is placed on every single food product package. Moreover, the expiration date mark should be checked for the purpose of any visible changes. Sensory examination for the unusual odors is recommended. The lot (batch) coding facilitates product recall of food product should be recorded by food reception personnel – see Fig. 16.

Any suspicions during reception should be resulted in refusal of acceptance of delivered product.

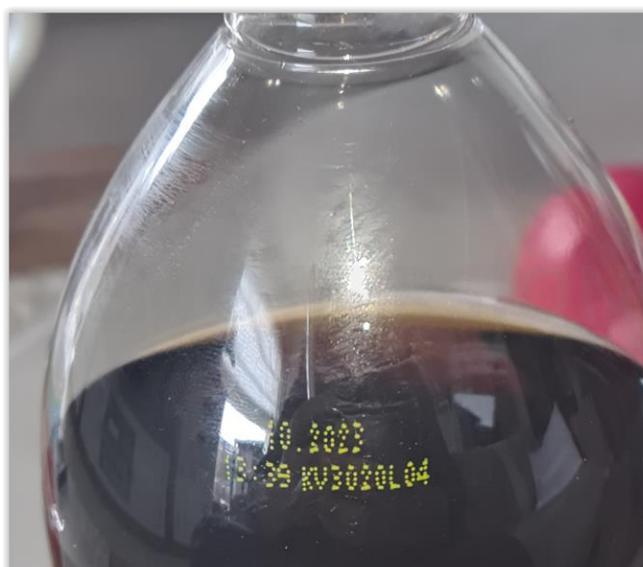


Figure 16: Expiration date



Figure 17: Lot (batch) coding facilitates product recall

5.6.9 Quality control during food process

During food preparation (opening the food products) the food chef should performed the sensory examination should be executed. Many food contaminants will influence on the food products by changing their color, odor, texture or flavor. Any suspicions or doubts should be resulted in withdrawal of food product.

6.FMEA (Failure Mode and Effect Analysis)

Failure Mode and Effects Analysis (FMEA) is an approach to discovering potential failures that may exist.

6.1 Introduction and method description

The aim of the analysis is to examine the actual state in the Organization in terms of the possibility of carrying out an attack with the participation of CBRN on the food chain. The analysis by FMEA - (Failure Mode and Effect Analysis) are able to identify potential failure modes in a system and their causes and effects.

6.1.1 The FMEA systematically:

- failure cause and effect analysis,
- analysis of the possibilities and effects of defects,
- analysis of possible causes and effects of defects,
- analysis of the causes, effects and criticality of defects

Risk is the product of the vulnerability to a hazard (P), the impact of the risk (W) and the probability of its occurrence (PR).

$$R=P*W*PR$$

Each of the elements will be assessed on a five-point scale according to the tables below.

Table 1 - Vulnerability Assessment.

SCALE	VULNERABILITY ASSESSMENT (P) HIGHER THE LESS WE ARE PROTECTED AGAINST THIS HAZARD
1	low (comprehensive security measures implemented and supervised)
2	average (partial security measures implemented and supervised)
3	high (comprehensive unsupervised security)
4	very high (unsupervised partial security)
5	critical (no security system)

Table 2 - Risk Impact Assessment.

SCALE	THE IMPACT OF A THREAT (W) HIGHER IT IS THE MORE ADVERSE ITS EFFECTS ARE
1	low (possibility of further functioning)
2	average (difficulties in functioning)
3	high (excluding part of the facility from functioning)
4	very high (over 50% of the facility is unfunctional)
5	critical (complete exclusion from the functioning of the facility)

Table 3 - Assessment of the likelihood of a hazard occurring.

SCALE	THE LIKELIHOOD OF A hazard (PR) HIGHER IT IS, AS POTENTIALLY MORE PROBABLE THREAT MAY OCCUR
1	low (potential number of events: no more than once a year)
2	average (potential number of events: no more than one in 6 months)
3	high (potential number of events: no more than 1 per month)
4	very high (potential number of events: no more than 1 per week)
5	critical (potential number of events: 1 or more times a week)

Table 4 - Risk level.

No	The analyzed elements of the food safety chain	The vulnerability to the hazard P	The impact of the hazard W	The likelihood of a hazard occurring PR	Risk R R=P*W*PR

In order to estimate the risk priority number concerning food safety and security in organization, the following topics will be considered and analyse in order to introduce the countermeasure actions:

1. Food delivery - access to the facility
 - a. Vehicle access (monitoring, identification of unauthorized access, security)
 - b. Human access
2. Food transportation inside the facility
3. Security staff
4. Back-office access
5. Ready-made gastronomic products sold in an open manner (allowing free access to the product by third parties).
6. Preparation of the consumption areas to serve guests eating meals on the spot.
7. Preparation of food products for distribution.

8. Ready-made products service (both eaten on site and take-away).
9. The probability of inspection carried out by an individual posing as a Public Health Inspector

During the visits (project realization), the above mentioned areas were identified as vulnerable and were checked in order to estimate the probability of intentional or unintentional contamination of food products. The summary of the probability is presented in the Fig. 19.

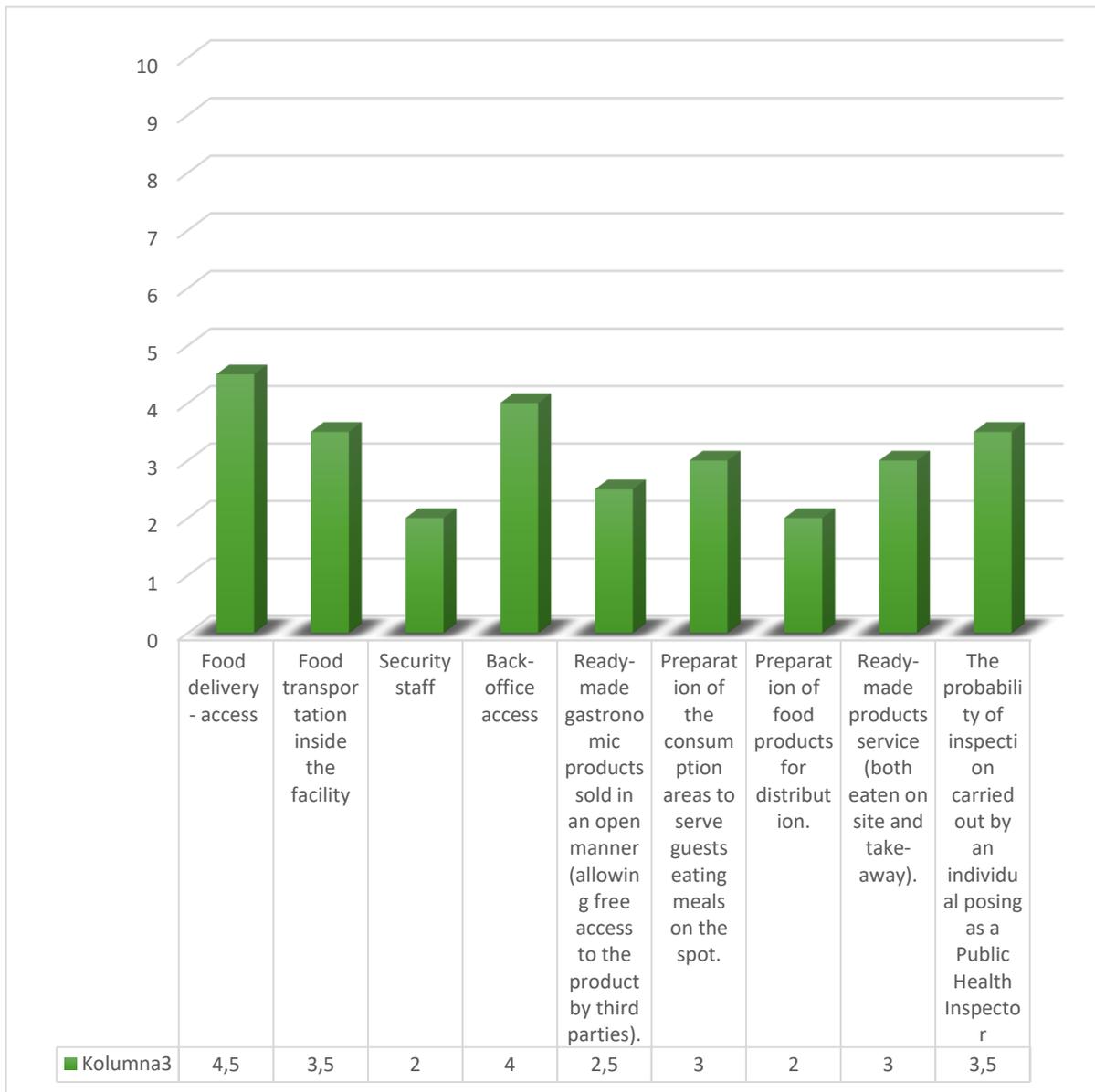


Figure 18: The probability of intentional or unintentional contamination of food products

In details:

6.2 Food delivery - access to the facility

6.2.1 Vehicle access (monitoring, identification of unauthorized access, security)

Food product delivery points to the facility are located inside see Fig. 20 or outside see Fig. 21 the premise. The delivery of food products are conducted using the ramp/ramps. In best option, the access to food product delivery point should be equipped with the gate for vehicles entering and covered by access monitoring points. The access roads should be equipped with speed limiters and have maximum facilities for inspection and possible refusal of entry for vehicles. Entry and exit roads should be clean (free) and allow for inspection. To make vehicles control easier regularly remove any objects from the road (tree leaves, wastes, etc.).

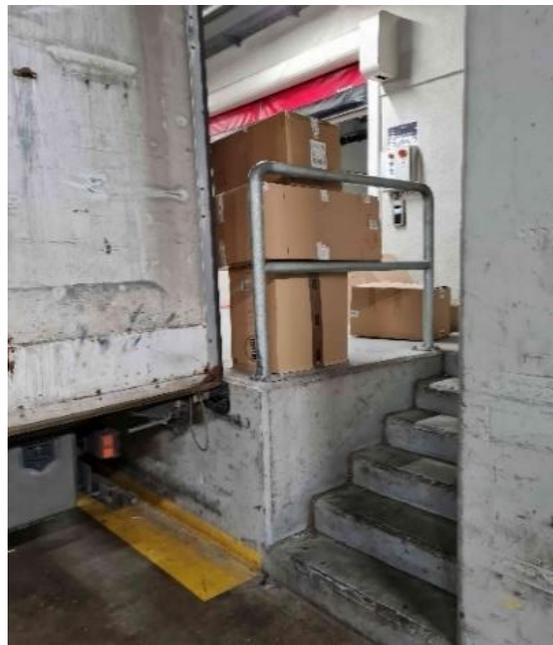


Figure 19: Inside food product delivery point



Figure 20: Outside food product delivery point

The delivery of food products should be conducted according to the established daily/weekly schedule. The delivery of food products out of the schedule should be avoided. In certain circumstances out of schedule delivery may be accepted with manager agreement and notification. The personnel from restaurants/catering points responsible for receiving the food products should check the documentation and the condition (inviolability) of the transported food products. The serial numbers and others key information from the security labels or seals should be performed and recorded.

6.2.2 Recommendations

- Equip the access to food product delivery point with barrier in order to prevent unauthorised enter.
- Equip the roads to the food product delivery points with speed limiters.
- Equip the delivery point with CCTV monitoring
- Introduce the food products delivery schedule
- Record the all vehicle (registration tags) transporting the food products
- Limit the vehicle access to the food product delivery point especially during food product delivery hours.
- Elaborate the list of circumstances allowing to deliver of food products outside dedicated schedule
- Report any suspicion activities to supervisors

6.2.3 Human access

Identification of personnel. Constant identification of employees is recommended. It can be done by using appropriately marked clothing and/or identification passes/ cards. Employees should be trained and motivated to be vigilant to identifying, monitoring and reporting the presence of any unauthorized person. The CCTV monitoring should be present. Access to delivery points should be allowed for the personnel based on held authorization (e.g. key or access card) or on knowledge of the password or code. The best protection combines both of these elements.

6.2.4 Recommendations

- Equip the delivery point with CCTV monitoring
- Equip the doors to delivery points with authorization
- Provide sufficient light allowing to recognize employee
- Keep the doors to the delivery points closed
- Report any suspicion activities to supervisors

6.3 Food transportation inside the facility

The food products should be received using dedicated ramp (ramp for the food products) or dedicated gate. In some situations, where there is only one ramp, the dedicated hours for receiving only food products should be established. The food products should be transported to restaurants/catering points using the closest route. In case of necessity of usage the elevators, the elevators should be dedicated only for the food products. In some situation, where there is only one elevator, the dedicated hours for food product transportation should be established. In this case, the elevator prior to the food product transportation should be cleaned and report of this activity should be recorded. It is forbidden to transport the food product using other ways. Do not leave food product unattended see Fig. 22.



Figure 21: Unattended food product

During the inspection visits performed, the vulnerability of the food products on contamination on the route from delivery point to the restaurant/catering point was elaborated see Fig 23. The observed pick in case of bakery products and vegetable and fruits is resulted from the fact that, in some situation was observed left unattended in front of closed restaurant/catering point.

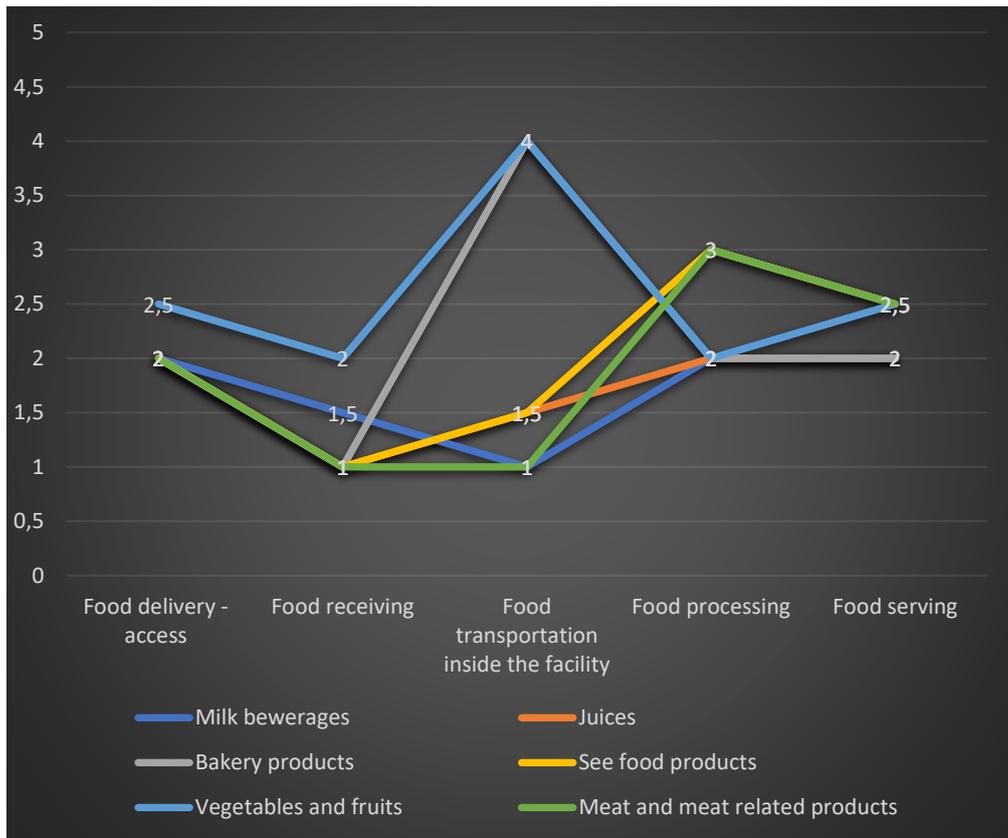


Figure 22: Vulnerability of food products in supply chain on CBRN agent contamination– on the basis on inspection visits

6.3.1 Recommendations

- Establishing the dedicated ramp or point for delivery only food products
- In case on availability of only one ramp or gate, establish the dedicated hours intended only for receiving the food products.
- In case of using the elevator for transportation of food products, establish the dedicated one only for the purpose of food product transportation.
- In case, where only one elevator is present, establish the dedicated hours only for food product transportation. In this case prior of food transportation hours, establish the protocol of cleaning the elevator.
- Do not use the same route of waste transportation and food transportation.
- Relocate the waste containers out from the food delivery area
- Establish the protocol for reporting of findings by personnel unattended food products.
- Quarantine unattended food products for the purpose of verification.
- Do not allow to transport food products out of the established food transportation route.

6.4 Security staff

The security personnel within their duties are the part of safety of food supply chain. They should record any irregularity and any suspicious behaviour to their supervisors. The key security personnel should be subjected to rigorous recruitment process and systematic assessment of the tasks entrusted as part of official duties.

6.4.1 Recommendations

- Establish the verification round for security personnel covering the delivery point and food transportation route.
- Establish the round for security personnel covering the food court area.
- Train the security personnel in field of CBRN threats and food protection.
- Introduce the reward system for security personnel reporting verified faults in food supply chain

6.5 Back-office access

The back office access to restaurants/catering points area should remain closed for all times see Fig 24. It should be equipped with authorization and CCTV monitoring. Only verified personnel should possess the access to this area. In case, when in this area the storage room for chemicals are present, it should be closed and monitor by CCTV. It is not allowed to storage the food products there. The security personnel should verify above mentioned. Any faults, should be reported to the supervisors. Any unattended food products found there should be secured.

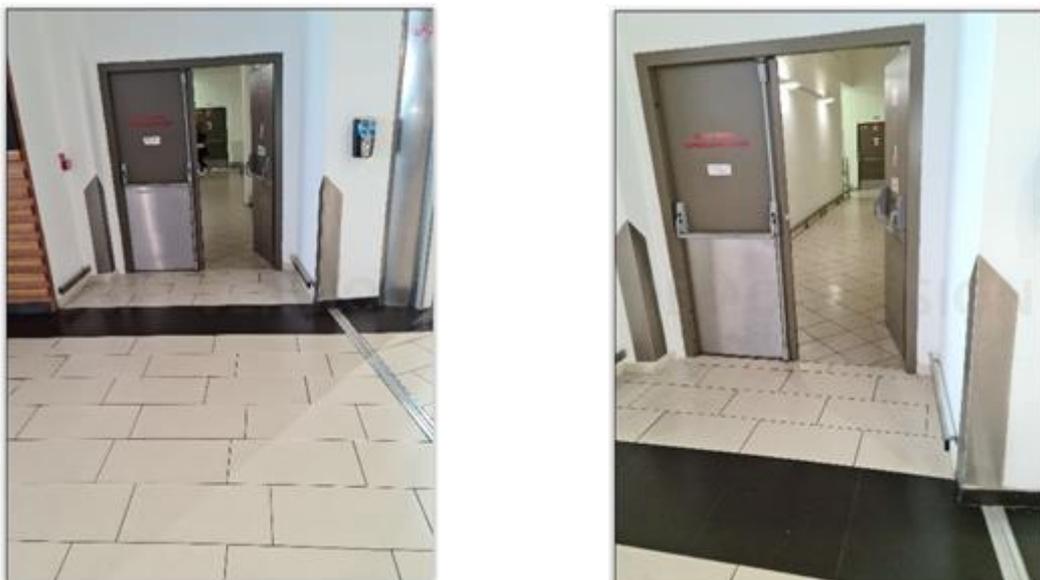


Figure 23: Open back office access to restaurants/catering points area

6.5.1 Recommendations

- Keep the door to back office access to restaurants/catering points area closed for all time
- Install the electronic verification access (key cards, PIN)
- Install the CCTV monitoring covering the back office access to restaurants/catering points area
- If chemicals storage room is present there, keep this door closed for all time. Install the electronic verification access (key cards, PIN) there. Install the CCTV monitoring covering this area.
- Do not allow to storage the food products there
- Report the cases of storage the food products there and remove the food products for the purpose of further verification
- Establish the protocol for faults reporting

6.6 Ready-made gastronomic products sold in an open manner (allowing free access to the product by third parties).

The open manner sales of food products creates the opportunity to increase the sale but from the perspective of food product safety, it's allowing to contaminate them see Fig. 25. The option is create the visible barrier between the food product and consumer see Fig. 26. Furthermore, in order to limit the risk of intentional or unintentional food contamination during sale is to installing the CCTV surveillance covering the area of open manner food products sale.



Figure 24: Foods sold 'open' for customers



Figure 25: Foods sold 'closed' for customers

6.6.1 Recommendations

- Introduce the closed manner food products sale
- Install the CCTV monitoring covering the area of sale
- Train the security personnel in reporting any suspicious customer behavior during food products purchase
- Establish the protocol for reporting of suspicious customer behavior

6.7 Preparation of the consumption areas to serve guests eating meals on the spot.

The area of consumption should be monitor by CCTV. Furthermore, the security personnel should be present in this area. The consumption area should remain clean see Fig. 27. Any suspicious behavior should be reported immediately to supervisors.

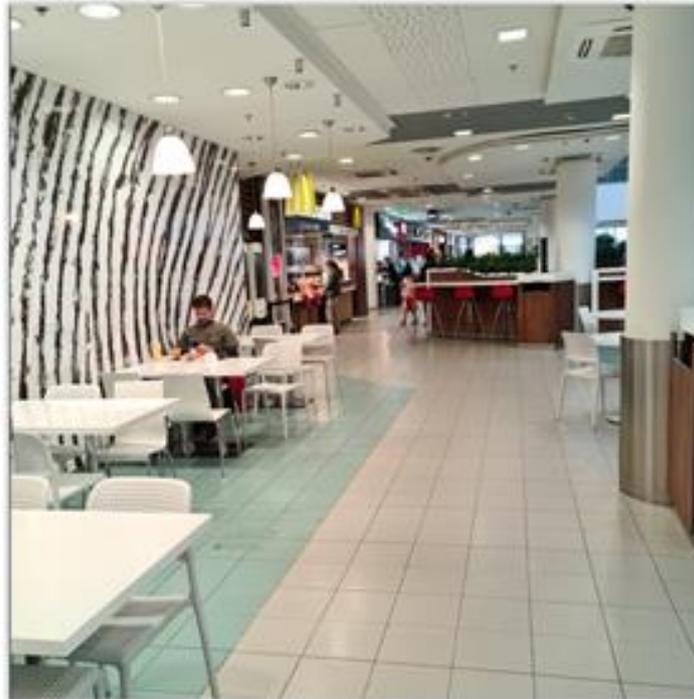


Figure 26: The consumption area

6.7.1 Recommendations

- Install the CCTV monitoring covering the consumption area
- Introduce the constant presence of security personnel in consumption area, if possible or increase the security round in this area.
- Introduce the protocol of reporting suspicious behavior
- Establish the cleaning protocol of the consumption area and methods of verification

6.8 Preparation of food products for distribution.

The observing the process of preparing meals is the most challenging one without interfere with whole process. However, the security staff should monitor the accessible areas and food personnel during preparation using CCTV monitoring or personally during their security rounds. Any suspicious behavior or nervousness among food personnel should be reported.

6.8.1 Recommendations

- Install the CCTV monitoring covering the food products preparation area, if possible
- Monitor the area during security rounds
- Introduce the protocol of reporting suspicious, nervousness behavior among food personnel
- Introduce the protocol of reporting suspicious, nervousness behavior among food personnel

6.9 Ready-made products service (both eaten on site and take-away).

The ordering the food is the process, where the food contamination is possible. In this case the contamination will be limited only to the dedicated product. The time between pick up the ready to meal and consumer call is essential. In most of the cases the food was left unattended. It create the opportunity for intentional food contamination.

6.9.1 Recommendations

- Install the CCTV monitoring covering the food products pick up point
- Introduce the protocol, in which the food personnel will not leave sold meal unattended.
- Sensitize the security personnel on this aspect of food supply chain.

6.10 The probability of inspection carried out by an individual posing as a Public Health Inspector

The individuals, which can pretend to be Health Inspector gaining the access to restricted areas of food supply chain. In order to limit the risk of food contamination resulted from their presence, the following recommendations are needed.

6.10.1 Recommendations

- Introduce the protocol of acceptance Health Inspection visits
- Introduce the process of verification of Health Inspection identity card
- Introduce the protocol of verification the Health Inspector identity
- Establishing the protocol of escort by security personnel the Health Inspection officers during whole visit

7. Post incident countermeasure procedures

7.1 Detection

Apart from sensory examination, there are existing methods, which could be used for the verification of the food product quality or for discovering the presence of agent in the food product. Below on the Figure., the simple immunochromatographic method to test the presence of most common biological food contaminants. The sample of testes food product should be placed in dot marked area and wait approx. 5 minutes for test results. Appearance of two bars in stick pointing out on the presence of biological agent. The detection and identification of CBRN hazards requires the integration of monitored sources. The countermeasures must be implemented early to mitigate the effects of a CBRN incident. The implementation of these systems for monitoring should be a priority if the use of chemical agents is anticipated. Conversely, if the use of biological agents is anticipated, accurate lab-

based diagnosis should be a priority to determine the most effective medical countermeasures to prevent the hazard from spreading.

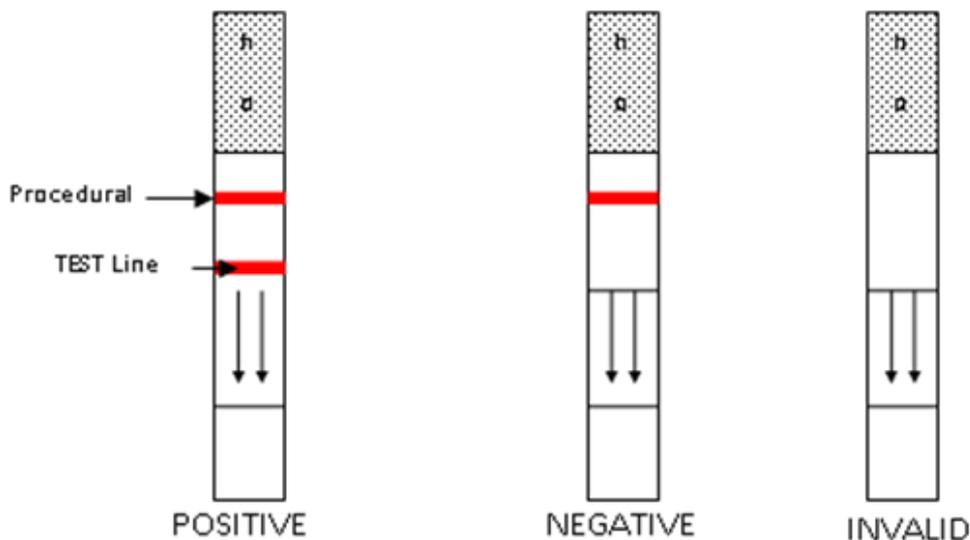


Figure 27: Biological agent detection method

7.2 Containment

Interrupt disease transmission. If transmission of the disease could cause a health emergency, quarantine measures should be implemented. The key elements are: isolation (e.g. quarantine) and treat infectious persons, minimization of exposure of uninfected persons. Quarantine is an enforced restriction of movement to control disease. The most used is short-term, voluntary home curfew, known as shelter-in-place or self-shielding, however in some situations “Cordon sanitaire” – a guarded barrier restricting passage into and out of an area is needed. The duration of quarantine varies from few hours to assess exposure threat, through days, while preventive treatment is provided and persons monitored for signs of illness to weeks for the duration of the incubation period. Likely to involve multiple small areas of exposed persons rather than entire neighborhoods or cities. There are 4 levels of quarantine: level 1: unknown disease entity, level 2: identified disease entity, level 3: escalating communicable disease, level 4: continued escalation. Quarantine requires compulsory detention or similar restriction of individuals or groups reasonably believed to be infected or exposed to a communicable disease. Quarantine areas should minimize transmission of infection and provide adequate food, clothing, medical care, and other necessities.

7.3 Triage

The medical segregation (triage) was introduced by Baron Dominique Jean Larrey. He was the Napoleon surgeon during his wars. He was also the inventor of the flying ambulances in order to transport the wounded soldiers to the field hospitals. He established the rules of triage according to the seriousness of the injury and priority in medical evacuation. His invention was the base of modern triage protocols.

The most common triage systems are: START and DLS triage systems. The START Triage (Single Triage and Rapid Treatment) is based on the injury's severity. The system is based on the following criteria: airway, breathing, circulation, disability (ABCD). The person executing the triage procedure takes approx. 30 sec. to categorize the patient to the following categories: immediate, delayed, expectant, minimal. The START is using a color-coded system to mark the victims. The color-coded system: immediate – red, delayed – yellow, expectant – black, minimal – green. Nowadays, in order to avoid under or over triage (improper triage categorization), the electronic devices are used. The devices will prevent the influence of human factor on executing the procedure. The triage categories will allow to prioritize in medical evacuation. The DLS (Disaster Life Support) triage system was introduced in armed forces as an answer to new challenges. The main differences between START and DLS are as follows: DLS – five categories: The START expectant category in DLS was divided into two separate categories marked with blue and black color, where the blue are the victims with life-threatening injuries with low chances of survival and black are the dead victims. The introduction of the blue category was related to saving the lives of persons, which are very difficult to replace from a military perspective (e.g. fighter pilots, highly trained personnel etc.). The loss of this personnel will directly influence (reduction) on the combat value of the military unit. The aim in executing the START triage is to divide the victims according to the severity of the injuries and potential to survive into 4 groups. The person executing the triage in approx. 30 seconds needs to categorize the victims on the basis of ABCD (Airways, Breathing, Circulation, Disabilities) protocol. Each victim needs to be tagged by appropriate color in order to prioritize the medical intervention and evacuation to the point of care. The groups: immediate (red) - immediately life-threatening problems with high potential for survival; delayed (yellow) – serious injuries, require medical care but management can be delayed without increasing morbidity or mortality; minimal (green) - require minor care or no care without adverse effect; expectant (black) – very serious injuries, life-threatening with low chance of survival (should receive comfort care until resources available) or dead victim. The aim of the DLS triage is to divide the victims into five categories according to the injury severity or health status. However, in contrast to the START system, the DLS triage starts with verbal commands allowing to separate minimal and delayed groups of victims. Next, in this triage system is to identify the dead victims, which should be tagged. Then, the rest of the victims belongs to the remaining two categories – immediate and expectant.

7.4 Evacuation

Controlled process of moving any person who is wounded, injured or/and ill to the established or existed point of care.

7.5 Decontamination

The process of removing deposited CBRN agent from personnel, equipment, and affected areas. In the case of internal contamination, specialized expertise, techniques, and facilities are required. Contaminated casualties should be decontaminated as close to the areas where they were contaminated as possible.

7.6 Epidemiological investigation

Factors to consider in deciding whether an investigation is warranted: the apparent number of persons affected, presence of unusual or severe clinical symptoms, lack of an obvious explanation for disease occurrence, perceived need to implement control measures, level of public concern, potential for contributing to medical knowledge.

7.6.1 Epidemic curves

The epidemic curves describes the frequency of the appearance of new cases over time. Is based on the date of disease onset. The curve shape in relation to the incubation period for a particular disease can provide the information concerning the source. There are three main types of epidemic curve.

Point source epidemic involves exposure of susceptible persons to a common source of the pathogen (e.g., contaminated drinking water)

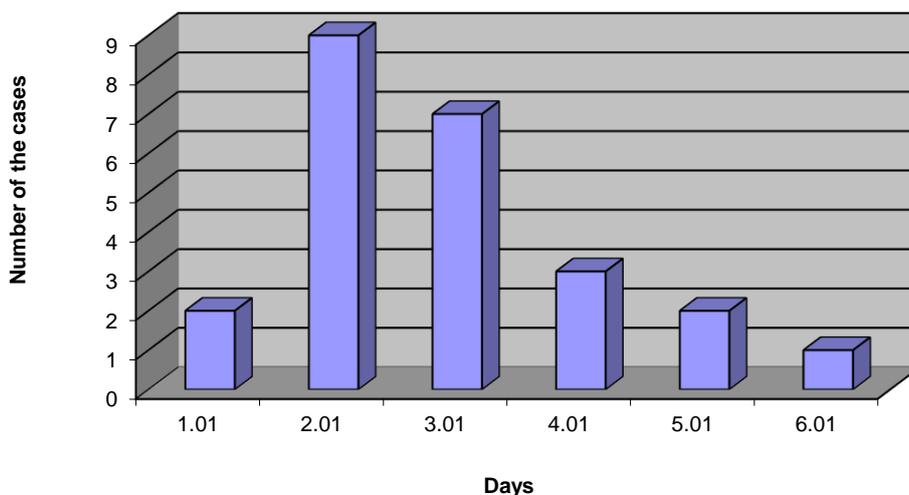


Figure 28: The example of Point source epidemic curve

Propagated (or progressive source) epidemic involves the transfer of the pathogen from one host to another.

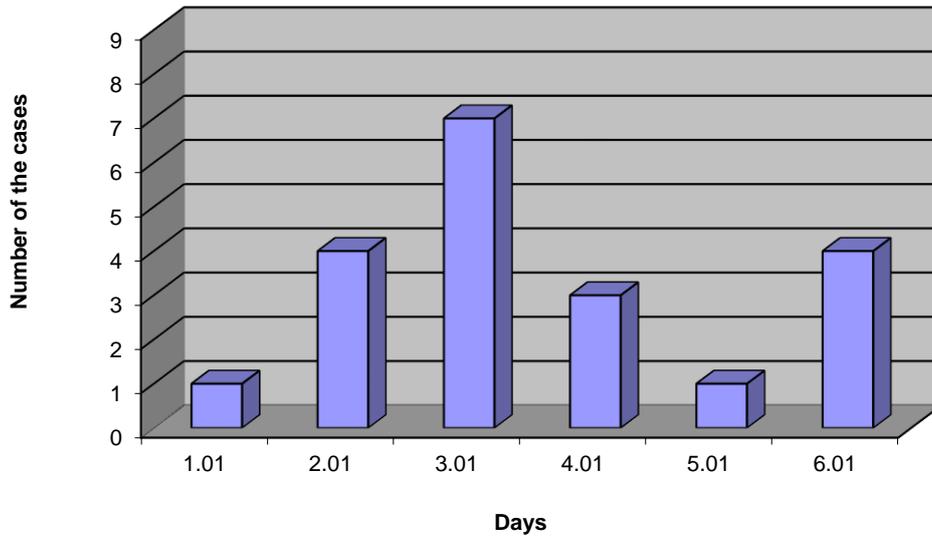


Figure 29: The example of propagated (or progressive source) epidemic curve

Continuous common source epidemics involves exposure of susceptible persons to a common source of the pathogen (e.g., contaminated drinking water).

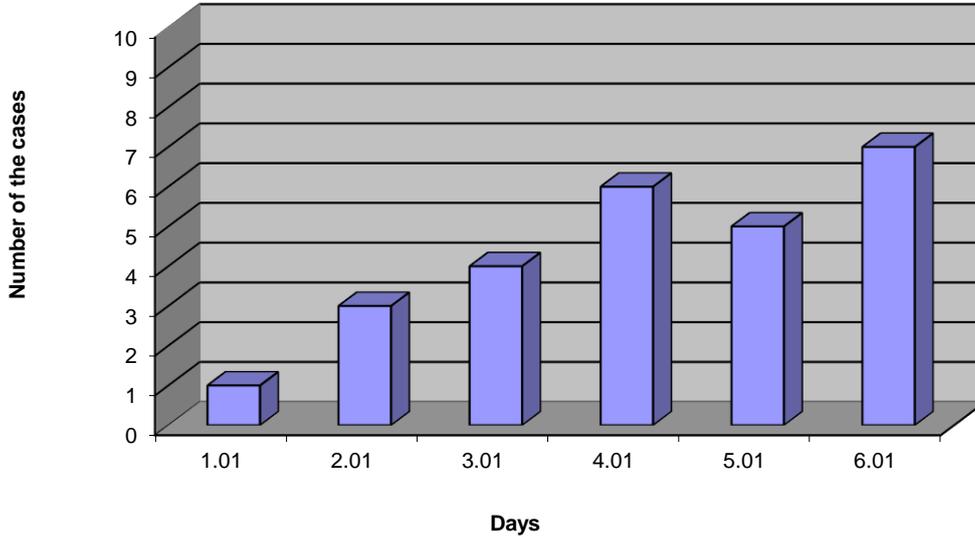


Figure 30: The example of continuous common source epidemic curve

7.6.2 Purpose of Epidemic Investigations

To confirm the threat or existence of an epidemic. Identify the causative agent, its source and mode of transmission. Determine the geographic distribution. Determine the public health impact, identifying those persons who are at highest risk for disease. Assess local response capacity. Identify the most effective control measures

Steps for conducting the investigation

- Confirm the existence of an epidemic.
- Confirm the diagnosis.
 - use standard clinical and laboratory techniques, once the presence of an epidemic is established, ongoing laboratory confirmation of a sample of cases is generally sufficient.
- Determine the number of cases.
 - establish a workable case definition - sensitivity and specificity of the case definition depend on: usual apparent-to-inapparent case ratio, pathognomonic signs and symptoms, laboratory support for diagnosis, accessibility of cases, level of expertise of available health personnel, amount of subjectivity involved in diagnosis
 - establish a case-finding mechanism
- Orient the patient data in terms of time, place, and person
 - date (and perhaps time) of onset of symptoms
 - incubation period
 - age and gender
 - place of residence
 - ethnic group (if applicable)
 - vaccination status (if pertinent)
- Determine who is at risk
 - prepare a graph (epidemic curve) showing the number of cases per day, which may indicate
 - the point at which the outbreak first occurred
 - the magnitude of the outbreak
 - the incubation period
 - possible modes of transmission
- If confined to a geographic area, mark the residence of each case on a map
 - allows for identification of clusters of cases
 - may pinpoint a common source of infection
- Identify those at highest risk of infection through a breakdown of patient data
- Develop and test hypotheses about transmission or risk factors
 - Generally use case-control study design
 - Laboratory analysis of environmental samples may be used to confirm a suspected source of infection
- Prepare a written report
 - include an estimate of the magnitude and health impact of the epidemic
 - include an estimate of the need for outside assistance and supplies
 - provides a valuable record for use in future investigations
 - serves as a useful teaching tool
- Execute control and preventive measures
 - Inform decision-makers to assure institution of appropriate control measures
 - Continued disease surveillance to determine the effectiveness of control measures

7.6.3 Elements of Epidemic Control

<u>Action</u>	<u>Example</u>
Control the source of the pathogen	Remove the source of contamination Remove persons from exposure Inactive or neutralize the pathogen Isolate and/or treat the infected person
Interrupt the transmission	Sterilize or interrupt environmental sources of spread Control mosquito or insect transmission Improve personal sanitation
Control or modify the host response to exposure	Immunize the susceptible Use prophylactic chemotherapy

7.7 The decision making process

The decision making process plays an important role in overall countermeasures activities. Some says that even a bad decision on the early stage of event is a way better than no decision. On every stage of incident (initial discovery, characterization and incident management) quick response and cooperation among all staff involved is crucial and directly influence on overall status see Fig.. It should be also emphases that the decision making person should be experienced, trained and possess confidence, which allow him/her to convince all coworkers to his/her decision.

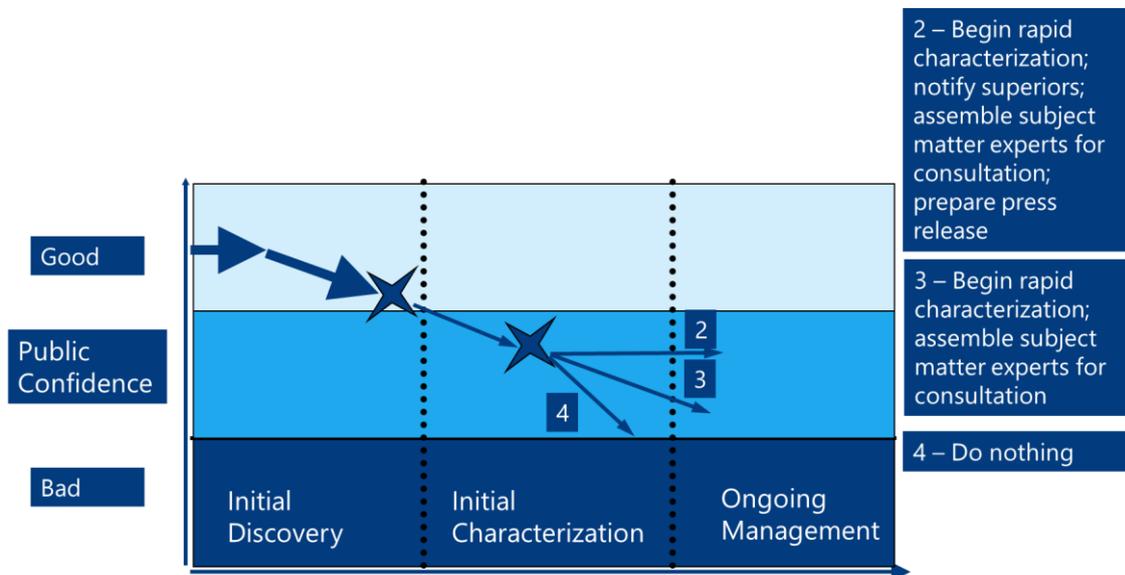


Figure 31: The decision making process chart

7.8 Recovery from attack

The emergency and crisis management procedures should be developed and trained with agencies and services in order to maximize collaboration and minimize confusion in the event of attack or unintentional food contamination. Organization should maintain an emergency key contacts (whom to inform, what to do list) list including both internal (executives, senior managers) and external partners (Environmental Health Officers, Police, Fire Fighters). All staff should be trained in emergency procedures. Arrangements for media management in order to minimize over-reaction should be key elements of a business continuity plan. In the event of intentional or unintentional release of CBRN agent, control of these activities will likely to be in the hands of the Police or other services. An effective traceability system, both upstream and downstream of food products should be developed to minimize the consequences of an attack. Special arrangements for the disposal of contaminated food products and other materials is necessary and should be elaborated. All regulations concerning security and general risk management (including Business Continuity and Disaster Planning) should be overviewed and collated to ensure that there are no contradictions or anomalies and that there are appropriate supporting procedures in place.

8. Conclusions

The challenges for food safety are enormous, ranging from biological contaminations that may occur already in the field and barn or in the kitchen or even during serving of the food to chemical contamination through environmental contaminants, agricultural residues or unsafe sanitary conditions in the kitchens of homes or restaurants. Furthermore, the increasing risk of usage the CBRN agents by the food products as a vector raised due to the fact of increasing level of their accessibility. However, these challenges can be met if precaution is used in the production, handling, transporting and serving the food to customer. Food and food safety may be the most important public health issues of our generation.

Food remains a precious commodity that will always be as risk and will always need to be treated with care and an open mind for possible threat causing problems. The presented countermeasures will limit the risk of intentional or unintentional food contamination and by this will positively influence not only on public health issue but also on business continuity.

Appendix 1

EU Food policy and food safety projects

European Union (EU) food safety policy is mainly governed by Articles 168 (public health) and 169 (consumer protection) of the Treaty on the Functioning of the European Union²⁴. Other regulation include:

Regulation EC 178/2002: contains general provisions for traceability, defining responsibilities and duties in terms of traceability of all Stakeholders in the Food and Animal Feed sectors.

Regulation EC 854/2004: laying down specific rules for the organization of official controls on products of animal origin intended for human consumption.

Regulation EC 852/2004: on the foodstuffs hygiene. It contains requirements of general hygiene for all food business operators.

Regulation EC 853/2004: laying down specific hygiene rules for food of animal origin, supplementing Regulation 852/2004.

Within EU, food defense has been the focus of two different EU FP7 security projects: EDEN²⁵ and SNIFFER²⁶. Furthermore, European Union set up in 2002 the agency in order to serve as an impartial source of scientific advice to risk managers and to communicate on risks associated with the food chain - The European Food Safety Authority (EFSA). The mission of the Agency is to provide "safety in the food chain from farm to fork"²⁷.

The list of relevant EU projects:

FOODSAFETY4EU - is a collaborative action to support the European Commission (EC) in shaping the Food Safety System of the future²⁸

MARLON - Monitoring of animals for feed-related risks in the long term. The project "aims to create an inventory of which epidemiological and monitoring initiatives exist, both within and outside the EU, which could provide useful data for the purpose of monitoring for health impacts of animal feeds, in particular those containing GM ingredients, on livestock animals"²⁹.

SECUFOOD - Security of European Food supply chain. (European Program on Critical Infrastructure Protection, addressing the program theme "Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks"³⁰).

²⁴

https://eur-lex.europa.eu/summary/chapter/food_safety.html?root_default=SUM_1_CODED%3D30&locale=en

²⁵ <https://cordis.europa.eu/project/id/313077>

²⁶ <https://cordis.europa.eu/project/id/285203>

²⁷ <https://www.efsa.europa.eu/en>

²⁸ <https://foodsafety4.eu/project/>

²⁹ <https://www.wur.nl/en/show/marlon.htm>

³⁰ http://www.coseritylab.it/resources/Imp_SecurFood_Opuscolo.pdf

CO-EXTRA: GM and non-GM supply chains: their CO-EXISTENCE and TRAcability (European project of the 6th framework program)³¹. The aim of the project was to “was to provide all the stakeholders of the food and feed chains with a central decision-support system integrating the tools, methods, models and guidelines needed to deal with the imminent arrival of large quantities of Genetically modified organisms (GMOs), further to the lift of the current de facto ban on GMOs in European Union (EU)”.

KeLDA (Kernel Lot Distribution Assessment) concerning the distribution of GM material in kernel lots imported within EU Member States, the evaluation of sampling strategies for the detection of GM materials in lots of bulk raw materials, and providing recommendations for implementing sampling strategies (European project of the 5th framework program)³².

³¹ <https://cordis.europa.eu/project/id/7158/reporting>

³² <https://www.sasa.gov.uk/content/kernel-lot-distribution-assessment-kelda-comparative-study-protein-and-dna-based-detection>