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Epidemiological Study of Food Poisoning Cases from 2013 to 2021, in Diyala Province, Iraq

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Abstract

Food poisoning is the disease of toxic or infectious nature resulting or suspected to be resulting from consumption of water or food. There are significantly underestimated cases of foodborne diseases, and relatively few well-investigated outbreaks are revealed, though these often give information on etiological agents and the reason behind contaminations. This retrospective case study of collective food poisoning was designed to the establishment of a database inherent to food poisoning specific for Diyala province / Iraq during the period between 2013-2021. The results show that, between 2013-2021, 5 outbreaks of food poisoning were observed in Diyala province involving 1188 cases (327 hospitalized & 0 deaths). The data in the study will give information on the present situation and epidemiological evolution during the period of the study. Female predominance was shown among the samples included in the study (Sex ratio M/F = 0.85), and (54% of cases were female, and 46% of cases were male), and the age groups which 68% were under 30 years old.62.8% of cases with water contaminated consumption, and 62.8% of cases in Baqubah2 sector. stool culture reports showed growth of different microorganism. Samples of Water contaminated consumption showed growth of *E.coli*,

Salmonella spp, Meat sandwiches and appetizers showed growth of *Salmonella* spp, *Campylobacter*, *Staphylococcus aureus*. Other food items such as Home-made cheese showed growth of *Listeria monocytogenes*, *Salmonella* spp

Falafel* (Crushed chickpea dough) and fish showed growth of *Ecoli* and *Listeria monocytogenes* respectively. salads, contaminated ice showed growth of *Salmonella* spp There was no evidence of Clostridium species, to determine the best long and short control measures, surveillance is essential for identification of foodborne diseases, their causes as well as their socioeconomic impacts.

Keywords: Food poisoning, foodborne diseases, Waterborne diseases, outbreak, Diyala province, retrospective, Ecoli.

دراسة وبائية لحالات التسمم الغذائي في محافظة ديالى من 2013 الى 2021

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الخلاصة

التسمم الغذائي هو مرض ذو طبيعة سمية او معدية ينجم أو يشتبه في أنه ناتج عن استهلاك الماء أو الطعام. هناك حالات من الأمراض المنقولة بالغذاء تم التقليل من شأنها بشكل كبير، وتم الكشف عن عدد قليل نسبيًا من الممرضات التي تم التحقيق فيها جيدًا، على الرغم من أن هذه غالبًا ما تقدم معلومات عن العوامل المسببة للأمراض والسبب وراء التلوث. تم تصميم دراسة الحالة بأثر رجعي للتسمم الغذائي الجماعي لتأسيس قاعدة بيانات ملازمة للتسمم الغذائي الخاص بمحافظة ديالى / العراق خلال الفترة ما بين 2013-2021. بينت النتائج أنه بين عامي 2013 - 2021 شوهدت 5 حالات تفشي تسمم غذائي في محافظة ديالى شملت 1188 حالة (327 في المستشفيات و 0 حالة وفاة). ستعطي البيانات الواردة في الدراسة معلومات عن الوضع الحالي والتطور الوبائي خلال فترة الدراسة. وظهرت غلبة الإناث بين العينات المشمولة في الدراسة (نسبة الجنس(M / F = 0.85 ، و (54٪ من الحالات كانت إناث، و 46٪ من الحالات كانت من الذكور)، والفئات العمرية 68٪ كانت أقل من 30 سنة. - 62.8٪ من الحالات تلوثت باستهلاك المياه، و 62.8٪ من الحالات في قطاع بعقوبة 2. أظهرت تقارير ثقافة البراز نمو الكائنات الحية الدقيقة المختلفة. أظهرت عينات استهلاك المياه الملوثة نمو بكتريا

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E.coliو Salmonella spp وشطائر اللحوم والمقبلات التي أظهرت نمو Salmonella spp و Campylobacter و Staphylococcus aureus.أظهرت المواد الغذائية الأخرى مثل الجبن محلي الصنع نمو الليستريا المستوحدة، السالمونيلا، الفلافل (الحمص المطحون).

اظهر تناول الاسماك نمو بكتريا *Ecoli* و *Listeria monocytogenes* اظهرت االدراسة ان تناول السلطة الملوثة نموا لانواع من بكتريا Salmonella spp ولم تظهر الدراسة دليلا على نمو انواع بكتريا Clostridium. ولتحديد أفضل تدابير المكافحة الطويلة والقصيرة، فإن المراقبة ضرورية لتحديد الأمراض التي تنتقل عن طريق الأغذية، وأسبابها وكذلك آثارها الاجتماعية والاقتصادية

الكلمات المفتاحية: تسمم غذائي، امراض المنقولة بالغذاء، امراض المنقولة بالماء، وباء، محافظة ديالى، استعادة للأحداث، ايشريشيا القولون.

Introduction

Food poisoning is the disease of toxic or infectious nature resulting or suspected to be resulting from consumption of water or food Most food poisoning can be traced to one of three major causes: bacteria, parasites, or viruses. These pathogens can be found on almost all of the food humans eat. However, heat from cooking usually kills pathogens on food before it reaches our plate [1]. Foods eaten raw are common sources of food poisoning because they don't go through the cooking process.Occasionally, food will come in contact with the organisms in fecal matter or vomit. This is most likely to occur when an ill person prepares food and doesn't wash their hands before cooking.Meat, eggs, and dairy products are frequently contaminated. Water may also be contaminated with organisms that cause illness [2]. When a case of acute gastroenteritis, presenting with combinations of the main abdominal pain symptoms, diarrhea and vomiting in at least two patients sharing a common meal, then it can be readily associated with the suspicion of an episode of a food poisoning [3]. There is a significant foodborne disease underestimation, and a relative few well-investigated outbreaks have been recorded although they often provide information about the aetiological agents and the reason behind contaminations. Thus, till now, no national system settled precisely foodborne diseases extent. Data from different countries

may demonstrate distinct variations which can reflect the way in which they are interpreted and collected such as food habits and geographic locations of people [4],[5]. Therefore, careful advise must be given when doing the comparison of the statistics of food borne diseases between a country and another. Surveillance is very necessary to identify causes and socioeconomic impact of foodborne diseases so as to help in determining the best control measures. It must involve a systematic collection of appropriate incident data, its assessment for accuracy and completeness, compilation into standard format as well as trend interpretation with providing specific outbreaks examples. Among the microorganisms causing FBDs are bacteria that have different virulence factors that give them the ability to cause a disease; among these factors, we can find toxins that can be produced in food or once the pathogen has colonized the digestive tract. It is to be noted that the aim of this chapter is to convey information about some characteristics of the main pathogens producing toxins in food, the diseases they can cause, their complications and treatment options as well as the main sources of contamination in restaurants or street markets [6-7].

Types of bacterial toxins

A bacterial toxin is a macromolecule mainly of protein origin, which can cause toxic damage in a specific organ of the host [8]. Toxins can be divided in endotoxins and exotoxins:
Endotoxins or lipopolysaccharides (LPS): These are the components of the outer membrane of the Gram-negative bacteria; they are considered [9].

Lipid A is a glycolipid formed by a disaccharide (glucosamine) bound to fatty acids, that are usually capric, lauric, myristic, palmitic, and stearic acids, which are inserted in the outer membrane of the bacterium. The nucleus a heteropolysaccharide derived from hexoses and heptoses. Lipid A and the nucleus are bound by the sugar acid 2-keto-3-deoxyoctanate (KDO). [10] the O chain is a repeating unit polymer of 1–8 glycosidic residues; this polymer is highly variable among bacterial species and genus. Exotoxins of Gram-negative enteropathogenic bacteria play an important role in the pathogenesis of diarrheal disease, causing hypersecretion

of liquids without the destruction and death of intestinal mucosal cells. These toxins are generically referred to as enterotoxins that are different from cytotoxins [11].

Aim of Study: To describe the reality of food poisoning problem and the main cause of food poisoning, and its cases reported from 2013-2021, in Diyala province.

Methods

Epidemiological descriptive retrospective study, from 29th December 2021 – 9th January 2022, for food poisoning cases from 2013 – 2021, in Diyala province. The data was collected from the information forms in surveillance unit \ Diyala health care department. Case definitions were formed which are as follows: (1) a probable case of food poisoning was defined as a previously well individual who suddenly developed any of the following symptoms after eating dinner diarrhea (3 or more loose stools in 24 hours or less) abdominal pain, nausea, vomiting or fever, and (2) a confirmed case of food poisoning was defined as a previously well individual who suddenly developed any 2 of the following symptoms after eating dinner on: diarrhea (3 or more loose stools in 24 hours or less) abdominal pain, nausea, vomiting or fever with laboratory confirmed results for the pathogenic isolates either microscopy and staining method or by culture microscopy.

Description of the study population was made in regard to age, sex, disease, sector, clinical sign, as well as evolutions. Data were entered into computerized databases following variables' determination. An environmental survey was undertaken to assess hygiene and sanitation of cook house, dining hall, hostel and nearby area of the mess., food preparation and storage of prepared food pending consumption were ascertained by interviewing the food handlers. Medical examination of food handlers was carried out and stool specimens were collected and sent for bacteriological examination.

Extrinsic parameters

Food factors are very important for the development of microorganisms; there are external or extrinsic factors. This term refers to environmental factors that affect the growth rate of microorganisms; these factors include temperature, oxygen availability, and relative humidity, as well as, the presence and activities of other microorganisms [12].

Statistical analysis

Analysis of data was carried out using the available statistical package of SPSS-25(Statistical packages for Scial Sciences –version 25).

Results

Between 2013 and 2021, 1188 case with gastroenritis (food poisoning) were notified in Diyala province (327 hospitalized), and no death. Analysis of the curve (Figure 1 and Table 1) showed a remarkable increase in the cases especially during 2018, with 5 outbreaks in 2013,2016,2017,2018, and 2019

Distribution of cases according to gender (figure 2) revealed that 54% of affected people were females and 46% were males and the sex ratio (M\F was 0.85.

Regarding the onset places (sectors) of cases (figure 3), it was shown that 62.8% (746 case) of cases had occurred in Baqubah2 sector, 9.3% (111 case) in Baqubah1 sector, 6.2% (74 case) in Baladrooz sector, 4.9% (58 case) in Khanaken sector, 4.6% (55 case) in Alkhalis sector, 3.6 % (43 case) in Almuqdadya sector, 1.9% (20 case) in Almansorya sector, and 6.8% (81 case) in peoples not from Diyala province.

Data in (figure 4) showed an evident elevation in the foodborne disease case numbers within the (20-29) year age group, followed by (10-19) year and (15-20) year groups. The age group (10-29) years was the most vulnerable age group because 68% of cases were under 29 years.

Results showed that 62% of cases had occurred by waterborne causes, while 38% had occurred by foodborne causes (Figure 5).

Few hours following exposure, analysis of different clinical symptoms of recorded cases (figure 8), showed 69% of cases with vomiting, 61% with abdominal pain, 35% with diarrhea, 22% headache, 12% fever, and 6% with other symptoms.

Most of the cases were due to the consumption of water contaminated (62%). According to our results, meat sandwiches and appetizers was the food causing most poisoning cases, i.e. 190 cases (16%) followed by home-made cheese in 88 case (7.4%), 87 case (7.4%) consumed and Falafel* (Crushed chickpea dough), 4% (48 case) ate fish, and 3% (38 case) with salads, contaminated ice (Table 2). stool culture reports showed growth of different microorganism. Samples of Water contaminated consumption showed growth of *E.coli*,*Salmonella* spp, Meat sandwiches and appetizers showed growth of *Salmonella* spp, *Campylobacter*,*Staphylococcus aureus*. Other food items such as Home-made cheese showed growth of *Listeria monocytogenes, Salmonella* spp

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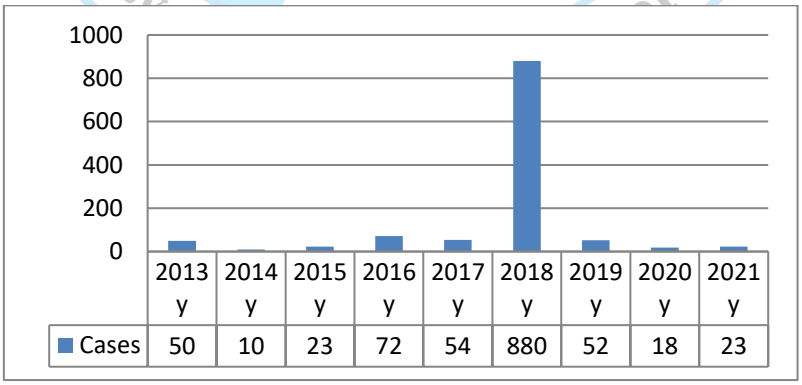

Figure 1: Distribution of cases from 2013-2021, in Diyala province

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Table 1: Outbreaks distribution from 2013-2021 in Diyala province.

Categories	Food poisoning outbreak	Food poisoning scattered cases (not outbreak)
2013	Foodborne diseases outbreak	---
2014	---	Cases of food poisoning
2015	---	Cases of food poisoning
2016	Foodborne diseases outbreak	--
2017	Foodborne diseases outbreak	--
2018	Waterborne diseases outbreak	--
2019	Foodborne diseases outbreak	--
2020	--	Cases of food poisoning
2021	--	Cases of food poisoning

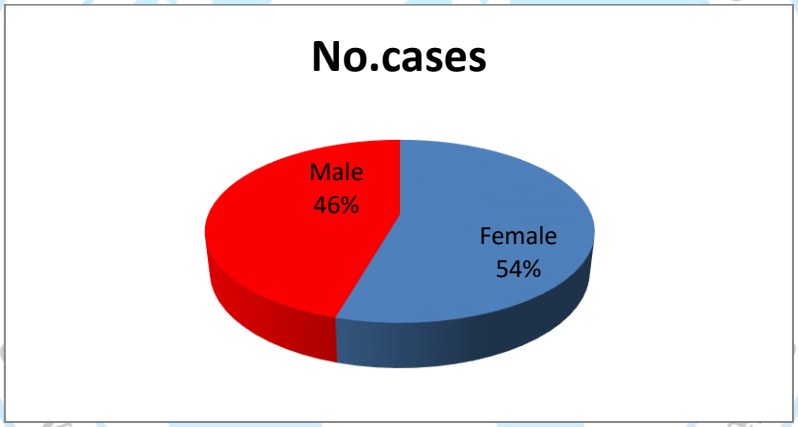

Figure 2: Distribution of cases according to gender, in Diyala province, from 2013-2021.

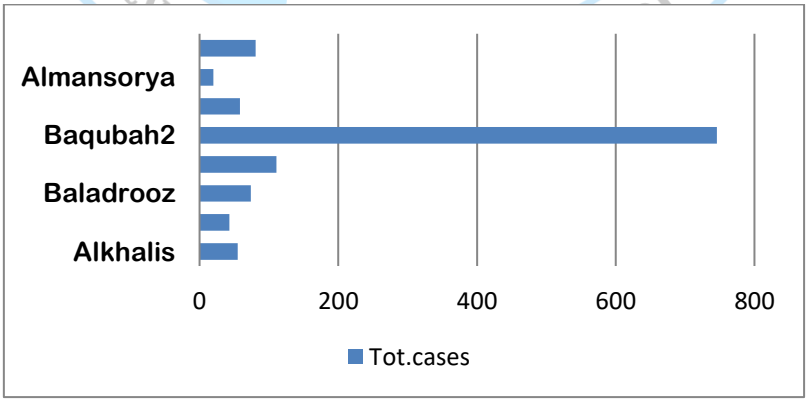

Figure 3: Distribution of cases according to sectors, from 2013-2021, in Diyala province

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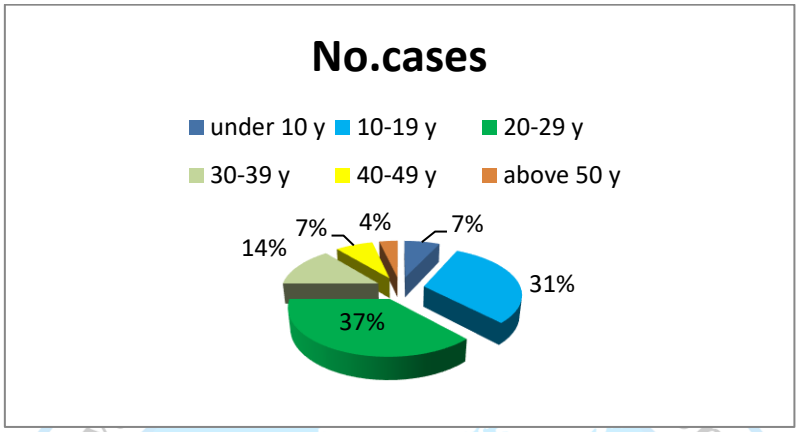

Figure 4: Cases according age groups, in Diyala province, from 2013-2021.

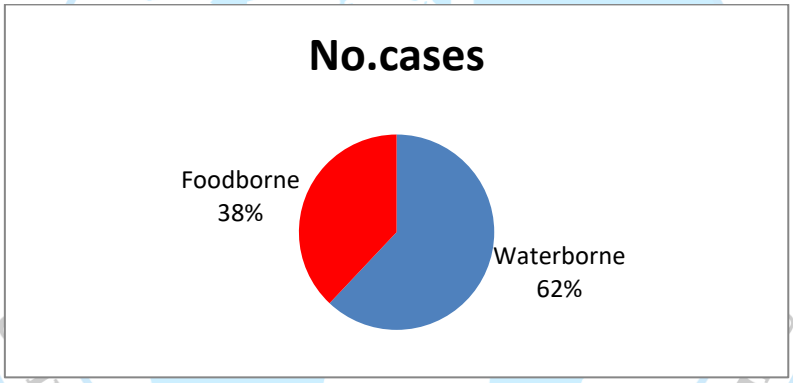

Figure 5: Percentage of cases according to the type of food poisoning

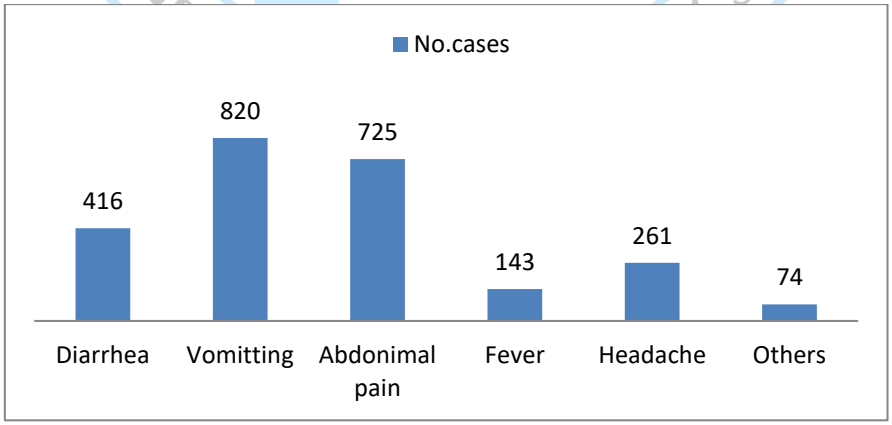

Figure 6: Clinical symptoms regarding to cases, from 2013-2021, in Diyala province.

Table 2: Distribution of cases according to causes, from 2013-2021, in Diyala province.

Causes (Suspected Food consumption)	Number of cases (Total cases = 1188)	% of cases	How soon symptoms start (after exposure)	Cause of food poisoning
Water contaminated consumption	737	62%	1-3 days	*E.coli*,*Salmonella* spp
Meat sandwiches and appetizers	190	16%	1-(1-3) day2 2-(2-4)days 3-(1-6 hrs)	*1-Salmonella* spp, 2-*Campylobacter jejeni*,*3-Staphylococcus aureus*
Home-made cheese	88	7.4%	1-(9-48 hrs) 2-(2-4)days 3-(1-3)days	*1-Listeria 2-monocytogenes*,*3-Salmonella* spp
Falafel* (Crushed chickpea dough)	87	7.4%	1-3 days	*E.coli*
Fish	48	4%	(9-48 hrs)	*Listeria monocytogenes*
salads, contaminated ice	38	3%	1-3 days	*Samonella* spp

Discussion

Regarding to current study. about two-thirds of the cases were happened in 2018 due to contaminated water consumption, in Baqubah2 sector, as the most outbreak affected among the 5 outbreaks occurred in Diyala province, from 2013 – 2021.

In our study we noticed the male was largely affected than the female with ratio female \ male (0.8\1). [13][14] found similar results concerning foodborne botulism and found similar results concerning Salmonella enterica, while [15] found similar results concerning Listeria monocytogenes.Food poisoning due to *Listeria monocytogenes* species are sporadic. It usually occurs due to the uncooked food or non-pasteurized milk. Main route of transmission is ingestion of spores or organisms in food. Food can also be contaminated by the food handlers. Poor hygiene and faecal contact are also responsible for transmission. A study done by [16], in a village of Maharashtra found that products consumed from outside vendors were the source of contamination and resulted in outbreak of acute gastroenteritis.

Milk and milk products are germinating medium for E-coli and Salmonella species. Food stored in faulty conditions leads to toxin productions by these organisms and hence food poisoning. This finding is similar to study done by [17].

The documentation of food poisoning cases was based on recording the cases that reach hospitals and primary health center, and does not reflect the reality of the problem, because most of cases treated as gastroenteritis inside and outside health institutions, according to the awareness and the education of the majority of peoples [18].

In most food poisoning cases, the contamination mode remained unclear, as many hypotheses are possible. This is usually because it is suspected that the process of recent meal preservation or preparation has failed. In low and middle-income countries, the risk of foodborne and waterborne diseases is higher as it is correlated with food preparation with unsafe water, poor hygiene, bad storage and preparation conditions, low education and knowledge levels as swell as inadequate food safety enforcements and legislations [6]. The current study showed that most food poisoning cases were associated with contaminated water consumption followed by outdoor meals consumption, which agreed with previous studies which reported that TIACs took place among families at home [19,20,21]. In case of food poisoning, a single clinical sign is not adequate for disease confirmation, particularly when the sign is not too specific such as headache, fatigue or malaise [22]. It mostly appears as a set of symptoms, e.g. gastrointestinal symptoms (gastric pains, diarrhea, nausea, vomiting, headache, fever and fatigue...) [23].

In the current study, a predominance of digestive signs was noticed including diarrhea, vomiting and abdominal pains, followed by fever and headache. These results were consistent with a former study performed by Gharb Chrarda Bni Hsen region [5]. Regarding to our study, Baqubah2 sector reported 62.8% of cases, while all others sector with 37.2% of cases, and that related to waterborne outbreak happened in Baqubah2 sector in (2018). The food poisoning cases in Diyala Province were mainly dealing with young population including children and adolescent (below 30) years with 75% of cases. This age group neglects outdoor hygienic measures and increases the possibility of food contamination resulting in extreme vulnerability to water or food-borne diseases [11]. The number of people poisoned at homes and restaurants is significantly lower than the number of people poisoned at other places while the number of people poisoned at school is significantly lower than the number of people poisoned at other

places. The number of poisoned citizens is significantly lower than the number of poisoned employees, students and other professional groups.

During our study period from 2013-2021 and at the level of Diyala province, and in accordance with the severity of cases, 72.5% were shown to be outpatients, 27.5% hospitalized and 0 died cases. The evolution of the state of health of patients is usually favorable (100%), which agreed with another study done by [24] in Taif University students on food poisoning. As a general evaluation, it can be said that consumers tend to consume foods such as meat and meat products, which can cause poisoning, in winter. Therefore, consumers' food preferences and cooking characteristics styles may also be a reason for the difference in poisoning between seasons. Both schools and workplaces are places where mass meal consumption takes place. Large masses are affected by contamination or negligence at any stage of the food chain at catering organizations where food is both produced and consumed at the same center and from which catering services are purchased. As a matter of fact.

Conclusions

This study permits having a general idea on the morbidity at the provincial level, between 2013 - 2021. In fact, the number of food poisoning cases and their outbreaks not reflect the really of the problem, which can be associated with health educations and public awareness or by a shortage in epidemiological knowledge with under-reported cases. Hundreds of cases go unnoticed since they are not notified to the health authorities, and although foodborne diseases can be severe and fatal, less severe cases usually go undiagnosed by routine surveillance measures. Surveillance is essential for foodborne disease identification, causes as well as socioeconomic effects and also for good and appropriate determination by the best long and short-term control measures. It must involve systematic collections of relevant incident information, its assessment for accuracy and perfection, complying with standard formats and interpretation of trends with examples from specific outbreaks.

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