Original article

Foodborne disease outbreak in a public school in El Salvador

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Abstract
Introduction. Foodborne diseases represent an increasing public health problem. It is estimated that globally around 600 million people get sick from consuming contaminated food. In El Salvador, 129 food poisoning cases were reported during 2023. **Objective.** Determine the causes of a foodborne illness outbreak in a public school in the municipality of Nahuizalco, department of Sonsonate. **Methodology.** A case-control study was conducted with a 2:1 ratio in an outbreak of 205 students from a public school in El Salvador. Measures of frequency, distribution and association were used such as Odds Ratios (OR) with their respective statistical significance. Nasopharyngeal and nail bed swabs were collected from food handlers. **Results.** Sixty four cases were identified, predominantly female (58 %). The most frequent symptom was abdominal pain (77 %) and the majority of cases were mild with outpatient management (67 %). Statistically, consumption of cereal with milk showed a significant association with illness with an Odds Ratio of 19. 67 (CI 95 %: 6. 78 – 57. 10). **Conclusion.** The associated cause with the outbreak was the ingestion of cereal with milk prepared by the school's food handlers. Due to the delay in notification of the outbreak to the health system, identification of the causal agent was not possible.

Keywords
Disease Outbreaks, Case-Control Studies, Communicable Diseases.

Resumen
Introducción. Las enfermedades transmitidas por alimentos representan un problema creciente de salud pública. Se calcula que hay alrededor de 600 millones de personas que enferman por ingerir alimentos contaminados en el mundo. En El Salvador, durante 2023, se reportaron 129 casos de intoxicación alimentaria. **Objetivo.** Determinar las causas de un brote de enfermedad transmitida por alimentos en un centro escolar público del municipio de Nahuizalco, departamento de Sonsonate. **Metodología.** Se realizó un estudio de casos y controles con relación 2:1 en 205 alumnos de un centro escolar público en El Salvador involucrados en un brote de enfermedad transmitida por alimentos. Se utilizaron medidas de frecuencia, distribución y asociación como *Odds Ratios* (OR) con sus respectivas medidas de significancia estadística. Y se recolectaron hisopados de los lechos ungueales y nasofaríngeos de los manipuladores de alimentos. **Resultados.** Se identificaron 64 casos confirmados, a predominio del sexo femenino (58 %). El síntoma más frecuente fue el dolor abdominal (77 %) y la mayoría de los casos fueron leves con manejo ambulatorio (67 %). En el análisis estadístico, el consumo de cereal con leche mostró una asociación significativa con un Odds Ratio de 19,67 (IC 95 %: 6,78 – 57,10). **Conclusión.** La causa asociada al brote fue la ingesta de cereal con leche preparado por los manipuladores de alimentos del centro escolar. Debido a la falta de pruebas diagnósticas y al retraso en la notificación del brote al sistema de salud, la identificación del agente causal no fue posible.

Palabras clave
Brotes de Enfermedades; Estudio de Casos y Controles; Enfermedades Transmisibles..

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Brote por enfermedad transmitida por alimentos en un centro escolar público en El Salvador

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Introduction

According to the World Health Organization, an outbreak of foodborne disease (FBD) happens when two or more people develop the illness after eating the same food, and due to an epidemiological investigation, statistical evidence determines that the food has the highest probability of causing the illness.[i,ii]

FBD result from contamination of food with pathogens, which can be chemical, physical, or biological.[ii,iii] Although viruses are common causative agents, bacteria cau-

se the most severe cases. FBD are classified into infections, including invasive and toxic infections and food poisoning, with agents such as *Salmonella and Escherichia coli* among the most frequent,[i,ii] although the causative agent is usually not identified.[iii]

It is estimated that around 600 million people are affected each year by eating contaminated food worldwide, been children the most vulnerable.[ii,iv] Moreover, 420 000 of these people die from this cause.[i,ii] Children under five years old are affected in 40 % of cases, with around 125 000 deaths per year in this age group.[i,ii] The United States has reported that the most common causative agents are noroviruses, *Salmonella spp, Clostridium perfringens, Campylobacter, and Staphylococcus aureus (S. aureus)*.[iii,v] Signs and symptoms can range from mild to severe, and in some cases, due to the risk, may require hospitalization. Although they usually manifest themselves mainly in the gastrointestinal system, other organs may also be affected, depending on the causative agent involved.[i,v]

According to the report "Foodborne diseases and their socioeconomic impact: Case studies in Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua" by the Food and Agriculture Organization of the United Nations, 2009, in El Salvador, the most common agents identified in food samples were: *S. aureus, Escherichia coli,* total coliforms*, Salmonella spp, Listeria monocytogenes, Clostridium perfringens*, molds, yeasts and saxitoxins.[vi] The samples studied included dairy products (non-pasteurized cheeses), ice used for the sale of soft drinks, frozen (known in El Salvador as minutas), handmade ice cream, fresh salads, cold meats, and seafood, among others. All these products come from schools, homes, and street businesses.[vi]

During 2023, there were 129 cases of acute food poisoning reported. The age groups with the highest frequency of cases were 20 to 29 and 10 to 19 years.[vii]

Risk factors include vulnerable groups such as children, the elderly, and those with diseases that compromise the immune system.[viii] Also, the particular circumstances of populations in schools, shelters, prisons, and foster homes or special-care homes, in unsanitary conditions for food preparation, and workers not certified for food handling, in addition to poor personal hygiene, lack of drinking water sources, overcrowding, inadequate cooking, and cold chain failures.[i,ix] Those conditions determine the susceptibility to a higher frequency of foodborne disease outbreaks in individuals facing these risk factors.[ix,x]

The timely management of outbreaks depends on several factors, including the immediate notification of local health systems, community responsibility to attend health care centers, intersectoral communication, and the availability of resources to carry out the investigation.[i,x,xi]

Between March 21 and 23, 2023, 64 cases of students with symptoms suggestive of FBD were reported after eating a refreshment at a public school in El Salvador during the morning shift. In response to these cases, an epidemiological investigation was conducted to identify the causes of the outbreak and determine its origin in the students of the school located in the municipality of Nahuizalco, department of Sonsonate.

Methodology

An analytical observational case-control study was conducted on a foodborne disease outbreak at a public school in El Salvador. The study included a total population of 693 students ranging from elementary to junior high school; 345 of them attended the morning shift. Of this shift, 205 students were present during the first day of the outbreak investigation. All students present at the school, as well as those taken to the regional hospital for medical attention, were interviewed.

A case was any person who attended school on March 21, 2023, who consumed any food from the school snack on that day, and who presented at least one of the following symptoms: fever, nausea, vomiting, diarrhea, abdominal pain, headache, general malaise, or muscle pain. A case-control was defined as any person who attended school on March 21, 2023, consumed any food from the school snack on that day, and did not present symptoms.

The inclusion criteria for cases and controls were to be a student or worker at the school and to accept participation in the study. The exclusion criterion for both cases and controls was not completing the data collection form because, in some cases, data collection began on one day and ended on the following day; however, some students did not attend on the second orthird day of the investigation. For the study, all persons who completed the outbreak investigation form were included, forming a final sample of 64 cases and 141 controls, in a ratio of one case for every two controls.

A questionnaire was developed in a digital format based on the Pan American Health Organization (PAHO/WHO) Guide to Foodborne Disease Surveillance Systems (VETA for its Spanish acronym) to captu-

re the information. This document guides conducting outbreak investigations related to food consumption.[xii]

To determine the incubation period the day and time of food ingestion and the day and time when symptoms suggestive of foodborne disease appeared were considered. The elapsed time in minutes was then calculated.

Given the presumption of an outbreak of FBD originating in the school refreshments, two microbiological samples were taken with swabs from hands, nail beds, and nasopharyngeal swabs from the personnel in charge of food handling at the laboratory of the national hospital in the area. The samples were taken by laboratory personnel, following the protocols established according to current institutional regulations. Samples were taken 48 hours after the outbreak due to the delay in notification. Food samples could not be collected for microbiological analysis because they were discarded before the outbreak investigation.

For the statistical analysis, the Kolmgórov-Smirnov normality test was performed and a result of $p < 0.05$ was obtained; frequencies, proportions, attack rate, and measures of central tendency (median) with their measures of dispersion (interquartile range) were calculated. In the bivariate analysis, chi-square or Fisher's exact test and odds ratio (OR) were used to test the association. The 95 % confidence interval (CI) and p value <0.05 were used as statistical significance tests. RStudio version 4.3.0 and Microsoft Excel 365 were used for data processing and analysis.

Ethical principles were in place during the FDA outbreak investigation. The participants' confidentiality and privacy were protected using numerical identifiers instead of personal names. Provisions were made to ensure the health and well-being of participants by providing appropriate medical care and counseling. Disclosure of results was transparent and accurate, avoiding distortion of information. Participants were thanked and followed up by local Ministry of Health staff.

Results

The results showed that only the students consumed the prepared food. A total of 205 students were interviewed, all from the municipality of Nahuizalco, Sonsonate. Of the total respondents, 56.6 % were male, and the age range was 6 to 17. A number of 64 cases was identified, of which 58 % were female, with a median age of 13 (IR: 10 - 14), a minimum age of 6 years old and a maximum age of 17 years old. The most frequently reported symptoms were abdominal pain (77 %) and nausea (64 %) and most of the cases received outpatient medical management (67 %) (Table 1).

The median age of the controls was 13 (IR: 10 - 14), with a minimum age of six and a maximum of 17; 63 % (89) were male, and the age group with the highest proportion was 10 to 14 years old with 62 % (87). No control presented any sign or symptom (Table 1).

Figure 1 illustrates the epidemic curve of the outbreak that lasted 53 hours. The shape of the curve suggests a common source of exposure, characterized by a rapid and steep increase in the number of cases during the first hours of the outbreak. The highest case proportion was recorded within the first five hours after food ingestion. The incubation period presented a median of 52 minutes (IR: 30 - 210).

Of 205 students, 119 (58 %) consumed cereal with milk, 38 (18.5 %) consumed beans, 25 (12.2 %) consumed tortillas, 21 (10.2 %) consumed cheese, 19 (9.3 %) consumed bread, 11 (5.4 %) consumed eggs, six (2.9 %) consumed mora leaves soup, four (1.9 %) consumed cream, two (1 %) consumed rice with milk and two (1 %) consumed plantain. Of the 119 students who consumed cereal with milk, 64 (53.7 %) became ill.

The results of the bacteriological study carried out on the personnel responsible for food processing and handling at the school revealed the presence of Staphylococcus epidermidis in the hand and nail bed cultures and the identification of coagulase-negative Staphylococcus in the nasopharyngeal cultures.

These bacteria are considered part of the normal microbiota of the human body and do not pose a health threat. However, it was impossible to perform stool cultures on the cases because the physician did not indicate this to theadmitted patients and, in other cases did not provide the sample.

The bivariate analysis of the cases adjusted for sex and age identified that the consumption of cereal with milk showed an association with an OR of 19. 67 (95 % CI: 6.78 - 57.10) and a p value <0.001. The rest of the foods did not show a statistical association (Table 2).

As intervention measures, the school was closed during the development of the investigation; the facilities were examined to identify weaknesses in the handling and safeguarding of food. Finally, an agreement was established to monitor food handlers and to ensure appropiate training and compliance with good practices for food handling.

Table 1. Clinical characteristics of reported cases of foodborne disease, March 2023.

Variables	Cases n= 64			Controls n=141			Total	%
	n	%	IC	n	%	IC	n	
Sex								
Male	27	42	(30.87-54.39)	89	63	(45.61-69.13)	116	56.6
Female	37	58	(45.61-69.13)	52	37	(30.87-54.39)	89	43.4
Age								
5 to 9 years	12	16	(11.06-29.97)	21	15	(11.06-29.97)	33	16.1
10 to 14 years	39	61	(48.69-71.94)	87	62	(51.82-74.71)	126	61.5
15 to 19 years	13	20	(12.27-31.71)	33	23	(12.27-31.71)	46	22.4
***Signs and Symptoms**								
Abdominal pain	49	77	(64.87-85.25)	-	-	-	49	23.9
Nausea	41	64	(51.82-74.71)	-	-	-	41	20.0
Headache	23	36	(25.29-48.18)	-	-	-	23	11.2
Vomiting	17	27	(17.3-38.48)	-	-	-	17	8.3
General malaise	14	22	(13.5-33.43)	-	-	-	14	6.8
Fever	9	14	(7.57-24.62)	-	-	-	9	4.4
Diarrhea	9	14	(7.57-24.62)	-	-	-	9	4.4
Dizziness	8	13	(6.47-22.77)	-	-	-	8	3.9
Care								
Outpatient care	43	67	(55-77.43)	141	100	-	184	89.8
No consultation	16	25	(16-36.82)	-	-	-	16	7.8
Inpatient care	5	8	(3.3-17)	-	-	-	5	2.4

*Each sign and symptom is averaged with 100 % of the cases that presented symptoms or signs..

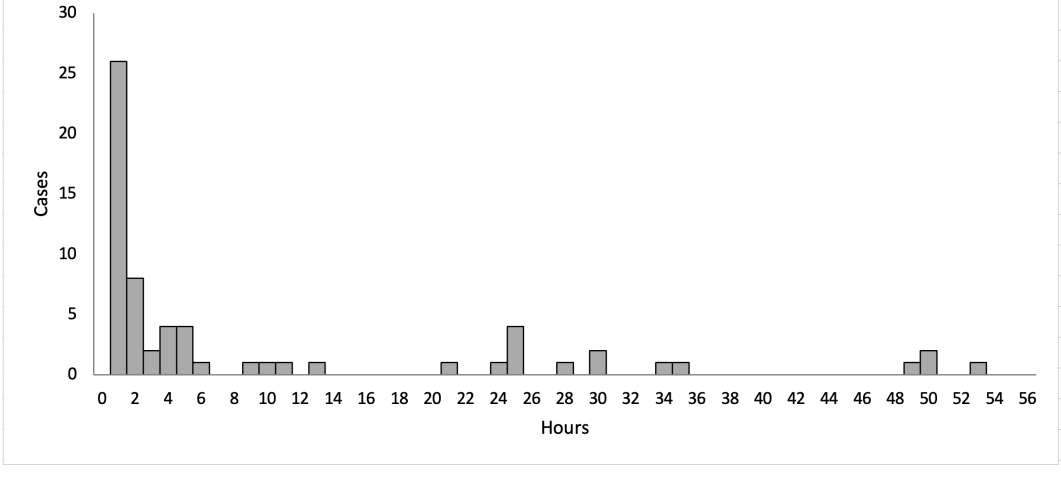

Figure 1. Epidemic curve of reported cases of foodborne disease, March 2023.

Discussion

This study was part of an outbreak investigation at a public school in El Salvador. The food consumption by 205 students was analyzed to identify risk factors associated with the outbreak. Cereal with milk was found to be the food with the highest risk association.

FBD outbreaks frequently occur in schools, particularly those that prepare food inside their facilities. As reported in a study on FBD in Colombia, most of these outbreaks occurred in educational institutions.[xiii] In addition, according to an analysis of FBD outbreaks reported by the National Network of Epidemiological Surveillance in Spain, over a period of ten years, the places wich had the highest frequency of this type of events were identified as restaurants, hotels, bars, schools, day-care centers, among others.[xiv] This information is similar to that reported in other researchs grom the Republic of Korea and the United States of America (USA), where it was evident that these kind of outbreaks are characterized by the concentration of people and

Table 2. Foods associated with food poisoning in a public school in the municipality of Nahuizalco, department of Sonsonate..

Food	OR	95 % CI	Test	Valor de la prueba	Valor de P
Cereal with milk	19.67	6.78 - 57.10	Fisher		< 0.001
Bread	2.72	0.94 - 7.80	Chi-square	4.47	0.03
Cream	2.24	0.31 - 16.28	Fisher		0.59
Plantain	2.22	0.14 - 36.10	Fisher		0.52
Cheese	2.19	0.88 - 5.45	Chi-square	2.93	0.08
Beans	1.37	0.65 - 2.85	Chi-square	0.68	0.40
Egg	1.28	0.36 - 4.52	Fisher		0.74
Tortilla	0.84	0.33 - 2.12	Chi-square	0.13	0.71
Mora leaves soup	0.43	0.05 - 3.77	Fisher		0.66

exposure to food prepared in large quantities by food handlers.[xv]

In this study, the outbreak occurred in a public school in the western region of El Salvador. It was noted that symptoms occurred more frequently in adolescents between 12 and 19 years old, given that most students were in higher classes. In addition, students in lower classes usually bring prepared food from home and do not participate in school meals.

The proportion was higher in the female sex. The most common symptoms were abdominal pain, nausea, headache, and vomiting, and only one person needed hospitalization for mild dehydration. Other research studies have reported that outbreaks in school settings predominate between the ages of 5 and 19, while in daycare centers, they mainly affect children under five.[xvi] In addition, the severity of the disease tends to be greater in children under one year of life.[xvii] Most of these cases present a clinical picture with gastrointestinal symptoms, and patients rarely require hospitalization or present a worsening of the clinical situation resulting in death.[xiii,xviii]

In the epidemiological investigation of FBD outbreaks, one of the objectives is to identify the causative infectious agent. Of these investigations, 74 % fail to achieve this goal, according to an epidemiological analysis from Brazil.[xi] Meanwhile, in countries such as Spain, it reaches 36 %,[xiv] and in the United States, 15 %.[xv] This deficiency is attributed to the lack of control samples of food consumed or related to the cases where the late notification of the event to the health system and the delay in the launch of control and prevention actions caused such deficiency.[xiv] Such obstacles were present in the investigation of this outbreak.

The most frequent foods involved in FBD are meats and their derivatives, dairy products, eggs, salads, grains, and cereals.[iv,vi] In the latter, the most common isolated agents are related to toxins of fungal origin, while in dairy products and their derivatives, the identification of *Salmonella spp, Escherichia coli, Bacillus cereus, Listeria and Campylobacter* predominates. Concerning food handlers, fecal coliforms and *S. aureus* are the most frequently identified in samples of nasal swabs, hand swabs, and nail beds.[xix,xx]

During this outbreak, the swabs taken from the food handlers were collected late; as a result, agents that are part of the normal microbiota of the human body were identified, such as *Staphylococcus epidermidis*, which is not described as a potentially pathogenic agent, except for being associated to certain conditions such as surgical procedures, where it is more frequent to cause infection.[xxi]

S. aureus is a bacterium commonly present in 27 % of the hands and 37 % of the nostrils of food handlers, whose toxins can cause food poisoning[xx,xxii], and the incidence in outbreaks can be up to 12 %, according to a study carried out in Cuba. These food poisonings have an average incubation period of 30 minutes to eight hours.[xxiii,xxiv] Common symptoms include nausea, vomiting, abdominal pain, and diarrhea, which usually appear quickly and last up to 24 hours or more.[xxv]

The onset of symptoms corresponds to a relatively short incubation period, taking into account that abdominal pain and vomiting were the most frequent and that most of the cases were classified as mild, requiring only outpatient management, consistent with the characteristics described in other studies of outbreaks of food poisoning by *S. aureus*.[xx,xxii]

Furthermore, this agent is one of the most frequently reported infections in this type of outbreak, where it has been isolated from the hands and nostrils of food handlers of foods such as milk and those that have had contact with animal skin and require handling in their preparation for consumption.[xx,xxi]

According to the presented statistical analysis, there is a significant association between the intake of cereal and milk and the likelihood of becoming ill; this supports the hypothesis that this food was possibly the source of infection. The rest of the foods consumed by the students did not show significant associations, suggesting that the agent responsible could be specifically related to the cereal with milk or the handling and conditions under which it was prepared.

A limitation of this study was the delay in notifying local healthcare facilities of the outbreak since it was made 24 hours after the first cases appeared. This delay resulted in late disease control and prevention actions and in the failure to safeguard samples of food prepared and served that day.

It is essential to strengthen epidemiological surveillance in school settings to rapidly detect any disease outbreak and take the necessary measures to control it. This action implies effective coordination and close collaboration between health authorities, educational institutions, and the community to promote early detection, timely notification, and rapid and effective response to any intoxication event.

Conclusion

The identified cause of the food poisoning outbreak was the ingestion of cereal and milk prepared by the school's food handlers. However, due to the delay in reporting the outbreak to the health system, the lack of safekeeping of food samples, and the delay in taking swabs from the people in charge of this activity, it was not possible to identify the causal agent. However, due to the clinical presentation, the incubation period, and the food involved, it is suggested that it could be a case of *S. aureus* intoxication.

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References

i. Organización Panamericana de la Salud. Enfermedades transmitidas por alimentos 2023. Consulted on June 1st, 2023. Available at: https://www.paho.org/es/temas/enfermedades-transmitidas-por-alimentos

ii. Fernández S, Marcía J, Bu J, Baca Y, Chavez V, Montoya H, *et al.* Enfermedades transmitidas por Alimentos (ETAS); Una Alerta para el Consumidor. Cienc. Lat. Rev. Científica Multidiscip. 2021; 5(2):2284–2298. DOI: 10.37811/cl_rcm.v5i2.433

iii. Marin M, Rodríguez AR, Minier L, Zayas E. Caracterización de agentes bacterianos aislados en brotes de enfermedades transmitidas por alimentos. MEDISAN. 2020;24(2):235–251. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1029-30192020000200235

iv. Rodríguez AR, Marin M, Minier L, Rizo I. Epidemiologic surveillance of diseases outbreaks transmitted by foods in Santiago de Cuba province. MEDISAN. 2022;26(1):47–59. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1029-30192022000100047

v. Microbios y enfermedades transmitidos por los alimentos, Food Safety. CDC. 2017. Consulted on September 19, 2024. Available at: http://medbox.iiab.me/modules/en-cdc/www.cdc.gov/foodsafety/es/../../foodsafety/es/foodborne-germs-es.html

vi. Kopper G, Schneider S, Domínguez W, Gutiérrez G. Enfermedades transmitidas por alimentos y su impacto socioeconómico. Estudios de caso en Costa Rica, El Salvador, Guatemala, Honduras y Nicaragua. Roma. Organización de las naciones unidas para la agricultura y la alimentacion. 2009. 203 p. Available at: https://openknowledge.fao.org/items/dc05cec0-3099-4d2f-9c0a-87b799ad49a9

vii. Ministerio de Salud. Lineamientos técnicos del Sistema Nacional de Vigilancia Epidemiológica en

El Salvador VIGEPES. San Salvador, El Salvador. 2019. Available at: https://asp.salud.gov.sv/regulacion/pdf/lineamientos/lineamientostecnicossistemanacionaldevigilanciaepidemiologicavigepesv1.pdf

viii. CDC. Personas con mayor riesgo de presentar intoxicación alimentaria Seguridad alimenticia. 2021. Consulted on June 24, 2023. Available at: https://www.cdc.gov/foodsafety/es/people-at-risk-food-poisoning.html

ix. Estigarribia G, Aguilar G, Ríos P. Conocimientos, actitudes y prácticas sobre buenas prácticas de manufactura de manipuladores de alimentos en Caaguazú, Paraguay. Rev. Salud Pública Parag. 2019;9(2):22–28. DOI: 10.18004/rspp.2019.diciembre.22-28

x. Ulloa JO, Arteaga EMC, Avilés AMO, Moscoso SPD. Revisión sistemática de estudios sobre inocuidad alimentaria en Cuenca, Ecuador, periodo 1981-2017. Segur. Aliment. E Nutr. 2020;27:e020024–e020024. DOI: 10.20396/san.v27i0.8654199

xi. Sousa F das CA, Costa CEO, Rodrigues ACE, Siqueira HDS, *et al.* Análise epidemiológica dos surtos de Doenças Transmitidas por Alimentos (DTAs) no estado do Piauí entre os anos de 2015 a 2019. Res. Soc. Dev. 2021;10(7):e42610716756–e42610716756. DOI: 10.33448/rsd-v10i7.16756

xii. Organización Panamericana de la Salud. Guía VETA: Guia de Sistemas de Vigilancia de las Enfermedades Transmitidas por Alimentos (VETA) y la Investigación de brotes. 2019. Available at: https://www.paho.org/es/documentos/guia-veta-guia-sistemas-vigilancia-enfermedades-transmitidas-por-alimentos-veta

xiii. Orellana-Suarez K, Salcedo-Burgos EA. Enfermedades transmitidas por alimentos: factores sociodemográficos y de riesgo. MQRInvestigar. 2023;7(3):1440–1457. DOI: 10.56048/MQR20225.7.3.2023.1440-1457

xiv. Chong A, Peñuelas M, Guerrero M, Cabezas C, Díaz O, *et al.* Brotes de transmisión alimentaria. Red Nacional de Vigilancia Epidemiológica. 2012-2020. Bol. Epidemiológico Sem. 2021;29(5):53–63. Available at: https://revista.isciii.es/index.php/bes/article/view/1157

xv. Kim S-O, Kim S-S. Recent (2011–2017) foodborne outbreak cases in the Republic of Korea compared to the United States: a review. Food Sci. Biotechnol. 2021;30(2):185. DOI: 10.1007/s10068-020-00864-x

xvi. Mattison CP, Calderwood LE, Marsh ZA, Wikswo ME, Balachandran N, *et al.* Childcare and School Acute Gastroenteritis Outbreaks: 2009–2020. Pediatrics. 2022;150(5):e2021056002. DOI: 10.1542/peds.2021-056002

xvii. Granda AR, Miaja MF, Nicolás SD, Ibáñez AF, Velasco MEL, Álvarez MAA. Descripción clínica y epidemiológica de un brote grave de salmonelosis en una escuela infantil urbana. Rev. Esp. Quimioter. 2022;35(3):265–272. DOI: 10.37201/req/134.2021

xviii. Chiriboga JMD, Jachero JVM, García LV. Enfermedades transmitidas por bacterias patógenas presentes en los alimentos en América del Sur, artículo de revisión. ConcienciaDigital. 2023;6(3.1):117–141. DOI: 10.33262/concienciadigital.v6i3.1.2662

xix. Moreira OD, Peña YP, Placeres MR, Sánchez DG, Sosa OVP, Castillo VL. Risk profile of staphylococcal food poisoning outbreaks in Cuba. Rev. Cubana Med. Trop. 2021;73(1):1–16. Available at: https://revmedtropical.sld.cu/index.php/medtropical/article/view/514/493

xx. Taus MR, Sosa N, Goldaracena CA, Grenóvero S, Larrivey MA, *et al.* Portación de Staphylococcus aureus en manipuladores de alimentos de la ciudad de Gualeguaychú. Cienc. Docencia Tecnol. Supl. 2020;10(11). Available at: https://ojs-act.uner.edu.ar/index.php/Scdyt/article/view/950

xxi. Torres JGG, Toral CAE. Biofilms en pacientes con dispositivos ortopédicos. Salud Concienc. 2023;2(2):e27–e27. DOI: 10.55204/scc.v2i2.e27

xxii. Sanchez M, Farrando S. Enfermedades Transmitidas por Alimentos: Hablemos de Microbiología: Staphylococcus aureus. Experticia. 2021;1(12). Available at: https://revistas.uncu.edu.ar/ojs3/index.php/experticia/article/view/4766

xxiii. Solis Olivo F, Orozco González CN, Esquivel Franco CG. Inocuidad alimentaria y enfermedades transmitidas por alimentos (ETAs); sus efectos en la salud humana: una revisión. Horiz Enferm. 2023. 34(3):

689-707. Available at: https://ojs.uc.cl/index.php/RHE/article/view/64515

xxiv. Vázquez H, Castañeda Vazquez M, Cedeño C, Ramírez F, Carbajal O, Salas E, *et al.* Zoonosis perspectivas y actualidad. Prometeo Editores. 2022(22):19. Available at: https://www.researchgate.net/publication/361909867_ZOONOSIS_PERSPECTIVAS_Y_ACTUALIDADES_Editores

xxv. Manfredi EA, Rivas M. Brote de intoxicación alimentaria en un jardín de infantes de la provincia de Buenos Aires. Rev. Argent. Microbiol. 2019;51(4):354358. DOI: 10.1016/j.ram.2018.08.008