Systematic mapping of food safety outbreaks in the hospitality sector in the Dominican Republic

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Abstract

Purpose: The hospitality sector underpins the Dominican Republic's (DR) economy but may be a setting where foodborne disease outbreaks (FBDOs) can occur. The purpose of this research is to conduct a systematic mapping exercise on the available scientific literature related to FBDOs in hospitality in the DR and their link to reported food safety and hygienic practices.

Design/methodology/approach: A predefined search protocol applied the principles of PRISMA guidance. Publications (n= 2,793) from databases (e.g. Web of Science, PubMed) were identified, and systematically selected for relevance. A full-text assessment based on the inclusion criteria led to the identification of a refined list of studies and academic publications (n=22) included in this review. The descriptive analysis of the collated data is then presented graphically.

Findings: A low rate of reporting highlights a knowledge gap on FBDOs, the related food safety hazards and how they are mitigated by stakeholders and local health authorities in the DR. Improving government and other stakeholder capacity to report, investigate and understand FBDOs and the practices involved is essential.

Research limitations/implications: The research has implications for Government, businesses and public health officials and managers in the hospitality sector in the DR. A potential research limitation is that the search strategies could miss some relevant articles.

Originality/value: To the best of our knowledge this is the first systematic mapping research assessing evidence of FBDOs affecting hospitality in the DR.

Practical implications: The findings provide a framing for improved risk analysis in implementing food safety management strategies for FBDOs.

Keywords: systematic mapping; foodborne disease outbreaks; hospitality; Dominican Republic.

Paper type: Review article

1. Introduction

Foodborne disease outbreaks (FBDOs) in tourism dependant countries, such as the Dominican Republic (DR), represent a threat to their sustainable socio-economic development (WHO, 2021). Alqurashi *et al.* (2019) stated that there is a close and complex link between food safety and related socio-economic activities such as food business, international trade, and foodservice facilities. Food safety outbreaks, infections and intoxications are significant barriers toward social and economic development in developing countries and the disruption to health and to the economy in developing countries is an obstacle to achieving the Sustainable Development Goals 1-3, No Poverty, Zero Hunger, and Good Health and Well-being (Oduori *et al.*, 2022). FBDOs have the potential to cause significant damage to public health, the local and international economy of the countries concerned, and economic loss in all the business sectors involved (Yeni *et al.*, 2016). Estimates suggest that foodborne illness could cost at least

$100 million a year to the economy of developing countries (Jaffee *et al.*, 2019; Oduori *et al.*, 2022).

Travel-related diseases are more likely to occur in less developed geographic regions (Muresu *et al.*, 2020). The study of Indar and Perez (2015) reported that one in forty-nine people fall ill from FBDOs in the Caribbean. The continual potential risk of unsafe food and water is worsened by emerging or newly identified pathogens in food and beverages (Fung *et al.*, 2018; Rahman *et al.*, 2020). Moreover, the DR, like most Caribbean countries, has limited access to foodborne disease surveillance data (Guerra *et al.*, 2016; Hull-Jackson and Adesiyun, 2019; Lee, 2017). Therefore, there is national and local interest from public health authorities and tourism stakeholders to develop effective food hygiene and safety standards and management systems for the distribution of food and beverages in hospitality settings to ensure that they are safe to consume. Moreover, audits and training must occur regularly in accordance with national food safety regulations (Barnes *et al.*, 2022; Elobeid *et al.*, 2019; Insfran-Rivarola *et al.*, 2020; McFarland *et al.*, 2019; Osaili *et al.*, 2021). To sustain this success, proactive and preventive food safety measures in the hospitality industry need to be enforced and adopted by food service facilities, managers, food handlers and public health officials to reduce the risk of FBDOs. Fujisaki *et al*. (2020) state that a well-implemented and maintained food safety system

will reduce the likelihood of FBDOs considerably. However, studies assessing FBDOs associated with international travel identified the DR as the third most common destination for travel-associated infections (Johnson *et al.*, 2011), making the country a suitable lens of enquiry, and providing a motivation for the research.

The purpose of this research is to conduct a systematic mapping exercise of the available scientific literature related to FBDOs in hospitality in the DR and their link to reported food safety and hygiene practices. Systematic mapping is an approach that uses a structured a priory methodology to identify gaps and gather available evidence on a particular research topic (James *et al.*, 2016). This systematic map is used to provide some evidence-based recommendations for food safety and microbiological risks in the hospitality sector that can be used by relevant stakeholders, with specific reference to the scope of the research, the DR and other Caribbean countries.

2. Literature review

2.1. Food and tourism

The food and tourism sector have significant importance to countries' economies (Andersson *et al.*, 2017) contributing between 10% and 16% of the gross domestic product of the DR respectively (Goffi *et al.*, 2020; OECD/UNCTAD/ECLAC, 2020; WTTC, 2021). There is a natural synergy between the food and tourism sectors especially when local hotels, restaurant and hospitality promote authenticity and offer guests a pleasurable experience connected with food. This experience can include local products, national cuisine dishes and typical regional culinary delicatessen (Barnerjee *et al.*, 2017; Rousta and Jamshidi, 2019). Moreover, food is one of the key factors driving tourists' travel preferences (Björk and Kauppinen-Räisänen, 2016; Firdaus Siau *et al.*, 2015; Lee *et al.*, 2019).

In 2019, the arrival of foreign tourists in the DR reached 6.4 million visitors (Peralta, 2021). The tourist influx in the country promoted the development not only of the tourism sector but also the socio-economic development for other sectors such as agriculture, services and construction. For instance, local agricultural production supplied 85% of the total fresh primary products required by the tourism sector. Food and beverage consumption by the tourism

industry in 2017 in the DR was estimated to be about USD 490 million in the DR (Meyer, 2020; OECD/UNCTAD/ECLAC, 2020). These relations between local food products, restaurants, tourism are provided by local supply chains which can deliver to the increasing demand for healthy and safe products. This growth in the tourist sector was then hit by the Covid-19 pandemic with its impact on the tourism and hospitality industry across the world through travel restrictions, border closures, and quarantine requirements (Aharon *et al.*, 2021; Kaushal and Srivastava, 2021; Ozbay *et al.*, 2021; Rahman *et al.*, 2021; Song and Kim, 2021).

Pre-pandemic, tourists' perception of food safety, and any FBDOs, negatively impacted the national tourism sector and hotels' brand reputation. (Plante, 2019; Romero and Bogel Burroughs, 2019). Indeed, the hospitality and tourism industry and its competitiveness are highly vulnerable to political instability, terrorism, natural disasters, epidemics, foodborne disease, and health threats (Arbulú *et al.*, 2021; Indar *et al.*, 2020; Ma *et al.*, 2020; Rosselló *et al.*, 2020).

Torrens *et al.* (2015) state that through contaminated food and beverage items humans could be affected by about 200 pathogens and that 30% of emerging infectious diseases in the last 60

years have been caused by microorganisms that are transmitted through edible products. Biological agents e.g. bacteria, fungi, viruses and parasites are the most commonly reported biological hazards causing FBDOs (do Prado *et al.*, 2021). Enteritis and other diarrheal diseases

are among the top five causes of mortality in Latin American and Caribbean countries (Havelaar *et al.*, 2015; Olson *et al.*, 2019). Along with that, Travel Diarrheal (TD) affects 30-70% of international travellers mainly by bacterial etiologic agents in less economically developed countries (Hull-Jackson and Adesiyun, 2019; Yasami, 2021). Hence, food safety incidents create an adverse impact on the tourism and hospitality sectors (Duan *et al.*, 2021).

1.2. Food safety review in the Caribbean

Furthermore, relatively little is known of the incidence and risk of foodborne diseases in the tourism and hospitality sector in Caribbean countries. A detail record of any cases of FBDOs is needed in order to implement the appropriate food safety control measures at the time and in the future (Pires *et al.*, 2012). Food safety risk analysis is a useful tool, via risk assessment, for the identification at the local level of food hazards and risks and taking into account the specifics of the operating food chain (de Bock *et al.*, 2021).

The literature review by Pires *et al.,* (2012), which considered bacterial pathogens between 1993 and 2010, used the data from the Regional Information System on FBDOs of each country

within Latin America and the Caribbean. In general, the study concluded that food items such as meat, dairy products, seafood, eggs, vegetables and water were the most important sources of bacterial FBDOs during the investigation timeframe. Findings from this study showed 24 outbreaks in the DR but it does not specify the source of contamination (i.e., food or water). Guerra *et al.,* (2016) reviewed food safety and foodborne zoonoses in the Caribbean Region from 1995 to 2015. Species of *Campylobacter, Salmonella* and *Shigella* were the main pathogens in these incidents and although this data does not include the DR specifically, the findings increase the concern regarding FBDOs in the Caribbean region. Moreover, a 12-year review conducted by Hull-Jackson and Adesiyun (2019) aimed to determine the etiological agents, food and locations of FBDOs in Barbados. Findings reported during this period that *Salmonella* was the common pathogen identified and eggs and poultry were the primarily contamination source. Hotels and tourist resorts were the common location associated with these outbreaks.

Apart from these review articles there is limited information about FBDOs and public health and the hospitality sector in the DR. Even more scarce is the publicly available literature and information about travel associated FBDOs and only some anecdotal evidence could be found on online blogs and travel websites. On these online blogs some visitors shared their symptoms and the general experience related to foodborne illnesses during their stay in all-inclusive hotels in the DR (Christopher, 2013; Elliot, 2016; Meikle, 2009; TripAdvisor, 2018). Such personal episodes include subjective opinions but can still be used as a first step in a scientifical epidemiological investigation, if combined with more robust evidence. Timely reported personal episodes could be individual, single cases but also could be important early-warning notifications for associated FBDOs. The most important task for the further epidemiological investigation is to identify the causative agents, sources of contamination, the main food involved and the unsafe practices that led to the outbreak. A formal recording process is also an essential part of any surveillance system to preserve people's health and prevent further spread of disease (Ntshoe *et al.*, 2021; do Prado *et al.*, 2021).

In this study, we applied the method of systematic mapping which requires a predefined review protocol in order to guide the literature search. This systematic mapping review will be the first one critically appraising food hazards and travel associated risk in the DR. Therefore, we aim to explore and systematically examine the literature, and describe the evidence on foodborne

disease associated with travel/tourism in the DR to inform policy, as well as identify research gaps for future studies in the country.

3. Research methodology

3.1. Research questions and review protocol

Systematic mapping provides a broad overview of a specific research area, systematically organising existing data within the literature (Garcia *et al.*, 2019; Nguyen and Li, 2021). This method uses an a-priori methodology and reduces the likelihood of bias and increases the transparency of the approach (James *et al.*, 2016). Due to the limited information about FBDOs in the Caribbean and the DR, the authors found a need for a more methodical approach to map FBDOs in these countries. Hence, a systematic mapping exercise was carried out. This method was proposed for identifying data, categorising the data, analysing, summarising and reporting the findings of the subject of interest (Adhi Tama and Lim, 2021; Dalponte Ayastuy *et al.*,

2021). There have been previous reviews on food related illnesses in the Caribbean, which have included food safety-related aspects, bacterial foodborne zoonoses and documentation of FBDOs (Guerra *et al.*, 2016; Hull-Jackson and Adesiyun, 2019). However, the study by Hull-Jackson and Adesiyun, (2019) comprised of countries that are full member states of the Caribbean Community organisation (Caricom) of which the DR is not a member. Neither of the previous known reviews used a systematic approach for search and inclusion of studies.

The current systematic mapping protocol (Figure 1) follows the guidelines for systematic reviews and maps set by Collaboration for Environmental Evidence (CEE) (Collaboration for Environmental Evidence, 2013; James *et al.*, 2016).

Take in Figure 1

This systematic mapping approach defined two research questions in order to comply with the scope of the research and to satisfy completely the objectives of the study. A predefined protocol was developed to guide the literature search in an attempt to ensure methodological transparency and reproducibility. The protocol described the criteria which should be applied at each consecutive steps of the systematic mapping. This approach intended to reduce the

potential for bias during the preliminary search and to ensure collection of the relevant articles as objectively as possible. A copy of the original review protocol is registered in Open Science Framework (https://osf.io/wq3df). Any changes from protocol are included in the methodology here.

The primary question addressed was: What food safety outbreaks have affected the hospitality sector in the DR? This question has the following components:

Population (s) Hospitality sector in the DR

Occurrence (s) The occurrence of food safety outbreaks in the DR.

The secondary questions of this systematic mapping were:

What food safety practices have influenced food safety outbreaks in the DR?

What evidence is there that any food safety outbreaks were caused specifically by a weakness in food safety practices? have incidents occurred.

Population (s) Areas in the foodservice/hospitality sector in the DR where food safety

Intervention (s) different food safety practices

Comparator (s) Any relevant

Outcome(s) outbreaks

Questions were formulated using the PICO (population, intervention, comparator, outcomes) key elements as a process (Arton *et al.*, 2020). The PICO tool in qualitative evidence synthesis studies often does not work fully (Cooke *et al.*, 2012). In this study, the comparator (C) was not part of the search because it is irrelevant when qualitative research questions are used. Studies were included even where no comparator was present.

3.2 Search strategy

The bibliographic databases' search was carried out to test the specificity and sensitivity of the search string. A search of articles was conducted from the 26th of February to 3rd of April 2020. However, any restrictions on the date or the article type were applied. Keyword, Boolean expressions, and Truncation (*) symbol were applied to broaden the search across all included bibliographic databases (Table 1). The grey literature search involved searching through

specific organisation websites, grey literature databases and bibliographic databases is presented in Table 1. It was conducted from 27th October to 2nd November 2020 and tried to identify relevant outbreak reports using the combination of key elements with the same search algorithms which were applied for the published articles. Any restrictions on the date or the articles type were applied. **Take in Table 1**

3.3 Articles screening

All the relevant articles were retrieved by the search protocol according to the predefined inclusion criteria. The inclusion criteria were as follows: (1) studies which examine food safety outbreaks in hospitality premises in the DR; (2) studies which focused epidemiological investigations of food safety outbreak in the DR; (3) studies in English, Spanish and German which are relevant to the objectives of the survey. Studies which focus on food safety incidents caused by agents with chemical and physical nature and/or allergenic substances were excluded. The initial search used the title and abstract concurrently and applied the predefined inclusion criteria retrieved related articles and all the duplicates detected by the web-based citation management software (RefWorks ver.2.0.) were removed. The relevance of each of the remaining articles was assessed. If the relevance of the article was not clear at the title and abstract assessment stage, the article was assessed during the full-text review. In general, the

articles were assessed independently by a single reviewer. In cases where some queries arose during the inclusion steps a second reviewer took part and screened the article and the final decision on whether to include was resolved by discussion. The articles which provided a solid laboratory confirmation of the microbiological nature of the etiological agent and that food or water was the most probable route for transmission, rather than any other route, were also considered as eligible for the survey. Outbreaks reported in multiple publications were

recorded only once.

3.4 Data extraction and analysis

Data from the eligible articles were retained and exported to Microsoft Excel (ver.16.37) for coding and analysis. Preliminary coding of the articles was based on their credentials such as author/s, year and type of publication. After the preliminary coding the content of each article was examined for the presence of the following supplementary information: location, risk factors, major study findings, year of outbreak, food settings, food category, source of contamination, etiological agent, number of people affected, number of laboratory-confirmed cases, number of hospitalisations, sign and symptoms, deaths, food safety practices, and socio-demographic characteristics of targeted participants (see Appendix 1).

Descriptive statistics were used for the data analysis and the results were summarised and presented graphically by Microsoft Excel Chart. The figures presenting the publication/reported year and etiological agents identified are in the results section.

4. Results

4.1. The search process

The preliminary search identified a total of 2,793 articles. Further searching included seven studies from the grey literature and two through reference checking in the primary sources. By using the inclusion and exclusion criteria on titles and abstracts and further full text assessment

using the guidance from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2015). The results for mapping were reported in Figure 2. Take 22 relevant articles were eligible for systematic mapping (Figure 2).

The eligible studies included 21 articles which came from diverse official, international scientific and peer-reviewed journals (Appendix 2) and one report from an unpublished investigation by Ministry of Health in the DR (personal communication). Appendix 1 of this paper includes a list of the primary studies along with their main features.

4.2 Scientific literature of travel-associated foodborne diseases in the DR

This study used systematic mapping to gather information and evidence from academic and grey sources on foodborne outbreaks in the DR. The articles analysed were published between 1992 and 2016 (Figure 2) with four articles in 2011 and three in 2015, and either one or two articles in other years.

Take in Figure 3

4.3. The etiological agents involved in the foodborne outbreaks

The systematic mapping identified etiological agents including bacteria, microalgae, parasites and virus (Figure 4). *Salmonella enterica* serotypes Enteritidis, Typhimurium, Newport and Javiana, non-typhoidal *Salmonella* spp., *Campylobacter, V. cholerae* serogroup O1 and *Shigella* serogroups, e.g. Shiga toxin (Stx)-producing *S. dysenteriae* type 4 were the most prevalent microbiological agents (40%). Parasites such as *Toxoplasma gondii*, *Cyclospora cayetanensis* and *Entamoeba hystolitica* (14%) were also indentified as etiological agents.

Some of the articles (14%) identified Norovirus as etiological agent. Others (32%) were linked to ciguatera fish poisoning outbreaks (CFP caused by ciguatoxins) in hotel settings after seafood and fish consumption.

Take in Figure 4

291

292 The systematic mapping used seven articles that reported FBDOs in food premises such as all-inclusive hotel restaurants (Develoux *et al.*, 2008; Gupta *et al.*, 2007; Lange *et al.*, 1992; Martínez *et al.*, 2011; Ministerio de Salud Publica, 2016; Páez Jiménez *et al.*, 2004; Szakacs and McCarthy, 2007), dining, wedding banquet (Blume *et al.*, 1999; Jiménez *et al.*, 2011), and a guest house (Perez *et al.*, 2001). However, eight articles did not reported the food premises.

The FBDOs were categorised into three types: (1) the consumption of unsafe food and water (72%); (2) Travel Diarrhoea (18%); and (3) poor handling in food premises. The results defined the lack of hygiene or care in food handling as the most prevalent factors responsible for the contamination of the food in approximately 83.3% of the articles; the weak sanitisation of the equipment and utensils accounted for 58.3%; and inadequate storage of food was the most prevalent factor in 41.6% of the analysed outbreaks.

The summarised data of systematic mapping based on eleven articles showed a broad range of people affected (from three to 74-years-old) and 2.324 people fell ill as estimated in the included articles. The most commonly reported symptoms were acute diarrhoea, abdominal cramps, vomiting, nausea and fever, while seven articles did not provide any information about the symptoms. None of the sources reported how many locals, staff or workers were affected.

During the collection of data, the systematic mapping revealed that few articles provided any information about the implemented control measures in the hotel premises (Doménech-Sánchez *et al.*, 2011; Jimenez *et al.*, 2004; Jiménez *et al.*, 2011; Loharikar *et al.*, 2015).

5. Discussion

This review provides the first comprehensive and systematic examination of published articles (*n=22)* related to FBDOs in hospitality settings in the DR covering a period from 1992 to 2016.

The paucity of scientifically based research and investigations into FBDOs has a significant impact on government, non-governmental private sectors such as hospitality, and educational organisations seeking to record and investigate foodborne diseases (Lakhan *et al.*, 2013). In line with previous studies on the Caribbean (Guerra et al., 2016; Hull-Jackson and Adesiyun, 2019; Lakhan et al., 2013), this research finds a low rate of reported or investigated FBDOs. The systematic mapping did detect a greater number of reports in 2011 and 2015. These reports were related to several large outbreaks which affected tourist from different countries and raised international concern. (Jiménez et al., 2011; Loharikar et al., 2015; Newton et al., 2011;

Fillion and Mileno, 2015).

The study adopted a systematic mapping approach to provide details such as attribution sources, foodstuff implicated and the type of improper food handling practices that lead to the reported outbreaks. A systematic review approach has been used in the literature before in a similar context. Magalhães *et al.,* (2019) tried to establish the link between published reports of foodborne disease and traceability in the food chain. Similar to this study that the information provided could be used by stakeholders to develop policies and food safety regulations. The literature review conducted by Ortega and Tschirley (2017) which considers less developed economies in Asia and Sub-Saharan Africa concluded that the lack of information on food safety issues affects the development and implementation of agri-food

systems. As a result, the tourism industry is also affected especially when it relies on local food production to satisfy visitors' food demand. The aforementioned reviews focused on developed and less developed economies and stressed the persistent deficiency of information about foodborne diseases and poor notification systems, thus concurring with this study. Lebelo *et al*. (2022) stated that the ability to predict and prevent foodborne disease and food contamination could not be underestimated or neglected because of the negative impact that

FBDOs can have on public health and the economy (Gissing *et al.*, 2017). The analysis in this work provides summarised information about the etiological agents which affected travellers on hotel premises (Ingram *et al.*, 2013). The likely contributory factors to FBDOs which the systematic mapping identified were the consumption of unsafe food and water. The primary studies support the findings of this systematic mapping by providing specific evidence of etiological agent related to the cases under investigation (Gray *et al.*, 2015; Gupta *et al.*, 2007; do Prado *et al.*, 2021; Zhi *et al.*, 2021).

In comparison with the aforementioned research, this study used a more structured methodology which provided explicit and reproducible systematic mapping. Similarly, Torres et al. (2021) found that a systematic review had been useful in the identification of neglected areas during food safety hazard surveys. Other authors also support the idea that surveillance and epidemiological studies and active laboratory surveillance in the hospitality premises have limitations and leave gaps in the information available about foodborne diseases, sources and etiological agents which is required for proper surveillance (Hull-Jackson and Adesiyun, 2019; Mohammadi *et al.*, 2022; Ntshoe *et al.*, 2021; Torres *et al.*, 2021). In particular, by providing

354 scientific evidence, the systematic mapping could facilitate governmental decisions and policy
355 makers and their recommendations towards undertaking food safety and risk analysis in 356 hospitality sectors in the DR and in other regions in order to prevent threats for public health.

357 Moreover, assessing the compliance towards food safety regulations and voluntary

358 certifications will improve the efficacy of food hygiene and safety practices in this sector.
359 Applying the results of systematic mapping could also reduce the foodborne disease burden,
360 and the associated economic and health implications at national and regional levels (Indar *et*
361 *al.*, 2020). The improved integration of information between health authorities and hotel
362 businesses should enhance the effectiveness of a notification and surveillance system by
363 inclusion of data from several sources e.g. hotels, locals premises, regional and international
364 food supply chains, etc.

365

366 6. Conclusion

367 Systematic mapping is a useful tool to examine existing literature sources to identify the
368 common microbiological agents and sources of food contamination within the scope of a given
369 investigation (time frame, location, types of incidents, location of incidents etc.). Systematic
370 mapping relies on primary research and the lack of sufficient information can decrease its

power and effectiveness to draw conclusions. A challenge with systematic mapping is the degree of confidentiality of the information associated with FBDOs affecting staff and workers in hospitality, and how managers or policy-makers control the availability of such information for public scrutiny. Future research should be focused on the risk analysis, management, and communication of foodborne outbreaks. The contribution of this study is to demonstrate the value of systematic mapping of both public and private evidence sources (e.g. government information not publically available) and how this could firstly, reveal the areas and practices that needs improvements in order to prevent FBDOs. Secondly, the appropriate management systems and control measures that should be applied at the local and national level to minimise the risk of FBDOs associated with the hospitality sector can be identified. A further contribution is to suggest in future research combining systematic mapping as the first stage of the research with supporting methodologies such as AcciMap analysis to develop the findings of systematic mapping further to gain evidence of where practices or contributing socio-

technical factors have contributed to FBDOs and what actions can be taken to prevent further problems in the future.

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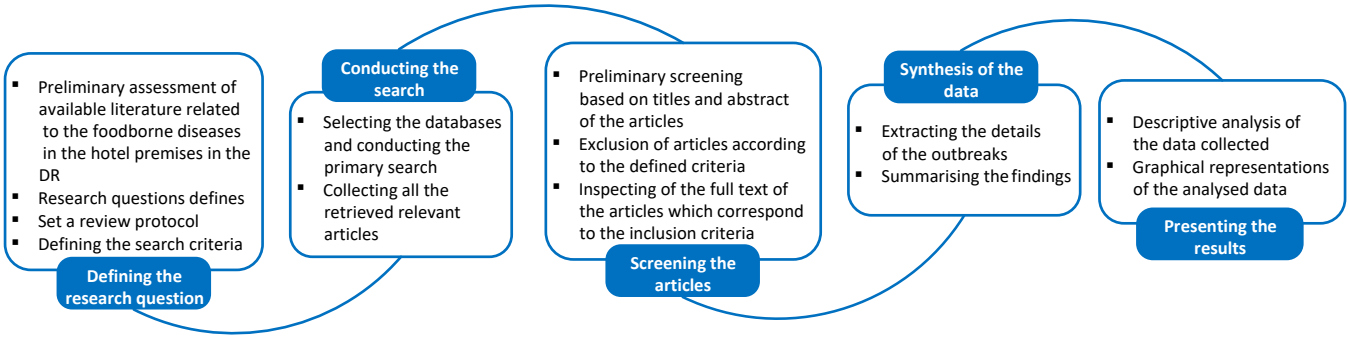

Figure 1. Consecutive steps of the systematic mapping protocol (adapted from Garcia *et al.*, 2019).

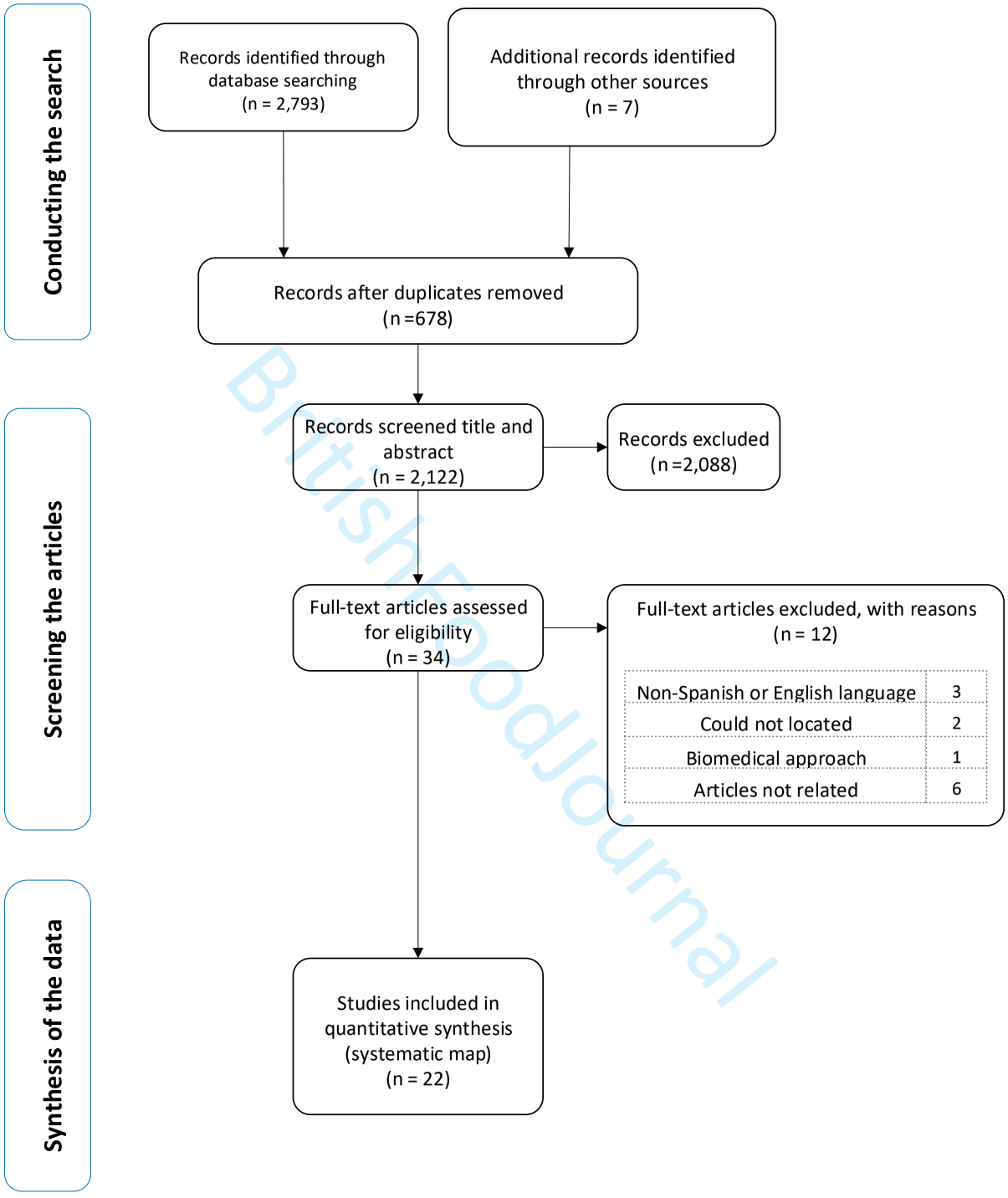

Figure 2. The applied PRISMA principles and the number (n) of articles included in the systematic mapping after the searching process.

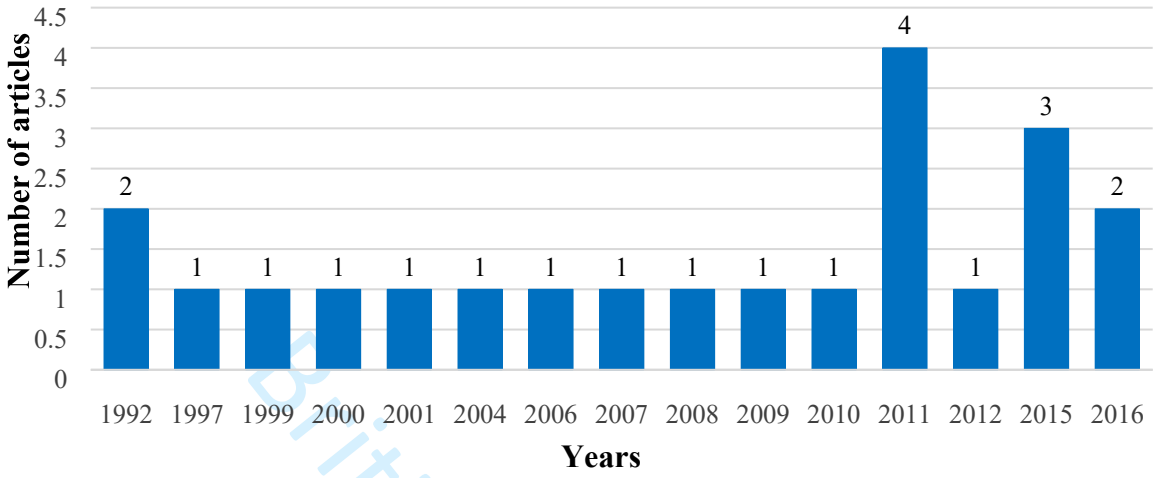

Figure 3. The distribution of eligible articles included in the systematic mapping.

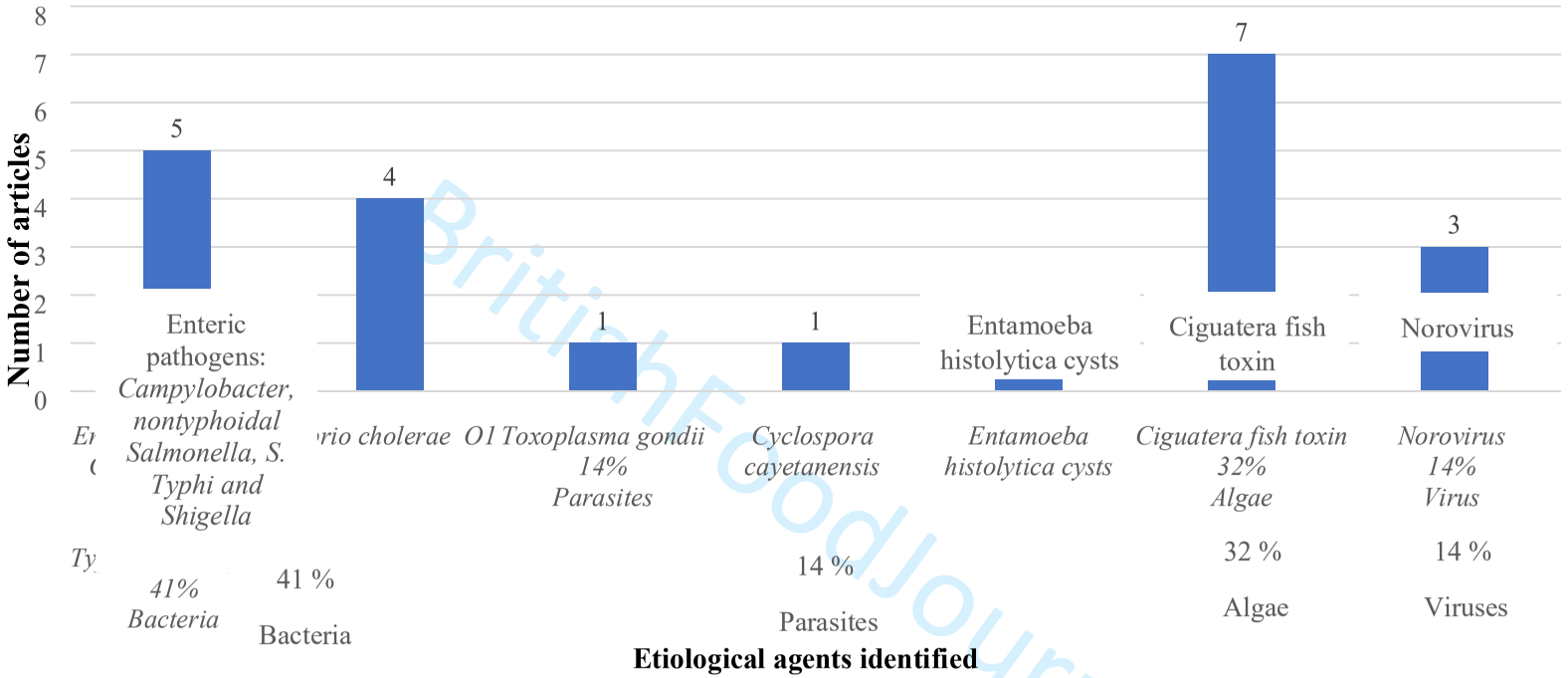

Figure 4. The identified etiological agents related to foodborne outbreaks in the hospitality settings in the DR.

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Table 1. The list of databases and the string terms which was used in the search strategy and academic search information.

Database	Search string
Web of Science EBSCOhost Wiley online library PubMed	(food*) AND TOPIC: (disease* OR outbreak* OR contamination OR intoxication OR poison* OR pathogen* "gastrointestinal disorder" OR infection* OR allergy OR hygiene OR sanitation OR Campylobacter* OR Cryptosporidi* OR Cyclospor*OR "Escherichia coli" OR "E. coli " OR "Hemolytic Uremic Syndrome" OR Giardia* OR Listeri* OR Salmonell* OR Shigell* OR Toxoplasm*OR Vibrio OR cholera* OR Yersini* OR Norovirus OR Hepatitis OR Staphylococcus OR "waterborne" OR diarr* OR vomiting OR "Ciguatoxins" OR epidemic OR epidemiology or pandemic) AND TOPIC: (Caribbean Or Dominican Republic)
Academic searches	
Bibliography databases	Google Advance Search, Google Scholar and Pubmed
Specific websites	Public Health Department Dominican Republic, US Centers for Disease Control and Prevention (CDC), World Health Organisation (WHO), Pan American Health Organisation (PAHO/WHO), Food and Agriculture Organisation of the United Nations (FAO).
Grey literature databases	Dissertations and theses from ProQuest, EThOS, Institutional Repository from a Technological Institute of Santo Domingo (INTEC)

Appendix 1. Summarised characteristics and data extracted of the final studies included in the systematic mapping.

Year	First author/year (ref)	Title	Type	Contributing Factors	Year Outbreak	Disease	Source Implicated	Food Setting	Etiologic Agents	# Of Cases/ People/Where	Symptoms	Socio-Demographic Characteristics
1992	Lange *et al.*,	Travel and Ciguatera Fish Poisoning.	Article	Risk to travelers to endemic regions	1987 - 1990	Ciguatera	Suspected fish included grouper, red snapper, and amberjack.	Hotel restaurant	Ciguatera toxin	1	Paraesthesia of the extremities or around the mouth, weakness, pruritus and diarrhoea	Not reported
1992	Roca *et al.*,	Toxoplasmosis and hepatitis.	Article	Eaten raw or partly cooked foods foods.	Not reported	Toxoplasmosis	Eaten raw or partly cooked	Not reported	*Toxoplasma gondii*	1	Acute hepatitis; a high fever, general weakness, aching joints and jaundice.	23-year-old male

		Ciguatera fish poisoning following travel to the tropics.										
1997	Sanner *et al.,*			Food and Potable water	Not reported	Ciguatera fish poisoning	Meal of grouper	Not reported	Ciguatera toxin	16 people	Vomiting and watery diarrhoea	Not reported
			Article									
1999	Blume *et al.,*	Ciguatera poisoning. Growing differential diagnostic significance in the age of foreign tourism.	Article	Ciguatera fish 1999	and lemon	Dinning	Ciguatera 4 people poisoning	Peak bass intoxicationtoxin sauce.	Ciguatera		Paraesthesia, nervousness, inverse temperature perception, muscle cramps, headache and dizziness	22 and 31 years

2000	Green *et al.,*	Two Simultaneous Cases of *Cyclospora cayetanensis enteritis* Returning from the Dominican Republic	Article		Not Reported	Not reported 2 people reported	1998	*Cyclospora cayetanensis*	Gastroenteritis	Not reported	Diarrhoea	72-74 year
2001	Perez *et al.,*	Treatment of Ciguatera Poisoning with Gabapentin.	Article	Food and Potable Not reported	Punta Cana	2 people	Ciguatera fish water	Dusky grouper	toxin	Ciguatera		Nausea, vomiting, abdominal cramps, and watery diarrhoea	32- 37 years old

Year	First author/year (ref)	Title	Type	Contributing Factors	Year Outbreak	Disease	Source Implicated	Food Setting	Etiologic Agents	# Of Cases/ People/W here	Symptoms	Socio-Demographic Characteristics
2004	Jiménez *et al.*,	Waterborne outbreak among Spanish tourists in a holiday resort in the Dominican Republic.	Article	Sewage system to the water supply system	2002	Amebic dysentery (amebiasis)	Consumption of unsafe foods or drinking untreated fresh water.	Resort	Entamoeba hystolitica cysts	76	Acute diarrhoea	The mean age was 31.6 +3.5 years. 61.8% of cases were male
2007	Gupta *et al.,*	Emergence of Shiga toxin 1 genes within *Shigella dysenteriae* type 4 isolates from travellers returning from the Island of Hispanola	Article	Endemic in the island of Hispañola.	2004-2005	Shigellosis	Not reported	All-inclusive resort in Punta Cana	Stx1-producing *S. dysenteriae* 4	2 cases / 6 people	abdominal cramping, and non-bloody diarrhoea	17-year-old male resident of Florida / 3-yearold boy
2007	Szakacs & McCarthy,	An all-inclusive vacation.	Article	Food and Potable water	Not reported	Typhoid fever	Food or water contaminated with faeces.	Resort in Punta Cana	*Salmonella enteritica* serovar Typhi	Not reported	Abdominal cramping, nonbloody diarrhoea and fever	70-year-old

2008	Develoux *et al.*,	A case of ciguatera fish poisoning in a French traveler	Article	Ciguatera poisoning/ ingested fish could not be specified	2008	Ciguatera	The species of ingested fish could not be specified.	A hotel-club of Puerto-Plata	Ciguatera toxin	2	Abdominal cramps and diarrhoea	Not reported
2009	Doménech-Sánchez *et al.*,	Gastroenteritis Outbreaks in 2 Tourist Resorts, Dominican Republic	Article	Sewage water	2005	Gastroenteritis	Water	Not reported	Norovirus	773	Diarrhoea, vomiting, headache and fatigue	Not reported
2010	Doménech-Sánchez *et al.*,	Unmanageable norovirus outbreak in a single resort located in the Dominican Republic	Article	Food and Potable water	2007	Acute gastroenteritis	Contaminated food or water as the source of the infection.	Not reported	Norovirus	800	Not reported	Not reported

Year	First author/year (ref)	Title	Type	Contributing Factors	Year Outbreak	Disease	Source Implicated	Food Setting	Etiologic Agents	# Of Cases/ People/Where	Symptoms	Socio-Demographic Characteristics
2011	Johnson *et al.,*	*Salmonella* infections associated with international travel: a Foodborne Diseases Active Surveillance Network (FoodNet) study.	Article	Travel-associated	2004-2008	Salmonellosis		Not reported	*Salmonella* Not *enterica* identified serotype	66	abdominal cramps, and bloody diarrhoea	3-year-old boy
2011	Jiménez *et al.,*	Multinational cholera outbreak after wedding in the Dominican Republic.	Article	Poor food handling practices	2011	Cholera	Shrimp and prawns were served on ice or ice sculptures.	Wedding banquet	*Vibrio cholerae* O1	42 case-patients	Watery diarrhoea, nausea, vomiting, cramps	Median age of case-patients was 42.5 years (range 16–84 years); 33 (79%) were male

		Cholera in United States Associated with Epidemic in Hispaniola.										
2011	Newton *et al.,*			Consumption of contaminated food or water	Not reported	Cholera	Not reported	Not reported	*Vibrio cholerae* O1	23 associated cases, 9 to Dominicans	Not reported	Not reported
			Article									
2011	Martinez *et al.,*	Un caso de ciguatera en viajera a la República Dominicana	Article	Ciguatera fish poisoning	Not reported	Ciguatera intoxication	Chillo hervido (*Lutjanus vivanus*).	Lodge in Santo Domingo	Ciguatera toxin	1 people	Nausea, vomiting, chills, and diarrhoea	44 years old woman

2012	Kendall *et al.,*	Travel-associated enteric infections diagnosed after return to the United States, Foodborne Diseases Active Surveillance Network (FoodNet), 20042009.	Article			Enteric infection	Enteric infection	Not reported	2004-2009	Not reported	Travellers	*Campylobacter* (42%), nontyphoidal *Salmonella* (32%), and *Shigella* (13%	201	Not reported	Not reported
2015	Fillion & Mileno,	Cholera in travelers: shifting tides in epidemiology, management, and prevention	Article	Cholera	2010	Cholera	Not reported	Not reported		Not reported		*Vibrio cholerae* O1	9 travellers	Not reported	Not reported

Year	First author/year (ref)	Title	Type	Contributing Factors	Year Outbreak	Disease	Source Implicated	Food Setting	Etiologic Agents	# Of Cases/ People/W here	Symptoms	Socio-Demographic Characteristics
2015	Loharikar *et al.,*	Cholera in the United States, 2001-2011: a reflection of patterns of global epidemiology and travel.	Article	Cholera	2011	Cholera	Not reported	Not reported	*Vibrio cholerae* O1	40	Not reported	Not reported
2015	Gray *et al.,*	Prevalence of Stx-producing *Shigella* species isolated from French Travelers Returning from the Caribbean: An Emerging Pathogen with International Implications	Article	Environmental factors have contributed to the emergence of these species in that region.	Records between 1994 and 2008	Shigellosis	Not reported	Not reported	stx-positive. This included nine strains of *S. flexneri* 2a, one *S. dysenteriae* 4, and one *S. flexneri* Y. An *S. flexneri* 2a	Not reported	Not reported	Not reported
2016	Ministerio de Salud Pública,	Brote de gastroenteritis, Complejo hotelero Live Style Resort Puerto Plata	Report	Contaminated water and ice	2016	Acute gastroenteritis	Contaminated water and ice.	Live Style Resort	Norovirus	301	Not reported	Not reported
2016	Thompson *et al.,*	Ciguatera fish poisoning after Caribbean travel.	Article	Ciguatera fish poisoning	Not reported	Ciguatera intoxication	Dog snapper	Not reported	Ciguatera toxin	2 people	Nausea, vomiting and diarrhoea. Severe generalized pruritus	68 years old

Appendix 2. Review of literature sources of final articles (n=22) included in the systematic mapping exercise.

Journals/source	SRJ (2019) Ranking Medicine Category	Number of articles
Archives of Internal Medicine	66	1
Eurosurveillance	201	2
Clinical Microbiology and Infection	212	1
Emerging Infectious Diseases	249	3
Current Infectious Disease Reports	796	1
American Journal of Tropical Medicine and Hygiene	1183	1
Epidemiology and Infection	1281	1
Clinical Infectious Diseases	4900	2
Medizinische Klinik	4960	1
Canadian Medical Association Journal	-	1
Enfermedades Infecciosas y Microbiología Clínica	-	1
Foodborne Pathogens and Disease	-	1
Medicina Clínica	-	1
Journal of Travel Medicine	297	1
Canadian Medical Association	41	1
Zeitschrift fur Gastroenterologie (Z gastroenterol)	4424	1
The New England Journal of Medicine	8	1
Unpublished report (Public Health Department in the Dominican Republic)	-	1
Total		22

Response to reviewer and Editor Comments

Editors comments	
The paper may be of interest but needs major upgrades. Have a look at the reviewers comments plus those below:	Thank you for the opportunity to revise the paper.
Motivation of the Paper. in the introduction I do not understand and see clearly the theoretical contribution of the paper. I think the paper, at the present form, partially fails to formulate a research problem, which is of interest. We have partial answers on what we know now about the topic and what we do not know. The author should more in detail and in a more systematic way present answer on these questions, but also what we need to know. Why is this important, for research, for practise? Also, the introduction is critical and I suggest the following key points within this section (Positioning, Gap, Purpose, Central argument, Organizing, Contribution, So what?)	Thank you for this comment which we have reflected on in our revision on all these points. Despite the available review articles where authors collect very limited information about the FBDOs in the Caribbean islands and the Dominican Republic, still there is a need for a more methodical approach of FBD and the systematic mapping could provide such approach an approach especially as a first stage of a research process to then inform other methodologies such as AcciMap analysis.
literature. The paper should be grounded more on food literature, this helps you in better develop a contribution for this stream of research data should be updated;	Thank you for your comment. We have completely revised the Literature review Section 2 Lines 88 – 127 to be more grounded on food literature.
- Building your discussion: I would suggest that a discussion section be more comprehensively developed that links back to your initial research questions and a clear statement of proposed contributions, once you have reframed your arguments and developed some propositions. What should we, as readers, take away regarding your study? What are the key theoretical contributions that are gained? How can these findings contribute to the literature stream associated with food businesses? What do we know about this literature stream now that we have read your study? What future research should be conducted within this literature stream that can be extended based upon your study? This is what I often call “closing the loop”. Specifically, you a) state in the introduction that there is a gap (your research questions), and you plan to address the gap theoretically; b) present a formally developed and very focused literature review that gives the rational for the study and develop propositions/hypos that reflect this gap; and c) “Close the loop”, by developing your discussion section that ties back to the research question(s). In the end,	Following reviewers comments we hope we have presented the arguments in a more coherent way and we have linked back to the research questions. The whole paper has been restructured but especially the discussion and conclusion section. Lines 327-379.

1
2

you hope that the reader has been able to read the article and see the article, in its entirety, as encapsulating the resolution of a theoretical or empirical gap.	
Reviewer: 1 Recommendation: Major Revision	
The topic is worth investigating due to the problem statement mentioned, but the originality of your paper is what is missing. Do be bold enough to include your own possible interpretation in the Discussion section, to add originality to your paper. Including "What's something new or important that my paper contributes?" in the Conclusion would definitely go a long way in making this paper worthy of publication. Originality: Does the paper contain new and significant information adequate to justify publication?: Vague or not clearly defined. The knowledge gaps were identified and reemphasized in Conclusion. Key findings were mentioned, the study "has examined" the context and evidence of food safety outbreaks in DR but does not explicitly mention the knowledge contribution: whether from a theoretical or practical perspective. Suggestion: The author(s) should answer the "So, having known what food safety outbreaks have affected the hospitality sector in DR, what does my study contribute?" based on their findings to justify publication.	Thank you for this comment which we have considered. In the abstract we have highlighted “To the best of our knowledge this is the first systematic mapping research assessing evidence of FBDOs affecting hospitality in the DR.” demonstrating a contribution to existing research. We have rewritten the conclusion and lines 381-400 now read: “The contribution of this study is to demonstrate the value of systematic mapping of both public and private evidence sources (e.g. government information not publically available) and how this could firstly, reveal the areas and practices that need improvement in order to prevent FBDOs. Secondly, the appropriate management systems and control measures that should be applied at the local and national level to minimise the risk of FBDOs associated with the hospitality sector can be identified. A further contribution is to suggest in future research combining systematic mapping as a first stage of the research with supporting methodologies such as AcciMap analysis to develop the findings of systematic mapping further to gain evidence of where practices or contributing sociotechnical factors have contributed to FBDOs and what actions can be taken to prevent further problems in the future.”
Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, although slight addition can improve the food safety and tourism review. The inclusion of grey literature can be further justified.	The literature review section has been completely revised based on these comments see lines 81-172. Details on the inclusion of grey literature are included in Table 1, Lines 230-232; lines 273-274; lines 287-288.

Methodology: Partially. Although systematic mapping is frequently used in environmental science, the research reliability can be further elaborated, eg. screening and coding process. The broad nature and rapid search which may led some articles to be missed could also be another area worth addressing.	Based on comments from reviewers the methodology section has been completely revised to meet the comments made – lines 175 – 270. We hope we have addressed these points. The section has been divided into four subsections: research questions and review protocol; search strategy;

Further explanation on why the study's population(s) mentioned two different contexts would help to improve methodological section. Reason(s) for having no comparator under the Component is another aspect worth addressing.	articles screening; data extraction and analysis. The lack of comparator has been complained in this section.
Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes.	Thank you for this comment
Implications: Partially. Although the paper's findings matched the previous studies, as well as comparing the outcomes of other studies, the paper's own "voice" is lost. One way to improve this section is to suggest probable reason(s) or what could work and what could not work, based on the original research questions, in the context of DR.	Thank you for this comment the implications have now been included in the abstract. Lines 389-400 have been included to address implications. “Future research should be focused on the risk analysis, management, and communication of foodborne outbreaks. The contribution of this study is to demonstrate the value of systematic mapping of both public and private evidence sources (e.g. government information not publically available) and how this could firstly, reveal the areas and practices that need improvement in order to prevent FBDOs. Secondly, the appropriate management systems and control measures that should be applied at the local and national level to minimise the risk of FBDOs associated with the hospitality sector can be identified. A further contribution is to suggest in future research combining systematic mapping as a first stage of the research with supporting methodologies such as AcciMap analysis to develop the findings of systematic mapping further to gain evidence of where practices or contributing socio-technical factors have contributed to FBDOs and what actions can be taken to prevent further problems in the future.”

Quality of Communication: Yes.	Thank you for this comment
Reviewer: 2 Recommendation: Reject	
An interesting paper and could be of interest to the travel industry	Thank you for this comment
Originality: Does the paper contain new and significant information adequate to justify publication?: Original but old data	We have considered this statement. The systematic review was conducted in 2020 so although the data is up to 2016, this is because there was not relevant evidence in the other years. We have considered more general contemporary literature that has been published since the systematic mapping exercise and integrated it into the narrative so seek to address this comment.
2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes	We are not quite sure what the comment "Yes" refers to here.

Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Yes	Thank you for this comment
Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes	Thank you for this comment

Implications for research, practice and/or society: Studies need updating	Thank you for this comment the implications have now been included in the abstract. Lines 389-400 have been included to address implications. “Future research should be focused on the risk analysis, management, and communication of foodborne outbreaks. The contribution of this study is to demonstrate the value of systematic mapping of both public and private evidence sources (e.g. government information not publically available) and how this could firstly, reveal the areas and practices that need improvement in order to prevent FBDOs. Secondly, the appropriate management systems and control measures that should be applied at the local and national level to minimise the risk of FBDOs associated with the hospitality sector can be identified. A further contribution is to suggest in future research combining systematic mapping as a first stage of the research with supporting methodologies such as AcciMap analysis to develop the findings of systematic mapping further to gain evidence of where practices or contributing socio-technical factors have contributed to FBDOs and what actions can be taken to prevent further problems in the future.”
Quality of Communication: good	Thank you for this comment
Reviewer: 3 Recommendation: Major Revision	
Paper entitled "Systematic mapping of food safety outbreaks in the hospitality sector in the Dominican Republic" represent valuable attempt for making a overview and discovering research gaps and trends in the researched area.	Thank you for this comment
In aim to help author/authors in the process of paper improvement I will provide my comments and suggestions for each part of the paper in the following sentences.	Thank you for your comments and the time you have taken to consider the paper
Abstract is not structured by BFJ Author guidelines. Take a look at BFJ website and find information for manuscript preparation. Purpose, Design/methodology/approach, Findings and Originality are mandatory four	Thank you for this comment the abstract has been revised and restructured to meet the comments.

sub-headings and their accompanying explanations must always be included in structured abstract. Additionally, implications for theory, further research, food handlers and policy-makers are missing, even they have vital role for paper quality. Keep in the mind that systematic maps play an important role in evidence syntheses because they are able to cover the breadth of science often needed for policy-based questions.	
Further, clearly information of paper motivation, purpose, aim, and scope have to be included in Introduction section. Did you check your paper length? There are five tables/figures in your paper and please allow 280 words for each figure or table.	Thank you for this comment which we have reflected on in our revision. The motivation for the research is articulated in line 78, the purpose and scope lines 80-87 and the aim - line 170. The introduction of more literature and addressing all the reviewers' comments has made it difficult to remain within the word count. We have moved two tables to be appendices and we have merged Table 1 and 2. We have tried to reduce the paper as much as we can.
Relationship to Literature: The paper mostly demonstrate understanding of relevant literature in the field of food safety, but additional literature should be included especially from BFJ and other high ranking journals in researched fields.	Thank you for these positive comments and the suggestions to improve the paper. We have added more relevant and recent literature throughout our major revision of the paper. The depth of literature critiqued has made it difficult to meet the word count.
Methodology: Method and data section in the paper has to be improved. First, stages of systematic mapping have to be clearly introduced in Methodology sections. Second, several important questions have to be answered: - What is the current state of knowledge for researched topic? - How much evidence there is? - What populations, interventions, exposure or outcomes have been studied?- How studies have been carried out? Third, please set clearly inclusion/exclusion criteria for systematic mapping. Fourth, define scoping. Fifth, clearly define systematic mapping protocol. Then, you can access searching, screening and coding the evidences, and produce relevant database.	Based on comments from reviewers the methodology section has been completely revised to meet the comments made – lines 175 – 270. We hope we have addressed these points.

Results: Data are analysed properly, but has to be discussed more clearly. The good idea may be comparison of research findings with similar studies undertaken in other countries, developed and developing...	Thank you for this comment. We have revised the discussion section Lines 328-379 to compare the research findings with contemporary literature and hope this is now more discursive and critical.
Implications for research, practice and/or society: In the current form, papers do not offer proper implications for theory, further research, food handlers and	Thank you for this comment the implications have now been included in the abstract. Lines 389-400 have been included to address implications.

2

policy-makers. Such implications is vital because they will justify systematic mapping process.	"Future research should be focused on the risk analysis, management, and communication of foodborne outbreaks. The contribution of this study is to demonstrate the value of systematic mapping of both public and private evidence sources (e.g. government information not publically available) and how this could firstly, reveal the areas and practices that need improvement in order to prevent FBDOs. Secondly, the appropriate management systems and control measures that should be applied at the local and national level to minimise the risk of FBDOs associated with the hospitality sector can be identified. A further contribution is to suggest in future research combining systematic mapping as a first stage of the research with supporting methodologies such as AcciMap analysis to develop the findings of systematic mapping further to gain evidence of where practices or contributing socio-technical factors have contributed to FBDOs and what actions can be taken to prevent further problems in the future."
Quality of Communication: Yes. The paper is well written.	Thank you for this comment

3