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A One Year Retrospective Study of Gastroenteritis Outbreaks in Croatia: Incidences and Etiology

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A B S T R A C T

Gastroenteritis is one of the most commonly reported communicable diseases in Croatia, where there is a well-established system for the surveillance of this disease. The aim of this study was to identify the frequency and the most causative agents of gastroenteritis outbreaks and to identify underlying factors contributing to disease outbreaks.We analysed 89 reported outbreaks documented by local epidemiologists to the Croatian National Institute of Public Health during 2006. Most outbreaks happened during the summer (39.3%).Causative agents in the summer were mostly bacteriae while viruses were mostly the causative agents in the spring ($p<0.01$). Also bacteria was the most causative agent in outbreaks conducted in private households and public restaurants, while viruses, mostly norovirus, were causative agents in outbreaks in homes for elderly people and hospitals ($p<0.01$). Bacterial infections were related to substandard practices in food preparation and warehousing, and virus infections were related to person-to-person contact (fecal-oral route and airborne transmission) ($p<0.01$). However, it is important to recognize the need for continuous public education, especially for professionals involved in food preparing as a step in how to prevent gastroenteritis.

Key words: *gastroenteritis, outbreak, descriptive statistics, Croatia*

Introduction

In Croatia, there is a mandatory notification system for registering individual cases of illnesses and outbreaks, which serve to control infectious diseases for more than 80 years. A statutory notification is forwarded from every physician, who diagnoses an infectious disease, to competent local epidemiology units (altogether 113) which operate inside 21 County Institutes for Public Health, within 24 hours. Outbreaks of infectious diseases are reported immediately by phone or fax. The purpose of this is to prevent spreading communicable disease as soon as possible. In the end, all notifications are collected and analysed at the Croatian National Institute of Public Health. This system tracks 88 specified infectious disease[1–3]. Gastroenteritis is one of the most commonly reported diseases in Croatia, with 17 629 reported cases in 2006 followed by Varicella disease (19 549). Of all gastroenteritis cases, 4 734 were salmonellosis, significantly related to public food preparation, livestock breeding and the food manufactured from this livestock. In 2006 106.62 salmonellosis cases were reported in Croatia *per* 100 000, in comparison to 38.69 *per* 100000 in states within the European region and 62.96 *per* 100 000 in EU members[5]. Reported incidences of salmonellosis cases in neighbouring countries were also lower, in Slovenia there were 74.78, Serbia 31.4 and in Bosnia and Hercegovina 7.52 per 100 000[5].

Every year foodborne diseases affect one third of the population in developed countries[6]. *Salmonella spp*. was the most common cause of foodborne outbreaks in the WHO European Region (around 75%). Most of these outbreaks are due to the consumption of food of animal origin, particularly insufficiently cooked eggs or foods containing raw eggs, such as mayonnaise, ice cream or cream-filled pastries. Foodborne viruses were the second most frequent outbreak cause in 2006. About 40% of all these outbreaks over the past decade were caused by the consumption of food in private homes[6,7]. The fact that gastroenteritis is one of the most common disease worldwide[8] is important because of its significant financial burden. It is a notable public health problem considering the number of sick people, deaths, costs of treatment,

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hospital stays, and absenteeism from work or school. In The Netherlands, for example the cost of gastroenteritis was 77 Euro ( ) *per* case and amounted to approximately 345 million for all patients. An estimate cost for patients with *Salmonella, Campylobacter* or norovirus was 10–17% of the cost of gastroenteritis[9].

While most of these illnesses are preventable, we are interested to find out where most outbreaks occur, whether in public services or in domestic places and how improper food handling practice contributes to illnesses. Therefore, the aim of this study was to identify the frequency and the most causative agents of gastroenteritis outbreaks and to identify underlying factors contributing to disease outbreaks. Those findings can help us to improve control measures to prevent occurrences of illnesses in the community.

Materials and Methods

This study includes all outbreaks of gastroenteritis reported to the Croatian National Institute of Public Health between 1 January and 31 December 2006. The data was analysed from standardized questionnaires concerning the outbreaks submitted by local epidemiologists. The collected data included: county of outbreak onset, source of outbreak report, setting of the outbreak, causative agent, month of onset outbreak, duration, number of exposed, cases, incidents of hospitalization or death, probable and confirmed vehicle of infection transmission and source of infection, microbiological results of stool, professional conclusion for the cause of the outbreak and conducted outbreak control measures. Source of outbreak report was the way in which an epidemic is identified (notification from professional medical services, residents in the community and through manditory notifications). The number of exposed was calculated on epidemiological evidence based on the posibility of same food or water consumption as ill people. The month of outbreak onset was defined by the date of onset in the first case of an outbreak. In case of foodborne outbreak, data such as microbiological results of sampled food, environmental samples from places where the food was prepared and from people who were preparing the food, was analysed. In case of waterborne outbreaks, data of microbiological results of sampled water was collected.

An outbreak was defined as an incident in which two or more people experienced similar symptoms such as diarrhea and/or vomiting and there were epidemiologically connected by ingesting the same food or water from the same source which was identified as the source of illness. A confirmed foodborne outbreak is defined as an incident in which two or more people experience similar symptoms after food ingestion and where an epidemiological review suggests the food was a source of illness[10].

Data analysis included descriptive statistics (frequencies, proportions, range, median, mode), and nonparametric χ^2-test. We considered $p<0.05$ to be statistically significant. For data analysis, the commercial SPSS 15.0 software was used.

Results

During the year 2006, local epidemiology units reported 102 outbreaks, of which 89 showed symptoms of gastroenteritis, to the Croatian National Institute of Public Health. The sources that reported the gastroenteritis outbreak are as follows: 68.5% were from professional medical services, 18% from the public, and 9% from mandatory notifications. A total of 49 outbreaks were from the coastal region (including the following counties: Primorsko-goranska, Ličko-senjska, Istarska, Zadarska, Šibensko-kninska, Splitsko-dalmatinska and Dubrovačko-neretvanska) and 40 outbreaks came from the continental region of Croatia (including the following counties: Bjelovarsko-bilogorska, Virovitičko-podravska, Požeško-slavonska, Brodsko-posavska, Osječko-baranjska, Vukovarsko-srijemska, Sisačko-moslavačka, Karlovačka, City of Zagreb and County of Zagreb). The most reported cases of outbreaks were from the counties of Primorsko-Goranska (14; 15.7%) and Istra (12; 13.5%) (Table 1).

There was no significant difference between region and causative agents of outbreaks ($\chi^2=6.007$; df=4; $p>0.05$). From all outbreaks, 1686 cases were affected, in relation to 15 737 exposed individuals. A median number of cases per outbreak were 11 or mode 6 (in a range between 2–126 cases). The major portion of cases was with 6–20 affected people (Table 2).

TABLE 1
REPORTED GASTROENTERITIS OUTBREAKS ACCORDING TO COUNTY BY FREQUENCY AND PERCENT IN CROATIA, 2006

County with outbreak onset	n	(%)
City of Zagreb	8	9.0
Ličko-senjska	1	1.1
Požeško-slavonska	4	4.5
Brodsko-posavska	5	5.6
Zadarska	2	2.2
Osječko-baranjska	1	1.1
Šibensko-kninska	7	7.9
Vukovarsko-srijemska	4	4.5
Istarska	12	13.5
Zagrebačka	1	1.1
Dubrovačko-neretvanska	6	6.7
Međimurska	4	4.5
Krapinsko-zagorska	1	1.1
Sisačko-moslavačka	7	7.9
Karlovačka	2	2.2
ght Varaždinska	3	3.4
Primorsko-goranska	14	15.7
Splitsko-dalmatinska	7	7.9
Total	89	100.0

TABLE 2
THE PORTION OF GASTROENTERITIS CASES PER OUTBREAK IN CROATIA, 2006

Number of cases per outbreak	(%)
2–5	16.9
6–20	55.1
21–50	20.1
>50	7.9

In total 180 individuals were hospitalized (in range 0–21; median per outbreak 1, mode 0) and there were no deaths. The duration of an outbreak was between 2 to 49 days, with a median of 7 days and mode of 5 days.

Most outbreaks happened in public restaurants (39.3%), private households (32.6%), and hospitals and homes for elderly people (20.2%). The onset of the outbreaks occurred mostly in the summer (39.3%), spring and autumn (22.5%) and winter (15.7%) (Figure 1).

There exist statistical significance (χ^2=23.6; df=6, p<0.01) between the type of agents and month of reported outbreaks. In the summer, causative agents were mostly bacteriae and in the spring they were viruses.

The probable vehicles for transmitting the infections were as follows: foodborne 30.3% (number 27), person-to-person contact 16.9% (15), combination of person-to-person contact and foodborne 16.9% (15), waterborne 1.1% (1) and unknown 34.8% (31). Microbiological confirmed foodborne outbreaks were 16.9% (number 15). The most pathogens in foodborne outbreaks were confirmed in cakes, deserts 12.4%, meats and meat products 10.1%, eggs 3.4% and fish or shells 2.2%.

In total, 1,906 stool and vomit samples were collect. The most causative agents were *Salmonella enteritidis* (47.2%), norovirus (14.6%), *Clostriduim perfringens* (3.4%) and rotaviruses (2.2%). In 16.9% of the cases, causative agents were unexplained. In order to confirm the cause of the epidemic, a microbiological analysis was made of the working environment, equipment (21) as well as microbiological analysis from the hands (17) of the professionals who were preparing the food. The results were most positive for the bacterium species *Enterobacteriacae*, as well as an increased number of total bacteria, and *Staphylococcus aureus*. From 71 food samples *S. enteritidis* was most detected (number 19), in comparison to *S. infantis*, *S. senftenberg, S. coeln*, *St. aureus*, *Enterobacteriacae*.

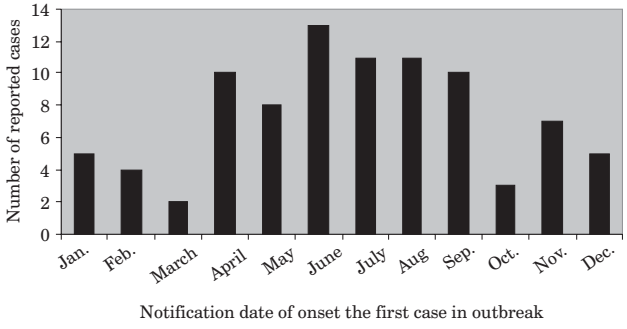

Fig 1. The number of reported cases of gastroenteritis outbreaks in Croatia by month, 2006.

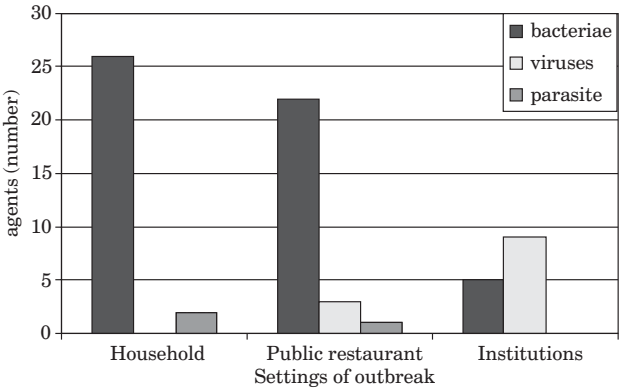

Fig 2. Frequency of outbreaks causative agents by settings of outbreak in Croatia, 2006.

χ^2-test showed us statistically significant differences between causative agent in the location of the outbreaks: a bacterium was the most causative agent in outbreaks conducted in private households and public restaurants, while viruses, mostly norovirus, were in outbreaks in homes for elderly people and hospitals (χ^2=56.14; df=8; p<0.01) (Figure 2).

There was no significant statistical relation between the type of causative agents and the number of cases (χ^2=12.59; df=12; p>0.05). Epidemiologists who were documenting the outbreaks suggested the main cause of the outbreak based on microbiological analysis. The leading cause was the consumption of undercooked food of animal origin (22.5%), infected food handlers (12.4%), storage at temperatures that favour the growth of pathogenics (11.2%), or person-to-person contact (11.2%).

There is a significant difference between the setting of an outbreak and the main cause of it (χ^2=50.78; df=12; p<0.01). Outbreaks occurring in private households and public restaurants happen because of poor hygienic conditions and temperatures that are not adequate for preparing food and storing cooked food. In settings such as hospitals and homes for elderly people, outbreaks were associated with person-to-person transmission of enteric pathogens, predominantly norovirus.

In addition, there was a connection between causative agents and the main cause of the outbreak (χ^2=24.69; df=6; p<0.01). Bacterial infections were related to poor practices in food preparation and warehousing, while virus infections were related to person-to-person contact (fecal-oral route and airborne transmission).

Discussion

As we can see, during the year 2006, there were 89 outbreaks of gastroenteritis reported to the Croatian Na-

tional Institute of Public Health, mostly from medical services. The most frequent number of illness per outbreak was six, with no hospitalizations. The duration of the outbreaks was mostly 5 days and happened in the summer. Summer outbreaks usually were related to bacterium while spring outbreaks were associated with viruses. In regards to the setting of the outbreaks and causative agent, we found that bacterium was the most causative agent in outbreaks occurring in public restaurants and private households while viral pathogens, notably norovirus, were associated with outbreaks in semi-closed settings such as homes for the elderly and hospitals. The vehicle of infection transmission was mostly food, followed by the combination of food and person-to-person contact. Microbiological analyses isolate from stool and food samples, determined *Salmonella sp.* as the most causative agent. From environmental samples, we found out that the presence of bacteria such as *Enterobacteriacae*, increased the number of total bacteria, and St. aureus suggested poor personal hygiene.

Considering the burden of gastroenteritis disease on individuals and society, it is important to establish a routine surveillance of communicable disease[11]. In Croatia, all medical professionals in the public and private sector have a mandatory obligation to report suspicion or lab-confirmations for 88 communicable diseases. However, the difference between the reported 49 outbreaks from the coastal region in relation to the 40 outbreaks from the continental region of Croatia could indicate better promptness in notification on behalf of the coastal region. On the other hand, the difference could be related to the climate conditions that support an environment for microorganismic growth. In addition, it is possible that many domestic outbreaks were underreported so we need to advocate the importance of reporting and analyzing the notifications of outbreaks since familiarity with the epidemiological situation in country can be helpful in determining the causes of gastroenteritis. Our interest, besides the incidences and etiology of the outbreaks, was finding the most frequent setting for the outbreaks. In this study, those places were primarily restaurants. This could be because a disease is more likely to be registered if it occurs in a restaurant, or because more meals are prepared for more people and so the possibility of food contamination resulting in illness rises. We have found that outbreaks in restaurants were often connected with wedding celebrations and sacraments, which are traditional in Croatia. In these cases, it was often that the person organising the celebration supplied the restaurant with food that was sanitary uncontrolled and of unknown origin (such as cakes, desserts, pork and lamb meat, and meat products). The other extenuating circumstance was preparing large amounts of food several hours or days (e.g. cakes) before consumption, coupled with its storage at temperatures that favor the growth of pathogenic bacteria and/or the formation of toxins. The data from a prior conducted study suggested a linear association between the environmental temperature and the number of reported cases of salmonellosis[12]. These findings reinforce the need for education on food handling, especially since there are people who prepare food for the public in Croatia without adequate professional education. That fact is also related to inadequate hand washing by food workers, which is also an important contributing factor to foodborne disease outbreaks[13]. In our study, the microbiological analysis of hand smears by food handlers were most positive on bacterium species *Enterobacteriacae*, with an increased number of total bacteria, and St. aureus which suggests poor personal hygiene. Good personal and food preparing hygiene practice play one of the most important roles in controlling gastroenteritis outbreaks. For example, the retention of bacteria on food contact surfaces increases the risk of cross-contamination of these microorganisms in food. *S. enteritidis* recovered from surfaces at high contamination levels last for at least 4 days, but at moderate level, the numbers decreased to the detection limit within 24 hour and at low level within one hour[14]. Microorganisms easily transmit from wet sponges to stainless steel surfaces and from these surfaces to food[14] e.g. important in preparing raw salad. An experiment for a washing-up process simulation, where soiled dishes contaminated with bacteria (*Salmonella, Campylobacter* and *Escherichia coli* O157: H7) were washed in a bowl of warm water containing detergent, show that proportion of the dishes remained contaminated with all the pathogen types after a typical washing-up. *E coli* and *Salmonella* survived towel or air-drying dishes, and after towel drying, the cloth became contaminated on every occasion[15]. Also washing sterile dishes after contaminated dishes result in the sterile dishes to become contaminated with pathogens, but transmission to food was rare[15]. These results indicate the risk in domestic settings but also in public food preparing places since many of them do not have a dishwasher. One study supports the benefits of using a household dishwasher at a temperature of 71°C as suitable for cleaning and disinfecting medical equipment contaminated with bacteria and virus. In both cases, the study found the dishwasher process to be a suitable means of disinfection medical instruments[16]. All of this addresses the importance of continual professional education, which in Croatia is obligatory for all food handlers and food sellers every four years[17], especially in regards to the structure of employees in food handling. Results from a prior study indicated that certified food handlers had a greater knowledge of food safety information than did non-certificated food handlers. Their results support the need for mandatory food certification for food handlers and for recertification at least every 10 years[18]. In addition, 22.9% of outbreaks were through an infected person or carrier in a restaurant as the cause of the outbreak (the leading cause of viral infections in institutions was 61.1%). This information implies negligence of restaurant managers who can and must monitor employee illness. Viral pathogens were associated with outbreaks in semi-closed settings such as homes for elderly people and hospitals. Transmission was usually connected with household member with gastroenteritis, contact with a person with gastroenteritis outside the

household and poor hand hygiene[19]. In our study, viruses, as causative agents of gastroenteritis was statistically significant mostly in settings where the predominant way of transmission was person-by-person (fecal-oral route or airborne transmission) with maximum activity in the spring. Beside viruses and bacterium as causative agents, 58 patients in four outbreaks related to food consumption confirmed trichinosis. All cases were linked with eating meat originating from a home-slaughtered pig. Those affected had eaten a smoked sausage. In conclusion, we want to underline the importance of continued reporting of all gastroenteritis outbreaks. Three years prior to this study, the number of salmonellosis cases was something lower e.g. in 2003 5 755 cases, in 2004 4 940 cases and in year 2005 5 619 cases. Generally we concluded that the incidences of gastroenteritis illnes stagnated. Information about disease circulation is important to share with sanitary inspection and veterinary services because they also participate in preventing the dissemination of communicable diseases especially linked by food. Because our outbreaks were mostly connected with restaurants with poor hygiene practice, inadequate cooking, cooling or reheating or the handling of food by an infected person or carrier, we must focus on the implementation of a food safety system well know as Hazard Analysis Critical Control Point (HACCP) which will be during year 2009 mandatory regulate in Croatia. It will help in preventing food related disease by monitoring processes like cooking, cooling, reheating, hot and cold holding. The system helps to identify where hazards can be reduced or eliminated to prevent illness but also will assist in certain costs reductions, litigation, etc[20]. We must insist on certification for food handlers and for recertification every 4 year. The main problem is in an insufficient number of sanitary inspectors who can control implementation of the law. One study showed significant reductions in the frequency of failure connected with cross contamination in kitchen work and in knowledge of foodborne disease when implemented in an announced restaurant inspection program[21]. A Good practice that must remain in Croatia is that all food handlers must bring their stool samples every 6 months on analyses, despite a different practice in EU countries. Moreover, it is important to improve public education of good food preparation practice.

REFERENCES

1. Narodne novine, 60 (1992) 1. — 2. Narodne novine, 23 (1994) 1. — 3. HRVATSKI ZAVOD ZA JAVNO ZDRAVSTVO, Definicije zaraznih bolesti koje se prijavljuju (HZJZ, Zagreb, 2006). Available from: URL: http://www.hzjz.hr/epidemiologija.htm. — 4. ALERAJ B, Croatian Journal of Infection, 27 (2007) 87. — 5.WHO Regional Office for Europe, HFA-DB. Available from: URL: http://data.euro.who.int/hfadb — 6. DENNY J, BOELAERT F, BORCK B, HEUER OE, AMMON A, MAKELA P, Euro Surveill, 12 (2007). Available from: URL: http://www.eurosurveillance.org/ew/2007/071220.asp#. — 7. WHO, Several foodborne diseases are increasing in Europe. Press Release EURO/16/03. Available from: URL: http://www.euro.who.int/eprise/main/who/mediacentre/PR/2003/20031212_2. — 8. BERN C, MARTINES J, DE ZOYSA I, Bull World Health Organ, 70 (1992) 705. — 9. VAN DE BRANDHOF WE, DE WITT GA, DE WITT MAS, VAN DUYNHOVEN YTHP, Epidemiol Infect, 132 (2004) 211. — 10. WHO Surveillance Programme for Control of foodborne Infections and Intoxications in Europe 8th report, 1999–2000. — 11. PAN AMERICAN HEALTH ORGANIZATION, Epidemiol Bull, 21 (2000). Available from: URL: http://www.paho.org/english/sha/eb_v21n1-vigil.htm — 12. KOVATS RS, EDWARDS SJ, HAJAT S, ARMSTRONG BG, EBI KL, MENNE B, Epidemiol Infect, 132 (2004) 443. — 13. ALLWOOD PB, JENKINGS T, PAULUS L, HEDBERG CW, J Food Prot, 12 (2004) 2825. — 14. KUSUMANINGRUM HD, RIBOLDI G, HAZELEGER WC, BEUMER RR, Int J Food Microbiol, 85 (2003) 227. — 15. MATTICK K, DURHAM K, DOMINQUE G, JORGENSEN F, SEN M, SCHAFFNER DW, HUMPHREY T, Int J Food Microbiol, 85 (2003) 213. — 16. EBNER W, EITEL A, SCHERRER M, DASCHNER FD, J Hosp Infect, 45 (2000) 155. — 17. Narodne novine, 23 (1994). Available from: URL: http://narodne-novine.nn.hr/clanci/ sluzbeni/260590.html. — 18. HISLOP N, SHAW K, J Food Prot, 72 (2009) 431. — 19.DE WITT MAS, KOPMANS MPG, VAN DUYNHOVEN YTHP, Emerg Infec Dis, 9 (2003) 1563. — 20. US FDA CENTER FOR FOOD SAFETY & APPLIED NUTRITION, Available from: URL: http://www. cfsan.fda.gov/~comm/haccpov.html — 21. RESKE KA, JENKINS T, FERNANDEZ C, VANAMBER D, HEDBERG CW, J Environ Health, 69 (2007) 27.

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JEDNOGODIŠNJA RETROSPEKTIVNA STUDIJA EPIDEMIJA GASTROENTERITISA U HRVATSKOJ: INCIDENCIJA I UZROČNOST

S A Ž E T A K

Gastroenteritis je jedna od najčešće prijavljivanih zaraznih bolesti u Hrvatskoj, gdje postoji dobar sustav nadzora i praćenja tih bolesti. Cilj ovog rada je utvrditi činjenice o epidemijama gastroenteritisa s naglaskom na učestalost javljanja i najčešćih uzročnika, te okolnosti koje pridonose pojavi epidemija. Analizirali smo 89 prijavljena slučaja pomoću upitnika ispunjenih od strane područnih epidemiologa proslijeđenih Hrvatskom zavodu za javno zdravstvo tijekom 2006. godine. Većina epidemija dogodila se tijekom ljeta (39,3%). Najčešći uzročnici ljeti bile su bakterije, a u proljeće virusi ($p<0,01$). Također, bakterije su bile najčešći uzročnici epidemija u domaćinstvima i restoranima, dok su virusi, uglavnom norovirus, bili u epidemijama domova za starije osobe i bolnicama ($p<0,01$). Bakterijske infekcije u vezi su s lošom higijenskom praksom u pripravi i pohrani namirnica, dok se virusne infekcije vežu uz međuljudski prijenos (feko-oralni ili putem zraka) ($p<0,01$).U svakom slučaju, najvažnije je prepoznati potrebu za trajnom edukacijom javnosti, te osobito profesionalaca u pripravi namirnica kao koraka u prevenciji gastroenteritisa.