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Theme

Epidemiology of bacterial diarrhea in children under 5 years of age

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I dedicate this work

To my Mom and Dad who have always supported me since childhood

To my brothers Jugurta and Gaya and to my sister-in-law

To my brother, friend, helper and more to Ghiles

To my nephew Zakaria and my niece Lea

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To the small lab

To the one and only Feriel my partner from the begging

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Miss. Feriel HAMMAM

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List of Abbreviation

ATB: Antibiotics

DEC: Diarrheagenic *E. coli*

EHEC: Enterohemorrhagic *Escherichia coli*

EIEC: Enteroinvasive *Escherichia coli*

EPEC: Enteropathogenic *Escherichia coli*

ETEC: Enterotoxigenic *Escherichia coli*

HUS: Hemolytic uremic syndrome

iNTS: Invasive non-typhoidal *Salmonella*

MIC: Minimum inhibitory concentration

Stx: Shigatoxin

TSI: Triple Sugar Iron

XLD: Xylose Lysine Deoxycholate

Introduction

Diarrheal diseases collectively constitute a serious public health challenge globally, especially as the leading cause of death in children (after respiratory diseases) (Ugboko et al., 2020). It is one of the major causes of morbidity and mortality among children less than 5 years of age in developing countries (Boschi-Pinto et al., 2006). Acute gastroenteritis is generally defined as a decrease in stool consistency (loose or watery) and/or an increase in stool frequency (typically 3 per 24 hours), with or without fever and/or vomiting. Diarrhea typically lasts less than 7 days and always less than 14 days. However, a change in stool consistency from the previous state is more significant for diarrhea than the number of stools, especially in the first months of life. (Guarino et al., 2008). The prevalence of this disease has been associated with contributory factors such as untimely weaning of children from breastfeeding, drinking of unsafe water, encouraging bottle-feeding, and malnutrition (Wardlaw et al., 2010).

Diarrhea could be caused by different enteric pathogens which include bacteria, viruses, and parasites (Zenebe et al., 2020). Not all bacterial diarrhea is due to specific bacteria (diarrhea caused by dysmicrobism, i.e. by changing the balance of intestinal flora) (Mariani-Kurkdjian et al., 2016a). There are more than ten bacterial agents responsible for diarrhea, sometimes requiring a specific technology for their research. Many bacteria are incriminated in the etiology of acute infectious diarrhea. Some of these bacteria are well-established enteropathogens (*Salmonella* spp., *Shigella* spp., *Campylobacter* spp., *Yersinia* spp., etc.). Other bacteria have become pathogenic after the acquisition of virulence factors. This is particularly true of *Escherichia coli*, which accounts for 80% of the aerobic intestinal flora of humans. *E. coli* is both a commensal bacterium and an enteropathogenic bacterium through the expression of acquired and/or constitutive virulence factors. Thus, an enteropathogenic power is currently recognized for six pathovars of *Escherichia coli* (Mariani-Kurkdjian et al., 2016a).

The genus *Escherichia* includes five species of which *E.coli* is by far the most important. *E. coli* are widespread commensals of the digestive tract and the diagnosis of *E. coli* gastroenteritis requires that a stool culture be performed to look for strains that have particular pathogenicity. In practice, testing is difficult and molecular biology is used in reference laboratories. Enteropathogenic *E. coli* (EPEC), responsible for many childhood diarrheas in the third world, is at the origin of the epidemics of the 1950s and 1960s in Western countries, in particular for serotypes 0111 and 055. Cotrimoxazole is sometimes useful, but the main treatment is dehydration with oral rehydration fluids. Enterotoxigenic

E. coli (ETEC) is the leading cause of bacterial diarrhea in children in the Third World and a major cause of travelers' diarrhea in adults. The diarrhea is severe, toxin-like, and requires the use of oral rehydration fluids but no antibiotic treatment. (Foster-Nyarko and Pallen, 2022)

E. coli Enterohemorrhagic (EHEC) is a rare strain (*E. coli* 0157:H7) that produces verotoxin (or Shiga-like-toxin), which causes a digestive tract picture of bloody diarrhea or limited to common diarrhea, or which is almost asymptomatic. In 10% to 15% of cases, this toxin induces a hemolytic uremic syndrome (HUS), linked to the triggering by the toxin of glomerular thrombotic microangiopathy, a localized manifestation of intravascular coagulation, the clinical manifestations of which are severe anemia with schizocytes, thrombocytopenia, renal failure and proteinuria. The risk of HUS is higher when the child is younger, less than 3 years old (Dupont, 2010). The O157:H7 lineage of enterohemorrhagic *E.coli* is a geographically disseminated complex of highly related genotypes that share a common ancestry. The common clone that is found worldwide carriesseveral markers of events in its evolution, including markers for the acquisition of virulencegenes and loss of physiological characteristics, such as sorbitol fermentation ability and β- glucuronidase production (Kim et al., 2001). The epidemiological significance of enteric pathotypes of *E.coli* in children varies with geographical region. Studies have also shown that factors such as the health status of the host as well as the environmental, geographic andsocial conditions could influence the distribution of *E. coli* phylogroups in humans and animals (Gordon and Cowling, 2003). The DEC (Diarrheagenic *E. coli)* was found in 8.6%of diarrheic stool samples examined from Libyan children. Only EPEC (1.2%), ETEC (3.3%), and EAEC (4.1%) were detected; EHEC and EIEC were not detected (Ali et al., 2012)

Salmonella is one of the most problematic foodborne and zoonotic pathogens that threaten general health and well-being (Balasubramanian et al., 2019) *Salmonella* remains the leading cause of bacterial gastroenteritis and is also one of the most extensively studied and well-characterized bacterial species (Webale et al., 2020a). Despite that *Salmonella* continue to remain an important human pathogen and a serious public health concern worldwide (Hardy, 2004). Non-typhoidal *Salmonella* can cause serious illness in children, also acute *Salmonella* gastroenteritis does not require any antibiotic treatment if it is brief and rapidly resolved. When diarrhea lasts more than 4 days, even without fever, antibiotic treatment is useful and helps to shorten the duration of diarrhea. The only indication for

systematic treatment concerns young infants less than 6 months of age, in whom the risk of bacteremia is high, with the possibility of secondary localization (meningitis) (Dupont, 2010). In addition to transient and trivial *Salmonella* gastroenteritis, severe salmonellosis with signs of invasiveness (bloody and profuse diarrhea, persistent fever, general condition) requires antibiotic treatment. Treatment The severity of the clinical picture of salmonellosis is unpredictable and the indication for antibiotic treatment in young children is based on clinical criteria. This variability of the picture, together with the highly contagious nature of the germ, leads to the need to monitor the environment and to look for salmonella in relatives to prevent them from contaminating other subjects, particularly patients at risk, sickle cell patients or those with an immune deficiency. The β-lactamases, with their low intracellular penetration, are active during the dissemination phase and cure the acute infectious episode. However, they cannot reach all intracellular foci, which explain the relapses of typhoid fever in spite of a well conducted treatment. Fluoroquinolones are the best current treatment for salmonellosis in adults, as they combine activity on *Salmonella* and strong intracellular penetration. They cannot be used in pediatrics as first-line treatment because of potential joint toxicity. In practice, it is usual to start with a 3rd generation cephalosporin injection, with a relay per os for the rest of the treatment (Dupont, 2010).

The innovation of antibiotics led to optimism that enteric bacterial infections could be controlled and prevented. However, enteric bacteria resistance to antibiotics is still the leading cause of death globally (Webale et al., 2020b). The increasing resistance is due to inappropriate antibiotic use increasing selection and transmission of antibiotic-resistant strains in the city (Webale et al., 2020c). In this era when there's an extreme lack of recent antibiotics under improvement to combat the developing antimicrobial resistance, justifying the want for non-stop antimicrobial resistance surveillance. However, there are constrained records on the prevalence of antimicrobial resistance of enteric bacterial pathogens among children.

While in our study we have based ourselves on the research of the two enteropathogenic bacteria EHEC and *Salmonella* for their power to be found almost everywhere (vegetables, animals, and humans) and for the fact that they can contaminate the whole and their easy transmission, knowing that children under 5 years are the most fragile about gastroenteritis due to their age, their intestinal microbiota and the fact that the great risk of infectious diarrhea is dehydration, as well as the fact that they cannot be treated with all existing antibiotics due to the toxicity of some they were the subject of this study. The

importance of testing the resistance of the bacterial strains if they exist is primordial for the treatment and cure of these children. The ultimate goal of our work is to raise awareness that infectious gastroenteritis can be prevented and cured.

Results

1. Study population:

A total of 57 stool samples were collected; 52 from the pediatric service of Bejaia's hospital and 5 from the emergency room. An additional 17 samples were collected from a private pediatrician's office.

The symptomatology was as follows: diarrhea, fever, and vomiting sometimes accompanied by abdominal cramps (37 cases) and the remaining 22 cases had no symptoms.

In our case, all samples for *Salmonella* screening were negative (Figure 03).

Concerning *E. coli* O157:H7, at the beginning; 03 strains were obtained from the isolation procedure.

After identification using API20E gallery, only one strain was identified from child 5 as *E.coli* sorbitol negative.

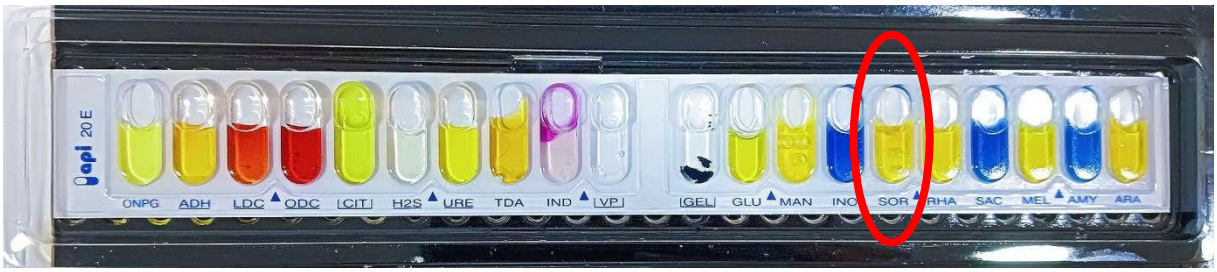

Figure 05: Result for *E.coli* reference strain.

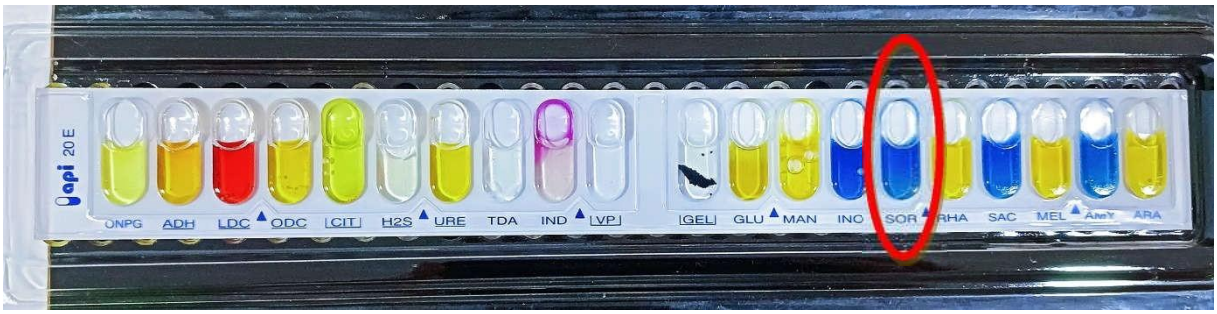

Figure 06: Results of the API20E gallery for the strain sorbitol-negative.

ONPG+ ADH- LDC+ ODC- CIT- H2S- URE- IND+ VP GEL-

Once the little child boy was diagnosed, he was treated by ATBs. His symptoms were acute diarrhea with a fever for more than 3 days. After a while, the child felt better and cured.

2. Determination of minimum inhibitory concentrations (MICs)

Table 02: Results and interpretation of MICs.

Used antibiotics																					
Cefazolin					**Ampicillin**						**Gentamicin**					**Ciprofloxacin**							
0.5	1	2	4	**8**	0.5	1	2	**4**	8	16	0.5	1	**2**	4	8	0.06	**0.125**	0.25	0.5	1	2	4	8
+	+	+	+	-	+	+	+	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-

Cefazolin: The sorbitol-negative *E.coli* strain was resistant [MIC= 8] mg/L .

Ampicillin: The sorbitol-negative *E.coli* strain was susceptible [MIC= 4] mg/L.

Gentamicin: The sorbitol-negative *E.coli* strain was resistant [MIC= 2] mg/L.

Ciprofloxacin: The sorbitol-negative *E.coli* strain was susceptible [MIC= 0.125] mg/L.

Discussion

Our study population consisted of children less than 5 years of age with acute diarrhea and who were hospitalized or visited the health center as an outpatient.

More than 0.5 million diarrheal deaths occurred among children younger than 5 years globally in 2017, 88% of which occurred in South Asia and sub-Saharan Africa (2020). The etiology of acute diarrhea differs between regions depending on economic development, local climate, and geography (The Chinese Centers for Disease Control and Prevention (CDC) Etiology of Diarrhea Surveillance Study Team et al., 2021)In Algeria, there is no specific study on bacterial epidemiology in children under 5 years old.

In the hospital, the study showed that diarrhea was more common in infants (37cases of diarrhea) and we analyzed 20 stool samples (children without diarrhea). In private pediatrics, 17 stool specimens were examined (children with diarrhea and fever). We also found that diarrhea was more frequently reported in male children than in female children. Only one strain of *E.coli* sorbitol negative was found and it was from the private pediatrician's office. We deduce that the infections caused by these two bacteria both *E.coli* O157:H7 and *Salmonella* are not as widespread in Bejaia.

Breastfed infants who are not yet on solid foods often have loose stools, which were considered normal. A sudden increase in the number of loose stools may indicate diarrhea in these infants. However, having liquid stools for more than 24 hours is never normal.

Present at 80% in the composition of the intestinal flora, *E.coli* performs an essential mission of protection against bacterial attacks. The majority of strains of *E.coli* are completely harmless to humans; a minority of them can be dangerous and cause, in particular, intestinal infections of varying intensity. These bacteria can cause gastroenteritis, but also hemorrhagic colitis, and, in the most serious cases, hemolytic uremic syndrome (SHU). EHEC-related HUS is lethal in 3-5% of cases and is the leading cause of acute renal failure in young children, one-third of whom will have renal sequelae. The virulence of EHEC is closely linked to the production of a toxin called Shiga-toxin (Stx) (Mariani-Kurkdjian et al., 2016b).

Invasive non-typhoidal *Salmonella* infections disease has proven to be a major public health concern, especially in sub-Saharan Africa. Here, distinct *S. Enteritidis* clades are circulating that can be associated with iNTS disease (Feasey et al., 2016). A potential reason for this might be their ability to be opportunistically invasive in the presence of *Plasmodium falciparum malaria* and human immunodeficiency virus (HIV) hence, the disease burden is

highest in infants and young children potentially resulting in higher CFR (Published case fatality rates). Outside of Africa, other genetic lineages seem to fluctuate that are potentially less invasive and, moreover, the iNTS disease burden has been less investigated, particularly in remote areas in Latin America and Asia (Feasey et al., 2016).

Antibiotics (ATB) only act against bacteria and they are very effective. Which were both an advantage and a disadvantage. Because ATBs do not only attack the nasty pathogenic bacteria, but also the good bacteria, beneficial to the body. Taking ATBs can disrupt the complex balance of the intestinal flora. This transient imbalance can result in soft stools, or even diarrhea (diarrhea associated with ATB). But it can also, more rarely, cause constipation and even in the event of severe diarrhea, do not ever interrupt your antibiotic treatment until you have consulted the catering doctor. ATB susceptibility testing should not be performed routinely. The use of antibiotics is not currently recommended in EHEC diarrhea, as it is a risk factor for the onset of HUS by the release of *stx* toxins. Only azithromycin could be of interest and its place in the therapeutic arsenal for EHEC infections is under evaluation (Mariani-Kurkdjian et al., 2016a), except in cases of complications and in immunocompromised patients. It is then based on co-trimoxazole, cyclins, 3rd generation cephalosporins and fluoroquinolones (de Truchis and de Truchis, 2007a).

Bacterial causes are less proven (15% of cases): *E.coli*, *Salmonella,* or more rarely *Shigella*, *Yersinia*, *Campylobacter*, *Clostridium. difficile*. It is also necessary to look for other causes of favorable reactions in children, such as remote infections (ENT infections, ear infections, pneumopathy, malaria), previous antibiotic therapy, intolerance to milk, etc (de Truchis and de Truchis, 2007a) so, the prevention of infections with the *E. coli* depends in particular on the choice of foods and among these, we find meat, in particular ground beef, which is undercooked; raw milk products, such as cheese; flour-based preparations (pizza, cookie dough, cake, pie, etc) that are insufficiently cooked; vegetables, salad, fruit and aromatic herbs, especially those eaten raw.

The aim of treatment is above all to combat dehydration and undernutrition (Cézard et al., 2002). The treatment is therefore based essentially on oral rehydration fluids and early refeeding (de Truchis and de Truchis, 2007b). There is now a consensus on the major interest in maintaining enteral feeding during acute diarrhea in children; there is no reason to stop breastfeeding, which would be the cause of a high risk of dehydration; transit slowing agents (loperamide) are not recommended, and are formally contraindicated before the age of 2. Silicates (diosmectite), probiotics (*Lactobacillus acidophilus, Saccharomyces boulardii*),

and antisecretory agents (racecadotril) are effective in reducing the duration of diarrhea. Antibiotic treatment is indicated, as in adults, only in invasive diarrhea, after stool culture, or in specific areas (de Truchis and de Truchis, 2007c).

There is also a study on the evaluation of the efficacy of *Lactobacillus rhamnosus* GG (LGG) in the treatment of acute diarrhea in children. A systematic review with meta-analysis. In summary, the analysis revealed that treatment with LGG reduced both the duration of diarrhea and the hospital stay duration, especially in specific patient subsets. A striking finding was the time to improvement in stool consistency, which more investigators have confirmed since 2010 (Guarner and Schaafsma, 1998) (Nixon et al., 2012) (Aggarwal et al., 2014). In the whole range of diarrhea cases, the management of stools with this probiotic strain showed a modest beneficial effect on the number of stools per day and the time to improvement in stool consistency. However, no reduction in stool frequency was observed on days 2 and 3 (Li et al., 2019).

Figure 07: Summary diagram of the means of prevention

Apart from bacterial diarrhea, there is also viral gastroenteritis, which is also dangerous and deadly for children, and the most important thing is the rotavirus vaccine. There are two rotavirus vaccines, live attenuated recombinant viruses, available without a prescription and used in infants from the age of 6 weeks (Dupont et al., 1992).

Conclusion

Our study let us conclude that bacterial diarrhea and diarrhea in general is a really serious matter. In children, the most important treatment for diarrhea is to avoid dehydration and loss of mineral salts. First, the treatment is symptomatic, based mainly on rehydration, in other words, the child must drink enough, in small quantities to avoid vomiting, using liquids rich in sugars and mineral salts.

Secondly, the strict observance of the basic hygienic and sanitary measures of this hydration represents the basis of the prevention of food infections and intoxications. Concerning infections, it is equally important to avoid contact with patients.

In addition, breastfeeding is an essential element in the prevention of the development and relief of infectious diarrhea. And taking antibiotics correctly is crucial in order not to develop more resistance than there is already.

Finally, the hospitals in Bejaia where the collections were done were found to be in the hygienic standards for the reason of not finding pathogenic strains except for one which is why extensive research is required to complete the study in the rest of Algerian hospitals.

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Annexes

Annex 01: Information sheet

IDENTIFICATION OF THE CHILD

Name: ……..... First Name: …….…..…….. Sex: F ☐ M ☐

Age: …… Date of birth: …….

Place of birth: …….

Weight: ……

Stool culture code: …….

Residence: Rural ☐ Urban ☐

Age of the mother: ……

CHILD'S CLINICAL AND BIOLOGICAL INFORMATION

Hospitalization: YES ☐ NO ☐

Date of hospitalization: …… Service :……...

Reason for hospitalization: …….

Date of discharge: ……

Mode of recruitment: External (ER) ☐ Internal ☐

Symptoms: YES ☐ NO ☐

Types of symptoms: …….……...

Onset of symptoms: …….

Presence of diarrhea: YES ☐ NO ☐

Onset of diarrhoea: ……...

Presence of bloody diarrhea YES ☐ NO ☐

Abdominal cramps: YES ☐ NO ☐

Fever: YES ☐ NO ☐

Vomiting: YES ☐ NO ☐

Antibiotic therapy YES ☐ NO ☐

ATB administered: ……..……...

Medication administered: ……..…….

Persons with diarrhoea in the home other than the child?

YES ☐ NO ☐

Suspected diagnosis : ……

Catheter: YES ☐ NO ☐

Type of catheter :……

Associated pathology: YES ☐ NO ☐ Type of pathology:……

Biology: CRP (12h) …….. CRP(72h) : ……..……

FNS : ……

Contact with animals: YES ☐ NO ☐

Types of animals:……

Contact with manure: YES ☐ NO ☐

Types of manure: …….

Water source : Mineral ☐ Tap ☐ Tanker ☐

Type of feeding: Bottle ☐ Breast ☐

Mixed ☐ Food ☐

Types of food :	Meat	YES ☐	NO ☐
	Raw milk	YES ☐	NO ☐
	Raw food	YES ☐	NO ☐
	Juice	YES ☐	NO ☐
	Seafood	YES ☐	NO ☐

Annex 02:

Table 03*: List of the patients sampled from the hospital and their personal information

Hospital	Sex	Age	Weight	Residence	Hospitalization	Symptoms	Administered ATB					Contact with animals	Water source	Type of breastfeeding	Other Food
							Vancomycin	Claforan	Gentamicin	Bacterim	Clamoxyl				
P 1	M	1m 17d	4kg	U	Yes	Absence	No	No	No	No	No	No	Mineral	Bottle	/
P 2	M	7 m	5kg	U	Yes	Absence	No	No	No	No	No	No	Mineral	Bottle	/
P 3	F	2m1/2	4,5kg	R	Yes	Diarrhea	No	No	No	No	No	Yes	Mineral	Bottle	/
P4	F	6m	5,5kg	U	Yes	Fever, diarrhea	No	No	No	No	No	No	Mineral	Bottle	/
P 5	F	4y	17kg	R	No	Absence	No	No	No	No	No	Yes	Mineral	Bottle	/

P 6	F	13m	10kg	U	Yes	Fever, vomiting	No	No	No	No	No	No	Mineral	Breast	/
P 7	M	13m	11kg	U	Yes	Fever	No	No	No	No	No	No	Mineral	Bottle	/
P 8	F	15m	11kg	U	Yes	Absence	No	No	No	No	Yes	No	Mineral	Bottle	/
P 9	F	1y	10kg	U	Yes	Fever	No	Yes	No	No	No	No	Mineral	Bottle	Chicken, seafood
P10	F	1m	3kg	U	Yes	Diarrhea	No	No	No	No	No	No	Mineral	Bottle	/
P11	F	7m	4,5kg	U	Yes	Absence	No	No	No	Yes	No	Yes	Mineral	Bottle	/
P12	F	2y	13kg	U	Yes	Fever, diarrhea	No	No	No	No	No	Yes	Mineral	Mixed	All
P13	F	3m	5kg	U	No	Fever, diarrhea	No	No	No	No	No	No	Mineral	Breast	/
P14	M	12m	9kg	U	Yes	Fever, vomiting	No	No	No	No	No	No	Mineral	Breast	/
P 15	M	21m	14kg	U	Yes	Fever, vomiting	No	Yes	No	No	No	No	Mineral	Mixed	Meat, raw milk, fish
P16	M	10m	9kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	Yes	Mineral	Breast	/
P17	M	2m	4kg	R	Yes	Fever, diarrhea	No	Yes	Yes	No	No	Yes	Mineral	Bottle	/
P18	M	32d	3kg	U	Yes	Fever, diarrhea	Yes	Yes	Yes	No	Yes	No	Mineral	Bottle	/
P19	F	2m	5kg	U	Yes	Fever	No	Yes	Yes	No	No	No	Mineral	Breast	/
P20	F	1m	5kg	U	Yes	Absence	No	No	No	No	Yes	No	Mineral	Breast	/
P 21	M	42d	5kg	U	Yes	Diarrhea	No	Yes	Yes	No	No	Yes	Mineral	Mixed	/

P 22	M	1m	3kg	U	Yes	Diarrhea	No	Yes	Yes	No	No	No	Mineral	Bottle	/
P 23	F	9m	6kg	U	Yes	Absence	Yes	Yes	Yes	No	No	No	Mineral	Mixed	/
P 24	F	19m	10kg	U	No	Fever, diarrhea	No	No	No	No	No	No	Mineral	Breast	Meat and raw vegetables
P 25	M	13m	10kg	R	Yes	Diarrhea	No	Yes	Yes	No	No	Yes	Mineral	Bottle	Meat, raw milk
P 26	F	2m	5kg	U	Yes	Absence	No	No	Yes	No	No	No	Mineral	Bottle	/
P 27	M	45d	4kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	No	Mineral	Bottle	/
P 28	M	2m	5kg	U	Yes	Fever, diarrhea	No	No	Non	No	No	No	Mineral	Mixed	/
P 29	F	30m	15kg	v	Yes	Fever, diarrhea	No	Non	Non	No	No	No	Mineral	Bottle	Raw milk, raw vegetables
P 30	M	15m	13kg	U	Yes	Fever, diarrhea	No	Non	Non	No	Yes	No	Mineral	Breast	Meat, raw vegetables
P 31	M	16m	13kg	U	Yes	Fever	No	Yes	Yes	No	No	No	Mineral	Mixed	/
P 32	M	2y	12kg	U	Yes	Absence	No	No	Non	No	No	No	Mineral	Bottle	/
P 33	F	2y	14kg	R	Yes	Diarrhea	No	Yes	Non	No	No	No	Mineral	Breast	Raw vegetables, meat, juice

P34	F	2m	5kg	U	Yes	Diarrhea, vomiting	No	No	Non	No	Yes	No	Mineral	Breast	/
P 35	M	2m	4kg	R	Yes	Fever, diarrhea	No	Yes	Yes	No	No	No	Mineral	Mixed	/
P 36	M	1m	5kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	No	Mineral	Breast	/
P 37	F	5m	6kg	U	Yes	Fever, diarrhea	No	No	No	No	No	Yes	Mineral	Breast	/
P38	M	8m	4kg	R	Yes	Absence	No	No	No	No	No	Yes	Mineral	Bottle	/
P 39	M	2m1/2	5kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	No	Mineral	Breast	/
P 40	M	1m	4Kg 1/2	U	Yes	Diarrhea	No	Yes	Yes	No	No	No	Mineral	Mixed	/
P 41	F	1m	2kg	R	Yes	Absence	Yes	No	No	No	No	No	Mineral	Mixed	/
P 42	M	17m	10kg	R	Yes	Absence	Yes	Yes	No	No	No	Yes	Mineral	Mixed	/
P 43	M	3m	3kg8	U	Yes	Diarrhea	No	No	No	No	No	No	Mineral	Bottle	/
P 44	M	1y	10kg	U	Yes	Fever, diarrhea	No	No	No	No	Yes	No	Mineral	Mixed	/
P 45	M	53d	5kg	U	Yes	Vomiting, diarrhea	No	Yes	No	No	No	Yes	Mineral	Breast	/
P 46	M	2y	10kg	U	Yes	Diarrhea, vomiting	No	Yes	Yes	No	No	Yes	Mineral	Breast	Raw milk, raw vegetables, meat

P 47	F	11m	7kg 1/2	U	Yes	Fever, diarrhea	No	No	No	No	No	No	Mineral	Bottle	Meat, raw vegetables
P 48	M	6m	7kg 1/2	R	Yes	Fever, diarrhea, vomiting	No	Yes	Yes	No	No	No	Mineral	Mixed	/
P 49	M	37d	4kg	U	Yes	Diarrhea	No	Yes	Yes	No	No	No	Mineral	Mixed	/
P 50	F	32d	3kg	R	Yes	Fever, diarrhea	No	Yes	Yes	No	Yes	No	Mineral	Bottle	/
P 51	M	30d	3kg 1/2	U	Yes	Diarrhea	No	Yes	Yes	No	No	No	Mineral	Breast	/
P 52	F	4m	6kg	R	Yes	Diarrhea	Yes	Yes	No	No	No	Yes	Mineral	Bottle	/
P 53	F	30m	4kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	No	Mineral	Breast	/
P 54	M	6m	7kg 1/2	R	No	Fever, diarrhea	No	No	No	No	No	Yes	Mineral	Mixed	/
P 55	M	21 m	9kg	U	No	Absence	No	No	No	No	No	Yes	Mineral	Breast	/
P56	F	6 m	3,9 kg	U	Yes	Fever, diarrhea, vomiting	No	Yes	No	No	No	No	Mineral	Bottle	/
P 57	F	2 m	5,6 kg	U	Yes	Fever, diarrhea	No	Yes	Yes	No	No	Yes	Mineral	Breast	/

Private															
C 1	M	6m	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C2	M	7m	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C3	M	40d	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C4	M	8m	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C 5	M	2y	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C 6	M	1y	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C7	M	4y	18kg	U	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	Yes	N.D	N.D	N.D
C8	F	5y	25kg	R	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	Yes	N.D	N.D	N.D
C9	M	17m	8kg	U	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C 10	F	2y	10kg	R	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	Yes	N.D	Mixed	N.D
C11	M	7m	5kg	R	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C12	M	5y	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C 13	F	3y	11kg	R	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	Mixed	N.D
C 14	M	4y	19kg	N.D	No	Fever, diarrhea, vomiting	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

C15	M	3y	17kg	N.D	No	Fever, diarrhea, vomiting	N.D	N.D	N.D	N.D	N.D	Yes	N.D	N.D	N.D
C 16	F	3y	15kg	N.D	No	Fever, diarrhea, vomiting	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
C 17	F	3y	N.D	N.D	No	Fever, diarrhea	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Annex 03:

Tableau 04*: Results of the samples taken from the hospital and the private pediatrician

Hospital	Sex	Age	EHEC	*Salmonella*
Patient 1	M	1month 17days	Neg	Neg
Patient 2	M	7 months	Neg	Neg
Patient 3	F	2months 1/2	Neg	Neg
Patient 4	F	6months	Neg	Neg
Patient 5	F	4years	Neg	Neg
Patient 6	F	13months	Neg	Neg
Patient 7	M	13months	Neg	Neg
Patient 8	F	15months	Neg	Neg
Patient 9	F	1year	Neg	Neg
Patient 10	F	1months	Neg	Neg
Patient 11	F	7months	Neg	Neg
Patient 12	F	2years	**Pos**	Neg
Patient 13	F	3months	Neg	Neg
Patient 14	M	12months	Neg	Neg
Patient 15	M	21months	Neg	Neg
Patient 16	M	10months	Neg	Neg
Patient 17	M	2months	Neg	Neg
Patient 18	M	32days	Neg	Neg
Patient 19	F	2months	Neg	Neg
Patient 20	F	1months	Neg	Neg
Patient 21	M	42days	Neg	Neg
Patient 22	M	1months	Neg	Neg
Patient 23	F	9months	Neg	Neg
Patient 24	F	19months	Neg	Neg
Patient 25	M	13months	Neg	Neg
Patient 26	F	2months	Neg	Neg
Patient 27	M	45days	Neg	Neg
Patient 28	M	2months	Neg	Neg
Patient 29	F	30months	Neg	Neg
Patient 30	M	15months	Neg	Neg
Patient 31	M	16months	Neg	Neg
Patient 32	M	2years	Neg	Neg
Patient 33	F	2years	Neg	Neg
Patient 34	F	2months	Neg	Neg
Patient 35	M	2months	Neg	Neg
Patient 36	M	1months	Neg	Neg

Patient 37	F	5months	Neg	Neg
Patient 38	M	8months	Neg	Neg
Patient 39	M	2months 1/2	Neg	Neg
Patient 40	M	1months	Neg	Neg
Patient 41	F	1months	Neg	Neg
Patient 42	M	17months	Neg	Neg
Patient 43	M	3months	Neg	Neg
Patient 44	M	1year	Neg	Neg
Patient 45	M	53days	Neg	Neg
Patient 46	M	2years	Neg	Neg
Patient 47	F	11months	Neg	Neg
Patient 48	M	6mo,ths	Neg	Neg
Patient 49	M	37days	Neg	Neg
Patient 50	F	32days	Neg	Neg
Patient 51	M	30days	Neg	Neg
Patient 52	F	4months	Neg	Neg
Patient 53	F	30months	Neg	Neg
Patient 54	M	6months	Neg	Neg
Patient 55	M	21 months	Neg	Neg
Patient 56	F	6 months	Neg	Neg
Patient 57	F	2 months	Neg	Neg
Private				
Child 1	M	6months	Neg	Neg
Child 2	M	7days	Neg	Neg
Child 3	M	40days	Neg	Neg
Child 4	M	8months	**Pos**	Neg
Child 5	M	2years	Neg	Neg
Child 6	M	1year	**Pos**	Neg
Child 7	M	4years	Neg	Neg
Child 8	F	5years	Neg	Neg
Child 9	M	17months	Neg	Neg
Child 10	F	2years	Neg	Neg
Child 11	M	7months	Neg	Neg
Child 12	M	5years	Neg	Neg
Child 13	F	3years	Neg	Neg
Child 14	M	4years	Neg	Neg
Child 15	M	3years	Neg	Neg
Child 16	F	3years	Neg	Neg
Child 17	F	3years	Neg	Neg

Summary

The aim of our study is to evaluate the epidemiological aspects of *salmonella* and *E.coli* 0157 : H7 bacterial diarrhea in children under 5 years of age.

A total of 57 stool samples were collected; 52 from the pediatric service of Bejaia's hospital and 5 from the emergency room. An additional 17 samples were collected from a private pediatrician's office. 37 cases suffered from diarrhea and fever. After isolation and identification of bacteria from the stool culture one strain of *E.coli* sorbitol negative was found while the results for *Salmonella* were negative . The sensibility of the strain to antibiotics was determined by the Mueller Hinton agar plate method and the MIC's were also determined.

Diarrhea cases in Bejaia among children are not bacterial in the majority pf time, but that doesn't mean that prevention should be excluded. It is a serious matter which needs constant checking.

Keywords: Diarrhea, Children, EHEC, *Salmonella*

Résumé

L'objectif de notre étude est d'évaluer les aspects épidémiologiques des diarrhées bactériennes à *Salmonella* et E.coli 0157 : H7 chez les enfants de moins de 5 ans.

Un total de 57 échantillons de selles ont été collectés ; 52 dans le service de pédiatrie de l'hôpital de Bejaia et 5 aux urgences. Dix-sept autres échantillons ont été collectés dans le cabinet d'un pédiatre privé. 37 cas souffraient de diarrhée et de fièvre. Après isolement et identification des bactéries, une souche d'*E.coli* sorbitol négative a été trouvée, tandis que les résultats pour *Salmonella* étaient négatifs. La sensibilité de la souche aux antibiotiques a été déterminée par la méthode de Mueller Hinton sur milieu solide et les CMI ont également été déterminées.

Les cas de diarrhée à Bejaia chez les enfants ne sont pas bactériens dans la majorité des cas, mais cela ne veut pas dire que la prévention doit être exclue. Il s'agit d'une question sérieuse qui nécessite un contrôle constant.

Mots-clés : Diarrhée, Enfants, EHEC, *Salmonella*

Agzul

Iswi n tezrawt-a, d aktazel n wayen i d-yessegray waîîan n tazzla n tɛebbuvt i d-ittekken seg (salmonelles et E.coli 0157 : H7) $er warrac i yesɛan ddaw n semmus (5) n yiseggasen.

Negmer-d 57 n yimedyaten, gar-asen 52 deg ugezdu n warrac imecîah n sbiîar n Bgayet, ma d 5 nniven, deg ugezdu n tezwirtin. Negmer-d da$en 17 n lZalat $er umejjay nwarrac uslig. Uvnen 37 s tawla d tazzla n tɛebbuvt. Asmi ttwaɛɛzlent lbiktiryat-a, send adtent-id-afen deg tebZirt n lebraz, nessawev ad d-naf (E.coli sorbitol) d anabaw. Ula d igemmav n (Salmonella) d inabawen.

Nessawev-d $er yigemmav, s usemres n tarrayt n (plaque d'agar de Mueller Hinton),ula d (CMI), ttwaseknen-d.

LZalat n waîîan-a n tazzla n tɛebbuvt deg Bgayet d win ur yesɛin ara lbiktiryat s umata, d acu yessefk ad iZader umdan iman-is, yewwi-d ad yettɛassa iman-is.

Awalen isura: tazzla n tɛebbuvt, arrac, EHEC, Salmonella.