# Impact of Wash on Campylobacter Distribution

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**Abstract**

Diarrhea diseases caused by campylobacteriaceae out ways the one caused by either salmonell or yersinia. Therefore, it is better to identify the different types of species causing the disease and their level of drug resistance as well as the predisposing factors. This could be accomplished by gathering literatures and compiling them in the manner that could answer the question at hand both nationally and internationally. Accordingly, the literatures revealed that Cabpylobacter species are common in the human gut; especially in children less than five years of age and the domestic animals. Animals like chicken, cattle, goat, sheep, and pig are identified to be carrying the bacteria, in that order. The most common species of campylobacter identified are C. jejuni, C. coli, C. lary in the same order. The most virulent species is C. jejuni. Resistance to Erythromycin, $\beta$-lactams, tetracycline, chloramphenicol, trimethoprim/sulfamethoxazole quinolones, aminoglycosides, clindamycin, doxycycline, gentamicin, kanamycin, streptomycin andnalidixic acid were identified in our country and Ghana. There is no established surveillance system in Ethiopia; unlike that of the developing country. But hygiene and sanitation practice of our country is very poor; contributing a lot for the distribution of the campylobacter. While the primary target for control measures is the poultry (meat) production chain, other transmission vehicles, such as raw milk and drinking-water, can be controlled through appropriate treatment, e.g. pasteurization of milk and chlorination of water. Hence, different treatment alternative has to be sought focusing C. jejuni and chicken. Furthermore, hygiene and sanitation has to be improved; focusing on prevention.

**Keywords:** WASH, Campylobacter, Drug resistance

## 1. Introduction

The name Campylobacter is derived from the Greek word and has a meaning of curved (Zhahirul, 2010). Campylobacter species are micro-aerophilic, gram-negative, spiral shaped cells with corkscrew-like motility. They are the most common cause of bacterial gastroenteritis in many countries and are transmitted primarily through foods to humans (Food Safety Authority of Ireland, 2011, Zhahirul I, 2010). It was first identified in 1886 by Theodore Escherich who observed and described non-culturable spiral-shaped bacteria (Silva et.al, 2011, Zhahirul, 2010); in the colon of children who had died of cholera infantum (Zhahirul,2010). In 1962, Campylobacter, then still known as 'related Vibrio' was described as a rare and opportunistic human pathogen that was isolated from blood culture of humans. In 1972, Campylobacter jejuni was first isolated from human diarrheal stools by applying a filtration technique. The subsequent development of selective Campylobacter stool culture techniques led to the recognition that C. jejuni was a more common cause of human diarrheal illness (Zhahirul, 2010).

Campylobacteriosis usually takes the form of gastroenteritis, or inflammation of the intestines, and the characteristic symptoms are watery-mucous diarrhea often with the presence of blood in stool, nausea, vomiting, abdominal pain and fever (Natalia e.al, 2014). Campylobacteriosis is the cause of acute diarrhea, mostly in young children, than Salmonella and Yersinia (Natalia et.al, 2014). In many countries, the organism is isolated 3–4 times more frequently from patients with alimentary tract infections than other bacterial entero-pathogens (such as Salmonella or Escherichia coli) (WHO, 2013).

It is often difficult to trace sources of exposure to Campylobacter because of the sporadic nature of the infection, and the important role of cross-contamination (WHO, 2013). WHO, FAO and OIE are also collaborating to address antimicrobial resistance, recognizing the serious nature and extent of the problems. For example, the use of fluoroquinolones, such as enrofloxacin, in food-producing animals has resulted in the development of ciprofloxacin-resistant Campylobacter; such bacteria have spread throughout the world through travel and food trade (WHO, 2013).

The principal reservoir of Campylobacter spp. is the alimentary tract of wild and domesticated birds and mammals (Food Safety Authority of Ireland, 2011). Multiple studies have also shown that Campylobacter, preferentially, colonize the lower gastrointestinal tract of cattle but has also been found in the liver, gall bladder and bile juice (Facciolà et.al, 2017).Campylobacter spp. are frequently isolated from foods of animal origin. Poultry is regarded as one of the most important reservoirs for Campylobacter spp. and constitutes a very significant vehicle for its transmission to humans (Akosuaet.a., 2017, Brena et.al, 2016, Food Safety Authority of Ireland, 2011, *TesfayeKassa et.al., 2005*). The outbreak investigations suggested that in over 25% of the cases, chicken was identified as the source of the outbreak; in 33% of the cases, the source was unknown (Silva et.al, 2011). It is estimated that the handling, preparation and consumption of broiler meat may account for 20% to 30% of human cases of campylobacteriosis in European Member States (Food Safety Authority of Ireland, 2011).

While the primary target for control measures is the poultry (meat) production chain, other transmission vehicles, such as raw milk and drinking-water, can be controlled through appropriate treatment, e.g. pasteurization of milk and chlorination of water. Campylobacter control needs to be adapted to local possibilities, practicalities and preferences (WHO, 2013). The main purpose of this paper is to identify the most common species of campylobacter in Ethiopia, their multi drug resistance capacity and the risk factors. Hence, it will be possible to undertake surviellance and for prevention.

## 2. Campylobacter

Campylobacter spp. are generally commensal organisms; however, occasionally they serve as enteric pathogens in the young of some species, e.g. calves, lambs and puppies. They have also been isolated from sea water, streams, rivers and estuaries which have been subjected to feacal contamination (Food Safety Authority of Ireland, 2011).

Levin(2007) suggested that these organisms should be referred to as “thermotolerant” since they do not exhibit true thermophily (growth at 55˚C or above) (Silva et.al,2011) (Table 1).

**Table 1: Limits for growth of Campylobacter spp. (Food Safety Authority of Ireland, 2011)**

| Parameter | Range | Optimum |
|---|---|---|
| Temperature | 32-45 | 42-43 |
| PH | 4.9-9 | 6.5-7.5 |
| NaCl | 0-1.5 | 0.5 |
| Water activity | >0.987 | 0.977 |
| Atmosphere | | 5%O2 and 10%CO2 |

**Taxonomy**

The family Campylobacteraceae (proposed in 1991) includes four closely related genera; Campylobacter, Arcobacter, Dehalospirillum and Sulfurospirillum. The genus Campylobacter currently contains 26 species of which 19 have been isolated from humans. There are also 10 subspecies of which nine are from human(Public health England, 2018). Eighteen species and subspecies have been described, but two (Campylobacter jejuni and C.coli) are most frequently associated with human enteric infection(Johanna et.al., 2000Natalia e.al,2014,Food Safety Authority of Ireland, 2011, Mathew W.,2019). Which is the same in our country too (Belay Tafa et al, 2014, AyalewLingerihet.al.,2013,*TesfayeKassa et.al., 2005*). Although C. jejuni and C. coli continue to be the leading cause of bacterial gastroenteritis in humans worldwide, advances in molecular biology and development of innovative culture methodologies have led to the detection and isolation of a range of under-recognized and nutritionally fastidious Campylobacter species, including C. concisus, C. upsaliensis and C. ureolyticus(Johanna et.al., 2000).

**Identification**

The detection of Campylobacter strains also requires a high level of laboratory expertise which is financially costly and time consuming (Johanna et.al, 2000); because it is difficult to isolate, grow and identify(Facciolà et.al,2017). Only C. jejunican be routinely identified with phenotypic markers, and commercial systems may misidentify non-jejunispecies. Some of the researches done in Ethiopia utilize lab based commercial systems and reported the existence of C. jejuni, C. coli and C. lari (Brena et.al 2016, Belay Tafa et al, 2014, AyalewLingerih et.al,2013,*TesfayeKassa et.al, 2005*). In most routine laboratories, the identification of Campylobacter spp. is based on growth on selective media, colony morphology, gram stain and a combination of biochemical test (Facciolà et.al, 2017, Zhahirul I,2010). The introduction of new culture-independent diagnostic tests (CIDTs) is starting to allow better monitoring of disease burden and trends in industrialized countries. If the cost of these diagnostic platforms drops sufficiently, and if their sensitivity and specificity are validated in LMIC settings, identification becomes so easy (WHO, 2013).The lack of specific symptoms makes the diagnosis of campylobacteriosis necessary to carry out specialized microbiological diagnostics (Natalia e.al,2014). Recent scientific advances offer new approaches; for example, whole genome sequencing has led to an improved understanding of pathogenesis (WHO, 2013). New and more cost effective approaches may be possible using samples from biobanks, e.g. from colon cancer screening programme(WHO, 2013).

**Campylobacteriosis**

Campylobacter species have been associated with a range of gastrointestinal diseases, particularly gastroenteritis, Irritable Bowel Disorder (IBD) and periodontitis(Public health England, 2018). The major sequelae of Campylobacteriosis are Guillain-Barre syndrome (GBS), reactive arthritis (ReA) and irritable bowel syndrome (IBS) (WHO, 2013). In some instances, infection of the gastrointestinal tract by these bacteria can progress to life-threatening extra-gastrointestinal diseases (Public health England, 2018).

Campylobacter spp. may be transmitted to humans either directly or indirectly. Direct transmission can occur via contact with infected animals, infected carcasses or infected water. Indirect transmission can occur through the ingestion of contaminated food or water (Food Safety Authority of Ireland, 2011). The infective dose is quite low, ranging from 500 to 10,000 cells (Food Safety Authority of Ireland, 2011, Public health England, 2018). There are no researches done in our country that estimates the infective dose. But majority of Ethiopian community feed on raw meat.Campylobacter infection was also associated with increased intestinal permeability and intestinal and systemic inflammation (Caroline et.al,2019).

**Epidemiology**

Recently, EFSA described the factors influencing campylobacteriosis infections, namely the age (higher occurrence rates in children under 5 years old) (Silva et.al,2011, Johanna et.al., 2000,), the season (a higher number of campylobacteriosis cases is reported during the summer months) (Silva et.al,2011, Johanna et.al., 2000). Specifically during spring and fall (Johanna et.al., 2000), the strain variation (certain strains are less pathogenic than others); especially C. jejuni (Zhahirul,2010), host immunity, travel and the demographic factors (i.e., the social economic status)( Johanna et.al., 2000). Foodborne zoonosis are an important cause of morbidity and mortality worldwide; the World Health Organization estimates that over two million people (figure. 1) die each year from diarrheal diseases mainly caused by the ingestion of contaminated foods ( Silva et.al,2011). In Ethiopian, the proportion of households with access to improved water supply, personal hygiene and sanitation facilities is 57%, 7% and 4%, respectively. As a result, diarrhoea, one of the water, sanitation and hygiene (WASH) related diseases, cause 24.88% of morbidity occurring in under five children and is the forth cause of morbidity in the general population (Mihret, 2013).

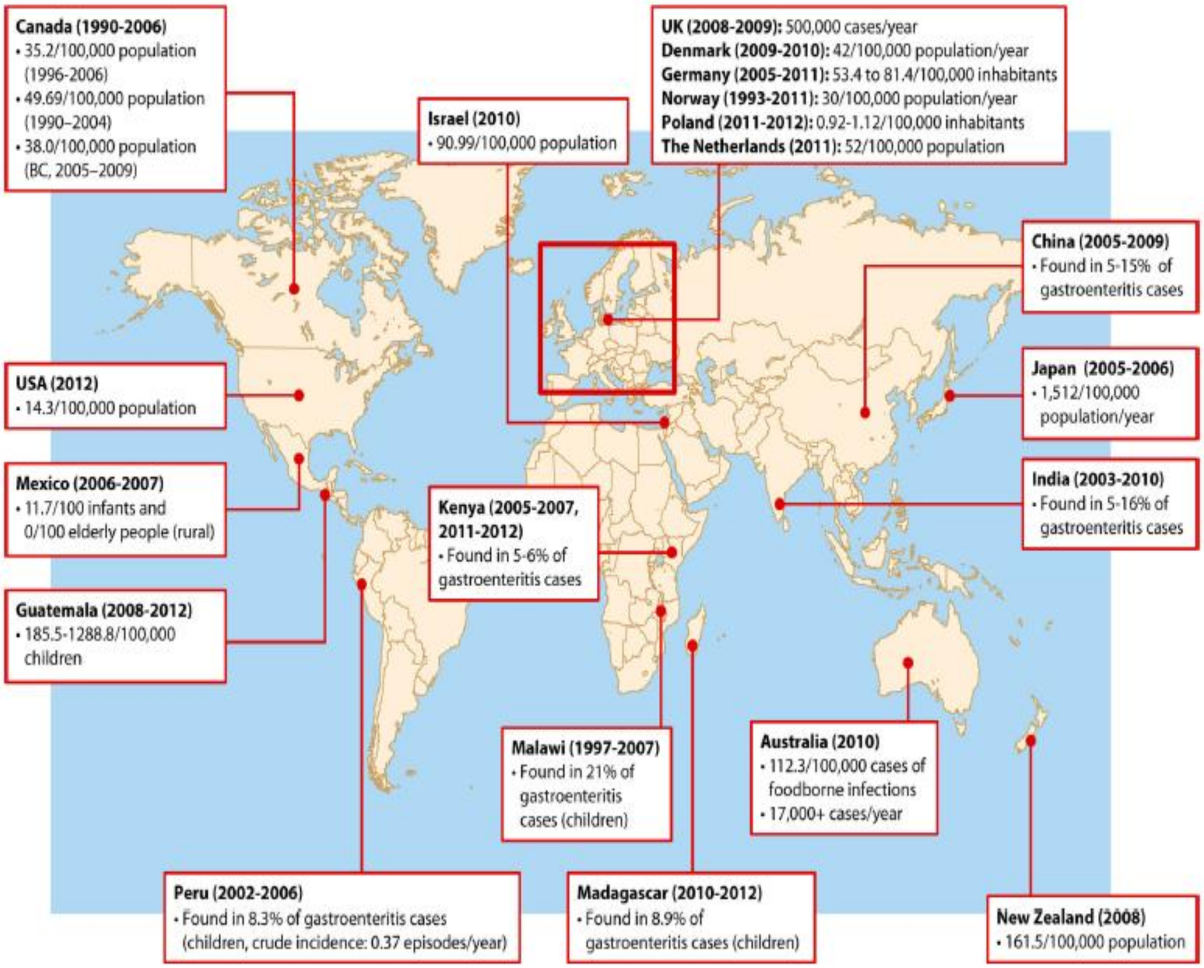


**Figure 1: Victims of Diarrheal diseases worldwide (Food Safety Authority of Ireland, 2011)**

C. jejuni is the leading cause of bacterial food-borne pathogenesis globally. Over 550 million cases of Campylobacteriosis are reported yearly (Mathew W.,2019). In almost all of the researches done in Ethiopia, C. jejuni takes the first place(Brenaet.al., 2016, Belay Tafa et al, 2014, AyalewLingerih et.al.,2013, Lemma Dadi and Daniel Asrat,2008, *TesfayeKassa et.al., 2005*, TesfayeKassa, 2004).

What's really interesting about C. jejuni is it exists primarily as a commensal (where the bacteria benefit but the host is unaffected) in birds, particularly broiler chickens (Mathew W.,2019).

However, upon transmission into the human small intestine, which usually takes place through ingestion of undercooked chicken, the C. jejuni become pathogenic and invade the body through the wall of the small intestine, causing severe gastroenteritis. In roughly one in 1000 cases, the infection can lead to very serious immune disorders such as reactive arthritis and Guillain-Barrésyndrome (Mathew W.,2019). Though C. jejuni is identified as the most frequent cause of bacterial gastroenteritis in developed countries (5-8), it is a common cause of diarrheal illness in the developing world, particularly in the first few years of life (Zhahirul I,2010); being serious in infants under one year old (AyalewLingerih et.al.,2013). In Bangladesh, C. jejuni has been reported as the second (17%) commonest entero-pathogen in diarrhoeal patients of young children after rotavirus (20%) (Zhahirul I,2010).

In low and middle income countries (LMIC), cohort-based studies are more common than population-based studies, in particular among children under five years of age and in sentinel sites (AyalewLingerihet.al.,2013). The burden of Campylobacter is 7.5 million disability adjusted life year (DALY) or 8.4% of the total burden of diarrheal diseases and among identified pathogens ranks fourth after rotavirus (18.7 million DALY) and typhoid fever (12.2 million DALY) and cryptosporidiosis (8.3 million DALY) (10).( (WHO, 2013).). High (34.1%) prevalence was recorded in Jimma among children less than two years of age (AyalewLingerihet.al.,2013).

The incidence of campylobacteriosis was estimated to be 9.3 per 1000 person/years in the United Kingdom (for 2008–2009) and 5.8 per 1000 person/years in the Netherlands (for 2009). Only one out of every 9.3 cases in the United Kingdom and one out of 12 in the Netherlands is reported to national surveillance bodies (WHO, 2013). There is no national surveillance done in Ethiopia (Ayalewet.al.,2013). In the USA, it is estimated that one out of 30.3 cases is reported by Food Net sites, and that national incidence was 1.3 million cases in 2006 or 4.4 per 1000.

These studies also indicate that one out of seven patients with campylobacteriosis in the United Kingdom, and one out of four in the Netherlands, consulted their doctor; this reflects the severe nature of campylobacteriosis. As the fecal samples were tested for a number of pathogens, the incidence of campylobacteriosis can be compared with that of other enteric pathogens (WHO, 2013).

## 3. Sources of exposure

### Animals

The principal reservoir of Campylobacter spp. is the alimentary tract of wild and domesticated birds and mammals (Food Safety Authority of Ireland, 2011).Multiple studies have also shown that Campylobacter, preferentially, colonize the lower gastrointestinal tract of cattle but has also been found in the liver, gall bladder and bile juice (Facciolà et.al,2017). The fecal analysis done in Jimma and few Oromiya parts revealed that there is infection with campylobacter species like C. jejuni, C. coli and C. lari (Brenaet.al.,2016, TesfayeKassa et.al.,2005).

The same is true in Ghana (Akosua et.al, 2017). Moreover, there is a higher prevalence of Campylobacter in cattle from intensive farming [68%] than in adult cattle grazing (7.3%) (Facciolà et.al,2017).Because they share localized and contaminated water and food(Facciolà et.al,2017).As for the pigs, these appear to be predominantly colonizedby C. coli and, less frequently, by C. Jejuni(Facciolà et.al,2017); unlike the studies done in Jimma which is c.coli (TesfayeKassaet.al.,2005). Shellfish and sea gulls are mostly colonized by c.lari(Facciolà et.al,2017). Pests are also infected by C. jejuni, C. coli, C. upsaliensis, C. helveticus, and C. Lari(Facciolà et.al,2017). It has been shown that even the flies represent an important carrier for Campylobacter and they are, therefore, able to contaminate both humans that animals [97-99] (Facciolà et.al,2017). This is serious when sanitation coverage of ethiopia is only 4% (Mihret, 2013).

### Contaminated foods

Campylobacter spp. are frequently isolated from foods of animal origin. Poultry is regarded as one of the most important reservoirs for Campylobacter spp. and constitutes a very significant vehicle for its transmission to humans (Akosuaet.al., 2017, Brena et.al, 2016, Food Safety Authority of Ireland, 2011, *TesfayeKassa et.al., 2005*). The outbreak investigations suggested that in over 25% of the cases, chicken was identified as the source of the outbreak; in 33% of the cases, the source was unknown (Silva et.al,2011). The laboratory investigation done on meat served in Addis Ababa revealed that C. jejuni, C. coli and C. lari contamination is there (Lemma Dadi and Daniel Asrat, 2008). Cross-contamination of ready-to-eat foods, direct hand-to-mouth transfer during food preparation and to a lesser extent consumption of undercooked poultry meat have all been identified as important modes of transmission (fig. 2). Eventhough raw chicken feeding is not common in our country, the studies shown that poultry is the most infected animal (Brenaet.al., 2016, Lemma Dadi and Daniel Asrat, 2008, *TesfayeKassa et.al., 2005*, TesfayeKassa, 2004).

It is estimated that the handling, preparation and consumption of broiler meat may account for 20% to 30% of human cases of campylobacteriosis in European Member States. High (36.4%) prevalence of C. jejuni was observed in the poultry farms found at Debrezeit and other two parts of Oromia (Brenaet.al., 2016). Other foods associated with Campylobacter spp. include raw drinking milk, contaminated drinking water, fresh produce and bivalve molluscs(Food Safety Authority of Ireland, 2011). The vast majorities of Campylobacter infections are not linked to outbreaks and occur as sporadic infections. Contact with farm animals, especially poultry, cattle and pigs are considered the main source of Campylobacter infection (Zhahirul I,2010). Chicken, cattle, sheep, goat and pigs are the most investigated animals in Ethiopia and all are positive to campylobacter in that order (Brenaet.al., 2016,Lemma Dadi and Daniel Asrat, 2008,*TesfayeKassa et.al., 2005*).

The result of an EU wide baseline study revealed an Irish prevalence in broiler batches of 83.1% and a prevalence of 98.3% on carcasses at the end of slaughtering process (Food Safety Authority of Ireland, 2011). This is far more than the one identified in the study at Jimma (39.6%)(*TesfayeKassa, Solomon Gebreselassie, Daniel Asrat. 2005*) and 36.4% in parts of Oromiya (Brena, 2016) and 9.3% of meat sold in Addis Ababa (Lemma Dadi and Daniel Asrat, 2008). While 84.9% was identified win under 2 children found in low resource stings (Caroline et.al.,2019).

The smaller figure in our country does not guarantee that there is lower prevalence of campylobacter. Rather the sensitivity and specificity of laboratory appliances used (Johanna et.al., 2000), the period of the year the study had taken place(Silva et.al,2011), the number of individuals investigated (Johanna et.al., 2000) could determine.

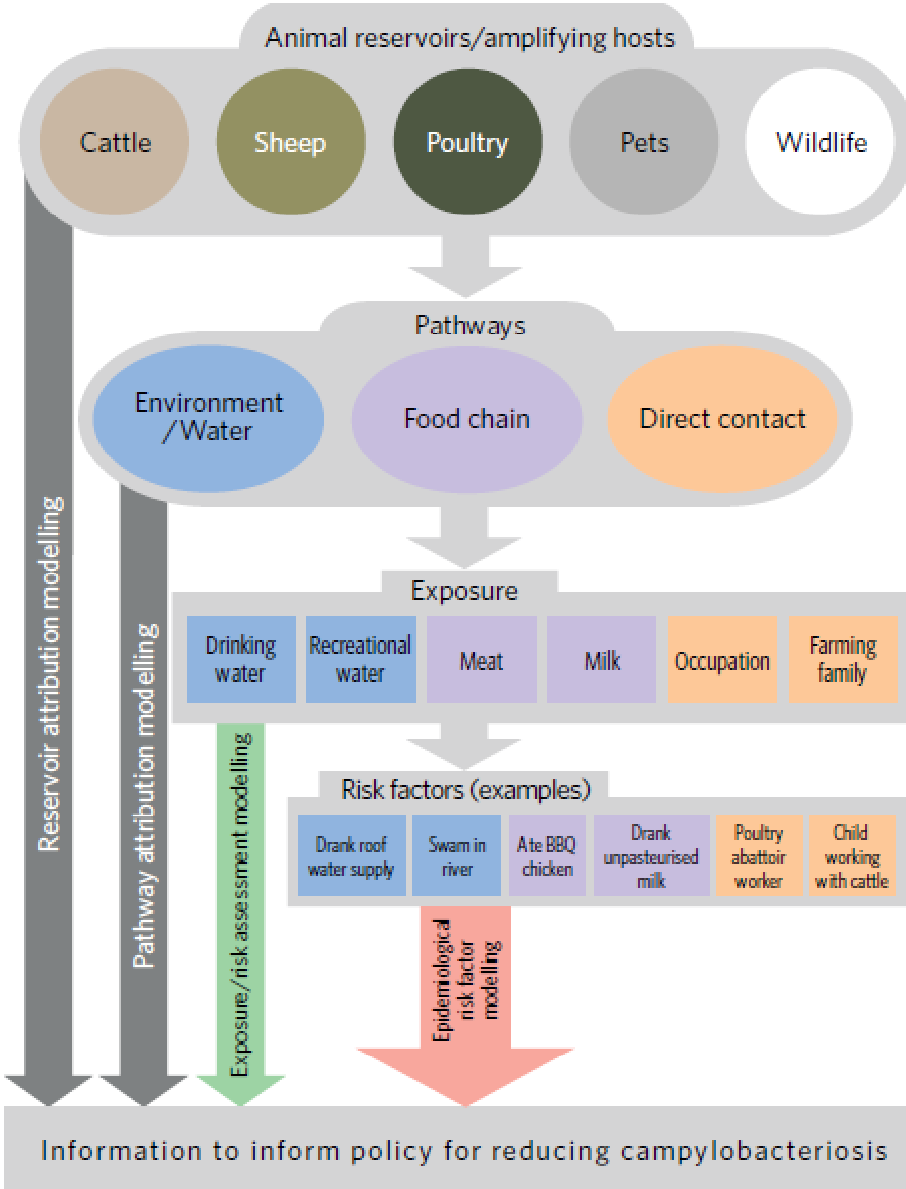


**Figure 2: Campylobacter contamination routes (WHO, 2013)**

**Prevention**

Because of the complex epidemiology of Campylobacter, a multi-tiered approach to control is needed, taking into consideration the different reservoirs, pathways, exposures, and risk factors. Prevention is more important, since antibiotic treatment should be reserved forcomplicated, severe or invasive infections and is not recommended to be used routinely.Erythromycin has been the most commonly used agent for treating Campylobacter enteritisas indicated in (Johanna et.al., 2000). The same study revealed the effect of erythromycin treatment on the duration of diarrhoeawas notclinically significant even when used in an early phase of infection(Johanna et.al., 2000). In the 1980s, theintroduction of fluoroquinolones offered a new approach to antibiotic intervention. However, theresistance in Campylobacter spp. to fluoroquinolones has clearly increased over the pastdecade in many parts of the world (Facciolà et.al, 2017, Johanna et.al., 2000). The resistance pattern and capacity was continually getting increased (Facciolà et.al,2017)(Table 2). Resistance to Erythromycin, $\beta$-lactams, tetracycline, chloramphenicol, trimethoprim/sulfamethoxazole quinolones, aminoglycosides, clindamycin, doxycycline,gentamicin, kanamycin, streptomycin andnalidixic acid were identified in our country (Brena et.al.,2016, Belay Tafa et al, 2014, AyalewLingerihet.al.,2013,Lemma Dadi and Daniel Asrat, 2008 and TesfayeKassa, 2004) (Table 2).

In 2010 in the United States, only 1% of the strains of C. jejuni isolates from human infections were resistant to erythromycin, while 43% were resistant to tetracycline and 22% to ciprofloxacin [165]. In the same year, the FDA has reported almost overlapping data observed in strains of C. jejuniisolates from chicken meat. In 2010 In the European Union 2% of C. jejuni fromhumans were resistant to erythromycin, 21% to tetracycline(Facciolà et.al,2017)and 52% to fluoroquinolones; in strains isolatedfrom chicken meat values were 2%, 22% and 50%, respectively.Both in the US than in Europe, the antibioticresistance is greater in C. coli than in C. jejuni(Facciolà et.al,2017).

**Table 2: Different researches done on types and their resistance to anitibiotics in Ethiopia and other countries**

| **Author/year** | **Country** | **Methods** | **Target** | **Sample** | **Species identified in order** | **Most** | **Antibiotic resistance in order** |
|---|---|---|---|---|---|---|---|
| AyalewLingerih et.al.,2013 | Gonder, Ethiopia | lab based cross sectional | <5 children | Stool | c. jejuni and c.coli | C jejuni | Ampicillin, tetracycline, trimethoprim-sulfamethoxazole |
| *TesfayeKassa et.al., 2005* | Jimma, Ethiopia | lab based cross sectional | Chicken, cattle, sheep, and pig | Fecal specimen | c. jejunic.coli, c. lari | c. jejuni in chicken | Not done |
| Belay Tafa et al, 2014 | Jimma, Ethiopia | lab based cross sectional | <5 children | Stool | c. jejunic.coli, c. lari | c. jejuni | Ampicillin, trimethoprim-sulfamethoxazole tetracycline, chloramphenicol, clindamycin, doxycycline, |
| Akosua et.al., 2017 | Ghana | lab based cross sectional | Cattle, sheep, goat and pig | Fecal and carcass | c. jejunic.coli, c. lari | c. jejuni | Erythromycin, $\beta$-lactams, tetracycline, chloramphenicol, trimethoprim/sulfamethoxazole quinolones, aminoglycosides |
| Brena | Oromiya | PCR based cross | Poultry | Fecal | c.jejuni | c.jejuni | Not done |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| et.al.,2016 | (horro, debrezeit and Jarso) | sectional | | | | | |
| Caroline et.al, 2019 | Country with Low resource setting | Lab based cohort | Children under 2 | Stool and questionnaire | Campylobacter | Same | Not done |
| Lemma Dadi and Daniel Asrat, 2008 | Addis ababa, ethiopia | Lab based cross sectional | Chicken, sheep, pork, goat, beef | Meat | c. jejunic.coli, c. lari | Same order | ampicillin, gentamicin, kanamycin, streptomycin and tetracycline, amoxicillin, chloramphenicol and erythromycin |
| TesfayeKassa, 2004 | Jimma, Ethiopia | Lab based cross sectional | Chicken, cattle, sheep, pig | Fecal | c. jejunic.coli, c. lari | c. jejuni | Cephalothin, rimethoprim-sulfamethoxazole, ampicillin, streptomycin, and nalidixic acid |

**Surveillance**

The true incidence of gastroenteritis due to Campylobacter spp. is poorly known, particularly in LMIC (WHO, 2013); partly due to absence of surveillance system (WHO, 2013). Studies in high-income countries have estimated the annual incidence at between 4.4 and 9.3 per 1000 population. (WHO, 2013) (Table 3).

**Table 3: Established surveillance in different parts of the world**

| Author/Year | Country | Established surveillance | statutory notifiable | sentinel systems | No established | Other |
|---|---|---|---|---|---|---|
| Johanna et.al., 2000 | EU(EFSA) | 18 countries | 9 countries | 7 countries | | |
| Facciolà et.al,2017 | USA(FoodNet) | 10 states | | | | |
| WHO, 2013) | LMIC | | | | | National reference center |
| Ayalew et.al.,2013 | Ethiopia | | | | | Cohort/cross sectional |

While surveillance of enteric diseases, including Campylobacteriosis, is common in high-income countries, it is rarely attempted in other parts of the world (WHO, 2013). The survey done in 18 European countries revealed that all countries except portugalhad a nationalsurveillance system for human Campylobacter infections. In 9 countries Campylobacterinfection was statutory notifiable. 7 countries had sentinel systems which covered part of thecountry(WHO, 2013).Some countries have invested heavily in reducing Campylobacteriosis transmitted via specific food chains, with some success. Yet, from a global perspective, Campylobacteriosis in humans remains difficult to prevent (WHO, 2013).

**Hygiene and sanitation**

There is strong relationship between WASH and diarrhoeal diseases (Natnael, 2012). Diarrhoeal diseases are characteristically transmitted via the faeco-oral route (Jenna, 2016, WaterAid, 2012). Poor WASH increases an individual's exposure to faecal pathogens through multiple pathways (Jenna, 2016).The main transmission routes are via 'the five Fs diagram': fingers, fluids, flies, fields/floors and food (WaterAid, 2012) (figure. 3).

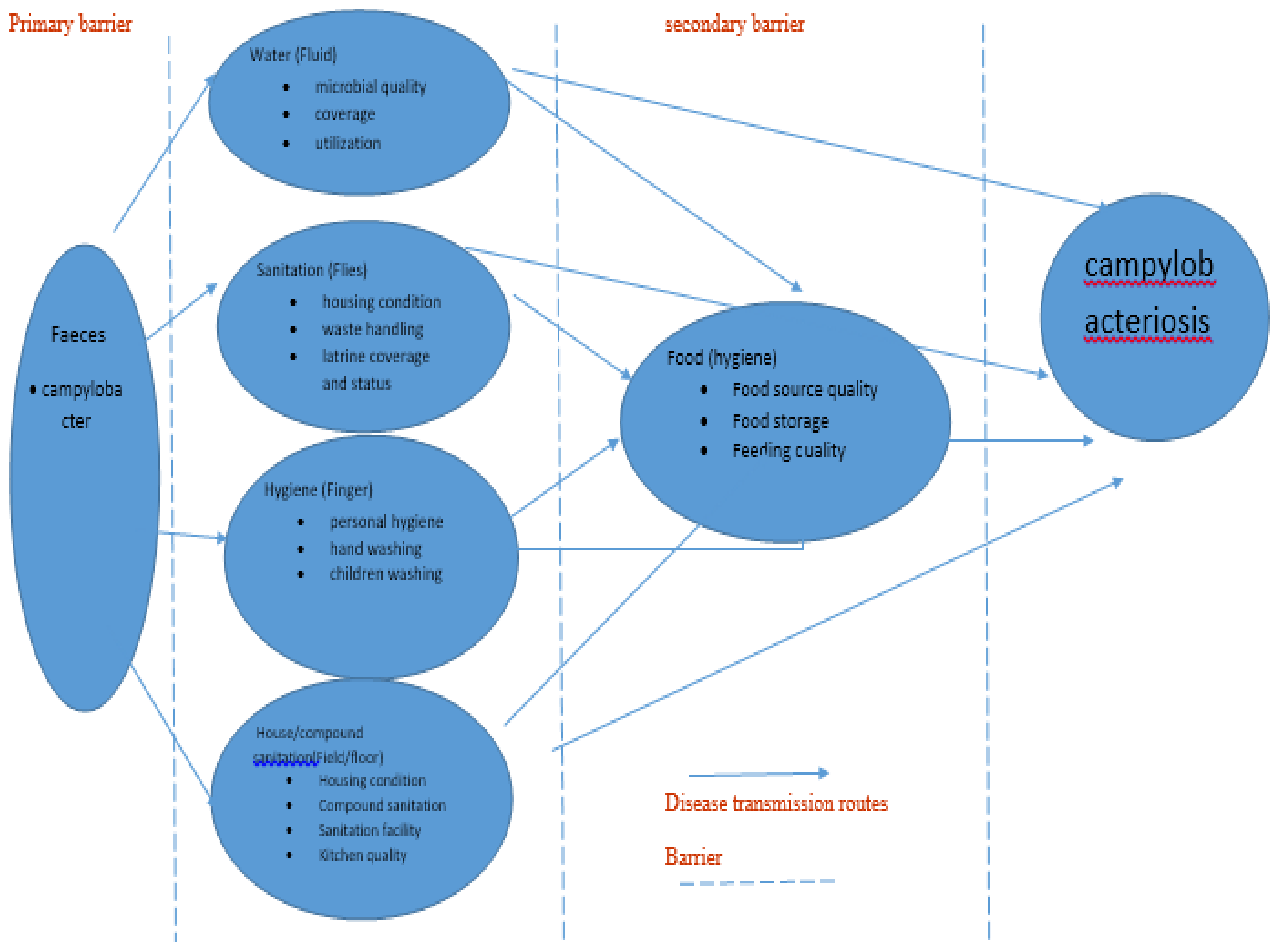


**Figure 3: Routes of contamination of campylobacter (Source: Water Aid, 2012)**

Infectious agents originating from faeces follow different routes (poor WASH) to find their ways to new victim (fig 3). The four arrows, according to WaterAid, that originate from faeces on the left represent the primary routes by which infectious organisms enter the environment. Theprimary barriers, which constitute improvement of access to improved sanitation facilities and implementation of effective WASH, can stop the transmission of etiological agents from propagating into the human environment.

Handwashing with soap at critical times, especially before eating and after contact with excreta, can reduce diarrhoeal disease by up to 47%(Water Aid, 2012). Access to basic hygiene facilities and consistent hygiene practices with special considerations to the vulnerable and peoples with disability are critical for prevention and control of excreta borne infectious diseases (Hazel, 2013). The secondary barriers, according to WaterAid, are 'hygiene practices stop faecal pathogens that have got into the environment in stools or on hands from multiplying and reaching new hosts.

Factors associated with a reduced risk of Campylobacter detection included exclusive breastfeeding (risk ratio, 0.57; 95% confidence interval, .47–.67), treatment of drinking water (0.76; 0.70–0.83), access to an improved latrine (0.89; 0.82–0.97), and recent macrolide antibiotic use (0.68; 0.63–0.74). A high Campylobacter burden was associated with a lower length-for-age Z score at 24 months (−1.82; 95% confidence interval, −1.94 to −1.70) compared with a low burden (−1.49; −1.60 to −1.38). This association was robust to confounders and consistent across sites. (Caroline et.al.,2019). Latrine usage, water source, boiling drinking water, bottle feeding, nutritional status and exposure to domestic animals had statistically significant association were identified as a risk factors in the study done at Jimma (AyalewLingerihet.al.,2013). SinceCampylobacter is a zoonotic hazard, with both food- and waterborne routes of transmission, and in lightof the challenges it presents in terms of control, it is clear that – both locally and globally – the infectionneeds to be addressed in a multidisciplinary manner. Close collaboration is thus essential (WHO, 2013).

**4. Conclusions**

Campylobacter species are better called thermotolerant bacteria than thermophilic. They prefer low oxygen content and optimum $P^H$. But refrigeration cannot kill these bacteria. Eventhough there are about 26 campylobacter species identified till now, the most common ones are C. jejuni, C. coli and C. lari. C. jejuni is the most prevalent and the most drug resistant to antibiotics. They directly or indirectly infect human through contaminated food, water, or unhygienic conditions. The main reservoirs are chicken, cattle, goat, sheep and pigs including human beings. Campylobacter can cause diarrheal diseases more than salmonella, yersinia or E. coli; especially in children less than five years of age commonly during the summer season. Majority of them are resistant to antibiotics. Above all, molecular based study is lucking in our county and there is no established surveillance system.

It is better to focus on C. jejuni and chicken when trying to intervene. But better laboratory procedures have to be followed in order to identify more species and their antibiotic resistance. Because refrigeration cannot kill them, it is better not to feed raw food products like meat, milk or untreated water. In addition, it is better to focus on prevention by properly keeping hygiene and sanitation. These all has to be supported by adequate study and better surveillance system.

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