

Multidrug Resistance in *Vibrio* Spp. And *Shigella* Spp.: Emergence of Untreatable Pathogens

Kittappa Vinothkumar¹, Neha Rajpara^{1,2}, Mrinalini Nair² and Ashima Kushwaha Bhardwaj^{1*}

¹Department of Human Health and Diseases, School of Biological Sciences and Biotechnology, Indian Institute of Advanced Research, Koba Institutional Area, Gandhinagar, Gujarat-382007

²Department of Microbiology and Biotechnology Centre, Maharaja Sayaji Rao University of Baroda, Vadodara, Gujarat-390002, India.

*Corresponding Author: Ashima K. Bhardwaj, Department of Human Health and Diseases, School of Biological Sciences and Biotechnology, Indian Institute of Advanced Research, Koba Institutional Area, Gandhinagar, Gujarat-382007
E-mail: ashima.bhardwaj@gmail.com; Phone: +917930514235

Abstract

Gastroenteritis or infectious diarrhea, generally caused by viral or bacterial or parasitic infections is responsible for morbidity and mortality, especially in children. Bacterial gastroenteritis is caused by the agents such as *Vibrio* spp., *Salmonella* spp., *Shigella* spp., *Campylobacter jejuni*, *Yersinia enterocolitica*, enterohemorrhagic *Escherichia coli* (EHEC) and other diarrheagenic *E. coli*. Diarrheal diseases caused by multi-drug resistant bacteria such as *Vibrio* and *Shigella* spp. are a major health problem in the developing countries with poor hygiene and limited resources. Various mobile genetic elements such as integrons, plasmids and SXT elements are involved in drug resistance. Apart from mobile genetic elements, various inherent mechanisms such as mutations in drug target sites and efflux pumps are also involved in imparting drug resistance. This chapter describes the major diarrhea-causing pathogenic bacteria in India i.e. *Vibrio* spp. and *Shigella* spp., their prevalence, treatment complications and molecular epidemiology of antibiotic resistance.

Introduction

Gastroenteritis or infectious diarrhea is a common medical condition due to the inflammation of the stomach and small intestine. It is generally caused by viral or bacterial or parasitic infections and is manifested by diarrhea, abdominal cramps and vomiting [1]. The increase in morbidity and mortality rate due to acute gastroenteritis in the past decades has led to a worrisome situation. The diarrheal diseases exist as the second major cause of death in children worldwide (Figure 1) accounting for 1.6 to 2.5 million deaths annually and in developing countries every child encounters 3 episodes of diarrheal infections per year [2-4]. India ranks among the top countries with 336,600 cases and a very high number of annual child deaths due to diarrhea [3,4]. Though there is a decline in the mortality rate of diarrhea in the past few years, it still persists as one of the major causes of morbidity and mortality in children [2]. The gastroenteritis caused by protozoan parasites accounts for a relatively small proportion of cases in developing countries and is uncommon in developed countries. The parasitic agents such as *Giardia intestinalis*, *Cryptosporidium parvum*, *Entamoeba histolytica* and *Cyclospora cayatanensis* most commonly cause acute diarrheal illnesses in children [5]. The virus-mediated gastroenteritis is caused by the agents such as rotavirus, enteric adenovirus, norovirus, sapovirus, and astrovirus. Rotavirus remains as the most common etiological agent of diarrhea in children worldwide accounting for around 0.5 million deaths per year, followed by norovirus [6,7]. Bacterial gastroenteritis is caused by the bacterial genus such as *Vibrio*, *Salmonella*, *Shigella*, *Campylobacter jejuni*, *Yersinia enterocolitica*, enterohemorrhagic *Escherichia coli* (EHEC) and other diarrheagenic *E. coli*. In developing countries, gastroenteritis through bacteria is more prevalent whereas viruses are the predominant cause of acute diarrhea, especially during the winter season in industrialized countries [5]. The frequency of occurrence of intestinal infections due to *Vibrio* and *Shigella* species is more in developing countries like India [5,8,9]. Hence, the following sections would focus on the major diarrhea-causing pathogenic bacteria in India i.e. *Vibrio* spp. and *Shigella* spp. and the problems in their treatment.