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Distribution trends & antibiogram pattern of *Salmonella enterica* serovar Newport in India

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***Background & objectives*: Salmonellosis is a major public health concern worldwide. Besides typhoidal salmonellae, infections due to non-typhoidal serovars of *Salmonella* are also associated with high morbidity and mortality leading to huge economic losses. Among non-typhoidal serovars, *Salmonella* Newport has been reported as a major cause of foodborne infections resulting in outbreaks due to consumption of contaminated food items. Little data related to this serovar are available from India leading to the scarcity of information on the distribution trends of this important serovar in the country. Therefore, an effort was made in the present study to generate data on distribution trends and antibiogram of *S.* Newport in the country.**

***Methods*: *S.* Newport isolates received at the National Salmonella and Escherichia Centre at Kasauli, India, during January 2010 to December 2013 were analysed for their distribution trends and antibiogram data were also generated using standard methods.**

***Results*: In the present study, *S.* Newport isolates were received from eight States and one union territory of the country and highest proportion of *S.* Newport isolates were found to be from humans (53.61%) followed by animals (27.84%) and food (18.56%). *S.* Newport isolates exhibited resistance to all drugs used in the present study except chloramphenicol, ciprofloxacin and cefuroxime.**

***Interpretation & conclusions*: Considering distribution of this important serovar of *Salmonalla* and its wide range of reservoirs, steps towards formulation and execution of efficient surveillance programmes should be taken.**

Key words Antibiogram - distribution - foodborne - outbreaks - *Salmonella* Newport

Genus *Salmonella* is comprised of two species and 2,579 serovars[1]. *Salmonella enterica* subsp. enterica comprises 1,531 serovars which are largely associated with human infections[2], commonly acquired by consumption of contaminated food. Although typhoidal Salmonellae remains to be the important cause of morbidity and mortality, non-typhoidal Salmonellae are a leading cause of food poisoning and enteric infections and emerged as an important public health problem worldwide[3]. It is estimated that non-typhoidal serovars of *Salmonella* cause 93.8 million human infections and 1,55,000 deaths annually[4]. These serovars account for 38 per cent of foodborne illnesses[5], and are responsible for 35 per cent of hospitalizations

and 28 per cent of deaths due to foodborne illnesses[6]. Moreover, non-typhoidal Salmonellae have a wide range of reservoirs and are widely distributed[7].

Salmonella Newport is one of the most important serovars and it is ranked in top three *Salmonella* serovars associated with foodborne outbreaks in the United States[5]. *S.* Newport has been reported to be responsible for several major outbreaks associated with tomatoes, ground beef, alfalfa sprouts, mung beans, cantaloupe and many other food products[8]. *S.* Newport has been reported to cause a wide spectrum of clinical diseases in humans, such as diarrhoea, ileocecal lymphadenitis, chest wall abscess, pyosalpinx, osteomyelitis, endocarditis, meningitis, splenic abscess, septicaemia[9] and bacteraemia[10].

Although *S.* Newport has emerged as an important human pathogen in the last few decades and initiation of enhanced surveillance of this serovar is advocated in several countries, there is scarcity of data about the prevalence and distribution of *S.* Newport in India. Therefore, an attempt was made in the present study to generate data on the distribution trends of *S.* Newport throughout the country.

Material & Methods

Ninety seven *S.* Newport isolates, received at the National Salmonella and Escherichia Centre, Central Research Institute, Kasauli, India, from various medical, veterinary and research institutes throughout the country, during January 2010 to December 2013 constituted the material for the study. Bacterial isolates were identified on the basis of culture characteristics, Gram staining and conventional biochemical tests[11]. Isolates identified as salmonellae were further subjected to serotyping[1] using an array of various *Salmonella* antisera (Statens Serum Institute, Copenhagen, Denmark; Denka Seiken Co. Ltd., Tokyo Japan).

Antimicrobial susceptibility testing: All serologically confirmed *S.* Newport isolates were tested for antimicrobial susceptibility by disc diffusion method[12] using the following 12 antimicrobials (Hi Media Laboratories, Pvt. Ltd., Mumbai, India): ampicillin (10 µg), ceftazidime (30 µg), cefotaxime (30 µg), cefuroxime (30 µg), chloramphenicol (30 µg), trimethoprim-sulphamethoxazole (co-trimoxazole) (1.25/23.75 µg), kanamycin (30 µg), norfloxacin (10 µg), ciprofloxacin (5 µg), nalidixic acid (30 µg), tetracycline (30 µg), and nitrofurantoin (300 µg), according to the Clinical and Laboratory Standards Institute (CLSI) guidelines and interpretative criteria[12]. *Escherichia coli* ATCC 25922 was used as standard strain.

Results

A total of 3,924 suspected *Salmonella* isolates were received during the study period. Of these, 1,850 (47.1%) isolates were identified as *Salmonella*. Among serotyped isolates, 97 (5.24%) were serologically identified as *S.* Newport which were received from eight States and one union territory *viz*. Tamil Nadu (56.7%), West Bengal (14.4%), Uttrakhand (7.2%) Bihar (6.2%), Haryana (6.2%), Maharashtra (4.1%) Delhi (NCT) (3.1%), Himachal Pradesh (1%) and Punjab (1%) (Table I). Among isolates from humans, highest proportion was found from stool (86.5%) followed by blood (11.5%) and urine (1.9%) (Table II). *S.* Newport isolates from animals were found to be of poultry origin (77.7%) and porcine origin (22.2%) whereas milk (66.6%) and meat (33.3%) were found to be the main sources of *S.* Newport amongst food items. *S.* Newport isolates were found to be resistant to ampicillin (87.62%), cefotaxime (30.9%), ceftazidime (30.9%), kanamycin (30.9%), co-trimoxazole (25.7%), tetracycline (24.7%), nalidixic acid (23.7%), nitrofurantoin (23.7%) and norfloxacin (22.7%) whereas, all the isolates were found to be susceptible to chloramphenicol, ciprofloxacin and cefuroxime.

Discussion

Of the 97 *S.* Newport isolates analysed in the present study, maximum number of isolates was found to be from humans followed by animals and food indicating its importance as human pathogen. Among human

Table I. Place-wise distribution of *Salmonella enterica* serovar Newport

States	No. of *S.* Newport isolates received				
	2010	2011	2012	2013	Total n (%)
Tamil Nadu	19	17	9	10	55 (56.7)
West Bengal	9	3	-	2	14 (14.4)
Uttrakhand	0	6	-	1	7 (7.2)
Bihar	-	-	6	-	6 (6.2)
Haryana	-	-	6	-	6 (6.2)
Maharashtra	3	-	-	1	4 (4.1)
Delhi (NCT)	-	3	-	-	3 (3.1)
Punjab	-	1	-	-	1 (1)
Himachal Pradesh	-	-	1	-	1 (1)

Table II. Source wise distribution of *Salmonella enterica* serovar Newport

Source	States (no. of isolates)	Sample	2010	2011	2012	2013	Total n (%)	Per cent age amongst each source
Human (n=52)	TN (33) WB (11) MH (4) DL (3) PB (1)	Stool	21	14	7	3	45 (46.4)	86.5
		Blood	1	1	1	3	6 (6.2)	11.5
		Urine	-	-	1	-	1 (1.0)	1.9
Animal (n=27)	TN (15) UK (6) HR (6)	Poultry	12	4	5	-	21 (21.6)	77.8
		Porcine	-	6	-	-	6 (6.2)	22.2
Others (n=18)	TN (7) BH (6) WB (3) UK (1) HP (1)	Milk	2	3	7	-	12 (12.4)	66.7
		Meat	1	-	5	-	6 (6.2)	33.3
Total			37	28	26	6	97	

TN, Tamil Nadu; WB, West Bengal; MH, Maharashtra; DL, Delhi; PB, Punjab; UK, Uttrakhand; HR, Haryana; BH, Bihar; HP, Himachal Pradesh

isolates, maximum number of *S.* Newport isolates was from stool. Inappropriate treatment and disposal of sewage continues to be the major hurdle in attaining good hygiene and sanitary conditions and therefore, may contribute to dissemination of *S.* Newport into the environment. Presence of *S.* Newport in human faeces may result in possible transmission of *S.* Newport through contaminated water bodies and vegetables irrigated using contaminated water sources apart from the other animal reservoirs. *S.* Newport outbreaks due to the consumption of contaminated mung beans[8], cantaloupe[13], ready to eat salad vegetables[14], watermelon[15] and mango[16] have been reported earlier from various countries. Isolation of *S.* Newport from blood and urine shows the potential of this serovar to cause invasive infections as has been reported earlier[9].

S. Newport isolates obtained from animals and food products of animal origin have caused septicaemic illness in both animals and humans[17]. Amongst *S.* Newport isolates from animals, 77.8 and 22.2 per cent were found to be of poultry and swine origin, respectively. Both of these reservoirs may act as an important source of *S.* Newport infections in humans due to consumption of undercooked poultry[18], eggs[19] and pork[20]. Live poultry may also act as an important source of *S.* Newport infection[21]. Swine can be asymptomatic reservoirs of salmonellae[22] and may become colonized by ingesting contaminated faeces or through snout to snout contact[23]. Salmonellae can be found commonly in the environment of pig farms which helps in the maintenance of the bacteria in the herds[24].

Both vegetarian and non-vegetarian populations are susceptible to *S.* Newport infections due to the consumption of contaminated meat and milk[25]. Therefore, high standards of hygiene are required to be maintained in dairy farms and food processing industries. Administration of *S.* Newport vaccine in cattle may further help in controlling infections in dairy herds. It will also check environmental dissemination of *S.* Newport by controlling faecal shedding into the environment[26]. No specific trends were observed in the number of the *S.* Newport isolates from various parts of the country.

Highest resistance was observed against ampicillin and third generation cephalosporins followed by co-trimoxazole, tetracycline, and nalidixic acid. However, all isolates were found to be susceptible to chloramphenicol and ciprofloxacin. Third-generation cephalosporins are the drugs of choice for treatment of persons with non-typhoidal *Salmonella* infections that require chemotherapy or when fluoroquinolones are contraindicated.

Although an attempt has been made in the present study to generate data on the distribution of *S.* Newport in India, the scenario may actually be much complicated and, therefore, necessitate formulation and execution of efficient surveillance programmes which will result in generation of enough epidemiological data, further facilitating public health authorities to understand the epidemiological trends of *S.* Newport in the country. Moreover, shifts in the prevalence of specific strain types and serovars in human and animal populations is a consequence of its introduction through international travel, human migration, food, animal feed and livestock trade. Therefore, national level surveillance programmes should be collaborated with global monitoring programmes.

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***Conflicts of Interest*:** None.

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