Increasing Quinolone Resistance in Salmonella enterica Serotype Enteritidis

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Until recently, Salmonella enterica serotype Enteritidis has remained sensitive to most antibiotics. However, national surveillance data from Denmark show that quinolone resistance in S. Enteritidis has increased from 0.8% in 1995 to 8.5% in 2000. These data support concerns that the current use of quinolone in food animals leads to increasing resistance in S. Enteritidis and that action should be taken to limit such use.

Salmonella enterica serotype Enteritidis is the most common cause of foodborne salmonellosis worldwide. Historically, this serotype has remained sensitive to most antibiotics, unlike other common serotypes such as Typhimurium, Hadar, Virchow, and Infantis, in which resistance to a wide range of antimicrobial agents is common (1). Recently in Denmark, we have recorded increasing resistance to quinolones in S. Enteritidis from human infections. This finding is cause for concern because fluoroquinolones are first-line drugs for treatment of human salmonellosis.

The Study

From 1995 to 2000, 13,334 S. Enteritidis infections were recorded in Denmark, accounting for 62% of all zoonotic salmonella infections. To monitor drug resistance (2), we examined a random sample of 2,546 isolates, of which 82 (3.2%) were resistant to the quinolone nalidixic acid. These data showed that quinolone resistance increased from 0.8% (3 of 384 isolates) in 1995 to 8.5% (31 of 366) in 2000 (Figure). Resistance to other antimicrobial agents was infrequent, and quinolone resistance was mainly present as a single resistance.

Quinolone resistance was related to foreign travel as well as S. Enteritidis phage type (PT). In isolates from patients with a known history of foreign travel, 8.9% were resistant, compared with 2.4% in domestically acquired infections (p<0.0001; Table). In 157 patients who had returned from a European destination (excluding Scandinavia), 18 (11.5%) had resistant isolates. Resistance was highest in patients returning from Spain: 12 (19.7%) of 61 isolates were resistant. Five (7.5%) resistant strains were found in 67 isolates from Asia (mainly Turkey and Thailand), but no resistant strains were recovered from 25 persons who had traveled to Africa.

Figure. Annual proportion of quinolone resistance in isolates of Salmonella Enteritidis, Denmark, 1995–2000.

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zoonotic reservoir. The prevalence of resistance in S. Enteritidis was, in our study, highest in patients returning from developed countries. Furthermore, fluoroquinolones are not used to treat children. In children <15 years of age, the prevalence of quinolone-resistant strains was 9.5% (4/42) among patients with a history of foreign travel and 1.4% (7/499) in domestically acquired cases. The corresponding figures for adults were 8.9% (23/260) and 2.7% (47/1744). Finally, the use of quinolones in humans could not conceivably be responsible for the large variation in the prevalence of resistance by phage type. If the use of quinolones in human medicine contributed to the emergence of quinolone resistance in S. Enteritidis, resistance would be found independently of phage type.

Increasing quinolone resistance is not confined to foodborne salmonella but also includes campylobacters; resistance is primarily driven by the use of fluoroquinolones in the livestock production (8,9). Limited quantities of fluoroquinolones are currently used in food production in Scandinavia. During 1997-1998, the annual use of the liquid formulation of fluoroquinolones for 130 million to 140 million poultry was <150 kg; during 1999-2000, usage decreased to <100 kg (2). Unfortunately, quantitative data on the use of fluoroquinolones are not available from most areas. Several fluoroquinolones are licensed and used in other countries of Europe, Southeast Asia, and the Americas for treatment of food animals, particularly for mass medication in the poultry industry, mainly for broiler chickens (2,8-10). Our data support concerns that the current pattern of quinolone use in food animals leads to increasing quinolone resistance in S. Enteritidis and that action should be taken to limit this use.

Dr. Mølbak is a medical epidemiologist at Statens Serum Institut in Copenhagen, Denmark. Professional interests include zoonotic foodborne bacterial infections, diarrheal diseases epidemiology, and methods in epidemiology.

### References