Decline in Ciprofloxacin-Resistant *Salmonella enterica* Serovar Choleraesuis in Taiwan, 2001–2011

To the Editor—Most human infections due to *Salmonella enterica* serovar Choleraesuis (*Salmonella Choleraesuis*) in Taiwan are reported to be epidemiologically and genetically closely related to those isolated from *Salmonella Choleraesuis*–infected swine [1, 2]. Studies conducted in the early half of the previous decade (2000–2004) in Taiwan revealed a marked increase in the number of human infections caused by *Salmonella Choleraesuis*, particularly bacteremia and mycotic aneurysm, and in the number of quinolone-resistant isolates [1, 3, 4]. In 2002, the Taiwan Department of Agriculture began to strictly regulate the use of antibiotics in livestock and banned in animals the use of antibiotics that were also commonly used in humans [5]. The extent of quinolone use in animals in Taiwan has been reduced since then [6]. In 2004, hog farmers in Taiwan began immunizing their stocks with Suisaloral (Impfstoffwerk Dessau-Tornau GmbH, Germany), a live attenuated *Salmonella Choleraesuis* vaccine, and in 2005 the Taiwan Department of Health established a system for monitoring the residual amount of antimicrobial agents in food products. Few studies, however, have...
been conducted to determine the incidence of infections due to *Salmonella* Choleraesuis and the changes in resistance patterns to ciprofloxacin at 2 medical centers in Taiwan during the period 2001–2011.

This study was conducted at 2 tertiary care hospitals, the National Taiwan University Hospital and the National Cheng Kung University Hospital, located in northern and southern Taiwan, respectively. The isolates of *Salmonella* Choleraesuis were identified by conventional methods, and susceptibility (resistance) to ciprofloxacin was determined by measuring resistance to nalidixic acid using the disk diffusion method [7].

Figure 1. Incidence of bacteremia caused by *Salmonella enterica* serovar Choleraesuis and ciprofloxacin susceptibility. A, Incidence (episodes per 1000 inpatients) of bacteremia caused by *Salmonella* Choleraesuis at 2 medical centers in Taiwan, the National Taiwan University Hospital and the National Cheng Kung University Hospital, during the period 2001–2011. The arrow indicates the year (2004) of introduction of the *Salmonella* Choleraesuis vaccine (Suisaloral, Impfstoffwerk Dessau-Tornau GmbH, Germany) into pig farms in Taiwan. B, Decline in ciprofloxacin susceptibility of bacteremic *Salmonella* Choleraesuis isolates obtained from 2 medical centers during 2001–2011. Abbreviations: NCKUH, National Cheng Kung University Hospital; NTUH, National Taiwan University Hospital; S. Choleraesuis, *Salmonella enterica* serovar Choleraesuis.
We found that there was a significant reduction in the incidence of *Salmonella* Choleraesuis bacteremia during 2005–2006 since its peak in 2004 (χ² test for trend, \(P < .01\)) and that the incidence remained low at both institutions during 2006–2011 (Figure 1A). In contrast, the percentage of *Salmonella* Choleraesuis isolates with ciprofloxacin resistance was approximately 80% during 2001–2004 and 100% during 2006–2011 (\(P < .01\); Figure 1B).

We speculate that strict regulation of antibiotic usage and the adoption of *Salmonella* Choleraesuis vaccination in hog farms partly contributed to the marked decline in *Salmonella* Choleraesuis infections in humans in Taiwan during the period 2001–2011.

**Note**

*Potential conflicts of interest.* All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

**Chun-Hsing Liao,¹ Wen-Chien Ko,² and Po-Ren Hsueh³,4**

¹Department of Internal Medicine, Far Eastern Memorial Hospital, Taipei County; ²Department of Internal Medicine, National Cheng Kung University Hospital and Medical College, Tainan; Departments of ³Laboratory Medicine and ⁴Internal Medicine, National Taiwan University Hospital, National Taiwan University College of Medicine, Taipei, Taiwan

**References**