China Takes Aim at Rampant Antibiotic Resistance

SHANGHAI—In a true-life drama on the Chinese talk show *Shihou Zhu Geliang*, a young man has so little confidence in the hygiene of his company’s cafeteria that he supplements each meal with antibiotics. That is his undoing. When the man later falls ill, drugs fail to save him. An autopsy reveals why: His body is riddled with multiple strains of drug-resistant bacteria.

The case may have been extreme, but *Shihou Zhu Geliang* had a serious message. The episode accompanied a government-led crusade to warn Chinese against the perils of frivolous antibiotic consumption. The campaign culminated last week in a Health Ministry directive laying out stricter regulations for prescription drugs. “Problems with public awareness and with doctors [prescribing] habits have led to excessive antibiotic use in China,” says Ni Yuxing, head of the clinical microbiology department at Ruijin Hospital here. “And that has created resistant bacteria.”

Bacteria that cannot be stopped by common drugs are proliferating around the world (*Science*, 18 July 2008, p. 356). But a health care system that encourages doctors to churn out prescriptions, intensive marketing by pharmaceutical companies, and heavy use of antibiotics in animal husbandry and fisheries make China a special case. More than 60% of *Staphylococcus aureus* isolates from Chinese patients in surveyed hospitals in 2009 were methicillin-resistant—the dreaded MRSA—up from 40% in 2000. The proportion of *Streptococcus pneumoniae* isolates resistant to macrolides, meanwhile, now tops 70%. Roughly the same share of *Escherichia coli* isolates are resistant to quinolones—the highest rate in the world.

China’s health ministry hopes to ward off calamitous outbreaks of drug-resistant strains. The new regulations, which take effect 1 August, are the latest in a string of measures that started with the launch of a drug-resistance-monitoring network in 2004 and an ambitious 3-year program, now in progress, to combat the overprescription of drugs. But critics say that without an overhaul of the health care system, the new measures may have limited success.

“Antibiotic resistance is a serious public health threat in China,” says Xiao Yonghong, an infectious disease specialist at Zhejiang University in Hangzhou. He oversees the Health Ministry’s National Antibacterial Resistance Investigation Net, which covers 80 hospitals nationwide. Drug resistance is most acute in densely populated cities in the east. Erythromycin-resistant *S. pneumoniae*, for example, appeared in 94% of isolates from children tested in hospitals here in 2004 and 2005. The sole strains of common drug-resistant bacteria not thriving in China are vancomycin-resistant *Enterococci*. Xiao says: “That’s the only good news.”

China’s woes are in part the consequence of earlier health care reforms. Until the early 1980s, China had government-provisioned care bolstered by “barefoot doctors”: min-


In the meantime, growing numbers of Chinese farmers discovered that rearing livestock on antibiotics yielded larger animals and boosted profits. In a 2007 survey, Xiao estimated that nearly half of the 210,000 tons of antibiotics produced in China end up in animal feed. The U.S. Food and Drug Administration warned in 2007 that Chinese farm-raised fish are laced with fluoroquinolones and other antibiotics not approved for use in U.S. seafood.

Those drugs find their way into the human gut. In an unpublished study, Zhu Baoli of the Institute of Microbiology in Beijing and colleagues sequenced gut microbes in Chinese, Danish, and Spanish people. Chinese guts had the highest number of antibiotic-resistant genes. They were also dominated by genes resistant to tetracycline, which in China is mostly used in animal feed. While that might not affect clinical treatment with drugs other than tetracycline, Zhu says, “some drugs that are used in animals are also used in humans.”

China’s woes extend beyond the doctor’s office and the dinner table. As the story of the man worried about cafeteria food shows, some Chinese pop antibiotics the way Americans pop vitamins. Until 2004, antibiotics were legally available over the counter in China, and families sometimes kept a stash at home.

In 2010, the Health Ministry separated doctors’ pay from prescription drug sales. Its new directive goes further, by requiring that drugs be divided into three classes, with drugs with the highest resistance rates to be prescribed only by specialists. Violators can lose prescription rights or their medical license, while offending hospitals can be fined. But the government has not offered hospitals an alternative source of funding to replace drug profits. “A comprehensive overhaul” is needed, Reynolds says.

Even with further reforms, significant obstacles remain. In a survey in Guizhou Province in southwest China, Reynolds found that many doctors mistakenly believed their patients—not the bacteria inhabiting their bodies—had developed antibiotic resistance. Meanwhile, reliance is climbing. Says Zhu: “You now have genes resistant to almost every antibiotic available on the market.”

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On the drip. In China, antibiotics are commonly taken intravenously for colds and other maladies that are often treated less aggressively in the west.