communication between the infection control staff and the medical and nursing teams, and organization of multiple educative workshop sessions. No IMP-13-producing isolates were detected before or after the detection of IMP-13-producing P. monteilii, either in the burn unit or in any other hospital ward. Up until now, P. monteilii infections had not occurred in this hospital and, in contrast to P. putida, are not yet reported in the literature.

The blaIMP-13 gene has been reported in association with multiple outbreaks of P. aeruginosa abroad, but no outbreak has occurred at this hospital. Instead, GES-12-expressing A. baumannii and ESBL-producing P. aeruginosa outbreaks (P. Bogaerts, personal data) were previously reported in this setting, while, ironically, such isolates could not be recovered from the hospital environment. To the best of our knowledge, only blaIMP-12 has been reported in a P. putida clinical isolate,7 whereas no outbreak due to a blaIMP-13-expressing P. aeruginosa has ever been reported. The fact that P. monteilii expressing IMP-13 was recovered in the environment, although unrelated to any IMP-13 outbreak, further underlines the potential role of several Pseudomonas spp. to act as silent environmental reservoirs of metallo-β-lactamase genes.

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Transparency declarations
None to declare.

References
of MDR-TB. Since isoniazid has not been widely used as mono-
therapy for latent TB in China, this could explain the relative
lack of single resistance to isoniazid in new TB cases observed
in this study. It is obvious that percentages of TB cases with
resistance to any of the four drugs in the Zunyi area were
much higher than those from other provinces among previously
treated TB cases (Table 1), suggesting that the Zunyi area of
Guizhou province is one of the worst-affected areas in China
and should be included in future surveillance of drug resistance
in tuberculosis to better represent the prevalence of MDR-TB in
China.

To compare our results with those from other high-burden
countries, such as India and Russia, we selectively included in
Table 1 four studies with the highest proportions of MDR
among previously treated patients (from 49% in Haryana to
38.2% in Rajasthan) out of the eight studies from India,\(^6\) five
countries with the highest proportions of MDR among new TB
cases (from 14.4% in Latvia to 4.0% in Ivanovo Oblast)
out of 83 countries/territories surveyed between 2002 and 2007.\(^6\)

Comparison of the results shows that the Zunyi area of
Guizhou Province, China, has the highest rate of TB cases resistant
to ethambutol among previously treated patients (41.8%),
and is one of the top 10 areas in the world in terms of the esti-
mated proportion of MDR-TB cases among previously treated TB
cases. Consequently, more surveillance should be conducted in
the Zunyi area to monitor the trend of MDR-TB transmission,
improve the treatment outcomes of TB patients and control
the spread of drug-resistant TB, especially MDR-TB.

**Table 1.** Prevalence of drug resistance in previously treated and new tuberculosis cases from different geographical locations of the world

<table>
<thead>
<tr>
<th>Country or region</th>
<th>Study period</th>
<th>number of patients</th>
<th>RIF</th>
<th>INH</th>
<th>STR</th>
<th>EMB</th>
<th>MDR</th>
<th>number of patients</th>
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<th>INH</th>
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RIF, rifampicin; INH, isoniazid; STR, streptomycin; EMB, ethambutol; MDR, multidrug-resistant; NA, data not available.
\(^a\)Data from this study.
\(^b\)Weighted mean for 10 provinces of China: Beijing, Guangdong, Heilongjiang, Henan, Hubei, Inner Mongolia, Liaoning, Shandong, Shanghai and Zhejiang.

Comparison of the results shows that the Zunyi area of Guizhou Province, China, has the highest rate of TB cases resistant to ethambutol among previously treated patients (41.8%), and is one of the top 10 areas in the world in terms of the estimated proportion of MDR-TB cases among previously treated TB cases. Consequently, more surveillance should be conducted in the Zunyi area to monitor the trend of MDR-TB transmission, improve the treatment outcomes of TB patients and control the spread of drug-resistant TB, especially MDR-TB.

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Fluoroquinolone-resistant tuberculosis at a medical centre in Taiwan, 2005–10

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**Keywords:** fluoroquinolone resistance, TB, Mycobacterium tuberculosis

Sir,

Recently, van den Boogaard et al.1 reported that the rate of fluoroquinolone-resistant *Mycobacterium tuberculosis* in Tanzania was as low as 0.7% (2/291) and that resistance was not related to previous exposure to fluoroquinolones. In our previous study conducted in northern Taiwan, we found that patients of younger age had a higher rate of anti-tuberculosis (TB) drug resistance than patients of advanced age.2 However, few studies have evaluated the characteristics of patients with ofloxacin-resistant *M. tuberculosis* in Taiwan. Therefore, we performed this study to determine the risk factors associated with ofloxacin resistance among patients with TB in Taiwan.

This study was conducted at the National Taiwan University Hospital, a 2500-bed tertiary care centre in northern Taiwan. Isolates obtained from patients who had a culture positive for *M. tuberculosis* at the hospital during the period January 2005 to December 2010 were included in this retrospective analysis. A non-duplicate isolate was defined as a single isolate collected for evaluation from a single patient who visited the hospital. If a patient had multiple isolates, only the first isolate was analysed. All specimens were processed and pretreated as described previously.3 Testing of susceptibility to anti-TB drugs, including isoniazid (0.2 and 1.0 mg/L), rifampicin (1 mg/L), ethambutol (5 mg/L), ofloxacin (1 mg/L), streptomycin (2 and 10 mg/L), rifabutin (0.5 mg/L), ethionamide (5 mg/L) and para-aminosalicylic acid (PAS) (2 mg/L), was performed.3 Drug resistance was defined as resistance to isoniazid (0.2 mg/L), rifampicin (1 mg/L), ethambutol (5 mg/L), ofloxacin (1 mg/L) and streptomycin (2 mg/L).

During the study period, a total of 2693 non-duplicate isolates that had been isolated during the 6 year period were analysed. Among them, isoniazid resistance was found in 359 (13.3%) isolates and rifampicin resistance in 112 (4.2%). In addition, 106 (3.9%) isolates were resistant to ethambutol and 269 (10.0%) isolates were resistant to streptomycin. Overall, 89 (3.3%) isolates were considered multidrug-resistant (MDR) *M. tuberculosis*, and 36 (1.34%) of the isolates were resistant to ofloxacin. Associations between demographic characteristics, ofloxacin-resistant *M. tuberculosis* and MDR *M. tuberculosis* are shown in Table 1. We found that persons 34 to <44 years of age were more likely to have an ofloxacin-resistant *M. tuberculosis* strain than persons in any other age subgroup, including elderly patients (patients aged ≥64 years). A total of 5 of 36 ofloxacin-resistant isolates were collected from non-respiratory specimens, including two specimens from pleural fluid, two from urine and one from CSF. Furthermore, among 36 ofloxacin-resistant *M. tuberculosis* isolates, 28 (77.8%) were proven to be MDR *M. tuberculosis*, and only 8 (22.2%) isolates were susceptible to all of the first-line anti-TB drugs tested. The resistance rates among the second-line anti-TB drugs were 33.3% for PAS, 13.9% for ethionamide and 47.2% for rifabutin.

Huang et al.4 demonstrated that the rate of fluoroquinolone resistance increased markedly from 7.7% (95% confidence interval [CI] 7.14%–14.13%) during the period 1995–97 to 22.2% (95% CI 20.0%–30.0%) during the period 1998–2000. The resistance rate to ofloxacin among *M. tuberculosis* isolates in this study was only 1.34%, which is only marginally higher than the resistance rate to ciprofloxacin among *M. tuberculosis* isolates reported by van den Boogaard et al.1 (0.7%). Although susceptibility testing of ciprofloxacin was not performed in the present study, susceptibility profiles among *M. tuberculosis* isolates have been reported to be similar between ofloxacin and ciprofloxacin.5 Therefore, we suggest that antimicrobial resistance among *M. tuberculosis* isolates be monitored at different sites.

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References


4 Hanif M, Malik S, Dhingra VK. Acquired drug resistance pattern in *M. tuberculosis* have an ofloxacin-resistant strain than persons in any other age subgroup, including elderly patients (patients aged ≥64 years). A total of 5 of 36 ofloxacin-resistant isolates were collected from non-respiratory specimens, including two specimens from pleural fluid, two from urine and one from CSF. Furthermore, among 36 ofloxacin-resistant *M. tuberculosis* isolates, 28 (77.8%) were proven to be MDR *M. tuberculosis*, and only 8 (22.2%) isolates were susceptible to all of the first-line anti-TB drugs tested. The resistance rates among the second-line anti-TB drugs were 33.3% for PAS, 13.9% for ethionamide and 47.2% for rifabutin.

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