Predicting the future of XDR tuberculosis

The US Centers for Disease Control and Prevention (CDC) and Gandhi and colleagues have reported cases of extensively drug-resistant (XDR) tuberculosis; these cases have high mortality rates and the number of these cases seems to be increasing. XDR tuberculosis is now of great public-health concern. Many questions need to be answered before effective strategies for controlling the emerging global XDR tuberculosis epidemic can be designed. These questions can only be answered by the collection of appropriate data, but data collection takes time. Before these data are obtained some insights into XDR tuberculosis epidemiology could be acquired by analysing theoretical models. Models can be used as health policy tools to predict the evolution of drug-resistant strains and to design effective epidemic control strategies.

WHO has specified two targets for reducing the global tuberculosis epidemic: (1) detecting and treating at least 70% of sputum smear-positive cases (currently approximately 53% are detected), and (2) attaining an 85% cure rate (currently around 82% of drug-sensitive cases are cured, but the cure rates of drug-resistant cases are substantially lower). Epidemics that are driven mainly by drug-sensitive strains may be controlled by achieving the WHO targets. However, in certain areas multidrug-resistant (MDR) tuberculosis strains have arisen because of imperfect treatment adherence or inadequate treatment, or both; these strains are now being transmitted and the levels of MDR tuberculosis are rising. The virulent XDR tuberculosis strains have evolved from MDR strains through acquired resistance; in certain areas where levels of MDR tuberculosis are already high, such as South Korea and Latvia, 15–19% of the MDR tuberculosis cases are now XDR tuberculosis cases. It is essential to prevent the transmission of XDR tuberculosis strains, but it is also necessary to effectively control MDR tuberculosis epidemics to prevent MDR strains from evolving into XDR strains.

The potential epidemiological effects of reaching the WHO targets for tuberculosis control are not obvious, but can be predicted by using theoretical multi-strain models. If MDR tuberculosis case detection and treatment rates increase to the WHO target of 70%, without simultaneously increasing MDR tuberculosis cure rates, XDR tuberculosis could increase exponentially (figure). This exponential increase in XDR tuberculosis cases would be the result of the synergistic interaction of acquired resistance (from MDR tuberculosis strains) and transmitted resistance of post-MDR tuberculosis (ie, XDR tuberculosis strains). Under these conditions—ie, without the effective control of MDR tuberculosis epidemics—XDR tuberculosis will quickly become uncontrollable.

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We declare that we have no conflicts of interest.