Modeling the introduction of sterilizing treatment for tuberculosis in low- and middle-income countries

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To reduce the costs of tuberculosis (TB) treatment, in many low- and middle-income countries, active TB infections are still controlled by *non-sterilizing* treatment that leaves the patients latently infected, i.e., they still bear the pathogenic bacterium (Kochy bacilli) in a dormant state. These patients may still develop an active TB infection if malnutrition, comorbidities, or immuno-suppressive treatments weaken their immune systems. On the other hand, in countries with higher income, more expensive *sterilizing* treatment is offered to TB patients, leaving them pathogen-free.

In this presentation, we propose a mathematical model mimicking the introduction of sterilizing TB treatment in the presence of non-sterilizing TB treatment. Using this TB transmission model, we compare the epidemiological and economic performance of sterilizing and non-sterilizing cures in the long and short run. The proposed model presents the intuitive idea that sterilizing cure performs better in the long-term perspective. Yet, sterilizing treatment is considerably more expensive if the relative difference between the costs of the two treatments is maintained constant over a long time.

However, the relative cost of sterilizing treatment may decrease over time due to the development of new drug-producing technologies. In such a case, the sterilizing treatment may become even cheaper than the non-sterilizing treatment in the long-term perspective. Nonetheless, the introduction of sterilizing treatment may not seem appealing to the local healthcare authorities in low-

and middle-income countries because their long-term budget for TB control is designed according to the costs of non-sterilizing treatment.

We intend to provide solid arguments in favor of introducing gradually the sterilizing treatment within the limits of the fixed budget initially designed for only non-sterilizing treatment. For this purpose, we formulate an optimal control problem with resource allocation between the two treatments and solve it numerically under the budget constraint of the isoperimetric type. As a result, we obtain the optimal resource allocation scheme and perform different epidemiological assessments compared to the baseline case, which consists of using only non-sterilizing treatment.

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