Modelling and Parameter Identification of Tuberculosis in Cameroon

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Tuberculosis (TB) is a common lethal infectious disease usually caused by Mycobacterium tuberculosis. TB is a preventable and curable disease which most often affects the lungs. According to the WHO, TB to date, claims the second largest number of victims due to a single infectious agent right after HIV/AIDS. Although a widespread implementation of control measures focus on case finding and short-course chemotherapy, the global burden of TB has increased over the past two decades [1].

A deterministic model of tuberculosis in sub-Saharan Africa in general and Cameroon in particular is designed and analyzed with respect to its transmission dynamics. The model includes both frequency- and density-dependent transmissions. It is shown that the model is mathematically well-posed and epidemiologically reasonable. Solutions are non-negative and bounded whenever the initial values are non-negative. A sensitivity analysis of model parameters is performed and the most sensitive parameters of the model are identified using the Gauss-Newton Method [2]. In particular, parameters representing the proportion of individuals having access to medical facilities have a large impact on the dynamics of the disease. We demonstrate how an increase of these parameter values over time can significantly reduce the disease burden in the population within the next 15 years.

References

[1] WHO (2012). Fact sheet number 104. Technical report, World Health Organization, Geneva, Switzerland.

[2] Deuflhard, P. (2004). *Newton Methods for Nonlinear Problems: Affne Invariance and Adaptive Algorithms*, volume 35. Springer Series in Computational Mathematics. Springer Verlag, Berlin.