

Modeling The Dynamics of Substance Use and Abuse by Tertiary Students in Ghana

By

Eugene Tettey Ayerkain (eayerkain@aims.edu.gh)

July 2023

*AN ESSAY PRESENTED TO AIMS-GHANA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
MASTER OF SCIENCE IN MATHEMATICS*



AIMS

African Institute for
Mathematical Sciences
GHANA

Abstract

In this project, we model drug abuse as an infection. We developed a mathematical model comprising of six compartments to explain the dynamics of substance use and abuse among tertiary students in Ghana. Stability analysis was conducted using the linearisation approach after positivity and boundedness of solutions were established. Both the drug-free equilibrium and drug-endemic equilibrium points were obtained. The next generation matrix is used to find the drug reproductive number (R_0). Local stability of both equilibrium points were conducted, revealing the system to be locally asymptotically stable and unstable at the drug-free equilibrium and drug-endemic equilibrium respectively. We also performed sensitivity analysis on R_0 to determine the contribution of each parameter to the drug-reproductive number. It was found that the parameters β_2 and Λ had the most influence on R_0 . Numerical simulations are conducted in support of theoretical findings to visualize the dynamics of the system and effects of varying contact rates between susceptible individuals and heavy drug users (people from infectious compartments). Possible intervention strategies were established from both the theoretical and numerical analysis of the model. Information gained from sensitivity analysis and simulations led to the conclusion that reducing contact rates between non-users and heavy-users and maximizing the rate at which users go in for treatment will play a critical role in curbing the problem and in addition, education and sensitization campaigns on campuses with proper monitoring and evaluation by stakeholders and university authorities.

Keywords: *Drug abuse, drug reproductive number, sensitivity analysis, equilibrium points.*

Figure 4.1 represents the model for substance abuse among tertiary students in Ghana.

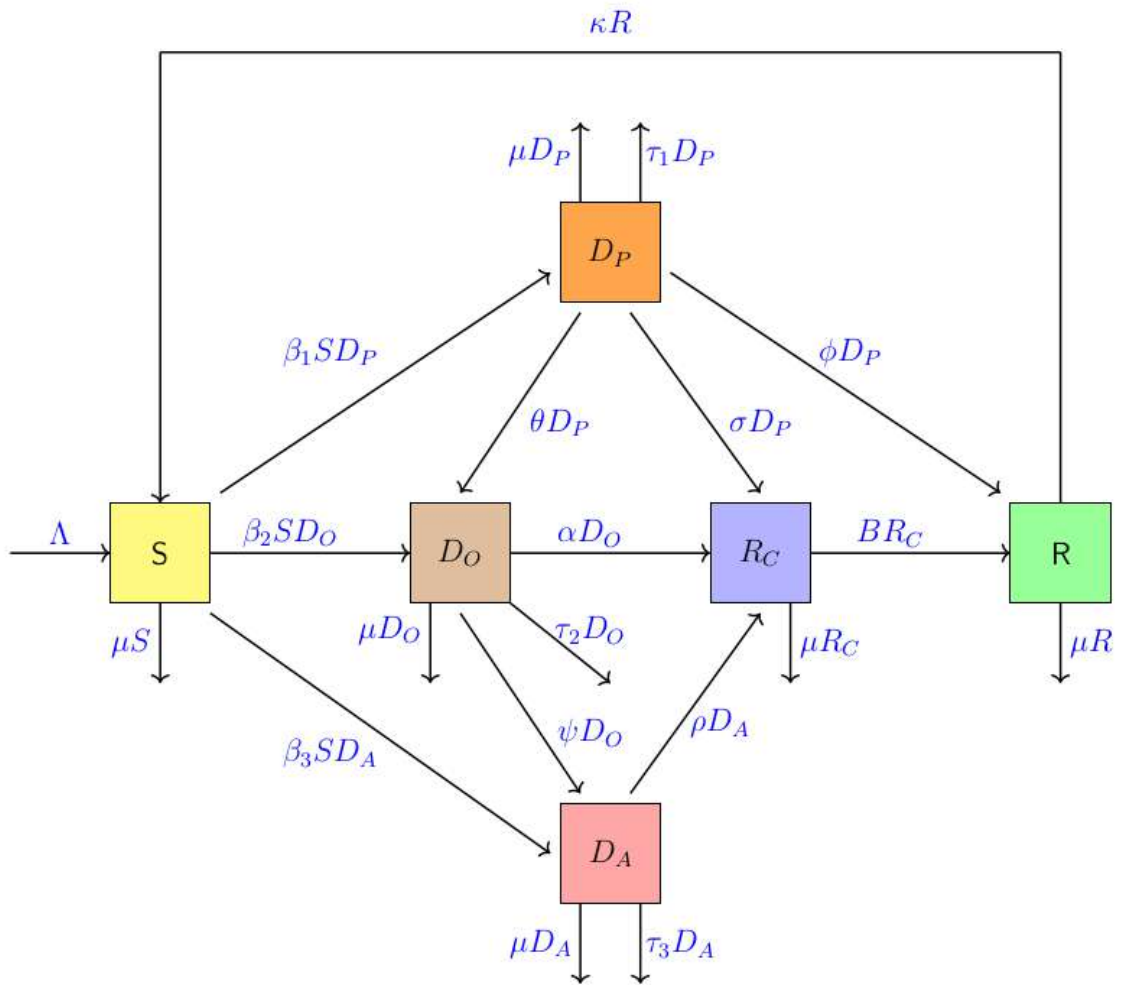


Figure 4.1: Schematic diagram of Substance abuse Model