



# Analysis and Optimal Control of a Mathematical Model of Malaria

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**Abstract:** In this work, we propose a mathematical model of malaria which takes into account the vector class represented by  $S_v, I_v$  and humans class represented by  $S_h, E_h, I_h$  and  $R_h$ . The basic reproduction number  $R_0$  of the model is determined. We introduce two controls in our initial model. Therefore, the model with control will be presented and studied. The objective of the model with optimal control is to observe the effect of preventive measures, represented here by control  $u_1$ , and curative measures, represented by control  $u_2$ , on the evolution of malaria disease. The controls  $u_1$  and  $u_2$  will be characterized. Then we use the Python software for the numerical simulation of the model.

**Keywords:** *malaria; reproduction number; vector; simulation; optimal control.*

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## 1 Introduction

Malaria is an acute febrile illness caused by Plasmodium parasites, which are spread to people through the bites of infected female Anopheles mosquitoes. It is preventable and curable. Malaria is a life-threatening disease primarily found in tropical countries. It was first discovered in India in the 15<sup>th</sup> century. However, without prompt diagnosis and effective treatment, a case of uncomplicated malaria can progress to a severe form of the disease, which is often fatal without treatment. Malaria is not contagious and cannot spread from one person to another; the disease is transmitted through the bites of female Anopheles mosquitoes. The world's population is at risk of exposure to malaria [9]. In 2021, an estimated 247 million people contracted malaria in 85 countries. That same year, the disease claimed approximately 619000 lives [9]. The first symptoms of malaria

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