

# Extension of the SIR Model Using a Stratified Population and a Hospital Compartment

Leonard MADA\*

Syonic SRL, Dr. Grigore T. Popa, no. 81, 300291 Timișoara, Romania  
E-mail: leo.mada@syonic.eu

\* Author to whom correspondence should be addressed

## Abstract

*Background and Aim:* The classical Susceptible-Infected-Removed (SIR) model is a very simple model for the spread of an infection. The aim of this work was to extend this model to include additional compartments for hospitalized and dead patients and to apply the model to a stratified population. *Materials and Methods:* The various mathematical models were implemented in R using the package deSolve and visualized using ggplot2 and shiny. Various model parameters were chosen artificially to explore the effects on the spread of an epidemic, but were not calibrated on real data. Output variables included daily hospitalization rates and death rates, as well as total patients in the hospital during each day. *Results:* The SIR model can be easily extended to include separate compartments for Recovered and Deceased patients. The population was stratified into young adults and old people; a proportion of 20% old persons was used for most analysis. Old people were modeled using higher rates of hospitalization and death. The daily rates of hospitalization and death were explored interactively using various model parameters. *Conclusion:* The extended SIR model was easy to use and allowed interactive exploration of various parameters. Such a model could be used to monitor a real epidemic and to forecast health-care resources needed during the epidemic.

**Keywords:** Compartmental models; Epidemiology; Infection rate; Age

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