Title of the Project: Transmission Dynamics and Spread of Infectious diseases: Modelling, Prediction and control.

Funding Agency	Council of Scientific and Industrial Research(CSIR)
Sanctioned Amount	Rs. 8.5 Lakhs
Project Duration	3 years
Project Status	Continuing since January, 2015

PI : Prof. Tapan Kumar Kar
Department of Mathematics, IIEST, Shibpur

Brief Description of the Project:

Mathematical models are particularly useful in the cases where field or laboratory data are not available, complete, appropriate, or directly applicable to the decision being made. In these cases, results from models often provided a valuable perspective on alternative decisions. However, even when extensive data are available, the complexity of the situation may require a model for interpreting interaction or expanding result to higher spatial scales, longer time scales, longer time scales, or higher levels of biological organization. The purpose of this project is to develop mathematical models on infectious disease which is to be used as a tool to study the mechanism by which disease spread, to predict the future course of an outbreak and to evaluate strategies to control an epidemic.

Keywords: Epidemics, vector, HIV/AIDS, SIR model, vaccination, Pontryagin's maximum principle

Methodologies/Approaches Adopted

Mathematical and computational modeling is an essential scientific tool to control the spared of infectious diseases. We shall do this in following fundamental ways (i) formulation of the initial questions, (ii) development of the conceptual model, (iii) construction of the model, (iv) testing and validation of the model For the purpose of modeling we may use mathematical tools like qualitative theory of ordinary differential equations, delay differential equations, stochastic differential equation, optimization techniques, numerical analysis and control theory beside the standard technique of cost benefit analysis used in economics. Attempts will be made to give interpretation of the mathematical results to the extent possible. For simultaneous purposes we shall use the software packages like Matlab, Mathematica etc.

Continued work on system model, start analysis and computer code development for simultaneous purposes, exchange of knowledge with clinicians, public health specialists. Review model for general impact on epidemics, discussion with the clinicians and public health specialists, completion of whole work and preparation of the final technical report.

Project Highlights

Two important aspects of the project are

1. Modelling at the Population Level (between-host modelling): This will focus on the modeling of transmission of disease (special focus on HIV, Malaria and TB) between host individuals using system of coupled ODEs, PDEs, contact networks, agent-based models, game theory, etc.

2. Public health aspects of disease modeling modelling: This will look at how modeling van inform public health aspects such as control measure foe epidemics and will also consider the problems from real world situations.

Project Achievements:

We except to discover new approaches (e.g. algorithms, computational strategies, modeling methods) and outcomes that will broadly assist others interested in constructing and analyzing epidemic modeling.

Publications:

1. Jana Soovoojeet,GuriaSrabani ,DasUttam, Kar T. K. and GhoraiAbhijit. Effect of harvesting and infection on predator in a prey–predator system Nonlinear Dyn (2015) 81:917–930. (Springer).
2. Jana Soovoojeet, HalderPalash, Nandi Swapan Kumar and Kar, T. K. Global dynamics of a SEIRS epidemic model with saturated disease transmission rate and vaccination control , Int. J. Appl. Comput. Math. DOI 10.1007/s40819-015-0088-9 (Springer).
3. Mondal ,Prasanta Kumar and Kar, T. K., Optimal treatment control and bifurcation analysis of a tuberculosis model with effect of multiple re-infections. Int. J. Dynam. Control DOI 10.1007/s40435-015-0176-z (Springer)
4. Mondal ,Prasanta Kumar, Jana Soovoojeet, HalderPalash and Kar, T. K.. Dynamical behavior of an epidemic model in a fuzzy transmission .International Journal of Uncertainty, 23(5)(2015) 651–665 (World Scientific).
5. Jana Soovoojeet and HalderPalash and Kar, T. K. Optimal control and stability analysis of an epidemic model with population dispersal. Chaos, Solitons and Fractals 83(2016) 67-81(Elsevier).
6. Jana Soovoojeet, HalderPalash and Kar, T. K. Complex dynamics of an epidemic model with vaccination and treatment controls. Int. J. Dynam. Control DOI 10.1007/s40435-015-0189-7 (Springer)

Project Staff

Dhiraj Kumar Das, M.Sc., Registered for PhD.