TO

ALMIGHTY, OMNIPRESENT & MERCYFUL GOD,

MY PARENTS, WIFE & BABY KALPA SHIKHA

(III)

SOCIO-ECONOMIC SYSTEMS ANALYSIS & DESIGN IN HEALTH CARE PLANNING

by

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CERTIFICATE

Certified that the thesis entitled, "Socio-Economic Systems Analysis and Design in Health Care Planning", which is being submitted by Mr. L.C. Agarwal for the degree of Doctor of Philosophy in Electrical Engineering of the Indian Institute of Technology, Delhi, is a record of the student's own work carried out by him under my supervision and guidance.

The matter embodied in this thesis has not been submitted for the award of any other degree.

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ABSTRACT

Lately systems engineers and operations researchers have been actively engaged in modelling large scale socio-economic systems such as the economic , educational, transportation, health care, military, communication systems, etc., which together constitute the environmental system in which man lives. With the inherent complexities involved in these systems, a multi-dimensional systems approach has become mandatory. The research in this thesis is particularly directed at investigating the problems associated with one of the important societal service systems, namely, the community health care delivery system.

Certain basic concepts and postulates of physical systems modelling theory have been suitably generalized to encompass modelling and analysis of a variety of socio-economic systems, which can be represented symbolically in terms of discrete components* and their interconnections. In the present research an effort has been made for its further appropriate generalization and extension to health service system, referred to above, with a view to incorporating spatial, structural and dynamic aspects in modelling, analysis and predictive applications.

A community health care delivery system has been viewed as a triad of health need, demand and resources in terms of a network theory based physical systems modelling framework, which

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* Recent advances in physical system theory have begun to extend its scope of application to systems and components which are characterized by continuum in space.

applies a component-to-system formulation approach. A real-life health service system for the IIT Delhi community serves as the backdrop against which the dynamic systems modelling and simulation in the thesis proceed at both conceptual as well as operational stages of research investigation.

Quite frequently the policy makers and health administrators for community health organizations, in the absence of an integrated systems approach, are confronted with resource deployment problems pertaining to duplication of resources, ineffective location of facilities and inefficient use of personnel etc. Since the health-care systems are generally faced with greater demand than they can satisfy, it is of vital importance to allocate the available resources in an optimally health-effective manner. A comprehensive approach to health planning must be based on the total macrocosm of the community in which an individual lives-the myriad of activities that are initiated when an individual seeks to improve his health-rather than on his health and use of available health services.

Since socio-economic systems, such as real-life community health care system, are profoundly influenced by social, administrative and human decisions of probabilistic nature, complete behaviour of such systems often cannot be described adequately by a deterministic model. A recourse is therefore taken to the component-to-system modelling construct of physical system theory to develop and empirically implement a stochastic system

model of health care delivery. The health service system is identified in our study as an aggregate of interconnected components with each component modelled in terms of two complementary variables - a through-variable Y, representing the flow of "patients" and an across-variable X, representing their per unit values. Identified components are modelled, atleast conceptually in isolation. From the component terminal equations and their inter-connection pattern a state model for the system is developed which describes the dynamics of the patient flow-volumes in four health states as well as their associated per unit values.

The empirical exercises of calibration, validation and prediction on behalf of the models are carried out in the specific context of the resident community and sickbay in I.I.T. Estate at a level of disaggregation corresponding to 13 population sub-groups and four patient health states for both deterministic as well as stochastic representation. A computer-aided methodology for health-care system planning through 'optimal' health-effective resource allocation strategy is suitably illustrated.

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