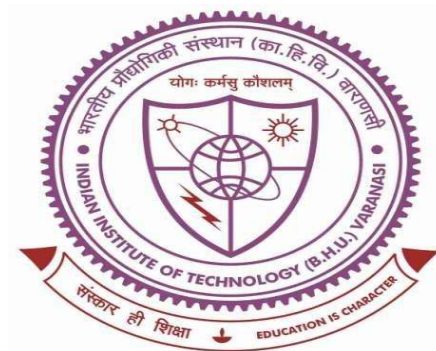


**Public Procurement, Policy, Socioeconomic Challenges, and  
Healthcare Burden in India: An Integrated Study on Medicine  
Distribution, Costs, and Out-of-Pocket Expenditures**



**Thesis submitted in partial fulfilment**

**for the Award of Degree**

**Doctor of Philosophy**

**By**

**Manikandan Arumugam**

**Department of Pharmaceutical Engineering and Technology**

**Indian Institute of Technology**

**Banaras Hindu University**

**Varanasi-221005**

## CERTIFICATE

---

It is certified that the work contained in the thesis titled “**Public Procurement, Policy, Socioeconomic Challenges, and Healthcare Burden in India: An Integrated Study on Medicine Distribution, Costs, and Out-of-Pocket Expenditures**” by **Manikandan Arumugam** has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy, and SOTA for the award of Ph.D. Degree.

**Prof (Dr) Hemalatha Siva**  
**Head of the Department**  
**(Supervisor)**

## DECLARATION BY THE CANDIDATE

---

I, **Manikandan Arumugam**, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of **Prof (Dr) Hemalatha Siva** from July 2021 to December 2024, at the Department of Pharmaceutical Engineering and Technology, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the researchers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

**Date:**

**Place:** IIT (BHU), Varanasi



**(Manikandan Arumugam)**

## DECLARATION BY THE SUPERVISOR

---

It is certified that the above statement made by the student is correct to the best of our knowledge.

**Prof (Dr) Hemalatha Siva**

**Head of the Department**

**(Supervisor)**

## COPYRIGHT TRANSFER CERTIFICATE

---

**Title of the Thesis** : Public Procurement, Policy, Socioeconomic Challenges, and Healthcare Burden in India: An Integrated Study on Medicine Distribution, Costs, and Out-of-Pocket Expenditures.

**Name of the Student** : Manikandan Arumugam

### Copyright Transfer

The undersigned hereby assigns to the Indian Institute of Technology (Banaras Hindu University) Varanasi all rights under copyright that may exist in and for the above thesis submitted for the award of the **Doctor of Philosophy**.

**Date:**

**Place:** IIT (BHU), Varanasi



(Manikandan Arumugam)

**Note:** However, the author may reproduce or authorize others to reproduce material extracted verbatim from the thesis or derivative of the thesis for author's personal use provided that the source and the Institute's copyright notice are indicated.

## ACKNOWLEDGEMENTS

---

I am very grateful to **Bharat Ratna Mahamana Pandit Madan Mohan Malaviya Ji** for providing such a divine platform. I extend my special thanks and gratitude to **Yogi Adityanath**, the Honorable Chief Minister of Uttar Pradesh, the Government of Uttar Pradesh, and the Government of India for granting me permission to pursue my Ph.D., enabling me to further my academic aspirations.

I thank my supervisor and HOD, **Prof. (Mrs.) Siva Hemalatha**, Department of Pharmaceutical Engineering & Technology, IIT (BHU), for her invaluable expertise, unwavering support, and inspiring mentorship throughout my research journey.

I would like to express my sincere gratitude to **Dr. Pramood Kumar Jain**, the then Director of IIT BHU, for his steadfast support and guidance in facilitating my Ph.D. registration. His encouragement was instrumental in embarking on this academic journey. I also thank **Dr. A.N. Sahu and Dr. Abha Mishra** (RPEC members) for their valuable insights and constructive evaluations. Their expertise and feedback have significantly shaped the direction and quality of my research.

I would like to express my gratitude to **Prof. Brahmeshwar Mishra, Prof. Sanjay Singh, Prof. S.K. Singh, Prof. Sushant Kumar Shrivastava, Prof. Sairam Krishnamurthy, Prof. Senthil Raja, Prof. M.S. Muthu, Dr. Ruchi Chawla, Dr. Gyan Prakash Modi, Dr. Vinod Tiwari, Dr. Sunil Kumar Mishra, Dr. Prasanta Kumar Nayak, Dr. Shreyansh Kumar Jain, Dr. Ashish Kumar Agrawal, Dr. Rajnish, Dr. Deepak Kumar, Dr. Dinesh Kumar, Dr. Jairam Meena, and Dr. Ashok Kumar.**

I extend my heartfelt gratitude to **Mr. S.P. Elangovan IAS (Retired), Mr. Umanath IAS,** Special Secretary to the Chief Minister of Tamil Nadu, **Mr. Devesh Chaturvedi IAS, Mr. Kanchan Verma IAS, Ms. Yamini Sarangi IAS, Ms. Poma Tuda IAS, Ms. Kartikeya Goel IAS, Mr. Muralidhar Reddy IAS, Mr. G.S. Naveen Kumar IAS, Ms. Anupuma Jorwal IAS, Mr. Balamurali IAS, and Mr. Akshath Verma IAS** for their encouragement and support during my Ph.D. journey.

I would like to express my heartfelt and special thanks to **Dr. K.M. Noorulla,** Associate Professor at Arsi University, Ethiopia, for his constant support, encouragement, and motivation throughout my Ph.D. journey.

I also acknowledge the **Technical and Non-technical staff** for their invaluable support throughout my Ph.D. journey.

I extend my special thanks to the **Medical Corporations and their Staffs** in Tamil Nadu, Kerala, Andhra Pradesh, Uttar Pradesh, Odisha, Rajasthan, and Chhattisgarh for their invaluable support in data collection during my Ph.D. journey. Your contributions have significantly enriched my research.

I would like to extend my special thanks to the **District Administration of Agra, CMO Agra, the Indian Medical Association (IMA Agra),** and both public and private hospitals in Agra for their invaluable support throughout my Ph.D. journey.

I would also like to express my heartfelt gratitude to **Dr. J.P. Singh, Dr. Vinay Kumar, Dr. Selvaraj Sakthivel, Dr. Pawan Kumar, Dr. Gnana Prakash, Dr. Mohd Yasir, Mr. Manish Kalwaniya, Dr. Swetlana Gautam, Mr. Gagan Singh, and Kaushal Singh** for their expertise and guidance, which have significantly enriched my research experience.

My heartiest thanks to **Ms. Nikitha, Mr. Desh Deepak, Mr. Neeraj Kumar, Ms. Amrita, and Mr. Obulu** - research scholars who supported this project by sharing their knowledge, suggestions, and value addition.

Last but not least, my heartfelt thanks go to the **Almighty** for His blessings and guidance, and to my **family members**:

Special thanks to my wife, **Mrs. Tabitha Manikandan**, for her unwavering support and encouragement, and to my son, **Master Vishwanath**, whose joy and laughter have been a constant source of motivation throughout my Ph.D. journey.

I also thank **Mr. Arumugam, Mrs. Valli Arumugam, Mrs. Anandalakshme Elangovan, Mr. Samuel Suresh, Mrs. Prassunna, Mr. Sasi Kumar, Mrs. Sathya Sasikumar, Miss Vandita, Mr. Sasidharan, Miss Soundarya** for their unwavering love, support, and encouragement throughout my Ph.D.

**Manikandan Arumugam**

# TABLE OF CONTENTS

---

<b>Chapter</b>	<b>Title</b>	<b>Page No</b>
	<b>ACKNOWLEDGEMENTS</b>	<b>v</b>
	<b>TABLE OF CONTENTS</b>	<b>viii</b>
	<b>LIST OF FIGURES</b>	<b>xi</b>
	<b>LIST OF TABLES</b>	<b>xii</b>
	<b>LIST OF ABBREVIATIONS/ACRONYMS</b>	<b>xiv</b>
	<b>PREFACE</b>	<b>xvii</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Background	1
	1.2 Sustainable Development Goals 3 (SDG 3) - Good Health and Well-being	2
	1.3 Out-of-Pocket Expenditure in Healthcare	4
	1.4 Socioeconomic Influences on Healthcare Expenditure	9
	1.5 Public Drug Procurement in India	11
	1.6 Focus of the Integrated Research Approach in this Thesis	12
	1.7 Organization of the Thesis	13
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>17</b>
	2.1 Government Efforts in Reducing the Burden of Medicine OOPE	17
	2.2 Burden of OOPE on Infectious Diseases such as Tuberculosis	22
	2.3 Burden of OOPE among Pregnant Women	28
	2.4 Public Drug Procurement and Distribution	31
<b>3</b>	<b>OBJECTIVES</b>	<b>36</b>

3.1	General Objective of this Integrated Study	36
3.2	Specific Objectives of this Integrated Study	36
<b>4</b>	<b>FINANCIAL BURDEN OF MEDICINES</b>	<b>38</b>
4.1	Background of the Study	38
4.2	Methodology	40
4.3	Results	49
4.4	Discussion	64
4.5	Limitations and Strengths of this Study	66
4.6	Conclusions	67
4.7	Strategic Recommendations Based on the Study's Findings	68
<b>5</b>	<b>TB DRUG THERAPY CHALLENGES</b>	<b>69</b>
5.1	Background of the Study	69
5.2	Methodology	71
5.3	Results	75
5.4	Discussion	93
5.5	Limitations and Strengths of this Study	97
5.6	Conclusions	97
5.7	Ethical Considerations	98
<b>6</b>	<b>FINANCIAL CONSIDERATIONS IN PREGNANCY OUTCOMES</b>	<b>99</b>
6.1	Background of the Study	99
6.2	Methodology	100
6.3	Results	106
6.4	Discussion	116
6.5	Limitations and Strengths of this Study	119

	6.6 Conclusions	120
	6.7 Ethical Considerations	120
<b>7</b>	<b>PUBLIC DRUG PROCUREMENT PERFORMANCE</b>	<b>122</b>
	7.1 Background of the Study	122
	7.2 Methodology	124
	7.3 Findings	131
	7.4 Discussion	140
	7.5 Limitations and Strengths of this Study	143
	7.6 Conclusions	143
	7.7 Strategic Recommendations	144
<b>8</b>	<b>SUMMARY AND CONCLUSION</b>	<b>145</b>
	8.1 Summary of this Integrated Study	145
	8.2 Conclusion of this Integrated Study	157
	8.3 Addressing Social Determinants of Health to Reduce Healthcare Inequities	158
	8.4 Strategic Recommendations	159
	8.5 Mechanisms for Implementing Policy Recommendations	160
	8.6 Future Scope of the Integrated Study	161
	<b>REFERENCES</b>	<b>163</b>
	<b>APPENDIX A</b>	<b>187</b>
	<b>APPENDIX B</b>	<b>207</b>
	<b>APPENDIX C</b>	<b>220</b>
	<b>APPENDIX D</b>	<b>230</b>
	<b>APPENDIX E</b>	<b>235</b>

## LIST OF FIGURES

---

Name of Figure	Page No
<b>Figure 1.1:</b> Sustainable Development Goals (17 SDGs)	3
<b>Figure 4.1:</b> Prisma Flow Chart	50

## LIST OF TABLES

---

Name of Table	Page No
<b>Table 4.1:</b> Concept Maps, Keywords, and Alternatives for Search Strategy	43
<b>Table 4.2:</b> Data Collection Form	48
<b>Table 4.3:</b> Methodical Integrity of the Included Studies	51
<b>Table 4.4:</b> Description of the Participant Demographics and the Methodology of the Survey Conducted in the Included Studies	52
<b>Table 4.5:</b> Description of the Statistical Analysis and Outcomes Reported in the Included Studies	54
<b>Table 5.1:</b> Descriptive statistics on the socio-demographic characteristics of People Living with TB in the study facilities (Oct 2022-Mar 2023), Agra District, Uttar Pradesh, India (n=2244)	76
<b>Table 5.2:</b> Medical characteristics of the study participants, service utilization and policy measures among public and private hospital patients (Oct 2022-Mar 2023), Agra District, Uttar Pradesh, India (n=2244)	79
<b>Table 5.3:</b> OOPE of the study participants, and policy measures among public and private hospital patients (Oct 2022-Mar 2023), Agra District, Uttar Pradesh, India (n=2244)	81
<b>Table 5.4:</b> Socio-demographic characteristics of health professionals, patients, and patient relatives around the study facilities for the qualitative findings (Oct 2022-Mar 2023), Agra District, Uttar Pradesh, India (n=49)	85
<b>Table 5.5:</b> Perceived factors contributing to the impaired public service utilization and OOPE on medicines by the health professionals, patients, and patient relatives in the study facilities (Oct 2022-Mar 2023), Agra District, Uttar Pradesh, India (n=49)	88
<b>Table 6.1:</b> Descriptive Statistics on the Socioeconomic, Demographic, and Geographic factors across three clusters of women who gave live births in the study setting (January 2023 to December 2023), Agra District, Uttar Pradesh, India	107

<b>Table 6.2:</b>	Financial and Healthcare Utilization variables across three clusters of women who gave live birth in the study setting (January 2023 to December 2023), Agra District, Uttar Pradesh, India	110
<b>Table 6.3:</b>	Perceived factors contributing to the burden of OOPE on pregnancy and related healthcare expenses in the study setting (January 2023 to December 2023), Agra District, Uttar Pradesh, India (n=50)	114
<b>Table 7.1:</b>	Sample States for the Study (Period of the Study: 2021-2022)	124
<b>Table 7.2:</b>	Public Drug Procurement – Key Performance Indicators and Scoring Criteria (Period of the Study: 2021-2022)	127
<b>Table 7.3:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Tamil Nadu (Period of the Study: 2021-2022)	132
<b>Table 7.4:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Andhra Pradesh (Period of the Study: 2021-2022)	133
<b>Table 7.5:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Rajasthan (Period of the Study: 2021-2022)	134
<b>Table 7.6:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Chhattisgarh (Period of the Study: 2021-2022)	135
<b>Table 7.7:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Uttar Pradesh (Period of the Study: 2021-2022)	136
<b>Table 7.8:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Odisha (Period of the Study: 2021-2022)	137
<b>Table 7.9:</b>	Public Drug Procurement – Key Performance Indicators Evaluation of Kerala (Period of the Study: 2021-2022)	138
<b>Table 7.10:</b>	Total Scores based on the Performance Indicators Evaluation on Sample States for the Study (Period of the Study: 2021-2022)	139

## LIST OF ABBREVIATIONS/ACRONYMS

---

ab - Abstract  
ABS - Abstract  
AIDS - Acquired Immunodeficiency Syndrome  
AIIMS - All-India Institute of Medical Sciences  
AML - Additional Medicines List  
APMSIDC - Andhra Pradesh Medical Services & Infrastructure Development Corporation  
ASHA - Accredited Social Health Activist  
ATT - Anti-TB Therapy  
AWW - Anganwadi Worker  
BPG - Benzathine Penicillin G Injection  
CBHI - Community-based Health Insurance  
CDS - Centralized Drug Procurement  
CES - Consumer Expenditure Surveys  
cGMP - Current Good Manufacturing Practices  
CGMSCL - Chhattisgarh Medical Services Corporation Limited  
CHARLS - China Health And Retirement Longitudinal Study  
CHC - Community Health Centers  
CHE - Catastrophic Health Expenditure/Current Health Expenditure  
CMO - Chief Medical Officer  
CPR - Centre for Policy Research  
DBT - Direct Benefit Transfers  
DGGHE - Domestic General Government Health Expenditure  
DLI - Digital Library of India  
DM - Diabetes mellitus  
DOT - Directly Observed Therapy  
DOTS - Directly Observed Treatment, Short-Course  
ECD - Elective Cesarean Delivery  
EMD - Earnest Money Deposit  
EML - Essential Medicines List  
FCFS - First-Come, First-Serve  
GDP - Gross Domestic Product  
GGE - General Government Expenditure  
GLP - Good Laboratory Practice  
GMP - Good Manufacturing Practices  
HIV - Human Immunodeficiency Virus

HMS - Health and Morbidity Survey  
ICMR - Indian Council of Medical Research  
ICSSR - Indian Council of Social Science Research  
INR - Indian Rupees  
IPHA - Indian Public Health Association  
IQR - Inter-Quartile Range  
IVF - *in-vitro* fertilization  
JAS - Jan Aushadhi Scheme  
JSY - Janani Suraksha Yojana  
KAMRC - Kala-azar Medical Research Centre  
KEY - Keywords  
km - Kilometers  
KMSCL - Kerala Medical Services Corporation Limited  
KPIs - Key Performance Indicators  
kw - Keywords  
LMIC - Low- and Middle-Income Countries  
MDR - Multidrug-resistant  
MeSH - Medical Subject Headings  
MoF - Ministry of Finance  
MoHFW - Ministry of Health and Family Welfare  
MRI - Magnetic Resonance Imaging  
MSME - Micro, Small, and Medium Enterprises  
NCD - Non-communicable Disease  
NHA - National Health Authority  
NHM - National Health Mission  
NPPA - National Pharmaceutical Pricing Authority  
NSSO - National Sample Survey Organization  
NTEP - National Tuberculosis Elimination Program  
NTEP - National Tuberculosis Elimination Programme  
OCP - Oral Contraceptive Pills  
OCV - Oral Cholera Vaccine  
OECD - Organisation for Economic Co-operation and Development  
OOP - Out-of-Pocket  
OOPE - Out-of-Pocket Expenditure/Out-of-Pocket Expense  
OPD - Out Patient Department  
OSMCL - Odisha State Medical Corporation Limited  
OTC - Over-the-counter

PCB – Pollution Control Board  
PFI - Population Foundation of India  
PHC - Primary Health Care  
PHFI - Public Health Foundation of India  
PICO - Patient/Population, Intervention, Comparison and Outcomes  
PLWHA - People living with HIV/AIDS  
PMJAY - Pradhan Mantri Jan Arogya Yojana  
PPM - Public-Private Mix  
PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses  
Pub - Public Sector  
Pvt - Private Sector  
Raj - Rajasthan  
RHD - Rheumatic Heart Disease  
RMSCL - Rajasthan Medical Services Corporation Limited  
Rs - Indian Rupees  
RSBY - Rastriya Swasthya Bima Yojana  
SAGE - Study on Global AGEing and Adult Health  
SD - Standard Deviation  
SDG - Sustainable Development Goals  
SES - Socioeconomic Status  
SNHAS - Subnational Health Accounts  
SVD - Spontaneous Vaginal Delivery  
TB - Tuberculosis  
THE - Total Health Expenditure  
ti - Title  
TN - Tamil Nadu  
TNMSC - Tamil Nadu Medical Services Corporation  
TPT - TB Prevention Therapy  
UHC - Universal Health Coverage  
UPMSCL - Uttar Pradesh Medical Supplies Corporation Limited  
USD - United States Dollar  
VHAI - Voluntary Health Association of India  
VL - Visceral Leishmaniasis  
WB - West Bengal  
WHO - World Health Organization  
WHO/HAI - World Health Organization/Health Action International

## PREFACE

---

The surge in medical out-of-pocket expenditures (OOPE) incurred by households and individuals, particularly in low and moderate-income countries (LMICs), is a pressing issue. OOPE for medicines is the most inequitable form of medical care financing, representing a significant obstacle to universal health coverage (UHC). High OOPE often forces individuals to forego essential medical care or face financial instability, with pharmaceutical expenses constituting a substantial portion of these costs. In LMICs, up to 56% of healthcare budgets are spent on medications.

India, with a population of approximately 1.40 billion, faces significant challenges in healthcare delivery, exacerbated by urbanization and demographic shifts toward non-communicable diseases (NCDs). The healthcare system is overburdened, with OOPE on medicines accounting for 70% of total healthcare expenditure. Public policy plays a crucial role in addressing OOPE, yet many households lack access to affordable healthcare, resulting in financial crises.

Tuberculosis (TB) remains a major infectious disease, with India experiencing high incidence rates. The limited affordability of TB treatment, coupled with high OOPE and inadequate health infrastructure, hampers efforts to achieve universal health coverage. Various national initiatives aim to reduce OOPE and improve medicine availability but are overshadowed by the growing needs of a large population.

The financial burden of pregnancy and childbirth in India is influenced by socioeconomic and demographic factors, with a significant portion of OOPE related to maternity services. The high costs associated with prenatal and postnatal care disproportionately impact lower-income groups, revealing the need for effective policy interventions. Geographic disparities in

healthcare access further exacerbate these challenges, emphasizing the necessity for expanded insurance coverage and support programs.

India's public drug procurement and distribution system faces numerous challenges, influenced by diverse regional strategies and complex state-specific policies. Inefficiencies and quality issues are prevalent due to inadequate regulation and fragmented frameworks. Evaluating these procurement processes is essential, focusing on efficiency, cost-effectiveness, and quality to enhance drug availability and public confidence.

Given the facts, this integrated study aims to holistically examine the multifaceted challenges surrounding healthcare access and medication distribution in India. The specific objectives of this integrated study include

- ***Study 1 - On Financial Burden of Medicines:*** To evaluate the impact of government efforts to reduce out-of-pocket expenditures for medicines in India (Systematic way of data synthesis based on published evidence).
- ***Study 2 - On TB Drug Therapy Challenges:*** To explore socioeconomic and health policy challenges concerning the availability, accessibility, and affordability of quality drug therapy among people living with tuberculosis.
- ***Study 3 - On Financial Considerations in Pregnancy Outcomes:*** To assess the impact of financial considerations on pregnancy outcomes and enhance healthcare access for expectant mothers.
- ***Study 4 - On Public Drug Procurement Performance:*** To conduct a performance assessment of public drug procurement across seven different states from diverse geographic regions in India, focusing on procurement efficiency, cost-effectiveness, and the quality of distribution systems.