



MALLA REDDY VISHWAVIDYAPEETH

(Deemed to be University)

Suraram X Roads, Jeedimetla, Hyderabad 500055

**School of Public Health, Emerging Healthcare & Technology
(SPHEHT)**

**COURSE STRUCTURE
&
SYLLABUS DOCUMENT**

**Master of Public Health
Year 2026–28 Batch**

Course Structure

SEMESTER - I								
S. No.	Category	Common/ Specialisation	Course Code	Name of the Subject	L	T	P	Credits
CORE								
1	MC	Common		Fundamentals of Epidemiology	3	1	0	4
2	MC	Common		Essentials of Biostatistics	2	2	0	4
3	MC	Common		Communicable and Noncommunicable Diseases	2	1	0	3
4	MC	Common		Behavioral Health Theories and Practices	2	1	0	3
5	MC	Common		Environmental and Occupational Health	3	1	0	4
6	MC	Common		Health Policy and Systems Research	1	1	0	2
7	VAC	Common		AI in Healthcare: Foundation	1	0	0	1
				TOTAL CONTACT HOURS	14	7	0	21
				TOTAL CREDITS				21

SEMESTER - II								
S. No.	Category	Common/ Specialisation	Course Code	Name of the Subject	L	T	P	Credits
CORE								
1	MC	Common		Advanced Epidemiology	2	1	0	3
2	MC	Common		Applied Biostatistics	2	1	0	3
3	MC	Common		Hospital and Healthcare Management	2	1	0	3
4	SEC	Common		Artificial Intelligence and Digital Health Informatics	1	1	0	2
5	MC	Common		Monitoring, Evaluation, Accountability, and Learning in Public Health Programmes	1	1	0	2
6	MC	Common		Reproductive, Maternal, Neonatal, Child, and Adolescent Health	3	0	0	3

SEMESTER - II								
S. No.	Category	Common/ Specialisation	Course Code	Name of the Subject	L	T	P	Credits
7	SI	Common		Summer Internship: Hospital and Community Health Systems	0	0	8	4
8	VAC	Common		Life and Professional Skills	0	0	2	1
				TOTAL CONTACT HOURS	11	5	10	26
				TOTAL CREDITS				21

SEMESTER - III							
S. No.	Category	Common/ Specialisation	Name of the Subject	L	T	P	Cr edi ts
CORE							
1	MC	Common	Applied Research Methods	2	1	0	3
2	MC	Common	Genetics and Human Disease	2	0	0	2
3	MC	Common	Health Economics and Financing	2	0	0	2
4	MD	Common	Interprofessional Practice in Public Health	1	1	0	2
5	SEC	Common	Data Analytics using MS-Excel and R Programming	1	2	0	3
6	MC	Common	Public Health Gerontology	2	0	0	2
SPECIALISATIONS/ELECTIVES (Choose Any Two)							
7	MS	Biostatistics	Advanced Statistical Methods	3	0	0	3
8	MS	Biostatistics	Categorical Data Analysis and Survival Analysis	3	0	0	3
7	MS	Epidemiology or Infectious	Infectious Disease Epidemiology	3	0	0	3
8	MS	Epidemiology	Experimental Epidemiology	3	0	0	3
7	MS	Health Data Science and Analytics	Healthcare Data Management and Programming	3	0	0	3
8	MS	Health Data Science and Analytics	Data Visualization and Health Communication	3	0	0	3
7	MS	Health Economics and Outcomes Research	Economic Decision Modeling and Cost-Effectiveness Analysis	3	0	0	3
8	MS	Health Economics and	Health Technology Assessment and Market Access	3	0	0	3

SEMESTER - III							
S. No.	Category	Common/ Specialisation	Name of the Subject	L	T	P	Credits
		Outcomes Research					
8	MS	Infectious Diseases	Antimicrobial Resistance and Vaccinology	3	0	0	3
7	MS	Maternal and Child Health	Maternal and Child Nutrition	3	0	0	3
8	MS	Maternal and Child Health	Maternal and Perinatal Mental Health	3	0	0	3
7	MS	Non-Communicable Diseases	Epidemiology of Non-Communicable Diseases	3	0	0	3
8	MS	Non-Communicable Diseases	Non-Pharmacological NCD Interventions	3	0	0	3
7	MS	Occupational Health and Industrial Hygiene	Principles of Industrial Hygiene and Workplace Safety	3	0	0	3
8	MS	Occupational Health and Industrial Hygiene	Occupational Medicine and Toxicology	3	0	0	3
7	MS	Planetary Health and Sustainability	Climate Change and Planetary Health	3	0	0	3
8	MS	Planetary Health and Sustainability	Environmental Risk Assessment and Mitigation	3	0	0	3
7	MS	Public Health Nutrition	Nutritional Epidemiology	3	0	0	3
8	MS	Public Health Nutrition	Nutrigenomics	3	0	0	3
			TOTAL CREDITS	16	4	0	20
			TOTAL CONTACT HOURS (Core + 2 Electives)	20			

SEMESTER - IV							
S. No.	Category	Common/ Specialisation	Name of the Subject	L	T	P	Credits
CORE							
1	SEC	Common	Healthcare Informatics	2	1	0	3

SEMESTER - IV							
S. N o.	Category	Common/ Specialisation	Name of the Subject	L	T	P	Credits
2	MC	Common	Global Health Governance and Diplomacy	3	1	0	4
3	VAC	Common	Public Health Governance, Law, and Bioethics	2	1	0	3
4	RP	Common	Capstone Project / Thesis	0	0	14	7
SPECIALISATIONS/ELECTIVES (Choose Any One)							
5	MS	Biostatistics	Big Data Analytics and Cloud Computing	2	1	0	3
5	MS	Epidemiology or Planetary Health and Sustainability	Spatial Epidemiology and GIS in Public Health	2	1	0	3
5	MS	Health Data Science and Analytics	Machine Learning and Predictive Analytics in Public Health	2	1	0	3
5	MS	Health Economics and Outcomes Research	Applied Econometrics for Health Data	2	1	0	3
5	MS	Infectious Diseases or Non-communicable Diseases	Infection-Associated Chronic Diseases	2	1	0	3
5	MS	Maternal and Child Health	Maternal and Neonatal Care Strategies	2	1	0	3
5	MS	Occupational Health and Industrial Hygiene	Occupational Health Exposure Assessment	2	1	0	3
5	MS	Public Health Nutrition	Nutrition Assessment and Counseling	2	1	0	3
			TOTAL	9	4	14	20
			TOTAL CONTACT HOURS	27			

Detailed Syllabus

Semester - I

Fundamentals of Epidemiology

Category: Major Core (MC) | **L-T-P:** 3-1-0 | **Credits:** 4

Course Objectives

- Introduce the foundational concepts, historical evolution, aims, basic principles, and transmission dynamics of epidemiology.
- Analyze mechanisms of disease surveillance, outbreak investigations, and epidemiological frameworks in public health practice.
- Evaluate approaches to disease prevention and assess the validity, reliability, and diagnostic performance of disease screening tests.
- Differentiate, critique, and design descriptive, analytical observational, and experimental epidemiological study designs.
- Compute and interpret standard measures of disease occurrence, risk, and association, applying analytical techniques to real-world datasets and field-level investigations.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the concepts, scope, historical evolution, and essential functions of public health.
- **CO2:** Analyze the determinants of health, population health concepts, and factors influencing health equity and disparities.
- **CO3:** Apply public health strategies for disease prevention, health promotion, health protection, and community health improvement.
- **CO4:** Evaluate healthcare systems, healthcare delivery models, and emerging public health innovations to recommend improvements in health services and population health.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA3 (Analytical Reasoning & Research Skills), GA5 (Effective Communication), GA7 (Reflective Thinking & Field Application), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Epidemiology

- Definition, historical evolution, and key pioneers of epidemiology
- Aims, primary functions, and foundational principles of epidemiology
- Role and relevance of epidemiology in population health and clinical decision-making

Unit II: Disease Outbreak Investigation and Surveillance

- Principles, objectives, and operational types of public health surveillance systems (active, passive, and sentinel)

- National surveillance frameworks and programmes (such as IDSP)
- Systematic step-by-step procedures for investigating an infectious disease outbreak
- Epidemic curves, attack rates, and formulating public health control measures

Unit III: Dynamics of Disease Transmission and Epidemiologic Triad

- Chain of infection: agents, reservoirs, portals of exit/entry, modes of transmission, and susceptible hosts
- The Epidemiologic Triad model: interaction between agent, host, and environmental factors
- Concepts of herd immunity, carrier states, incubation period, and their practical significance in disease control

Unit IV: Natural History of Disease

- Pathological continuum: stage of susceptibility, presymptomatic/subclinical phase, clinical disease, and outcomes (recovery, disability, death)
- Critical diagnostic windows, latency periods, and the iceberg phenomenon of disease
- Significance of the natural history of disease in clinical research and population-level health planning

Unit V: Disease Prevention and Screening

- Primordial, primary, secondary, and tertiary levels of disease prevention and intervention strategies
- Principles, criteria, and rationale for establishing population screening programs
- Diagnostic metrics for validity: sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)
- Evaluation of test reliability (repeatability) and sources of screening biases (lead-time and length bias)

Unit VI: Overview of Epidemiological Study Designs

- Classification hierarchy and taxonomy of epidemiological study designs
- Fundamental distinctions: descriptive versus analytical study designs
- Observational versus experimental paradigms: strengths, limitations, and selection criteria

Unit VII: Descriptive Observational Studies

- Case reports and case series: applications, utility in rare clinical conditions, and limitations
- Ecologic (correlational) studies and the concept of ecological fallacy
- Cross-sectional studies: methodology, point prevalence determination, and strengths/weaknesses

Unit VIII: Analytical Observational Studies

- Cohort studies: prospective, retrospective, and ambidirectional designs; calculating relative risk
- Case-control studies: selection of cases and controls, matching techniques, and calculating odds ratios
- Nested study designs: nested case-control and case-cohort architectures and their efficiencies
- Addressing systematic errors: selection bias, information bias, and confounding

Unit IX: Experimental and Quasi-Experimental Studies

- Design principles of Randomized Controlled Trials (RCTs): randomization, allocation concealment, and blinding/masking
- Quasi-experimental and community trial designs in population-level interventions
- Phases of clinical trials (Phase 0 through Phase IV) and ethical considerations in human research

Unit X: Measures of Disease Occurrence and Association

- Measures of disease occurrence: incidence (cumulative incidence, incidence density), prevalence (point, period), rates, ratios, and proportions
- Measures of association: Relative Risk (Risk Ratio), Rate Ratio, and Odds Ratio
- Measures of impact: Attributable Risk, Attributable Proportion, and Population Attributable Risk

Unit XI: Analytic Exercises and Practical Application

- Real-world data analysis: calculating 2x2 contingency tables, diagnostic accuracy metrics, and measures of risk
- Interpretation of published epidemiological papers and investigation reports
- Experiential field visit to healthcare or surveillance facilities to observe epidemiological workflow and data recording in practice

Suggested Readings

- Celentano, D. D., Szklo, M., & Farag, Y. Gordis Epidemiology. 7th ed. Elsevier.
- Aschengrau, A., & Seage, G. R. Essentials of Epidemiology in Public Health. 4th ed. Jones & Bartlett Learning.
- Szklo, M., & Nieto, F. J. Epidemiology Beyond the Basics. 4th ed. Jones & Bartlett Learning.

Essentials of Biostatistics

Category: Major Core (MC) | **L-T-P:** 2-2-0 | **Credits:** 4

Course Objectives

- Introduce the fundamental principles of random variables, probability theory, and theoretical probability distributions applied to health and epidemiological research.
- Develop competency in statistical software (R/SPSS) for data cleaning, manipulation, descriptive summarization, and advanced public health data visualization.
- Formulate appropriate sampling strategies, calculate necessary sample sizes, and determine statistical power for robust public health study designs.
- Apply bivariate inferential statistical tests, critically evaluating hypothesis testing frameworks, effect sizes, p-values, and confidence intervals.
- Perform end-to-end biostatistical analysis on complex real-world public health datasets to synthesize evidence and guide data-driven decision-making

Course Outcomes (COs):

- **CO1:** Interpret fundamental concepts of random variables, probability theory, and theoretical distributions in the context of epidemiological and health research.
- **CO2:** Utilize statistical software to manipulate, summarize, and visually communicate complex public health datasets.
- **CO3:** Determine appropriate sampling methods, sample sizes, and statistical power requirements for public health study designs.
- **CO4:** Conduct and interpret bivariate inferential statistical tests, critically evaluating hypotheses, p-values, and confidence intervals.
- **CO5:** Evaluate real-world public health datasets through comprehensive biostatistical analysis, drawing data-driven conclusions for evidence-based decision-making

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital & Technical Literacy, GA5: Effective Communication & Data Presentation, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Types of Variables and Data Distribution in Health Research

- Classification and scales of measurement: nominal, ordinal, discrete, and continuous variables
- Concept and characteristics of random variables in biomedical and public health studies
- Understanding data distributions: symmetry, skewness, and kurtosis

Unit II: Introduction to Statistical Software for Health Data Management

- Introduction to statistical computing environments (R / SPSS interface and architecture)
- Data entry, variable definition, importing/exporting health datasets, and data cleaning
- Data manipulation workflows: recoding variables, computing new indicators, filtering, and merging health datasets

Unit III: Descriptive Biostatistics and Precision Metrics

- Measures of central tendency: arithmetic mean, median, and mode (applications and sensitivity to outliers)
- Measures of dispersion: range, interquartile range (IQR), variance, and standard deviation (SD)

- Quantifying estimation precision: Standard Error of the Mean (SEM) vs. Standard Deviation (SD)
- Execution of descriptive summaries using statistical software packages

Unit IV: Data Visualization in Public Health

- Principles of effective graphical representation for epidemiological and clinical data
- Generation and selection of charts: bar charts, pie charts, histograms, frequency polygons, and box-and-whisker plots
- Visualizing bivariate patterns: scatter plots and line graphs
- Interpretation and reporting of graphical outputs for health communication

Unit V: Probability Theory and Discrete Distributions

- Core laws and axioms of probability: addition rule, multiplication rule, and conditional probability
- Concept of probability distributions for discrete random variables
- Binomial distribution: properties, assumptions, and public health applications
- Poisson distribution: characteristics and applications in modeling rare events and disease incidence rates

Unit VI: Continuous Distributions and the Central Limit Theorem

- Continuous probability distributions and the Gaussian (Normal) distribution curve
- Standard Normal Distribution and calculation/interpretation of Z-scores
- Sampling distribution of the mean and the Central Limit Theorem (CLT)
- Application of normal approximation in biostatistical parameter estimation

Unit VII: Framework of Statistical Inference and Hypothesis Testing

- Foundations of statistical inference: parameter estimation vs. hypothesis testing
- Null (H_0) and alternative (H_a) hypotheses; one-tailed vs. two-tailed tests
- Decision errors: Type I error (α), Type II error (β), and statistical power ($1 - \beta$)
- Statistical significance: understanding and interpreting p-values and 95% confidence intervals

Unit VIII: Sampling Techniques, Sample Size Determination, and Power Analysis

- Probability sampling methods (simple random, systematic, stratified, cluster, multistage) vs. non-probability sampling
- Concepts of sampling error and selection bias in population health studies
- Principles and formulas for sample size determination for estimating population means and proportions
- Statistical power analysis and minimum sample size requirements for hypothesis testing

Unit IX: Bivariate Inferential Methods and Software Execution

- Comparison of continuous means: Student's independent t-test, paired t-test, and One-Way ANOVA
- Analysis of categorical variables: Pearson's Chi-square test of independence, Fisher's exact test, and continuity corrections
- Correlation analysis: Pearson's correlation coefficient (r) and Spearman's rank correlation (ρ)
- Software-based execution, test assumption validation, and tabular reporting of bivariate tests

Unit X: Applied Biostatistics Lab: Real-World Public Health Data Analysis

- End-to-end data pipeline: formulation of research questions, data hygiene, and exploratory data analysis
- Implementation of integrated statistical workflows on epidemiological survey datasets (e.g., NFHS, NSSO, or disease registries)
- Synthesis of analytical results into academic tables and evidence summaries

- Critical interpretation of statistical findings to support public health policy and intervention planning

Suggested Readings

- Rosner, B. Fundamentals of Biostatistics. 8th ed. Cengage Learning, 2024.
- Singhal, Y. K. Methods in Biostatistics. 11th ed. Jaypee Brothers Medical Publishers, 2025.
- Petrie, A., & Sabin, C. Medical Statistics at a Glance. 4th ed. Wiley-Blackwell, 2019.
- Zuur, A. F., Ieno, E. N., & Meesters, E. H. W. G. A Beginner's Guide to R. Springer.
- Indrayan, A., & Malhotra, R. K. Medical Biostatistics. 4th ed. CRC Press/Chapman & Hall, 2017.

Communicable and Noncommunicable Diseases

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Explain the epidemiological transition, disease transmission dynamics, and epidemiology of communicable diseases.
- Describe the epidemiology, prevention, and control of major communicable diseases of public health importance.
- Explain the epidemiology, risk factors, prevention, and control of major noncommunicable diseases.
- Apply disease prevention principles and evaluate national and global policies, programmes, and strategies for disease control.
- Analyze public health case studies and apply evidence-based approaches to disease prevention and control in diverse population settings.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the epidemiological transition, disease transmission dynamics, and the epidemiology of communicable diseases.
- **CO2:** Describe the epidemiology, prevention, and control of major communicable diseases of public health importance.
- **CO3:** Explain the epidemiology, risk factors, prevention, and control of major noncommunicable diseases.
- **CO4:** Apply principles of disease prevention and evaluate national and global policies, programmes, and strategies for communicable and noncommunicable disease control.
- **CO5:** Analyze public health case studies and apply evidence-based approaches to disease prevention and control in diverse population settings.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Communication, GA7: Reflective Thinking & Field Application, GA8: Social Responsibility, Health Equity & Global Citizenship, GA10: Lifelong Learning & Self-Directed Growth

Unit I: The Epidemiological Transition and Disease Burden

- Shifts in disease patterns: historical transition from infectious to chronic diseases
- The "Double Burden" of disease and epidemiological transition in India
- Demographic transition, urbanization, lifestyle changes, and health system impacts

Unit II: Dynamics of Disease Transmission

- Elements of the chain of infection: reservoir, mode of transmission, and susceptible host
- Epidemiological parameters: Basic Reproduction Number (R_0) and Effective Reproduction Number (R_t)
- Herd immunity thresholds, serial intervals, and transmission modeling fundamentals

Unit III: Introduction to Communicable Diseases

- General concepts, classification, and public health impact of infectious diseases
- Surveillance mechanisms, notification guidelines, and epidemic potential
- Global health security and international frameworks for infectious disease containment

Unit IV: Major Infectious Diseases (I)

- Epidemiology, clinical features, and transmission of Tuberculosis; National Tuberculosis Elimination Programme (NTEP)
- Malaria: vector dynamics, epidemiology, diagnostic methods, and National Vector Borne Disease Control Programme
- Leprosy: clinical classification, epidemiology, and elimination strategies under NLEP

Unit V: Major Infectious Diseases (II)

- HIV/AIDS: global and national burden, modes of transmission, screening, and NACO/NACP strategies
- Viral Hepatitis (A, B, C, D, E): transmission routes, prevention, and National Viral Hepatitis Control Program (NVHCP)
- Harm reduction strategies, stigma mitigation, and continuum of care models

Unit VI: Vaccine-Preventable Diseases and Digital Immunization

- Childhood and adult vaccine-preventable diseases (measles, polio, diphtheria, pertussis, tetanus, rubella)
- Universal Immunization Programme (UIP) and targeted intensification via Mission Indradhanush
- Digital health applications in supply chains and beneficiary tracking: eVIN and the U-WIN platform

Unit VII: One Health and Zoonoses

- Cross-species transmission and the animal-human-environment interface
- Epidemiology, surveillance, and outbreak containment for emerging zoonoses: Nipah virus, Rabies, and Avian Influenza
- Implementation framework of the National One Health Mission and multisectoral coordination

Unit VIII: Introduction to Noncommunicable Diseases

- Overview, definitions, and rising trends in noncommunicable disease (NCD) morbidity and mortality
- Modifiable behavioral risk factors (tobacco, alcohol, unhealthy diet, physical inactivity) and metabolic markers
- Primary, secondary, and tertiary levels of prevention applied to chronic conditions

Unit IX: Cardiovascular and Chronic Respiratory Diseases

- Epidemiology, pathology, and management of Hypertension and Coronary Heart Disease
- Cerebrovascular accidents (Stroke): risk factors, emergency response, and post-stroke rehabilitation
- Chronic Obstructive Pulmonary Disease (COPD) and Asthma: indoor/outdoor environmental exposure and clinical burden

Unit X: Diabetes Mellitus and Obesity

- Diabetes Mellitus (Type 1 and Type 2): diagnostic criteria, glycemic control, and systemic micro/macrovacular complications
- Epidemiology of overweight and obesity, body mass index (BMI) cut-offs for Asian populations, and metabolic syndrome
- Community-based screening, lifestyle interventions, and lifestyle medicine frameworks

Unit XI: Oncology (Cancer Epidemiology)

- Cancer epidemiology: global and Indian cancer incidence, prevalence, and mortality patterns
- Site-specific priority cancers: oral, breast, and cervical cancers
- Cancer screening methodologies, early detection protocols, and palliative care integration

Unit XII: Mental Health and Noncommunicable Diseases

- Public health burden of common and severe mental disorders; bidirectional link between chronic illness and mental health
- National Mental Health Programme (NMHP) and integration of mental healthcare into primary health centers and NCD clinics
- Digital mental health solutions: architecture and delivery of the Tele-MANAS initiative

Unit XIII: National and Global Disease Control Policies and Frameworks

- National Programme for Prevention & Control of Non-Communicable Diseases (NP-NCD)
- Ayushman Arogya Mandir (Health and Wellness Centres) and primary care service packages
- WHO global action plans, NCD Best Buys, and Sustainable Development Goal targets (SDG 3.3 and 3.4)

Unit XIV: Case Studies and Public Health Applications

- Applied case analyses of real-world outbreak responses, cluster investigations, and chronic care programs
- Evidence-based synthesis: designing targeted interventions for vulnerable and underserved populations
- Evaluating implementation challenges and health system bottlenecks in disease control

Unit XV: Practical Experiential Learning and Field Visits

- Field visits to public healthcare facilities, NCD screening clinics, or disease surveillance units
- Observation of service delivery pathways, registries, cold chain infrastructure, and patient counseling
- Compilation and presentation of field assessment reports

Suggested Readings

- Park, K. *Park's Textbook of Preventive and Social Medicine*. 28th ed. Banarsidas Bhanot Publishers, 2025.
- Blaser, M. J., Cohen, J. I., & Holland, S. M. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*. 10th ed. Elsevier.
- Narain, J. P., & Kumar, R. *Textbook of Chronic Noncommunicable Diseases: The Health Challenge of 21st Century*. 1st ed. Jaypee Brothers Medical Publishers.

Behavioral Health Theories and Practices

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, history, scope, and biopsychosocial frameworks of behavioral health sciences in public health.
- Examine the biological, psychological, sociocultural, and structural determinants shaping human health behaviors and health equity.
- Apply individual, interpersonal, and ecological theories and models of behavior change to design effective public health interventions.
- Analyze methods of health communication, community engagement, needs assessment, and behavioral research for population-level health promotion.
- Evaluate ethical dilemmas, professional standards, emerging digital technologies, and contemporary innovations in behavioral health practice.

Course Outcomes:

- CO1: Explain the fundamental concepts, principles and scope of behavioral health sciences in public health.
- CO2: Describe the biological, psychological, social, cultural and environmental determinants influencing health behaviour.

- CO3: Apply behavioural science theories and models to understand health behaviours and design behaviour change interventions.
- CO4: Interpret the role of health communication, community engagement and behavioural research in promoting population health.
- CO5: Evaluate ethical issues, emerging technologies and contemporary approaches in behavioural health practice.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Communication & Health Promotion, GA6: Professional Ethics, Equity & Cultural Sensitivity, GA8: Social Responsibility, Community Engagement & Global Citizenship, GA10: Lifelong Learning & Self-Directed Growth

Unit I: Introduction to Behavioral Health Sciences

- Definition, scope, and importance of behavioral health sciences
- Public health and behavioral health: concepts and relationship
- Evolution and interdisciplinary nature of behavioral health sciences
- Biopsychosocial model of health
- Role of behavioral health sciences in disease prevention, health promotion, and population health

Unit II: Foundations of Behavioral Sciences

- Behaviourism: Classical and Operant Conditioning
- Social Learning Theory
- Cognitive theories of behaviour
- Developmental perspectives (Piaget, Vygotsky, and Erikson)
- Humanistic perspectives (Maslow and Rogers)

Unit III: Determinants of Health Behaviour

- Biological and psychological determinants
- Social and cultural determinants
- Family, peer, and community influences
- Environmental, commercial, and political determinants
- Health equity and social determinants of health

Unit IV: Health Behaviour Theories and Models

- Health Belief Model (HBM)
- Theory of Reasoned Action (TRA)
- Theory of Planned Behaviour (TPB)
- Social Cognitive Theory (SCT)
- Transtheoretical Model (TTM)

Unit V: Ecological and Community-Based Models

- Social Ecological Model
- Diffusion of Innovations Theory

- Community Organization Model
- PRECEDE-PROCEED Model
- Behaviour Change Wheel (COM-B framework)

Unit VI: Behaviour Change and Health Promotion

- Principles of behaviour change
- Health communication
- Information, Education, and Communication (IEC)
- Behaviour Change Communication (BCC) and Social and Behaviour Change Communication (SBCC)
- Social marketing and behavioural economics

Unit VII: Behavioural Assessment and Research

- Behavioural assessment and needs assessment
- Knowledge, Attitude, and Practice (KAP) studies
- Behavioural surveillance and health indicators
- Qualitative and quantitative methods in behavioural research
- Monitoring and evaluation of behaviour change interventions

Unit VIII: Community Engagement and Behavioural Interventions

- Community participation and empowerment
- Community mobilization
- Stakeholder engagement and multisectoral collaboration
- Behavioural counselling and supportive interventions
- Designing community-based behaviour change programmes

Unit IX: Ethics and Professional Issues in Behavioral Health

- Ethical principles in behavioural health practice and research
- Confidentiality and informed consent
- Cultural competence and working with diverse populations
- Professional responsibilities in behavioural health practice
- Legal and ethical issues in public health interventions

Unit X: Emerging Trends in Behavioral Health Sciences

- Digital health and mobile health interventions
- Telehealth and tele-counselling
- Artificial intelligence in behavioural health
- Wellness, resilience, and positive mental health
- Future directions in behavioural health sciences

Suggested Readings

- Glanz, K., Rimer, B. K., & Viswanath, K. *Health Behavior: Theory, Research, and Practice*. Jossey-Bass/Wiley.
- Coreil, J. *Social and Behavioral Foundations of Public Health*. SAGE Publications.
- Larsen, K. *Health Promotion in Health Care – Vital Theories and Research*. Routledge.

Environmental and Occupational Health

Category: Major Core (MC) | **L-T-P:** 3-1-0 | **Credits:** 4

Course Objectives

- Explain the foundational concepts, principles, and determinants of environmental and occupational health.
- Analyze physical, chemical, biological, radiological, and workplace hazards, environmental pollution, and climate change impacts on human health.
- Apply environmental sanitation, waste management, vector control, and workplace safety practices for disease prevention.
- Evaluate occupational health surveillance systems, risk assessment methods, hazard control hierarchies, ergonomics, and workplace safety regulations.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the concepts, principles, determinants, and significance of environmental and occupational health, including their role in protecting public health.
- **CO2:** Analyze environmental hazards, pollution, climate change, and workplace hazards to assess their impact on human health.
- **CO3:** Apply environmental health protection measures, occupational safety practices, and disease prevention strategies to promote healthy living and safe workplaces.
- **CO4:** Evaluate occupational health management systems, workplace risk assessment, hazard control measures, ergonomics, and health promotion strategies to improve occupational health and safety.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility, Sustainability & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Foundations of Environmental Health and Environmental Hazards

- Definition, concepts, scope, importance, environment–human health relationship, and determinants of environmental health
- Physical, chemical, biological, radiological, and psychosocial environmental hazards
- Environmental pollution sources, routes of exposure, and adverse health effects
- Radiation hazards, climate change dynamics, and environmental health risk assessment

Unit II: Environmental Health Protection and Sanitation Management

- Environmental sanitation principles, safe drinking water supply, and water quality standards
- Solid waste management, electronic waste (e-waste), and hazardous waste handling
- Biomedical waste management guidelines and municipal sewage disposal systems
- Vector control strategies, pest management, and environmental protection measures

Unit III: Foundations of Occupational Health, Diseases, and Workplace Safety

- Concepts, principles, and scope of occupational health across formal and informal work settings
- Workplace hazards and the impact of occupation on worker health
- Overview of occupational diseases, work-related illnesses, and occupational toxicities
- Work-related injury prevention, essential workplace safety practices, and accident control

Unit IV: Occupational Health Management, Ergonomics, and Risk Assessment

- Occupational health surveillance and workplace health risk assessment methodologies
- Hierarchy of hazard control measures (engineering, administrative, and personal controls)
- Ergonomics, workplace design, and Personal Protective Equipment (PPE) standards
- Workplace health promotion, occupational safety legislation, and health management systems

Suggested Readings

- Levy, B.S., Wegman, D.H., Baron, S.L., & Sokas, R.K. *Occupational and Environmental Health: Recognizing and Preventing Disease and Injury*. Oxford University Press.
- Park, K. *Park's Textbook of Preventive and Social Medicine*. Banarsidas Bhanot.
- Friis, R.H. *Essentials of Environmental Health*. Jones & Bartlett Learning.

Health Policy and Systems Research

Category: Major Core (MC) | **L-T-P:** 1-1-0 | **Credits:** 2

Course Objectives

- Introduce the foundational concepts, principles, evolution, and interdisciplinary scope of Health Policy and Systems Research (HPSR).
- Apply systems thinking and structural frameworks to analyze health systems, complex interactions, and comparative global delivery models.
- Examine the health policy lifecycle, governance, stewardship, and policy analysis frameworks including stakeholder dynamics.
- Evaluate health system performance, resilience, implementation research approaches, and strategies for evidence-informed policymaking.
- Critically appraise Indian and global health reforms, primary healthcare transformations, digital health innovations, and contemporary challenges.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the concepts, principles and scope of Health Policy and Systems Research (HPSR).
- **CO2:** Analyze health systems using systems thinking and health system frameworks.
- **CO3:** Examine health policy processes, governance mechanisms and policy analysis frameworks.
- **CO4:** Evaluate health system performance, strengthening strategies and evidence-informed policymaking.

- **CO5:** Critically appraise contemporary health system reforms and emerging challenges in national and global contexts.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Policy Research Skills, GA5: Effective Communication & Policy Advocacy, GA6: Professional Ethics, Governance & Accountability, GA8: Social Responsibility, Health Systems Equity & Global Health, GA10: Lifelong Learning & Evidence-Informed Practice

Unit I: Foundations of Health Policy and Systems Research

- Evolution, scope, and principles of Health Policy and Systems Research (HPSR)
- Health systems and health policy: concepts and interrelationship
- Goals, functions, and attributes of health systems
- Interdisciplinary nature of HPSR
- Role of HPSR in improving health system performance and population health

Unit II: Health Systems and Systems Thinking

- WHO Health System Building Blocks
- Systems thinking and complexity in health systems
- Health system actors, institutions, and interactions
- Comparative health system models (Beveridge, Bismarck, National Health Insurance, and Market-oriented systems)
- Universal Health Coverage and people-centred health systems

Unit III: Health Policy: Concepts, Process and Analysis

- Concepts, determinants, and typology of health policies
- Policy agenda setting and formulation
- Policy implementation and evaluation
- Walt and Gilson Policy Triangle Framework
- Stakeholder analysis and policy advocacy

Unit IV: Governance, Institutions and Leadership in Health Systems

- Governance, stewardship, and accountability
- Regulation and institutional arrangements in health systems
- Leadership for health system development
- Decentralization and intersectoral coordination
- Community participation and social accountability

Unit V: Health System Performance and Strengthening

- Health System Performance Assessment (HSPA)
- Dimensions of performance: quality, equity, efficiency, responsiveness, and access
- Health system resilience and adaptive capacity
- Primary Health Care as a strategy for health systems strengthening
- Monitoring progress towards Universal Health Coverage

Unit VI: Health Policy and Systems Research Approaches

- Research questions and conceptual frameworks in HPSR
- Policy analysis in HPSR
- Implementation research in health systems
- Embedded research for programme improvement
- Knowledge generation for health system strengthening

Unit VII: Evidence-Informed Policymaking and Knowledge Translation

- Evidence-informed policymaking
- Knowledge translation and knowledge-to-action framework
- Policy briefs and policy dialogues
- Research utilization in health policy decisions
- Barriers and facilitators to evidence uptake

Unit VIII: Health Reforms and Contemporary Challenges

- Evolution of the Indian Health System
- National Health Policy 2017 and major health sector reforms
- Ayushman Bharat and Comprehensive Primary Health Care
- Global health governance and Sustainable Development Goals
- Digital health and health system transformation
- Future directions in Health Policy and Systems Research

Suggested Readings

- Buse, K., Mays, N., & Walt, G. *Making Health Policy*. McGraw-Hill / Open University Press.
- Gilson, L. *Health Policy and Systems Research: A Methodology Reader*. World Health Organization.
- de Savigny, D., & Adam, T. *Systems Thinking for Health Systems Strengthening*. World Health Organization.

AI in Healthcare: Foundation

Category: Foundation | **Mode:** Lecture and hands-on demos (12 h) plus activities and assessment (4 h) | **Credits:** 1

Course Objectives

- Introduce core AI concepts and explain how they are applied across the healthcare system.
- Identify major healthcare use cases of AI and critically evaluate AI tools using basic performance measures.
- Apply ethical, legal, and regulatory principles to AI use in healthcare.
- Facilitate the responsible use of no-code AI tools to propose realistic healthcare solutions.

Course Outcomes: On completion, students will be able to:

- CO1: Explain core AI concepts (machine learning, deep learning, NLP, generative AI) and how they are applied across the healthcare system, in plain language.
- CO2: Identify and describe major healthcare use cases of AI, such as diagnostics and imaging, clinical decision support, drug discovery, public health surveillance, and hospital operations.
- CO3: Critically evaluate an AI tool's claims by interpreting basic performance measures (accuracy, sensitivity, specificity, false positives/negatives) and recognising bias, data-quality problems and limitations.
- CO4: Apply ethical, legal and regulatory principles (privacy, consent, fairness, accountability, transparency) to AI use in healthcare.
- CO5: Use no-code AI tools responsibly and propose a realistic AI solution for a healthcare problem in their own discipline.

Graduate Attributes Addressed: Disciplinary and interdisciplinary knowledge, Critical thinking and problem solving, Digital and technological literacy, Ethics, professionalism and social responsibility, Communication and teamwork, Innovation and entrepreneurship, Lifelong learning

Unit I: Introduction to AI and Health Data

- What AI is and isn't; AI vs ML vs deep learning; how machines "learn" from data (no maths).
- Types of health data (EHR, imaging, genomics, wearables); data quality and "garbage in, garbage out".
- Activity: train a simple image classifier using Teachable Machine.

Unit II: AI Applications in Healthcare

- Medical imaging (radiology, pathology, ophthalmology); clinical decision support and risk prediction.
- NLP for clinical notes; generative AI and chatbots; drug discovery; public health and epidemic surveillance; hospital operations and telemedicine.
- Activity: case demos and group discussion.

Unit III: Evaluating AI: Does It Actually Work?

- Reading performance metrics in plain terms; sensitivity vs specificity with clinical examples; overfitting.
- Validation and clinical trials of AI; bias and generalisability across populations; explainability.
- Activity: critique a published AI tool's claim.

Unit IV: Ethics, Law and Governance

- Patient privacy and consent (HIPAA/GDPR/India's DPDP Act at awareness level).
- Algorithmic bias and health equity; accountability when AI errs; regulation of AI as a medical device; human-in-the-loop principles.
- Activity: ethical dilemma role-play.

Unit V: Using AI Responsibly and Capstone

- Prompting generative AI for clinical and academic work; hallucinations and verification; future trends.
- Final group presentation proposing an AI solution to a healthcare problem.

Prerequisites

- None. No coding or mathematics beyond basic statistics is needed.
- Hands-on work uses no-code tools (e.g., ChatGPT/Claude, Teachable Machine, Orange Data Mining, Google Colab notebooks run as pre-built demos, public AI-demo sites for imaging and symptom checkers).

Teaching Methods

- Interactive lectures, live demonstrations, case-based learning, group discussions, role-play and short guided no-code exercises.

Recommended Readings

Key Textbooks & Reference Books

1. **Topol, E.** (2019). *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*. Basic Books.
2. **Bohr, A., & Memarzadeh, K.** (Eds.). (2020). *Artificial Intelligence in Healthcare*. Academic Press.
3. **Agrawal, A., Gans, J., & Goldfarb, A.** (2018). *Prediction Machines: The Simple Economics of Artificial Intelligence*. Harvard Business Review Press.

Regulatory Reports & Ethical Guidelines

1. **World Health Organization.** (2021). *Ethics and governance of artificial intelligence for health: WHO guidance*. Geneva: World Health Organization.
2. **Ministry of Law and Justice, Government of India.** (2023). *The Digital Personal Data Protection Act, 2023 (DPDP Act)*. Gazette of India.
3. **U.S. Food and Drug Administration (FDA).** (2021). *Artificial Intelligence/Machine Learning (AI/ML)-Based Software as a Medical Device (SaMD) Action Plan*.

Online Interactive & No-Code Resources

1. **Google Teachable Machine:**
<https://teachablemachine.withgoogle.com/>
2. **Orange Data Mining (Visual Programming & Interactive Workflows):**
<https://orangedatamining.com/>
3. **WHO / ITU Focus Group on Artificial Intelligence for Health (FG-AI4H)**
Resources: <https://www.who.int/initiatives/cih>

Semester II

Advanced Epidemiology

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Appraise advanced epidemiological study designs, evaluating their methodological strengths, operational limitations, and criteria for selection in public health research.
- Evaluate and interpret complex measures of disease occurrence, risk, and association, establishing the distinction between statistical association and causal inference.
- Formulate analytical and design strategies to identify, prevent, adjust for, and report major threats to internal validity (systematic bias, confounding, and effect measure modification).
- Apply advanced analytical methodologies, including stratification, multivariable modeling, and survival analysis, to epidemiological datasets.
- Evaluate epidemiological dynamics of priority communicable and noncommunicable diseases through applied secondary data analysis and field-level investigations.

Course Outcomes: On completion, students will be able to:

- **CO1:** To understand the strengths and limitations of various epidemiological study designs and learn how to select the most appropriate study design for a research project
- **CO2:** To evaluate and interpret measures of disease occurrence and association; differentiate between association and causation
- **CO3:** To identify and evaluate threats to validity of a research study (bias, confounding, and interaction/effect measure modification) and learn how to avoid and/or analyze and report them
- **CO4:** To gain epidemiological perspectives on communicable and noncommunicable diseases

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital & Technical Data Competency, GA5: Effective Communication, GA7: Reflective Thinking & Field Application, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Advanced Review and Selection of Epidemiological Study Designs

- Comparative appraisal of descriptive, observational analytical (cohort, case-control, nested), and experimental study architectures
- Methodological considerations, trade-offs, and feasibility criteria for selecting study designs in research projects
- Advanced sampling, matching, and recruitment strategies in epidemiological designs

Unit II: Measures of Disease Occurrence and Association

- Precision metrics and advanced estimation of incidence density, cumulative incidence, and period prevalence
- In-depth evaluation and interpretation of relative risk, rate ratios, odds ratios, and hazard ratios

- Absolute and attributable risk measures: attributable risk, population attributable fraction, and impact metrics

Unit III: Association and Causation

- Conceptual paradigms of causality in epidemiology: sufficiency, necessity, and component causes (Rothman's causal pies)
- Critical evaluation of Bradford Hill criteria for causal inference
- Differentiating statistical correlation, direct association, and true causal mechanisms

Unit IV: Stratification, Adjustment, and Multivariate Analysis

- Principles of stratified analysis: Mantel-Haenszel pooling methods and test of homogeneity
- Direct and indirect standardization techniques in population health data
- Introduction to multivariable modeling (multivariable linear, logistic, and proportional hazards regression) to adjust for covariates

Unit V: Survival Analysis in Epidemiological Research

- Time-to-event data concepts, censoring mechanisms (right, left, interval), and survival functions
- Life table methods and Kaplan-Meier product-limit estimation
- Log-rank test for comparing survival distributions and fundamentals of Cox proportional hazards regression

Unit VI: Threats to Validity – I: Bias

- Classification of systematic errors versus random error in epidemiological research
- Selection bias: Berkson's bias, healthy worker effect, non-response, and loss to follow-up
- Information (measurement) bias: recall bias, interviewer bias, reporting bias, and misclassification (differential vs. non-differential)
- Strategies to minimize and report bias in study design and execution

Unit VII: Threats to Validity – II: Confounding

- Definition, criteria, and mechanisms of confounding variables
- Directed Acyclic Graphs (DAGs) and conceptualizing confounding pathways
- Methods of handling confounding in study design (restriction, matching, randomization) and data analysis (stratification, regression adjustment)

Unit VIII: Threats to Validity – III: Interaction and Effect Measure Modification

- Definition and distinction between confounding and effect measure modification
- Additive versus multiplicative models of interaction

- Analytical approaches to test, evaluate, and report biological and statistical interaction

Unit IX: Epidemiological Perspective of Communicable Diseases

- Surveillance, transmission dynamics, and mathematical modeling (R_0 , herd immunity) of infectious agents
- Epidemic curves, attack rates, and advanced outbreak investigation protocols
- Epidemiological evaluation of emerging, re-emerging, and vaccine-preventable infectious diseases

Unit X: Epidemiological Perspective of Noncommunicable Diseases

- Chronic disease epidemiology: latency, multi-factorial etiology, and cumulative exposures
- Methodological approaches for tracking behavioral, metabolic, and environmental risk factors
- Evaluation of population screening programs, natural history interventions, and chronic disease registries

Unit XI: Practical Exercises and Secondary Data Analysis

- Hands-on computational exercises: calculating 2x2 contingency tables, stratified odds ratios, and survival metrics
- Secondary epidemiological data analysis using institutional/public health survey datasets
- Critical appraisal and synthesis of published epidemiological research papers

Unit XII: Experiential Learning and Field Visit

- Field visits to public health institutes, disease registries, or epidemiological surveillance centers
- Field-level data capture, validation, and real-world operational workflows
- Compilation, interpretation, and defense of field-based epidemiological observations

Suggested Readings

- Szklo, M., & Nieto, F. J. *Epidemiology Beyond the Basics*. 4th ed. Jones & Bartlett Learning.
- Celentano, D. D., Szklo, M., & Farag, Y. *Gordis Epidemiology*. 7th ed. Elsevier, 2023.
- Lash, T. L., VanderWeele, T. J., Haneuse, S., & Rothman, K. J. *Modern Epidemiology*. 4th ed. Wolters Kluwer, 2020.

Applied Biostatistics

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Appraise advanced epidemiological study designs, evaluating their methodological strengths, operational limitations, and criteria for selection in public health research.
- Evaluate and interpret complex measures of disease occurrence, risk, and association, establishing the distinction between statistical association and causal inference.
- Formulate analytical and design strategies to identify, prevent, adjust for, and report major threats to internal validity (systematic bias, confounding, and effect measure modification).
- Apply advanced analytical methodologies, including stratification, multivariable modeling, and survival analysis, to epidemiological datasets.
- Evaluate epidemiological dynamics of priority communicable and noncommunicable diseases through applied secondary data analysis and field-level investigations.

Course Outcomes: On completion, students will be able to:

- **CO1:** Execute core biostatistical data management tasks and apply advanced probability concepts (Bayesian inference, ROC curves, diagnostic accuracy) using statistical software.
- **CO2:** Perform and interpret parametric and non-parametric hypothesis tests for continuous variables (t-tests, ANOVA, ANCOVA, Wilcoxon, Mann-Whitney) on public health data.
- **CO3:** Analyze categorical datasets and measure inter-rater reliability using Chi-squared tests, exact methods, McNemar's test, and Kappa statistics.
- **CO4:** Evaluate epidemiologic associations (Risk Ratios, Odds Ratios) and build multivariable regression models (Linear, Logistic, Ordinal, Conditional) to assess confounding and interaction.
- **CO5:** Synthesize complex, multi-variable health datasets by designing end-to-end analytical pipelines, evaluating model fit, and drawing actionable public health conclusions.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital & Technical Data Competency, GA5: Effective Communication, GA7: Reflective Thinking & Field Application, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Review and Selection of Epidemiological Study Designs

- Methodological review of observational (descriptive and analytical) and experimental study designs
- Strengths, limitations, and operational trade-offs across cohort, case-control, cross-sectional, and experimental studies
- Practical considerations and criteria for selecting an appropriate study design for specific research questions and projects

Unit II: Measures of Disease Occurrence and Association

- Precision calculation and interpretation of incidence rates, incidence density, and cumulative incidence
- Evaluation of point and period prevalence measures in dynamic and fixed cohorts
- Critical estimation and comparative interpretation of measures of association: relative risk, odds ratios, and hazard ratios

Unit III: Association and Causation

- Conceptual paradigms of causality: direct vs. indirect association and spurious correlations
- Models of disease causation: sufficient cause and component causes (causal pie models)
- Critical appraisal and application of the Bradford Hill viewpoints/criteria for causal inference

Unit IV: Stratification, Adjustment, and Multivariate Analysis

- Principles and techniques of stratified analysis in epidemiology
- Mantel-Haenszel methods for pooled estimates and assessing homogeneity
- Fundamentals of multivariable regression modeling for covariate adjustment and control

Unit V: Survival Analysis

- Introduction to time-to-event data and mechanisms of censoring (right, left, and interval)
- Life table methods and Kaplan-Meier product-limit survival curve estimation
- Principles of comparing survival curves (log-rank test) and introduction to Cox proportional hazards models

Unit VI: Threats to Validity – I: Bias

- Nature and classification of systematic errors versus random error in epidemiological studies
- Selection bias: Berkson's bias, healthy worker effect, volunteer bias, and loss to follow-up
- Information/measurement bias: recall bias, interviewer bias, and differential vs. non-differential misclassification
- Methodological strategies to minimize, identify, and report bias

Unit VII: Threats to Validity – II: Confounding

- Definition, criteria, and operational mechanisms of confounding in epidemiological research

- Methods of identifying and evaluating confounding (including causal diagrams / DAGs)
- Strategies to control confounding in study design (randomization, restriction, matching) and analysis (stratification, multivariable modeling)

Unit VIII: Threats to Validity – III: Interaction and Effect Measure Modification

- Definition and concept of interaction / effect measure modification
- Differences and distinction between confounding and effect measure modification
- Additive versus multiplicative models of interaction, analytical evaluation, and reporting guidelines

Unit IX: Epidemiological Perspective of Communicable Diseases

- Surveillance mechanisms, transmission parameters (R_0), and epidemic modeling of infectious agents
- Outbreak investigation methodologies, epidemic curves, and secondary attack rates
- Epidemiological evaluation of priority, emerging, and re-emerging infectious diseases

Unit X: Epidemiological Perspective of Noncommunicable Diseases

- Chronic disease epidemiology: latency periods, multi-factorial causation, and natural history tracking
- Methodologies for monitoring behavioral, environmental, and metabolic risk factors
- Population screening programs, evaluation of diagnostic validity, and chronic disease registries

Unit XI: Practical Exercises and Secondary Data Analysis

- Hands-on computational exercises: contingency tables, stratified odds ratios, and risk calculations
- Secondary data analysis workflows using public health and epidemiological datasets
- Critical appraisal and synthesis of published epidemiological research studies

Unit XII: Experiential Learning and Field Visit

- Structured field visits to epidemiological surveillance units, disease registries, or public health institutions
- Field-level data collection protocols, operational workflows, and surveillance system assessment
- Preparation, synthesis, and presentation of field observation reports

Suggested Readings

- Szklo, M., & Nieto, F. J. *Epidemiology Beyond the Basics*. 4th ed. Jones & Bartlett Learning.
- Celentano, D. D., Szklo, M., & Farag, Y. *Gordis Epidemiology*. 7th ed. Elsevier, 2023.

- Lash, T. L., VanderWeele, T. J., Haneuse, S., & Rothman, K. J. *Modern Epidemiology*. 4th ed. Wolters Kluwer, 2020.

Hospital and Healthcare Management

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the Indian hospital landscape, structural classifications, health systems architecture, and core administrative leadership roles.
- Analyze facility planning, equipment requirements, staffing models, and operational workflows for clinical, critical care, and diagnostic departments.
- Evaluate hospital support operations, biomedical waste regulations, infection control protocols, and national quality accreditation frameworks (NABH, NQAS).
- Examine healthcare financing systems, universal health coverage mechanisms (AB-PMJAY), national health policies, and strategic human resource management.
- Assess public health logistics, cold chain systems, primary healthcare delivery networks, and health management information systems (HMIS/DHIS2) for monitoring and evaluation

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the structural frameworks, WHO health system building blocks, and administrative roles across hospital and public health organizations.
- **CO2:** Analyze the design, staffing, equipment requirements, and operational challenges of clinical, diagnostic, and emergency departments.
- **CO3:** Evaluate hospital support services, quality assurance frameworks, patient safety standards, and biomedical waste management protocols.
- **CO4:** Apply health policy, financing strategies, health insurance mechanisms (UHC/PMJAY), and human resource management principles in healthcare organizations.
- **CO5:** Assess public health supply chain logistics, primary healthcare delivery networks, and program monitoring & evaluation (M&E) frameworks.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA4: Healthcare Operations & Digital Systems Literacy, GA5: Effective Communication & Administrative Leadership, GA6: Professional Ethics, Patient Safety & Medico-Legal Compliance, GA8: Social Responsibility & Public Healthcare Systems Strengthening, GA10: Lifelong Learning & Continuous Quality Improvement

Unit I: Hospital Sector and Systems Framework

- Indian hospital landscape: public, private, corporate, and non-profit healthcare sectors

- Functional classification, grading, and architectural zoning of hospitals
- Systems dynamics and the role/responsibilities of a hospital administrator
- Hospital master planning, feasibility studies, and facility commissioning considerations

Unit II: Ambulatory and Inpatient Care Management

- Outpatient Department (OPD): layout, patient flow optimization, queuing systems, and registration
- Inpatient Department (IPD): ward planning, nursing stations, and room classifications
- Manpower, linen, and equipment planning for inpatient nursing units
- Bed management, occupancy metrics, admission workflows, and discharge planning

Unit III: Critical Care and Emergency Services

- Accident and Emergency (A&E) Department: triage protocols, disaster preparedness, and resuscitation zones
- Intensive Care Units (ICU): architectural design, zoning, monitoring technology, and staffing norms
- Operation Theatre (OT) suite management: zoning concepts, HVAC/laminar airflow, scheduling, and sterile corridors
- Design, isolation protocols, and operational management of infectious disease isolation facilities

Unit IV: Diagnostic and Sterilization Services

- Clinical Laboratories (pathology, microbiology, biochemistry): biosafety levels, equipment planning, and workflow design
- Radiology and Imaging Services: layout planning, AERB radiation safety norms, and equipment management
- Central Sterile Services Department (CSSD): layout (dirty, clean, sterile zones), sterilization methods, and equipment handling
- Quality control, turnaround times (TAT), and equipment maintenance contracts (AMC/CMC)

Unit V: Hospital Support Services and Waste Management

- Utility and facility services: medical gas pipeline systems (MGPS), dietary/kitchen, and mortuary services
- Administrative support: front office, billing, admission-discharge-transfer (ADT), and transport/ambulance services
- Medical Records Department (MRD): electronic health records, archiving, and legal retention periods
- Infection prevention and control protocols, surveillance of healthcare-associated infections (HAIs)

- Biomedical Waste Management (BMWM) Rules: segregation, containment, color coding, treatment, and disposal

Unit VI: Quality Management, Patient Safety, and Medico-Legal Aspects

- Quality management frameworks, continuous quality improvement (CQI), and patient safety standards
- Hospital accreditation systems: National Accreditation Board for Hospitals & Healthcare Providers (NABH) standards
- National Quality Assurance Standards (NQAS) for public health facilities
- Medico-legal aspects: Consumer Protection Act, informed consent, clinical negligence, and statutory clearances

Unit VII: Healthcare Systems and Policy

- WHO Six Building Blocks of Health Systems framework
- Comparative dynamics of public versus private healthcare delivery models in India
- National Health Policy 2017: goals, principles, and strategic directions
- National Health Mission (NHM): structural architecture, rural (NRHM) and urban (NUHM) implementation

Unit VIII: Healthcare Financing and Health Insurance

- Healthcare financing models and progress toward Universal Health Coverage (UHC)
- Catastrophic health expenditure and Out-of-Pocket Expenditure (OOPE) mitigation
- Risk pooling mechanisms, social health insurance, and community-based health insurance models
- Ayushman Bharat - Pradhan Mantri Jan Arogya Yojana (AB-PMJAY): empanelment, claim packages, and operations

Unit IX: Human Resources for Health (HRH)

- Health workforce planning, staffing norms (IPHS standards), and workload indicators
- Recruitment pathways, onboarding, and credentialing/privileging processes
- Retention strategies, working conditions, and motivating health personnel in rural/remote areas
- Performance appraisal systems, continuous medical education (CME), and grievance management

Unit X: Public Health Supply Chain and Logistics

- Public health procurement guidelines, tendering processes, and vendor management
- Essential Medicines List (EML) / Essential Drugs List (EDL) and standard treatment guidelines
- Inventory control methods: ABC, VED, FSN, and Economic Order Quantity (EOQ) analyses

- Cold chain infrastructure, temperature monitoring, and logistics management information systems (e-Aushadhi, DVDMS)

Unit XI: Primary Healthcare and Community Delivery Networks

- Comprehensive Primary Health Care (CPHC) paradigm and operationalization
- Ayushman Arogya Mandir (Health & Wellness Centres): service expansion, staffing, and community engagement
- Organizational functioning of Sub-Centres, Primary Health Centres (PHCs), and Community Health Centres (CHCs)
- Integration of grassroots health workers (ASHA, ANM, MPW) within community care networks

Unit XII: Health Program Management and M&E Frameworks

- Program planning lifecycle, logframes, and results-based monitoring and evaluation (M&E)
- Health management indicators: input, process, output, outcome, and impact metrics
- Digital health governance and routine data platforms: Health Management Information System (HMIS) and DHIS2
- Data auditing, data quality assessment, and evidence-informed administrative decision-making

Suggested Readings

- Burns, L. R., Bradley, E. H., & Weiner, B. J. *Shortell & Kaluzny's Health Care Management: Organization Design and Behavior*. 7th ed. Cengage Learning, 2020.
- Knickman, J. R., & Elbel, B. *Jonas and Kovner's Health Care Delivery in the United States*. 13th ed. Springer Publishing Company, 2023.
- Joshi, D. C., & Joshi, M. *Hospital Administration*. 2nd ed. Jaypee Brothers Medical Publishers, 2022.
- Buchbinder, S. B., Shanks, N. H., & Kite, B. J. *Introduction to Health Care Management*. 4th ed. Jones & Bartlett Learning, 2021.
- Kunders, G. D. *Hospitals: Facilities Planning and Management*. McGraw-Hill Education.

Artificial Intelligence and Digital Health Informatics

Category: Skill Enhancement Courses (SEC) | **L-T-P:** 1-1-0 | **Credits:** 2

Course Objectives

- Introduce core digital health concepts, global strategies, electronic health record architectures, and interoperability standards in public health.
- Examine artificial intelligence, machine learning, deep learning, and natural language processing applications for epidemiological analysis and predictive modeling.

- Evaluate mobile health solutions, telemedicine systems, remote monitoring technologies, and implementation science frameworks for population health delivery.
- Analyze health data governance, privacy regulations, cybersecurity, algorithmic fairness, and ethical frameworks for healthcare AI deployments.
- Design data-driven digital health strategies, interactive dashboard prototypes, and scalable AI solutions to address complex public health challenges.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain core digital health architectures, health information standards, and electronic health record (EHR/EMR) interoperability frameworks.
- **CO2:** Apply artificial intelligence, machine learning, and natural language processing (NLP) methodologies to analyze epidemiological and public health datasets.
- **CO3:** Evaluate digital health interventions, telemedicine tools, and mobile health (mHealth) applications for population health delivery.
- **CO4:** Critically analyze algorithmic bias, privacy regulations, data governance, and ethical frameworks in healthcare AI implementations.
- **CO5:** Design scalable, AI-driven digital health strategies and dashboard solutions to address public health challenges.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA4 (Practical & Health Assessment Skills / Research Aptitude), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Digital Health & Health Informatics

- Concepts, scope, and digital transformation in health systems and public health practice
- WHO Global Strategy on Digital Health: strategic objectives and implementation frameworks
- Health system integration: overcoming fragmentation and advancing digital maturity

Unit II: Health Data Architecture & Interoperability

- Electronic Health Records (EHR) and Electronic Medical Records (EMR): architecture and workflows
- Health Information Exchanges (HIE) and centralized versus federated health data models
- Health data standards and terminologies: HL7, FHIR, ICD-11, and SNOMED CT
- Principles of health data storage, management, hygiene, and lifecycle governance

Unit III: AI & Machine Learning in Healthcare

- Fundamentals of machine learning: supervised, unsupervised, and semi-supervised learning paradigms
- Deep learning architectures and neural networks in biomedical data analysis
- Predictive modeling, classification algorithms, and risk stratification for population health outcomes

Unit IV: Natural Language Processing (NLP) & Medical LLMs

- Text mining and information extraction from unstructured clinical notes, registries, and narrative data
- NLP-driven syndromic surveillance and monitoring digital health signals
- Large Language Models (LLMs) and Generative AI applications in public health communication and decision support

Unit V: AI in Epidemiological Surveillance & Disease Modeling

- Automated disease outbreak detection and infectious disease trajectory modeling
- Geospatial analytics, Geographic Information Systems (GIS), and spatial-temporal disease mapping
- Syndromic surveillance algorithms and integration of multi-source non-traditional health data

Unit VI: mHealth, Telemedicine & Remote Patient Monitoring

- Telemedicine platforms, store-and-forward models, and virtual care delivery networks
- Mobile health (mHealth) interventions, digital tools for community health workers, and behavioral nudges
- Internet of Medical Things (IoMT), wearable biosensors, and remote patient monitoring systems
- Digital therapeutics (DTx): evidence base, clinical validation, and chronic disease management

Unit VII: Evaluation & Implementation Science of Digital Health

- Implementation frameworks for digital health interventions (e.g., WHO guidelines, RE-AIM)
- Assessing clinical efficacy, user adoption, usability testing, and human-centered design
- Cost-effectiveness, scalability metrics, and Return on Investment (ROI) evaluation in digital health

Unit VIII: Health Data Governance & Regulations

- Global and national data privacy frameworks: HIPAA, GDPR, and Indian legislative mandates (DPDP / DISHA)

- Health data ownership, consent architectures, and data de-identification/anonymization
- Cybersecurity standards, health infrastructure vulnerability mitigation, and ransomware prevention
- Regulatory pathways and approval lifecycles for Software as a Medical Device (SaMD)

Unit IX: Algorithmic Bias, Health Equity & Explainable AI (XAI)

- Sources of algorithmic bias, demographic underrepresentation, and risks of worsening health inequities
- Ethical principles for healthcare AI based on WHO Guidance (governance, autonomy, fairness, sustainability)
- Explainable AI (XAI): black-box models, interpretability techniques (SHAP, LIME), and transparency in clinical workflows

Unit X: Applied Studio / Hands-on Digital Health Lab

- Critical appraisal and audit of real-world healthcare AI tools and clinical decision support systems
- Interactive dashboard prototyping and public health data visualization exercises
- Formulation and defense of a comprehensive digital health innovation project proposal

Suggested Readings

- Hoyt, R. E., & Yoshihashi, P. R. *Health Informatics: Practical Guide*. 8th ed. Informatics Education, 2022.
- Panesar, A. *Machine Learning and AI for Healthcare*. 2nd ed. Apress, 2021.
- World Health Organization. *Ethics and Governance of Artificial Intelligence for Health: WHO Guidance*. World Health Organization, 2021.
- Rivas, H. *Digital Health: Entrepreneurship and Innovation in Healthcare Systems*. 1st ed. Elsevier, 2021.

Monitoring, Evaluation, Accountability, and Learning in Public Health Programmes

Category: Major Core (MC) | **L-T-P:** 1-1-0 | **Credits:** 2

Course Objectives

- Introduce the foundational principles, core purposes, and operational distinctions between monitoring and evaluation in health systems.
- Formulate and analyze program logic models and results frameworks linking inputs, processes, outputs, outcomes, and long-term impact.
- Construct, evaluate, and interpret health indicators using routine health data sources for continuous program tracking.

- Examine quantitative and qualitative evaluation methodologies to assess health program implementation, outcomes, and performance.
- Apply principles of data quality assurance, effective data visualization, ethical data stewardship, and evidence-informed decision-making.

Course Outcomes (COs):

- **CO1:** Understand the basic concepts, purpose, and key framework of monitoring and evaluation in public health.
- **CO2:** Identify health indicators and sources of routine data used to track health program progress.
- **CO3:** Understand basic evaluation methods used to assess health program performance and outcomes.
- **CO4:** Explain the principles of data quality, clear reporting, ethical data use, and evidence-based decision-making.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital Health & Routine Data Systems Competency, GA5: Effective Communication & Visual Reporting, GA6: Professional Ethics, Governance & Confidentiality, GA10: Lifelong Learning & Evidence-Based Decision-Making

Unit I: Introduction to Monitoring and Evaluation

- Basic definitions, concepts, and key distinctions: monitoring versus evaluation
- Significance and strategic importance of M&E in public health services and health systems
- Understanding program logic models: inputs, processes, outputs, outcomes, and impact
- Conceptual frameworks and results chains for health program planning and monitoring

Unit II: Health Indicators and Data Sources

- Definition, classifications, and levels of health indicators
- Selection criteria and characteristics of good health indicators
- Sources of routine health data, civil registration, and health management information systems
- Basic tools and operational methods for ongoing health monitoring and progress tracking

Unit III: Basic Evaluation Methods

- Types of program evaluation: process evaluation, outcome evaluation, and impact evaluation

- Introduction to quantitative and qualitative data collection tools in evaluation
- Key operational steps and considerations in planning a health program evaluation
- Assessing health program performance, effectiveness, and service delivery outcomes

Unit IV: Data Quality, Reporting, and Ethics

- Importance of data accuracy, validation, and routine data verification methods
- Data visualization, reporting techniques, and presenting M&E findings to stakeholders
- Utilizing M&E data for evidence-based decision-making and continuous health service improvement
- Ethical considerations, data privacy, and confidentiality in health data management

Suggested Readings

- Edberg, M. *Public Health Program Planning and Evaluation*. Jones & Bartlett Learning.
- Centers for Disease Control and Prevention. *Framework for Program Evaluation in Public Health*. Centers for Disease Control and Prevention.

Reproductive, Maternal, Neonatal, Child, and Adolescent Health

Category: Major Core (MC) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the conceptual evolution, life-course paradigm, continuum of care, and epidemiological burden of reproductive, maternal, newborn, child, and adolescent health.
- Analyze the biological, social, gender, economic, and environmental determinants shaping disparities and health equity across vulnerable populations.
- Examine evidence-based clinical and community interventions spanning sexual and reproductive health, safe motherhood, essential newborn care, and adolescent development.
- Evaluate key national flagship health missions, strategies, and guidelines (e.g., NHM, RMNCAH+N, SUMAN, LaQshya, RKSK, RBSK, and POSHAN Abhiyaan).
- Formulate robust public health approaches using routine monitoring indicators, health information systems, quality improvement frameworks, and digital health innovations.

Course Outcomes: On completion, students will be able to:

- CO1: Explain the epidemiology, determinants, and burden of reproductive, maternal, newborn, child, and adolescent health in India and globally.
- CO2: Critically evaluate evidence-based interventions and national and international programmes addressing RMNCH+A across the continuum of care.

- CO3: Assess the implementation, monitoring, and quality of RMNCH+A services using public health approaches and health system frameworks.
- CO4: Develop public health strategies to improve RMNCH+A outcomes through policy, programme planning, community engagement, and intersectoral collaboration.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Communication & Community Advocacy, GA6: Professional Ethics, Human Rights & Gender Sensitivity, GA8: Social Responsibility, Health Equity & Global Maternal-Child Health, GA10: Lifelong Learning & Evidence-Based Public Health Practice

Unit I: Introduction to RMNCH+A

- Evolution of maternal and child frameworks: MCH to RCH, RMNCH+A, and RMNCAH+N
- Life-course perspective and the continuum of care across stages and delivery levels
- Global priorities and Sustainable Development Goals (SDG 3 and related targets)
- Current burden, epidemiological patterns, and demographic trends in India and globally

Unit II: Determinants of RMNCH+A

- Social determinants of health, poverty, education, and social vulnerability
- Gender dynamics, human rights frameworks, and health equity considerations
- Cultural practices, traditional beliefs, and community health dynamics
- Nutritional, environmental, and commercial determinants influencing maternal and child outcomes

Unit III: Reproductive Health

- Sexual and reproductive health rights (SRHR) and preconception care
- Family planning services, modern contraceptive choices, and unmet need
- Infertility management and safe abortion services/regulations
- Sexually transmitted infections (STIs) and reproductive tract infections (RTIs) across the life course

Unit IV: Maternal Health

- Safe motherhood concepts: antenatal (ANC), intrapartum, and postnatal care (PNC)
- Maternal nutrition, anemia prevention, and high-risk pregnancy screening
- Patterns of maternal morbidity and causes of maternal mortality
- Maternal Death Surveillance and Response (MDSR) system
- Quality of intrapartum care, labor room standards, and respectful maternity care (RMC)

Unit V: Newborn Health

- Essential newborn care (ENBC), resuscitation protocols, and thermal protection
- Evidence-based neonatal survival strategies and early danger sign identification
- Care of preterm, low birth weight (LBW), and small for gestational age infants (KMC, SNCU/NBSU)
- Promotion of early initiation and exclusive breastfeeding, and lactation support
- Neonatal screening protocols and structural interventions to curb neonatal mortality

Unit VI: Child Health

- Principles of child physical, cognitive, and social development
- Integrated Management of Neonatal and Childhood Illness (IMNCI) guidelines
- Universal Immunization Programme (UIP) and national vaccination schedules
- Childhood nutrition, management of Severe Acute Malnutrition (SAM/MAM), and micronutrient deficiencies
- Prevention, diagnosis, and triage of common childhood illnesses (diarrhea, pneumonia) and developmental disabilities

Unit VII: Adolescent Health

- Physical, neurocognitive, and psychosocial stages of adolescent maturation
- Adolescent nutrition, anemia mitigation, and menstrual hygiene management (MHM)
- Adolescent mental health concerns, substance abuse prevention, and violence reduction
- Sexual and reproductive health education and Adolescent-Friendly Health Clinics (AFHCs)
- School health programs and institutional platforms for adolescent empowerment

Unit VIII: National RMNCH+A Strategies and Programmes

- Strategic architecture of the National Health Mission (NHM) and RMNCAH+N operational strategy
- Financial protection and conditional cash transfers: Janani Suraksha Yojana (JSY) and PMMVY
- Zero expense initiatives: Janani Shishu Suraksha Karyakram (JSSK) and SUMAN
- Clinical quality and outreach schemes: Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA) and LaQshya
- Health screening and adolescent programs: Rashtriya Bal Swasthya Karyakram (RBSK) and Rashtriya Kishor Swasthya Karyakram (RKSK)
- Nutrition missions: Integrated Child Development Services (ICDS) and POSHAN Abhiyaan

Unit IX: Monitoring, Evaluation and Emerging Issues in RMNCH+A

- Core tracking indicators: MMR, NMR, IMR, U5MR, TFR, and CPR

- Public health data sources: HMIS, National Family Health Survey (NFHS), and Sample Registration System (SRS)
- Quality improvement models, clinical audits, and implementation research in health systems
- Digital health platforms (e.g., RCH portal, Kilkari) and mHealth solutions
- Service delivery challenges in humanitarian crises, climate shocks, and future public health priorities

Suggested Readings

- Klein, R. J., Verbiest, S. M., & Riegelman, R. K. *Maternal and Child Health: Programs, Problems, and Policy in Public Health*. Jones & Bartlett Learning.
- Detels, R., Gulliford, M., Karim, Q. A., & Tan, C. C. *Oxford Textbook of Global Public Health*. Oxford University Press.
- Kotch, J. *Maternal and Child Health: Programs, Problems and Policy in Public Health*. Jones & Bartlett Learning.

Summer Internship: Hospital and Community Health Systems

Category: Summer Internship (SI) | **L-T-P:** 0-0-8 | **Credits:** 4

1. Purpose of the Internship

The Summer Internship aims to provide MPH students with supervised field experience in hospital and community health settings. Students will observe healthcare delivery processes, understand health system organization, identify public health challenges, and develop skills in documentation, assessment, communication, and reporting.

2. Internship Objectives

By the end of the internship, students should be able to:

1. Understand the organization, structure, and functioning of hospital and community health systems.
2. Describe patient flow, healthcare delivery processes, referral systems, and coordination between different levels of care.
3. Observe hospital departments, administrative functions, quality assurance processes, and infection prevention practices.
4. Understand the delivery of primary healthcare, community outreach services, and national health programmes.
5. Identify public health challenges and service delivery gaps using observation and available, authorized data.
6. Prepare a structured internship report with evidence-based observations and recommendations.

3. Course Outcomes (COs)

On successful completion of the internship, students will be able to:

- CO1: Describe the organization, structure, and functioning of hospital and community health systems.
- CO2: Observe and document healthcare delivery processes, patient flow, referral mechanisms, and coordination across levels of care.
- CO3: Identify public health needs, service delivery gaps, and operational challenges in hospital and community settings.
- CO4: Apply basic public health assessment, documentation, communication, and data interpretation skills during supervised field activities.
- CO5: Prepare an internship report presenting field observations, key findings, and feasible recommendations for improving healthcare delivery.

4. Internship Structure and Activities

Component I: Hospital Health Systems

Students should gain supervised exposure to relevant hospital departments and administrative functions.

Suggested areas of exposure:

- Hospital organization, governance, and administrative structure.
- Outpatient department (OPD) and inpatient department (IPD) workflows.
- Emergency and casualty services.
- Medical records and health information management.
- Hospital quality assurance and patient safety.
- Infection prevention and control.
- Pharmacy, laboratory, and diagnostic services.
- Hospital waste management and environmental sanitation.
- Patient referral, discharge, and continuity of care.
- Patient rights, confidentiality, and grievance redressal.
- Hospital indicators and basic service utilization data.

Expected student activities:

- Prepare a hospital organizational profile.
- Map patient flow through a selected service.
- Observe coordination between clinical and administrative departments.
- Document selected quality and patient safety practices.
- Identify an operational or service delivery challenge.
- Suggest practical improvements under the guidance of the assigned supervisor.

Component II: Community Health Systems

Students should understand how healthcare services are delivered outside hospital settings, with emphasis on primary healthcare, prevention, and community engagement.

Suggested areas of exposure:

- Primary Health Centres (PHCs) and Urban Primary Health Centres (UPHCs).
- Health and Wellness Centres/Ayushman Arogya Mandirs.
- Sub-centres and Health and Wellness services, where applicable.
- Community outreach and health education activities.
- Maternal and child health services.
- Immunization services and routine surveillance.
- Noncommunicable disease screening and follow-up.
- Communicable disease prevention and control.
- National health programmes and local implementation.
- Referral pathways between community facilities and hospitals.
- Community health workers, including ASHAs and ANMs.
- Social determinants of health and barriers to healthcare access.

Expected student activities:

- Prepare a profile of the selected community health facility.
- Observe service delivery and outreach activities.
- Document referral and follow-up mechanisms.
- Identify barriers to access, continuity, or utilization of health services.
- Participate in supervised health education or community assessment activities.
- Develop recommendations based on observed needs and available evidence.

5. Internship Implementation Guidelines

Before the internship

1. The department should identify and approve suitable hospital and community health placement sites.
2. Each student should receive a formal posting letter and reporting instructions.
3. A faculty mentor and a site supervisor should be assigned.
4. Students should attend an orientation on internship objectives, expected conduct, confidentiality, safety, and reporting requirements.
5. Each student should prepare an internship learning plan identifying the proposed activities and expected outputs.

During the internship

1. Students must follow the assigned duty schedule and maintain attendance.
2. All activities must be undertaken under the supervision of the designated site supervisor.
3. Students should maintain a daily logbook documenting activities, observations, learning, and challenges.
4. Students may observe clinical or administrative processes but must not perform clinical procedures or access restricted records without appropriate authorization.
5. Patient information must remain confidential. Identifiable patient data, photographs, and medical records must not be copied or included in reports without appropriate authorization.
6. Community surveys, interviews, or data collection must be undertaken only with institutional and site approval and any required consent or ethics clearance.
7. Students should meet their faculty mentor periodically to discuss progress and resolve difficulties.

8. Any safety incident, ethical concern, or problem at the placement site must be reported promptly to the supervisor.

After the internship

1. Students should obtain the required attendance and completion certification from the placement site.
2. Each student must submit the completed internship logbook.
3. Students should prepare an internship report covering both hospital and community health systems.
4. A presentation or viva voce may be conducted to assess learning and practical understanding.
5. The faculty mentor should evaluate the student's performance, documentation, professional conduct, and ability to make feasible recommendations.

6. Internship Logbook Guidelines

The logbook should be maintained daily and include:

- Date and duration of the activity.
- Name and type of department or facility visited.
- Activities observed or undertaken.
- Key learning points.
- Public health or healthcare management issues identified.
- Relevant indicators or authorized data reviewed.
- Challenges encountered.
- Recommendations or questions for further learning.
- Signature or verification by the site supervisor, as required.

Students should record their own observations and learning rather than reproduce confidential documents or submit generic descriptions of departments.

7. Expected Internship Deliverables

Every student should submit the following, subject to the department's approved requirements:

1. Hospital profile: Organization, services, staffing structure, patient flow, and key administrative functions.
2. Community health facility profile: Facility structure, services, population served, outreach activities, and referral linkages.
3. Daily logbook: Verified record of attendance, activities, and learning.
4. One focused assessment: A small assessment of a service delivery process, access barrier, quality issue, referral mechanism, or community health challenge.
5. Internship report: A structured document presenting objectives, methods of observation, findings, learning, limitations, and recommendations.
6. Presentation: Summary of the internship experience and key public health insights.

8. Suggested Internship Report Format

The final report may contain the following sections:

1. Title page and student details.
2. Certificate of internship completion, where required.
3. Acknowledgements.
4. Introduction and objectives.
5. Profile of the hospital and community health facilities.
6. Description of activities undertaken.
7. Observations on hospital and community health systems.
8. Focused assessment of the selected issue.
9. Findings and discussion.
10. Recommendations for service improvement.
11. Learning outcomes and reflection.
12. Limitations.
13. References and appendices, where appropriate.

Life and Professional Skills

Category: Value Added Course (VAC) | **L-T-P:** 0-0-2 | **Credits:** 1

*(Note: Students can choose either **Track A: Classical Dance (Bharatanatyam)** or **Track B: Media and Design** for Units II–IV after completing the common foundational module in Unit I.)*

Course Objectives

- Develop foundational life skills, emotional intelligence, personal discipline, and professional etiquette.
- Cultivate body awareness, posture, rhythm, and artistic expression (Track A) OR master visual literacy, graphic design principles, and media tools (Track B).
- Apply non-verbal communication and expressive storytelling techniques (Track A) OR construct impactful digital visual content for health communication (Track B).
- Build self-confidence, teamwork, and aesthetic appreciation through practical performance or digital portfolio presentation.

Course Outcomes: On completion, students will be able to:

- **CO1:** Demonstrate self-management, emotional intelligence, professional etiquette, and workplace ethics.
- **CO2:** Perform fundamental Bharatanatyam movements (*Adavus*), hand gestures (*Hastas*), and rhythmic cycles (Track A) OR apply core principles of design, color theory, typography, and visual hierarchy (Track B).
- **CO3:** Express emotional nuances and storytelling using *Abhinaya* and *Rasas* (Track A) OR design digital posters, infographics, and visual campaign assets using graphic software (Track B).
- **CO4:** Present a collaborative classical dance performance (Track A) OR construct a professional digital media portfolio showcasing creative communication skills (Track B).

Graduate Attributes Addressed: GA5 (Effective Communication), GA6 (Interpersonal & Teamwork Skills), GA7 (Ethical Reasoning & Professional Integrity), GA9 (Creative & Innovative Thinking), GA10 (Lifelong Learning & Self-Directed Growth)

Unit Syllabus

Unit I: Core Life Skills and Professional Etiquette (Common to All Students)

- Self-awareness, emotional intelligence, stress management, and personal resilience
- Goal setting, time management, personal discipline, and self-directed growth
- Professional workplace etiquette, active listening, body language, and grooming
- Principles of creative expression, aesthetic appreciation, and holistic well-being

Unit II: Foundational Track Skills (Elective Track Choice)

- **Track A (Bharatanatyam):** Origins and philosophy of Bharatanatyam, basic standing posture (*Araimandi*), fundamental feet and hand movements (*Adavus*), single and combined hand gestures (*Asamyutta & Samyutta Hastas*), and basic rhythmic cycles (*Tala*).
- **Track B (Media & Design):** Introduction to visual literacy, core design elements (line, shape, color, texture, space), color theory, typography fundamentals, layout balance, and principles of visual hierarchy.

Unit III: Expressive Practice and Communication (Elective Track Choice)

- **Track A (Bharatanatyam):** Facial expressions (*Mukhabhinaya*), exploration of the nine classical emotions (*Navarasas*), expressive storytelling (*Abhinaya*), rhythmic coordination, and developing stage presence.
- **Track B (Media & Design):** Digital design software (Canva / Adobe Express / Illustrator basics), visual storytelling, designing public health awareness posters, creating infographics, and digital layout optimization.

Unit IV: Performance, Portfolio, and Synthesis (Elective Track Choice)

- **Track A (Bharatanatyam):** Group choreography, synchronisation, stage entry/exit etiquette, public performance, peer review, and reflection on dance as a stress-relief practice.
- **Track B (Media & Design):** Principles of visual brand identity, executing a health awareness media campaign, portfolio assembly, digital presentation skills, and peer design critique.

Suggested Readings

- **Common Life Skills:**
 - Cottrell, S. *Skills for Success: Personal Development and Employability*. Palgrave Macmillan.
- **Track A (Bharatanatyam):**
 - Vatsyayan, K. *Classical Indian Dance in Literature and the Arts*. Sangeet Natak Akademi.

- Kothari, S. *Bharata Natyam*. Marg Publications.
- **Track B (Media & Design):**
 - Lupton, E. *Thinking with Type: A Critical Guide for Designers, Writers, Editors, & Students*. Princeton Architectural Press.
 - Lidwell, W., Holden, K., & Butler, J. *Universal Principles of Design*. Rockport Publishers.

Summer Internship: Hospital and Healthcare Systems

Category: Internship / Experiential Learning | **L-T-P:** 0-0-8 | **Credits:** 4

Course Objectives

- Gain practical, hands-on exposure to the operational, administrative, and clinical support workflows of hospitals and healthcare organizations.
- Analyze hospital management systems, patient care pathways, quality control measures, and infection control protocols in real-world settings.
- Understand health information systems (HIS), medical records management, supply chain dynamics, and regulatory compliance in healthcare facilities.
- Develop professional conduct, interprofessional teamwork skills, problem-solving abilities, and field reporting skills in healthcare settings.

Course Outcomes: On completion, students will be able to:

- **CO1:** Map and explain the administrative, operational, and clinical workflow structures of modern healthcare organizations and hospital departments.
- **CO2:** Evaluate hospital infection control practices, patient safety protocols, bio-medical waste management, and quality assurance standards (e.g., NABH/JCI guidelines).
- **CO3:** Analyze health data systems, billing processes, supply chain/pharmacy operations, and public health integration within hospital networks.
- **CO4:** Synthesize field experiences into a professional internship report and present evidence-based observations and operational recommendations to a review panel.

Graduate Attributes Addressed: GA4 (Practical & Health Assessment Skills / Field Competency), GA5 (Effective Communication), GA6 (Interpersonal & Teamwork Skills), GA7 (Ethical Reasoning & Professional Integrity), GA10 (Lifelong Learning & Self-Directed Growth)

Internship Structure & Field Syllabus

Module I: Healthcare Facility Orientation and Governance (Weeks 1–2)

- Overview of hospital organization structure, governance models, and leadership workflows
- Orientation to front-office operations: patient registration, admission, discharge, and transfer (ADT) processes

- Understanding emergency care units, outpatient departments (OPD), and inpatient departments (IPD) management
- Orientation to institutional safety, emergency response codes, and patient rights and responsibilities

Module II: Clinical Support Services, Infection Control, and Quality (Weeks 3–4)

- Practical exposure to central diagnostic labs, radiology, CSSD (Central Sterile Supply Department), and pharmacy workflows
- Observation of Hospital Infection Control Committee (HICC) protocols, hand hygiene compliance, and biosafety practices
- Biomedical Waste (BMW) segregation, handling, storage, and disposal monitoring
- Introduction to accreditation standards (NABH/NABL), quality indicators, patient safety goals, and incident reporting

Module III: Health Information Systems, Operations, and Material Management (Weeks 5–6)

- Hands-on exposure to Hospital Information Systems (HIS), Electronic Health Records (EHR), and ICD coding basics
- Material management, inventory control, drug procurement, cold chain storage, and medical equipment maintenance routines
- Hospital billing systems, health insurance processing, TPA (Third Party Administrator) desk operations, and revenue cycle management
- Integration of public health programs (e.g., national disease control programs, compulsory disease notifications) within hospital operations

Module IV: Departmental Attachment, Project Execution, and Reporting (Weeks 7–8)

- Dedicated attachment to a specific operational department (e.g., Quality, Operations, Public Health Outpatient Cell, or Medical Records)
- Identification of an operational/quality improvement challenge and data collection under facility mentorship
- Compilation of daily activity logs, weekly learning reflections, and formal field internship documentation
- Preparation and submission of the final Summer Internship Report and viva-voce presentation

Evaluation Criteria

- **Internal Assessment / Field Supervisor Evaluation (40%):** Attendance, discipline, daily logbook maintenance, field performance, and workplace ethics evaluation by the facility mentor.
- **Institutional Internship Report (30%):** Comprehensive written report detailing departmental rotations, operational workflows, case studies, and observational analysis.
- **Final Presentation & Viva-Voce (30%):** Defense of internship report, key learnings, and operational recommendations before an academic and industry expert panel.

Suggested Readings & Reference Materials

- Sakharkar, B. M. *Principles of Hospital Administration and Planning*. Jaypee Brothers Medical Publishers.
- Goel, S. L., & Kumar, R. *Hospital Administration and Management: Theory and Practice*. Deep & Deep Publications.
- National Accreditation Board for Hospitals & Healthcare Providers (NABH). *Standards for Hospitals*. Quality Council of India.
- World Health Organization. *Hospital Care Documentation & Patient Safety Guidelines*. WHO Guidelines Approved by the Guidelines Review Committee.

Semester III

Applied Research Methods

Category: Major Core (MC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Guide students in identifying public health research problems through comprehensive literature searches and framing clear aims, objectives, and testable hypotheses.
- Formulate robust research methodologies, encompassing study design selection, sampling frameworks, power analysis, sample size determination, and variable definition.
- Develop structured data collection instruments and essential administrative, ethical, and project management documentation.
- Prepare comprehensive research budgets, personnel justifications, and project implementation schedules.
- Apply hands-on research skills through mock data collection, electronic data management, scientific writing, publication ethics, and observational field visits

Course Outcomes

- **CO1:** Conduct a comprehensive literature review to identify public health research problems and formulate research aims, objectives, and hypotheses.
- **CO2:** Design a scientifically sound research methodology, including sampling strategy, sample size estimation, and data collection instruments.
- **CO3:** Prepare research documents, study management plans, and project budgets required for conducting public health research.
- **CO4:** Apply research methods through mock data collection, data management, scientific reporting, and dissemination of research findings

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital & Technical Data Management Competency, GA5: Effective Scientific Communication & Dissemination, GA6: Professional Ethics, Governance & Participant Protection, GA7: Reflective Thinking & Field Application, GA10: Lifelong Learning & Self-Directed Research

Unit I: Identification of Public Health Research Problems

- Understanding public health significance and framing the rationale of a research problem
- Conducting structured and detailed literature reviews across electronic databases
- Identifying epidemiological and public health knowledge gaps

Unit II: Research Aims, Objectives, and Hypotheses

- Formulating research aims and testable research hypotheses to address identified knowledge gaps
- Developing operational and SMART research objectives
- Developing study flow diagrams for project planning, timeline structuring, and execution

Unit III: Study Design and Research Methods

- Selection of appropriate study designs (observational, experimental, mixed-methods)
- Defining target population, study population, sampling frame, sampling unit, and study unit
- Formulating inclusion and exclusion criteria
- Operational definition and measurement of primary exposures, secondary exposures, and health outcomes
- Identification and handling of key covariables, confounders, and effect modifiers
- Sample size calculation and statistical power analysis for diverse study architectures

Unit IV: Development of Data Collection Instruments

- Questionnaire and instrument design principles: open-ended vs. closed-ended questions
- Logical sequencing, question routing, skip patterns, and logic checks
- Designing unbiased, culturally sensitive, and objective survey questions
- Pre-testing, piloting, and validation of survey instruments

Unit V: Preparation of Research Documents

- Preparation of administrative approvals and study management forms
- Drafting Participant Information Sheets (PIS) and Informed Consent Forms (ICF)
- Ethical considerations and regulatory compliance for institutional review boards (IRB/IEC)
- Designing case report forms (CRF), field data collection forms, and data entry templates

Unit VI: Research Budget and Project Planning

- Principles of health research budgeting and resource planning
- Preparation of line-item study budgets and operational costs
- Personnel justification, staffing structures, and budget justifications
- Project timeline charting (Gantt charts) and risk mitigation planning

Unit VII: Mock Data Collection and Data Management

- Conducting mock study data collection and field-testing protocols

- Online and digital data entry platforms (e.g., KoboToolbox, REDCap, Google Forms)
- Data hygiene, range checks, real-time data validation, and data cleaning routines
- Standard operating procedures for data security, backup, and quality assurance

Unit VIII: Scientific Reporting and Research Dissemination

- Best practices for reporting research findings and manuscript preparation (STROBE, CONSORT guidelines)
- Publication ethics: authorship criteria, conflict of interest, and avoiding plagiarism
- Strategies for research dissemination: policy briefs, peer-reviewed publications, and conference presentations
- Data archiving, data sharing policies, and secure disposal of participant identifiers after project completion

Unit IX: Practical Experiential Learning and Field Visit

- Observation of active research activities at public health institutions, research laboratories, or hospitals
- Exposure to community-based research settings and field epidemiological field stations
- Evaluation of operational field workflows, respondent engagement, and research management in practice
- Preparation and submission of field visit observation reports

Suggested Readings

- Szklo, M., & Nieto, F. J. *Epidemiology Beyond the Basics*. 4th ed. Jones and Bartlett Learning.
- Rasmussen, S. A., & Goodman, R. A. (Eds.). *The CDC Field Epidemiology Manual*. Oxford Academic, Oxford University Press, 2018.

Genetics and Human Disease

Category: Major Core (MC) | **L-T-P:** 2-0-0 | **Credits:** 2

Course Objectives

- Introduce foundational concepts of cell biology, molecular genetics, genome organization, and epigenetic regulation relevant to human health and disease.
- Examine the molecular and cytogenetic basis of human genetic variations, mutations, gametogenesis, embryogenesis, and congenital anomalies.
- Analyze the complex genetic and genomic architecture underlying major human diseases, including cardiovascular conditions, immunological disorders, and oncogenesis.
- Appraise modern diagnostic methodologies, such as cytogenetic karyotyping, PCR, Sanger sequencing, and next-generation sequencing (NGS) platforms.

- Evaluate the applications of public health genomics, personalized medicine, precision healthcare strategies, and their associated bioethical dimensions.

Course Outcomes (COs): On completion, students will be able to:

- **CO1:** Explain the fundamental concepts of human genetics, molecular biology, and genome organization relevant to human health and disease.
- **CO2:** Describe the genetic basis of inherited disorders, congenital anomalies, and common human diseases.
- **CO3:** Analyze the role of genetic testing, genomic technologies, and molecular diagnostics in disease prevention and management.
- **CO4:** Evaluate the applications of genomics and precision medicine in public health and healthcare.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital & Technical Data Management Competency, GA5: Effective Scientific Communication & Dissemination, GA6: Professional Ethics, Governance & Participant Protection, GA7: Reflective Thinking & Field Application, GA10: Lifelong Learning & Self-Directed Research

Unit I: Fundamentals of Cell Biology

- Cell structure, organelle specialization, and cellular functions
- Cell division cycles: mechanisms and regulation of mitosis and meiosis
- Cell–cell interactions, extracellular matrix, and cellular signaling pathways

Unit II: Molecular Basis of Genetics

- Structural organization of chromosomes, DNA double helix, RNA variants, and amino acids
- Central dogma of molecular biology: DNA replication and repair pathways
- Transcription mechanisms and post-transcriptional RNA processing/regulation
- Translation processes and post-translational protein modifications

Unit III: Genes, Genomes, and Gene Regulation

- Structural anatomy and functional expression of protein-coding and non-coding genes
- Human nuclear and mitochondrial genome organization
- Transcriptional and translational gene regulation mechanisms
- Epigenomics: DNA methylation, histone modification, and chromatin remodeling

Unit IV: Human Genetic Variation

- Molecular taxonomy of mutations: point mutations, frameshifts, and repeat expansions
- Chromosomal structural variations: deletions, duplications, inversions, and translocations
- Numerical chromosomal abnormalities: aneuploidy, polyploidy, and nondisjunction
- Population genetic variation, single nucleotide polymorphisms (SNPs), and genetic diversity

Unit V: Human Development and Congenital Disorders

- Fundamentals of gametogenesis, fertilization, embryogenesis, and stages of fetal development
- Etiology and clinical presentations of major chromosomal disorders (e.g., Down syndrome, Turner syndrome, Klinefelter syndrome)
- Morphogenesis defects, teratogenicity, and common structural congenital anomalies
- Conventional cytogenetics and diagnostic karyotyping methodologies

Unit VI: Genetics of Human Diseases

- Monogenic versus complex polygenic disease models
- Genetics of cardiovascular diseases: familial hypercholesterolemia, cardiomyopathies, and channelopathies
- Immunogenetics: HLA complex, primary immunodeficiencies, and autoimmune disease susceptibility
- Cancer genetics and genomics: oncogenes, tumor suppressor genes, and genomic instability in oncogenesis

Unit VII: Genetic Testing and Genomic Technologies

- Principles, indications, and workflow of diagnostic and predictive genetic testing
- Molecular diagnostic tools: Polymerase Chain Reaction (PCR) principles and primer design
- Sanger dideoxy sequencing: methodology and clinical utility
- Next-Generation Sequencing (NGS) platforms: targeted gene panels, whole-exome sequencing (WES), and whole-genome sequencing (WGS)

Unit VIII: Genomic Approaches to Human Diseases

- Paradigms of personalized medicine and precision healthcare strategies
- Public health genomics: population screening policies, newborn screening, and carrier screening
- Targeted pharmacogenomics and molecular stratification in clinical therapeutics
- Ethical, Legal, and Social Implications (ELSI) in genomics: genetic counseling, non-discrimination, and privacy in disease prevention

Suggested Readings

- Strachan, T., & Read, A. *Human Molecular Genetics*. 5th ed. Garland Science, Taylor & Francis Group.
- Mishra, S. (SAE ed.), & Sadler, T. W. (Int. ed.). *Langman's Medical Embryology*. 2nd South Asian ed. Wolters Kluwer.
- Kumar, V., Abbas, A. K., & Aster, J. C. *Robbins and Cotran Pathologic Basis of Disease*. 10th ed. (South Asian Edition). Elsevier.

Health Economics and Financing

Category: Major Core (MC) | **L-T-P:** 2-0-0 | **Credits:** 2

Course Objectives

- Introduce foundational economic concepts, micro- and macroeconomic principles, and the scope and importance of health economics in public health.
- Analyze healthcare cost components, catastrophic health expenditures, and the overall economic burden of disease on households and health systems.
- Apply standard economic evaluation techniques, including cost-effectiveness, cost-benefit, and cost-utility analyses, to support evidence-based healthcare resource allocation.
- Examine diverse health financing models, financial risk protection mechanisms, health insurance schemes (such as Ayushman Bharat–PM-JAY), and Public–Private Partnerships (PPPs).
- Evaluate National Health Accounts, domestic and global health financing policies, and real-world case studies to assess progress toward Universal Health Coverage (UHC).

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the basic concepts, principles, and terminology of health economics, including the economic burden of disease
- **CO2:** Describe healthcare financing mechanisms and apply economic evaluation methods in healthcare.
- **CO3:** Explain health insurance systems, public–private partnerships, and national and global health financing initiatives.
- **CO4:** Apply principles of health economics and financing to analyze public health programmes and real-world case studies.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA4 (Practical & Health Assessment Skills / Research Aptitude), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Health Economics

- Basic economic concepts, terminology, and market principles in healthcare
- Microeconomics and macroeconomics foundations relevant to health systems
- Definition, scope, multidisciplinary nature, and importance of health economics

Unit II: Healthcare Costs and Economic Burden of Disease

- Classification of healthcare costs: direct medical, direct non-medical, indirect, and intangible costs
- Out-of-pocket expenditure (OOPE) dynamics and distress healthcare financing
- Catastrophic health expenditure, medical impoverishment, and measuring the economic burden of disease

Unit III: Economic Evaluation in Healthcare

- Principles and taxonomy of health economic evaluation methodologies
- Cost analysis and Cost-Minimization Analysis (CMA)
- Cost-Effectiveness Analysis (CEA) and Incremental Cost-Effectiveness Ratios (ICER)
- Cost-Benefit Analysis (CBA) and monetary valuation of health outcomes
- Cost-Utility Analysis (CUA): Quality-Adjusted Life Years (QALYs) and Disability-Adjusted Life Years (DALYs)

Unit IV: Introduction to Health Financing

- Core concepts, goals, and functions of health financing systems (revenue collection, pooling, purchasing)
- Sources of health financing: tax-based financing, social insurance, private health insurance, and external/donor funding
- Strategic purchasing versus passive purchasing of healthcare services

Unit V: Health Insurance and Financial Risk Protection

- Risk pooling principles, adverse selection, moral hazard, and financial risk protection
- Roadmap toward Universal Health Coverage (UHC) and equity in service coverage
- Flagship health protection schemes: Ayushman Bharat – Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) design, implementation, and impact

Unit VI: Health Systems Financing and Resource Allocation

- Trends and patterns in public and total health expenditures
- Framework and methodology of National Health Accounts (NHA) and System of Health Accounts (SHA)
- Priority setting, cost-containment strategies, and budget allocation in healthcare systems

Unit VII: Public–Private Partnership (PPP) in Healthcare

- Conceptual rationale, frameworks, and operational models of PPP in the health sector
- Potential advantages, performance incentives, and systemic challenges of PPP contracts

- Role of private sector engagement in primary healthcare and specialized hospital services delivery

Unit VIII: National and Global Health Financing Initiatives

- Indian health financing landscape: National Health Policy mandates and fiscal devolution
- The World Health Organization (WHO) health systems financing framework
- Health financing pathways to achieve Sustainable Development Goal 3 (SDG 3.8 targets)

Unit IX: Case Studies and Applications in Health Economics and Financing

- Applied case analyses of national health financing reforms and universal coverage models
- Critical appraisal of published economic evaluations and health technology assessment (HTA) reports
- Economic analysis of specific public health disease control programs and real-world policy scenarios

Suggested Readings

- Park, K. *Park's Textbook of Preventive and Social Medicine*. 28th ed. Banarsidas Bhanot Publishers, 2025.
- Bhattacharya, J., Hyde, T., & Tu, P. *Health Economics*. 3rd ed. Red Globe Press (Macmillan), 2022.
- Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. *Methods for the Economic Evaluation of Health Care Programmes*. 4th ed. Oxford University Press, 2015.

Interprofessional Practice in Public Health

Category: Multidisciplinary (MD), | **L-T-P:** 1-1-0 | **Credits:** 2

Course Objectives

- Introduce the fundamental concepts, historical evolution, and core competencies of Interprofessional Education (IPE) and Collaborative Practice (IPCP) based on WHO frameworks.
- Examine the distinct scopes of practice, professional identities, and collaborative responsibilities across multidisciplinary and interprofessional healthcare teams.
- Apply interpersonal communication techniques, patient- and community-centered dialogues, active listening, and conflict negotiation strategies in clinical and public health settings.
- Analyze team dynamics, shared leadership paradigms, professional ethics, confidentiality, and mutual accountability within collaborative healthcare practice.

- Evaluate models of integrated healthcare delivery, care coordination, technology-enabled collaboration, and strategies to overcome professional barriers toward achieving Universal Health Coverage (UHC).

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the principles, concepts, and significance of interprofessional education and collaborative practice in public health.
- **CO2:** Describe the roles, responsibilities, and contributions of various healthcare and public health professionals within interdisciplinary teams.
- **CO3:** Apply effective communication, teamwork, leadership, and ethical principles to foster collaborative healthcare practice.
- **CO4:** Evaluate collaborative approaches to healthcare delivery and identify strategies to strengthen interprofessional collaboration for improved health outcomes.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA5: Effective Communication & Interpersonal Dialogue, GA6: Professional Ethics, Values & Mutual Accountability, GA8: Social Responsibility, Community Engagement & Patient Safety, GA9: Leadership, Teamwork & Interprofessional Collaboration, GA10: Lifelong Learning & Reflective Practice

Unit I: Introduction to Interprofessional Practice

- Concept, definitions, and historical evolution of Interprofessional Education (IPE)
- Collaborative practice in healthcare and population health
- WHO Framework for Action on Interprofessional Education and Collaborative Practice
- Importance and rationale of interprofessional collaboration in modern health systems
- Core competencies and foundational principles of collaborative practice

Unit II: Health Professionals and Team-Based Care

- Roles, scopes of practice, and responsibilities of physicians, nurses, public health professionals, and pharmacists
- Contributions of allied and support professionals: microbiologists, nutritionists, physiotherapists, psychologists, social workers, laboratory personnel, and community health workers
- Professional identity, boundaries, scope of practice, and professional accountability
- Structural differences between multidisciplinary, interdisciplinary, and interprofessional teams

Unit III: Communication and Collaboration in Interprofessional Teams

- Principles of effective communication and interpersonal communication dynamics
- Active listening, open information sharing, and standardized clinical documentation
- Collaborative decision-making processes and shared goal setting
- Patient- and community-centred communication approaches and cultural competence
- Identifying communication barriers and implementing mitigation strategies

Unit IV: Team Dynamics, Leadership and Professional Ethics

- Characteristics and functioning of high-performing teams
- Stages of team development (forming, storming, norming, performing)
- Collaborative leadership styles, shared authority, and decision-making
- Conflict resolution techniques, constructive negotiation, and consensus building
- Professional ethics, confidentiality, mutual respect for professional roles, and reflective practice

Unit V: Interprofessional Collaboration in Healthcare Delivery

- Integrated healthcare delivery systems and care coordination pathways
- Referral systems, handover protocols, and maintaining continuity of care
- Collaboration across diverse care settings: primary, secondary, tertiary, and community levels
- Intersectoral collaboration for addressing wider determinants of health
- Impact of team collaboration on patient safety, clinical quality improvement, and organizational culture

Unit VI: Challenges and Future Directions in Interprofessional Collaboration

- Professional silos, organizational barriers, hierarchical friction, and role ambiguity
- Institutional and policy strategies to foster, incentivize, and sustain interprofessional collaboration
- Digital health platforms, telehealth, electronic health records (EHR), and technology-enabled teamwork
- Future competencies in interprofessional collaborative practice
- Role of interprofessional collaboration in advancing Universal Health Coverage (UHC) and Sustainable Development Goals (SDGs)

Suggested Readings

- Reeves, S., Lewin, S., Espin, S., & Zwarenstein, M. *Interprofessional Teamwork for Health and Social Care*. Wiley-Blackwell.
- Institute of Medicine. *Interprofessional Education and Collaborative Practice: Creating a Blueprint for Nurse Educators*. National Academies Press.

Data Analytics using MS-Excel and R Programming

Category: Skill Enhancement Course (SEC) | **L-T-P:** 1-2-0 | **Credits:** 3

Course Objectives

- Perform data validation, lookup operations, and logical formula structures using MS-Excel.
- Create data summaries, Pivot Tables, and visual charts in MS-Excel for exploratory health and business data analysis.
- Import, clean, transform, and manipulate structured datasets in R using core functions, dplyr, and ggplot2.
- Apply inferential statistical tests, predictive regression models, and end-to-end automated analytics using MS-Excel and R.

Course Outcomes: On completion, students will be able to:

- **CO1:** Perform data entry, data validation, lookup operations, and logical formula structures using MS-Excel.
- **CO2:** Create data summaries, Pivot Tables, and visual charts in MS-Excel for exploratory health and business data analysis.
- **CO3:** Import, clean, transform, and manipulate structured datasets in R using core functions and dplyr.
- **CO4:** Construct advanced visual analytics and publication-ready graphs using R's ggplot2 and base graphics packages.
- **CO5:** Apply inferential statistical tests, regression models, and automated analytics using MS-Excel and R to derive insights from real-world datasets.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA3 (Digital & Technological Literacy), GA4 (Practical & Health Assessment Skills / Research Aptitude), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: MS-Excel Fundamentals, Data Validation, and Lookup Operations

- Arithmetic operations, formatting, cell references, filtering, grouping, and data validation rules in MS-Excel
- Practical/Tutorial Session: Implementing formulas, logical operators (IF, AND, OR), nested structures, and conditional formatting
- Data searching routines, VLOOKUP/XLOOKUP functionalities, and index-match principles
- Practical/Tutorial Session: Connecting external data sources, querying raw health datasets, and setting up automated lookup tables

Unit II: Data Aggregation, Visual Analytics, and Macros in MS-Excel

- Data aggregation principles, Pivot Table architecture, calculated fields, and multi-dimensional summaries

- Practical/Tutorial Session: Building interactive Pivot Charts, slicers, and visual dashboards for exploratory data analysis
- Data analysis tools, descriptive statistics utilities, and Analysis ToolPak applications
- Practical/Tutorial Session: Introduction to spreadsheet automation, macro recording, and macro-enabled analytical workflows

Unit III: R Environment, Data Manipulation, and Visualizations with ggplot2

- Overview of RStudio environment, R syntax, data types (numeric, character, factor), data structures (vectors, matrices, data frames), and package management
- Practical/Tutorial Session: Importing/exporting datasets across formats (CSV, Excel), missing value handling, and data cleaning routines
- Data frame manipulation, subsetting, filtering, mutating, and transformation using the dplyr package
- Practical/Tutorial Session: Generating descriptive statistics, graphical exploratory analysis, and publication-ready visual analytics using Base R and ggplot2

Unit IV: Inferential Statistics, Predictive Modeling, and Integrated Analytics

- Inferential statistics in R: Hypothesis testing principles, two-sample t-tests, and Analysis of Variance (ANOVA)
- Practical/Tutorial Session: Executing parametric statistical tests, interpreting model outputs, and evaluating statistical significance
- Predictive modeling in R: Correlation analysis, Simple/Multiple Linear Regression, and Binary Logistic Regression
- Integrated Project Practical: End-to-end dataset analysis, predictive modeling, automated reporting, and visual project presentations using MS-Excel and R

Suggested Readings

- Harvey, G. *Excel 2016 All-in-One For Dummies*. John Wiley & Sons.
- Walkenbach, J. *Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource*. Wiley Publishers.
- Wickham, H., Çetinkaya-Rundel, M., & Golemund, G. *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. 2nd ed., O'Reilly Media.

Public Health Gerontology

Category: Major Core (MC) | **L-T-P:** 2-0-0 | **Credits:** 2

Course Objectives

- Introduce the fundamental concepts, multidisciplinary scope, theories of ageing, and global and national demographic transitions of population ageing.
- Analyze the multidimensional biological, psychosocial, nutritional, and gender determinants influencing health and well-being in older adults.
- Examine the epidemiological burden of chronic diseases, multimorbidity, functional decline, cognitive impairments, and elder vulnerabilities.

- Evaluate health system models, integrated long-term care pathways, palliative services, and supportive age-friendly community environments based on WHO frameworks.
- Critically appraise national legislations, policies, welfare programs (e.g., NPHCE), and international initiatives under the UN/WHO Decade of Healthy Ageing (2021–2030).

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the concepts, theories, and demographic trends of population ageing from a public health perspective.
- **CO2:** Analyze the determinants, health needs, and disease burden among older adults.
- **CO3:** Evaluate public health strategies, health systems, policies, and programmes that promote healthy ageing and improve the well-being of older populations.
- **CO4:** Apply the principles of public health gerontology to address ageing-related challenges through community-based and age-friendly approaches.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA4 (Practical & Health Assessment Skills / Research Aptitude), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Gerontology and Public Health Gerontology

- Definitions, concepts, and scope of gerontology and public health gerontology
- Biological, psychological, and sociological theories of ageing
- Demographic transition, population ageing trends, and dependency ratios globally and in India
- Importance and emerging role of gerontology in public health and health system planning

Unit II: Ageing and Health

- Biological, psychological, social, and environmental dimensions of ageing
- Social determinants of health and structural inequities impacting older populations
- Gender dimensions of ageing and feminization of ageing
- Nutritional requirements, malnutrition, and dietary management in the elderly
- Sleep physiology, common sleep disturbances, and determinants of healthy ageing

Unit III: Burden of Disease and Functional Ageing

- Epidemiology of communicable and chronic noncommunicable diseases in older adults
- Multimorbidity, syndromes of frailty, physical disability, and falls
- Cognitive ageing, neurodegenerative conditions (dementia, Alzheimer's), and late-life mental health disorders
- Quality of life (QoL) assessments in geriatric populations
- Elder abuse, neglect, ageism, and vulnerability reduction

Unit IV: Healthy Ageing and Age-Friendly Environments

- The WHO Healthy Ageing Framework: concepts of intrinsic capacity and functional ability
- Active ageing paradigms, life satisfaction, and social participation
- Design and principles of Age-Friendly Cities and Communities (AFCC)
- Built environments, universal accessibility, assistive technologies, and mobility support

Unit V: Health Systems and Long-Term Care for Older Adults

- Continuum of care and integrated care models for older people (e.g., WHO ICOPE approach)
- Long-term care (LTC) models, institutional care, and day-care facilities
- Palliative care, end-of-life care, and home-based clinical services
- Community-based elderly care models and formal/informal caregiver support strategies

Unit VI: Policies, Programmes, and Public Health Responses

- National Policy on Older Persons (1999) and National Policy for Senior Citizens
- Operational framework of the National Programme for Health Care of the Elderly (NPHCE)
- Legal provisions and entitlements: Maintenance and Welfare of Parents and Senior Citizens Act (2007 and amendments)
- Global health governance: WHO/UN Decade of Healthy Ageing (2021–2030) priorities and action areas

Unit VII: Case Studies and Public Health Applications

- Evaluation of community-based geriatric interventions and age-friendly initiatives
- Analysis of real-world healthy ageing programs and elderly self-help models
- Public health case discussions on elder care delivery, social protection, and multi-sectoral collaboration

Suggested Readings

- Park, K. Park's Textbook of Preventive and Social Medicine. 28th ed. Banarsidas Bhanot Publishers, 2025.
- World Health Organization. World Report on Ageing and Health. World Health Organization, 2015.
- World Health Organization. Decade of Healthy Ageing: Baseline Report (2021–2030). World Health Organization.

SPECIALISATIONS/ELECTIVES (Choose Any Two)

Advanced Statistical Methods

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Develop advanced statistical thinking to select and justify appropriate analytical techniques aligned with public health research questions, study designs, and data types.
- Apply parametric and non-parametric comparative tests and evaluate their underlying assumptions using statistical software packages.
- Construct, fit, and diagnose multivariable statistical models, including multiple linear, logistic, and survival regression models, for public health data.
- Formulate clear, standardized statistical reports, tables, and graphs while identifying common statistical errors and interpreting effect sizes, p-values, and confidence intervals.
- Execute end-to-end data analysis projects on real-world public health datasets to synthesize statistical findings for program evaluation and evidence-based decision-making.

Course Outcomes: On completion, students will be able to:

- **CO1:** Select appropriate statistical methods based on research questions, study designs, and types of public health data.
- **CO2:** Apply advanced statistical techniques using statistical software for analyzing public health datasets.
- **CO3:** Interpret statistical outputs and communicate findings to support evidence-based public health practice.
- **CO4:** Analyze real-world public health datasets and prepare statistical reports for research and programme evaluation.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA3 (Digital & Technological Literacy), GA4 (Practical & Health Assessment Skills / Research Aptitude), GA7 (Ethical Reasoning & Professional Integrity), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Advanced Statistical Methods

- Role and applications of advanced biostatistics in epidemiological and public health research
- Cultivating statistical thinking and decision frameworks for selecting appropriate analytical methods
- Verification and evaluation of statistical test assumptions
- Statistical significance, p-values, 95% confidence intervals, and quantification of effect sizes

Unit II: Selection of Statistical Tests

- Theoretical distinction between parametric and non-parametric analytical frameworks
- Assessing distributional properties, normality tests, and homoscedasticity assumptions
- Decision algorithms for test selection based on study design, variable measurement scales, and research hypotheses

Unit III: Comparative Statistical Methods

- Parametric mean comparisons: independent Student's t-test, paired t-test, and Analysis of Variance (One-Way / Two-Way ANOVA)
- Non-parametric counterparts: Mann-Whitney U test, Wilcoxon signed-rank test, and Kruskal-Wallis test
- Categorical data analysis: Pearson's Chi-square test, Fisher's exact test, and continuity adjustments
- Post-hoc pairwise comparison tests, multiplicity adjustments, and subgroup analysis strategies

Unit IV: Correlation and Regression Analysis

- Bivariate correlation metrics: Pearson's product-moment and Spearman's rank correlation coefficients
- Simple linear regression: ordinary least squares (OLS) estimation, slope, and intercept interpretation
- Multiple linear regression: model specification, multivariable adjustment, and coefficient of determination (R^2)
- Binary logistic regression: odds ratios, log-odds transformations, and likelihood ratio metrics
- Regression diagnostics: multicollinearity (VIF), residual analysis, homoscedasticity, and outlier identification

Unit V: Advanced Analysis of Public Health Data

- Multivariable modeling strategies to adjust for confounders and identify interaction effects
- Trend analysis and time-series fundamentals in public health monitoring
- Survival analysis: Kaplan-Meier survival curves, log-rank testing, and introduction to Cox proportional hazards models
- Interpretation and handling of complex, multi-tiered public health datasets in program evaluation

Unit VI: Statistical Reporting and Interpretation

- Standardized reporting guidelines for statistical findings in scientific literature (e.g., SAMPL, STROBE)
- Designing professional statistical summary tables and publication-grade graphs
- In-depth interpretation of statistical software outputs (point estimates, standard errors, test statistics)
- Identifying common statistical pitfalls, misinterpretations (e.g., p-hacking, ecological fallacy), and critical appraisal of results

Unit VII: Case Studies in Public Health Statistics

- Methodological critique and appraisal of statistical methods in published public health research
- Dissecting analytic workflows, robustness of findings, and evidence synthesis across observational studies
- Translating complex statistical findings into actionable public health policies and interventions

Unit VIII: Practical Data Analysis Project

- Hands-on laboratory analysis of real-world public health and epidemiological datasets using statistical software (e.g., SPSS/R)
- End-to-end analytical pipeline: data cleaning, recoding, executing inferential tests, and fitting multivariable models
- Synthesis and drafting of formal statistical reports detailing methodologies, diagnostics, and findings
- Oral and visual presentation of statistical project results and defense of conclusions

Suggested Readings

- Daniel, W. W., & Cross, C. L. Biostatistics: A Foundation for Analysis in the Health Sciences. 11th ed. Wiley.
- Armitage, P., Berry, G., & Matthews, J. N. S. Statistical Methods in Medical Research. 4th ed. / 2nd ed. Wiley-Blackwell.

Categorical Data Analysis and Survival Analysis

Category: Major Core (MC) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, distributional properties, and analytical principles of categorical data and time-to-event survival outcomes in public health research.
- Formulate and execute inferential hypothesis tests and compute measures of association for independent and paired categorical health data.
- Apply and interpret binary, multinomial, and ordinal logistic regression models while evaluating model diagnostics and multivariable confounding.
- Estimate and contrast non-parametric and semi-parametric survival distributions using life tables, Kaplan-Meier methods, and log-rank tests.
- Implement Cox proportional hazards regression models, evaluate underlying assumptions, and communicate findings from real-world epidemiological datasets using statistical software.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the fundamental concepts, assumptions, and applications of categorical data analysis and survival analysis in public health research.
- **CO2:** Select and apply appropriate statistical tests to analyse categorical data and interpret measures of association in public health studies.
- **CO3:** Apply and interpret logistic regression models to examine relationships between categorical outcomes and explanatory variables.
- **CO4:** Estimate and compare survival distributions using appropriate methods, including Kaplan–Meier analysis and the log-rank test.
- **CO5:** Apply and interpret Cox proportional hazards regression, assess relevant model assumptions, and communicate findings from categorical and survival analyses using public health examples.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Categorical Data and Contingency Tables

- Types and classification of categorical variables: binary, nominal, and ordinal scales
- Probability distributions for discrete variables, sampling models, and proportions
- Construction, structure, and interpretation of two-way and multi-way contingency tables

Unit II: Hypothesis Testing and Measures of Association for Categorical Data

- Pearson's Chi-square (χ^2) test of independence and goodness-of-fit
- Continuity correction and Fisher's exact test for small sample sizes and sparse tables
- Measures of association: Odds Ratio (OR), Risk Ratio (RR), and Prevalence Ratio (PR)
- Construction and interpretation of 95% confidence intervals for association metrics
- Analysis of paired categorical data: McNemar's test and its epidemiological applications

Unit III: Binary and Multivariable Logistic Regression

- Binary logistic regression: logit link function, assumptions, and Maximum Likelihood Estimation
- Interpretation of regression coefficients (β) and conversion to adjusted odds ratios
- Multivariable logistic regression model building, confounding adjustment, and interaction assessment
- Goodness-of-fit assessment, deviance, Hosmer-Lemeshow test, and ROC/AUC performance metrics

Unit IV: Multinomial and Ordinal Logistic Regression

- Polytomous outcome frameworks: introduction to multinomial (multiclass) logistic regression
- Parameter estimation and interpretation of relative risk ratios in multinomial models
- Ordinal logistic regression: cumulative logit and proportional odds models
- Evaluation of the proportional odds assumption and handling model violations

Unit V: Foundations of Survival Analysis and Non-Parametric Estimation

- Concept of time-to-event outcomes and mechanisms of censoring (right, left, interval) and truncation
- Mathematical properties and relationships between survival function $S(t)$ and hazard function $h(t)$
- Actuarial life-table methods for interval-grouped data
- Kaplan-Meier product-limit estimation: calculation, survival curves, and median survival times
- Comparison of survival distributions using the log-rank test and generalized Wilcoxon tests

Unit VI: Cox Proportional Hazards Regression and Model Diagnostics

- Semi-parametric modeling: Cox proportional hazards model formulation and baseline hazard function
- Estimation, calculation, and public health interpretation of Hazard Ratios (HR)
- Multivariable Cox regression: controlling for confounders and testing interaction terms
- Testing and validating the proportional hazards assumption using Schoenfeld residuals and log-log plots
- Methodological approaches for handling non-proportional hazards (stratified Cox models and time-varying covariates)

Unit VII: Integrated Case Studies, Evidence Synthesis, and Reporting

- Critical appraisal of published epidemiological and clinical research using categorical and survival methods
- Synthesis and interpretation of multivariable regression outputs and survival parameters from public health studies
- Standardized reporting guidelines (SAMPL and STROBE) for categorical and time-to-event data
- Evidence-based translation of statistical findings into public health policy and intervention planning

Suggested Readings

- Agresti, A. *Categorical Data Analysis*. 3rd ed. Wiley, 2013.

- Hosmer, D. W., Jr., Lemeshow, S., & May, S. *Applied Survival Analysis: Regression Modeling of Time-to-Event Data*. 2nd ed. Wiley, 2008.
- Kleinbaum, D. G., & Klein, M. *Survival Analysis: A Self-Learning Text*. 3rd ed. Springer, 2012.

Infectious Disease Epidemiology

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the history, core principles, chain of infection, and transmission dynamics governing infectious disease occurrence across populations.
- Examine infectious disease surveillance frameworks, field epidemiology techniques, and step-by-step outbreak investigation protocols.
- Apply analytical and molecular epidemiological methods to evaluate vaccine effectiveness, diagnostic accuracy, and disease transmission patterns.
- Evaluate prevention, control, and containment strategies for priority communicable diseases and antimicrobial-resistant pathogens.
- Assess emerging zoonotic threats, One Health frameworks, mathematical modeling, genomic surveillance, and global health security policies for pandemic preparedness.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the epidemiological principles governing the occurrence, transmission, and distribution of infectious diseases in populations.
- **CO2:** Apply epidemiological methods and surveillance systems to investigate infectious disease outbreaks and interpret epidemiological data.
- **CO3:** Evaluate evidence-based prevention and control strategies for infectious diseases at community, national, and global levels.
- **CO4:** Critically analyze emerging and re-emerging infectious diseases using One Health and Global Health perspectives.
- **CO5:** Design epidemiologically informed strategies for infectious disease prevention, preparedness, and response using contemporary public health approaches.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Infectious Disease Epidemiology

- History, evolution, and scope of infectious disease epidemiology

- Epidemiological triad, chain of infection, and natural history of infectious diseases
- Measures of infectious disease frequency, attack rates, and secondary attack rates
- Endemic, epidemic, and pandemic occurrence patterns
- Global and national burden and epidemiological trends of infectious diseases in India

Unit II: Transmission Dynamics and Disease Ecology

- Reservoirs, sources of infection, and portals of entry and exit
- Direct and indirect transmission modes and vector dynamics
- Incubation period, latent period, infectious period, and serial interval
- Basic reproduction number (R_0), effective reproduction number (R_t), and herd immunity thresholds
- Host, agent, and environmental determinants, and principles of disease ecology

Unit III: Infectious Disease Surveillance Systems

- Objectives, legal frameworks, and principles of public health surveillance
- Surveillance typologies: passive, active, sentinel, syndromic, and event-based surveillance
- Integrated Disease Surveillance Programme (IDSP) and WHO global surveillance platforms
- Laboratory-supported surveillance, notifiable disease lists, and core surveillance quality indicators
- Systematic analysis, interpretation, and public health utilization of surveillance data

Unit IV: Outbreak Investigation and Field Epidemiology

- Detection, verification, and early confirmation of disease outbreaks
- Systematic ten-step protocol for field outbreak investigations
- Developing case definitions, case ascertainment, and descriptive epidemiological analysis
- Construction and interpretation of epidemic curves (point source, propagated, continuous)
- Hypothesis generation, analytical testing, contact tracing protocols, and environmental investigations
- Risk communication strategies, outbreak documentation, and scientific field reporting

Unit V: Analytical Methods in Infectious Disease Epidemiology

- Observational study designs applied to infectious diseases (cohort, case-control, test-negative designs)
- Transmission studies and household secondary attack rate calculations
- Evaluation of vaccine efficacy, vaccine effectiveness, and screening/diagnostic test performance
- Measures of epidemiological association and attributable risk

- Molecular epidemiology principles, strain typing, and introduction to spatial disease mapping (GIS)

Unit VI: Prevention and Control of Infectious Diseases

- Population vaccination strategies, cold chain maintenance, and immunization coverage targets
- Infection prevention and control (IPC) practices and surveillance of healthcare-associated infections (HAIs)
- Standard, contact, droplet, and airborne precautions; isolation versus quarantine measures
- Chemoprophylaxis, mass drug administration (MDA), integrated vector management, and environmental sanitation
- Antimicrobial stewardship programs and community-based disease containment strategies

Unit VII: Major Infectious Diseases of Public Health Importance

- Epidemiology, surveillance, diagnosis, and control of Tuberculosis (NTEP) and HIV/AIDS (NACP)
- Vector-borne infections: Malaria, Dengue, and Chikungunya epidemiology and elimination frameworks
- Respiratory and viral pathogens: seasonal/pandemic Influenza, SARS-CoV-2, and Viral Hepatitis (A, B, C, E)
- Enteric infections, diarrheal diseases, and neglected tropical diseases (NTDs)
- Antimicrobial-resistant (AMR) pathogens and current epidemiological transition trends in India

Unit VIII: Emerging and Re-emerging Infectious Diseases and One Health

- Drivers of pathogen emergence, zoonotic spillovers, and human-animal-wildlife interfaces
- Surveillance and clinical epidemiology of priority zoonoses (e.g., Nipah, Rabies, Avian Influenza)
- Antimicrobial resistance as an emerging global health threat
- Impact of climate change, ecological disruption, urbanization, and international travel on pathogen spread
- Multisectoral operationalization of the One Health approach and pandemic preparedness planning

Unit IX: Infectious Disease Modelling, Genomic and Digital Epidemiology

- Basic principles and compartment models in infectious disease dynamics (SIR/SEIR models)
- Epidemic trajectory forecasting and reproductive number estimation

- Genomic epidemiology: whole-genome pathogen sequencing, variant tracking, and phylogenetic analysis
- Wastewater-based epidemiology (WBE) and environmental surveillance
- Digital disease surveillance, artificial intelligence applications, and interactive public health decision dashboards

Unit X: Global Health Security, Policy and Future Directions

- International Health Regulations (IHR 2005) and Public Health Emergencies of International Concern (PHEIC)
- WHO Health Emergencies Programme and the Global Health Security Agenda (GHSA)
- Cross-border surveillance coordination and emergency operational center (EOC) functioning
- Bioethics, civil liberties, resource allocation, and risk communication during health crises
- Future technological frontiers and challenges in infectious disease epidemiology

Suggested Readings

- Giesecke, J. Modern Infectious Disease Epidemiology. CRC Press.
- Nelson, K. E., & Williams, C. M. Infectious Disease Epidemiology: Theory and Practice. Jones & Bartlett Learning.

Experimental Epidemiology

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the foundations of experimental epidemiology, trial architecture, and the distinction between observational and experimental intervention frameworks.
- Examine methodological mechanisms to minimize bias and confounding, including randomization techniques, allocation concealment, blinding, and control selection.
- Formulate individual-level and cluster/community-level trial designs while applying sample size determination, statistical power, and SPIRIT protocol development principles.
- Evaluate clinical trial conduct, bioethical regulations, prospective trial registration, safety monitoring committees (DSMB), and adverse event reporting.
- Analyze experimental data using intention-to-treat (ITT) versus per-protocol (PP) frameworks and critically appraise published trials using Cochrane RoB 2 and CONSORT reporting guidelines.

Course Outcomes: On completion, students will be able to:

- **CO1:** Differentiate between observational and experimental epidemiologic designs and identify appropriate intervention study frameworks for clinical and public health questions.

- **CO2:** Apply rigorous methodological techniques including randomization, allocation concealment, blinding, and placebo selection to minimize bias and confounding.
- **CO3:** Formulate experimental designs across individual-level (parallel, crossover, factorial) and cluster/community-level trials, accounting for sample size and power calculation principles.
- **CO4:** Interpret data through intention-to-treat (ITT) versus per-protocol (PP) frameworks, interim monitoring, and safety endpoints while adhering to global bioethical standards (Declaration of Helsinki, GCP, ICMR guidelines).
- **CO5:** Critically appraise published experimental studies using standardized reporting guidelines (CONSORT, SPIRIT) and risk of bias frameworks (Cochrane RoB 2).

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Scientific Communication & Reporting, GA6: Professional Bioethics, Regulatory Compliance & Clinical Integrity, GA7: Reflective Thinking & Intervention Design, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Foundations of Experimental Epidemiology & Trial Architecture

- Evolution of intervention studies and their hierarchical position in epidemiological evidence
- Observational versus experimental paradigms: causal inference (Bradford Hill's viewpoints) and the counterfactual framework
- Typology of intervention trials: preventive versus therapeutic trials
- Phases of clinical trials (Phase I to Phase IV), field trials, and community intervention trials (CITs)

Unit II: Randomization, Blinding, & Bias Control Mechanisms

- Randomization strategies: simple, block, stratified, and covariate-adaptive randomization (minimization)
- Allocation concealment mechanisms versus blinding procedures: single, double, and triple blinding
- Control group selection: placebo controls, active (standard of care) controls, and sham interventions
- Systematic influences: Hawthorne effect, placebo effect, and mitigation of ascertainment bias

Unit III: Advanced Experimental Study Designs

- Individual-level trial architectures: parallel-group, factorial (2×2), and crossover designs (washout periods, carryover effects)
- Cluster Randomized Trials (CRTs): unit of allocation versus unit of analysis
- Methodological considerations in cluster trials: Intraclass Correlation Coefficient (ICC) and Design Effect

- Stepped-wedge and adaptive trial designs in health systems and implementation research

Unit IV: Sample Size Determination, Protocol Development, & Endpoints

- Sample size estimation parameters: statistical power ($1 - \beta$), significance level (α), and minimal clinically important difference (MCID)
- Defining trial outcome measures: primary, secondary, composite, and surrogate endpoints
- Developing SPIRIT-compliant clinical trial protocols
- Strategies for participant recruitment, retention, and minimizing loss to follow-up

Unit V: Trial Conduct, Safety Monitoring, & Bioethics

- Historical bioethical milestones and guidelines: Nuremberg Code, Belmont Report, Declaration of Helsinki, and ICMR National Ethical Guidelines
- Mandatory prospective registration: clinical trial registries (CTRI, ClinicalTrials.gov)
- Roles and governance of Institutional Ethics Committees (IEC/IRB) and Good Clinical Practice (GCP) compliance
- Data and Safety Monitoring Boards (DSMB), predefined stopping rules, and adverse event (AE/SAE) reporting workflows

Unit VI: Statistical Analysis Paradigms & Data Interpretation

- Analytical paradigms: Intention-to-Treat (ITT), Per-Protocol (PP), and As-Treated analysis
- Handling missing outcome data, non-compliance, and protocol deviations
- Estimation and clinical interpretation of effect measures: Relative Risk (RR), Risk Difference (RD), and Hazard Ratio (HR)
- Absolute impact metrics: Number Needed to Treat (NNT) and Number Needed to Harm (NNH)

Unit VII: Evidence Synthesis, Critical Appraisal, & Reporting Standards

- Trial reporting frameworks: CONSORT Statement and extensions for cluster and non-pharmacological trials
- Evaluating study quality and methodological rigor using the Cochrane Risk of Bias 2 (RoB 2) tool
- Critical appraisal and journal club synthesis of landmark global public health and clinical trials

Suggested Readings

- Friedman, L. M., Furberg, C. D., DeMets, D. L., Reboussin, D. M., & Granger, C. B. *Fundamentals of Clinical Trials*. 5th ed. Springer Cham, 2015.

- Smith, P. G., Morrow, R. H., & Ross, D. A. *Field Trials of Health Interventions: A Toolbox*. 3rd ed. Oxford University Press, 2015.
- Gordis, L. (Celentano, D. D., & Szklo, M.). *Epidemiology*. 6th ed. Elsevier Saunders, 2019.

Healthcare Data Management and Programming

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce healthcare data ecosystems, sources of clinical and population health data, and international digital health interoperability standards.
- Design relational database architectures, normal forms, and implement Structured Query Language (SQL) data retrieval and aggregation queries for public health cohorts.
- Develop programmatic data wrangling, cleaning, and transformation pipelines using statistical computing environments (R/Python) on survey and surveillance microdata.
- Apply exploratory data analysis and grammar-of-graphics frameworks to construct demographic pyramids, epidemic curves, geospatial choropleth maps, and automated health dashboards.
- Evaluate health data privacy legislation, cybersecurity measures, de-identification methods, and data governance frameworks through applied public health case studies.

Course Outcomes: On completion, students will be able to:

- **CO1:** Understand healthcare data architectures, clinical/public health coding terminologies, and digital health standards.
- **CO2:** Design relational schemas, manage database structures, and extract public health indicators using SQL queries.
- **CO3:** Implement automated data cleaning, transformation, and quality assurance workflows using statistical programming (R / Python).
- **CO4:** Analyze epidemiological datasets and develop interactive public health dashboards and data visualizations.
- **CO5:** Evaluate data governance, security, confidentiality, and regulatory frameworks governing health data systems.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Scientific Communication & Reporting, GA6: Professional Bioethics, Regulatory Compliance & Clinical Integrity, GA7: Reflective Thinking & Intervention Design, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Introduction to Healthcare Data Ecosystems & Digital Health Standards

- Sources of clinical and population health data: Electronic Medical Records (EMR), Electronic Health Records (EHR), disease registries, and wearable data streams
- National health portals and public health survey datasets: HMIS, IHIP, and NFHS microdata
- Healthcare data taxonomy: structured, semi-structured, and unstructured health data
- International data standards and vocabularies: ICD-10/11, SNOMED CT, LOINC, DICOM, and HL7/FHIR
- Ayushman Bharat Digital Mission (ABDM) architecture: Health Facility Registry (HFR), Healthcare Professionals Registry (HPR), ABHA ID, and Consent Manager frameworks

Unit II: Healthcare Relational Database Management & SQL

- Relational database management fundamentals: entities, attributes, primary keys, foreign keys, and Entity-Relationship (ER) modeling
- Database normalization principles (1NF to 3NF) applied to hospital and clinic workflows
- Data Definition Language (DDL) and Data Manipulation Language (DML): schema design, table creation, record insertion, and modifications
- Data retrieval and querying with SQL: SELECT, WHERE, ORDER BY, aliasing, and filter operations
- Aggregate functions (COUNT, AVG, SUM, MIN, MAX), grouping clauses (GROUP BY, HAVING) for indicator calculation
- Relational joins: inner joins, left/right outer joins across demographic, visit, and laboratory tables
- Subqueries and nested queries for public health cohort identification and patient tracking

Unit III: Programming for Health Data Manipulation (R/Python)

- Development environment setup: RStudio and Jupyter Notebook ecosystems
- Core programming concepts: data structures (vectors, lists, matrices, data frames), indexing, and slicing
- Data ingestion workflows: reading tabular flat files (CSV, TSV), Excel spreadsheets, JSON files, and public health microdata
- Data tidying and wrangling: handling missing values, filtering rows, column selections, and variable recoding
- Reshaping datasets between long and wide formats using tidyverse/dplyr/tidyr (or Python pandas)
- Automating data validation rules, anomaly detection scripts, and quality control checks in survey and surveillance registers

Unit IV: Exploratory Data Analysis & Health Data Visualization

- Exploratory Data Analysis (EDA) pipelines for epidemiological surveillance datasets

- Constructing outbreak visualizations: epidemic curves, incidence rate trends, and attack rates
- Grammar of Graphics principles: static visual generation using ggplot2 (or Python seaborn/matplotlib)
- Visualizing population metrics: population age-sex pyramids, grouped bar charts, time-series lines, and boxplots
- Geospatial public health mapping basics: shapefiles, coordinate reference systems, and choropleth mapping of disease burden at district and state levels
- Introduction to reproducible reporting and interactive dashboards (R Markdown, Quarto, Streamlit, and Tableau fundamentals)

Unit V: Health Data Governance, Ethics, Security & Applied Case Studies

- Healthcare data privacy, confidentiality, and cybersecurity standards in health information systems
- Regulatory frameworks: HIPAA, GDPR, and India's Digital Personal Data Protection (DPDP) Act
- Anonymization and de-identification techniques: k-anonymity, differential privacy, and synthetic health data utility in research
- Enterprise health data governance: data provenance, metadata standards, audit logging, role-based access control (RBAC), and data lifecycle management
- Capstone practical walkthrough: end-to-end data pipeline cleaning an outbreak line-list, executing analytical SQL/programming queries, and drafting an evidence-based decision-support policy brief

Suggested Readings

- Reddy, C. K., & Aggarwal, C. C. *Healthcare Data Analytics*. 1st ed. CRC Press (Taylor & Francis Group), 2015.
- Harrison, E., & Pius, R. *R for Health Data Science*. 1st ed. CRC Press, 2020.
- Malik, U., Goldwasser, M., & Johnston, B. *SQL for Data Analytics*. 3rd ed. Packt Publishing, 2022.
- Hoyt, R. E., & Hersh, W. R. *Health Informatics: Practical Guide for Healthcare and Information Technology Professionals*. 7th ed. Informatics Education, 2018.

Data Visualization and Health Communication

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the foundational theories of health communication, ecological models, behavioral change frameworks, and cognitive principles of visual perception.
- Examine the principles of information design, pre-attentive visual attributes, chart typologies, and strategies to prevent deceptive visual scaling.

- Develop practical skills in wrangling public health datasets to construct interactive dashboards and spatial choropleth maps using modern analytical tools.
- Translate complex epidemiological evidence and health surveillance metrics into targeted policy briefs, infographics, and media communication assets.
- Formulate outbreak risk communication plans and infodemic management strategies while upholding bioethical standards in patient privacy and non-stigmatizing visual representation.

Course Outcomes: On completion, students will be able to:

- **CO1:** Understand the foundational theories of health communication, behavioral change models, and cognitive principles of visual perception.
- **CO2:** Evaluate and clean public health datasets (surveillance data, survey data, epidemiological metrics) for communicative representation.
- **CO3:** Design and construct static, interactive, and geospatial visualizations (dashboards, infographics, choropleth maps) using modern software tools (e.g., Tableau/Power BI, R/Python, GIS, Canva).
- **CO4:** Translate complex public health evidence and epidemiological findings into clear, audience-tailored messages for policymakers, healthcare providers, media, and diverse communities.
- **CO5:** Formulate risk and emergency crisis communication strategies (e.g., epidemic outbreaks, vaccine hesitancy) while upholding ethical standards in data privacy and representation.

Graduate Attributes Addressed: GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Scientific Communication & Reporting, GA6: Professional Bioethics, Regulatory Compliance & Clinical Integrity, GA7: Reflective Thinking & Intervention Design, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Foundations of Health Communication & Audience Framing

- Core concepts, historical evolution, and ecological models of health communication
- Social and Behavior Change Communication (SBCC) frameworks and theories of change
- Audience segmentation principles: categorizing policymakers, clinical providers, media, and general communities
- Assessing and addressing health literacy, numeracy, and cognitive load in population health
- Cultural competency, inclusivity, and tailored message framing across diverse socio-cultural contexts

Unit II: Principles of Visual Perception & Information Design

- Cognitive psychology of visual perception: Gestalt principles and visual hierarchy

- Leveraging pre-attentive attributes (color, size, shape, position) for intentional visual design
- Color theory in health communication: palettes, accessibility standards (color-blind friendly design), and typography
- Matching public health data types to chart typologies (time series, distributions, categorical comparisons, and relational plots)
- Identifying and avoiding chartjunk, distorted aspect ratios, deceptive axes, and misleading scales

Unit III: Hands-on Data Storytelling & Dashboard Tools

- Ingestion, audit, and wrangling of large public health datasets (e.g., NFHS, HMIS, WHO Global Health Observatory)
- Designing interactive dashboards and tracking operational health indicators in Tableau, Power BI, and spreadsheet environments
- Fundamentals of spatial epidemiology: spatial coordinate reference systems and boundary shapefiles
- Construction and interpretation of district- and state-level choropleth disease burden maps using QGIS and web-GIS tools
- Practical data storytelling frameworks: moving from raw exploratory figures to explanatory narrative presentations

Unit IV: Strategic Communication, Infographics & Policy Translation

- Translating epidemiological evidence into actionable policy briefs, executive summaries, and visual abstracts
- Principles of graphic design for public health: structuring multi-panel infographics, patient flyers, and educational campaign materials
- Developing digital public health campaign assets and micro-content for social media platforms
- Media advocacy: writing public health press releases, framing headlines, and collaborating with science journalists
- Crafting compelling data narratives for non-technical community and civic stakeholders

Unit V: Crisis, Risk Communication & Ethics in Data Presentation

- Principles of emergency communication: WHO Emergency Risk Communication (ERC) guidelines and CDC CERC frameworks
- Infodemic management: tracking health rumors, scientific debunking methodologies, and addressing vaccine hesitancy
- Communicating scientific uncertainty, evolving evidence, and probability to the public during disease outbreaks
- Ethical standards in health visualization: patient privacy, de-identification, and data suppression rules

- Mitigating framing bias, promoting health equity, and avoiding community-level stigmatization in disease reporting

Suggested Readings

- Knafllic, C. N. *Storytelling with Data: A Data Visualization Guide for Business Professionals*. 1st ed. John Wiley & Sons, 2015.
- Wright, K. B., Sparks, L., & O'Hair, H. D. *Health Communication in the 21st Century*. 3rd ed. Wiley-Blackwell, 2021.
- Evergreen, S. D. H. *Effective Data Visualization: The Right Chart for the Right Data*. 2nd ed. SAGE Publications, 2019.
- Nelson, D. E., Brownson, R. C., Remington, P. L., & Parvanta, C. *Communicating Public Health Information Effectively: A Guide for Practitioners*. 1st ed. American Public Health Association (APHA), 2002.
- World Health Organization. *WHO Outbreak Communication Planning Guide / Updated Infodemic Management Guidelines*. World Health Organization Press.

Economic Decision Modeling and Cost-Effectiveness Analysis

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the foundational principles, analytical frameworks, health technology assessment (HTA) pathways, and outcome valuation measures (QALYs, DALYs, WTP) in health economics.
- Formulate rigorous costing methodologies, discounting parameters, analytical perspectives, and decision rules using Incremental Cost-Effectiveness Ratios (ICER).
- Design, parameterize, and evaluate decision tree structures and roll-back expected value calculations for screening and clinical pathways.
- Construct cohort-based Markov state-transition models, transition probability matrices, tunnel states, and half-cycle correction mechanisms.
- Quantify parameter uncertainty via deterministic and probabilistic sensitivity analyses, critically appraise studies using the CHEERS 2022 checklist, and translate economic models into policy decisions.

Course Outcomes: On completion, students will be able to:

- **CO1:** Understand the foundational principles, frameworks, and outcome measures (QALYs, DALYs, ICER) in health economic evaluations.
- **CO2:** Quantify healthcare costs, utilize discounting methods, and adjust health preferences using standard utility elicitation techniques.
- **CO3:** Construct decision tree models and cohort-based Markov transition models for public health interventions.
- **CO4:** Perform deterministic and probabilistic sensitivity analyses to characterize parameter uncertainty.

- **CO5:** Critically appraise published economic evaluations using standardized reporting guidelines (CHEERS 2022) and translate findings into health policy decisions.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA5: Effective Scientific Communication & Reporting, GA6: Professional Bioethics, Regulatory Compliance & Clinical Integrity, GA7: Reflective Thinking & Intervention Design, GA10: Lifelong Learning & Evidence-Based Practice

Unit I: Foundations of Health Economic Evaluation & Outcome Measurement

- Introduction to Health Technology Assessment (HTA) and evidence-informed policymaking
- Typologies of health economic evaluation: Cost-Minimization Analysis (CMA), Cost-Effectiveness Analysis (CEA), Cost-Utility Analysis (CUA), and Cost-Benefit Analysis (CBA)
- Valuation of health outcomes: Quality-Adjusted Life Years (QALYs), Disability-Adjusted Life Years (DALYs), and Willingness-to-Pay (WTP)
- Health-related quality of life and utility elicitation instruments: EQ-5D, SF-6D, Standard Gamble (SG), and Time Trade-Off (TTO)

Unit II: Costing Methodologies, Discounting & Decision Rules

- Cost identification, measurement, and valuation: direct medical costs, direct non-medical costs, and indirect productivity losses
- Defining analytical perspectives: societal, healthcare payer, provider, and patient perspectives
- Time horizon selection, inflation adjustments, and differential discounting of costs and health outcomes
- Calculation and geometric interpretation of Incremental Cost-Effectiveness Ratios (ICER)
- Cost-effectiveness decision rules, cost-effectiveness planes, and national/contextual willingness-to-pay cost-effectiveness thresholds

Unit III: Decision Tree Modeling in Healthcare

- Structural components and architecture of decision trees: decision, chance, and terminal nodes
- Parameter estimation: probability pathways, terminal payoffs, costs, and quality-adjusted life years
- Mathematical roll-back analysis and calculation of expected values across decision paths

- Hands-on lab practicals: building decision tree algorithms for clinical management, triage strategies, and disease screening pathways

Unit IV: Markov State-Transition Modeling

- Conceptual framework: modeling recurring events, mutually exclusive health states, and cycle length selection
- Deriving and populating transition probability matrices and survival-to-transition conversions
- Advanced Markov techniques: incorporating tunnel states, time-dependent transition rates, and half-cycle corrections
- Hands-on lab practicals: executing cohort simulations, tracking state occupancy over lifetimes, and calculating long-term costs and QALYs

Unit V: Handling Uncertainty, Quality Appraisal & Policy Translation

- Characterizing parameter uncertainty: Deterministic Sensitivity Analysis (one-way, two-way, and tornado diagrams)
- Probabilistic Sensitivity Analysis (PSA): Monte Carlo simulation, parameter distributions, and Cost-Effectiveness Acceptability Curves (CEAC)
- Methodological quality appraisal of published evaluations using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS 2022) checklist
- HTA case studies, budget impact analysis (BIA), and translating modeled evidence into national health benefit package design and policy decisions

Suggested Readings

- Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. *Methods for the Economic Evaluation of Health Care Programmes*. 4th ed. Oxford University Press, 2015.
- Briggs, A., Claxton, K., & Sculpher, M. *Decision Modelling for Health Economic Evaluation*. Handbooks in Health Economic Evaluation Series. Oxford University Press, 2006.
- Muennig, P., & Bounthavong, M. *Cost-Effectiveness Analysis in Health: A Practical Approach*. 3rd ed. Jossey-Bass/Wiley, 2016.
- Neumann, P. J., Sanders, G. D., Russell, L. B., Siegel, J. E., & Ganiats, T. G. (Eds.). *Cost-Effectiveness in Health and Medicine*. 2nd ed. Oxford University Press, 2016.
- Gray, A. M., Clarke, P. M., Wolstenholme, J. L., & Wordsworth, S. *Applied Methods of Cost-Effectiveness Analysis in Healthcare*. Handbooks in Health Economic Evaluation Series. Oxford University Press, 2011.

Health Technology Assessment and Market Access

Category: Major Core (MC) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental principles, lifecycles of health innovations, and institutional policy frameworks governing Health Technology Assessment (HTA) in India and globally.
- Formulate and apply core health economic evaluation methods, including cost-effectiveness, cost-utility, and decision-analytic modeling.
- Analyze the role of real-world evidence, patient-reported outcome measures, and ethical and social considerations in technology appraisal and healthcare priority setting.
- Examine national and global pricing structures, reimbursement pathways, and health benefit package designs, with special focus on public health insurance schemes like Ayushman Bharat PM-JAY.
- Develop strategic market access value propositions and dossiers for pharmaceuticals, medical devices, and digital health interventions.

Course Outcomes: On completion, students will be able to:

- **CO1:** Understand the core concepts, principles, and policy frameworks of Health Technology Assessment (HTA) and market access globally and in India.
- **CO2:** Compare and apply economic evaluation methodologies (CBA, CEA, CUA, CMA) and decision-analytic modeling to evaluate healthcare technologies.
- **CO3:** Analyze real-world data (RWD), patient-reported outcome measures (PROMs/QALYs/DALYs), and ethical/social dimensions in technology appraisals.
- **CO4:** Evaluate global and national pricing mechanisms, reimbursement pathways, value dossiers, and health benefit package designs (e.g., Ayushman Bharat PM-JAY / HTAIn).
- **CO5:** Formulate a comprehensive market access strategy and value proposition dossier for a selected pharmaceutical, medical device, or digital health intervention.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Economic Modeling Skills, GA4: Health Policy, Reimbursement & Regulatory Systems Competency, GA5: Effective Professional Communication & Strategic Reporting, GA6: Professional Ethics, Equity & Distributive Justice, GA10: Lifelong Learning & Evidence-Based Healthcare Decision-Making

Unit I: Introduction to Health Technology Assessment (HTA)

- Scope, core principles, and lifecycle of health technologies
- Institutional frameworks and governance models: HTAIn, NICE, and CADTH
- Role of HTA in Universal Health Coverage (UHC) and healthcare priority setting
- Decision scoping and framing technology appraisals using structured policy frameworks

Unit II: Economic Evaluation Methods and Decision Modeling

- Economic evaluation types: Cost-Minimization Analysis (CMA), Cost-Effectiveness Analysis (CEA), Cost-Utility Analysis (CUA), and Cost-Benefit Analysis (CBA)
- Measuring health benefits: Quality-Adjusted Life Years (QALYs), Disability-Adjusted Life Years (DALYs), and ICER decision thresholds
- Decision-analytic modeling structures: Decision tree models and Markov models
- Budget Impact Analysis (BIA) and handling uncertainty in economic appraisals

Unit III: Evidence Synthesis & Real-World Evidence

- Systematic reviews and network meta-analyses in technology assessment
- Real-World Data (RWD) and Real-World Evidence (RWE) applications, sources, and methodological challenges
- Patient-reported outcome measures (PROMs) and patient centricity in value appraisals
- Ethical, legal, and social implications (ELSI) in health technology adoption

Unit IV: Pricing, Reimbursement & Market Access

- Pricing models: Value-based pricing, external and internal reference pricing
- Pharmaceutical and medical device pricing mechanisms in India: NPPA regulations and NLEM
- Managed Entry Agreements (MEAs) and performance-based risk-sharing schemes
- Health benefit package design and reimbursement mechanisms under Ayushman Bharat PM-JAY

Unit V: Global Value Dossiers & Practical Case Applications

- Structural components and strategic drafting of a Global Value Dossier (GVD)
- Commercialization pathways, payer communication, and value propositions
- Practical technology appraisals: Evaluating pharmaceuticals and biologicals
- Health technology assessment and access dynamics for medical devices and digital health solutions

Suggested Readings

- Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. *Methods for the Economic Evaluation of Health Care Programmes* (4th Edition). Oxford University Press.
- World Health Organization. *Health Technology Assessment: A Guide for Evaluators and Decision Makers*. WHO Guidelines Approved by the Guidelines Review Committee.
- Prinja, S., Bahuguna, P., & Downey, L. E. *Health Technology Assessment in India: Principles and Practice*. Springer Nature / Department of Health Research (MoHFW).
- Kolassa, E. M., & Vandervelde, P. *Market Access: Strategy, Pricing, and Reimbursement for Pharmaceuticals and Medical Devices*. CRC Press.

Antimicrobial Resistance and Vaccinology

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the biological foundations, epidemiological burden, transmission pathways, and One Health dimensions of antimicrobial resistance (AMR) across human, animal, and environmental interfaces.
- Examine AMR surveillance architectures, diagnostic stewardship principles, and global/national action frameworks (such as WHO NAP-AMR, GLASS, and ICMR networks).
- Analyze the immunological basis of immunization, classification of vaccine platforms, novel technologies, and vaccine safety assessment mechanisms.
- Evaluate vaccine development lifecycles, clinical trial phases, cold chain maintenance, logistics, and programmatic operationalization under the Universal Immunization Programme (UIP).
- Formulate strategic public health responses that address vaccine hesitancy and integrate antimicrobial stewardship programs (AMS) with targeted vaccination for infection prevention and outbreak containment.

Course Outcomes: On completion, students will be able to:

- **CO1:** Understand the biological mechanisms, global epidemiological burden, and drivers of antimicrobial resistance (AMR) across human, animal, and environmental domains (One Health approach).
- **CO2:** Compare and apply surveillance methodologies, diagnostic stewardship, and national/global action plans (e.g., WHO NAP-AMR, ICMR surveillance networks) to combat AMR.
- **CO3:** Analyze the immunology of vaccination, vaccine types (live-attenuated, inactivated, mRNA, vector-based), and vaccine safety/pharmacovigilance principles.
- **CO4:** Evaluate vaccine development pipelines, cold chain logistics, immunization program management, and strategies to address vaccine hesitancy.
- **CO5:** Formulate a comprehensive public health intervention plan combining antimicrobial stewardship programs (AMS) and targeted vaccination deployment for outbreak control

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Antimicrobial Resistance (AMR) & One Health

- Biological mechanisms of antimicrobial resistance (mutation, horizontal gene transfer, efflux pumps, enzymatic degradation)
- Drivers and selective pressures of AMR in healthcare, veterinary medicine, agriculture, and animal husbandry
- Global and national epidemiological burden of drug-resistant pathogens
- The One Health paradigm: Interlinkages between human health, animal health, agriculture, and ecosystem dynamics

Unit II: AMR Surveillance and Antimicrobial Stewardship (AMS)

- Global and national surveillance architectures: WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) and ICMR surveillance networks
- Structure and implementation of National Action Plans on AMR (NAP-AMR) and State Action Plans (SAP-AMR)
- Diagnostic stewardship: Rational use of diagnostics, rapid testing platforms, and antibiograms
- Hospital-based and community-level Antimicrobial Stewardship Programs (AMS): Core elements, prescription audits, and institutional policies

Unit III: Fundamentals of Vaccinology & Immunology

- Principles of protective immunity: Innate vs. adaptive responses, active vs. passive immunization, and herd immunity thresholds
- Traditional vaccine platforms: Live-attenuated, whole-inactivated, toxoid, and subunit vaccines
- Advanced vaccine technologies: Recombinant, viral-vectored, mRNA, and DNA platforms
- Role of adjuvants, formulation stability, antigen selection, and correlates of protection

Unit IV: Vaccine Development, Safety & Immunization Programs

- Preclinical testing pipelines and clinical trial phases (Phases I–IV)
- Vaccine pharmacovigilance and surveillance of Adverse Events Following Immunization (AEFI)
- Cold chain management, storage infrastructure, temperature monitoring, and logistics operations
- Immunization program delivery: Universal Immunization Programme (UIP), coverage tracking, and administrative systems

Unit V: Public Health Strategies: Combating Vaccine Hesitancy & Managing Outbreaks

- Determinants and drivers of vaccine hesitancy, infodemics, and public misinformation
- Risk communication, community engagement models, and strategic behavioral change interventions

- Synergy between vaccination policies and antimicrobial resistance mitigation (reducing pathogen load and inappropriate antibiotic use)
- Designing integrated outbreak response plans linking targeted immunization campaigns and active stewardship

Suggested Readings

- Plotkin, S. A., Orenstein, W. A., Offit, P. A., & Edwards, K. M. *Plotkin's Vaccines* (7th Edition). Elsevier.
- World Health Organization. *Antimicrobial Resistance: A Global Threat*. WHO Press.
- Bennett, J. E., Dolin, R., & Blaser, M. J. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases* (9th Edition). Elsevier.
- Fine, P., Eames, K., & Heymann, D. L. *Vaccination and World Health*. Oxford University Press.

Maternal and Child Nutrition

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, life-course perspective, and epidemiological burden of maternal and child undernutrition and overnutrition globally and in India.
- Examine physiological adaptations and nutritional requirements across the reproductive cycle, the critical first 1,000 days, infancy, childhood, and adolescence.
- Apply comprehensive nutritional assessment methods—including anthropometry, dietary assessment, biochemical markers, and WHO growth standards—to assess population and individual nutritional status.
- Evaluate major nutritional disorders, micronutrient deficiencies, and large-scale public health nutrition programs and policies (e.g., POSHAN Abhiyaan, ICDS, Anaemia Mukh Bharat).
- Design evidence-based maternal and child nutrition interventions incorporating social and behavior change communication (SBCC), program monitoring, nutrition surveillance, and emerging digital innovations.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the nutritional requirements across the continuum of care from preconception, pregnancy, lactation, infancy, childhood, and adolescence.
- **CO2:** Assess maternal and child nutritional status using anthropometric, dietary, clinical, biochemical, and growth assessment methods.
- **CO3:** Evaluate major nutritional disorders, micronutrient deficiencies, and evidence-based interventions for improving maternal and child health.

- **CO4:** Critically analyse national nutrition programmes, policies, and community-based interventions addressing maternal and child nutrition.
- **CO5:** Design evidence-based public health strategies for improving maternal and child nutrition through nutrition promotion, programme implementation, monitoring, and evaluation.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Introduction to Maternal & Child Nutrition and the Life-Course Continuum

- Concepts, scope, and principles of maternal and child nutrition; life-course perspective and the first 1,000 days window of opportunity
- Intergenerational cycle of malnutrition and the nutrition transition in low- and middle-income countries
- Global and national burden of maternal and child malnutrition; Sustainable Development Goals (SDGs) targeting nutrition
- Nutritional requirements across the continuum: Preconception care, adolescent nutrition, physiological adaptations during pregnancy, gestational weight gain, lactation, and impact on birth outcomes

Unit II: Fetal Development, Infant Feeding and Pediatric Nutrition

- Fetal growth and development; early initiation and exclusive breastfeeding; breast milk composition and the Baby-Friendly Hospital Initiative (BFHI)
- Lactation management, complementary feeding, and Infant and Young Child Feeding (IYCF) guidelines
- Nutrient requirements, growth trajectories, feeding patterns, and dietary diversity during infancy, school age, and adolescence
- Nutrition in vulnerable, marginalized, and emergency-affected child populations

Unit III: Nutritional Assessment, Deficiencies, and Clinical Disorders

- Nutritional assessment methods: Anthropometry (BMI, MUAC), dietary intake tools, clinical signs, and biochemical markers
- Growth monitoring, WHO Child Growth Standards, and growth chart interpretation
- Micronutrient deficiencies in women and children (iron, folic acid, calcium, vitamin D, iodine, zinc, vitamin A); supplementation, fortification, and biofortification strategies
- Pathophysiology and management of protein-energy malnutrition (stunting, wasting, underweight, SAM, MAM), childhood obesity, and nutrition during infections

Unit IV: Public Health Nutrition Programs and Interventions

- Flagship national nutrition programs: Integrated Child Development Services (ICDS), Anganwadi service delivery, and POSHAN Abhiyaan
- Disease-specific and setting-based schemes: Anaemia Mukh Bharat, PM POSHAN (Mid-Day Meal Scheme), and National Health Mission (NHM) initiatives
- Community-based Management of Acute Malnutrition (CMAM) and facility-based care pathways
- Nutrition-specific versus nutrition-sensitive interventions and inter-sectoral convergence

Unit V: Behavior Change, Policy Frameworks, and Emerging Priorities

- Nutrition education, maternal and infant feeding counseling techniques, and behavior change communication (BCC/SBCC)
- Social, cultural, and gender determinants of maternal and child nutrition; community participation models
- National Nutrition Policy, National Nutrition Strategy, food security frameworks, and routine nutrition surveillance
- Monitoring and evaluation of nutrition programs, digital monitoring platforms, and emerging challenges (climate change, humanitarian emergencies, and food systems)

Suggested Readings

- Lawrence, M., & Worsley, T. *Public Health Nutrition*. Routledge.
- Ross, A. C. *Modern Nutrition in Health and Disease*. Wolters Kluwer.
- Symonds, M. E., & Ramsay, M. *Maternal and Child Nutrition*. Wiley-Blackwell.

Maternal and Perinatal Mental Health

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the epidemiological burden, clinical manifestations, and socio-cultural determinants of common and severe perinatal mental disorders.
- Examine validated screening instruments, risk profiling protocols, and routine assessment workflows across facility and community maternal care settings.
- Apply evidence-based psychosocial interventions, task-sharing strategies, and community-led care models (e.g., WHO Thinking Healthy Programme) within primary healthcare.
- Analyze operational pathways, referral linkages, workforce training needs, and systemic barriers to integrating perinatal mental health into primary MCH/RMNCAH+ programs.

- Evaluate the intergenerational effects of perinatal mental ill-health on infant development, assess reproductive loss, and review mental health policy, legal, and equity frameworks for vulnerable populations.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the epidemiology, socio-cultural determinants, burden, and clinical manifestations of common perinatal mental disorders.
- **CO2:** Describe validated screening tools, early detection protocols, and clinical vs. community assessment frameworks in maternal healthcare.
- **CO3:** Apply evidence-based psychosocial interventions, WHO task-sharing models, and health system integration approaches within maternal and child health programs.
- **CO4:** Analyze the intergenerational impacts of perinatal mental ill-health, equity barriers, legal-policy frameworks, and multi-sectoral strategies for vulnerable populations.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Foundations & Global Burden of Perinatal Mental Health

- Epidemiology of common perinatal mental disorders (perinatal depression, anxiety disorders, and postpartum psychosis)
- Biological, psychological, and socio-cultural determinants of maternal mental distress
- Gender disadvantage, intimate partner violence (IPV), societal expectations, and mental health stigma
- Global and national disease burden, disability-adjusted life years (DALYs), and the maternal mental health treatment gap

Unit II: Screening, Assessment & Diagnostic Frameworks

- Psychometric properties and utility of validated screening tools: EPDS, PHQ-9, and GAD-7
- Routine early detection protocols during antenatal and postnatal care contacts
- Risk profiling: History of psychiatric illness, obstetric complications, social isolation, and stress factors
- Clinical assessment versus community-level triage and identification by frontline workers

Unit III: Psychosocial Interventions & Task-Sharing Models

- Evidence-based non-pharmacological therapies: Cognitive Behavioral Therapy (CBT) and Interpersonal Psychotherapy (IPT) adaptations
- WHO Thinking Healthy Programme: Principles, module structure, and delivery mechanisms
- Task-sharing frameworks: Equipping Community Health Workers (ASHAs/ANMs) and primary care nurses for psychosocial delivery
- Peer-led support networks, maternal support circles, and family-inclusive counseling approaches

Unit IV: Health Systems Integration & Referral Pathways

- Mainstreaming mental health into routine maternal and child health (MCH) and RMNCAH+ service platforms
- Stepped-care models, triage algorithms, and multi-tiered referral mechanisms between primary, secondary, and tertiary psychiatric care
- Capacity building, supervision cascades, and burnout prevention for the maternal healthcare workforce
- Health system constraints: Resource scarcity, service fragmentation, and administrative bottlenecks

Unit V: Intergenerational Impacts, Policy & Equity Analysis

- Effects of maternal mental illness on mother-infant bonding, attachment styles, infant neurodevelopment, and early childhood outcomes
- Psychosocial impact of reproductive trauma, miscarriage, stillbirth, and perinatal loss
- National Mental Health Policy, Mental Healthcare Act, and district-level operational programs
- Equity dimensions, intersectionality, and tailored multi-sectoral support for marginalized and vulnerable maternal groups

Suggested Readings

- Wenzel, A. *The Routledge International Handbook of Perinatal Mental Health Disorders*. Routledge.
- Míguez Varela, C. *Maternal Perinatal Mental Health*. MDPI.

Epidemiology of Non-communicable Diseases

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, historical evolution, epidemiological transitions, and shared determinants driving the global and national burden of non-communicable diseases (NCDs).

- Apply observational and experimental epidemiological study designs, exposure assessment techniques, and surveillance systems to investigate chronic disease etiology and population trends.
- Examine multi-level prevention models, population versus high-risk strategies, and screening principles for early detection and control of chronic conditions.
- Analyze health system responses, chronic care models, and multi-sectoral policies addressing long-term NCD management and healthcare financing.
- Evaluate national and global NCD control frameworks, program governance, and monitoring mechanisms for sustainable disease prevention.

Course Outcomes: On completion, students will be able to:

- **CO1:** Examine the global burden, epidemiological transitions, shared risk factors, and social determinants shaping non-communicable disease patterns.
- **CO2:** Apply advanced epidemiological study designs, measurement tools, and surveillance systems to investigate chronic disease etiology and population trends.
- **CO3:** Evaluate population-level and high-risk prevention strategies, early detection frameworks, and screening programs for chronic conditions.
- **CO4:** Analyze health system integration, multi-sectoral policies, health economics, and program governance for long-term disease control.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Epidemiological Research Skills, GA4: Public Health Surveillance & Chronic Disease Systems Competency, GA5: Effective Health Communication & Multi-Sectoral Advocacy, GA6: Professional Ethics, Equity & Social Justice in Chronic Care, GA10: Lifelong Learning & Evidence-Informed Health Policy Decision-Making

Unit I: Foundations, Global Burden, and Determinants of Chronic Diseases

- Concepts, principles, and historical evolution of chronic disease epidemiology
- Demographic, nutritional, and epidemiological transitions across global and Indian settings
- Global, regional, and national burden of major NCDs (cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes)
- Shared modifiable behavioral risk factors (tobacco, alcohol, physical inactivity, unhealthy diet) and underlying metabolic/biological determinants
- Social determinants of health, commercial determinants, and the life-course approach to chronic disease accumulation

Unit II: Epidemiological Methods and Surveillance Systems

- Application of observational (cohort, case-control, cross-sectional) and experimental designs to chronic disease etiology

- Methodological considerations: Long latency periods, multi-causality, measurement of cumulative exposure, and disease biomarkers
- Disease registries (population-based and hospital-based cancer registries) and national health surveys
- Routine NCD surveillance architectures, monitoring frameworks, and tracking of disease incidence, prevalence, and mortality patterns

Unit III: Prevention Models, Screening, and Early Detection Frameworks

- Levels of disease prevention: Primordial, primary, secondary, and tertiary prevention paradigms
- Rose's population-based prevention strategy versus targeted high-risk prevention approaches
- Principles of screening: Wilson-Jungner criteria, diagnostic validity, sensitivity, specificity, and predictive values
- Systematic chronic disease risk profiling, screening biases (lead-time, length bias), and evaluation of population-level screening programs

Unit IV: Health Systems, Policy, Governance, and Programmatic Responses

- Health system restructuring and Chronic Care Models (CCM) for the integration of NCD services in primary healthcare
- Multi-sectoral action, fiscal interventions (taxation on tobacco, sugar-sweetened beverages), and legislative/regulatory policies
- Health economics of chronic diseases: Catastrophic health expenditure, economic burden, and cost-effective interventions ("Best Buys")
- Implementation, governance, and monitoring of national frameworks (NP-NCD in India) and global targets (WHO Global NCD Action Plan, SDGs)

Suggested Readings

- Remington, P. L., Brownson, R. C., & Wegner, M. V. *Chronic Disease Epidemiology, Prevention, and Control*. American Public Health Association.
- World Health Organization. *Global Action Plan for the Prevention and Control of NCDs*. World Health Organization.

Non-Pharmacological NCD Interventions

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental principles, determinants, and evidence base underpinning non-pharmacological interventions, lifestyle medicine, and patient-centered chronic care models.

- Examine theories of health behavior change, motivational interviewing, lifestyle counseling, and evidence-based physical activity and exercise prescriptions across the life course.
- Analyze the impact of psychological well-being, stress physiology, and sleep hygiene on chronic disease pathways and clinical outcomes.
- Evaluate disease-specific non-pharmacological protocols, multidisciplinary rehabilitation programs, and patient self-management frameworks for major chronic conditions.
- Design population-level, community-based, digital health-enabled, and innovative lifestyle interventions for comprehensive NCD prevention and management.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the principles, determinants, and evidence underpinning non-pharmacological interventions for prevention and management of non-communicable diseases.
- **CO2:** Apply evidence-based lifestyle, behavioural, psychosocial, and physical activity interventions for major non-communicable diseases across diverse populations.
- **CO3:** Evaluate disease-specific, rehabilitation, and self-management approaches for comprehensive NCD prevention and long-term care.
- **CO4:** Design community-based, multidisciplinary, and technology-enabled intervention strategies for improving NCD outcomes.
- **CO5:** Critically appraise emerging innovations and future directions in non-pharmacological NCD prevention and management.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Epidemiological Research Skills, GA4: Public Health Surveillance & Chronic Disease Systems Competency, GA5: Effective Health Communication & Multi-Sectoral Advocacy, GA6: Professional Ethics, Equity & Social Justice in Chronic Care, GA10: Lifelong Learning & Evidence-Informed Health Policy Decision-Making

Unit I: Introduction to Non-Pharmacological Management & Lifestyle Modification

- Global burden of non-communicable diseases and major modifiable behavioral/metabolic risk factors
- Principles of non-pharmacological management, prevention continuum, and WHO "Best Buys"
- Lifestyle medicine paradigms, patient-centered care, and integrated chronic care models
- Healthy lifestyle practices: Dietary behaviors, physical activity promotion, tobacco and alcohol risk reduction, and social determinants of health behaviors

Unit II: Physical Activity, Exercise Prescription & Psychosocial Well-being

- WHO physical activity guidelines and FITT principles of exercise prescription (frequency, intensity, time, type)
- Aerobic, resistance, flexibility, and balance training across the life course; *Exercise is Medicine®* framework
- Psychological determinants of chronic conditions, stress physiology, and coping mechanisms
- Mind-body interventions: Mindfulness, relaxation techniques, cognitive-behavioral approaches, and sleep hygiene principles

Unit III: Behavior Change Theories, Health Coaching & Lifestyle Counseling

- Theoretical frameworks: Health Belief Model, Transtheoretical Model (Stages of Change), and Social Cognitive Theory
- Practical counseling techniques: Motivational interviewing, goal setting, self-monitoring, and relapse prevention
- Strategies for improving therapeutic adherence and promoting shared decision-making
- Patient health coaching, individual education plans, and tailored behavioral communication

Unit IV: Disease-Specific Protocols, Rehabilitation & Self-Management

- Non-pharmacological management of diabetes mellitus, hypertension, cardiovascular diseases, obesity, chronic kidney disease, and musculoskeletal disorders
- Cancer survivorship care, healthy ageing, and non-pharmacological approaches to multimorbidity
- Clinical rehabilitation models: Cardiac rehabilitation, pulmonary rehabilitation, and cancer rehabilitation
- Chronic disease self-management programs, patient empowerment, family-centered care, and peer-support networks

Unit V: Community Interventions, Digital Health & Emerging Innovations

- Population-level interventions: Workplace wellness, school-based programs, Healthy Cities initiatives, and social prescribing
- Digital health applications in NCD management: mHealth, remote patient monitoring, wearable sensors, mobile apps, and artificial intelligence
- Ethical standards, data privacy, and digital equity in technology-enabled chronic care
- Emerging innovations: Precision lifestyle medicine, digital therapeutics, yoga and meditation, nature-based interventions, and future trends

Suggested Readings

- Rippe, J. M. *Lifestyle Medicine*. CRC Press.
- Edberg, M. *Essentials of Health Behavior*. Jones & Bartlett Learning.

- Detels, R. *Oxford Textbook of Global Public Health*. Oxford University Press.

Principles of Industrial Hygiene and Workplace Safety

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the core principles, scope, historical evolution, and multidisciplinary foundations of industrial hygiene and occupational health.
- Identify, classify, and analyze major occupational hazards—including physical, chemical, biological, ergonomic, and psychosocial hazards—and their impacts on worker health.
- Apply standard occupational exposure assessment methods, environmental sampling strategies, biological monitoring, and interpretation of occupational exposure limits (OELs).
- Evaluate workplace hazards using the hierarchy of controls, risk assessment matrices, and occupational health surveillance mechanisms.
- Examine workplace safety protocols, incident investigation procedures, emergency preparedness plans, and national/international occupational safety legislation, standards, and management systems (e.g., OSH Code 2020, ISO 45001)

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the fundamental principles of industrial hygiene, occupational health, and workplace safety.
- **CO2:** Identify and classify workplace hazards and analyse their potential health effects on workers.
- **CO3:** Describe and apply basic principles of occupational exposure assessment, workplace monitoring, and interpretation of exposure limits.
- **CO4:** Evaluate workplace risks and recommend appropriate hazard-control and occupational safety measures.
- **CO5:** Analyse workplace safety scenarios and apply relevant legislation, standards, and preventive approaches to improve occupational health and safety.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Industrial Exposure Assessment Skills, GA4: Occupational Health Systems, Safety Compliance & Regulatory Competency, GA5: Effective Professional Communication & Incident Reporting, GA6: Professional Ethics, Worker Welfare & Social Justice, GA10: Lifelong Learning & Evidence-Informed Safety Management

Unit I: Foundations of Industrial Hygiene and Occupational Health

- Definition, scope, objectives, and historical evolution of industrial hygiene
- Core roles and professional ethics of industrial hygienists and occupational health specialists
- Fundamentals of occupational health and safety; relationship between occupational exposures, dose-response dynamics, and worker health
- Principles of occupational disease prevention and wellness promotion in the workplace

Unit II: Identification and Classification of Occupational Hazards

- Physical hazards: Noise, vibration, heat, cold, ionizing and non-ionizing radiation
- Chemical hazards: Airborne contaminants including dusts, fumes, gases, vapours, and organic solvents
- Biological hazards (infectious agents, bioaerosols) and ergonomic risk factors (biomechanical strain, repetitive motion, lifting, posture)
- Psychosocial hazards: Work-related stress, shift work, and organizational dynamics
- Routes of occupational entry (inhalation, dermal absorption, ingestion) and associated occupational diseases

Unit III: Occupational Exposure Assessment and Workplace Monitoring

- Principles of hazard identification, baseline profiling, and exposure assessment strategies
- Sampling methodologies: Active and passive air sampling, aerosol monitoring, and gas/vapour detection
- Physical agent assessments: Sound level measurement, dosimeters, and thermal stress indices (WBGT)
- Biological monitoring: Biomarkers of exposure, effect, and internal dose
- Occupational Exposure Limits (OELs): Time-Weighted Averages (TWA), Short-Term Exposure Limits (STEL), Ceiling (C) limits, and interpretation of monitoring data

Unit IV: Industrial Hygiene Controls and Risk Management

- Hierarchy of controls: Elimination, substitution, engineering controls, administrative interventions, and personal protective equipment (PPE)
- Engineering interventions: Local exhaust ventilation (LEV), general dilution ventilation, containment, and enclosure
- Administrative strategies: Work schedules, job rotation, training, and good housekeeping
- Personal protective equipment: Selection, fitting, maintenance, and respiratory protection programs
- Risk assessment methodologies, risk prioritization matrices, and routine occupational health surveillance

Unit V: Workplace Safety, Incident Prevention, Emergency Preparedness & Legal Frameworks

- Operational safety: Machine guarding, electrical hazards, chemical storage/handling, confined space entry, and working at heights
- Permit-to-work (PTW) systems, incident and near-miss reporting, root-cause analysis, and safety climate culture
- Emergency preparedness, evacuation strategies, fire prevention, and life safety systems
- Indian statutory framework: Key provisions under the Occupational Safety, Health and Working Conditions Code, 2020, and state enforcement bodies
- Global benchmarks: International Labour Organization (ILO) standards, ISO 45001 Occupational Health and Safety Management Systems, workplace inspections, and hazard assessment reporting

Suggested Readings

- Anna, D. H. *The Occupational Environment: Its Evaluation, Control, and Management* (3rd Edition). American Industrial Hygiene Association (AIHA).
- Plog, B. A., & Quinlan, P. J. *Fundamentals of Industrial Hygiene* (6th Edition). National Safety Council.
- Goetsch, D. L. *Occupational Safety and Health for Technologists, Engineers, and Managers* (9th Edition). Pearson.
- Ministry of Law and Justice, Government of India. *The Occupational Safety, Health and Working Conditions Code, 2020*. The Gazette of India.

Occupational Medicine and Toxicology

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Explain the principles, scope, and importance of occupational medicine and occupational health in public health practice.
- Identify workplace hazards, occupational exposures, and their potential effects on workers' health.
- Describe the epidemiology, clinical features, prevention, and control of major occupational diseases and work-related disorders.
- Explain the fundamental principles of toxicology, including dose-response relationships, routes of exposure, toxicity, and toxicokinetics.
- Develop an understanding of occupational risk assessment, exposure control, and workplace health surveillance for the prevention of occupational illnesses and injuries.
- Familiarize students with occupational health legislation, workplace safety programmes, and evidence-based strategies for protecting workers' health.

Course Outcomes: On completion, students will be able to:

- CO1: Explain the principles of occupational medicine, occupational health, and the relationship between work and health.
- CO2: Identify occupational hazards, exposure pathways, and workplace factors associated with adverse health outcomes.
- CO3: Describe major occupational diseases, work-related disorders, and their prevention and control.
- CO4: Explain toxicological principles and interpret the health effects of exposure to hazardous chemicals and toxic agents.
- CO5: Apply occupational risk assessment, workplace surveillance, and exposure prevention principles to occupational health problems.
- CO6: Analyse occupational health policies, legislation, and workplace health programmes and recommend evidence-based preventive strategies.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Occupational Risk Assessment Skills, GA4: Occupational Health Systems, Safety Compliance & Statutory Law Competency, GA5: Effective Technical Communication & Workplace Health Reporting, GA6: Professional Ethics, Worker Welfare & Social Justice, GA10: Lifelong Learning & Evidence-Informed Clinical and Preventive Practice

Unit I: Fundamentals of Occupational Medicine and Occupational Health

- Definition, scope, objectives, and historical evolution of occupational health and industrial medicine
- The bidirectional relationship between work, environment, and human health
- Organization and functions of occupational health services in industrial and non-industrial settings
- Introduction to occupational epidemiology, disease causation models, and work-relatedness of illness
- Roles, ethical responsibilities, and mutual duties of employers, employees, and occupational health physicians

Unit II: Workplace Hazards, Exposure Pathways & Occupational Safety

- Classification of workplace hazards: Physical, chemical, biological, ergonomic, and psychosocial risk factors
- Work-related stress, organizational burnout, and mental health determinants in the modern work environment
- Exposure pathways, routes of entry (inhalation, dermal absorption, ingestion), and baseline environmental monitoring
- Vulnerable worker groups: Migrant laborers, informal sector workers, aging workforce, and pregnant employees

- Occupational injuries, workplace accidents, injury epidemiology, and incident prevention protocols

Unit III: Clinical Occupational Medicine & Major Work-Related Diseases

- Occupational respiratory disorders: Pneumoconiosis, silicosis, asbestosis, coal workers' pneumoconiosis, and occupational asthma
- Occupational dermatology: Irritant contact dermatitis, allergic contact dermatitis, and chemical burns
- Physical agent-induced disorders: Noise-Induced Hearing Loss (NIHL), vibration syndromes, and thermal stress/heat-related illnesses
- Work-related musculoskeletal disorders (WMSDs), repetitive strain injuries, and ergonomics-related impairments
- Occupational biological infections, bloodborne pathogens, and occupational carcinogens (IARC Group 1 agents)

Unit IV: Principles of Toxicology & Industrial Toxicants

- Foundational toxicology: Toxicants, xenobiotics, toxicity grading, and threshold vs. non-threshold concepts
- Dose-response relationships, NOAEL, LOAEL, and determination of exposure thresholds
- Toxicokinetics: Absorption, distribution, biotransformation/metabolism, and excretion (ADME) mechanisms
- Acute, sub-chronic, and chronic toxicity; organ-specific toxicity (hepatotoxicity, nephrotoxicity, neurotoxicity)
- Toxicological profiles of major industrial agents: Heavy metals (lead, mercury, cadmium, arsenic), aromatic solvents, and pesticides

Unit V: Occupational Risk Assessment, Surveillance, and Statutory Governance

- Occupational risk assessment workflow: Hazard identification, dose-response analysis, exposure assessment, and risk characterization
- Hierarchy of controls: Elimination, chemical substitution, engineering isolation, administrative schedules, and PPE selection/fit-testing
- Occupational health surveillance: Pre-placement, periodic, and exit medical fitness examinations, and biological monitoring
- Emergency preparedness planning, first-aid infrastructure, and accident prevention systems
- Statutory regulatory frameworks: Key provisions of the Occupational Safety, Health and Working Conditions Code, 2020 (India), ILO conventions, and WHO workplace health guidelines
- Applied field practice: Workplace inspection walk-throughs, industrial accident investigation, and drafting evidence-based preventive health plans

Suggested Readings

- Ladou, J., & Harrison, R. *Current Occupational & Environmental Medicine* (or related recognized institutional reference texts). McGraw Hill / Elsevier.
- Klaassen, C. D. (Ed.). *Casarett & Doull's Toxicology: The Basic Science of Poisons* (9th Edition). McGraw Hill.
- International Labour Organization. *Fundamental Principles of Occupational Health and Safety*. ILO.
- World Health Organization. *Occupational Health: A Manual for Primary Health Care Workers*. WHO.
- International Labour Organization & World Health Organization. *Joint ILO/WHO Guidelines on Occupational Safety and Health Management Systems*. ILO / WHO Publications.

Climate Change and Planetary Health

Category: Major Core (MC) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the scientific foundations of the climate system, planetary boundaries, the Anthropocene, and broader environmental determinants of health.
- Examine direct and indirect health consequences of climate change, including extreme heat, air pollution, mental distress, and climate-sensitive communicable and non-communicable diseases.
- Analyze the impacts of changing climatic patterns on agricultural productivity, sustainable food systems, water security (WASH), and nutritional outcomes.
- Evaluate public health adaptation strategies, disaster risk reduction, heat action plans, early warning systems, and climate-resilient health infrastructure.
- Critically appraise national and international climate governance frameworks while designing interventions centered on One Health, sustainable healthcare delivery, green hospitals, and climate justice.

Course Outcomes: On completion, students will be able to:

- **CO1.** Explain the scientific basis of climate change and planetary health, including environmental determinants affecting human health.
- **CO2.** Assess the effects of climate change on communicable diseases, non-communicable diseases, nutrition, water security, occupational health, and vulnerable populations.
- **CO3.** Evaluate adaptation, mitigation, disaster preparedness, and health system resilience strategies for climate-related public health challenges.
- **CO4.** Critically examine national and international climate policies, governance frameworks, and sustainable development approaches relevant to public health.

- **CO5.** Design evidence-based public health interventions incorporating One Health, Planetary Health, climate communication, and sustainable healthcare principles.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Environmental Risk Assessment Skills, GA4: Planetary Health, Environmental Governance & Policy Systems Competency, GA5: Climate Communication, Health Advocacy & Community Engagement, GA6: Environmental Ethics, Equity & Climate Justice, GA10: Lifelong Learning & Sustainable Healthcare Practice

Unit I: Introduction to Climate Science and Planetary Health Foundations

- The physical climate system, greenhouse effect, global warming dynamics, and climate variability
- Planetary boundaries concept, ecological degradation, and health implications of the Anthropocene
- Environmental determinants of health and planetary life-support systems
- Direct and indirect pathways connecting climatic shifts to human population well-being

Unit II: Climate Impacts on Health, Disease Burden, and Vulnerability

- Thermal extremes: Heat stress pathophysiology, heatwave vulnerability, and occupational exposure risks
- Ambient air quality interactions, extreme weather events, and psychological/mental health burdens
- Epidemiology of climate-sensitive infections: Vector-borne diseases (dengue, malaria), water-borne pathogens, and food-borne illnesses
- Zoonotic spillover dynamics, antimicrobial resistance (AMR), and ecosystem disruptions
- Health inequities and differential vulnerabilities across gender, age, geography, and socioeconomic status

Unit III: Food Systems, Water Security, and Ecosystem Dependencies

- Climatic threats to agricultural productivity, crop nutrient density, and global food supply chains
- Malnutrition risks, stunting, wasting, and food insecurity in vulnerable regions
- Water scarcity, water quality degradation, and Water, Sanitation, and Hygiene (WASH) infrastructure
- Biodiversity conservation, natural capital, and critical ecosystem services supporting community health

Unit IV: Adaptation, Health System Resilience, and Policy Frameworks

- Disaster Risk Reduction (DRR), multi-hazard emergency preparedness, and integrated early warning systems
- Building climate-resilient health systems, facility retrofitting, and local Heat Action Plans (HAPs)
- Global environmental governance: United Nations Framework Convention on Climate Change (UNFCCC), Paris Agreement, and the Sustainable Development Goals (SDGs)
- National and state policy frameworks in India: National Action Plan on Climate Change (NAPCC), State Action Plans (SAPCC), and the National Programme on Climate Change and Human Health (NPCCHH)

Unit V: One Health, Sustainable Healthcare, and Climate Communication

- One Health and Planetary Health paradigms: Operationalizing human-animal-ecosystem surveillance
- Decarbonizing healthcare: Calculating the health sector carbon footprint, supply chain emissions, and healthcare waste management
- Green Hospital initiatives, low-carbon clinical delivery, and renewable energy adoption in healthcare
- Principles of climate justice, intergenerational equity, community health advocacy, and evidence-based risk communication

Suggested Readings

- Levy, B. S., & Patz, J. *Climate Change and Public Health*. Oxford University Press.
- Myers, S., & Frumkin, H. *Planetary Health: Protecting Nature to Protect Ourselves*. Island Press.
- Pachauri, S., Pachauri, A., & Jonathan, M. P. *Health and Climate Change: Unravelling the Connections*. Elsevier.
- Gronlund, C. *Environmental Health: Foundations for Public Health*. Springer Publishing.

Environmental Risk Assessment and Mitigation

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, terminology, historical evolution, and institutional frameworks governing environmental risk assessment in public health.
- Identify and classify environmental hazards across air, water, soil, and occupational settings, evaluating exposure pathways and health vulnerabilities.
- Apply the four-step environmental health risk assessment paradigm: hazard identification, dose-response assessment, exposure assessment, and risk characterization.
- Formulate and evaluate environmental risk management strategies, the hierarchy of controls, pollution prevention, and environmental remediation approaches.

- Examine environmental regulatory standards, risk communication principles, community-level mitigation planning, and real-world industrial and urban case scenarios.

Course Outcomes: On completion, students will be able to:

- CO1: Explain the principles, terminology, and framework of environmental risk assessment in public health.
- CO2: Identify environmental hazards, exposure pathways, vulnerable populations, and potential adverse health effects.
- CO3: Apply the steps of environmental risk assessment to environmental health problems using relevant exposure and health information.
- CO4: Evaluate environmental risk management and mitigation strategies, including relevant regulatory and public health approaches.
- CO5: Analyse environmental health case studies and recommend evidence-based risk reduction, communication, and monitoring measures.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Quantitative Risk Estimation Skills, GA4: Environmental Health Systems, Policy & Regulatory Compliance Competency, GA5: Risk Communication, Stakeholder Engagement & Public Reporting, GA6: Environmental Ethics, Vulnerability & Environmental Justice, GA10: Lifelong Learning & Evidence-Informed Environmental Decision-Making

Unit I: Introduction to Environmental Risk Assessment and Hazard Profiling

- Definition, scope, objectives, and historical development of environmental risk assessment in public health
- Core concepts and distinctions: Hazards, risk, exposure, susceptibility, and vulnerability
- Environmental risk assessment paradigms and standard institutional frameworks
- Broad typologies of environmental hazards: Air, water, soil, chemical, occupational, and physical hazards
- Exposure pathways, routes of entry (inhalation, ingestion, dermal), vulnerable populations, and environmental health inequalities

Unit II: Hazard Identification and Dose-Response Assessment

- Hazard identification: Environmental sources, toxic agent classification, and identification of adverse health endpoints
- Toxicological principles: Toxicokinetics, toxicodynamics, target organ toxicity, and acute versus chronic effects
- Fundamentals of dose-response relationships: Threshold vs. non-threshold mechanisms, NOAEL, LOAEL, and Benchmark Dose (BMD)

- Derivation and interpretation of toxicological benchmarks: Reference Dose (RfD), Reference Concentration (RfC), and cancer slope factors

Unit III: Exposure Assessment and Risk Characterization

- Principles of exposure assessment: Environmental sampling, ambient and personal monitoring, and exposure estimation models
- Quantification of intake doses, duration, frequency, and exposure characterization across diverse population strata
- Risk characterization: Synthesis of hazard, dose-response, and exposure findings
- Estimating and interpreting non-carcinogenic risk (Hazard Quotient, Hazard Index) and excess lifetime cancer risk
- Addressing uncertainty, variability, underlying assumptions, and methodological limitations in risk models

Unit IV: Environmental Risk Management and Mitigation Strategies

- Principles of environmental risk management: Risk prioritization, acceptability, and risk-benefit analysis
- Hierarchy of controls: Pollution prevention, source reduction, elimination, and substitution
- Engineering interventions, containment, dilution, and administrative mitigation protocols
- Environmental remediation: Site remediation, soil decontamination, water purification, and ecological restoration
- Routine environmental surveillance, compliance monitoring, and community-level mitigation planning

Unit V: Environmental Regulations, Risk Communication & Practical Case Applications

- Environmental regulatory landscape, ambient standards, permissible exposure guidelines, and emergency response frameworks
- Risk communication: Principles, message framing, crisis communication, and engaging affected communities
- Real-world case analyses: Urban air quality emergencies, contaminated industrial effluents/water systems, heavy metal poisoning, and hazardous waste disposal
- Formulation of applied environmental health risk assessment reports, site mitigation blueprints, and stakeholder action plans

Suggested Readings

- National Research Council. *Risk Assessment in the Federal Government: Managing the Process* (and related authoritative environmental health resources). The National Academies Press / Institutional Sources.
- Frumkin, H. (Ed.). *Environmental Health: From Global to Local*. Jossey-Bass.

- World Health Organization. *WHO Human Health Risk Assessment Toolkit: Chemical Hazards*. World Health Organization.
- World Health Organization. *Principles and Methods for the Assessment of Risk from Essential Trace Elements and Environmental Chemicals*. World Health Organization.

Nutritional Epidemiology

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Introduce the core principles, conceptual frameworks, and dietary assessment methodologies used in nutritional epidemiology and population health.
- Apply observational and experimental epidemiological study designs to evaluate diet-disease relationships and assess nutrition-specific interventions.
- Examine sources of dietary measurement error, validation studies, biomarker calibration, and statistical models for total energy intake adjustment.
- Analyze nutrient profiles, dietary patterns (data-driven and hypothesis-driven), and their epidemiological associations with major chronic cardiometabolic diseases.
- Evaluate the global nutrition transition, the double burden of malnutrition, and evidence synthesis methods used to translate nutritional data into public health policies and guidelines.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the principles of nutrigenomics, nutrigenetics, and gene–nutrient interactions and their significance in human health and disease prevention.
- **CO2:** Evaluate the influence of nutrients on gene expression, metabolic regulation, and individual variability in nutritional responses.
- **CO3:** Apply principles of nutrigenomics to personalized nutrition and the prevention and management of non-communicable diseases.
- **CO4:** Interpret nutrigenomic evidence, biomarkers, and emerging technologies to support evidence-based nutrition and public health practice.
- **CO5:** Critically evaluate the translation of nutrigenomics into public health, including ethical, legal, social, and policy implications.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Nutritional Epidemiological Research Skills, GA4: Public Health Nutrition, Dietary Surveillance & Systems Competency, GA5: Effective Health Communication & Scientific Data Presentation, GA6: Professional Ethics, Global Nutrition Equity & Health Advocacy, GA10: Lifelong Learning & Evidence-Based Nutrition Policy Formulation

Unit I: Foundations of Nutritional Epidemiology & Assessment Methods

- Definition, scope, historical evolution, and role of nutritional epidemiology in public health
- Dietary intake assessment methodologies: 24-hour dietary recalls, Food Frequency Questionnaires (FFQs), and weighed/estimated diet records
- Strengths, limitations, and cognitive biases associated with subjective dietary reports
- Anthropometric assessment tools, clinical indicators, and the role of recovery and concentration nutritional biomarkers

Unit II: Epidemiological Study Designs in Nutritional Research

- Ecological studies and multi-country food balance sheets: Applications and ecological fallacy
- Cross-sectional surveys and national dietary surveillance mechanisms
- Case-control studies in nutritional research: Selection of controls, recall bias, and reverse causality
- Prospective cohort studies: Long-term exposure tracking, repeated dietary assessments, and loss to follow-up
- Randomized Controlled Trials (RCTs) for dietary interventions: Compliance, blinding challenges, and attrition

Unit III: Measurement Error, Validation Studies & Energy Adjustment Models

- Nature and sources of variation in dietary data: Random vs. systematic measurement error, day-to-day variability, and within-person vs. between-person variation
- Design and execution of validation and reproducibility studies
- Total energy intake regulation: Biological rationale for energy adjustment in nutritional models
- Statistical models for energy adjustment: Standard nutrient density model, residual method, and energy partition models

Unit IV: Dietary Patterns, Biomarkers & Chronic Disease Epidemiology

- Reductionist approach (single nutrients) versus whole-diet approaches in epidemiology
- Deriving dietary patterns: Data-driven methods (Principal Component Analysis, cluster analysis) vs. hypothesis-driven methods (diet quality indices, Mediterranean Diet Score, DASH score)
- Use of nutritional biomarkers for exposure validation and mechanistic profiling
- Nutritional epidemiology of non-communicable diseases: Etiology, risk pathways, and population trends in obesity, type 2 diabetes, and cardiovascular diseases

Unit V: Nutrition Transition, Evidence Synthesis & Policy Integration

- Global demographic, epidemiological, and nutrition transitions across low- and middle-income countries

- Public health implications of the double burden of malnutrition (coexistence of undernutrition and obesity/NCDs)
- Evidence synthesis in public health nutrition: Methodological considerations in systematic reviews and meta-analyses of dietary exposures
- Translation of epidemiological evidence into Food-Based Dietary Guidelines (FBDGs)
- Evaluation, monitoring, and impact assessment of national public health nutrition policies and programs

Suggested Readings

- Willett, W. Nutritional Epidemiology (3rd Edition). Oxford University Press.
- Margetts, B. M., & Nelson, M. Design Concepts in Nutritional Epidemiology (2nd Edition). Oxford University Press.

Nutrigenomics

Category: Minor Stream (MS) | **L-T-P:** 3-0-0 | **Credits:** 3

Course Objectives

- Explain concepts of public health law, constitutional guarantees, governance structures, and international right-to-health covenants.
- Analyze statutory frameworks regulating food safety, pharmaceuticals, intellectual property rights, and access to essential medicines.
- Examine medical jurisprudence, patient rights, informed consent, medical negligence, and health regulations for vulnerable groups.
- Evaluate core bioethical principles, clinical trial regulations, and ethical issues in end-of-life care, organ donation, and health research.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the principles of nutrigenomics, nutrigenetics, and gene–nutrient interactions and their significance in human health and disease prevention.
- **CO2:** Evaluate the influence of nutrients on gene expression, metabolic regulation, and individual variability in nutritional responses.
- **CO3:** Apply principles of nutrigenomics to personalized nutrition and the prevention and management of non-communicable diseases.
- **CO4:** Interpret nutrigenomic evidence, biomarkers, and emerging technologies to support evidence-based nutrition and public health practice.
- **CO5:** Critically evaluate the translation of nutrigenomics into public health, including ethical, legal, social, and policy implications.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Molecular Evidence Interpretation Skills, GA4: Precision Health, Nutritional Systems & Policy Competency,

GA5: Effective Health Communication & Scientific Data Translation, GA6: Professional Ethics, Bioethics & Genetic Data Stewardship, GA10: Lifelong Learning & Evidence-Informed Personalized Nutrition Practice

Unit I: Introduction to Nutrigenomics, Nutrigenetics & Genetic Variation

- Definition, scope, evolution, and conceptual distinctions between nutrigenomics and nutrigenetics
- The tripartite relationship: Nutrition, the genome, and human health outcomes
- Concepts of precision nutrition, individualized dietary response, and applications in preventive medicine
- Genetic polymorphisms (SNPs, copy number variants) influencing nutrient absorption, transport, and metabolism
- Gene–diet and gene–environment interactions in the etiology of common multifactorial conditions

Unit II: Nutrient-Mediated Gene Regulation & Research Methodologies

- Mechanisms of nutrient-dependent gene regulation: Nutrient-responsive transcription factors and cellular signaling pathways
- Molecular mechanisms of metabolic adaptation to dietary components and epigenetic modulations
- Research paradigms in nutrigenomics: Multi-omics platforms (transcriptomics, proteomics, metabolomics) and nutrigenomic biomarkers
- Bioinformatics resources, biological databases, and analytical tools in nutritional genomics
- Methodological challenges, interpretation of genomic evidence, and limitations in nutritional research

Unit III: Gut Microbiome Dynamics & Metabolic Cross-Talk

- Host–microbiome symbiotic interactions and intestinal barrier integrity
- Diet-microbiome reciprocal interactions: Influence of dietary fiber, macronutrients, and micronutrients on microbial diversity
- Microbial metabolites (short-chain fatty acids, secondary bile acids, indole derivatives) and host metabolic signaling
- Microbiome profiling, dysbiosis, and microbiome-guided personalized nutritional strategies
- Translational role of the gut microbiome in systemic health promotion and disease risk modification

Unit IV: Personalized Nutrition, Functional Foods & Disease Management

- Core principles of personalized nutrition: Genotype-directed dietary interventions, phenotypic stratification, and risk prediction

- Behavioral, psychosocial, and lifestyle factors in designing individualized nutritional plans
- Nutrigenomics of non-communicable diseases: Obesity, type 2 diabetes mellitus, cardiovascular diseases, metabolic syndrome, cancer, and healthy ageing
- Functional foods, nutraceuticals, phytochemicals, and bioactive food components
- Evidence-based modulation of gene expression and metabolic phenotypes using targeted dietary bioactives

Unit V: Precision Public Health, Bioethics & Policy Translation

- Paradigm shift: From population-wide dietary guidelines to precision public health nutrition
- Integration of genomic nutrition into healthcare service delivery and community-based nutrition programs
- Direct-to-Consumer (DTC) genetic testing: Utility, analytic validity, clinical validity, and counseling needs
- Ethical, Legal, and Social Implications (ELSI): Genetic privacy, commercialization, data security, and disparities in access
- Regulatory frameworks, national policy considerations, implementation barriers, and future horizons in molecular public health nutrition

Suggested Readings

- De Caterina, R., Ordovás, J. M., & Martínez, J. A. Principles of Nutrigenetics and Nutrigenomics: Fundamentals of Individualized Nutrition. Academic Press.
- Ferguson, L. R. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. CRC Press.
- Marriott, B. P., Birt, D. F., Stallings, V. A., & Ross, A. C. Present Knowledge in Nutrition. Academic Press.

Semester IV

Healthcare Informatics

Category: Skill Enhancement Courses (SEC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the fundamental concepts, evolution, data ecosystems, and multidisciplinary domains of biomedical, clinical, and public health informatics.
- Examine the operational architecture of health information systems, electronic health records, diagnostic departmental workflows, and semantic interoperability standards.
- Apply digital health technologies, telemedicine modalities, remote monitoring, and clinical decision support systems (CDSS) to enhance patient care and clinical safety.
- Analyze public health informatics frameworks, spatial disease mapping, epidemiological surveillance registries, and emerging AI/ML innovations in population health.
- Evaluate health data privacy regulations, national digital missions (such as ABDM), ethical AI guidelines, and implementation science principles to design sustainable informatics solutions.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the concepts, components, standards and applications of healthcare informatics within healthcare and public health systems.
- **CO2:** Apply health information systems, electronic health records, interoperability standards and digital health technologies for healthcare delivery and public health decision-making.
- **CO3:** Analyze health data using informatics principles to support surveillance, quality improvement, healthcare management and evidence-based practice.
- **CO4:** Evaluate ethical, legal, privacy, security and governance issues related to health information systems and digital health.
- **CO5:** Design informatics-enabled solutions to improve healthcare quality, patient safety and population health.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Research Skills, GA4: Digital, Informatics & Health Technology Literacy, GA5: Effective Scientific & Visual Communication, GA6: Professional Ethics, Data Governance & Patient Confidentiality, GA10: Lifelong Learning & Technological Adaptation

Unit I: Introduction to Healthcare Informatics

- Definition, historical evolution, and scope of healthcare informatics
- Sub-disciplines: biomedical, clinical, and public health informatics
- Healthcare data ecosystem: sources, hierarchies, and life cycle of health data
- Strategic role of informatics in health system strengthening and digital transformation

Unit II: Health Information Systems (HIS)

- Structural components and architecture of Health Information Systems (HIS)
- Departmental systems: Hospital Information Systems, Laboratory Information Systems (LIS), and Radiology Information Systems (RIS)
- Pharmacy Information Systems and medication dispensing integration
- Health information workflow design, operational continuity, and decision support integrations

Unit III: Electronic Health Records and Interoperability

- Architectural models: Electronic Health Records (EHR), Electronic Medical Records (EMR), and Personal Health Records (PHR)
- Interoperability concepts: technical, syntactic, and semantic interoperability
- International messaging and data exchange standards: Health Level Seven (HL7) and Fast Healthcare Interoperability Resources (FHIR)
- Clinical terminologies and coding systems: SNOMED CT, ICD classifications, and LOINC

Unit IV: Digital Health Technologies

- Telemedicine and telehealth platforms: synchronous vs. asynchronous care delivery
- Mobile health (mHealth) applications and patient portals
- Wearable health biosensors and the Internet of Medical Things (IoMT)
- Remote patient monitoring systems and clinically validated digital therapeutics (DTx)

Unit V: Health Data Analytics and Visualization

- Structuring health databases, data hygiene, and data quality assurance
- Descriptive, exploratory, and predictive analytics in population health
- Designing interactive dashboards and visual communication tools for decision-makers
- Deriving clinical quality indicators and population-level performance metrics

Unit VI: Clinical Decision Support Systems (CDSS)

- Core concepts, taxonomy, and knowledge bases of CDSS
- Artificial intelligence-assisted clinical decision-making, automated alerts, and reminders
- Computerized Physician Order Entry (CPOE) and closed-loop medication safety
- Integration of decision logic into clinical workflows and alert fatigue mitigation

Unit VII: Public Health Informatics

- Digital disease surveillance networks and syndromic tracking platforms
- Immunization information systems, vaccine logistics, and digital registries
- Geographic Information Systems (GIS) and spatial analytics in outbreak response
- National health databases, clinical registries, One Health informatics, and digital epidemiology

Unit VIII: Artificial Intelligence and Emerging Technologies in Healthcare

- Foundations of Machine Learning and Deep Learning in biomedical domains
- Natural Language Processing (NLP) for unstructured health text extraction
- Big data infrastructures, distributed cloud computing, and blockchain applications for secure health transactions
- Generative AI, Large Language Models (LLMs), and precision medicine frontiers

Unit IX: Health Information Privacy, Security and Ethics

- Core data privacy principles, data confidentiality, and dynamic informed consent
- Healthcare cybersecurity architectures, vulnerability mitigation, and threats
- Legislative frameworks: Indian Digital Personal Data Protection (DPDP) Act and international regulations
- WHO ethical guidance on healthcare AI, fairness, bias mitigation, and data governance

Unit X: Digital Health Policies and Governance

- Ayushman Bharat Digital Mission (ABDM): building blocks, ABHA ID, and Unified Health Interface (UHI)
- National Digital Health Mission ecosystem and policy strategies in India
- WHO Global Strategy on Digital Health and transnational interoperability frameworks
- Digital health governance mechanisms and regulatory pathways

Unit XI: Implementation and Evaluation of Health Information Systems

- Strategic planning, deployment roadmaps, and stakeholder change management
- Human factors, user experience (UX), usability testing, and health workforce training
- Frameworks for system monitoring, technical evaluation, and performance audit
- Sustaining digital interventions and assessing long-term quality improvement outcomes

Unit XII: Future Directions in Healthcare Informatics

- Precision public health and multi-omic data integration
- Digital twins for predictive healthcare and smart hospital architectures

- Learning Health Systems (LHS) and self-optimizing health data networks
- Genomics informatics, open data ecosystems, healthcare innovation, and applied case studies

Suggested Readings

- Shortliffe, E. H., & Cimino, J. *Biomedical Informatics: Computer Applications in Health Care and Biomedicine*. Springer.
- Magnuson, J. A., & Fu, P. *Public Health Informatics and Information Systems*. Springer.

Global Health Governance and Diplomacy

Category: Major Core (MC) | **L-T-P:** 3-1-0 | **Credits:** 4

Course Objectives

- Introduce the fundamental concepts, historical evolution, and institutional architectures distinguishing international health from global health governance and diplomacy.
- Examine comparative healthcare systems, evaluating how differences in organization, financing, and delivery respond to globalization and cross-border health threats.
- Analyze the operational mandates, financing mechanisms, and accountability structures of multilateral agencies, philanthropic bodies, and public-private partnerships.
- Evaluate bilateral, multilateral, and regional cooperation platforms (such as ASEAN, EU, BRICS, SCO, and IORA) along with treaty negotiations and health diplomacy during pandemics.
- Apply stakeholder mapping, negotiation simulations, and policy analysis to advance Universal Health Coverage (UHC), the Sustainable Development Goals (SDGs), and international health equity

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Policy Analysis Skills, GA4: Global Health Architecture, Treaties & Governance Systems Competency, GA5: Negotiation, Cross-Cultural Communication & Strategic Advocacy, GA6: Professional Ethics, Global Health Equity & Human Rights, GA10: Lifelong Learning & Evidence-Informed International Decision-Making

Unit I: Foundations and Evolution of Global Health Governance

- Scope, relevance, and historical evolution of global health; distinctions between international health and global health
- Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs)

- Globalization dynamics: Cultural, political, social, and economic determinants shaping population health
- Cross-border health security challenges, global health inequalities, and core governance principles

Unit II: Comparative Healthcare Systems and Globalization

- Models of healthcare organization, financing, and service delivery across nations
- Structural analysis of public, private, and mixed healthcare systems
- Globalization and trade in health services: Medical travel and international health tourism
- Case studies in comparative health system performance and resilience under cross-border health pressures

Unit III: International Health Agencies and Institutional Architecture

- Mandates and governance structures of the World Health Organization (WHO) and United Nations bodies (UNICEF, UNAIDS)
- Global financial institutions: Role and influence of the World Bank and International Monetary Fund (IMF) in health sector lending
- Non-governmental organizations and humanitarian responders: International Red Cross and Médecins Sans Frontières (MSF)
- Global health initiatives and public-private partnerships: Gavi, the Vaccine Alliance, and philanthropic organizations
- Architecture of global health financing, financial accountability, transparency, and donor coordination

Unit IV: Global Health Diplomacy, Negotiation, and Regional Blocs

- Origins, principles, and strategic instruments of diplomacy: Soft power versus hard power in health statecraft
- Bilateral and multilateral negotiation pathways, binding treaties, and international agreements
- Regional and transnational mechanisms: Health agendas of ASEAN, European Union (EU), BRICS, Shanghai Cooperation Organisation (SCO), and IORA
- Cross-cultural communication, health advocacy, consensus building, and conflict resolution
- Health diplomacy in acute crises: Cross-border coordination, medical diplomacy, and vaccine geopolitics during epidemics and pandemics

Unit V: Global Health Policy, Equity, and Practical Simulations

- The 2030 Agenda: SDG 3 (Good Health and Well-being) and cross-sectoral interconnections with other goals
- Advancing Universal Health Coverage (UHC), distributive justice, and global health equity

- Development cooperation frameworks: South-South cooperation, North-South cooperation, and triangular partnerships
- India's strategic role in global health diplomacy, pharmaceutical supply chains, and international partnerships
- Applied diplomacy lab: Stakeholder power mapping, multilateral negotiation simulations, policy brief drafting, and presentation of evidence-based policy recommendations

Suggested Readings

- Johnson, J. A., & Stoskopf, C. Comparative Health Systems: Global Perspectives for the 21st Century. Jones & Bartlett Learning.
- Skolnik, R. Global Health 101. Jones & Bartlett Learning.
- Pillay, Y., & Holtz, T. H. Textbook of International Health: Global Health in a Dynamic World. Oxford University Press.
- World Health Organization. Global Health Governance and International Health Regulations. WHO Publications.
- United Nations. Sustainable Development Goals and the 2030 Agenda. United Nations Publications.
- World Bank. Health Financing and Health Systems Strengthening. World Bank Publications.

Public Health Governance, Law and Bioethics

Category: Value Added Courses(VAC) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Explain concepts of public health law, constitutional guarantees, governance structures, and international right-to-health covenants.
- Analyze statutory frameworks regulating food safety, pharmaceuticals, intellectual property rights, and access to essential medicines.
- Examine medical jurisprudence, patient rights, informed consent, medical negligence, and health regulations for vulnerable groups.
- Evaluate core bioethical principles, clinical trial regulations, and ethical issues in end-of-life care, organ donation, and health research.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the legal frameworks, constitutional guarantees, and international covenants governing public health in India and globally.
- **CO2:** Analyze the interrelationship between law, public health policy, socio-environmental determinants, and governance structures.
- **CO3:** Evaluate ethical principles, regulatory frameworks, and bioethical concerns in medical practice, clinical research, and public health delivery.
- **CO4:** Apply health legislation and statutory safeguards to address epidemic control, food safety, reproductive rights, vulnerable populations, and legal epidemiology.

Graduate Attributes Addressed: GA1 (Disciplinary & Interdisciplinary Knowledge), GA2 (Critical Thinking & Problem Solving), GA7 (Ethical Reasoning & Professional Integrity), GA8 (Social Responsibility & Global Citizenship), GA10 (Lifelong Learning & Self-Directed Growth)

Unit I: Foundations of Health Law, Human Rights, and Public Health Governance

- Concepts and principles of public health law, constitutional mandates, and legal epidemiology
- International right-to-health covenants and declarations: UDHR, ICESCR, WHO frameworks, and the Declaration of Helsinki
- Public health governance structures: Roles, functions, and oversight of the Ministry of Health and Family Welfare (MoHFW) and Directorate General of Health Services (DGHS)
- National and state public health policies, programs, and social health protection/insurance schemes (NHM, NUHM, JSY, RSBY)
- Statutory safeguards and criminal health offenses related to public safety and epidemic control under the IPC and CrPC

Unit II: Regulation of Food Safety, Pharmaceuticals, and Intellectual Property

- Right to food, food security principles, and statutory regulation under the Food Safety and Standards Act (FSSA), 2006
- Pharmaceutical and medical technology regulation: Drugs & Cosmetics Act, Medical Devices Rules, and ICMR research guidelines
- Intellectual Property Rights (IPR) in healthcare: TRIPS agreement, patent regimes, and compulsory licensing mechanisms
- Trade policies, drug pricing control, and strategies for ensuring global and national access to essential medicines

Unit III: Medical Jurisprudence, Patient Rights, and Healthcare Legislation

- Legal foundations of the doctor-patient relationship, informed consent, patient autonomy, and medical confidentiality
- Medical negligence, standard of care, professional misconduct, and applications of the Consumer Protection Act in healthcare
- Governance of medical education and clinical practice under the National Medical Commission (NMC) Act, 2019, and anti-quackery enforcement
- Disability rights in healthcare, reproductive rights, and legal protections for vulnerable and marginalized populations

Unit IV: Bioethics, Clinical Research, and Public Health Practice Ethics

- Core bioethical standards and foundational guidelines: Belmont Report and ICMR Ethical Guidelines for Biomedical Research
- Research ethics: Clinical trial regulations, human participant protections, informed consent processes, and Institutional Ethics Committee (IEC) review

- Legal and bioethical perspectives on euthanasia, end-of-life care, advance directives, and living wills
- Regulatory and bioethical frameworks governing organ transplantation, stem cell research, and legal protections under HIV/AIDS prevention and control legislation

Suggested Readings

- Park, K. *Park's Textbook of Preventive and Social Medicine*. Banarsidas Bhanot Publishers.
- Moitra, S., Chatterjee, C., & Debnath, D. *A Compendium on Health Laws*. New Era Law Publication.
- Herring, J. *Medical Law and Ethics*. Oxford University Press.

Capstone Project / Thesis

Category: Research Project / Dissertation (RP) | **L-T-P:** 0-0-14 | **Credits:** 7

Course Objectives

1. Develop students' ability to identify and formulate a relevant public health research problem.
2. Enable students to review scientific literature and identify research gaps.
3. Develop competency in selecting appropriate research designs, sampling methods, data collection tools, and analytical approaches.
4. Ensure ethical conduct of research, including confidentiality, informed consent, and responsible data management.
5. Develop practical skills in data collection, analysis, interpretation, and presentation of public health findings.
6. Enable students to prepare a structured thesis or capstone report and communicate evidence-based recommendations.

Course Outcomes (COs)

- CO1: Formulate a focused public health research question based on a critical review of relevant literature.
- CO2: Develop an appropriate research protocol using suitable study designs, sampling strategies, data collection methods, and analytical techniques.
- CO3: Apply ethical principles and appropriate procedures for research approvals, informed consent, confidentiality, and data management.
- CO4: Conduct or complete an approved public health research project and analyse and interpret the findings using appropriate methods.
- CO5: Prepare a scientifically structured thesis or capstone report with evidence-based conclusions and recommendations.
- CO6: Present, defend, and communicate research findings effectively to academic and public health audiences.

Capstone Project / Thesis Guidelines

A. Selection of Research Topic

Students should select a topic relevant to public health practice, research, policy, or programme implementation. Possible areas include:

- Epidemiology of communicable and noncommunicable diseases.
- Environmental and occupational health.
- Health systems, healthcare quality, and health administration.
- Health policy, health economics, and health financing.
- Maternal, child, adolescent, and reproductive health.
- Health promotion and behavioural sciences.
- Digital health, health informatics, and emerging technologies.
- Global health, health equity, and social determinants of health.
- Health programme evaluation and implementation research.

The topic must be feasible within the allotted academic period and approved by the assigned faculty supervisor and the relevant academic authority.

B. Research Protocol Development

Each student must prepare a research protocol containing:

1. Title of the study.
2. Introduction and background.
3. Statement of the research problem.
4. Rationale and significance of the study.
5. Review of relevant literature.
6. Research question and, where appropriate, hypothesis.
7. Aim and specific objectives.
8. Research methodology, including study design and setting.
9. Study population, eligibility criteria, sample size, and sampling technique.
10. Data collection tools and operational definitions.
11. Data management and statistical analysis plan.
12. Ethical considerations and proposed approvals.
13. Expected outcomes and public health implications.
14. Timeline and references.

C. Ethical Approval and Research Conduct

- Obtain the required institutional ethics committee approval before commencing research involving human participants or identifiable human data, as applicable.
- Obtain permissions from hospitals, communities, organizations, or other study sites where required.
- Secure informed consent or assent, as applicable.
- Maintain confidentiality, anonymity where feasible, and secure data storage.
- Do not fabricate, falsify, or manipulate data.
- Disclose conflicts of interest and use appropriate citation practices.
- Follow applicable institutional policies and ethical guidelines throughout the project.

D. Data Collection and Analysis

Students must conduct the approved study in accordance with the protocol. Depending on the research design, activities may include:

- Primary data collection through surveys, interviews, observations, or assessments.
- Secondary data analysis using authorized datasets.
- Qualitative data transcription, coding, and thematic analysis.
- Quantitative data cleaning, descriptive analysis, and appropriate statistical testing.
- Evaluation of health programmes, policies, or interventions.
- Interpretation of findings in relation to existing literature and public health practice.

Students must maintain appropriate documentation of data collection, analysis, and any approved changes to the research protocol.

E. Thesis / Capstone Report Structure

The final submission should ordinarily contain:

1. Title page.
2. Certificate or declaration, as prescribed by the university.
3. Acknowledgements.
4. Abstract.
5. Table of contents.
6. List of tables, figures, and abbreviations, where applicable.
7. Introduction and background.
8. Review of literature.
9. Aim and objectives.
10. Methodology.
11. Results or findings.
12. Discussion.
13. Strengths and limitations.
14. Conclusions and recommendations.
15. Public health implications.
16. References.
17. Appendices, including approved tools and participant information documents where applicable.

The university's prescribed thesis format, referencing style, and similarity-check requirements must be followed.

Proposed Course Outline and Practical Work

The following stages can be used to monitor student progress throughout the capstone project.

Stage 1: Research problem identification and literature review

- Identify a public health problem.
- Conduct a structured literature search.
- Develop the research question and rationale.

Stage 2: Protocol development

- Define aims and objectives.
- Select the research design and methodology.
- Develop data collection tools and an analysis plan.

Stage 3: Proposal presentation and approval

- Present the research proposal.
- Incorporate supervisor and review committee feedback.
- Obtain required permissions and ethical approvals.

Stage 4: Data collection and project implementation

- Conduct the approved study.
- Maintain research documentation.
- Ensure data quality and ethical compliance.

Stage 5: Data analysis and interpretation

- Analyse quantitative or qualitative data using appropriate methods.
- Prepare tables, figures, or thematic summaries.
- Interpret findings against the research objectives.

Stage 6: Thesis writing and final defence

- Prepare the complete thesis or capstone report.
- Submit the final document.
- Present and defend the findings before the designated evaluation panel.

5. Supervision and Monitoring Guidelines

- Each student should be assigned a faculty supervisor.
- The supervisor should approve the topic, guide protocol development, and monitor progress.
- Students should submit periodic progress reports.
- Supervisor meetings and milestones should be documented.
- Any substantial change in objectives, methodology, or study population should receive the necessary approval.
- The final thesis should be evaluated for research quality, methodological appropriateness, ethical compliance, originality, and clarity of presentation.

Big Data Analytics and Cloud Computing

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the foundational concepts, architectures, core characteristics, and public health applications of big data analytics and cloud computing.
- Identify diverse public health big data sources, storage models (data warehouses, data lakes), and methods for data cleaning, integration, and distributed processing.
- Apply descriptive, predictive, and prescriptive analytics, basic machine learning, and data visualization tools to monitor disease patterns and evaluate population health trends.
- Evaluate cloud delivery and deployment models (IaaS, PaaS, SaaS), cloud-based health information systems, scalability, interoperability, and cost trade-offs in healthcare delivery.
- Examine data privacy standards, cybersecurity risks, ethical governance, and statutory frameworks (including India's Digital Personal Data Protection Act, 2023) for responsible health data stewardship.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the fundamental concepts, characteristics, architecture, and applications of big data analytics and cloud computing in public health.
- **CO2:** Identify relevant sources of public health big data and describe approaches to data collection, storage, processing, and management.
- **CO3:** Apply basic big data analytics and visualization approaches to interpret public health datasets.
- **CO4:** Evaluate cloud computing applications, platforms, and services for healthcare data management and public health decision-making.
- **CO5:** Analyse data privacy, security, ethical, and governance challenges associated with big data and cloud-based health systems.
- **CO6:** Develop evidence-based recommendations using big data applications for public health surveillance, planning, and programme evaluation.

Unit I: Foundations and Sources of Public Health Big Data

- Definition, scope, historical evolution, and the "Vs" of big data in healthcare (Volume, Velocity, Variety, Veracity, Value)
- Ecosystem of public health data sources: Electronic Health Records (EHRs), national disease registries, demographic surveys, and disease surveillance networks
- Unconventional and high-velocity data: Mobile health (mHealth) applications, internet-of-things (IoT), wearable sensors, and social data streams
- Public health applications: Early warning systems, syndromic surveillance, and population health risk profiling

Unit II: Big Data Architecture, Distributed Processing, and Data Management

- Data lifecycle management: Ingestion, automated validation, data cleaning, harmonization, and integration
- Modern data storage paradigms: Relational databases, NoSQL, data warehouses, and data lakes

- Fundamentals of distributed computing architectures and scalable data pipelines for large-scale health records
- Data quality assurance, master patient indices, semantic interoperability, and standard health data exchange protocols (e.g., HL7, FHIR)

Unit III: Big Data Analytics Methods and Interactive Visual Analytics

- Typologies of analytics: Descriptive, diagnostic, predictive, and prescriptive health analytics
- Data mining workflows and introductory machine learning algorithms (clustering, classification, regression) applied to epidemiological trends
- Visual analytics principles: Translating complex public health datasets into decision dashboards
- Real-time geospatial mapping, heat maps, outbreak tracking displays, and surveillance communication tools

Unit IV: Cloud Computing Architecture and Healthcare Service Applications

- Cloud computing fundamentals: Virtualization, elastic computing, multi-tenancy, and core architectural models
- Cloud delivery models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)
- Deployment frameworks: Public, private, hybrid, and community clouds in healthcare
- Deployment of cloud-native health information systems, cloud-based EHRs, remote telemedicine platforms, and population health registries
- Platform scalability, fault tolerance, high availability, interoperability standards, and cost optimization considerations

Unit V: Data Privacy, Cybersecurity, Governance, and Applied Capstone

- Core security controls: Confidentiality, data integrity, role-based access control (RBAC), end-to-end encryption, and anonymization/pseudonymization techniques
- Ethical considerations: Informed consent models, secondary data use, algorithmic bias, and responsible data-sharing protocols
- Legal and statutory environments: Indian digital regulatory frameworks, the Digital Personal Data Protection Act (DPDPA), 2023, and international benchmark
- Hands-on practical lab: Analyzing sample public health datasets using visualization software and dashboard tools
- Case studies and capstone mini-project: Outbreak monitoring, evaluating real-world health program performance, and formulating data-driven policy recommendations

Suggested Readings

- Mayer-Schönberger, V., & Cukier, K. *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. Houghton Mifflin Harcourt.

- Erl, T., Puttini, R., & Mahmood, Z. *Cloud Computing: Concepts, Technology & Architecture*. Prentice Hall.
- World Health Organization. *WHO Resources on Digital Health and Health Information Systems*. World Health Organization.
- World Health Organization. *Digital Health and Health Data Governance Resources*. World Health Organization.
- Ministry of Law and Justice, Government of India. *The Digital Personal Data Protection Act, 2023*. The Gazette of India.

Spatial Epidemiology and GIS in Public Health

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Explain concepts of public health law, constitutional guarantees, governance structures, and international right-to-health covenants.
- Analyze statutory frameworks regulating food safety, pharmaceuticals, intellectual property rights, and access to essential medicines.
- Examine medical jurisprudence, patient rights, informed consent, medical negligence, and health regulations for vulnerable groups.
- Evaluate core bioethical principles, clinical trial regulations, and ethical issues in end-of-life care, organ donation, and health research.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the fundamental concepts, principles, and applications of spatial epidemiology and GIS in public health.
- **CO2:** Identify, collect, organize, and manage spatial and epidemiological data for public health applications.
- **CO3:** Create and interpret disease maps and thematic maps to describe geographic patterns of health outcomes.
- **CO4:** Apply basic spatial analytical techniques to examine disease distribution, clustering, and spatial relationships.
- **CO5:** Use GIS-based approaches to assess environmental health risks, healthcare accessibility, and public health resource distribution.
- **CO6:** Interpret spatial analysis findings and develop evidence-informed recommendations for public health surveillance, planning, and intervention.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Spatial Data Analysis Skills, GA4: Public Health Informatics, Geospatial Surveillance & Systems Competency, GA5: Cartographic Communication, Visual Analytics & Technical Reporting, GA6: Professional Ethics, Geospatial Privacy & Data Confidentiality, GA10: Lifelong Learning & Evidence-Informed Spatial Decision-Making

Unit I: Foundations of Spatial Epidemiology and GIS

- Definition, historical development, scope, and public health importance of spatial epidemiology
- Fundamentals, hardware, software, and core functional components of Geographic Information Systems (GIS)
- Epidemiological concepts of place, space, person, and time in disease distribution
- Geographic scale, spatial resolution, and practical applications in health systems and epidemiology

Unit II: Spatial Data, Geographic Referencing, and GIS Data Management

- Spatial data models: Vector (points, lines, polygons) and raster data architectures
- Geographic coordinates, latitude, longitude, Coordinate Reference Systems (CRS), and map projections
- Sources of geospatial and epidemiological data; georeferencing and geocoding workflows
- Relational spatial databases, attribute tables, spatial joins, and epidemiological data linkage
- Spatial data quality assurance, positional accuracy, geospatial privacy, and patient confidentiality

Unit III: Disease Mapping and Spatial Visualization

- Typologies of disease maps: Point distribution maps, choropleth maps, proportional symbol maps, and heat/density maps
- Visualizing health indicators: Disease counts, proportions, crude rates, and age-standardized mortality/morbidity rates
- Population denominators, small number problems, and rate smoothing principles
- Thematic cartography: Data classification schemes (quantile, equal interval, natural breaks), legends, scale, and visual hierarchy
- Interpreting geographic patterns, spatial gradients, and health disparities

Unit IV: Spatial Statistics, Autocorrelation, and Disease Cluster Detection

- Concepts of spatial dependence, spatial heterogeneity, and Tobler's First Law of Geography
- Global and local spatial autocorrelation metrics: Moran's I and Local Indicators of Spatial Association (LISA)
- Hotspot analysis (Getis-Ord G_i^*), spatial scan statistics, and disease cluster detection

- Methodological limitations: Ecological fallacy, Modifiable Areal Unit Problem (MAUP), and spatial edge effects
- Addressing spatial aggregation errors, parameter uncertainty, and confounding in geographic models

Unit V: GIS Applications in Environmental Health, Health Services, and Applied Decision-Making

- GIS in epidemiological surveillance, outbreak investigation, and contact tracing
- Environmental health modeling: Spatial assessment of air pollution, contaminated water networks, toxic waste sites, and vector habitats
- Healthcare accessibility and planning: Facility mapping, travel-time estimation, buffer analysis, proximity analysis, and network analysis for underserved populations
- Resource allocation modeling, emergency disaster preparedness, and health logistics planning
- Applied geospatial laboratory: Analyzing infectious disease and NCD datasets using open-source GIS platforms (e.g., QGIS), ethical stewardship of health coordinates, drafting spatial reports, and presenting policy recommendations

Suggested Readings

- Elliott, P., Cuzick, J., English, D., & Stern, R. (Eds.). Spatial Epidemiology: Methods and Applications. Oxford University Press.
- Cromley, E. K., & McLafferty, S. L. GIS and Public Health. Guilford Press.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. Geographic Information Systems and Science (3rd Edition). Wiley.
- Haining, R. Spatial Data Analysis: Theory and Practice. Cambridge University Press.
- QGIS Development Team. QGIS Training Manual and Official Documentation. QGIS Project.
- World Health Organization. GIS in Public Health Practice: Selected Technical Resources. WHO Publications.

Machine Learning and Predictive Analytics in Public Health

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the fundamentals of machine learning and predictive analytics and their applications in public health.

- Develop an understanding of public health datasets, data preparation, feature selection, and exploratory data analysis.
- Explain supervised and unsupervised machine learning methods relevant to epidemiology, disease prediction, and population health.
- Develop practical skills in building, evaluating, and interpreting predictive models using public health data.
- Examine the applications of predictive analytics in disease surveillance, risk stratification, healthcare planning, and resource allocation.
- Promote responsible use of machine learning by addressing bias, fairness, privacy, interpretability, and ethical considerations in public health.

Course Outcomes: On completion, students will be able to:

- **CO1:** Explain the fundamental concepts, terminology, and applications of machine learning and predictive analytics in public health.
- **CO2:** Prepare, explore, and preprocess public health datasets for machine learning applications.
- **CO3:** Select and apply appropriate supervised and unsupervised machine learning techniques to public health problems.
- **CO4:** Evaluate predictive models using appropriate performance metrics and interpret their results in public health contexts.
- **CO5:** Develop and communicate a basic predictive analytics workflow for a public health problem using suitable analytical tools.
- **CO6:** Assess ethical, privacy, fairness, bias, and interpretability considerations in the application of machine learning to public health.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Machine Learning Competency, GA4: Public Health Informatics, Predictive Modeling & Surveillance Systems Competency, GA5: Data Translation, Visual Reporting & Technical Communication, GA6: Professional Ethics, Algorithmic Fairness & Health Data Privacy, GA10: Lifelong Learning & Evidence-Informed Computational Decision-Making

Unit I: Introduction to Machine Learning & Predictive Analytics in Public Health

- Core concepts, taxonomy, and evolution of machine learning in healthcare
- Typologies of machine learning: Supervised, unsupervised, semi-supervised, and reinforcement learning
- Descriptive vs. predictive vs. prescriptive analytics in epidemiological contexts
- Public health use cases: Early syndromic detection, outbreak forecasting, and population risk scoring

Unit II: Public Health Data Management, Cleaning, and Preprocessing

- Data sources and formats: EHRs, epidemiological registries, surveys, vital statistics, and digital sensors

- Data quality dimensions, handling missing data, and outlier detection
- Exploratory data analysis (EDA) and data distribution analysis
- Feature preprocessing: Scaling, normalization, categorical encoding, and feature selection strategies
- Data partitioning: Training, validation, and testing split protocols

Unit III: Supervised Machine Learning Algorithms & Health Risk Modeling

- Linear regression and regularized regression (Ridge, Lasso) for continuous health outcomes
- Logistic regression for binary epidemiological endpoints
- Non-parametric and tree-based methods: Decision trees and ensemble approaches (Random Forests)
- Instance-based and kernel methods: kkk-Nearest Neighbors (kkk-NN) and Support Vector Machines (SVM)
- Applications in chronic disease prediction, clinical classification, and epidemiological risk assessment

Unit IV: Unsupervised Learning, Clustering & Predictive Model Evaluation

- Unsupervised learning: Principles and methods for population sub-group identification
- Clustering algorithms: kkk-means clustering, hierarchical clustering, and spatial/phenotypic pattern discovery
- Dimensionality reduction techniques: Principal Component Analysis (PCA) for high-dimensional health data
- Model validation strategies: kkk-fold cross-validation and bootstrap resampling
- Performance metrics: Confusion matrix, accuracy, sensitivity/recall, specificity, precision, F1-score, Receiver Operating Characteristic (ROC) curves, and Area Under the Curve (AUC)

Unit V: Applied Analytics, Ethical Governance & Model Translation

- Predictive analytics in action: Outbreak trajectory modeling, hospital readmission prediction, and targeted resource allocation
- Translating algorithmic outputs into actionable public health policies and frontline decision-making
- Algorithmic bias, data disparity, and health equity: Promoting fairness in machine learning models
- Explainability and interpretability: "Black-box" limitations, feature importance, SHAP, and LIME frameworks in clinical public health
- Data privacy, governance, statutory regulations, WHO ethical guidance on AI for health, and hands-on capstone project reporting

Suggested Readings

- James, G., Witten, D., Hastie, T., Tibshirani, R., & Taylor, J. *An Introduction to Statistical Learning: With Applications in R* (2nd Edition). Springer.
- Hastie, T., Tibshirani, R., & Friedman, J. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd Edition). Springer.
- Géron, A. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (3rd Edition). O'Reilly Media.
- World Health Organization. *WHO Guidance on Ethics and Governance of Artificial Intelligence for Health*. World Health Organization.

Applied Econometrics for Health Data

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the principles of econometrics and its applications in public health research and health economics.
- Develop an understanding of health data, economic variables, research hypotheses, and econometric model formulation.
- Enable students to apply regression techniques to analyse relationships between health outcomes and their socioeconomic, demographic, and healthcare-related determinants.
- Familiarize students with common econometric problems, including multicollinearity, heteroscedasticity, endogeneity, and omitted-variable bias.
- Develop practical skills in interpreting econometric outputs and evaluating health policies and healthcare interventions.
- Promote evidence-based decision-making through applied econometric analysis of public health datasets

Course Outcomes: On completion, students will be able to

- CO1: Explain the fundamental concepts, assumptions, and applications of econometrics in public health and health economics.
- CO2: Prepare and examine health datasets and formulate appropriate econometric models for public health research questions.
- CO3: Apply suitable regression models to analyse health outcomes and their socioeconomic and healthcare-related determinants.
- CO4: Identify and interpret common econometric problems and evaluate their implications for model validity.
- CO5: Analyse econometric outputs and apply appropriate methods to evaluate health policies, healthcare interventions, and health expenditure.
- CO6: Communicate findings from applied econometric analyses to support evidence-based public health decisions.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Quantitative Modeling Skills, GA4: Health Economics, Policy Analysis & Systems Competency, GA5: Effective Technical Communication & Empirical Reporting, GA6: Professional Ethics, Research

Unit I: Introduction to Econometrics in Public Health

- Definition, scope, and strategic importance of econometrics in public health and health economics
- Typologies and structures of empirical health data: Cross-sectional, time-series, and longitudinal/panel datasets
- Sources of secondary health data: National sample surveys, demographic surveys, and institutional healthcare records
- Translating health policy and public health questions into testable econometric models and hypotheses

Unit II: Foundations of Regression Analysis & Ordinary Least Squares

- Simple and multivariable linear regression models: Model formulation and parameter interpretation
- Ordinary Least Squares (OLS) estimation principles and Gauss-Markov assumptions
- Goodness-of-fit measures, statistical significance testing, and interpretation of marginal effects
- Empirical applications: Determinants of out-of-pocket health expenditures, inpatient length of stay, and healthcare service utilization

Unit III: Regression Models for Binary, Categorical, and Count Health Data

- Limited dependent variable models: Binary outcomes in public health (disease incidence, treatment uptake, health insurance status)
- Linear probability models vs. Logistic and Probit regressions: Estimation, interpretation of odds ratios, and predicted probabilities
- Categorical and ordinal health outcome models (multinomial and ordered response models)
- Count data modeling: Poisson and Negative Binomial regressions; interpretation of incidence rate ratios (IRR) for clinical visit frequencies and adverse events
- Model selection criteria and goodness-of-fit testing across discrete health outcomes

Unit IV: Econometric Problems and Diagnostic Techniques

- Multicollinearity: Detection (VIF), consequences, and remedial measures
- Heteroscedasticity: Breusch-Pagan/White tests and robust standard errors
- Autocorrelation in time-dependent data: Durbin-Watson test and Newey-West standard errors
- Endogeneity: Measurement error, omitted-variable bias, simultaneous causality, and confounding

- Model specification tests: Ramsey RESET test, functional form selection, and assessing overall structural validity

Unit V: Applied Econometrics for Health Policy, Program Evaluation & Practical Reporting

- Introduction to panel data: Pooled OLS, Fixed-Effects (FE), and Random-Effects (RE) estimators; Hausman specification test
- Quasi-experimental evaluation methods: Difference-in-Differences (DiD) framework and parallel trends assumption
- Instrumental Variables (IV) and Two-Stage Least Squares (2SLS) for addressing unobserved confounding
- Applications in evaluating universal health coverage reforms, health insurance expansion, and subsidy schemes
- Applied statistical laboratory: Data cleaning, model estimation using statistical software, interpretation of empirical coefficients, diagnostic checking, and drafting an econometric policy brief

Suggested Readings

- Wooldridge, J. M. *Introductory Econometrics: A Modern Approach* (7th Edition). Cengage Learning.
- Gujarati, D. N., & Porter, D. C. *Basic Econometrics* (5th Edition). McGraw-Hill.
- Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data* (2nd Edition). MIT Press.

Infection-Associated Chronic Diseases

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the relationship between infectious agents, persistent infections, chronic inflammation, and long-term disease outcomes.
- Explain the biological mechanisms through which infections contribute to chronic diseases and associated complications.
- Examine the epidemiology and public health significance of major infection-associated chronic diseases.
- Develop an understanding of screening, diagnosis, prevention, and management strategies for infection-associated chronic conditions.
- Evaluate public health programmes, vaccination strategies, and policies aimed at reducing the burden of infection-associated chronic diseases.
- Apply evidence-based approaches to analyse disease patterns, risk factors, and prevention strategies in population health.

Course Outcomes: On completion, students will be able to

- CO1: Explain the concepts, mechanisms, and epidemiological principles underlying infection-associated chronic diseases.

- CO2: Describe the major infectious agents and biological pathways associated with chronic diseases and long-term complications.
- CO3: Analyse the epidemiology, risk factors, and population-level burden of major infection-associated chronic diseases.
- CO4: Evaluate screening, prevention, vaccination, and management strategies for infection-associated chronic diseases.
- CO5: Assess public health programmes and policies addressing infection-associated chronic diseases.
- CO6: Analyse public health case studies and recommend evidence-based interventions to reduce infection-associated chronic disease burden.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Epidemiological Surveillance Skills, GA4: Public Health Programs, Health Systems & Chronic Care Competency, GA5: Effective Health Communication & Evidence-Based Advocacy, GA6: Professional Ethics, Global Health Equity & Patient Rights, GA10: Lifelong Learning & Evidence-Informed Clinical Prevention

Unit I: Foundations and Biological Mechanisms of Chronic Infection

- Scope, conceptual definitions, and historical evolution of infection-associated chronic diseases in public health
- Acute vs. persistent, latent, and chronic infections; host-pathogen interactions and microbial persistence mechanisms
- Pathways of chronic inflammation, immune evasion, immune-mediated tissue injury, and autoimmune sequelae
- Cellular transformations, epigenetic modifications, and mechanisms of infectious oncogenesis
- Interplay of biological susceptibility, host genetics, behavioural co-factors, and environmental exposures

Unit II: Infection-Associated Cancers and Gastrointestinal Disorders

- Human Papillomavirus (HPV): Oncogenic types, molecular pathogenesis, epidemiology of cervical, anogenital, and oropharyngeal cancers
- Viral Hepatitis: Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) natural history, cirrhosis progression, and hepatocellular carcinoma (HCC)
- *Helicobacter pylori*: Chronic gastritis, peptic ulcer disease, gastric adenocarcinoma, and MALT lymphoma
- Epstein-Barr Virus (EBV): Pathogenesis of nasopharyngeal carcinoma, Burkitt lymphoma, and Hodgkin lymphoma

- Chronic gastrointestinal complications and pathogen-driven dysbiosis in systemic pathology

Unit III: Infection-Associated Systemic Sequelae and Organ Damage

- Human Immunodeficiency Virus (HIV): Long-term non-AIDS co-morbidities, chronic immune activation, accelerated cardiovascular disease, and metabolic complications
- Tuberculosis (TB) and post-tubercular chronic lung diseases: Bronchiectasis, fibrosis, chronic airflow obstruction, and functional impairment
- Group A *Streptococcus*: Pathogenesis, autoimmune carditis, progression to Rheumatic Fever (RF), and Rheumatic Heart Disease (RHD)
- Infectious triggers in chronic renal disorders, glomerulonephritis, and post-infectious neurological syndromes

Unit IV: Prevention, Screening, and Clinical Management Strategies

- Primary prevention strategies: Prophylactic vaccination (HPV, HBV), injection safety, safe sex practices, and water/sanitation hygiene (WASH)
- Population screening and early detection protocols: Visual inspection (VIA/VILI), cervical cytology, HPV-DNA testing, and viral hepatitis rapid diagnostic cascades
- Secondary prevention, therapeutic eradication regimens (e.g., *H. pylori* triple therapy, HCV direct-acting antivirals), and secondary antibiotic prophylaxis for RHD
- Stepped-care models, multidisciplinary clinical pathways, and integrating infectious disease management into routine non-communicable disease (NCD) care

Unit V: Public Health Programs, Health Equity, and Applied Policy Case Studies

- Global and national surveillance systems, cancer registries, and monitoring disease burden (DALYs, attributable fractions)
- Strategic evaluation of public health initiatives: National Viral Hepatitis Control Program (NVHCP), National TB Elimination Program (NTEP), and national cancer screening programs
- Health system challenges: Diagnostic bottlenecks, financial hardship, access barriers, and stigmatization in marginalized groups
- Health equity, socio-economic disparities, and multi-sectoral policy integration
- Applied case appraisals: Outbreak-associated chronic sequelae, community-based elimination campaigns, drafting policy briefs, and formulating evidence-based intervention recommendations

Suggested Readings

- Kumar, V., Abbas, A. K., & Aster, J. C. *Robbins & Cotran Pathologic Basis of Disease*. Elsevier.
- Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. *Harrison's Principles of Internal Medicine*. McGraw Hill.
- International Agency for Research on Cancer. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. IARC / World Health Organization.
- World Health Organization. *Global Hepatitis Reports and Hepatitis Prevention Guidance*. WHO.
- World Health Organization. *Global Tuberculosis Reports*. WHO.

Maternal and Neonatal Care Strategies

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Explain the concepts, determinants, and public health significance of maternal and neonatal health.
- Describe evidence-based strategies for antenatal, intrapartum, postnatal, and newborn care.
- Examine major causes of maternal and neonatal morbidity and mortality and identify opportunities for prevention.
- Analyse national maternal and newborn health programmes, policies, and service delivery strategies in India.
- Evaluate interventions addressing high-risk pregnancies, obstetric emergencies, and neonatal complications from a public health perspective.
- Apply public health approaches to assess maternal and neonatal health indicators, programme performance, and quality of care.

Course Outcomes: On completion, students will be able to

CO1: Explain the determinants, indicators, and epidemiological patterns of maternal and neonatal health.

CO2: Describe evidence-based maternal care strategies across pregnancy, childbirth, and the postnatal period.

CO3: Explain essential newborn care and strategies for preventing and managing major neonatal health problems.

CO4: Analyse maternal and neonatal health policies, programmes, and health service delivery systems in India.

CO5: Evaluate interventions and quality improvement strategies aimed at reducing maternal and neonatal morbidity and mortality.

CO6: Apply public health data and case-based approaches to identify service gaps and recommend improvements in maternal and neonatal care.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Epidemiological Surveillance Skills, GA4: Maternal-Neonatal Health Systems, Policy & Quality Governance Competency, GA5: Empathetic Health Communication, Counseling & Community Advocacy, GA6: Professional Ethics, Respectful Maternity Care & Reproductive Rights, GA10: Lifelong Learning & Evidence-Informed Clinical and Program Decision-Making

Unit I: Foundations and Epidemiology of Maternal and Neonatal Health

- Concepts, scope, and principles of maternal, newborn, and child health across the life-course continuum
- Key indicators: Maternal Mortality Ratio (MMR), Neonatal Mortality Rate (NMR), Stillbirth Rate, and perinatal morbidity indices
- Epidemiological distribution and major direct and indirect causes of maternal and neonatal mortality
- Social, behavioral, cultural, and gender determinants of maternal-neonatal outcomes
- The Three Delays Model: Delays in deciding to seek care, reaching appropriate healthcare facilities, and receiving adequate care

Unit II: Antenatal Care and High-Risk Pregnancy Management

- Preconception care, early pregnancy registration, and WHO guidelines for antenatal care contacts
- Routine antenatal assessments, gestational weight monitoring, and nutritional supplementation (IFA, calcium)
- Screening protocols: Gestational diabetes mellitus, hypertensive disorders of pregnancy, and maternal infections (HIV, syphilis, hepatitis B)
- Clinical identification and triaging of high-risk pregnancies
- Birth preparedness, complication readiness planning, emergency transportation networks, and continuity of care

Unit III: Intrapartum, Emergency Obstetric and Postnatal Care

- Skilled birth attendance and institutional delivery systems; principles of Respectful Maternity Care (RMC)
- Evidence-based intrapartum monitoring: Modern labor surveillance tools and preventing unnecessary obstetric interventions
- Prevention, clinical diagnosis, and active management of obstetric emergencies: Postpartum Hemorrhage (PPH), pre-eclampsia/eclampsia, and puerperal sepsis
- Emergency Obstetric and Newborn Care (EmONC) facilities: Basic (BEmONC) vs. Comprehensive (CEmONC) readiness and referral mechanisms

- Routine postnatal care visits, postpartum depression screening, maternal nutrition, and postpartum family planning/contraception

Unit IV: Essential Newborn Care and Management of Neonatal Complications

- Immediate newborn care: Delayed cord clamping, thorough drying, skin-to-skin contact, thermal regulation, and early breastfeeding initiation
- Principles of basic neonatal resuscitation and danger sign recognition in neonates
- Management protocols for preterm and Low-Birth-Weight (LBW) infants: Kangaroo Mother Care (KMC) and specialized feeding support
- Prevention and empirical management of neonatal infections: Neonatal sepsis, pneumonia, and aseptic cord/skin care
- Newborn referral pathways, home-based post-discharge follow-ups, and strategies to prevent neonatal deaths

Unit V: Policies, Programs, Quality Improvement, and Applied Evaluation

- Strategic policy landscape: National Health Mission (NHM) and the RMNCAH+N operational strategy in India
- Financial protection and incentive schemes: Janani Suraksha Yojana (JSY) and Janani Shishu Suraksha Karyakram (JSSK)
- National service quality initiatives: Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA), SUMAN (Surakshit Matritva Aashwasan), and LaQshya labor room certification
- Facility-Based Newborn Care (FBNC: SNCUs, NBSUs, NBCCs) and Home-Based Newborn Care (HBNC/HBYC) programs
- Quality improvement systems: Maternal and Perinatal Death Surveillance and Response (MPDSR), clinical audits, root-cause analyses, health management information systems (HMIS), and case-based evaluations for evidence-based decision-making

Suggested Readings

- World Health Organization. *WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience*. World Health Organization.
- World Health Organization. *WHO Recommendations: Intrapartum Care for a Positive Childbirth Experience*. World Health Organization.
- World Health Organization. *WHO Recommendations on Maternal and Newborn Care for a Positive Postnatal Experience*. World Health Organization.
- World Health Organization. *WHO Recommendations for Care of the Preterm or Low-Birth-Weight Infant*. World Health Organization.

- Ministry of Health and Family Welfare, Government of India. *National Health Mission Guidelines and Maternal and Newborn Health Programme Documents*. MoHFW.

Occupational Health Exposure Assessment

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Introduce the principles and importance of occupational health exposure assessment in workplace health and safety.
- Explain occupational hazards, exposure routes, exposure determinants, and their potential health effects among workers.
- Familiarize students with occupational exposure assessment methods, workplace monitoring, and exposure measurement techniques.
- Develop the ability to interpret occupational exposure data and compare workplace exposures with relevant occupational exposure limits.
- Explain occupational exposure control measures, risk management strategies, and the hierarchy of controls.
- Develop practical skills in assessing workplace exposures and recommending evidence-based interventions to protect workers' health.

Course Outcomes: On completion, students will be able to

- CO1: Explain the principles, concepts, and importance of occupational health exposure assessment.
- CO2: Identify occupational hazards, exposure routes, determinants of exposure, and associated health effects.
- CO3: Apply appropriate methods for assessing and measuring occupational exposures in different workplace settings.
- CO4: Interpret occupational exposure monitoring data and evaluate exposure levels against relevant occupational exposure limits.
- CO5: Evaluate exposure control strategies and recommend evidence-based interventions to prevent occupational illness and injury.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Exposure Assessment Skills, GA4: Occupational Health Systems, Safety Compliance & Regulatory Competency, GA5: Technical Communication, Risk Reporting & Professional Documentation, GA6: Professional Ethics, Worker Rights & Occupational Health Equity, GA10: Lifelong Learning & Evidence-Informed Safety Decision-Making

Unit I: Fundamentals of Occupational Health Exposure Assessment

- Definition, historical evolution, scope, and public health importance of exposure assessment
- Core concepts: Hazard vs. risk, exposure intensity, frequency, duration, and cumulative exposure profiles
- Role of exposure assessment in occupational epidemiology, risk management, and regulatory compliance
- Establishing Similar Exposure Groups (SEGs) and defining baseline workplace exposure profiles

Unit II: Occupational Hazards and Health Effects

- Chemical hazards: Aerosols, dusts, fumes, mists, toxic gases, vapors, and organic solvents
- Physical hazards: Noise, segmental/whole-body vibration, ionizing/non-ionizing radiation, and thermal extremes
- Biological hazards, bioaerosols, ergonomic stressors, and psychosocial determinants of workplace exposure
- Primary routes of occupational intake: Inhalation, dermal absorption, ingestion, and target organ toxicology
- Acute vs. chronic occupational illnesses, latency periods, and exposure-response relationships

Unit III: Occupational Exposure Assessment Methods

- Walk-through workplace surveys, qualitative exposure characterization, and observational matrices
- Environmental monitoring strategies: Area sampling versus personal breathing-zone monitoring
- Active and passive air sampling instrumentation, particulate filters, sorbent tubes, and direct-reading monitors
- Physical exposure assessments: Sound level meters, noise dosimeters, and Wet Bulb Globe Temperature (WBGT) heat monitoring
- Biological monitoring: Biomarkers of internal dose, effect, and individual susceptibility

Unit IV: Exposure Measurement, Data Interpretation, and Standards

- Sampling strategy designs: Representative sampling, grab samples, and worst-case scenario sampling
- Statistical analysis of exposure data: Lognormal distributions, geometric mean, and geometric standard deviation
- Occupational Exposure Limits (OELs): Time-Weighted Average (TWA), Short-Term Exposure Limit (STEL), and Ceiling (C) values

- International and national benchmark standards: NIOSH Recommended Exposure Limits (RELs), OSHA Permissible Exposure Limits (PELs), and ACGIH Threshold Limit Values (TLVs)
- Data interpretation, measurement error, limit of detection (LOD), and compliance determination

Unit V: Occupational Exposure Control, Risk Management & Public Health Practice

- The hierarchy of controls: Elimination, chemical substitution, engineering containment, and local exhaust ventilation (LEV)
- Administrative controls: Work-rest cycles, job rotation, standard operating procedures, and safety training
- Personal Protective Equipment (PPE): Selection criteria, fit-testing protocols, and respiratory protection programs
- Occupational medical surveillance: Baseline medical exams, periodic screening, and biological effect monitoring
- Applied field analysis: Walk-through survey case evaluations, industrial exposure reporting, hazard mitigation planning, and presenting evidence-informed interventions

Suggested Readings

- National Institute for Occupational Safety and Health. *Occupational Exposure Sampling Strategy Manual*. NIOSH.
- Occupational Safety and Health Administration. *Occupational Safety and Health Standards and Guidance*. OSHA.
- International Labour Organization. *Encyclopaedia of Occupational Health and Safety*. ILO.
- American Conference of Governmental Industrial Hygienists. *Occupational Exposure Limits and Chemical Safety Guidance*. ACGIH.

Nutrition Assessment & Counselling

Category: Minor Stream (MS) | **L-T-P:** 2-1-0 | **Credits:** 3

Course Objectives

- Explain the principles of nutrition assessment and its importance in public health practice.
- Develop an understanding of anthropometric, clinical, dietary, biochemical, and socioeconomic methods of nutritional assessment.
- Familiarize students with nutritional assessment across the life course, including maternal and child nutrition, adolescence, adulthood, and older age.
- Develop skills in identifying nutritional deficiencies, excesses, malnutrition, and diet-related risk factors.
- Explain the principles and techniques of effective, culturally appropriate, and evidence-based nutrition counselling.
- Enable students to develop nutrition education and counselling strategies for individuals, families, and communities.

Course Outcomes: On completion, students will be able to

- CO1: Explain the principles, purposes, and components of nutrition assessment in public health.
- CO2: Apply appropriate anthropometric, clinical, dietary, and biochemical methods to assess nutritional status.
- CO3: Interpret nutritional assessment findings and identify nutritional problems and associated risk factors across the life course.
- CO4: Develop appropriate nutrition counselling plans based on individual needs, dietary practices, and assessment findings.
- CO5: Apply effective communication, behaviour-change, and culturally sensitive counselling techniques in nutrition practice.
- CO6: Design nutrition education and community-based counselling strategies to address nutritional problems and promote healthy dietary practices.

Graduate Attributes Addressed: GA1: Disciplinary & Interdisciplinary Knowledge, GA2: Critical Thinking & Problem Solving, GA3: Analytical Reasoning & Nutritional Assessment Competency, GA4: Public Health Nutrition, Dietary Surveillance & Systems Competency, GA5: Empathetic Health Communication, Motivational Interviewing & Counseling Skills, GA6: Professional Ethics, Cultural Sensitivity & Patient-Centered Care, GA10: Lifelong Learning & Evidence-Informed Dietary Guidance

Unit I: Introduction & Methodological Components of Nutrition Assessment

- Definition, scope, objectives, and public health significance of nutrition assessment
- Broad determinants of nutritional status: Biological, socioeconomic, and environmental factors
- The ABCD framework of nutritional assessment: Anthropometric, Biochemical, Clinical, and Dietary components
- Sources of error, methodological limitations, and ethical considerations in nutritional screening

Unit II: Anthropometry, Growth Standards, and Dietary Assessment Methods

- Anthropometric measurements: Height, weight, Body Mass Index (BMI), waist circumference, waist-to-hip ratio, and mid-upper arm circumference (MUAC)
- Growth monitoring: Application of WHO Child Growth Standards, growth chart plotting, and percentile interpretation
- Clinical assessment: Recognizing physical signs and symptoms of protein-energy malnutrition and vitamin/mineral deficiencies
- Dietary assessment methodologies: 24-hour dietary recalls, Food Frequency Questionnaires (FFQs), diet histories, weighed food records, and dietary diversity scoring

Unit III: Biochemical Assessment and Life-Course Nutritional Profiling

- Biochemical markers: Functional and static indicators (e.g., hemoglobin, serum ferritin, lipid profiles, blood glucose, micronutrient indices)
- Integration of clinical, biochemical, and dietary findings for comprehensive status evaluation
- Life-course nutritional assessment: Specific considerations for maternal, infant, pediatric, adolescent, adult, and geriatric populations
- Identification and risk stratification of vulnerable groups: Undernutrition (stunting, wasting, underweight), micronutrient deficiencies ("hidden hunger"), and overnutrition/obesity

Unit IV: Principles of Nutrition Counseling and Behavior Change Communication

- Core principles of nutrition counseling: Client-centered approaches, active listening, and building rapport
- The counseling process: Assessment, goal setting, intervention delivery, and monitoring
- Behavior Change Communication (BCC) and Social and Behavior Change (SBC) paradigms
- Motivational interviewing techniques: Expressing empathy, developing discrepancy, rolling with resistance, and supporting self-efficacy
- Overcoming cultural, socioeconomic, and behavioral barriers to dietary modification

Unit V: Applied Nutrition Care Plans, Chronic Disease Counseling & Evaluation

- Designing individualized nutrition care plans and practical dietary advice
- Developing culturally appropriate nutrition education materials and visual aids
- Targeted nutritional counseling for diet-related non-communicable diseases: Type 2 diabetes, hypertension, cardiovascular diseases, and metabolic syndrome
- Practical skill application: Counseling role-plays, case study analyses, follow-up scheduling, and evaluating counseling efficacy and behavioral outcomes

Suggested Readings

- World Health Organization. *WHO Child Growth Standards*. World Health Organization.
- World Health Organization. *WHO Anthro Survey Analyser and Child Growth Assessment Resources*. World Health Organization.
- Raymond, J. L., & Morrow, K. *Krause and Mahan's Food & the Nutrition Care Process*. Elsevier.
- Boyle, M. A., and colleagues. *Community Nutrition in Action: An Entrepreneurial Approach*. Cengage Learning.
- World Health Organization, & UNICEF. *Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals*. World Health Organization.