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MODELS OF HEALTH MANAGEMENT: A REVIEW

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Abstract
Health models are important because they provide a framework for understanding health and illness. These models can focus on different aspects of well-being, such as physical, social, emotional, and spiritual dimensions. Integrative medical practitioners prefer models that consider multiple factors when assessing health. The most popular models address biological, social, and psychological dimensions, and there is a growing trend towards including spiritual dimensions as well. These models, unlike the biomedical model, align with the principles of integrative health and provide a more comprehensive understanding of health and wellness.Top of Form

I. INTRODUCTION

The WHO defines Health as "*A complete state of physical, social and mental wellbeing, and not merely the absence of disease or infirmity*". *"Health is a state of complete physical, social and mental well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being, without distinction of race, religion, political beliefs or economic and social conditions." (WHO, 1946 & 1948)*. The importance of good health and living a long life is a fundamental aspect of the human experience. When individuals are healthy, they tend to be more vibrant, and energetic and have a positive outlook on life. These attributes not only have a positive impact on society as a whole, but they also contribute to economic development. Health economists have stressed that investing in health and education are crucial factors in determining the quality of human capital. In other words, the level of health directly affects the overall human capital stock. Additionally, health plays a role in economic growth through its influence on education and fertility. A healthy population is essential for increasing labour productivity, economic growth, and per capita income. As a result, the field of health economics has emerged, aiming to understand the decision-making process of individuals, healthcare providers, private and public organizations, and governments concerning health. Collaborating with experts from various fields such as biology and medicine, health economists have developed different models to study and manage health. The purpose of this paper is to present and explore the various models available in the health economics literature regarding the management of health.

II. THE OTTAWA CHARTER FOR HEALTH PROMOTION

Canada hosted the inaugural international conference on health promotion in Ottawa in 1986. The Charter refers to the document outlining the functions and principles of health promotion. In response to the Social Model of Health, the WHO held its first International Conference on Health Promotion in 1986 in Ottawa, Canada. The outcome of this conference was a document that provided organizations and key stakeholders with guidelines to help incorporate health promotion into their strategies, policies, and campaigns. The aim was to take action to achieve *'health for all by the year 2000 and beyond'* through health promotion and reduce inequalities in health. Three Principles of health promotion, Eight Prerequisites (conditions or resources) for gains in health and Five Priority or Action areas are suggested by the Ottawa Charter for Health Promotion, which was developed by the World Health Organization (WHO), represents an approach to health development aimed at reducing health inequalities. Rooted in the social model of health, the charter defines health promotion as the "process of enabling people to increase control over, and to improve, their health" (WHO, 1998). The charter outlines three fundamental strategies for health promotion: enabling, mediating, and advocacy. These strategies collectively work towards empowering individuals and communities, fostering collaboration, and advocating for policies that enhance overall health and well-being. (VCAA HHD Study Design). Health promotion is a process that empowers individuals to enhance control over and improve their health. Unlike a curative approach, health promotion emphasizes prevention and addresses the root causes of diseases rather than the diseases themselves. It adopts a population-focused perspective, aiming to enhance overall well-being by targeting the factors that contribute to health issues.

Three Basic Principles of Health Promotion: *Empowerment***:** Health promotion seeks to empower individuals and communities, enabling them to take control of their health and make informed decisions. *Participation***:** Involving people in the decision-making processes related to their health ensures that interventions are culturally sensitive and tailored to the specific needs of the community.

*Equity***:** Health promotion aims to address and reduce health inequalities, ensuring that everyone has the opportunity to achieve their highest level of health.

Eight Prerequisites (conditions or resources) for gains in health are: *Peace***:** A stable and peaceful environment is essential for promoting health. *Shelter***:** Access to safe and secure housing is a fundamental prerequisite for health. *Education***:** Promoting health requires education to empower individuals with knowledge and skills. *Food***:** An adequate and nutritious food supply is crucial for maintaining health. *Income***:** Economic stability and fair distribution of resources contribute to better health outcomes. *Stable Ecosystem:* A sustainable and balanced environment supports overall health. *Social Justice:* Fairness and social equality are prerequisites for improving health. *Equitable Health Care:* Access to healthcare services without discrimination is essential for promoting health.

Five Priority or Action Areas: *Build Healthy Public Policy*: Advocating for policies that support health at the community and societal levels. *Create Supportive Environments*: Fostering environments that promote health and well-being. *Strengthen Community Action*: Encouraging community involvement and collaboration for health promotion. *Develop Personal Skills*: Enhancing individual capabilities to make informed health choices. *Reorient Health Services*: Shifting the focus of healthcare to preventive measures and health promotion.

Environmental Management often involves taking preventive measures against further pollution, driven by concerns about potential critical thresholds being surpassed. This approach aligns with the precautionary principle, asserting that action to prevent or restrict environmental damage should not be deferred due to uncertainties surrounding the causes or extent of the damage **(Hanley et al. 2007)**. Additionally, a conceptual framework aimed at enhancing health and well-being emphasizes the need to address social, economic, and environmental determinants of health for meaningful health improvements. The model recognizes that to achieve health gains, efforts must be directed at addressing these multifaceted determinants (VCAA HHD Study Design).

Five Key Principles (A.R.E.A.S.)

A*ddresses the broader determinants of health*: Health promotion strategies increasingly focus on broader determinants, including gender, ethnicity, socioeconomic status, location, and the physical environment. These factors influence behavioural determinants and maintain a significant relationship with health, emphasizing the need for a comprehensive approach to address these interconnected elements in promoting overall well-being.

R*educe social inequities*: The goal is to promote equity for all individuals, and achieving this requires addressing social determinants that contribute to inequality. Factors such as gender, culture, socioeconomic status, location, and the physical environment must be targeted to create a more equitable and just health landscape.

E*mpower Individuals and Communities*: Empowering individuals and communities with health knowledge means giving them the ability to make informed decisions about their health and actively participate in adopting healthy behaviours.

A*ccess to Health Care*: Access to health care is a crucial factor influencing health status. The social model of health aims to ensure universal access to healthcare. Various social factors, such as cultural and language barriers, economic and geographical considerations, and education levels, can impact access to healthcare.

*Inter-****S****ectorial collaboration*: To effectively address the social determinants of health and positively impact health status, it is essential to engage all relevant organizations and stakeholders who hold influence over social and environmental factors. This inclusive approach ensures a comprehensive effort to address and improve health outcomes.

III. MODELS in Health Economics

Health economic models are crafted to assess health and cost outcomes resulting from the introduction of a new healthcare intervention. Typically, this involves creating a cost-effectiveness model to estimate the "value for money" and a budget impact model to gauge the financial implications for healthcare payers. These models serve as crucial tools in demonstrating the value and financial impact of a new healthcare intervention, playing a vital role in securing payer reimbursement, especially in markets with established and developing Health Technology Assessment (HTA) institutions. Beyond the duration of clinical trials, health economic models aid in extrapolating outcomes of interest. They are meticulously designed to encompass and accumulate all health and cost consequences associated with a healthcare intervention over a specified horizon, as dictated by the study's objectives and methodologies.

Budget Impact Model (BIM): It serves as a health economic decision modelling tool that calculates the anticipated additional budget and cost-offsets resulting from the introduction of a new healthcare technology. This model is an integral component of health technology assessments and value dossier submissions for pharmaceuticals and medical devices seeking reimbursement. Its primary purpose is to assist healthcare payers in improving budgeting and accounting processes. Additionally, the BIM functions as a potent decision-making tool, facilitating what-if analyses. For instance, it enables the evaluation of current and future market shares of various healthcare interventions, considering their associated health outcomes over time. Health economic modelling plays a pivotal role in designing and programming the Budget Impact Model interface, incorporating factors such as the clinical and safety profile of the new product, acquisition costs, administration costs, healthcare expenses, societal costs, and other relevant considerations from both payer and societal perspectives.

Cost Effectiveness Model: It informs economic decisions by computing a ratio of benefit, value or output to cost incurred to achieve such output. Cost-effectiveness analysis in healthcare usually implies selecting Quality Adjusted Life year or QALY as a generic measure of health benefit, although other health outcomes such as Life Years (LY), Hospitalisations averted or Lengths of Stay (LoS) can be selected. Cost-effectiveness modelling involves calculating an incremental cost-effectiveness ratio that compares added benefit to added cost. This ratio is then compared to a threshold value that differs in various countries. The threshold value often reflects the opportunity cost of generating one QALY in a given healthcare system. Cost-effectiveness modelling requires a rigorous selection of health states to be included in the model structure. Usually, this involves simulating the number of hypothetical

patients in specific states (no, acute, chronic disease state) and generic states (alive or absorbing state) of interest over time. Specialized microsimulation software packages exist to perform such analysis. **(Milton C. Weinstein, David B. Nash, Alan M. Garber, 1997)**

Epidemiology Model: An epidemiology model is a mathematical or computational representation used to analyze the distribution and determinants of health-related events within a population. These models are fundamental tools in epidemiology, a branch of public health that investigates the patterns, causes, and effects of health and disease conditions in populations. Epidemiology models are designed to simulate and understand the dynamics of diseases, infections, or health-related events. They can be used to estimate the prevalence and incidence of a particular condition, identify risk factors, and predict the potential impact of interventions or changes in health behaviours. There are various types of epidemiology models, including: **Descriptive Models:** Which focus on characterizing the distribution of a disease in terms of person, place, and time, providing a snapshot of the affected population. **Analytical Models:** Aim to identify and evaluate factors that contribute to the occurrence of a health event, such as case-control studies or cohort studies. **Mathematical Models:** Utilize mathematical equations to represent the spread of diseases in populations, including compartmental models like the SIR (Susceptible-Infectious-Removed) model commonly used in infectious disease epidemiology. **Simulation Models:** Employ computer-based simulations to model the progression of diseases, often used for predicting outcomes and assessing the impact of interventions. Epidemiology models play a crucial role in public health by providing insights into the dynamics of diseases, aiding in the development of preventive strategies, and informing public health policies. **(John Snow (1813–1858), Ignaz Semmelweis (1818–1865), Florence Nightingale (1820–1910), Richard Doll (1912–2005) and A. Bradford Hill (1897–1991))**

Early Drug Pricing Model: It is a financial and strategic tool used in the pharmaceutical industry to estimate and determine the pricing strategy for a drug in its early stages of development, typically before it enters the market. This model incorporates various factors to assess the potential financial implications and market positioning of the drug. Key considerations in an early drug pricing model may include: *Research and Development Costs***:** Evaluating the investment incurred during the drug's research and development phases, including pre-clinical and clinical trials. *Clinical Trial Outcomes***:** Analyzing the anticipated efficacy and safety outcomes from clinical trials, which can influence the perceived value of the drug. *Manufacturing Expenses***:** Estimating the costs associated with producing the drug on a larger scale, considering manufacturing processes and scalability. *Market Demand and Competition***:** Assessing the anticipated market demand for the drug, as well as the competitive landscape, to determine how the drug might be positioned relative to existing or potential competitors. *Regulatory Environment***:** Considering the regulatory pathway and requirements for approval, as this can impact the time to market and associated costs. *Health Economics and Value Proposition***:** Incorporating health economic considerations and defining the value proposition of the drug, which may involve assessing its cost-effectiveness and overall value to patients and healthcare systems. By integrating these factors, an early drug pricing model aids pharmaceutical companies in making informed decisions about the initial pricing of a drug. This strategic pricing approach aims to strike a balance between ensuring the drug's financial viability and competitiveness in the market, while also reflecting its potential value to patients and healthcare providers. The model is crucial for shaping the overall commercialization strategy and optimizing the drug's market positioning as it progresses through the development pipeline.

Portfolio Optimisation Model: It is a financial tool and quantitative technique used to strategically allocate resources among a set of investments or assets to achieve specific objectives while considering risk factors. This model is particularly relevant in investment management and financial planning, where decision-makers seek to maximize returns or achieve certain financial goals within a given level of risk tolerance. Key components and considerations in a portfolio optimization model include: *Investment Options:* The various assets, securities, or projects that constitute the investment portfolio. These could include stocks, bonds, real estate, or, in broader applications, projects within a business portfolio. *Return Expectations:* Estimations of the expected returns from each investment option, reflecting the historical performance, future growth potential, and other relevant factors. *Risk Factors:* Assessment of the risks associated with each investment, considering factors such as volatility, market conditions, and external economic variables. *Correlation Analysis:* Examination of the correlations between different investments to understand how they may behave to each other. *Constraints:* Any limitations or restrictions, such as budget constraints, regulatory requirements, or specific investment criteria, that need to be considered in the portfolio allocation. *Optimization Objectives:* Clearly defined goals, whether maximizing returns, minimizing risk, achieving a target level of income, or balancing a combination of these objectives. The model uses mathematical algorithms and statistical methods to find the optimal allocation of resources that aligns with the specified objectives and constraints. This process involves balancing the trade-off between risk and returns to construct a portfolio that maximizes the desired outcomes within the defined parameters. In broader business contexts, the principles of portfolio optimization can also be applied to allocate resources among different projects, initiatives, or business units to maximize overall performance and efficiency while managing risk. **(Harry Markowitz, 1952)**

Risk-Sharing Model: Risk-sharing models refer to contractual agreements or arrangements between different stakeholders in the healthcare industry, particularly between pharmaceutical manufacturers and healthcare payers or insurers. These models are designed to share and manage the financial risks associated with the performance or outcomes of specific medical treatments, therapies, or drugs. The goal is to align the interests of both parties and create a more value-driven and sustainable healthcare system. Several types of risk-sharing models exist, each with its structure and focus: *Pay-for-Performance (P4P):* In this model, payment to the healthcare provider or manufacturer is tied to the achievement of predefined performance metrics or outcomes. For example, a pharmaceutical company might receive additional payments if their drug demonstrates superior efficacy or if patients achieve specific health goals. *Outcomes-Based Pricing:* This model links the price of a healthcare product or service to its real-world effectiveness or health outcomes. If the treatment does not meet predetermined benchmarks, the payer may negotiate a reduced price. *Shared Savings Agreements:* These agreements involve sharing the financial benefits resulting from cost savings or improved health outcomes between the payer and the provider or manufacturer. It encourages efficiency and cost-effectiveness. *Risk Pools:* In risk pool arrangements, multiple payers contribute to a shared fund that covers the costs of high-priced or high-risk medical treatments. This approach helps distribute the financial burden among multiple entities. *Capitated Payments:* In capitation, providers or manufacturers receive a fixed payment per patient over a specified period, regardless of the actual services or treatments delivered. This model incentivizes efficiency and cost containment. These risk-sharing models aim to address some of the challenges

associated with healthcare costs, particularly in situations where the efficacy or long-term outcomes of a treatment may be uncertain. By linking payments to performance or outcomes, these models seek to ensure that payers receive value for their investment, while manufacturers are incentivized to produce effective and cost-efficient healthcare solutions. The adoption of risk-sharing models reflects a broader shift toward value-based healthcare, where payment is increasingly tied to the quality and outcomes of care rather than volume alone.

Decision Tree Model: As a decision analysis technique, relies on conditional and joint probabilities to ascertain the most probable outcomes in a specific scenario. In the realm of health economics, this methodology proves invaluable for assessing various health interventions, facilitating a comprehensive comparison of the benefits, costs, and associated risks for each option. The utility of decision tree models extends to the evaluation of treatments in addressing drug and alcohol-related issues. Their efficacy lies in their ability to account for both population heterogeneity and recurrent events, providing a nuanced understanding of complex healthcare scenarios. Notably, decision tree models offer a practical advantage by being relatively straightforward to construct compared to more complex models like Markov models. The latter often necessitates a mastery of advanced statistical techniques, making decision tree models a more accessible and user-friendly option for health economic analyses. **(Ronald A. Howard [1934], Howard Raiffa [1924-2016], Jerome Cornfield [1912-1979] and Leonard J. Savage [1917-1971])**

Markov Model: It is classified as a stochastic model, and employs time-dependent probabilities to model the future state of a system. Within the realm of health economics, this modelling approach serves as a valuable tool for predicting the long-term costs and benefits associated with diverse health interventions while accounting for parameter uncertainty. Health economists find Markov models particularly beneficial due to their capacity to elucidate how variations in parameters, such as cost or effectiveness, may impact long-term outcomes. This understanding enables informed decision-making regarding the cost-effectiveness of different interventions, acknowledging and navigating the inherent uncertainty surrounding these parameters. Additionally, Markov models facilitate the application of Monte Carlo simulations, enabling the assessment of expected values of perfect information across various scenarios. This capability enhances the depth of analysis and supports the exploration of optimal decision pathways in the face of uncertainty within health economic evaluations. **(Andrey Markov [1856-1922])**

Outcome Model: It is a subtype of cost-effectiveness modelling, that serves to compare the costs and outcomes associated with different healthcare interventions, scrutinizing their impact on patients' health status, quality of life, and survival rates. The merits of employing outcome models in health economics lie in their ability to assess the cost-effectiveness of interventions, pinpoint cost-effective treatments for specific conditions, and forecast changes in patient outcomes over time. These models offer valuable insights into the influence of factors like age, gender, or genetic variations on patient treatment responses. Despite their advantages, it is important to acknowledge that using outcome models in health economics also comes with associated disadvantages. These include: Scarce clinical trial data as a result of the substantial expenses associated with conducting them; Challenges arising in interpreting intricate data sets sourced from multiple origins; Transparency compromised due to proprietary rights held over the specific software employed in model creation; Extrapolating results across different population groups becomes challenging due to variations in genetics or environmental factors; and Uncertainty persists regarding long-term effects, stemming from limitations in available studies.

System Dynamics Model: It is employed in health economics, is a mathematical tool designed to scrutinize the interconnected relationships among elements within a system. This model emphasizes comprehending the ripple effects of changes in one area on others and delves into the enduring consequences of diverse actions. Valuable for unravelling the intricate relationships influencing health outcomes, such as healthcare costs, resource availability, disease transmission rates, and individual behaviours, system dynamics models play a crucial role. Their utility lies in identifying potential solutions for intricate issues like healthcare accessibility or escalating costs by analyzing how diverse interventions impact these intricate systems over time. **(Jay W. Forrester [1918-2016])**

Causal Model: It is a statistical approach, that aims to pinpoint the causal relationships between variables, making it particularly useful for analyzing intricate systems like healthcare interventions. This methodology enhances comprehension of how diverse factors mutually influence one another. In the context of health economics, employing causal models offers decision-makers valuable insights into the potential effects of various interventions on patient outcomes and healthcare resource utilization. Integrating evidence from clinical trials and real-world data into these models enables decision-makers to discern the interventions most likely to succeed and anticipate the necessary resources for implementation. This holistic approach empowers decision-makers in health economics to make informed choices based on a comprehensive understanding of causal relationships. **(Sir Ronald A. Fisher (1890–1962), Jerzy Neyman (1894–1981), Donald Rubin (1943), Judea Pearl (1936))**

Simulation Model: It is computer-based and driven by mathematical equations, replicates real-life situations and proves invaluable in analyzing intricate systems like healthcare systems. In health economics, these models serve to predict the impacts of diverse interventions or policies on costs and outcomes. Their advantages are manifold, enabling researchers to explore numerous scenarios and comprehend the intricate interactions between multiple factors within the system. This capability facilitates a deeper understanding of how alterations in one variable may influence others, offering valuable insights for decision-makers in health economics to navigate complex scenarios and make informed choices. *Health Econometrics:* Health econometrics entails applying analytical techniques from economics to address healthcare issues, utilizing economic theory and methods for the analysis of data concerning healthcare costs, outcomes, and other relevant factors. This discipline proves instrumental in assessing the cost-effectiveness of various interventions or policies. Additionally, health econometrics serves decision-making purposes, aiding in the determination of optimal funding allocations for specific interventions. By leveraging economic tools and methodologies, health econometrics enhances the understanding and optimization of resource utilization in healthcare contexts. The advantages of health econometrics are: Offer insights into intricate issues within healthcare systems; Quantify the costs linked with diverse interventions; Identify potential benefits that may have been overlooked; and Facilitate the prioritization of interventions based on their cost-effectiveness ratios. *Value of Information:* Cost-effectiveness models are employed to evaluate the economic efficiency of healthcare interventions. These models integrate data on costs, outcomes, and various factors, furnishing payers with essential information to inform decisions on whether the benefits of an intervention justify its associated costs. *Cost-Effectiveness Analyses:*

Cost-effectiveness analyses, a form of economic evaluation in healthcare, gauge the health outcomes of an intervention in a singular natural unit, such as cases averted or life-years saved. These analyses employ a generic measure of health status, such as Disability Adjusted Life Years (DALYs) or Quality Adjusted Life Years (QALYs), to assess and compare the benefits derived from various interventions.

Health economics models serve as crucial tools for comprehending the healthcare system and making well-informed decisions regarding proposed medications and treatments. These models, despite their varied types, each possess distinct strengths and weaknesses, including challenges related to data availability, complexities in interpreting data sets, and uncertainties surrounding long-term effects. Nevertheless, within the realm of Health Economics and Outcomes Research (HEOR), these models maintain their pivotal role in guiding decision-making processes for stakeholders in the healthcare industry. A health economics model essentially acts as a simplified representation of reality, facilitating a deeper understanding of how the healthcare system operates. These models systematically analyze and contrast the benefits and costs of suggested medicines and treatments, aiming to identify those that offer optimal value to patients. Given the diverse array of models available, each with its unique set of advantages and limitations, they remain indispensable in the field of HEOR for evaluating and guiding stakeholders through decision-making processes. Furthermore, health economics models contribute significantly to unravelling the intricate relationships among various factors within the healthcare system. They prove invaluable in predicting potential outcomes under different scenarios. This guide will expound on nine types of models utilized in health economics to shed light on their diverse applications and significance. **(John von Neumann (1903–1957), Richard Bellman (1920–1984), Jay W. Forrester (1918–2016), George E. P. Box (1919–2013), Herbert A. Simon (1916–2001))**

IV. MODELS ON HEALTHCARE

Models of health are 'conceptual frameworks' or ways of thinking about health. The Models are:

Grossman's Investment Model of Health: Grossman's model significantly contributes by differentiating health as an outcome—an essential commodity that brings satisfaction to individuals—from medical care, which is positioned as an input in the process of health production. According to Grossman's framework, individuals both request and generate health. Health is pursued because it affects the time available for generating income and wealth and acts as a source of inherent satisfaction. Decreased health not only diminishes happiness but also impedes the ability to earn. The model illustrates health production as a consequence of individual endeavors, involving elements such as diet, lifestyle decisions, and medical care. The effectiveness of health production relies on the knowledge and educational levels of individuals.

In this model, medical care represents just one element in the broader process of health production. Each individual begins life with a 'stock of health,' analogous to capital, which undergoes natural depreciation over time with age. However, this health stock can be augmented through investments in time, effort, knowledge, or by seeking medical care. Grossman's model encompasses two crucial insights. Firstly, it recognizes that medical care is only one factor contributing to improvements in health, with health outcomes primarily influenced by various factors beyond medical care. Secondly, individuals don't pursue health care for its intrinsic value; rather, the utility derived from health care results from the subsequent enhancements in health. Consequently, the demand for health care is considered a derived demand. The investment model of health asserts that the demand for health depends on both the cost of health capital and the rate of depreciation of the health stock. Similar to investing in depreciable capital goods, such as a computer, the disparity between gross (total) and net investment is determined by the rate at which health capital depreciates.

The comprehensive cost of generating any health stock includes expenses associated with counteracting depreciation and the costs linked to additional units of health stock, as explained by **Johnson-Lans (2006)**. The marginal efficiency of capital serves as the health demand curve, resembling a production function by establishing the relationship between the inputs and outputs of the health stock. Once the marginal efficiency of the capital schedule is determined, it becomes possible to identify the level at which an individual will choose to produce. A rational individual will allocate more resources to health production until the added value of increased healthiness equals the marginal cost of production.

Importantly, the marginal efficiency of the capital schedule is unique to each individual. Its position depends on the initial period, where an individual with a lower health endowment requires more inputs to achieve an equivalent level of health stock compared to someone with a higher initial endowment. In such cases, the marginal efficiency of the capital curve shifts to the left compared to an individual starting life in a healthier state. The model challenges the assumption that an identical increase in inputs to the health production function will result in the same marginal improvement across different individuals (Johnson-Lans, 2006).

The Investment Aspects of the Grossman Model: Grossman's theory centres on household and production dynamics, where the main goals involve generating essential commodities within households through the use of time and market goods and services. All available time is allocated to either directly producing these commodities or engaging in labour to earn income for acquiring market goods. For example, in creating a fundamental commodity like nourishment, a household can choose between home-cooked, restaurant, take-out, or prepared meals, each involving different combinations of the household's time and market goods. Similarly, health can be produced through various activities and goods such as exercise, diet, medical care, and lifestyle modifications. The theory of health demand begins by assuming, for simplicity, that individuals derive utility from two goods: health (H) and a composite of all other fundamental commodities (O).

$$U = U(H, O)$$

Both (H) and (O) are aggregated over time, considering the individual's time preference, which reflects varying degrees of impatience regarding when they prefer to experience benefits. Consequently, (H) becomes a weighted summation of the healthy days experienced by the individual throughout their lifetime. These healthy days originate from the person's health stock (HS), indicating that a greater health stock will result in a higher number of healthy days.

The health stock at a specific time (HS_t) is determined by the health stock in the preceding period (HS_{t-1}), adjusted for any depreciation in health stock during that period (d), and augmented by any health investments (I_t) made by the individual. The relationship is expressed as follows:

$$HS - HS - 1 - dr + li$$

Becker played a crucial role in reshaping economic inquiry and expanding the scope of economists' work. Initially known for his ground-breaking work on discrimination, he went on to conduct pioneering research in areas traditionally considered outside the realm of economics, such as fertility, demographics, education, crime and punishment, and marriage and divorce. One of his significant contributions was the symposium on "Investment in Human Beings," featured in a special issue of the "Journal of Political Economy" in 1962. This symposium laid the foundation for his influential 1964 book, "Human Capital," which is now regarded as a classic in economic research. The book established the theoretical framework for an entire field of study bearing the same name. Within this conceptual framework, individuals are viewed as active participants who engage in spending and investing in themselves and their offspring with a forward-looking perspective. Various activities, including education and training, job search, migration, and medical care, are all interpreted as strategic investments in human capital. This perspective emphasizes the long-term benefits and returns associated with acquiring and enhancing skills, knowledge, and overall well-being, aligning with Becker's pioneering work on human capital theory.

Medical Model: Emerging during the Enlightenment in the 18th Century, a period marked by the ascendancy of traditional natural sciences in academia and medical practice, the enduring belief in science as the panacea for all ailments has become a fundamental tenet of modern medicine. This conception of health is simplified, framing it as a measurable attribute contingent upon the presence or absence of disease. While this perspective provides a straightforward metric for health assessment, its pronounced emphasis on disease absence as the primary indicator of good health, coupled with an excessive reliance on the influence of medical science, tends to overlook the substantial impact of other critical factors on overall well-being. **(Hippocrates (circa 460–370 BCE), Galen (129–c. 200), Rudolf Virchow (1821–1902), Louis Pasteur (1822–1895) and Robert Koch (1843–1910), Thomas Sydenham (1624–1689))**

Biomedical Model of Health: Biomedical models, highlighted by authors like **Foucault (1973)**, centre on advancing medical practices, treatments, and illness prevention through the analysis of the physical body's biological basis. The term 'medical gaze,' as articulated by Foucault, describes how doctors rely on medical examinations and biological testing to determine illnesses. Biological constituents within the Biomedical model involve understanding complex diseases through pure biological processes such as hormonal imbalances, neurophysiological abnormalities, genetic defects, bacterial and viral infections, as well as physical causes. The core tenets of this approach assert that (a) mental disorders stem from biological abnormalities primarily located in the brain, (b) there is no meaningful distinction between mental and physical diseases, and (c) emphasis is placed on biological treatments.

Disease Model of Health: George Engel (1977) critiqued the predominant biomedical model, which emphasizes solely the biological aspects of diseases, disorders, and malfunctioning. Critics argue that this dualistic approach neglects other influential factors triggering disease processes. It disregards the role of social, cultural, and environmental factors in understanding health. The biomedical model, grounded in molecular biology, assumes diseases are fully explained by deviations from the norm of measurable biological variables. However, it excludes the social, psychological, and behavioural dimensions of illness from its framework. The model not only treats disease independently of social behaviour but also requires explanations for behavioural aberrations based on disordered somatic processes, whether biochemical or neurophysiological.

Social Model of Health: The Social Model of Health, developed in the late 1970s and 1980s, takes a comprehensive approach by addressing broader influences on health, including social, cultural, environmental, and economic factors, rather than solely focusing on disease and injury. This model adopts a community-oriented strategy for disease prevention, emphasizing policies, education, and health promotion. In contrast to models centred on lifestyles and behaviour, the Social Model of Health recognizes the necessity for societal changes to establish the prerequisites for health. This shift in perspective emerged as a response to disparities in health levels within the community, acknowledging that some individuals were not experiencing the same levels of health despite an understanding of the impact of lifestyle and behaviours on health. **(Engels and Social Determinants (19th Century), Ivan Illich (1926–2002), The Black Report (1980), Alma Ata Declaration (1978), Michael Marmot (1945))**

Community Organization Model: It facilitates a collaborative decision-making process empowering communities to enhance their health. It underscores the importance of community engagement in identifying crucial health issues and devising strategies for their resolution. Communities leverage their strengths, uniting to create programs aimed at achieving health objectives. Key features of the Community Organization Model comprise: *Comprehensive Understanding*: Prioritizing a thorough understanding of the context and root causes of health issues. *Collaborative Decision Making*: Encouraging collaborative decision-making and effective problem-solving within the community. *Targeted Efforts*: Concentrating efforts on specific health issues for a more focused and impactful approach. *Inclusive Participation*: Actively involving diverse groups and organizations within the community to foster a sense of collective responsibility. *Capacity and Power Building*: Emphasizing the development and sustenance of community capacity and power to bring about enduring change. *Feedback Mechanism*: Establishing a feedback loop with the community, ensuring transparency and accountability throughout decision-making and program implementation processes. **(Ralph Nader (1934-), Saul Alinsky (1909–1972), John L. McKnight (1935-), Wade Rathke (1948-), Myles Horton (1905–1990), Paulo Freire (1921–1997))**

Community Readiness Model: It operates on the premise that communities are driven by the disparity between current health situations or behaviours and the aspiration to achieve a specific goal. Community readiness, in this context, signifies how prepared

a community is to take action to address a particular health issue. The model outlines several stages in community readiness: *Absence of Awareness***:** The community lacks recognition of the health issue. *Denial or Resistance:* There is minimal acknowledgement or concern among community members regarding the health issue. *Vague Awareness:* The community may express concern, but motivation to address the health issue remains low. *Pre-Planning:* The community acknowledges the need for action, but focused activity around the health issue is lacking. *Preparation:* Community leaders begin planning and supporting approaches to address the health issue. *Initiation:* The community initiates activities to address the health issue. *Stabilization:* Community activities receive support from administrators and other leaders. *Confirmation/Expansion:* Activities have been implemented, and the community is comfortable with addressing the health issue. *High Level of Community Ownership:* Data supporting efforts are gathered, and the approach may be replicated in other communities. By recognizing and progressing through these stages, the Community Readiness Model provides a framework for communities to assess and enhance their preparedness to tackle specific health issues. (**Barbara A. Israel and Gary R. Anderson**)

Precede-Proceed Model: It is an inclusive framework designed for evaluating health needs and developing, implementing, and assessing health promotion and other public health programs to address those needs. PRECEDE offers the organizational structure for strategically planning a specific and concentrated public health program. On the other hand, PROCEED provides the structural framework for the effective implementation and evaluation of the public health program. Together, these components form a comprehensive approach to the planning, execution, and evaluation of health programs to ensure they effectively address identified health needs. (**Lawrence W. Green, Marshall W. Kreuter [1974]**)

> PRECEDE, an acronym for Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation, encompasses a systematic approach to community assessment. This involves: **Social Assessment:** Identifying the social problems and needs within a population, with a focus on defining desired outcomes. **Epidemiological Assessment:** Recognizing health determinants related to identified issues, prioritizing and establishing goals accordingly. **Ecological Assessment:** Analyzing behavioural and environmental determinants that influence and support identified behaviours and lifestyles. This includes pinpointing administrative and policy factors that impact implementation. **Matching Interventions:** Aligning appropriate interventions with identified factors to encourage desired changes and outcomes. **Implementation of Interventions:** Executing the selected interventions to facilitate the anticipated changes in the community.
> In essence, PRECEDE provides a structured process for identifying, prioritizing, and addressing health issues within a community, integrating various assessments and interventions for effective health program planning and implementation.
>
> PROCEED, denoting Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development, focuses on program implementation and the identification of desired outcomes. The process involves designing interventions, assessing resource availability, and implementing the program. Subsequently, the model includes process evaluation to determine if the program effectively reaches the target population and achieves desired goals. Additionally, impact evaluation assesses changes in behaviour resulting from the program. Finally, outcome evaluation gauges whether there is a decrease in the incidence or prevalence of identified negative behaviour or an increase in identified positive behaviour. In essence, PROCEED guides the entire process from program design to outcome evaluation, ensuring a comprehensive approach to educational and environmental development.

Rural Clinical Models for Health Promotion and Disease Prevention: Healthcare providers and facilities play a crucial role in enhancing the health of rural residents, utilizing various strategies and theories discussed in this module to improve patient outcomes. In rural healthcare settings, clinical models supporting systems change and innovative care delivery has been adopted, particularly in managing and preventing chronic conditions and diseases. One such model is Chronic Disease Management, exemplified by the Chronic Disease Self-Management Program. This workshop, conducted over six weeks for two and a half hours each week, takes place in community settings such as senior centres, churches, libraries, and hospitals. Attendees, dealing with various chronic health issues, benefit from sessions facilitated by trained leaders, including non-health professionals with chronic diseases themselves. The program covers diverse subjects, ranging from techniques to cope with frustration, fatigue, pain, and isolation, to exercises for strength and flexibility, appropriate medication use, effective communication with family and health professionals, nutrition, decision-making, and evaluating new treatments. This model exemplifies a comprehensive approach to empowering individuals in rural areas to manage their health effectively.

Workplace Model for Health Promotion and Disease Prevention: Health promotion and disease prevention programs, commonly known as worksite wellness programs, can be advantageous for rural workplaces. Wellness, viewed as an active decision-making process contributing to positive health behaviours and outcomes, is a key focus. Research indicates that worksite wellness programs bring about a positive impact on the overall workforce by enhancing employee wellness, increasing productivity, improving employee retention, and reducing absenteeism. Moreover, these programs have demonstrated efficacy in decreasing the costs associated with injury and illness. In addition to workplaces, similar models are applied in rural communities to seamlessly integrate health and human services, emphasizing the holistic well-being of residents.

Health Belief Model: It serves as a theoretical framework guiding health promotion and disease prevention programs, particularly in explaining and predicting individual changes in health behaviours. Widely adopted, it stands out as one of the most utilized models for comprehending health behaviours. This model emphasizes key elements centred on individual beliefs about health conditions, which in turn predict health-related behaviours. The influential factors identified by the Health Belief Model include an individual's perceived threat of sickness or disease (perceived susceptibility), belief in the severity of consequences (perceived severity), recognition of potential positive benefits from taking action (perceived benefits), acknowledgement of barriers to action,

exposure to factors prompting action (cues to action), and confidence in the ability to succeed (self-efficacy). Originally developed in the 1950s to understand factors influencing the use of preventive services, the Health Belief Model has evolved to address contemporary concerns in prevention, detection, and lifestyle behaviours, spanning sexual risk behaviours to injury prevention. Emphasized by **Glanz et al. (1997)**, it remains a cornerstone in health education and promotion. The model's central tenet asserts that individuals' beliefs regarding their susceptibility to disease and their perceptions of the benefits of preventive action significantly influence their willingness to engage in such actions. Core constructs encompass perceived health problems, susceptibility and severity, benefits and barriers, cues to action, and self-efficacy. Particularly applicable in prevention-related and asymptomatic health concerns, the Health Belief Model finds frequent use in areas like early cancer detection and hypertension screening, where beliefs play a pivotal role, often surpassing overt symptoms. **(Irwin M. Rosenstock, Godfrey M. Hochbaum, Kegels, Nancy Krieger, Judith Becker Niditch and Victor J. Strecher)**

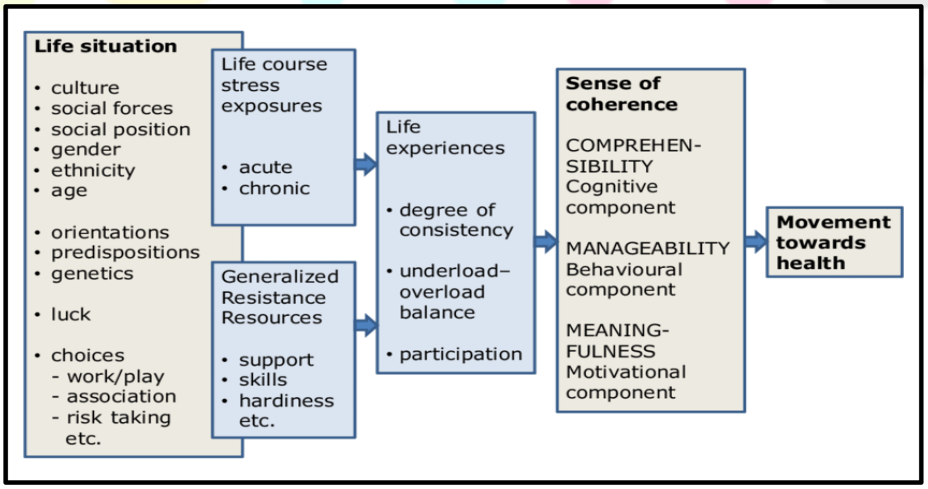
Stages of Change Model: It also known as the Transtheoretical Model, outlines an individual's readiness to alter behaviour through distinct stages: Pre-contemplation, where there is no intention of action; Contemplation, involving intentions and a plan for future action; Preparation, indicating intention and initial steps; Action, when behaviour has changed briefly; Maintenance, where changed behaviour is sustained long-term; and Termination, signifying no desire to return to prior negative behaviours. This model provides a structured framework for understanding and facilitating successful transitions in behaviour change. **(James O. Prochaska [1942-2023] and Carlo C. DiClemente [])**

Biopsychosocial Model: Evidence supporting the application of the biopsychosocial model dates back to ancient Asian (2600 BC) and Greek (500 BC) civilizations. The model was later theorized by psychiatrist George L. Engel, who emphasized the simultaneous consideration of biological, psychological, and social dimensions in understanding and treating patients. While acknowledging the importance of the biomedical model, Engel criticized its narrow focus on patients as objects. Theodore Millon furthered research on the biopsychosocial model, developing a systematic approach to clinical presentations in various treatment settings. The model posits that complex phenomena have multiple causes and asserts that biological, psychological, and social factors collectively play a significant role in human functioning within the context of disease or illness. Health, according to this model, is best understood through the interplay of these factors, contrasting with the traditional biomedical model. Modern neuroscience supports this perspective by highlighting the interconnectedness of the brain and behaviour, emphasizing that psychological and sociocultural phenomena are represented in the brain through structural changes. Neuroscience does not seek to reduce all phenomena to neurotransmission but acknowledges the ongoing significance of psychological and sociocultural events in mental health and illness. For instance, a stressful life event like receiving a cancer diagnosis triggers immediate biological changes with subsequent psychological, biological, and social consequences, illustrating the intricate interplay within the biopsychosocial model, particularly evident in breast cancer patients. (**George L. Engel (1913–1999)**)

Differences between **The Biomedical Model** and **The Biopsychosocial Model** are highlighted in the table given below:

	Biomedical Model	Biopsychosocial Model
Considering factors	Only takes account of biological	Takes account of biological, factors. psychological and social factors.
Views on what causes illness	All physical factors - pathogens, injury, physiological change.	Multiple factors - physical, social and psychological.
Patient responsibility	No responsibility on the patient, because all factors are out of the patient's control.	There is patient responsibility because lifestyle has an influence.
Treatment Style	Bodily interventions only.	Whole person themes, mind and body.
Responsible for treatments	Doctor only.	Doctor and patient combined.
Role of psychology	No relationship with physical illness.	Causal influence and consequence of physical illness.

Salutogenic Model: The model developed by **Aaron Antonovsky (1923–1994)** revolves around comprehending the factors contributing to human health and well-being. Central to this model are key elements such as the "sense of coherence," which comprises comprehensibility, manageability, and meaningfulness, along with generalized resistance resources (GRR) and the acknowledgement of life stressors. The model accentuates the health continuum, emphasizing an individual's capacity to make sense of and successfully cope with challenges. With practical applications in public health and healthcare, this model guides interventions to enhance well-being by fortifying the sense of coherence and utilizing available resources effectively.



***Source**: Benz, Carina et al. (2014).*

Ecosystem Model of Health: The ecosystem model of health represents a holistic approach that considers the intricate interplay of various factors influencing an individual's well-being within a broader environmental context. Drawing parallels between ecological principles and health dynamics, it underscores the interdependence of biological, psychological, social, and environmental elements. Key components of this model include recognizing individual uniqueness, the microsystem involving immediate social environments, the mesosystem examining interactions between different microsystems, the exosystem incorporating external settings, the macro system encompassing broader cultural and societal influences, and the chronosystem integrating the dimension of time and life transitions. Emphasizing dynamic and reciprocal relationships across these levels, the model highlights how changes in one part of the system can ripple through the entire ecosystem, influencing health outcomes. Widely employed in public health and community interventions, it guides efforts to create supportive environments that promote health and well-being across multiple interconnected levels, transcending a focus solely on individual behaviours. Certainly, health-related studies encompass a diverse array of topics, and researchers employ various models to explore, analyze, and predict different aspects of health and healthcare. Some commonly used types of models in health-related studies include:

Epidemiological Model plays a pivotal role, particularly the SIR (Susceptible-Infectious-Recovered) model, designed to analyze the spread of infectious diseases within populations. An extension of this model is the SEIR (Susceptible-Exposed-Infectious-Recovered) model, which introduces an exposed compartment to account for individuals not yet infectious. Additionally, compartmental models are commonly used, categorizing the population based on health status and modelling transitions between these compartments. These models provide essential frameworks for understanding and predicting the dynamics of infectious diseases, aiding researchers and public health professionals in assessing the transmission and impact of diseases within populations. Some notable epidemiological models include: Koch's Postulates (Henle-Koch Postulates), Web of Causation Model, Agent-Host-Environment Model, Chain of Infection Model, Ecological Model, Dose-Response Model,

Machine Learning Model plays a crucial role. Predictive models forecast disease outbreaks and patient outcomes, while classification models identify patterns to categorize patients and diagnose diseases. Regression models analyze variable relationships for predicting disease progression, and Natural Language Processing (NLP) models extract information from healthcare documents. These models offer versatile tools for analysis and prediction in healthcare research, enhancing insights and predictions based on diverse datasets.

Health Economic Model includes cost-effectiveness models, which evaluate the cost-effectiveness of various healthcare interventions, and budget impact models, which assess the financial implications of adopting new healthcare technologies or treatments.

Simulation Model in health studies encompasses agent-based models, which simulate individual agents like patients or healthcare providers and their interactions to study the emergence of health-related phenomena. Additionally, Monte Carlo Simulation is employed for probabilistic modelling and analysis of complex health systems and processes.

Genetic Model in health research includes Genome-Wide Association Studies (GWAS), which explore the link between genetic variations and the risk of developing specific diseases. Population genetics models are utilized to study the distribution and changes in genetic variations within populations.

Biostatistical Model in health research includes Survival Analysis, which models time-to-event data, often applied in studies involving patient survival. Another model is Meta-Analysis, which combines results from multiple studies to draw more comprehensive conclusions.

Public Health Model encompasses the Health Impact Assessment (HIA), which evaluates the potential health effects of policies, projects, or programs. Community health models focus on examining factors influencing the health of specific communities.

The versatility of these models allows their application across diverse health-related disciplines such as epidemiology, medicine, public health, genetics, and healthcare management. They serve to gain insights, make predictions, and inform decision-making. The selection of a particular model depends on the specific research question and the available data for a given study.

Ecological Model: A Guide for Health Promotion and Practice frames the ecological perspective as *"...the interaction between, and interdependence of, factors within and across all levels of a health problem. It highlights people's interactions with their physical and sociocultural environments."*. Ecological models in health behaviour analysis consider multiple levels of influence. Intrapersonal or individual factors, such as knowledge and attitudes, shape individual behaviour. Interpersonal factors involve interactions with others, providing social support or creating barriers to healthy behaviour. Institutional and organizational factors encompass rules, policies, and structures that can either constrain or promote health. Community factors, like social norms, impact behaviours within groups, while public policy factors, including laws and policies at various levels, regulate or support health actions, especially in disease prevention and management. The application of these models allows for a comprehensive understanding of health behaviours, recognizing the intricate interplay of factors at different levels.

Environmental Health Behaviour Model: The environmental health behaviour model centres around an individual maximizing utility from health (H) and a bundle of goods and services (X), constrained by full income in both the current (X_0) and future (X_1) periods. Health in the present (H_0) and various personal, household, and community-level characteristics (Z_y), including local environmental quality, are predetermined. Future health (H1) is influenced by these characteristics, public services (Z_y), and preventive actions ($X_{H,0}$) taken in the present at a price pH. Investing in environmental health reduces current utility (V_0) by reducing consumption of other goods (X_0) but enhances future utility (V_1) by improving future health (H_1). The present value of future utility (V_1) is discounted by a factor (δ) determined by the personal discount rate (ρ), influenced by intrinsic characteristics and economic conditions ($Z\rho$). The common functional form for δ is constant exponential discounting: $\delta=e^{(-\rho \cdot t)}$, where ρ is a constant discount rate. The utility function is applicable in both periods.

$$V = V_0 + \delta V_1 = V_0 X_0 - p_H X_{H,0}, H_0, Z_y + \delta \rho(Z_\rho) \cdot V_1 X_1, H_1(X_{H,0}), Z_y$$

and the first-order conditions for utility maximization yield

$$0 = -p_H \frac{\partial V_0}{\partial X_{H,0}} + \delta \cdot \frac{\partial V_1}{\partial H_1} \cdot \frac{\partial H_1}{\partial X_{H,0}}.$$

The first-order conditions (2) indicate that households equate the marginal value of reduced current consumption to the discounted marginal value of increased future health. Decisions regarding environmental health behaviours are contingent upon factors such as their current cost, marginal productivity concerning future health, the marginal utilities of present consumption versus future health, and personal discount rates. All these variables are influenced by exogenous characteristics denoted as Zy. Since the future utility function is unknown at the time of decision-making, realistic expectations about the future marginal utility of health and the marginal productivity of behaviour become crucial. This implies that choices related to investing in environmental health behaviours are likely shaped by beliefs about disease prevention, access to information, income constraints, and public services, which may either complement or substitute for private environmental health behaviours, in addition to personal discount rates **(Atmadja et al. 2017)**.

V. Economic Valuation Techniques on Human Health

Quantifying the impacts of environmental degradation on human health is crucial for informed health policy development. Various valuation studies worldwide have addressed environmental risks to public health, employing revealed and stated preference techniques. Revealed preferences, utilizing observable market information, include cost of illness, human capital surveys, hedonic pricing, and Quality Adjusted Life Year studies. Stated preferences, and constructing the market through questionnaires, involve methods like Contingent Valuation (CVM) and Choice Experiments (CE). Cost of illness studies measure direct and indirect economic costs associated with a disease, estimating potential savings from disease eradication. Human capital surveys gauge productivity loss due to illness, valuing life based on foregone earnings from premature mortality. General equilibrium macroeconomic modelling provides damage cost estimates from environmental hazards at the national or international level, assessing welfare impacts on parameters like income and consumption across all economic sectors.

Quality Adjusted Life Year (QALY) studies assess both the quality and quantity of life, assigning values from 0 (death) to 1 (perfect health) for a Life Year. This allows QALYs to indicate the benefits of healthcare interventions in terms of health-related quality. By considering intervention costs, a cost-effectiveness analysis (cost per QALY) facilitates comparisons of different interventions. Monetizing QALYs enables a dollar value estimation for health interventions or policies, supporting subsequent cost-benefit analysis. Stated Willingness to Pay, often obtained through contingent valuation or discrete choice studies, is a common method to monetize QALYs. Other approaches include time-trade-offs, standard gambling, and the visual analogue scale. Hedonic pricing methods examine differences in housing prices or wages in polluted vs. unpolluted areas or hazardous vs. non-hazardous jobs, reflecting the value individuals place on avoiding health damages.

Stated preference approaches, such as the Contingent Valuation Method (CVM) and Choice Experiments (CE), differ in how economic values are elicited. In CVM, respondents are presented with a scenario describing changes resulting from the policy under evaluation and asked about their maximum Willingness to Pay for its implementation. Based on Lancaster's theory of value, choice experiments describe the good in terms of attributes and levels, including price. Respondents choose their preferred option from sets of alternatives with different attribute combinations, allowing the evaluation of the marginal value of attributes in monetary terms. Choice experiments can also assess policy implications by considering policy impacts as attributes to be valued.

To value health damage, establishing a dose-response function linking pollutant concentrations to health impacts is essential. Initial considerations include the impacts of environmental degradation on mortality, expressed as an increase in the probability of premature death, and on quality of life, represented by a reduction in morbidity risk. Respondents are then asked about their Willingness to Pay for a prevention scenario (stated preference approach) or benefits are assessed through the costs saved if the risk is eradicated (cost of illness studies). The Value of Statistical Life (VSL) is calculated by dividing the value of a small risk change by the actual change in risk, capturing the effect of small risk changes on the risk of premature death for a large population.

As primary data collection for dose-response functions and valuations can be resource-intensive, benefit transfer techniques are employed to use original values from existing studies and adapt them to policy sites after adjusting for certain parameters. Meta-analyses, which analyse and synthesize valuation estimates from multiple studies, have been conducted to examine the determinants of these estimates. In a meta-analysis regression, the dependent variable is a common summary statistic, such as a predicted variable for Willingness to Pay, while independent variables include characteristics of the primary data, study design, valuation method, sample size, model specification, econometric methods, and date of publication. This approach allows for the establishment of value transfer functions to estimate values for policy sites based on properly adjusted information from existing studies on similar sites.

Each method for valuing health impacts has its inherent strengths and limitations, and the choice between them should be driven by the specific case study's data availability and socio-economic-political framework. For example, human capital surveys may face challenges in assigning wages for housework or non-cash labour, and hedonic methods require a well-functioning market for housing or labour that internalizes health risks. The cost-of-illness approach may underestimate the full damage of illness, as it may not capture psychological suffering and physical pain. Using Quality Adjusted Life Years (QALYs) for estimating damage costs may also lead to underestimations, and opponents argue that these measures may not appropriately represent individual preferences for health. Additionally, QALYs ignore distributional effects related to the dependence of Willingness to Pay (WTP) on income. Macroeconomic modelling, while providing a broad perspective, often relies on simplistic assumptions about the economy, and many impacts may be unquantifiable and thus not adequately modelled.

The Contingent Valuation Method (CVM), while widely used, faces criticisms related to its reliability, including issues such as hypothetical bias, strategic bias, yes-saying bias, and embedding effect. Hypothetical bias suggests that respondents may not accurately know their values without participating in an actual market. Strategic bias occurs when respondents deliberately under or overstate their Willingness to Pay (WTP), influenced by expectations about the actual fees they might pay or the hypothetical nature of the exercise. Yes-saying bias reflects a tendency to express positive WTP due to the act of giving for social good rather than the perceived importance of the good itself. Embedding bias suggests that WTP is not affected by the scale of the good being offered. To address these challenges, the Blue Ribbon Panel under NOAA has proposed best practice guidelines for designing and implementing contingent valuation studies.

Comparing methods for environmental valuation, **Boxall (1996)** assert that choice experiments (CEs) offer significant advantages over other valuation techniques due to their experimental nature. CEs allow the representation of different environmental states through attributes and levels in specific choice situations. This experimental approach has a distinct advantage as it prompts respondents to explicitly make trade-offs among various attributes, providing policymakers with valuable insights into public preferences for diverse environmental conditions. This explicit consideration of environmental health effects enables the explicit assessment and valuation of policy or project impacts. Both the Contingent Valuation Method (CVM) and CEs represent preferences consistent with utility theory, with CEs addressing some biases present in CVM. Therefore, the authors suggest that the application of CEs should be further emphasized in health economics for evaluating the health impacts of environmental policies **(Remoundou and Koundouri, 2009)**.

VI. Conclusion

The significance of environmental health cannot be overstated. It plays a vital role in reducing the likelihood of diseases, enhancing the overall quality and length of life, conserving biodiversity, and mitigating the impacts of global warming. To gain a comprehensive understanding of this field, experts in various disciplines, including environmental economics, community medicine, and environmental engineering, have developed different models. These models assist in comprehending the production and disposal of pollutants, their effects on affected populations, and the connection between exposure to pollutants and health outcomes. Environmental health encompasses a wide range of scientific fields, such as epidemiology, toxicology, environmental science, and engineering, which collaborate to tackle the complex challenges posed by environmental factors on human health. By comprehending and addressing these challenges, we can strive to create a healthier and safer environment for everyone. Environmental health is a crucial aspect of public health as it focuses on the interaction between humans and their surroundings. Early pioneers in this field, such as **Paracelsus (1493-1541) and Goethe (1749-1832)**, recognized the importance of this relationship in promoting human well-being and establishing secure communities. To fully grasp the scope of environmental health, it is essential to consider seven fundamental concepts: toxicity, exposure, dose/response, individual susceptibility, risks and benefits, environmental justice, and community resources and action. The aforementioned models indicate that the health of individuals and society is paramount for improving economic, social, and human capital, which are essential for achieving sustainable development goals related to societal health.

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