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Addressing the Double Burden of Infectious and Non-Communicable Diseases: A Public Health Perspective

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Abstract:

The interactive presence of infectious diseases (IDs) and non-communicable diseases (NCDs), often known as the so-called double burden of disease, has become a critical and complicated issue of global population health, especially in low- and middle-income countries (LMICs). This review is a critical analysis of epidemiological transition, determinants underlying it, biological interactions, and systemic challenges of this dual burden. Although the majority of global mortality is nowadays associated with NCDs, infectious diseases remain within the population, including tuberculosis, HIV/AIDS, and emerging infections, which present an overlapping and interacting disease burden. These conditions are interconnected by the similarities of risk factors such as poverty, high rates of urbanisation, environmental exposures, and lifestyle changes as well as by biological processes which intensify the progression and outcome of diseases. The review also identifies some of the important health system challenges such as fragmented service delivery, lack of resources, shortages of the workforce, and lack of proper surveillance systems to effectively manage co-morbid conditions. The health outcomes to the population are immense, including morbidity and mortality, economic burden, and productivity. The solutions to the double burden are people-centred, which involve integrating prevention, early detection, and coordinated care in the context of enhanced primary healthcare. To address the overall determinants of health and secure sustainable changes in population health outcomes, there is a need to adopt policy-based, multi-sectoral strategies.

Keywords: Double burden of disease; Infectious diseases; non-communicable diseases; Epidemiology; Integrated care

1. Introduction

The world health has experienced a radical change over the last several decades with a shift in the major disease burden towards non-communicable diseases (NCDs). But this shift has been unequal among the regions especially in the low and middle-income countries (LMIC) where infectious diseases are still rife and NCDs are rapidly on the rise. Consequently, numerous nations are currently faced with the so-called double burden of disease, i.e., infectious diseases, including tuberculosis (TB), HIV/AIDS, and respiratory infections, alongside chronic ones, including diabetes, cardiovascular diseases, and cancer (Ong et al., 2021; World Health Organization [WHO], 2025). Such a two-fold load is not only an outcome of epidemiological transition but rather a phenomenon with strong structural preconditions and socioeconomic determinants. Traditionally, the health systems of LMICs were focused on responding to acute infectious diseases, and vertical programs were aimed at the particular conditions. Nevertheless, the swift increase of NCDs has revealed the weak sides of these systems that are not always able to offer the long-lasting and interdisciplinary treatment of chronic illnesses (Bukhman et al., 2015). NCDs are on the rise and have a close relationship with urbanisation, ageing of the population, and lifestyle modifications, such as unhealthy diets, sedentary lifestyle, tobacco use, alcohol use (Miranda et al., 2008). The COVID-19 pandemic also demonstrated that infectious diseases and NCDs are interconnected. The pandemic has had a huge impact on the health system disruptions, and people with underlying NCDs were disproportionately affected by COVID-19 (Fekadu et al., 2021; Sanyaolu et al., 2020). Through these interactions, the ineffectiveness of disease-specific methods and the necessity of integrated public health methods are highlighted (Yismaw et al, 2025). Syndemics is one of the concepts that can help to comprehend this complexity because it acknowledges that diseases do not exist in a vacuum but instead interact within a particular social, economic, and environmental environment, which is often compounded by inequality (Horton, 2020; Mendenhall, 2020). To solve the double burden, therefore, one needs to take an all-inclusive approach that is based on the integration of epidemiological knowledge, health system strengthening, and policy interventions.

Objectives of the Review:

1. To examine the epidemiological trends and distribution of infectious and non-communicable diseases contributing to the double burden, with a focus on low- and middle-income countries.
2. To analyse the biological, clinical, and socio-environmental interactions between infectious diseases and NCDs, including shared risk factors and syndemic relationships.
3. To evaluate current public health strategies and propose integrated, evidence-based approaches for addressing the double burden through health system strengthening and policy interventions.

2. Epidemiology of the Double Burden

2.1 Epidemiological Transition and Changing Disease Patterns

The burden of disease in the world over the last thirty years has been experiencing a fundamental change characterized by a dramatic shift in the non-communicable diseases (NCDs) as opposed to communicable diseases. As the Global Burden of Disease (GBD) Study 2021 indicates, the term NCDs covers cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions, and today, they represent the main cause of mortality and disability-adjusted life years (DALYs) in the world (Ong et al., 2023). This shift is indicative of the enhancement of the management of numerous infectious diseases by vaccination, antimicrobial treatment, and population health, as well as demographic shifts in the ageing of the population and prolonged life expectancy.

2.2 Persistence of Infectious Diseases in LMICs

The burden of disease in the world over the last thirty years has been experiencing a fundamental change characterized by a dramatic shift in the non-communicable diseases (NCDs) as opposed to communicable diseases. The NCDs (cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions) comprise the greatest portion of the global mortality and disability-adjusted life years (DALYs) according to the Global Burden of Disease (GBD) Study 2021 (Ong et al., 2023). This shift is due to the rise in the management of most infectious diseases through vaccination, antimicrobial therapy, as well as the implementation of public health measures, and the demographic factors of ageing of the population and longer life expectancy.

2.3 Role of Behavioural and Metabolic Risk

Factors

The growing pre-eminence of NCDs is directly interconnected with the change of behavioural and metabolic risk factors. The use of tobacco, unhealthy eating habits, sedentary lifestyles, and high blood pressure have become significant contributors to the disease burden in the world (Brauer et al., 2024). Despite the fact that some consumption decreases in smoking rates have been achieved due to global tobacco control efforts, the forecasts show that tobacco use is still projected to remain a major cause of disease burden without more vigorous policy interventions (GBD 2021; Tobacco Forecasting Collaborators, 2024). Likewise, the world obesity and metabolic epidemics are indicative of broader food systems, urban living, and socioeconomic transformation.

2.4 Blurring Boundaries Between Infectious Diseases and NCDs

Notably, the demarcation between the infectious and non-communicable diseases is increasingly becoming blurred with an ever-growing body of evidence that indicates that a considerable percentage of the non-communicable diseases are attributable to infectious etiologies. As an example, infections contribute to a significant proportion of cancer occurrence on the world level, specifically when it comes to viral-related cancer like cervical and liver cancer (Coates et al., 2020). The overlap of this nature is what highlights the importance of disease pathways being interconnected and the need to have an integrated approach to the prevention and control of diseases.

2.5 Epidemiological Context in LMICs

IThe dual burden of disease is greatest in the low- and middle-income countries (LMICs) as the population health is being redefined by the rapid demographic, epidemiological and socioeconomic transitions that are occurring. Infectious diseases are also endemic in such environments because of the sustained problems of poor sanitation, overpopulation, and accessibility to healthcare to the timely diagnosis and treatment of both the infectious and non-communicable diseases among many populations especially in rural and underserved regions (Table 1). Such a services. Tuberculosis remains one of the most significant social health issues and the prevalence of the disease is reported to be high in multiple areas despite the current global efforts to control the problem (Lee et al., 2025; Yismaw et al., 2025). On the same note, lower respiratory infections are currently the cause of significant morbidity and mortality, especially in children, the elderly, and immunocompromised groups (Wang et al., 2024).

2.6 Rising Burden of NCDs in Transitioning Societies

Meanwhile, non-communicable diseases are rapidly increasing in LMICs due to urbanization and industrialization and lifestyle change. Lifestyle alterations, such as eating more processed food rich in sugars, fats, and salt and engaging in less physical activity, have played a role in the rising cases of high blood pressure, obesity, and diabetes (Zhou et al., 2021). Such trend is especially clear in such countries like India, where economic growth and urbanisation have changed the conditions of living and health behaviour greatly.

2.7 India as a Case Study of the Double Burden

India is also a clear case of such a dual burden since it is still plagued by high rates of infectious diseases and a growing burden of NCDs. The combination of all these conditions is further complicated by the regional differences, where there are still regions that are still grappling with the outbreak of infectious diseases and there are those that are more dominated by chronic diseases. This heterogeneity is related to socioeconomic status disparities, access to healthcare, and environmental disparities within states and populations.

2.8 Health System Inequalities and UHC Challenges

The Universal Health Coverage (UHC) is still not achieved evenly, restricting access to the necessary health services and increasing health outcomes inequalities (WHO, 2024). There are numerous barriers

fragmented healthcare system is very challenging to the health systems trying to effectively react to dual burden, so more integrated and equitable models of service delivery are needed.

Table 1: Global Burden and Epidemiological Transition of IDs and NCDs

Indicator	Infectious Diseases (IDs)	Non-Communicable Diseases (NCDs)
Global Trend	Declining but persistent	Rapidly increasing

Major Diseases	TB, HIV/AIDS, respiratory infections	CVDs, diabetes, cancer
Geographic Burden	LMICs	Global (increasing in LMICs)
Mortality Contribution	High in LMICs	Majority of global deaths
Key Drivers	Poverty, sanitation, and infections	Lifestyle, ageing, urbanisation
Transition Pattern	Declining in HICs	Rising globally
Interaction	Can lead to NCDs (e.g., infections → cancer)	Increase infection susceptibility

3. Demographic and Socioeconomic Patterns

3.1 Socioeconomic Inequalities and Disease Vulnerability

Demographic and socioeconomic factors greatly affect the distribution of the double burden of disease by determining the exposure to the threat and access to healthcare. The poorer populations are more affected as they have higher exposure to the determinants of infectious diseases like poor housing conditions, poor sanitation and access to clean water. Simultaneously, these populations have become more susceptible to the risk factors of NCD such as poor diets, occupational risk, and reduced physical activity possibilities. The combined risk profile of this dual exposure is that underprivileged groups are exposed to both communicable and non-communicable health risks at the same time.

3.2 Age Dynamics and Shifting Disease Patterns

Age also has the significant influence on the patterns of disease. Although infectious diseases are generally linked with the younger population, NCDs tend to be common in older adults. This difference is however becoming less apparent in LMICs and NCDs are more and more being diagnosed at younger ages because of early exposure to behavioural and environmental risk factors. This epidemiological change leads to the length of the disease, greater health care demands, and greater lifetime economic impact which exerts additional pressure on individuals and health systems.

3.3 Urban–Rural Disparities in Disease Distribution

The complexity of the double burden is further revealed by the urban rural differences. As a result of the density of population in the city, especially the informal settlements and slums, there is increased exposure to infectious diseases and NCD risk factors. Poor sanitation and overcrowding would be promoting the spread of infectious diseases and urban lifestyles would make people sedentary and shift their diets and be exposed to environmental pollutants. Conversely, rural residents are commonly affected more by infectious diseases because of the lack of healthcare, health literacy, and infrastructure, although NCDs are slowly taking over because of changing lifestyle trends and the spread of risks (Yusuf et al, 2021).

3.4 Syndemic Clustering and Health Inequities

The syndemic framework offers useful information on the way these conditions are concentrated among vulnerable groups and are a result of mutual social, economic, and environmental determinants (Singer et al., 2017). Overlapping exposures to risk factors in the urban slums, under-serviced rural areas, compound the health burdens, increasing morbidity, mortality, and increasing health disparities (Figure1). These trends highlight the need to focus on not just on the diseases but on the determinants of health such as poverty, inequality, access to healthcare services among others.

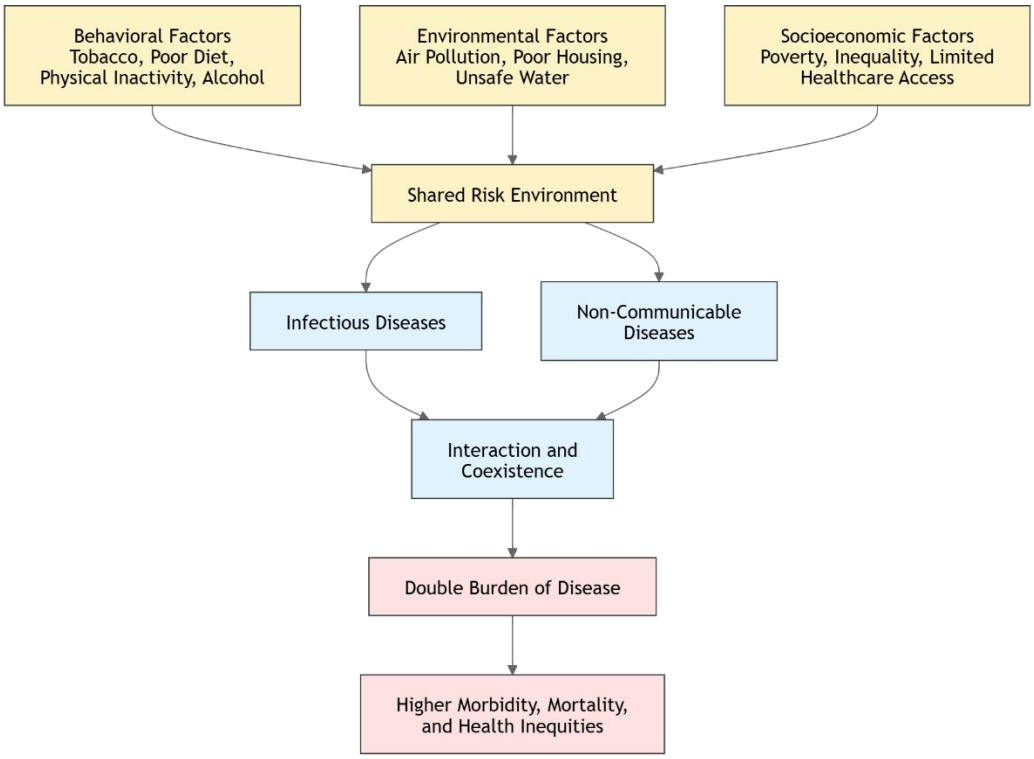

Figure 1: Shared Risk Factors Pathway

4. Interactions Between Infectious Diseases and NCDs

The interdependence between infectious diseases (ID) and non-communicable diseases (NCD) is now being acknowledged as two-way, multifaceted and highly interrelated. These diseases are not independent categories, but rather they interact in biological, clinical, and socio-environmental ways causing the compounding of health risks and more adverse outcomes. This interaction is also associated with the overall disease burden, especially in low and middle income countries (LMICs) where people tend to be subjected to both overlapping risk factors and health system constraints. These interactions are the key to understanding the development of integrated public health strategies and enhancing disease prevention and management.

4.1 Biological Interactions

4.2 Infectious Etiologies of Non-Communicable Diseases

The direct and well-established role of infectious diseases in the pathogenesis of various non-communicable diseases is especially in the case of chronic infection, dysregulation of the immune system, and the chronic destruction of tissues. Infectious agents are responsible to a large percentage of the cancer incidence in the world. As an illustration, chronical infection with human papillomavirus (HPV) is the leading cause of cervical cancer, and chronic infections with hepatitis B and hepatitis C virus are the major risk factors of hepatocellular carcinoma (De Martel et al., 2020; Parkin et al., 2020). These infections activate carcinogenic events by means of genomic instability, persistent inflammation and immune evasion.

4.3 Chronic Infections and Organ-Specific Disease Burden

In addition to cancer, chronic infections may cause progressive and organ damage as well as systemic disease. Chronic liver disease, encompassing cirrhosis and liver failure, is a major health burden in the world, and its occurrence is a major contributor of chronic liver disease due to long-term viral infections (Devarbhavi et al., 2023). In the same vein, infectious and genetic interactions are factors

that lead to chronic kidney disease, especially in groups with high susceptibility to the condition caused by environmental and socioeconomic factors (Yusuf et al., 2021).

4.4 Inflammation as a Linking Pathway Between IDs and NCDs

Moreover, chronic infections tend to cause long-term inflammatory reactions, which are becoming a well-known pathway connecting infectious diseases with NCDs. Stable inflammation may cause endothelial dysfunction, metabolic changes, and immune system changes, all of which result in the occurrence of cardiovascular diseases, diabetes, and other chronic illnesses. This biological continuum points to the fact that infectious exposures, particularly those that are unsolved or repeated may have far reaching consequences even beyond the initial infection.

5.NCDs Increasing Infection Risk

5.1 Immunological Mechanisms Linking NCDs to Infection Susceptibility

The interplay between infectious and non-communicable diseases is also observed in the opposite direction, in which underlying chronic conditions predispose to infections and aggravate the outcomes of the disease. One of the most outstanding examples of this connection is diabetes mellitus. In diabetes, the innate and adaptive immune response is defective, as the macrophages are weakened, and the cytokine functions are disturbed, making it hard to contain the infection. Consequently, diabetes is one of the primary factors contributing to the active development of tuberculosis (TB), is linked to the delayed diagnosis and the increased bacterial loads, and worse treatment outcomes (Foe-Essomba et al., 2021).

5.2 Epidemiological Overlap of Diabetes and Tuberculosis

The interrelationship between diabetes and TB has emerged as an issue of great concern to the general population, mostly in LMICs where the prevalence of both diseases is very high. Research has shown that the percentage of TB patients with diabetes is high, which means that there is an increasing level of overlap between the two diseases among populations (Noubiap et al., 2019). This site of overlap not only makes the clinical management tricky, but also it risks treatment failure, relapse, and mortality. This, therefore, has prompted the adoption of combined screening measures (including regular diabetes screening of TB patients) to enhance early detection and control (Gujral et al., 2026).

5.3 Broader Implications for Multimorbidity and Infection Risk

On a larger scale, patients with NCDs are usually more susceptible to infections because of the presence of chronic inflammation, dysfunction of the body organs, and the impact of prolonged medication. Such physiological alterations compromise host defence and make one more vulnerable to a broad spectrum of infectious pathogens. It is this vulnerability that underscores the necessity to include NCD management into infectious disease control approaches and the reverse with a focus on integrated, patient-centred care approaches.

5.4 Conceptual Framework of Syndemics

Syndemics concept offers a holistic approach to the explanation of the interaction between infectious diseases and NCDs in the context of social and environment at large (Figure 2). A syndemic is the association of two or more diseases that behave in a synergistic manner in a population, which is precipitated by common social determinants, including poverty, inequality, and inaccessibility to healthcare (Singer et al., 2017). The syndemic approach is based on the interplay between the biological interactions and structural conditions unlike the traditional models which focus on the effects of diseases separately.

5.5 Examples of Syndemic Interactions

In the syndemic relationship, diseases like tuberculosis and diabetes are examples of a typical manifestation of the syndrome condition in the context of the double burden. Diabetes predisposes to TB, whereas socioeconomic status, including poor living conditions, malnutrition, and poor access to healthcare contribute to the spread of the disease and poor treatment compliance (Table 2). Likewise, the interplay between HIV and malnutrition shows how biological weakness and social disadvantage interact to increase the adverse health outcomes.

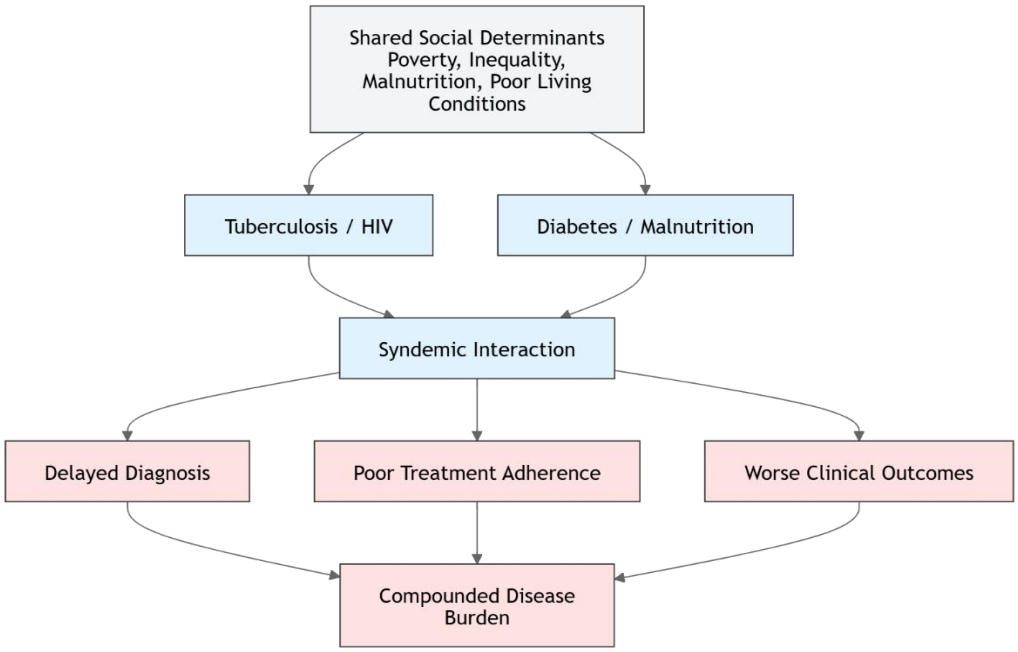

Figure 2: Syndemic Interaction Model

5.6 Syndemics in LMICs and Health System Implications

Syndemics are especially common in LMICs, where people face a number of interacting risks, and health systems might be unable to handle complex and multi-morbidity illnesses. This model emphasizes that to solve the double burden, biomedical interventions are not enough; rather, there is the need to have multifaceted approaches that would both focus on the interactions between diseases and on the social determinants of health.

Table 2: Biological and Clinical Interactions Between IDs and NCDs

Interaction Type	Mechanism	Example	Outcome
Infection → NCD	Chronic inflammation, immune dysregulation	HPV → Cervical cancer	Increased cancer burden
Infection → Organ Damage	Viral persistence	Hepatitis → Liver cirrhosis	Chronic disease
NCD → Infection Risk	Impaired immunity	Diabetes → TB	Higher infection risk
NCD → Severe Outcomes	Organ dysfunction	CVD → Severe COVID-19	Increased mortality
Syndemic Interaction	Social + biological synergy	TB + Diabetes	Compounded burden

6. Shared Risk Factors

6.1 Overview of Shared Determinants

Infectious diseases (IDs) and non-communicable diseases (NCDs) have a dual burden, which is a complex interaction of shared risk factors that act at individual, community, and structural levels. These determinants do not only predispose certain diseases but also contribute to the co-occurrence of diseases and interaction which further increases health risk and makes the disease management more difficult. These common risk factors are important in understanding how to develop integrated and preventive interventions in public health.

6.2 Behavioural and Lifestyle Risk Factors

Risk factors at the behavioural level, which include tobacco use, poor diets, physical inactivity, and detrimental alcohol use, are central to the increasing number of NCDs and also determine susceptibility to infectious diseases. An example, tobacco use is a significant contributor of cardiovascular diseases, chronic respiratory diseases, and cancers, however, it also disrupts immunity and predisposes individuals to infections, including tuberculosis and respiratory diseases. In the same vein, unhealthy lifestyles, which are marked by excessive intake of junk and processed foods, sugar, and unhealthy fats, lead to obesity and diabetes as well as metabolic disorders. The conditions, in their turn, undermine immune defences and precondition severe outcomes of infectious diseases. The increasing international influence of these behavioural and metabolic hazards has been effectively recorded, and their core contribution to the development of the disease patterns is outlined (Brauer et al., 2024).

6.3 Environmental and Structural Determinants

Other than the behaviors of individuals, the environmental and structural factors are important determinants of exposure to infectious diseases as well as NCDs. The dietary behavior and nutritional condition largely depend on food environments especially in fast urbanizing environments. In most LMICs, food that is both affordable and healthy is scarce and instead, the one that offers the highest energy content with the least nutrients is accessible and leads to increased prevalence of diet-related NCDs. Meanwhile, inappropriate living conditions including overcrowding, unsanitary conditions, and access to clean water contribute to the spread of infectious diseases. Experiments in the peri-urban area, like the one in India, show the effect of the food acquisition patterns and environmental limitations on the nutritional outcomes and the long-term health risks (Turner, 2020).

6.4 Poverty, Inequality, and Vulnerability

Some of the strongest underlying determinants of the double burden include poverty and socioeconomic inequality. The poor populations with poor housing, access to healthcare, and the environment are disproportionately exposed to the risks of infectious diseases. At the same time, such populations become more susceptible to the risk factors of NCD, such as unhealthy nutrition, workplace risks, and physical activity. This two-fold exposure causes the cycle of vulnerability where people are exposed to both acute infections and chronic illness. This connection is further illustrated by the example of neglected tropical diseases; since most of them are found in marginalized communities and lead to the long-term disability, it strengthens the relationship between poverty, infection, and chronic health issues (Hotez, 2021).

6.5 Environmental Exposures and Occupational Risks

The double burden is further compounded by environmental exposures such as air pollution and work related hazards. Air pollution is a significant contributor to respiratory and cardiovascular diseases, not to mention that it predisposes one to respiratory illnesses. Equally, there is the risk of getting exposed to dangerous working conditions that may heighten the susceptibility to both infectious and chronic illnesses especially among the low-income groups pursuing informal or high-risk jobs.

6.6 Implications for Public Health Interventions

In general, the common risk factors of the two-fold burden of disease are highly intertwined and embedded in social, economic, and environmental realms. These overlapping determinants do not only contribute to the occurrence of diseases, but also the exacerbation of health inequity, which disproportionately affects the vulnerable groups. The dual burden should be tackled with multi sectoral strategies, thus not focusing on individual level interventions, but improving the living conditions (Table 3), food systems, environmental health, and social protection. These are needed to minimize the disease burden and produce sustainable population health improvements.

Table 3: Shared Risk Factors for IDs and NCDs

Category	Risk Factor	Impact on IDs	Impact on NCDs
Behavioral	Tobacco	↑ TB, respiratory infections	Cancer, CVD
Behavioral	Poor diet	Weak immunity	Obesity, diabetes
Behavioral	Physical inactivity	Indirect	CVD, diabetes

Environmental	Air pollution	Respiratory infections	CVD, COPD
Structural	Poverty	Poor sanitation → infections	Limited healthcare access
Structural	Urbanization	Overcrowding	Lifestyle diseases

7. Health system challenges

7.1 Structural Limitations of Health Systems in LMICs

Low- and middle-income countries (LMICs) have significant and complex problems in dealing with the twofold burden of infectious diseases (IDs) and non-communicable diseases (NCDs) in health systems. The historical design of the health system, resource constraints, and structural inefficiencies are the sources of these challenges, which, in combination, impede the provision of complex and interdisciplinary care. Consequently, most health systems are finding it difficult to respond adequately to the growing complexity of comorbid acute and chronic conditions.

7.2 Fragmentation and Vertical Program Approaches

The fragmentation of health services is one of the most vital problems as systems are still strongly skewed towards vertical and disease-focused programs. Traditionally, infectious disease programs (including those against tuberculosis, HIV/AIDS, and malaria) have been created on the basis of specific funding streams, infrastructure, and training of workforce. Although these programs have been successful in key ways, they are usually vertical and therefore fail to coordinate with the rest of health services. Conversely, NCD care involves long term, continuous management such as frequent monitoring, lifestyle change, and continuous access to drugs. The concurrent nature of these parallel systems introduces inefficiencies, service redundancy, and service gaps especially among people with co-morbidities (Van Olmen et al., 2011).

7.3 Integration Challenges in Service Delivery

The incorporation of the management of NCD within the current infectious disease platforms is both an opportunity and a challenge. Even though the service delivery models of infectious disease programs offer credible service delivery structures which can be capitalized to offer the care of the NCDs, integration of the chronic disease management necessitates a substantial restructuring of the service delivery models. These involve the creation of combined clinical guidelines, cross training of healthcare personnel and the creation of coordinated referral systems. In the absence of this integration, the patients with multiple conditions tend to experience disjointed care pathways, which result in delayed diagnosis, low treatment adherence, and poor outcomes (WHO, 2025).

7.4 Resource Constraints and Infrastructure Gaps

These issues are also worsened by resource constraints. The LMICs have scarce financial capacity and resources that are forced to be distributed among competing health priorities. Programs on infectious diseases are also usually externally funded and the NCD programs are usually underfunded leading to unequal services. Inadequate infrastructure, lack of diagnostic capacity and unreliable supply chains of important medicines limit the capacity of the health systems to effectively control both types of disease especially in rural and underserved regions.

7.5 Workforce Shortages and Capacity Limitations

The other significant issue is the lack of healthcare workforce and their unbalanced distribution. Most LMICs have shortages of trained healthcare workers, such as physicians, nurses and allied health workers. The current personnel is in many cases overworked and can be inadequately trained to handle chronic NCDs in addition to infectious diseases. Additionally, training programs often have a disease-specific nature, which does not allow healthcare workers to deliver integrated patient-centered care. Enhancement of workforce capacity by means of training, task switching and interdisciplinary strategy is thus critical.

7.6 Gaps in Surveillance and Health Information Systems

Moreover, health information and surveillance systems are usually incompetent to record the complexity of the double burden. Most of the systems are still focused on individual diseases and are thus not adequately tracking the patterns of co-morbidity and multimorbidity. This is a barrier to evidence-based decision-making, resource distribution, and assessment of public health interventions due to the absence of integrated data. Enhancement of surveillance

systems to realize holistic health information is essential to enhance planning and response.

7.7 Pressure on Primary Healthcare Systems

Last but not least, the growing strain on primary healthcare systems is also an issue. Primary care is the initial contact point of the majority of patients and is at the center of prevention, early diagnosis, and chronic disease management. Nevertheless, the available primary healthcare systems in LMICs are not sufficiently resourced and sufficiently equipped to deal with the increasing complexity of the double burden. Overcrowding in patients, lack of diagnostic equipment, and workforce size frequently lead to the delay in diagnoses and disjuncture (Swadzian et al, 2020).

7.8 Implications for Health System Strengthening

To conclude, the health system obstacles such as fragmentation, low resources, lack of workforce, and poor surveillance play a significant role in limiting the capacity of LMICs to overcome the double burden of communicable and non-communicable diseases. To address these challenges, a shift towards integrated and resilient and people-centered health systems that can provide ongoing and coordinated care along the disease spectrum is needed (Table 4). This type of change is crucial in order to enhance health outcomes and attain sustainable progress in the field of the public health.

Table 4: Health System Challenges in LMICs

Challenge	Description	Impact
Fragmentation	Vertical disease programs	Poor integrated care
Resource Constraints	Limited funding & infrastructure	Reduced service delivery
Workforce Shortage	Lack of trained staff	Poor disease management
Surveillance Gaps	Weak data systems	Poor planning
Access Inequality	Rural–urban disparities	Health inequities
Primary Care Burden	Overloaded systems	Delayed diagnosis

8. Public Health Implications

8.1 Overview of Population Health Impact

To conclude, the health system obstacles such as fragmentation, low resources, lack of workforce, and poor surveillance play a significant role in limiting the capacity of LMICs to overcome the double burden of communicable and non-communicable diseases. To overcome these issues, there is a need to focus on integrated and resilient and people-centered health systems that can deliver continuous and coordinated care across the disease spectrum (Table 4). This type of change is crucial in order to enhance health outcomes and attain sustainable progress in the field of the public health.

8.2 Increased Morbidity and Mortality

Among the greatest implications is the rise in morbidity and mortality among coexisting conditions. The pre-existing NCD predisposes individuals to the infectious diseases because of the impaired immune response, persistent inflammation, and underlying organ damage. This has been evident through the COVID-19 pandemic, where patients with conditions such as diabetes, cardiovascular disease, and obesity were disproportionately hospitalized, with severe complications, and died (Albitar et al., 2020; Clark et al., 2020). These relations underscore the fact that the incidence of NCDs may increase the severity of infectious disease, which results in poor clinical outcomes and high case fatality rates.

8.3 Long-Term Morbidity and Disability Burden

Besides acute effects, the double burden has been known to cause long-term morbidity and disability. The complications linked to the chronic diseases, like diabetes, include cardiovascular disease, kidney failure, neuropathy, and visual impairment, which substantially diminish the quality of life and precondition the necessity of continuous medical attention (Harding et al., 2019). These conditions, together with frequent or chronic infectious diseases, form a cycle of deteriorating health, long-term morbidity, and susceptibility to additional morbidity. This increasing co-morbidity and multimorbidity is an

added burden to both individuals and the health care system (Clark et al, 2020).

8.4 Economic Burden and Financial Strain

The economic impacts of the double burden are also important. At the domestic level, people have to spend a lot out of pocket to treat acute infectious diseases and provide long-term care to the NCD, and it may cause financial stress and devastating health expenditure. Governments at the national level have to invest in dealing with both types of diseases at the same time, and this can strain already constrained healthcare budgets. The financial strain on health systems caused by chronic disease care and the episodic costs of infectious disease outbreaks puts a continued financial burden on health systems.

8.5 Strain on Healthcare Systems

The doubled burden also imposes significant burden on healthcare systems that have to deal with immediate infectious disease threats as well as long-term chronic disease management. Health facilities are usually expected to offer a broad spectrum of services including emergency services and infection control to on-going monitoring of NCDs and their treatment. Such a twofold burden may strain healthcare systems especially in the LMICs where resources are scarce and poor quality of care, increased waiting hours, and service delivery inefficiencies are experienced (Asare-Baah et al, 2024).

8.6 Impact on Productivity and Socioeconomic Development

Outside the health sector, the double burden also has a significant effect on socioeconomic development and productivity. People living with various health conditions tend to have less working capacity, high absenteeism and early deaths, which all decrease the productivity of the workforce. Chronic diseases, especially, may result in long-term disability whereas frequent infectious diseases may cause a disruption in economic activity. On a larger scale, such wastage of human capital may retard economic development, as well as stifle developmental objectives, particularly in nations with high number of workers in the working age bracket.

8.7 Health Inequities and Vulnerable Populations

Lastly, the double burden helps to increase health inequities, as the vulnerable groups have a disproportionate disease burden. The risk of infectious and non-communicable diseases is increased due to socioeconomic disadvantage and limited access to healthcare as well as exposure to multiple risk factors, resulting in a cycle of disparity and unfavorable health outcomes.

8.8 Implications for Public Health Action

To conclude, the health implications of the double burden are far-reaching and multi-dimensional, and they impact not only personal health but also health, economic, and social well-being. The solution to these challenges will involve integrated, equity-based solutions to enhance the health systems, mitigate risk factors, and enhance access to holistic care along the disease spectrum.

9. Strategies to Address the Double Burden

9.1 Need for Integrated and Multi-Sectoral Approaches

To overcome the double burden of infectious diseases (IDs) and non-communicable diseases (NCDs), it is necessary to shift the paradigm of fragmented, disease-specific interventions toward system-wide and multi-sectoral interventions. Isolated interventions are inadequate due to the overlapping epidemiology and bidirectional interactions of these types of diseases given the similarity of their risk factors. Rather than that, the key to sustainable improvement in population health is coordinated efforts to enhance health systems, prevent diseases and deal with underlying social determinants.

9.2 Integrated Care Models

One of the key elements of this reaction is the implementation of integrated care models, which should provide multidisciplinary services related to infectious diseases and NCDs in a single framework. The traditional vertical programs have worked well in treating the particular disease but fail to consider the continuity of care and co-morbidity. Integrated models, on the contrary, allow screening, diagnosing, treating, and following up on multiple conditions at the same time, improving efficiency and patient outcomes. As an example, the integration of NCD screening and control with the current HIV and tuberculosis programs has shown a substantial potential in enhancing the early diagnosis, and chronic disease management (WHO, 2023). Likewise, systematic reviews suggest that the combination of HIV services with general health services improves access, decreases duplication

and increases continuity of care (Bulstra et al., 2021). Integrating NCD care into the regular HIV-based services in LMICs has demonstrated positive outcomes in enhancing the management of chronic diseases and the efficient use of resources (Kintu et al., 2020).

9.3 Strengthening Primary Healthcare and Universal Health Coverage

It is also essential to strengthen the primary healthcare systems in order to deal with the double burden. Primary care is the cornerstone of health systems, which consists of accessible, continuous, and person-centered care throughout life. Through a well-developed primary healthcare system, it is possible to ensure early disease detection, prevention of risks, and chronic treatment of the infectious diseases as well as NCDs (Figure 3). Universal Health Coverage (UHC) is one of the objectives in that regard, and it implies that every person is afforded the necessary health services without any issues related to financial burden. The ways to address health inequities and enhance outcomes include the expansion of coverage, better service quality, and the decrease of out-of-pocket spending (WHO, 2024).

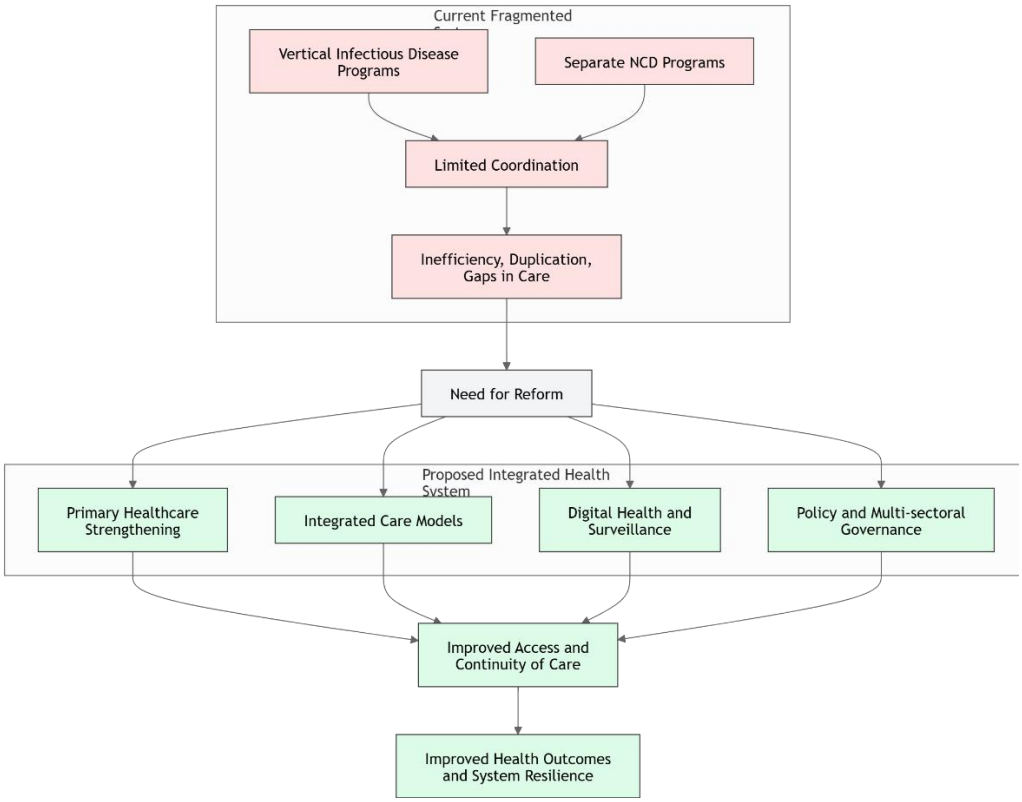

Figure 3: Health System Response Framework

9.4 Prevention and Risk Reduction Strategies

Prevention strategies should also be given priority as most of the risk factors that cause the double burden are preventable. Tobacco consumption, poor diet, sedentary lifestyles, and environmental exposures are some of the public health interventions that can considerably decrease the occurrence of NCDs as well as increasing resilience to infectious diseases. Moreover, vaccinations and early diagnosis programs are very important in preventing infectious diseases and their chronic complications. Prevention should be incorporated in routine medical care and community-based interventions to achieve the greatest effect.

9.5 Surveillance Systems and Digital Health Innovations

Another major strategy is the creation of strong surveillance and data systems. It requires integrated health information systems that will capture the data on both infectious diseases and NCDs, and how the two interact with each other. These systems allow the closer observation of the disease tendencies, the detection of high-risk groups, and evidence-based decisions. Digital

health technologies, in this case, present tremendous possibilities to improve data collection, tracking patients, and arranging care. As an illustration, the adoption of digital health systems in the LMICs has indicated positive results in the field of health information management, service delivery, and clinical decision-making (Muinga et al., 2020). These resources have the potential to help enable more effective and integrated healthcare delivery when used well.

9.6 Policy, Governance, and Multi-Sectoral Collaboration

Lastly, it is important to consider the double burden issue with powerful policy and governance structures that are facilitated by multi-sectoral cooperation. The healthcare system has a very limited number of factors, which affect health outcomes, such as education, housing, nutrition, and environmental conditions. Thus, the best responses are to be conducted at the level of intersectoral coordination. Implementation research should inform policy development in order to make sure that the interventions are context-specific, scalable, and sustainable (Rasanathan et al., 2024). Moreover, to overcome complicated health issues like HIV and NCD co-morbidity, national and global strategies are necessary that are consistent with the broader objectives of national and global public health (Chen et al., 2025).

9.7 Strategic Implications for Public Health Practice

To conclude, the case of addressing the issue of the double burden of infectious and non-communicable diseases should be approached through an integrated approach that entails integrated care delivery, robust primary healthcare systems, preventive approaches to public health, improved surveillance, and supportive policy frameworks. These are complementary strategies that should be put in place in a coordinated way such that they can continuously reduce disease burden, promote health equity and resilience within the health system.

10. Conclusion

The dual burden of infectious and non-communicable diseases is an acute and ongoing problem in the global population health especially in the low- and middle-income states that are experiencing a rapid epidemiological and socioeconomic change. This review highlights the idea that the coexistence of these disease types is not a transient phenomenon but a long-term reality that is influenced by interrelated biological, behavioral and structural factors. Poor health conditions that are characterised by poverty, lack of sanitation and access to health care have sustained infectious diseases and NCDs have increased as a result of urbanisation, ageing, and change of lifestyle. Notably, the interrelationship between these conditions, including by way of immune impairment, chronic inflammation, and common risk factors, results in accumulating morbidity, higher mortality, and difficult clinical treatment.

One of the implications of this dual burden is the unsuitability of the traditional, siloed health approaches to treat infectious diseases and NCDs independently. The lack of integration, disjointed health systems, and vertical programs make prevention and care efforts less effective, especially when it comes to people with co-morbid conditions. The need to shift to more integrated, people-centered health systems with more emphasis on continuity of care, early detection, and inter-disease management is urgent. Moreover, effective policy-based and multi-sectoral intervention that goes beyond the health sector is the way to deal with the double burden. The interventions should address the social determinants of health at a larger scale such as poverty elimination, better living standards, and healthier living conditions. Primary healthcare, workforce capacity, surveillance systems and digital health innovation are the key areas to invest in to have resilient systems that can meet emerging health requirements.

To conclude, addressing the double burden requires a paradigm shift of integrated, equity-based, and sustainable public health approaches that have the potential to reduce the burden of disease, enhance the health system, and ensure long-term population health and development.

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