**IPS Interdisciplinary Journal of Social Sciences**
*IPS Int. J. Soc. Sci., 3(1): 42-53 (2025)*
*DOI:* https://doi.org/10.54117/3kf0k215

# Occupational Health Governance and Workforce Productivity in Nigeria: Addressing the Burden of Microbial Infections

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## Abstract

Microbial infections impose substantial burdens on workforce productivity in Nigeria, with profound implications for economic growth, household welfare, and national development. This comprehensive review examines the mechanisms through which infectious diseases affect worker performance, labour supply, and economic output across formal and informal sectors. Drawing on recent epidemiological evidence, occupational health studies, and economic analyses, the findings reveal that prevalent infections including malaria, respiratory tract infections, and antimicrobial-resistant pathogens significantly compromise workforce efficiency. Experimental evidence demonstrates that workplace-based malaria treatment programmes increase worker earnings substantially, underscoring the direct productivity benefits of infection control. Occupational exposure studies among waste handlers reveal that the vast majority of workers experience health-related complaints, with respiratory and skin infections predominating, yet only a small fraction seek hospital care while most resort to self-medication. Antimicrobial resistance threatens to exacerbate these productivity losses, with experts warning of billions in annual economic costs and potential global GDP decline, with Nigeria facing disproportionate impacts. Informal sector workers, constituting the overwhelming majority of Nigeria's workforce, face particular vulnerabilities due to poor working conditions, absence of occupational health protections, and limited access to health insurance. The poverty-disease cycle operates powerfully in working communities, as infection-related productivity losses reduce earnings, limit healthcare access, and perpetuate economic hardship. Policy recommendations emphasise strengthening occupational health regulations, expanding health insurance coverage for informal workers, implementing workplace infection control measures, and investing in antimicrobial stewardship to preserve workforce productivity and advance sustainable development.

**Keywords:** Microbial infections, workforce productivity, Nigeria, occupational health, antimicrobial resistance, absenteeism, presenteeism, informal sector, economic development, health policy

**Article History**
Received: 30 Oct 2025
Accepted: 25 Nov 2025
Published: 08 Dec 2025

Scan QR Code to view[1]



**How to cite this paper:** Madubueze, M. H. C., Mbanefo, O. D., Anekwe, J. K., Nwadiogbu, N. M., & Egberi, A. E. (2026). Occupational health governance and workforce productivity in Nigeria: Addressing the burden of microbial infections. *IPS Interdisciplinary Journal of Social Sciences*, *3*(1), 42–53. https://doi.org/10.54117/3kf0k215

## 1. Introduction

### 1.1 Background to the Study

The relationship between microbial infections and workforce productivity represents a critical determinant of economic development in Nigeria, where infectious diseases remain endemic and the labour force constitutes the nation's most valuable productive asset. As Africa's most populous nation and largest economy, Nigeria's developmental aspirations depend fundamentally on the health and productivity of its workers across agriculture, industry, and services. Yet prevalent infections including malaria, respiratory diseases, tuberculosis, and increasingly antimicrobial-resistant pathogens systematically undermine worker performance, reduce labour supply, and constrain economic output.

The magnitude of this challenge is underscored by experimental evidence from the agricultural sector, where a randomised study among Nigerian sugarcane cutters demonstrated that offering workplace-based malaria testing and treatment increased worker earnings by approximately 10 percent over subsequent weeks (Dillon *et al.*, 2021). This finding reveals not only the direct productivity impact of a

treatable infection but also the potential returns to workplace health interventions. For workers testing positive for malaria, treatment increased labour supply and earnings; for those testing negative, the health information itself led to increased productivity through more efficient labour allocation.

Occupational exposure to infectious pathogens creates additional burdens for workers in high-risk sectors. A study of artisanal municipal solid waste handlers in Aba found that 95 percent of workers reported health-related complaints, with respiratory infections affecting 57 percent and skin infections affecting 87 percent (Osim *et al.*, 2025). Despite this high burden, only 4 percent sought hospital care, while 78 percent resorted to self-medication through over-the-counter drugs. Personal protective equipment acquisition (15 percent) and use (3 percent) were extremely low, reflecting the systemic failures in occupational health protection that characterise much of Nigeria's informal economy.

The emergence and spread of antimicrobial resistance threatens to exacerbate these productivity losses by making common infections more difficult and expensive to treat. The Nigerian Infectious Diseases Society has warned that unregulated access to antibiotics and inappropriate dispensing practices are fuelling AMR, with experts calling for stricter enforcement of prescription-only regulations (Akporehe, 2025). Public health experts estimate that AMR could cost Nigeria billions of Naira annually through longer hospital stays, higher medical expenses, and decreased workforce productivity (Fatunbi, 2025). A 2022 World Bank report projects that by 2050, AMR could cause a 3.8 percent global GDP decline, with countries like Nigeria facing the worst impacts.

### 1.2 Concept of Microbial Infections

Microbial infections encompass diseases caused by pathogenic microorganisms including bacteria, viruses, parasites, and fungi that affect human health through various transmission routes and clinical manifestations. In the context of workforce productivity, infections of particular relevance include those with high prevalence among working-age adults, those that cause significant morbidity and work incapacity, and those that are occupationally acquired through workplace exposures.

Malaria remains the most prevalent parasitic infection affecting Nigerian workers, particularly those in agriculture and other physically demanding sectors where exposure to mosquito vectors is highest. The disease causes fever, fatigue, anaemia, and systemic illness that directly impairs physical work capacity. *Plasmodium falciparum*, the predominant species in Nigeria, is associated with substantial morbidity among adults, with recurrent infections contributing to chronic anaemia and reduced productivity even during asymptomatic periods.

Respiratory tract infections, both bacterial and viral, constitute a major cause of work absenteeism and presenteeism. The study of waste handlers in Aba isolated 704 bacterial and 191 fungal organisms from workers' respiratory tracts and skin, with *Staphylococcus epidermidis* (24 percent), *Bacillus cereus* (13 percent), and *Staphylococcus aureus* (29 percent) predominating (Osim *et al.*, 2025). These organisms, acquired through occupational exposure to contaminated waste, caused respiratory and skin infections that impaired workers' health and productivity.

Occupationally acquired infections represent a distinct category where the workplace itself serves as the source of exposure. Waste handlers, healthcare workers, agricultural workers, and others in high-risk occupations face elevated risks of infection due to contact with contaminated materials, biological agents, or infected individuals. A study of Nigerian automobile artisans revealed exposure to various occupational hazards causing injuries and illnesses including malaria, stress, and pains, with workers developing informal prevention mechanisms in the absence of formal occupational safety and health protections (Igbolekwu, 2025).

Antimicrobial-resistant infections constitute an emerging threat to workforce health, as common bacterial infections become increasingly difficult to treat with standard antibiotics. Resistant infections require longer treatment courses, more expensive antibiotics, and result in longer illness durations and greater productivity losses. The Nigerian Infectious Diseases Society has called for stricter regulation of antimicrobial sales and upscaling of awareness creation on AMR among all One Health stakeholders (Akporehe, 2025).

### 1.3 Workforce Productivity and National Development

Workforce productivity, defined as the output generated per worker or per hour worked, constitutes a fundamental determinant of economic growth and national development. In Nigeria, where the labour force is projected to continue growing rapidly, enhancing productivity is essential for translating population growth into economic prosperity. The health of workers is a critical input to productivity, affecting their ability to work, the intensity of effort they can sustain, and the quality of their output.

The structure of Nigeria's workforce presents particular challenges for productivity enhancement. Approximately 90 percent of Nigerian workers are employed in the informal sector, where working conditions are often poor, occupational health protections are minimal, and access to healthcare is limited (Igbolekwu, 2025; Onyekachi, 2025). Informal sector workers including artisans, traders, farmers, and casual labourers face high exposure to infectious diseases while lacking the social protections available to formal sector employees. Their productivity losses due to illness translate directly into income losses, with no sick pay or health insurance to cushion the impact.

Agricultural workers, who constitute a substantial portion of the labour force, face particular vulnerabilities. The sugarcane cutter study demonstrated that malaria infection significantly reduces physical work capacity, with treated workers showing substantial productivity gains (Dillon *et al.*, 2021). In physically demanding occupations where earnings depend on output, even modest improvements in health can translate into meaningful income increases. The study estimated that the offer of workplace-based malaria testing and treatment increased worker earnings by approximately 10 percent, representing both private gains to workers and productivity gains to employers.

The economic costs of infection-related productivity losses extend beyond individual workers to affect employers, industries, and the national economy. Employers face costs from absenteeism (workers missing work due to illness) and presenteeism (workers attending work while ill but performing below capacity). Presenteeism has been identified as a significant but often overlooked factor affecting productivity in Nigerian organisations, with studies recommending that it be discouraged among staff (Onyekachi, 2025). At the macroeconomic level, widespread infection burdens reduce the productive capacity of the workforce, constrain economic growth, and perpetuate poverty.

### 1.4 Statement of the Problem

Despite the recognised importance of a healthy workforce for economic development, Nigeria faces a silent crisis where microbial infections systematically undermine worker productivity with insufficient policy attention or intervention. The problem manifests across multiple interconnected dimensions that together constrain the nation's developmental potential.

First, the burden of infections among working-age adults remains unacceptably high. Malaria prevalence among adults, while lower than among children, remains substantial and causes significant morbidity. Respiratory infections, skin infections, and other occupationally acquired diseases affect workers in high-risk sectors with inadequate protections. The waste handler study found that 95 percent of workers experienced health-related complaints, yet only 4 percent sought appropriate medical care (Osim *et al.*, 2025). This treatment gap means that infections persist longer, cause greater productivity losses, and may progress to more severe outcomes.

Second, antimicrobial resistance threatens to exacerbate these burdens by making infections more difficult and expensive to treat. Experts warn that AMR could cost Nigeria billions of Naira annually through longer hospital stays, higher medical expenses, and decreased workforce productivity (Fatunbi, 2025). The Nigerian Infectious Diseases Society has raised alarms about widespread antibiotic misuse, with 72.4 percent of community pharmacies and 89.3 percent of patent medicine vendors dispensing antibiotics without prescriptions (Akporehe, 2025). Without urgent action, the economic losses will be devastating, threatening Nigeria's long-term economic stability.

Third, occupational health protections remain grossly inadequate, particularly for the 90 percent of workers in the informal sector. The Federal Ministry of Labour and Employment has statutory responsibility for occupational safety and health, including safeguarding workers through workplace inspections, accident investigations, and policy development (Igbolekwu, 2025). However, enforcement capacity is limited, and informal sector workers fall outside the scope of most regulatory protections. A study of automobile artisans revealed that in the absence of formal occupational safety and health policies, workers develop individual prevention mechanisms based on risk perception, but ignore hazards perceived as low-risk (Igbolekwu, 2025).

Fourth, health insurance coverage remains extremely low among workers, particularly in the informal sector. A study of artisans in Rivers State found that knowledge of social health insurance programmes was significantly low, with mean knowledge scores ranging from 1.75 to 2.55 on a 4-point scale (Onyekachi, 2025). This lack of awareness and coverage limits workers' access to affordable healthcare, forcing reliance on self-medication and delaying appropriate treatment. The waste handler study found that 78 percent indulged in self-medication via over-the-counter drugs, while only 4 percent visited hospitals (Osim *et al.*, 2025).

### 1.5 Aim and Objectives

This review aims to comprehensively examine the developmental implications of microbial infections on Nigerian workforce productivity, with particular attention to the mechanisms through which infections affect worker performance, the sectoral variations in infection burdens, and the policy interventions that can mitigate productivity losses. The specific objectives are:

1. To identify the prevalent microbial infections affecting Nigerian working populations and their distribution across occupational categories
2. To analyse the occupational exposure pathways through which workers acquire infections in different sectors
3. To assess the impact of infections on workforce productivity through absenteeism, presenteeism, and reduced work efficiency
4. To estimate the economic costs of infection-related productivity losses to employers, workers, and the national economy
5. To examine the vulnerabilities of informal sector workers and other high-risk groups
6. To evaluate existing occupational health policies and workplace health programmes in Nigeria
7. To propose evidence-based recommendations for strengthening workforce health and protecting productivity

### 1.6 Scope and Significance

This review encompasses the spectrum of microbial infections affecting Nigerian workers across formal and informal sectors, with particular attention to those with the greatest prevalence and productivity impact. The scope includes analysis of occupational exposure pathways, infection-related productivity losses, economic burden estimation, and policy responses. The geographic scope is national, with attention to variations in infection burdens and occupational structures across Nigeria's diverse economic landscape.

The significance of this review lies in its potential to inform evidence-based policy making at multiple levels. For the

Federal Ministry of Labour and Employment, it provides comprehensive analysis of occupational health challenges and recommendations for strengthening regulatory frameworks and enforcement mechanisms. For the Federal Ministry of Health, the Nigeria Centre for Disease Control and Prevention, and state health agencies, it illuminates the workplace as a critical setting for infection control and health promotion. For employers and industry associations, it offers evidence on the business case for workplace health investments and guidance on effective interventions. For labour unions and worker organisations, it provides advocacy tools for demanding improved occupational health protections. For development partners, it identifies priority areas for investment and technical support.

The urgency of this inquiry is underscored by the convergence of multiple threats: the persistent burden of endemic infections, the emergence and spread of antimicrobial resistance, the vulnerabilities of informal sector workers, and the inadequacy of occupational health protections. Each of these represents a drag on productivity and a barrier to development that Nigeria cannot afford to ignore.

## 2. Overview of Microbial Infections in Nigeria

### 2.1 Prevalent Infectious Diseases among Working Populations

Working-age adults in Nigeria face a substantial burden of infectious diseases that directly impacts their productive capacity. While much epidemiological attention has focused on children under five and pregnant women, adults of working age experience significant morbidity from both endemic infections and emerging threats. Understanding the prevalence and distribution of these infections is essential for designing targeted workplace health interventions.

Malaria remains the most prevalent parasitic infection affecting Nigerian workers, particularly those in occupations with outdoor exposure during peak mosquito biting hours. Agricultural workers, construction labourers, security personnel, and others who work outdoors face elevated risks. The sugarcane cutter study in Niger State found that baseline malaria prevalence among workers was substantial enough that offering testing and treatment produced significant productivity gains (Dillon *et al*, 2021). While the study did not report precise prevalence figures, the finding that treatment increased earnings by 10 percent implies that a meaningful proportion of workers were infected and that infection substantially impaired their work capacity.

Tuberculosis continues to affect working-age adults, with Nigeria having one of the highest burdens in Africa. TB is a disease of poverty that disproportionately affects workers in crowded, poorly ventilated workplaces and those with compromised nutritional status. The disease causes prolonged morbidity, requiring months of treatment during which work capacity is severely reduced. Multi-drug resistant TB, which requires longer and more toxic treatment, poses an even greater threat to workforce productivity.

Respiratory tract infections, including pneumonia, bronchitis, and influenza, are major causes of acute work absenteeism. Workers in occupations with exposure to dust, fumes, or crowds face elevated risks. The waste handler study documented high rates of respiratory infections (57 percent) among workers exposed to contaminated waste (Osim *et al.*, 2025). These infections cause acute illness that typically resolves within days to weeks but can recur frequently, leading to cumulative productivity losses.

Skin and soft tissue infections affect workers in occupations with exposure to contaminated materials, moisture, or minor trauma that compromises skin integrity. The waste handler study found that 87 percent of workers experienced skin infections, reflecting the high exposure to pathogens in municipal waste (Osim *et al.*, 2025). These infections, while rarely life-threatening, cause discomfort, disability, and work absence.

Gastrointestinal infections, including typhoid fever, cholera, and diarrhoeal diseases, affect workers through contaminated food and water. Workers in occupations with limited access to clean water and sanitation facilities face elevated risks. These infections cause acute illness with rapid onset of symptoms that incapacitate workers for days.

### 2.2 Occupational Exposure to Microbial Pathogens

Workplace environments in Nigeria present diverse exposure pathways through which workers acquire microbial infections. Understanding these pathways is essential for designing effective prevention strategies tailored to specific occupational risks.

Waste handlers face perhaps the most diverse and intense exposure to microbial pathogens. The study of artisanal municipal solid waste handlers in Aba documented the range of organisms to which these workers are exposed, isolating 704 bacterial and 191 fungal organisms from workers' respiratory tracts and skin (Osim *et al.*, 2025). Predominant bacterial isolates included *Staphylococcus aureus* (29 percent), *Staphylococcus epidermidis* (24 percent), *Bacillus cereus* (13 percent), *Proteus* species (nine percent), *Escherichia coli* (eight percent), *Klebsiella pneumoniae* (six percent), and *Pseudomonas aeruginosa* (six percent). Fungal isolates included *Aspergillus flavus* (30 percent), *Aspergillus fumigatus* (17 percent), *Candida albicans* (15 percent), and *Penicillium* species (14 percent). These organisms cause respiratory, skin, and systemic infections that impair worker health and productivity.

Healthcare workers face exposure to bloodborne pathogens (hepatitis B and C, HIV), respiratory pathogens (tuberculosis, influenza, COVID-19), and other infectious agents through contact with patients and contaminated materials. Despite the availability of preventive measures including vaccination and personal protective equipment, coverage and compliance remain incomplete, leaving many healthcare workers at risk.

Agricultural workers face exposure to zoonotic pathogens from livestock, soil-borne organisms, and vector-borne diseases including malaria. Workers in livestock production may acquire infections such as brucellosis, Q fever, and leptospirosis. Field workers face malaria risk where vector control is inadequate. Pesticide exposure, while not infectious,

can compromise immune function and increase susceptibility to infections.

Automobile artisans and other informal sector workers face exposure to varied hazards depending on their specific trades. A study of occupational safety and health among automobile artisans in Ogun State found that workers were exposed to injuries and illnesses including malaria, stress, and pains, with 32 percent reporting malaria as a health challenge (Igbolekwu, 2025). Workers developed informal prevention mechanisms based on risk perception, such as eating foods they believed boosted immunity, but ignored hazards perceived as low-risk.

Construction workers face exposure to dust, noise, and physical hazards that can compromise respiratory health and increase susceptibility to respiratory infections. Workers on large projects may live in crowded camps where respiratory pathogens transmit readily. Poor sanitation at worksites can expose workers to gastrointestinal pathogens.

### 2.3 Emerging and Re-Emerging Infections

The landscape of infectious diseases affecting Nigerian workers is not static, with emerging and re-emerging infections creating new challenges for occupational health. These threats require adaptive responses from employers, health systems, and regulatory authorities.

The COVID-19 pandemic demonstrated the potential for novel pathogens to disrupt workforce productivity on a massive scale. Beyond the direct morbidity and mortality caused by the virus, pandemic control measures including lockdowns, travel restrictions, and workplace closures disrupted economic activity across all sectors. The pandemic also highlighted the vulnerabilities of workers in essential occupations, including healthcare, retail, and transportation, who faced elevated exposure risks without adequate protections.

Lassa fever, a viral haemorrhagic fever endemic in parts of Nigeria, poses risks to workers in affected regions, particularly those in agriculture and food storage where contact with infected rodents may occur. Healthcare workers caring for Lassa fever patients face nosocomial transmission risks if infection control measures are inadequate. The Nigeria Centre for Disease Control and Prevention has documented ongoing transmission across multiple states, with cases occurring throughout the year but peaking during dry months.

Meningococcal meningitis outbreaks periodically affect Nigeria, with the 2026 outbreak in Yobe State killing 20 boarding school students and infecting hundreds more (The Black Examiner, 2026). While this outbreak affected students rather than workers, similar risks exist in crowded workplaces including factories, construction camps, and dormitories. Workers in close-contact occupations face elevated transmission risks during outbreak periods.

Monkeypox, now renamed mpox, has emerged as a global concern with cases reported in Nigeria. Transmission occurs through close contact with infected individuals or animals, placing healthcare workers and those in occupations with animal contact at potential risk.

### 2.4 Antimicrobial Resistance and Workforce Health

Antimicrobial resistance represents perhaps the most concerning trend in infectious disease epidemiology, with profound implications for workforce health and productivity. The Nigerian Infectious Diseases Society has raised alarms about the growing threat of AMR, driven by widespread antibiotic misuse in both human and animal health sectors (Akporehe, 2025).

The scale of antibiotic misuse in Nigeria is staggering. Studies have documented that 72.4 percent of community pharmacies and 89.3 percent of patent medicine vendors dispense antibiotics without prescriptions (Akporehe, 2025). This practice, driven by economic pressures on providers and demand from patients seeking quick fixes, fuels resistance by exposing bacteria to antibiotics when they are not needed, at incorrect doses, or for insufficient durations. A Nigeria Health Watch community poll found that 50 percent of respondents keep antibiotics at home, about 41 percent reported reusing leftover medication, while 34.2 percent said they share or buy antibiotics without any laboratory testing (Alagboso and Iroegbu, 2025).

The consequences for workforce health are already apparent. Resistant infections require longer treatment courses with more expensive antibiotics, resulting in longer illness durations and greater productivity losses. When first-line antibiotics fail, workers must navigate more complex treatment regimens, often requiring specialist care that may be inaccessible or unaffordable. The economic burden falls heaviest on low-income workers who can least afford prolonged illness or expensive treatment.

Fatunbi (2025) warns that AMR is not waiting for us to catch up, but with decisive steps including digital verification, enforcement incentives, public engagement, and market reform, Nigeria can turn the tide. The Nigerian Infectious Diseases Society has called for stricter regulation of antimicrobial sales, upscaling of awareness creation on AMR among all One Health stakeholders, and improved infection prevention and control practices in healthcare facilities (Akporehe, 2025).

The workplace has a role to play in addressing AMR through health education, promotion of appropriate healthcare-seeking behaviour, and support for workers with infections. Employers can reinforce messages about completing antibiotic courses, not sharing medications, and seeking appropriate care rather than self-medicating. Occupational health services can support antimicrobial stewardship by ensuring that workers receive appropriate diagnosis and treatment.

## 3. Impact of Microbial Infections on Workforce Productivity

### 3.1 Absenteeism and Presenteeism

Microbial infections affect workforce productivity through two primary mechanisms: absenteeism, where workers miss work entirely due to illness, and presenteeism, where workers attend work while ill but perform below their normal capacity. Both mechanisms impose substantial costs on employers and workers, though presenteeism has received less attention in research and policy.

Absenteeism due to infectious diseases is widespread in Nigeria, though precise national estimates are lacking. Acute infections including malaria, respiratory tract infections, and diarrhoeal diseases cause short-term absences that can accumulate to significant time lost over a working year. A worker with two or three malaria episodes annually may miss one to two weeks of work, with corresponding income losses and productivity reductions for employers. More severe infections, including tuberculosis, can cause prolonged absence lasting months, often resulting in job loss and permanent exit from the workforce.

The sugarcane cutter study provides experimental evidence of absenteeism effects. Workers offered malaria testing and treatment showed increased labour supply, meaning they worked more days than control workers (Dillon *et al*., 2021). This finding implies that untreated malaria was causing workers to miss work days that they would have worked if healthy. The productivity gains from treatment (10 percent earnings increase) reflect both reduced absenteeism and improved performance on days worked.

Presenteeism is increasingly recognised as a significant but hidden cost of illness. Workers who attend work while ill are less productive than usual due to fatigue, pain, difficulty concentrating, and reduced physical capacity. Presenteeism may actually exceed absenteeism in economic cost, particularly for illnesses that cause moderate symptoms but do not fully incapacitate workers. Onyekachi (2025) studied presenteeism among informal sector workers in Rivers State and found that it significantly affects productivity, recommending that organisations develop strategies to discourage presenteeism among staff.

The drivers of presenteeism in Nigerian workplaces include economic pressures (workers cannot afford unpaid sick leave), job insecurity (fear of being replaced if absent), cultural expectations (presenteeism as demonstration of commitment), and limited access to healthcare (workers cannot obtain timely diagnosis and treatment). Informal sector workers face the strongest pressures for presenteeism, as their earnings depend directly on daily work and they lack sick pay or employment protections.

Presenteeism also has public health implications, as infectious workers attending work may transmit infections to colleagues. Respiratory infections, in particular, spread readily in workplace settings where ill workers continue to interact with others. This creates a vicious cycle where presenteeism by infected workers causes illness in others, multiplying productivity losses.

### 3.2 Reduced Work Efficiency and Output

Beyond the binary distinction between absenteeism and presenteeism, infections reduce the efficiency and output of workers who continue working. This effect is particularly pronounced in physically demanding occupations where infection-related fatigue, anaemia, and malaise directly impair work capacity.

The sugarcane cutter study provides the most rigorous evidence of infection-related productivity impairment. Sugarcane cutting is a physically demanding task where output can be precisely measured. The study found that workers who tested positive for malaria and received treatment subsequently increased their earnings by approximately 10 percent relative to controls (Dillon *et al*., 2021). This effect represents the combined impact of reduced absenteeism and increased output on days worked. Notably, workers who tested negative also increased productivity, suggesting that the health information itself enabled better labour allocation.

The mechanisms through which malaria impairs physical work capacity include: fever and systemic symptoms during acute episodes; anaemia resulting from recurrent infections; fatigue and malaise that persist after acute symptoms resolve; and reduced motivation and effort. These effects compound over time, as workers with chronic or recurrent infections experience cumulative impairment.

Respiratory infections reduce work efficiency through cough, fatigue, and shortness of breath that limit physical exertion. Workers in occupations requiring heavy labour or sustained effort are most affected. The waste handler study found that respiratory infections affected 57 percent of workers, with consequent impairment of their ability to perform physically demanding waste collection and sorting tasks (Osim *et al.*, 2025).

Skin infections, affecting 87 percent of waste handlers in the Aba study, cause discomfort, pain, and limitation of hand function that impairs workers' ability to handle materials effectively (Osim *et al.*, 2025). These infections may also discourage workers from fully engaging with tasks that exacerbate symptoms.

Cognitive impairment from infections affects workers in all occupations, including those requiring mental rather than physical effort. Malaria, typhoid, and other febrile illnesses cause difficulty concentrating, slowed thinking, and impaired decision-making that reduce productivity in white-collar and service occupations. These effects are difficult to measure but are nonetheless real and economically significant.

### 3.3 Economic Costs to Employers and Government

The economic costs of infection-related productivity losses accrue to multiple actors including employers, workers, government, and the broader economy. Quantifying these costs is essential for making the case for investment in workplace health interventions.

Employers bear costs from both absenteeism and presenteeism. Absenteeism costs include: lost output from absent workers; payments for sick leave where provided; administrative costs of managing absence; and costs of hiring and training temporary replacements. Presenteeism costs include: reduced output from ill workers; errors and quality problems caused by impaired performance; and potential transmission of infections to other workers causing additional illness.

The sugarcane cutter study provides a basis for estimating employer costs of malaria in physically demanding occupations. The finding that treatment increased worker earnings by 10 percent implies that untreated malaria reduced worker output by a similar margin (Dillon *et al*., 2025). For employers paying piece rates, this translates directly into reduced output per worker. For employers paying time wages, it represents reduced value generated per wage paid.

Government bears costs through reduced tax revenues when worker earnings and corporate profits decline, increased healthcare expenditures for treating infections, and social welfare costs when workers become too ill to work. The economic burden of antimicrobial resistance, which threatens to increase all these costs, has been estimated at billions of Naira annually (Fatunbi, 2025).

The Nigerian Infectious Diseases Society has emphasised that AMR could cost Nigeria billions of Naira annually through longer hospital stays, higher medical expenses, and decreased workforce productivity (Akporehe, 2025). Industries relying on antibiotics, such as livestock farming, could experience reduced food production and exports, worsening Nigeria's economic struggles. The World Bank projects that by 2050, AMR could cause a 3.8 percent global GDP decline, with low- and middle-income countries like Nigeria facing the worst impacts (Fatunbi, 2025).

Presenteeism costs have been less studied in Nigeria but are potentially substantial. Onyekachi (2025) found that presenteeism significantly affects productivity among informal sector workers, though they did not quantify the magnitude. International studies suggest that presenteeism costs often exceed absenteeism costs, particularly for conditions that cause moderate impairment but do not fully incapacitate workers.

### 3.4 Informal Sector Vulnerabilities

The informal sector, employing approximately 90 percent of Nigeria's workforce, presents particular vulnerabilities to infection-related productivity losses. Informal workers including artisans, traders, farmers, and casual labourers face high infection risks, lack occupational health protections, have limited healthcare access, and experience direct income losses when illness prevents work.

Working conditions in the informal sector are often characterised by exposure to infectious hazards without adequate protections. The waste handler study documented extreme exposure levels with minimal use of personal protective equipment (Osim *et al.*, 2025). Only 15 percent of workers acquired any PPE, and only three percent consistently used it. Workers lacked access to clean water for handwashing, sanitation facilities, and other basic protections that would reduce infection risk.

The automobile artisan study found that in the absence of formal occupational safety and health policies, workers develop individual prevention mechanisms based on risk perception (Igbolekwu, 2025). Workers reported eating foods they believed boosted immunity, such as bitter kola, ginger, and garlic, to protect against malaria and other infections. However, they ignored hazards perceived as low-risk, reflecting the limitations of individual-level adaptations in the absence of systematic protections.

Healthcare access for informal workers is severely constrained. The waste handler study found that only four percent of workers sought hospital care for their health complaints, while 78 percent resorted to self-medication through over-the-counter drugs (Osim *et al.*, 2025). This pattern reflects multiple barriers: cost of formal care, distance to health facilities, lost work time required to seek care, and limited health insurance coverage.

Health insurance coverage among informal workers is extremely low. A study of artisans in Rivers State found that knowledge of social health insurance programmes was significantly low, with mean knowledge scores ranging from 1.75 to 2.55 on a 4-point scale (Onyekachi, 2025). This lack of awareness translates into low enrolment, leaving most workers without financial protection when illness strikes.

The economic consequences of illness for informal workers are immediate and severe. Without sick pay or employment protections, workers who cannot work earn nothing. A week of illness means a week without income, with cascading effects on household food security, children's education, and other essential expenditures. This economic pressure drives presenteeism, as workers attend work while ill rather than lose income, perpetuating infection transmission and compromising recovery.

### 3.5 Gender and Vulnerable Worker Groups

The impact of microbial infections on workforce productivity is not distributed equally across worker populations, with gender and other social stratifications creating systematic differences in exposure, susceptibility, and consequences. Understanding these differential impacts is essential for designing equitable and effective interventions.

Women workers face distinct infection risks related to their occupational roles, biological factors, and social position. Women predominate in healthcare occupations, where exposure to infectious patients is high. They also constitute a substantial portion of agricultural workers, particularly in subsistence farming, where malaria and other vector-borne diseases are endemic. Women's roles as primary caregivers for ill family members may increase their exposure to household infections while also reducing time available for their own healthcare seeking.

Pregnancy increases susceptibility to certain infections and their complications. Malaria in pregnancy causes maternal anaemia, low birth weight, and increased infant mortality, with implications for women's health and productivity during and after pregnancy. Pregnant workers in occupations with infection risks require appropriate protections, yet these are rarely provided.

The waste handler study found that 67 percent of workers were male and 33 percent female (Osim *et al.*, 2025). While both genders experienced high infection rates, gender differences in

specific infections were not reported. Understanding whether men and women face different exposure pathways or experience different infections would enable more targeted interventions.

Other vulnerable worker groups include migrant workers, who may face language barriers, limited social support, and exclusion from health services; workers with chronic health conditions that increase infection susceptibility; and workers in precarious employment arrangements who lack job security and workplace protections.

Young workers entering the labour force may lack immunity to locally endemic infections acquired in childhood elsewhere. Workers relocating from low-transmission to high-transmission areas face elevated malaria risk. Older workers may have waning immunity to some infections and increased susceptibility to complications.

## 4. Socio-Economic and Developmental Consequences

### 4.1 Impact on National Economic Growth

The aggregate effect of infection-related productivity losses on Nigeria's economic growth is substantial, though precise quantification remains challenging due to data limitations. The mechanisms through which infections affect growth include: reduced labour productivity; increased healthcare expenditures that crowd out productive investment; diminished human capital accumulation; and reduced foreign investment due to perceived health risks.

Labour productivity losses from infections reduce the output generated per worker, constraining economic growth. With approximately 90 percent of workers in the informal sector where output is difficult to measure, the full extent of these losses may be underestimated in national accounts. The sugarcane cutter study suggests that productivity losses from malaria alone may be substantial in physically demanding occupations (Dillon *et al*., 2021). Extrapolating such findings to the broader economy suggests that aggregate losses are significant.

Healthcare expenditures for treating infections divert resources from productive investment. The dominance of out-of-pocket payments means that households bear most of these costs, reducing disposable income available for consumption, education, and investment. Government health expenditures, while lower than international benchmarks, nonetheless represent resources that could otherwise fund infrastructure, education, or other developmental priorities.

Human capital accumulation is compromised when workers' health reduces their ability to acquire skills and experience. Workers with chronic or recurrent infections may be unable to pursue training opportunities, change jobs, or advance in their careers. The cognitive effects of childhood infections, carried forward into working age, reduce the quality of the workforce entering the labour market each year.

Foreign direct investment may be deterred by perceptions of health risks in the workforce and population. Investors consider workforce health when making location decisions, and high disease burdens may make Nigeria less attractive relative to healthier competitors. This effect is difficult to quantify but is recognised in investment climate assessments.

### 4.2 Healthcare Expenditure and Social Security Burden

The economic burden of treating infections falls heavily on households, employers, and government, with implications for poverty, productivity, and social welfare. Understanding these cost burdens is essential for designing financing mechanisms that protect households while ensuring access to needed care.

Household out-of-pocket expenditures for infection treatment represent a direct drain on disposable income. The waste handler study found that 78 percent of workers relied on self-medication through over-the-counter drugs, reflecting both cost barriers to formal care and limited health insurance coverage (Osim *et al.*, 2025). While the cost of self-medication may be lower than formal care in the short term, it often results in inappropriate treatment, incomplete dosing, and delayed diagnosis of serious conditions, generating higher long-term costs.

Employer expenditures for worker health include direct provision of health services where available, health insurance premiums for covered workers, and costs of absenteeism and presenteeism. The sugarcane cutter study demonstrates that workplace health investments can yield returns through increased productivity, suggesting that employer provision of health services may be economically rational (Dillon *et al*., 2021). However, most employers, particularly small and informal sector operators, do not provide health benefits.

Government health expenditures for treating infections are substantial, though constrained by limited budgets. The Federal Ministry of Health and state ministries allocate resources to disease control programmes, primary healthcare services, and tertiary care. The Basic Health Care Provision Fund provides additional resources for primary healthcare, though implementation challenges limit its impact. The World Bank's HOPE-GOV programme aims to improve the availability and effectiveness of financing for primary healthcare (Ministry of Budget and Economic Planning, 2026).

Social security systems in Nigeria provide limited coverage for workers facing illness-related income losses. The informal sector, where most workers are employed, falls outside formal social protection mechanisms. Workers who become too ill to work face income losses with minimal safety net, driving households into poverty and perpetuating the poverty-disease cycle.

### 4.3 Poverty–Disease Cycle in Working Communities

The relationship between poverty and infectious disease in Nigerian working communities exemplifies a classic vicious cycle where each condition reinforces the other. Poverty creates conditions conducive to infection through inadequate housing, poor nutrition, limited access to clean water and sanitation, and inability to afford preventive measures. Infection, in turn, deepens poverty through productivity losses, healthcare expenditures, and reduced human capital accumulation.

Workers in low-income occupations face the highest infection risks and the most severe consequences when illness occurs. The waste handler study documented extreme exposure levels among workers in one of the most marginalised occupations (Osim *et al.*, 2025). These workers earn low wages, lack protective equipment, have no access to occupational health services, and rely on self-medication when illness occurs. When they become too ill to work, they have no income and no safety net.

The automobile artisan study found that workers in this informal sector occupation faced multiple health hazards with minimal protections (Igbolekwu, 2025). Their individual-level adaptations, such as eating immunity-boosting foods, reflect agency within severe constraints but cannot substitute for systematic occupational health protections. When illness occurs, productivity losses translate directly into income losses.

Health insurance coverage, which could protect workers from catastrophic health expenditures and facilitate access to appropriate care, remains extremely low among informal workers. The Rivers State study found low knowledge of social health insurance programmes, with mean knowledge scores indicating limited awareness (Onyekachi, 2025). This knowledge gap reflects broader failures in outreach and education, as well as design challenges in making insurance accessible and affordable for informal workers.

The poverty-disease cycle operates at household as well as individual levels. When working adults become ill, household income declines while healthcare expenditures rise, forcing trade-offs with other essentials including children's education and nutrition. Children may be withdrawn from school to contribute to household income or care for ill parents, compromising their educational attainment and future earning potential. These intergenerational effects perpetuate poverty across generations.

### 4.4 Case Studies of Outbreaks Affecting Productivity

Examining specific instances where infectious disease outbreaks have affected workforce productivity in Nigeria illuminates the mechanisms through which infections disrupt economic activity and the importance of preparedness and response.

**The COVID-19 Pandemic**: While not exclusively Nigerian, the COVID-19 pandemic's impact on Nigeria's workforce was profound and multifaceted. Lockdowns and movement restrictions disrupted economic activity across all sectors, with informal workers bearing the heaviest burden as they could not work from home and lacked savings to weather income losses. Essential workers in healthcare, transportation, and retail faced elevated infection risks with inadequate protections. The pandemic exposed the fragility of livelihoods dependent on daily earnings and the absence of social protection mechanisms for most workers.

**Meningitis Outbreaks**: Periodic meningitis outbreaks in Nigeria's meningitis belt affect workers as well as children. The 2026 Yobe State outbreak, while concentrated in schools, demonstrates the potential for outbreaks to disrupt economic activity in affected communities (The Black Examiner, 2026). Healthcare facilities become overwhelmed, movement may be restricted, and fear of infection reduces economic activity. Workers in healthcare face elevated risks, and those in other sectors may reduce work attendance.

**Lassa Fever**: Endemic Lassa fever transmission affects workers in agriculture and food storage in affected regions. Outbreaks strain healthcare facilities, divert resources from other services, and create fear that reduces economic activity. Healthcare workers caring for Lassa fever patients face occupational risks that may deter workforce participation.

**Cholera Outbreaks**: Cholera outbreaks, often linked to contaminated water sources, disrupt economic activity in affected communities. Workers may be unable to work due to illness or caregiving responsibilities. Markets may be closed or avoided. Healthcare facilities become overwhelmed. The economic disruption compounds the direct health impacts, with ripple effects throughout local economies.

## 5. Policy and Workplace Health Strategies

### 5.1 Occupational Health and Safety Regulations

Strengthening Nigeria's occupational health and safety regulatory framework is essential for protecting workers from infection risks and preserving workforce productivity. The Federal Ministry of Labour and Employment has statutory responsibility for occupational safety and health, including safeguarding workers through workplace inspections, accident investigations, and policy development (Igbolekwu, 2025).

The current regulatory framework includes the Factories Act, which sets standards for workplace safety but applies primarily to formal sector establishments. The Act's coverage excludes most informal sector workplaces where the majority of Nigerians work, leaving these workers without regulatory protection. Expanding coverage to include informal sector workplaces, or developing alternative mechanisms for reaching these workers, is essential for addressing the regulatory gap.

Enforcement capacity is a critical constraint. The Factory Inspectorate Division of the Federal Ministry of Labour has limited staff and resources relative to the number of workplaces requiring inspection. Strengthening inspectorate capacity through increased funding, staff recruitment and training, and use of technology for remote monitoring would improve compliance. Collaboration with state governments, which have labour ministries, could extend reach.

Standards for infection control in workplaces should be developed or strengthened, addressing ventilation, crowding, sanitation, personal protective equipment, and sick leave policies. These standards should be evidence-based and developed through consultation with employers, workers, and occupational health experts. Sector-specific guidance may be needed for high-risk industries including healthcare, waste management, and agriculture.

Penalties for non-compliance must be meaningful enough to deter violations. Currently, penalties are often too low to outweigh the costs of compliance, particularly for larger employers. Strengthening penalty provisions and ensuring consistent enforcement would improve the deterrent effect.

**5.2 Workplace Infection Prevention and Control Measures**

Employers have both the responsibility and the economic interest to implement infection prevention and control measures that protect workers and preserve productivity. The sugarcane cutter study demonstrates that workplace health investments can yield substantial returns through increased productivity (Dillon *et al*., 2021). While not all interventions will generate such direct returns, many will be cost-effective when worker health and productivity benefits are considered.

Provision of clean water and sanitation facilities at workplaces is fundamental for infection prevention. Workers need access to safe drinking water and handwashing facilities with soap. For workplaces where workers eat meals, facilities for safe food storage and preparation are needed. These basic interventions prevent gastrointestinal infections and support hygiene generally.

Personal protective equipment must be provided and its use enforced where workers face infection risks. The waste handler study found that only 15 percent of workers acquired any PPE and only three percent consistently used it, despite extreme exposure to infectious agents (Osim *et al.*, 2025). Employers must provide appropriate PPE, train workers in its use, and ensure compliance through supervision and enforcement.

Vaccination programmes can protect workers from vaccine-preventable infections. Employers should facilitate access to recommended vaccines including influenza, hepatitis B, and tetanus. For healthcare workers and others at occupational risk, additional vaccines may be indicated. Workplace vaccination programmes can achieve high coverage by removing access barriers.

Vector control measures reduce malaria and other vector-borne disease risks for workers in affected areas. This includes provision of insecticide-treated nets for workers in overnight accommodation, indoor residual spraying where applicable, and environmental management to reduce breeding sites. Agricultural workers may benefit from insect repellent and appropriate clothing.

Sick leave policies that enable workers to stay home when ill without income loss reduce presenteeism and associated transmission. The absence of sick pay in most informal and many formal workplaces drives presenteeism, as workers cannot afford unpaid leave. While expanding formal sick leave coverage is challenging, particularly in the informal sector, innovative approaches such as pooled insurance mechanisms could provide partial income replacement.

**5.3 Health Insurance and Social Protection Programs**

Expanding health insurance coverage is essential for protecting workers from catastrophic health expenditures and facilitating access to appropriate care. The low coverage among informal workers documented in multiple studies (Onyekachi, 2025; Osim *et al.*, 2025) represents a major gap in social protection that leaves workers vulnerable when illness strikes.

The National Health Insurance Authority Act 2022 provides a framework for expanding coverage, including provisions for the informal sector. The Act establishes the Vulnerable Group Fund and encourages states to establish their own health insurance schemes. Implementation remains challenging, with many states yet to operationalise schemes and enrolment targets unmet.

State-level health insurance schemes offer potential for reaching informal workers. States including Lagos, Kwara, and others have established schemes with varying designs and coverage levels. Lessons from these experiences should inform expansion to other states. Premiums must be affordable for low-income workers, and benefit packages must include treatment for common infections affecting working populations.

Community-based health insurance and cooperative models can reach workers in organised groups such as artisan associations, market unions, and farmer cooperatives. These models leverage existing social structures for enrolment, premium collection, and governance. The automobile artisans and other informal worker groups could potentially be reached through such mechanisms (Igbolekwu, 2025).

Beyond health insurance, broader social protection programmes including cash transfers and income support during illness would protect workers from the economic consequences of infection-related productivity losses. While such programmes are resource-intensive, they could be targeted to the most vulnerable workers and linked to health promotion activities.

**5.4 Public–Private Sector Collaboration**

Effective responses to infection-related productivity losses require collaboration between public and private sectors, recognising the shared interest in a healthy workforce and the complementary roles each sector can play.

Government has responsibility for regulatory frameworks, policy development, surveillance, and provision of public goods including disease control programmes. The Federal Ministry of Labour and Employment, Federal Ministry of Health, and Nigeria Centre for Disease Control and Prevention provide essential public sector functions. State governments implement policies and deliver services at subnational level.

Private sector employers have direct interests in workforce health and opportunities to implement workplace interventions. Large formal sector employers can establish occupational health services, provide health insurance, and implement infection control programmes. Small and informal sector employers face greater constraints but can still take basic protective measures.

Industry associations and trade unions can facilitate collective action, disseminate information, and advocate for supportive policies. Associations of waste pickers, automobile artisans, and other informal worker groups can organise their members for health promotion and insurance enrolment. Trade unions in formal sectors can negotiate for improved occupational health protections.

Development partners provide technical assistance, financing, and knowledge sharing. The World Bank's HOPE-GOV programme supports governance reforms in health and education (Ministry of Budget and Economic Planning, 2026). UNICEF supports WASH and immunisation programmes. Bilateral partners provide technical assistance and funding for disease control.

The upcoming 5th Global High-Level Ministerial Conference on Antimicrobial Resistance, to be hosted by Nigeria in 2026, offers an opportunity to galvanise partnerships and position stewardship as a cornerstone of health security and economic resilience (Alagboso and Iroegbu, 2025). The conference can mobilise private sector participation and attract partnerships for AMR control, including workplace-focused interventions.

**5.5 Conclusion and Recommendations**

The evidence presented in this review demonstrates conclusively that microbial infections impose substantial burdens on Nigerian workforce productivity, with profound implications for economic growth, household welfare, and national development. The mechanisms through which infections affect productivity are multiple and reinforcing: absenteeism removes workers from the workforce; presenteeism reduces their output when they attend work while ill; and long-term health effects compromise human capital accumulation and earning potential over working lifetimes.

The magnitude of these effects is substantial. The sugarcane cutter study found that untreated malaria reduced worker earnings by approximately 10 percent, a productivity loss that translates into billions of Naira annually when extrapolated across affected sectors (Dillon *et al*., 2021). The waste handler study documented infection rates exceeding 90 percent in a vulnerable occupational group, with almost no access to occupational health protections (Osim *et al.*, 2025). Antimicrobial resistance threatens to increase these losses by making infections more difficult and expensive to treat, with potential GDP impacts reaching 3.8 percent globally by 2050 (Fatunbi, 2025).

Informal sector workers, constituting approximately 90 percent of Nigeria's workforce, face particular vulnerabilities. They work in conditions of high exposure with minimal protections, lack access to affordable healthcare, have no health insurance coverage, and experience direct income losses when illness prevents work. Their situation reflects broader failures in occupational health regulation, social protection, and health system design that must be addressed.

The poverty-disease cycle operates powerfully in working communities, as infection-related productivity losses reduce earnings, limit healthcare access, and perpetuate economic hardship. Breaking this cycle requires comprehensive strategies addressing both the immediate causes of infection and the underlying determinants of vulnerability.

Based on the evidence reviewed, the following recommendations are offered for strengthening workforce health and protecting productivity from the impacts of microbial infections:

1. **Strengthen occupational health regulations** by expanding coverage to include informal sector workplaces, increasing enforcement capacity, developing infection control standards, and establishing meaningful penalties for non-compliance.

2. **Implement workplace infection prevention and control measures** including provision of clean water and sanitation, personal protective equipment, vaccination programmes, vector control, and supportive sick leave policies. The sugarcane cutter study demonstrates that such investments can yield substantial productivity returns.

3. **Expand health insurance coverage for informal workers** through state-level schemes, community-based models, and linkage with worker associations. The low awareness and coverage documented in multiple studies must be addressed through outreach and enrolment support.

4. **Address antimicrobial resistance through workplace health programmes** by promoting appropriate antibiotic use, supporting adherence to prescribed regimens, and discouraging self-medication. Employers and occupational health services can reinforce public health messages.

5. **Strengthen surveillance of occupationally acquired infections** to provide data for priority setting and intervention design. The waste handler study demonstrates the value of focused occupational health research; routine surveillance would complement such studies.

6. **Target interventions to high-risk occupations** including waste handlers, healthcare workers, agricultural workers, and others with documented elevated risks. The extreme infection rates among waste handlers demand urgent attention.

7. **Develop social protection mechanisms for workers facing illness-related income losses**, including paid sick leave where feasible and income support programmes for informal workers. These mechanisms would reduce presenteeism and protect households from poverty.

8. **Strengthen public-private sector collaboration** through industry associations, trade unions, and development partnerships. The upcoming AMR conference provides an opportunity to mobilise action.

9. **Invest in research on infection-related productivity losses** to better quantify impacts, identify cost-effective interventions, and track progress. The sugarcane cutter study provides a model for rigorous evaluation; similar studies in other occupations would inform policy.

10. **Integrate workforce health into national development planning**, recognising that a healthy workforce is essential for achieving economic growth and poverty reduction targets. The HOPE-GOV programme's focus on human capital provides a platform for this integration.

Implementing these recommendations will require sustained political will, adequate resources, and effective collaboration across sectors and levels of government. The challenges are substantial, but so too are the potential rewards: a healthier, more productive workforce contributing to stronger economic growth and reduced poverty. The cost of inaction, measured in lost productivity, preventable illness, and foregone development, is far greater than the cost of effective response.

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