



COURSE: POLITICS: PHILOSOPHY AND ECONOMICS

ENHANCING VACCINE UPTAKE

IN SUB-SAHARAN AFRICA

A behavioral insights approach

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INTRODUCTION

Background of the Issue

Vaccination is a cornerstone of global public health, significantly reducing the incidence of infectious diseases and their associated mortality. Vaccine coverage remains suboptimal in many regions, particularly Sub-Saharan Africa. The region faces unique challenges, such as logistical issues, cultural barriers, and underdeveloped healthcare infrastructure, which complicate the effective delivery and acceptance of vaccines. Logistical issues include inadequate transportation and storage facilities, leading to difficulties maintaining the cold chain necessary for vaccine potency. Cultural barriers encompass various beliefs and practices that may lead to vaccine hesitancy, such as mistrust of vaccines or healthcare providers, misinformation, and traditional health beliefs. Additionally, the healthcare infrastructure in many parts of Sub-Saharan Africa is often underfunded and needs more resources and personnel to implement comprehensive vaccination programs.

Addressing these challenges requires innovative approaches. Behavioral insights, which draw on psychology, sociology, and behavioral economics, offer promising strategies to mitigate vaccine hesitancy and improve vaccination rates. These insights help us understand the cognitive biases, social norms, and cultural beliefs that influence health behaviors. By applying these principles, public health initiatives can be tailored to more effectively engage communities, build trust, and encourage positive health behaviors.

Research Question

This thesis seeks to answer the central question: "How can behavioral insights be utilized to overcome vaccine hesitancy and improve vaccination coverage in Sub-Saharan Africa?"

Outline of the Thesis

The structure of this thesis begins with Chapter 1: Introduction, which provides an overview of the thesis, including the background of the issue, the research question, and the thesis structure. Chapter 2: The Framework in Sub-Saharan Africa analyzes the broader socio-political and economic context in Sub-Saharan Africa, highlighting factors influencing public health policies and vaccination efforts and setting the stage for a detailed examination of specific regional health and vaccination challenges. Chapter 3: Vaccination Coverage and Impact explores the current state of vaccination in Sub-Saharan Africa, focusing on diseases like measles, tuberculosis, COVID-19, and hepatitis B, and examines the impact of vaccination programs while identifying barriers to higher coverage. Chapter 4: Case Study on COVID-19 Vaccination provides an in-depth analysis of COVID-19 vaccination efforts in Sub-Saharan Africa, drawing on behavioral insights to understand vaccine hesitancy and propose practical interventions, utilizing the "Behavioral Insights to Promote Demand for COVID-19 Vaccines in Sub-Saharan Africa" report as a primary source. Chapter 5: Behavioral Interventions for Vaccination discusses various behavioral interventions, including educational campaigns, trusted local figures, and interactive tools to combat misinformation, evaluating the effectiveness of these strategies in promoting vaccine acceptance and public health outcomes in Sub-Saharan Africa. Finally, the Conclusion synthesizes the insights from the previous chapters and presents actionable recommendations for future public health initiatives to improve vaccination coverage in Sub-Saharan Africa.

This introduction provides a comprehensive overview of the thesis, outlining the significant challenges faced in vaccine delivery and acceptance in Sub-Saharan Africa and highlighting the potential of behavioral insights to address these issues.

Capitolo 1

THE FRAMEWORK IN SUB-SAHARAN AFRICA

To better grasp the health and vaccination landscape in Sub-Saharan Africa, it is crucial first to explore the region's broader socio-political and economic framework. This initial analysis will comprehensively understand the factors influencing public health policies and initiatives. By examining the political stability, financial conditions, and social structures within Sub-Saharan Africa, we can uncover the underlying challenges and opportunities that impact health outcomes. This macro context sets the stage for a more informed discussion on specific health and vaccination strategies, paving the way for targeted interventions and sustainable health improvements in the region.

1.1 Macro Context Analysis

1.1.1 *Political Analysis of Sub-Saharan*

Significant challenges and disparities mark the political landscapes of Sub-Saharan Africa (SSA) and North Africa. This section examines these regions' political instability and governance issues, arguing that while they share common challenges, their political situations' underlying causes and implications differ fundamentally.

Both regions grapple with corruption, political scandals, and contested governance, historically undermining political and economic stability. These shared difficulties suggest a pan-African struggle against political malfeasance and mismanagement (Addis & Zhu, 2018).

While corruption and governance issues are widespread, SSA and North Africa differ significantly in their political dynamics. SSA's political instability often stems from

ethnic tensions and poorly managed resources, leading to frequent clashes and political volatility. In contrast, North Africa experiences political unrest primarily driven by authoritarianism and demands for reform, particularly highlighted by the Arab Spring movements (Addis & Zhu, 2018).

SSA's political challenges are deeply intertwined with socio-economic inequalities that will be deeply analyzed in the following sections where the unfair distribution of wealth and high youth unemployment catalyze political unrest; at the same time, a crucial phenomenon in the region is the limited freedom of the press, that is both related to the contents that journals and institutions can share and also to the slice of the population that is reachable (Addis & Zhu, 2018). Conversely, while economically more stable, North Africa suffers from political upheavals that often lead to rapid regime changes, reflecting a more politically sensitive environment to governance failures.

North Africa's political landscape is significantly shaped by external influences, including international responses to political crises such as Libya and Egypt (Addis & Zhu, 2018). SSA's political instability, however, tends to be more influenced by internal governance failures, with less pronounced external intervention. The external influences on SSA have recently changed since the Chinese and English governments launched a series of interventions regarding transportation, investments, and agreements between these governments and SSA.

Conflicts in Sub-Saharan Africa (SSA) and North Africa are fueled by a complex interplay of political, economic, and social factors, each region exhibiting distinct patterns and consequences of strife. In SSA, conflicts are predominantly internal and often ethnically driven, stemming from longstanding grievances over inequitable resource distribution and political marginalization. These conflicts are exacerbated by weak state institutions that fail to effectively manage diversity or address local communities' needs, leading to frequent insurgencies and civil unrest (Addis & Zhu, 2018). In contrast, North Africa's conflicts are more politically oriented, frequently linked to authoritarian governance and public demands for political freedoms and reforms. The Arab Spring, for instance, illustrates how demands for democratic

governance can escalate into widespread political turmoil, destabilizing entire regimes (Addis & Zhu, 2018). The distinction in conflict dynamics between the two regions points to the need for region-specific conflict resolution strategies, where SSA might benefit from initiatives to strengthen state capacity and promote inclusive governance. In contrast, conflict mitigation in North Africa could focus more on political reforms and enhancing civil liberties.

The central argument here is that governance failures are manifestly central to the political crises in both regions, yet the nature of these failures differs. In SSA, governance challenges are more about managing diversity and resource allocation, while in North Africa, the challenge is fundamentally about political inclusiveness and reform (Addis & Zhu, 2018).

Understanding these nuanced differences is crucial for developing effective policy responses. For SSA, enhancing governance could mean focusing on ethnic inclusivity and transparent resource management. For North Africa, the focus should be on political reforms that broaden political participation and ensure regime accountability (Addis & Zhu, 2018).

This comparative analysis underscores that while SSA and North Africa face similar challenges of political instability and governance issues, the roots and manifestations of these challenges diverge significantly. Addressing these issues effectively requires tailored approaches considering each region's unique political, economic, and social contexts.

1.1.2 Political Stability and Governance: The Impacts on Health Systems in Sub-Saharan Africa

The health sector in Sub-Saharan Africa (SSA) presents a compelling study of the interplay between political stability, governance, and public policy. The neoliberal reforms spearheaded by international financial institutions like the International Monetary Fund (IMF) and the World Bank have deeply influenced these dynamics, leading to significant shifts in health service delivery across the region.

Since the 1980s, Sub-Saharan Africa has witnessed a pronounced shift towards neoliberalism, driven by the IMF and the World Bank's structural adjustment policies. These policies have enforced a market-driven approach to health care, emphasizing privatization and commercialization at the expense of public welfare systems (Ichoku & Ifelunini, 2016). This ideological shift has not only altered the structure of healthcare systems but has also affected the political and governance landscapes of the affected countries.

The neoliberal agenda has often reduced state-funded health services, pushing a more significant share of health care provision onto the private sector. This has sometimes destabilized the political environment, as governments face public discontent over deteriorating health services and increased costs borne by the poor and vulnerable. As governance focuses more on compliance with international financial prescriptions than on meeting the immediate health needs of the populace, public trust and the legitimacy of state authorities can erode, leading to political instability (Ichoku & Ifelunini, 2016).

Promoting private health care has led to unethical practices, such as the proliferation of counterfeit drugs and inadequate medical facilities, driven by profit motives rather than patient care standards (Ichoku & Ifelunini, 2016). This profit-driven focus detracts from ethical medical practices and diminishes the government's role in safeguarding public health, leading to governance challenges centered around accountability and transparency.

Neoliberal policies have resulted in public health policies that often favor the interests of private investors over those of the general population, particularly the vulnerable and poor. For example, the shift towards cost-recovery measures in public hospitals has decreased access to necessary services for lower-income individuals, exacerbating health disparities (Ichoku & Ifelunini, 2016).

The transition towards privatization has been uneven across SSA, with significant variances in public vs. private health care utilization among countries. For instance, private health care dominates in some regions due to the decline in public facility use brought on by policy changes. This shift has also been linked to increased healthcare

costs, making essential health services unaffordable for many (Ichoku & Ifelunini, 2016).

The evidence suggests that neoliberal policies, while intended to introduce efficiencies into the health sector, have instead compromised the quality and accessibility of health care, particularly for the most vulnerable groups in SSA. The authors advocate for a fundamental reversal of these policies, recommending the adoption of universal health coverage principles that prioritize public health needs over market profitability. This would involve a shift to a more inclusive, state-funded health system that guarantees health care as a universal right rather than a commercial product (Ichoku & Ifelunini, 2016).

While the article by Ichoku and Ifelunini (2016) provides a critical overview of the neoliberal policies impacting health systems in Sub-Saharan Africa, it is essential to recognize that the region's current healthcare challenges are not solely the result of recent policy changes. Sub-Saharan Africa's complex history, marked by colonial legacies, post-independence political instability, and varied economic trajectories, has deeply influenced its health systems. Geopolitical factors, including foreign aid dependencies, international trade agreements, and global economic pressures, have also played significant roles. These elements, combined with internal factors such as governance variability, ethnic conflicts, and resource mismanagement, contribute to a multifaceted healthcare landscape. Understanding these factors is crucial for developing comprehensive strategies that address the root causes of healthcare challenges in the region beyond only neoliberal reform impacts.

1.1.3 Economic Analysis of Sub-Saharan Africa

The economic landscape of Sub-Saharan Africa (SSA) is marked by a dynamic interplay of challenges and opportunities that shape its development trajectory. Despite historical economic hurdles, recent decades have shown significant progress, fueled by various factors, including international investments and a rich endowment of natural resources.

Between 1981 and 2000, the GDP of SSA grew by 9%, a modest increase compared to the global GDP growth of 188% during the same period. However, from 2000 to 2021, SSA's GDP experienced a dramatic surge of 354%, primarily driven by Chinese loans and investments. This period contrasts sharply with the global GDP growth of 184% (Scirè, 2023). As of 2021, the GDP of SSA stood at \$1.9 trillion, remarkably close to Italy's GDP of \$2.1 trillion, underlying still a problematic situation due to the remarkable difference in the size of the two territories. (Scirè, 2023).

SSA has abundant natural resources and a young demographic, which positions it uniquely for future growth. The region's low median age is a potential asset for its labor market, enhancing its human capital potential. Leveraging these resources effectively remains a critical challenge and opportunity for the region.

While SSA has made strides in economic growth, it faces significant challenges, including corruption and inefficient financial management. These issues hinder effective resource utilization and equitable growth distribution, impacting economic stability and development.

The region's economic expansion has also been accompanied by an increasing reliance on external debt, raising concerns about sustainability and financial autonomy. The tightening global financial conditions and the appreciation of the US dollar have exacerbated debt service costs, increasing the risk of debt distress for countries with constrained fiscal spaces (African Economic Outlook, 2023).

SSA's economic journey reflects a distinct path compared to global trends, characterized by delayed starts but rapid recent growth, suggesting a catching-up process. This growth has been both a result of and a challenge for the region's political and economic policies.

Sub-Saharan Africa's economic resilience in the face of global uncertainties has been partially attributed to the private sector's adaptability and growth. The private sector's role in driving economic activity must be balanced, especially in non-resource-intensive economies, where diversity in economic activities has led to more robust

growth figures. However, despite its potential, the private sector in SSA faces significant barriers, including limited access to finance, inadequate infrastructure, and regulatory constraints that stifle innovation and growth. Strategic reforms to enhance private sector involvement could unlock significant economic potential and drive sustainable regional growth (African Economic Outlook, 2023).

While SSA has shown potential in transitioning to a green economy, the pace could have been more stable and challenging. The region requires substantial investments in sustainable infrastructure to mitigate climate change's effects and capitalize on green growth opportunities. Current financing gaps, however, pose a significant hurdle, with the African Economic Outlook 2023 noting that between \$2.6 trillion and \$2.8 trillion is needed by 2030 to implement SSA's climate action commitments. Bridging this gap necessitates innovative financing solutions and more robust engagement from international partners to support SSA's green transition (African Economic Outlook, 2023).

Governance remains a pivotal area where SSA must make considerable advances to ensure economic stability and growth. Corruption, poor fiscal management, and political instability undermine economic development. Policy reforms are critical to enhance transparency, improve public sector management, and foster a stable political environment. Such reforms should also aim to strengthen fiscal responsibility and expand the tax base to reduce the heavy reliance on external borrowing, posing the risk of debt distress (African Economic Outlook, 2023).

Addressing these critical issues with targeted interventions can significantly alter the economic landscape of Sub-Saharan Africa. By bolstering the private sector, closing financing gaps for sustainable development, and implementing rigorous governance reforms, SSA can achieve sustained economic growth and greater resilience against global economic shocks. These strategic interventions will address immediate economic challenges and lay a foundation for long-term prosperity in the region.

1.1.4 Analysis of Economic Factors Influencing Health Outcomes in Sub-Saharan Africa

Sub-Saharan Africa has seen significant, albeit inelastic, improvements in health outcomes corresponding to increases in health expenditures. Despite a substantial rise in healthcare spending from \$42.82 to \$97.07 per capita between 2003 and 2011, health improvements have been marginal. This spending still needs to be higher than global averages, indicating a dire need for increased funding and better allocation to achieve substantial health improvements (Arthur & Oaikhenan, 2017).

The GDP of SSA countries plays a crucial role in determining health outcomes. The region's average health expenditure is alarmingly below the world average — SSA spends only 6% of its GDP on healthcare compared to 13% and 17% in OECD countries and North America, respectively. This disparity underscores the region's underinvestment in health relative to its economic capacity, highlighting a significant area for policy intervention (Arthur & Oaikhenan, 2017).

Foreign aid has been pivotal in addressing health challenges in SSA. Investments have been channeled into critical areas such as immunization programs and infectious disease control, directly impacting health outcomes. However, the reliance on foreign aid for health expenditures raises concerns about sustainability and the need for SSA governments to allocate more domestic resources to health (Arthur & Oaikhenan, 2017).

The interaction between public and private health expenditures in SSA shows that while both significantly affect health outcomes, their impacts differ. Public expenditure effectively reduces mortality rates, whereas private expenditure substantially improves life expectancy. This dual role emphasizes the need for a balanced approach in health funding to cater to both immediate health crises and long-term health sustainability (Arthur & Oaikhenan, 2017).

Given the significant but inelastic effect of expenditure on health outcomes, it is recommended that SSA countries increase their health expenditure, particularly public health expenditure. Adequate health insurance schemes could alleviate the burden of

out-of-pocket expenses on individuals, thereby enhancing health access and equity (Arthur & Oaikhenan, 2017).

The economic analysis reveals that despite SSA's efforts to improve health outcomes through increased expenditure, the impact remains limited by the overall economic constraints and insufficient investment in health relative to GDP. There is a clear need for strategic policy reforms to increase health sector funding and optimize the expenditure mix between public and private sources to achieve better health outcomes across the region.

1.1.5 Societal Dynamics in Sub-Saharan Africa: Education, Culture, and Social Phenomena

Sub-Saharan Africa's population comprises approximately 1.1 billion individuals, characterized by a youthful demographic profile. The gender distribution is relatively balanced, with about 50.3% male and 49.7% female. The population is distributed by age: approximately 43% are aged 0-15 years, 19% are aged 15-30, and the remainder are above 30. This young demographic poses opportunities and challenges for the region, necessitating significant health, education, and employment investments to ensure sustainable development (United Nations, 2022).

Sub-Saharan Africa is distinguished by its exceptional linguistic variety, with over 2000 languages spoken across the region. This richness highlights the cultural complexity and varied ethnic backgrounds of its populations. The median age in SSA is notably low, reflecting a predominantly young demographic poised to shape the region's future. Such youthful demographics are advantageous for potential economic growth but also necessitate significant investments in education and employment opportunities to prevent societal strain.

The dynamics of mortality and fertility are crucial indicators with profound implications for economic growth in Sub-Saharan Africa. The region has historically exhibited high fertility rates, with notable demographic studies indicating that this trend has hurt economic growth. High fertility rates contribute to rapid population

growth, which strains the already limited economic resources and social infrastructure. This leads to a diminution of per capita resources, further exacerbating the region's economic challenges. On the other hand, life expectancy improvements, reflecting mortality rate declines, influence economic growth positively. As life expectancy increases, the workforce becomes more robust and productive, enhancing the region's economic output. This dual effect of demographic variables places a unique burden on the economic strategies of Sub-Saharan African nations, emphasizing the need for policies that manage fertility rates while improving health outcomes to boost life expectancy (Akintunde et al., 2013).

The diverse cultural landscape in SSA reflects deep-rooted traditions intertwined with modern influences. However, the vast array of cultures also presents challenges, particularly regarding regional and ethnic integration. Educational systems are pivotal in bridging these divides, fostering a sense of national identity while respecting cultural diversity. Effective educational policies incorporating cultural awareness can significantly contribute to national cohesion and stability (World Bank, 2019).

Education in SSA varies significantly in terms of accessibility and quality. While some regions show improved literacy and educational attainment, others need more resources and infrastructural deficiencies. UNESCO's 2023 report highlights that SSA faces the world's highest rates of education exclusion, with over one-fifth of children between the ages of 6 and 11 and one-third between the ages of 12 and 14 not attending school. Improving these figures is critical for harnessing the demographic dividend of the region's youthful population (UNESCO, 2023).

Religious and ethnic identities shape SSA's social interactions and community life. The region is characterized by a high degree of religious diversity, with significant populations of Christians, Muslims, and followers of indigenous beliefs, which often influence social norms and practices. Understanding these dynamics is essential for developing policies that respect religious and ethnic identities while promoting inclusivity.

Sub-Saharan Africa's society, with its youthful energy and cultural diversity, holds immense potential. Prioritizing education and embracing cultural diversity through inclusive policies can transform these societal characteristics into catalysts for sustainable development and social harmony. SSA can effectively navigate its social and economic challenges by fostering an educated, culturally aware, and economically active population.

1.1.6 Social Structure and Education: Influences on Health Outcomes in Sub-Saharan Africa

The interplay between education and health outcomes is profound and multifaceted, significantly impacting public health efforts across Sub-Saharan Africa. The literacy rates and the quality of education systems play critical roles in shaping these outcomes, reflecting broader socio-economic dynamics that influence public health strategies.

Literacy rates in SSA vary significantly, influencing individual and community health outcomes. Higher literacy correlates with better health knowledge and practices, including higher vaccination rates and lower incidence of preventable diseases. Literacy empowers individuals to access, understand, and utilize health information effectively, leading to improved self-care and participation in public health initiatives (Olafsdottir et al., 2011).

The quality of the education system in SSA directly impacts the efficacy of public health campaigns. A robust education system can enhance the understanding and implementation of health-related knowledge, fostering communities more responsive to public health directives. However, many regions within SSA face underfunded schools, insufficient educational materials, and inadequate teacher training, which hinder the optimal delivery of health education. These educational deficiencies can impede the effectiveness of interventions to improve health outcomes, such as those targeting under-five mortality rates and maternal health (Olafsdottir et al., 2011).

The infrastructure of the education system, including the availability of schools and qualified educators, also plays a crucial role in disseminating health information. In

areas where educational infrastructure is robust, public health campaigns can leverage schools as platforms for disseminating critical health information and services, thus reaching a large segment of the population effectively. Conversely, in regions lacking such infrastructure, public health campaigns often need help to achieve their desired impact, demonstrating the vital link between educational infrastructure and health outcomes (Olafsdottir et al., 2011).

The relationship between education and health outcomes in Sub-Saharan Africa is a critical area of focus for improving public health. Enhancing literacy rates and improving the quality and reach of education systems can significantly bolster health outcomes. Public health campaigns integrated into educational programs are more successful, highlighting the importance of concurrent investments in education and health sectors to achieve substantial public health improvements in SSA.

1.2 Health System and Investments

Significant disparities in the availability and quality of medical facilities characterize the healthcare infrastructure in Sub-Saharan Africa. While a modest number of hospitals exist, many are concentrated in urban areas, leaving rural regions underserved. The average in-patient bed density in the WHO African Region is considerably low at 10 per 10,000 people, compared to global benchmarks, which suggest 18 to 39 in-patient beds per 10,000 people in lower-income and upper-income countries, respectively. This discrepancy highlights the urgent need for increased investment in hospital infrastructure to accommodate the growing population and to improve healthcare access (World Health Organization, 2022).

The healthcare workforce in Sub-Saharan Africa is critically underserved and unevenly distributed. There are acute shortages, particularly of specialist doctors and trained nursing staff. The region faces a significant challenge due to the migration of trained professionals to more affluent countries, exacerbating the shortage. This brain drain is more pronounced in countries that cannot offer competitive remuneration or working conditions. The density of healthcare professionals is lowest in rural areas,

further compounding access issues for the most vulnerable populations (World Health Organization, 2022).

Access to healthcare facilities in Sub-Saharan Africa varies dramatically between urban and rural settings. In urban areas, the private sector provides approximately 55.9% of health services, reflecting better healthcare availability and diversity in service provision. Conversely, traditional and spiritual healers account for a significant portion (67.1%) of health services in rural and peri-urban areas, indicating a reliance on non-formal healthcare systems due to the lack of accessible, formal medical facilities (World Health Organization, 2022).

Sub-Saharan Africa's healthcare infrastructure faces numerous challenges that require urgent attention to improve health outcomes across the region. Enhancing the healthcare workforce, improving the quality and reach of facilities, and bridging the gap between urban and rural healthcare services are critical steps needed to advance health equity and access. Without significant investments and reforms in healthcare infrastructure, the region will continue to struggle with health disparities and insufficient medical care coverage.

The allocation of national budgets to healthcare in Sub-Saharan Africa has shown a trend of weak incremental growth before the pandemic, with government health expenditure increasing by only 3% annually over the past two decades. This slow growth has been attributed to sluggish economic growth, limited improvement in revenue mobilization, and a lack of political prioritization for health. Despite these challenges, there has been a notable shift towards stronger reprioritization of health in the budget post-pandemic, with a significant rise in government health expenditure observed in 2020, marking the most significant annual increase since records began (ODI, 2024).

International aid has played a crucial role in supplementing national health budgets, particularly in times of crisis such as the COVID-19 pandemic. This aid has been essential in bolstering health systems and addressing urgent health needs across the

region. However, the sustainability of relying heavily on international aid could be better, emphasizing the need for countries to increase domestic funding for health.

Specific investments in health infrastructure and services have been uneven across Sub-Saharan Africa, with many countries facing significant gaps in essential medical supplies, equipment, and facilities. Investments are often directed toward immediate needs rather than long-term infrastructure development, which is crucial for sustainable health improvements.

Sub-Saharan Africa faces significant challenges in healthcare financing, with a need for increased domestic funding and better prioritization of health in national budgets. While international aid continues to support health systems temporarily, strategic investments in health infrastructure and services are essential for long-term sustainability and improved regional health outcomes.

1.3 Public Health and Vaccination

Sub-Saharan Africa faces unique health challenges that significantly impact its socio-economic development. The region's disease burden is heavily influenced by infectious diseases like HIV/AIDS, malaria, cholera, gonorrhea, and tuberculosis, alongside a rising prevalence of non-communicable diseases (NCDs). Understanding these health challenges is crucial for effective healthcare planning and intervention.

HIV/AIDS

The prevalence of HIV/AIDS in sub-Saharan Africa varies significantly by region, with Southern Africa being the most brutal hit. Countries like Eswatini, Lesotho, and South Africa have adult HIV prevalence rates exceeding 20%. Data collection is facilitated through antenatal clinic surveillance and national household surveys, which help estimate the number of people living with HIV, the incidence of new infections, and access to antiretroviral therapy. Despite improvements in data collection methods over the years, discrepancies in data quality and timeliness still exist, affecting the accuracy and effectiveness of intervention strategies.

HIV/AIDS remains one of the most severe public health crises in sub-Saharan Africa. The region accounts for over two-thirds of the global total of new HIV infections. The epidemic reduces life expectancy and devastates families, communities, and national economies.

HIV/AIDS places a considerable strain on healthcare systems, consuming substantial medical resources and overshadowing other health priorities. The need for long-term treatment and care for those living with HIV complicates healthcare delivery and resource allocation.

Efforts to manage HIV/AIDS include widespread antiretroviral therapy (ART) programs, prevention campaigns, and international aid support. However, challenges such as drug resistance, access to treatment in rural areas, and the stigma associated with the disease persist, hindering effective management.

Ongoing public health campaigns aimed at HIV/AIDS in sub-Saharan Africa primarily focus on prevention, testing, and destigmatization of the disease. Initiatives such as the ABC (Abstain, Be faithful, Condom use) campaign have been widely promoted. More recently, campaigns emphasize "Treatment as Prevention" (TasP), encouraging early and widespread access to antiretroviral therapy to reduce community viral loads and prevent transmission. The effectiveness of these campaigns varies widely, with some regions achieving significant reductions in new infections while others struggle due to sociocultural barriers and inconsistent implementation.

Malaria

Malaria surveillance in sub-Saharan Africa relies on health facility reporting and community-based surveys to track cases and outbreaks. Data are used to guiding the distribution of resources like bed nets and medications and to monitor trends in incidence and treatment resistance. While significant strides have been made in data collection, challenges remain in ensuring complete and timely reporting from remote areas. Additionally, the variability in diagnostic capabilities across regions can lead to

underreporting or misclassifying malaria cases, complicating efforts to assess and respond to the disease burden accurately.

Malaria is endemic in sub-Saharan Africa, with significant impacts on child mortality and adult productivity. It is responsible for hundreds of thousands of deaths annually, particularly among children under five.

Strategies to combat malaria include insecticide-treated mosquito nets, indoor residual spraying, and preventive antimalarial medications. These efforts have substantially reduced malaria incidence but must be sustained to achieve eradication.

Issues such as mosquito resistance to insecticides, parasite resistance to antimalarials, and inconsistent funding hamper effective malaria control. Moreover, environmental and socio-economic factors contribute to the complexity of malaria prevention.

Malaria prevention campaigns in sub-Saharan Africa are robust, including mass distribution of insecticide-treated nets (ITNs), intermittent preventive treatment in pregnancy (IPTp), and seasonal malaria chemoprevention (SMC) in high transmission areas. These campaigns are often supported by international donors and local governments, leading to measurable reductions in malaria rates. However, funding inconsistencies, resistance development, and coverage gaps, especially in rural and remote areas, limit their effectiveness.

Tuberculosis (TB)

TB data in sub-Saharan Africa is collected through national TB control programs tasked with case reporting and tracking treatment outcomes. Enhanced by the WHO's push for more robust data through the Directly Observed Treatment, Short-course (DOTS) strategy, data collection includes monitoring of drug-resistant TB strains and co-infection with HIV. However, the quality of TB data is often hindered by diagnostic challenges, incomplete case reporting, and inconsistent data collection across different regions, which may obscure the actual burden of the disease.

Tuberculosis remains a significant health concern, with high incidence rates exacerbated by the HIV epidemic. Co-infection with HIV and TB poses considerable treatment challenges and elevates mortality rates.

Despite the implementation of the DOTS strategy (Directly Observed Treatment, Short-course), challenges remain in ensuring treatment adherence, diagnosing drug-resistant strains, and integrating TB care with HIV services.

TB significantly strains healthcare resources, requiring long-term treatment strategies and specialized care, often diverting resources from other health services.

Public health campaigns for tuberculosis focus on early detection, adherence to treatment, and public education to reduce stigma. The Stop TB Partnership's Global Plan to End TB has driven initiatives to expand access to diagnostic and treatment facilities. Moreover, community outreach programs aiming to educate the public on TB symptoms and the importance of completing TB treatments have had varying success, heavily dependent on community engagement and continuous funding.

Emerging Non-Communicable Diseases (NCDs)

Data on non-communicable diseases in sub-Saharan Africa are less comprehensive than for infectious diseases, reflecting the relatively recent focus on NCDs in health surveillance. Most data come from health facility records, demographic health surveys, and occasional specialized studies focusing on specific conditions like hypertension, diabetes, or cancer. These data sources often need more granularity to understand NCD patterns fully and are limited by infrequent data collection that does not adequately capture trends or emerging health issues. Efforts to integrate NCD indicators into routine health information systems are ongoing, but significant gaps remain in data quality and coverage.

There is a noticeable rise in non-communicable diseases such as diabetes, cardiovascular diseases, and cancers. This shift reflects changes in lifestyle, including dietary habits, physical inactivity, and urbanization.

Factors such as increased life expectancy, urbanization, and adoption of Western lifestyles contribute to the rising NCD burden. These diseases require chronic care, which is currently underdeveloped in many parts of the region.

NCDs impose significant economic burdens due to loss of productivity and high healthcare costs. They challenge healthcare systems that are not equipped to manage chronic care and require considerable investment in healthcare infrastructure.

Campaigns addressing non-communicable diseases in sub-Saharan Africa include initiatives to promote healthier lifestyles, such as the WHO's "25 by 25" goal, which aims to reduce premature mortality from NCDs by 25% by 2025. These campaigns focus on reducing risk factors associated with NCDs, such as improving diet, increasing physical activity, and reducing tobacco and alcohol use. Effectiveness is often hampered by urbanization, changing lifestyles, and a need for more awareness about NCDs. There is also a need to integrate NCD prevention into primary healthcare settings better to reach broader populations.

The disease burden in sub-Saharan Africa is diverse and dynamic, requiring integrated approaches to healthcare that address both infectious and non-communicable diseases. Future health policies must strengthen healthcare systems, enhance disease surveillance, and promote public health interventions that address existing and emerging health challenges. There is also a critical need for sustained funding and international cooperation to support these efforts effectively.

1.4 Introduction to Behavioral Science and Its Tools

Behavioral science delves into the cognitive processes that shape human behaviors, decisions, and social interactions. It is an interdisciplinary field that explores human actions and interactions. It uses insights from psychology, sociology, anthropology, and economics to understand how people make decisions and how they can be influenced. Such understanding is pivotal when addressing public health challenges such as vaccine hesitancy, particularly in Sub-Saharan Africa, where cultural, economic, and logistic factors uniquely intertwine.

At its core, behavioral science examines the cognitive processes behind decision-making, including biases, heuristics (mental shortcuts), and the influence of social networks and norms. By studying these factors, researchers can predict behaviors in various contexts and design interventions to encourage beneficial habits and discourage harmful ones.

Behavioral science is fundamentally about understanding why people do what they do. It investigates how various internal and external factors influence thoughts, emotions, and behaviors. These internal factors include cognitive biases and heuristics. Cognitive biases are systematic patterns of deviation from norm or rationality in judgment, leading individuals to make illogical decisions. They are mental shortcuts that our brains take to simplify complex decision-making processes. For example, confirmation bias causes people to favor information that confirms their preexisting beliefs. This can lead to a skewed perception of reality. Another example is the availability heuristic, which makes people overestimate the importance of readily available information, often leading to inaccurate judgments. Understanding these cognitive biases is crucial in designing effective interventions.

External factors include social influences and environmental cues. Social networks and norms play a crucial role in shaping behavior. Social norms are the unwritten rules of behavior that are considered acceptable in a group or society. They can be powerful influencers of behavior, often more so than individual beliefs or preferences. People are influenced by the behavior and attitudes of those around them, which can spread behaviors through communities. For instance, if a significant portion of a community is hesitant about vaccines, this attitude can influence others, creating a social norm that is resistant to change. Understanding and leveraging these social norms can be a key strategy in addressing public health challenges.

Behavioral science also considers the role of emotions in decision-making. Emotions can drive decisions in powerful ways, sometimes overriding rational thought processes. Fear, for example, can lead to avoidance behaviors, while positive emotions can encourage engagement and exploration.

Behavioral science, with its interdisciplinary nature, draws from psychology to understand individual mental processes and behaviors, sociology to study social structures and their impact on human behavior, anthropology to explore cultural influences, and economics to examine how incentives and resources shape decisions. This comprehensive approach allows for a nuanced understanding of complex human behaviors. This interdisciplinary nature of behavioral science not only enriches our understanding of human behavior but also broadens our perspective on public health challenges, sparking intrigue and enlightenment.

In practical terms, applying behavioral science involves designing interventions that consider these various influences. For public health initiatives like promoting vaccination, this might mean creating campaigns that address specific cognitive biases, leveraging social networks to spread positive health behaviors, and crafting messages that resonate emotionally with the target audience. This practical application of behavioral science is not only fascinating but also holds the potential to significantly improve public health outcomes.

For example, understanding the local cultural context can help design culturally sensitive interventions that are more likely to be accepted. Economic insights can guide the creation of incentives that make vaccination more accessible and appealing. Logistical considerations can ensure that interventions are practical and feasible given the local infrastructure.

Core Concepts of Behavioral Science:

1. **Heuristics and Biases**

Heuristics are mental shortcuts that simplify decision-making but can sometimes lead to systematic errors or biases. Here are a few critical heuristics:

- *Availability Heuristic*: This involves estimating the likelihood of events based on how easily examples come to mind. For instance, after seeing news reports about airplane accidents, people might overestimate the danger of flying, even though statistically, it is much safer than driving. The vividness and emotional

impact of the news make such events more memorable and thus seem more common than they are.

- *Representativeness Heuristic*: People assess the probability of an event by how much it resembles their existing stereotype of that event. For example, Imagine someone flips a coin six times and gets the sequence HHTHTT. When asked which sequence is more likely to occur next, people often think another mixed pattern, like HTTHTH, is more likely than getting six heads in a row (HHHHHH). This happens because the mixed pattern seems more random and representative of how we expect coin tosses to look. Both sequences are equally probable since each flip is independent, and the probability of any specific sequence of six flips is the same. This bias in judgment is due to the representativeness heuristic, where people assess probabilities based on how much an outcome resembles their idea of randomness rather than using actual statistical reasoning.
- *Anchoring* occurs when people rely too heavily on the first information they encounter (the 'anchor') when making decisions. For example, the anchoring heuristic related to discounted prices can be seen in a supermarket. Imagine a TV is listed with an original price of \$1,200 but is now on sale for \$800. The original price of \$1,200 is an anchor, making the \$800 sale seem like a great deal. Even if the TV's fair market value is around \$800, shoppers feel they are getting a bargain because their perception is anchored to the higher original price. This anchoring effect leads them to perceive the discount as more significant than it might be, influencing their decision to purchase. This initial anchor can unduly influence final decisions. To overcome this bias, gathering as much information as possible before deciding and considering a wide range of possibilities rather than just the first one that comes to mind is essential (Plous, 1993, p. 233).

2. System 1 and System 2 Thinking

System 1 and System 2 Thinking refer to two different modes of thought:

- *System 1*: Fast, automatic, and intuitive. This system is used for quick decisions, such as recognizing a friend's face in a crowd or driving on a familiar route. It operates with little conscious effort but is prone to biases. For instance, when asked to estimate how much a product is worth based on its packaging, people might make a quick judgment influenced by the design and brand rather than the actual product quality (Kahneman, 2011).
- *System 2*: Slow, deliberate, and analytical. This system is used for more complex decisions, like solving math problems or planning vacations. It requires conscious effort and is more reliable, but it can be exhausting. For example, when making a significant financial decision, such as an investment, engaging System 2 allows for thorough analysis and consideration of risks and benefits (Kahneman, 2011).

3. Nudging

Nudging involves subtle environmental changes that can influence behavior without restricting freedom of choice. Here are some examples:

- *Default Options*: Defaults can powerfully impact choices. For instance, default options can be seen in organ donation policies. In countries where the default option is to be an organ donor (opt-out system), most people remain donors because they are anchored to the default choice and do not take the extra step to change it. Conversely, fewer people become donors in countries where the default is not to be a donor (opt-in system) because they would have to take action to opt in. The initial default setting acts as an anchor, significantly influencing people's decisions by providing a starting point from which many do not move away. People tend to stick with the default due to inertia or perceived endorsement of that option (Tversky & Kahneman, 1986).
- *Simplification and Convenience*: This phenomenon can effectively nudge people toward desired behaviors by making those behaviors easier to perform. How things are structured can heavily influence our choices, as our minds tend to gravitate toward the path of least resistance. For instance, in a cafeteria, if healthier food options like fruits and salads are placed at eye level and within

easy reach, while less healthy options like sugary snacks are positioned on lower or higher shelves, people are more likely to choose the healthier options. This arrangement leverages convenience, as people pick the most accessible and visible, subtly guiding them toward better dietary choices without requiring conscious effort. By strategically organizing environments, it is possible to encourage more beneficial behaviors naturally and effortlessly.

- *Reminders and Prompts:* Reminders and prompts can effectively nudge behavior by providing timely cues that encourage desired actions. The structure and timing of these reminders are crucial, as they can significantly impact our behavior by bringing essential tasks to the forefront of our minds at the right moment. For example, sending text message reminders to people to pay their bills on time can reduce late payments. Humans generally intend to manage our responsibilities and remember important tasks. However, we often rely on external systems to help us stay on track because we can be naturally forgetful or distracted. We want to behave in a certain way but sometimes need more immediate motivation or attention. A gentle reminder at the right time—when people are likely to be accessible and attentive, like mid-morning or early afternoon—can help overcome this laziness, prompting us to act more efficiently and fostering better habits. By strategically timing these reminders, it is possible to support people in managing their responsibilities and achieving their goals more effectively (Tversky & Kahneman, 1986).

4. Framing Effects

Framing refers to how information is presented and how it influences decision-making.

Here are some examples:

- *Positive vs. Negative Framing:* Framing can significantly affect decisions by influencing perceived choices. For instance, a surgery with a 90% survival rate sounds more favorable than one with a 10% mortality rate, even though both convey the same information. People naturally respond more positively to optimistic framing because we prefer positive outcomes. As a result, individuals are more likely to opt for the surgery when the survival rate is

highlighted. This is particularly important because information is often deliberately framed to shape our perceptions and decisions. Understanding the impact of framing helps us critically assess how information is presented, enabling us to make more informed decisions aligned with our valid preferences (Tversky & Kahneman, 1986).

5. Related Concepts

- *Prospect Theory*: Developed by Kahneman and Tversky, explains that people value gains and losses differently, leading to inconsistent risk behavior. For example, consider choosing between receiving \$100 for sure or taking a 50% chance to win \$200. Most people choose the guaranteed \$100, showing risk aversion when it comes to gains because they prefer the certainty of a smaller gain over the possibility of a larger one. Conversely, when faced with a choice between an inevitable loss of \$100 or a 50% chance of losing \$200, most people opt for the gamble, preferring the chance to avoid a loss altogether, even if it means potentially losing more. This illustrates loss aversion, where the pain of losing is felt more strongly than the pleasure of gaining. People are more motivated to avoid losses than achieve gains, leading to irrational financial decisions. Understanding Prospect Theory makes it possible to comprehend better why individuals often behave inconsistently in situations involving risk and can develop strategies to manage these biases (Tversky & Kahneman, 1986).
- *Bounded Rationality*: This concept, proposed by Herbert Simon, suggests that people aim to satisfy rather than optimize decision-making. In simpler terms, we often settle for 'good enough' rather than striving for the best possible outcome. This is due to limitations in our cognitive abilities, the information available, and the time we have to make decisions. For example, when shopping for a new phone, a person might settle for one that meets their essential criteria rather than exhaustively comparing all options to find the best choice (Plous, 1993, p. 233).

These concepts illustrate how behavioral science insights can improve decision-making in various contexts, from personal finance and health to consumer behavior and policy design. The more we understand these principles, the more effectively it is possible to design interventions that guide people toward better choices without limiting their freedom. This knowledge can inspire us to make a positive impact in our sphere.

Tools Used in Behavioral Science:

1. **Surveys and Questionnaires:** These are commonly used to gather data on attitudes, beliefs, and intended behaviors from a large population. They can help identify the prevalence of vaccine hesitancy and its underlying causes.

2. **Interviews and Focus Groups:** These qualitative tools provide deeper insights into the personal and community factors influencing behavior. They are essential for understanding the complex reasons behind vaccine hesitancy in different cultural contexts.

3. **Experiments:** Controlled, randomized controlled trials allow researchers to test the effectiveness of specific interventions on behavior change. This is critical in determining what strategies may work best in promoting vaccination.

4. **Behavioral Economics:** This aspect of behavioral science applies psychological insights to economic models, studying how people behave in the market instead of how they would if they were purely rational agents. Techniques such as nudging—making small environmental changes that make the desired choice the easiest or most appealing—can be particularly effective.

5. **Data Analytics:** Using big data and machine learning to analyze trends and patterns in behavior over time can provide actionable insights. For instance, analyzing health records and vaccination rates can help identify areas with significant hesitancy and the factors correlating with it.

6. **Social Media Analysis:** As a modern tool, analyzing trends and sentiments on social media platforms can offer real-time insights into public opinions and misinformation patterns about vaccines, which is crucial for timely and targeted interventions.

7. **Randomized Controlled Trials (RCTs):** The gold standard for testing the effectiveness of behavioral interventions. RCTs can determine how changes in policy or practice affect vaccine uptake.

8. **Qualitative Methods:** Deep dives through interviews and focus groups can uncover nuanced insights into why specific populations may accept or reject vaccines

When applied thoughtfully, these tools can help understand and shape public perceptions and behaviors toward vaccines in Sub-Saharan Africa, providing a foundation to address vaccine hesitancy effectively. The following sections will delve deeper into how these tools are specifically utilized to combat vaccine hesitancy in the region.

Capitolo 2

VACCINATION COVERAGE AND IMPACT IN SUB-SAHARAN AFRICA

2.1 Vaccination Coverage and Impact

In Sub-Saharan Africa, the burden of vaccine-preventable diseases remains disproportionately high, presenting unique challenges and opportunities for public health interventions. This chapter will explore the critical role of vaccinations in mitigating the spread of infectious diseases that significantly impact the region's health landscape. Despite the availability of effective vaccines, numerous barriers, such as logistical constraints, limited healthcare infrastructure, vaccine hesitancy, and socio-economic factors, hinder optimal vaccination coverage. By examining diseases like measles, tuberculosis, COVID-19, and hepatitis B, this analysis sheds light on the importance of enhancing vaccination efforts.

- **Measles (Morbillo)**

Measles remains a critical health concern in Sub-Saharan Africa due to its highly contagious nature and potential for large outbreaks. Despite the availability of a highly effective vaccine, measles outbreaks continue, mainly due to gaps in vaccination coverage. According to the World Health Organization, in 2019, there were over 9 million measles cases and 207,500 deaths globally, with a significant portion of these occurring in Africa. The measles vaccine not only prevents new infections but also decreases the mortality rate, especially among young children who are most vulnerable to severe complications from the disease.

- **Tuberculosis (TB)**

Tuberculosis is one of the top 10 causes of death worldwide. It poses a significant health threat in Sub-Saharan Africa, exacerbated by the high prevalence of HIV/AIDS, which weakens the immune system, making individuals more susceptible to T.B. The Bacille Calmette-Guérin (B.C.G.) vaccine is primarily used in countries with a high prevalence of T.B. to protect against severe forms of tuberculosis in children. The ongoing challenge in the region is maintaining high B.C.G. vaccination rates to ensure community-wide health benefits, especially as drug-resistant forms of T.B. emerge.

- **COVID-19**

The COVID-19 pandemic has highlighted critical vaccine distribution and uptake issues in Sub-Saharan Africa. As of the latest data, vaccine coverage remains lower in this region than global averages due to supply constraints, logistical challenges, and vaccine hesitancy. The COVID-19 vaccination efforts have also provided an opportunity to strengthen the overall health infrastructure, which can benefit other vaccination programs. The pandemic underscores the importance of timely and equitable vaccine access during global health emergencies.

- **Hepatitis B**

Hepatitis B is highly endemic in Sub-Saharan Africa, with a significant percentage of the population at risk of chronic infection, which can lead to liver cirrhosis or carcinoma. Vaccination against hepatitis B is highly effective and has been included in routine immunization programs in many African countries. Ensuring high coverage rates is essential to prevent mother-to-child transmission at birth and during early childhood, which are crucial steps in controlling the spread of the disease in the region.

Excluded Diseases from Detailed Analysis:

- **Malaria:** While there is a vaccine for malaria (R.T.S., S/AS01), its efficacy ranges between 35-55%, primarily used in Sub-Saharan Africa. About half a million people die from malaria each year, with numbers slightly decreasing. The vaccine focuses mainly on preventing severe disease in young children.

Due to the low efficacy and high mortality rates, malaria will not be a primary focus in the analysis of vaccination efforts.

- **Ebola:** The Ebola vaccine is explicitly used for outbreak control rather than routine immunization, making it less relevant for an analysis focused on general vaccination programs in Sub-Saharan Africa.

2.2 Assessing Vaccine Analysis for Key Diseases

To describe the vaccination coverage and impact of the diseases in Sub-Saharan Africa, we will address the following key factors: vaccine uptake (U, Uptake), the effect of vaccination (I, impact), and vaccine hesitancy (H, Hesitancy)(U.I.H.).

2.2.1 MEASLES

Vaccine Uptake

The measles vaccine uptake in Sub-Saharan Africa reveals a complex landscape with significant disparities. Coverage rates for the first dose of the measles-containing vaccine (MCV1) are moderately high on average, but there is a substantial drop in coverage for the second dose (MCV2). For instance, a multi-country study highlighted that MCV2 coverage varies widely and is influenced by factors community and individual factors such as maternal education, health facility access, and socio-economic status (Chilot et al., 2022). Moreover, the COVID-19 pandemic disrupted measles vaccination efforts, leading to further setbacks in achieving targeted coverage rates (Masresha, 2023).

Impact of Vaccination

The measles vaccination has significantly impacted public health in Sub-Saharan Africa. Historically, vaccination efforts have resulted in a dramatic decrease in measles-related mortality. For instance, global measles deaths decreased by 79% from 2000 to 2015 due to intensified vaccination efforts (WHO, 2017). However, the region still faces outbreaks due to gaps in immunization coverage, particularly highlighted

during periods like 2017-2021 when measles surged amid global vaccination challenges (Masresha, 2023).

Vaccine Hesitancy

Vaccine hesitancy is a critical barrier to achieving measles elimination in the region. Factors contributing to hesitancy include misinformation, lack of vaccine trust, logistical challenges, and socio-economic barriers. For example, a systematic review identified significant individual and healthcare system obstacles, such as inadequate vaccine supply, poor health infrastructure, and limited access to healthcare services, directly affecting vaccination uptake (Bangura et al., 2020).

In conclusion, while measles vaccine coverage in Sub-Saharan Africa has significantly decreased mortality, the region still faces challenges due to vaccine hesitancy and logistical barriers. Addressing these issues through targeted interventions, community engagement, and strengthening health systems is crucial for improving vaccine coverage and moving toward measles elimination.

2.2.2 TUBERCULOSIS (TB)

Vaccine Uptake

Tuberculosis (T.B.) remains a major public health challenge in Sub-Saharan Africa, where significant efforts are needed to improve vaccination and control strategies. The Bacillus Calmette-Guérin (B.C.G.) vaccine, the primary defense against T.B., has widespread but variable coverage across the region. The WHO highlights that despite the availability of the B.C.G. vaccine, many children do not receive it within the recommended timeframe, which hampers effective control of T.B. spread (World Health Organization, 2023) (World Health Organization, 2018).

Impact of Vaccination

The impact of T.B. vaccination and control efforts in Sub-Saharan Africa has significantly reduced the incidence and mortality rates, but challenges remain. Over

the past decade, T.B. incidence in the region has declined, attributed to better diagnosis, improved treatment strategies, and ongoing vaccination efforts. However, T.B. remains one of the leading causes of death among infectious diseases in the region, particularly among those co-infected with H.I.V. (World Health Organization, 2023a) (*Tuberculosis in the WHO African Region: 2023 Progress Update.*, 2024). There has also been a notable reduction in T.B. incidence rates due to ongoing health interventions and vaccination programs. Nevertheless, these must be accelerated to meet global T.B. elimination goals (World Health Organization, 2018).

Vaccine Hesitancy

Vaccine hesitancy for T.B. in Sub-Saharan Africa is compounded by the stigma associated with the disease, which significantly impacts patient outcomes and public health strategies. Stigmatization leads to delays in seeking treatment, discontinuation of therapy, and reluctance to disclose health status. This is particularly severe in regions where T.B. is falsely associated with H.I.V., adding a layer of social stigma. Educating communities and reducing stigma are crucial for improving vaccination and treatment adherence rates (Esso–Hanam Atake, 2023).

In conclusion, while there has been progress in the fight against T.B. in Sub-Saharan Africa, the region faces unique challenges that require targeted public health interventions and community engagement strategies to improve vaccine uptake and reduce the disease burden. Continued education, stigma reduction, and healthcare infrastructure efforts are essential to sustain and build on the current gains in T.B. control and eradication efforts.

2.2.3 COVID-19

Vaccine Uptake

The uptake of COVID-19 vaccines in Sub-Saharan Africa has been notably slower than global averages. As of mid-2023, various countries across the region show significant disparities in vaccination rates. Seychelles and Mauritius are among the countries with the highest rates, while many other nations lag significantly behind due

to various barriers, including limited vaccine supplies and logistical challenges. In Tanzania, for example, only 18% of surveyed individuals had received a COVID-19 vaccine, with significant regional differences ranging from 8% in urban areas like Dar es Salaam to 37% in rural areas like Simiyu (Msuya et al., 2023).

Impact of Vaccination

Despite the challenges in vaccine rollout, the impact of COVID-19 vaccination in reducing disease incidence, hospitalizations, and deaths cannot be overstated. Studies have shown that vaccines significantly decrease severe COVID-19 infections and associated mortality. Moreover, the economic impact of vaccinations is profound, potentially saving billions in healthcare costs and lost productivity. Continued efforts in vaccination can play a critical role in stabilizing both public health systems and the broader economic landscape in Sub-Saharan Africa (Msuya et al., 2023).

Vaccine Hesitancy

Vaccine hesitancy remains a significant obstacle to achieving widespread vaccination coverage. Key factors contributing to hesitancy include concerns about vaccine safety and efficacy, misinformation, and a lack of trust in health authorities. Surveys reveal that side effects, safety concerns, and a perceived low risk of contracting COVID-19 are among the region's most common reasons for vaccine hesitancy. Moreover, individuals' socio-economic and educational backgrounds also influence their willingness to get vaccinated, with lower education and income levels often correlating with higher vaccine acceptance (Wollburg et al., 2023).

Efforts to increase COVID-19 Vaccination in Sub-Saharan Africa face numerous hurdles, including logistical challenges and vaccine hesitancy, mainly due to safety concerns and misinformation. Overcoming these obstacles is critical for reducing the pandemic's health and economic impacts. Tailored outreach and education campaigns that address specific local needs and leverage trusted community voices are vital for improving the region's vaccine uptake and public health resilience.

2.2.4 HEPATITIS B

Vaccine Uptake:

The hepatitis B vaccination coverage in Sub-Saharan Africa varies widely, reflecting a range of public health policies and implementation challenges. While countries like Uganda have recently integrated the hepatitis B birth dose vaccine into their immunization schedules to improve early-life coverage, overall regional uptake remains suboptimal. Only 30% of countries in the WHO Africa region have adopted policies for universal hepatitis B birth dose vaccination (B.D.V.), and fewer than 10% of African infants receive timely B.D.V. (Spearman et al., 2023)(C.D.C., 2023). This low uptake contributes significantly to the ongoing prevalence of hepatitis B across the region, with more than 91 million people in Africa infected with hepatitis B or C (WHO | Regional Office for Africa).

Impact of Vaccination:

Implementing widespread hepatitis B vaccination, particularly the birth dose, could significantly reduce the incidence of chronic hepatitis B, which is a significant cause of liver cirrhosis and liver cancer. Studies have shown that administering the B.D.V. within 24 hours of birth is a cost-effective strategy that substantially lowers the long-term risk of chronic hepatitis B infection (Spearman et al., 2023)(Caelers, 2022). Enhancing vaccination coverage could thus be critical in reducing the health burden and associated economic costs of hepatitis B in the region.

Vaccine Hesitancy:

Factors contributing to vaccine hesitancy include limited availability of vaccines, high costs, fear of side effects, and a lack of trust in vaccine efficacy. In Somalia, for example, reasons cited for not receiving the vaccine include unavailability (32.8%) and high costs (26.7%), alongside fears of side effects (12.6%) and a lack of trust in vaccine quality (8.5%) (Abdifitah Said Ali et al., 2023). Additionally, there is a critical need for culturally and regionally targeted communication strategies to enhance

knowledge and reduce stigma associated with hepatitis B, which is often misconceived as primarily a sexually transmitted infection (Spearman et al., 2023).

In conclusion, hepatitis B vaccination coverage in Sub-Saharan Africa faces significant challenges, including low uptake rates, particularly among infants, due to logistical, financial, and cultural barriers. Enhancing awareness through targeted communication and improving access to vaccines are critical steps toward reducing the prevalence of hepatitis B and its associated health burdens in the region. A concerted effort to integrate hepatitis B vaccinations within existing healthcare frameworks, alongside addressing vaccine hesitancy through community engagement and education, is essential for achieving broader immunization coverage and better health outcomes.

2.3 Leveraging Behavioral Insights to Enhance Vaccine Uptake in Sub-Saharan Africa: Perspectives from the Behavioral Insights Team (BIT)

In this section, the analysis will delve into checking a general source that describes the situation regarding vaccine uptake and specifies which behaviors are related to vaccination uptake; lastly, some interventions are proposed by "The Behavioural Insights Team".

Introduction to Behavioral Insights and Vaccine Uptake in Low- and Middle-Income Countries

The Behavioral Insights Team (BIT) analysis provides an invaluable foundation for exploring strategies to enhance vaccine uptake in Sub-Saharan Africa. The BIT report comprehensively addresses the multifaceted challenges of increasing vaccination rates in low- and middle-income countries (LMICs), which includes many Sub-Saharan African nations. This section delves into the essential findings and methodologies outlined in the report, reflecting on how these can be applied or adapted to the specific context of Sub-Saharan Africa.

In recent years, the global health community has made significant strides in improving vaccine coverage, preventing an estimated 2-3 million deaths annually from preventable diseases. However, despite these advancements, an additional 1.5 million deaths could be avoided with further improvements in vaccination coverage. In 2018, 19.4 million infants globally did not receive essential vaccines, with the burden of under-vaccination overwhelmingly concentrated in low- and middle-income countries (LMICs). Notably, ten LMICs account for 60% of these unprotected children. Furthermore, about 1 in 5 un- and under-vaccinated children live in fragile or humanitarian settings (Merriam & Behrendt, 2020).

The "Decade of Vaccines" initiative, launched in 2011, aimed to achieve 90% vaccine coverage in national immunization programs. By the decade's end, 20 million children had received vaccinations since 2010. However, the uptake of critical vaccines like D.T.P. (Diphtheria, Tetanus, and Pertussis) and the first dose of the measles-containing vaccine plateaued at 85%. This plateau highlights the ongoing challenges in achieving higher vaccine coverage in LMICs.

The drivers of under-vaccination in LMICs are multifaceted, encompassing both structural and behavioral determinants. Structural factors include political commitment, adequate funding, vaccine supply and storage capacity, and health facility access. As identified by Philipps et al., behavioral determinants include awareness and education about vaccines, perceived vaccine safety and effectiveness, available free time for vaccination, and facility wait times. Despite the overwhelming support for Vaccination in LMICs, anti-vaccine sentiment is rising, mirroring trends in the Global North.

While structural barriers require structural solutions, individual and collective decisions significantly influence vaccination uptake. Behavioral science offers valuable insights into addressing these barriers. For instance, interventions that frame non-vaccination as an active choice rather than an omission can mitigate omission bias and increase vaccine uptake. This approach is crucial in addressing parental concerns about vaccine side effects versus disease symptoms.

The application of behavioral science to vaccination policies has gained traction. The 2019 Global Vaccination Summit emphasized the need for behavioral science research to inform vaccination programs. The WHO's 2013 advice on 'Tailoring Immunisation Programmes' and UNICEF's 'Demand for Health Services Field Guide' are notable examples of integrating behavioral insights into health service strategies. The WHO's 'Measuring Behavioural and Social Drivers of Vaccination' (BeSD) Working Group aims to develop tools and guidance to address local reasons for under-vaccination.

Despite these efforts, behavioral insights research on Vaccination in LMICs remains underdeveloped. Extensive research in high-income countries (H.I.C.s) has evaluated strategies to increase vaccine uptake, but similar high-quality intervention research in LMICs is limited. This gap highlights the need for targeted research to understand and address the specific barriers to vaccination in these contexts (Merriam & Behrendt, 2020).

In the context of Sub-Saharan Africa, enhancing vaccine uptake through a behavioral insights approach is crucial. Understanding this region's unique structural and behavioral barriers can inform effective interventions. Health programs can improve vaccine coverage by applying behavioral science principles, such as framing non-vaccination as an active choice and addressing omission bias. Investing in behavioral insights research tailored to Sub-Saharan Africa can provide the necessary evidence to design and implement strategies that overcome barriers and increase vaccine uptake, ultimately reducing preventable disease deaths in the region (Merriam & Behrendt, 2020).

2.4 An introduction to behavioral insights

Behavioral insights use evidence of human behavior's conscious and non-conscious drivers to address practical issues. Coined in 2010 by a team within the U.K. government's Cabinet Office, this approach has since informed policy and improved public services globally. Established from this initiative, the Behavioral Insights Team

became a social purpose company in 2014. Today, over 200 government bodies worldwide have dedicated resources for applied behavioral science. Wellcome supported the Behavioral Insights Team to analyze opportunities for behavioral insights research on vaccine uptake in LMICs.

Policymakers have historically aimed to influence behavior, from encouraging pension savings to promoting healthier eating. Traditional economics, which assumes people are rational actors making logical choices based on available information, has often informed policy design. However, since the 1970s, psychology and behavioral economics research has challenged these assumptions, showing that individual behavior is influenced by context and how choices are presented.

The dual-process model of thinking, popularized by Daniel Kahneman in "Thinking, Fast and Slow," underpins much of this research. It describes two concurrent thought processes: the automatic, intuitive "System One" and the reflective, deliberate "System Two." While System One helps us engage with the world efficiently, it can lead to biased and incoherent decision-making. The behavioral insights approach acknowledges these biases and designs policies, systems, and services based on a realistic model of human behavior.

Behavioral insights involve three core components: integrating evidence about human behavior from various disciplines, applying this evidence to solve real-world problems, and rigorously evaluating interventions to promote evidence-based policymaking. As a problem-solving method rather than a rigid framework, this approach encompasses a wide range of applications.

Cappelen et al. argue that several attributes of vaccination make people susceptible to biases in vaccination decisions. The uncertainty of vaccination outcomes (e.g., not knowing if one will contract the disease if not immunized but being aware of potential side effects of vaccination), the time discrepancy between vaccination costs and benefits, and the benefits and costs accruing to different individuals (particularly in childhood vaccination) contribute to this susceptibility. While vaccination appears

beneficial at the population level, the individual cost-benefit analysis is more uncertain.

In the context of Sub-Saharan Africa, applying behavioral insights to enhance vaccine uptake can address these biases. Understanding and mitigating these biases can inform effective strategies to increase vaccination rates, thus reducing preventable diseases in the region.

The subsequent table, reported directly from the article, describes fundamental behavioral biases relevant to vaccination behavior. This understanding will provide valuable context for the following landscape analysis (Merriam & Behrendt, 2020).

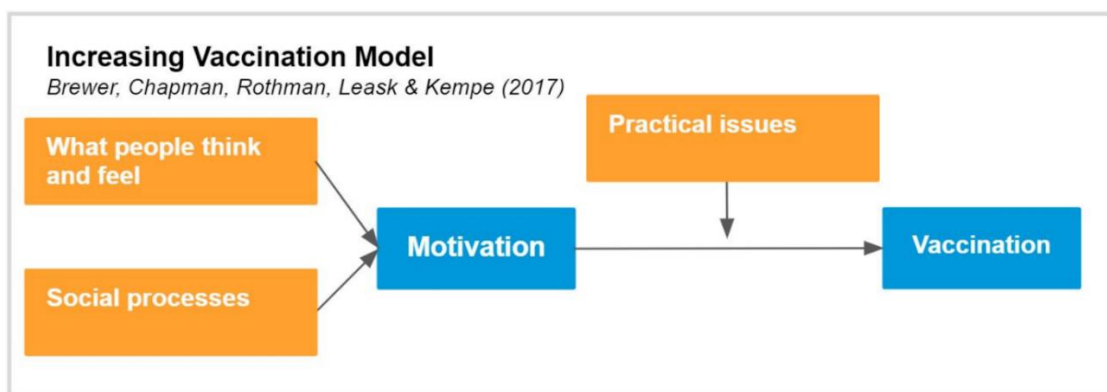
Bias	Description
Status quo bias	Most decisions include an option that involves doing nothing or continuing with a previous decision. When presented with such a decision, people disproportionately stick with the status quo, particularly when they do not strongly prefer alternative options. Additionally, people tend to be biased towards doing nothing over doing something because of the relative effort involved in making a choice, mainly when presented with a complex decision.
Omission bias	'Omission bias' describes the tendency for people to judge harmful actions more harshly than inaction, even when both might cause equivalent harm. In the context of vaccination, omission bias can explain why some parents may hesitate to have their child vaccinated because they are more concerned about directly causing harm (i.e., bringing about adverse side effects) than they are about failing to prevent the disease.
Loss aversion	We know people are generally loss-averse, meaning we will make more significant efforts to avoid a potential loss than benefitting from an equivalent gain. Suppose individuals consider vaccination a risky choice for themselves or their families. In that case, they may be sensitive to a message stressing the potential losses

	<p>associated with not being vaccinated (e.g., "If your child is not vaccinated, they will be vulnerable to killer diseases"). Alternatively, if a parent considers the risk of vaccination low, a 'gain-framed' message focusing on potential benefits of behavior may be compelling (e.g., "Vaccination can protect your child against killer diseases").</p>
Present bias	<p>Present bias describes the tendency for people to overvalue immediate rewards at the expense of their long-term intentions. If benefits are present and costs are future, people tend to ignore the costs. This is true of vaccination behavior: for a given individual, getting vaccinated entails costs today (such as the time lost or experiencing the potential side effects), a part of which will be compensated in the long term (reduced likelihood of infection by the virus).</p>
Intention-behaviour gap	<p>The 'intention-behavior gap' describes people's failure to follow through on favorable intentions. Even when people intend to get vaccinated, and we provide timely prompts to help them achieve this, people may still fail to follow through due to forgetfulness, a lapse in willpower, or other difficulties or distractions. Though intentions predict behavioral outcomes, a meta-analysis of 47 experimental studies found that interventions that successfully produced a medium-to-large intention change resulted in only a small-to-medium-sized effect on behavior. There is evidence of such an intention-behavior gap in the literature on Vaccination: one study found that over 70% of U.K. parents intended to vaccinate their children against seasonal flu, but only 52.8% reported doing so.</p>
Friction costs	<p>We are more likely to complete tasks that we find easy. The behavioral literature has shown that even seemingly irrelevant details that make a task marginally more effortful, known</p>

	as 'friction costs,' have a disproportionate effect on whether we end up doing something.
Conformity and social influence	Social norms are a society or group's values, actions, and expectations. We tend to imitate what others around us do, as the behavior of the majority is perceived to indicate the 'desirable' or 'correct' course of action. In places where vaccination uptake is high, vaccination is the social norm. Reciprocity refers to the social norm of obliging repayment of favors and shunning those who freeload off others. Vaccination could induce reciprocal behavior as the board shares the benefits of vaccination.
Conformity and social influence	Confirmation bias describes the tendency for people to seek out or evaluate information in a way that fits with their existing thinking and preconceptions. People with unfavorable views towards vaccination are more likely to seek out content with a negative stance on vaccination, and those in favor of vaccines are more likely to seek out content that supports vaccination. This phenomenon can be explained by the theory of 'cognitive dissonance', which posits that people strive to achieve consistency in their cognitions and beliefs and, in turn, in their actions.
Availability heuristic	The availability heuristic describes the tendency to judge the frequency of an event or outcome by how easily it comes to mind. Rare events, such as an adverse reaction to a vaccination, stand out because they are more memory and attention-catching. They will likely be reported in the media or discussed within social groups. In turn, these rare events are more easily retrieved from memory, and people tend to overestimate the probability of their happening.

2.5 Vaccination, Attitudes, Intentions, and Behaviors

Brewer et al. proposed the 'Increasing Vaccination Model' in a recent review of behavioral science evidence for effective strategies to encourage vaccination. This model suggests that people's attitudes (what they think and feel) and broader social processes jointly influence their motivations and intentions towards immunization. Practical barriers mediate the relationship between favorable intentions to vaccinate and actual vaccination behavior. Considering the intention-behavior gap when interpreting evidence for interventions to increase vaccination is crucial. Many studies use vaccination intentions as an outcome measure, though this is not a reliable proxy for behavior. Therefore, we should not assume that a successful change in attitudes and intentions will necessarily translate into behavior change.

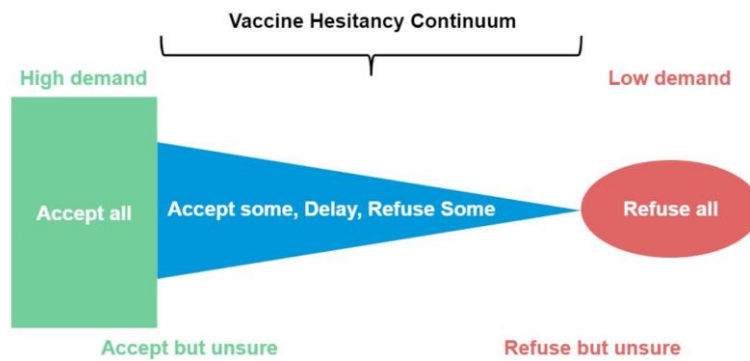


(Figure 1: Increasing Vaccination Model)

In a 2014 report, the WHO Strategic Advisory Group of Experts on Immunisation (SAGE) explored the determinants of 'vaccine hesitancy,' defined as both delay in the acceptance of vaccines and outright refusal of vaccination despite the availability of vaccine services. Notably, the report noted that vaccine hesitancy can vary across vaccines, with some people accepting certain vaccines while refusing others.

The SAGE working group proposed the '3Cs' model of vaccine hesitancy determinants, identifying complacency, convenience, and vaccine confidence as critical factors contributing to vaccine hesitancy. Vaccine confidence refers to lacking trust in vaccines and the health system delivering them. Complacency describes

situations where people do not consider vaccines important, often because the diseases they prevent are not prevalent, making people naive to their potentially devastating effects. Lastly, vaccines might be theoretically available but not necessarily convenient to access. In a separate paper, Betsch et al. proposed an additional fourth 'C': calculation, describing individuals who do not receive vaccination because they believe the costs outweigh the benefits.



(Figure 2: Continuum of vaccine hesitancy)

Reflecting on how the older '4Cs' model maps onto Brewer et al.'s more recent Increasing Vaccination Model is helpful. We consider that 'confidence' and 'complacency' describe 'what people think and feel' about vaccination. Similarly, 'convenience' describes the 'practical barriers' that prevent people from acting on their intentions. The fourth 'C,' 'calculation,' encompasses individuals weighing attitudinal, social, and practical factors to make their ultimate vaccination decision.

Understanding these models and their implications is crucial for enhancing vaccine uptake in Sub-Saharan Africa. By addressing the determinants of vaccine hesitancy—confidence, complacency, convenience, and calculation—behavioral interventions can be designed to overcome barriers and increase vaccination rates in the region. This approach aligns with the Increasing Vaccination Model, which integrates these factors to inform strategies that effectively promote vaccination behavior (Merriam & Behrendt, 2020).

2.6 Behavioral Strategies to Enhance Vaccine Demand and Supply

The BIT conducted a comprehensive review of existing evidence, focusing on demand and supply-side interventions. This involved analyzing studies that utilized behavioral approaches to increase vaccine uptake and identifying key patterns and gaps in the research.

Behavioral Interventions to Encourage Vaccine Demand

1. **Education and Information About Vaccines:** The report found that targeted educational interventions, particularly visually engaging and easily accessible, can significantly improve vaccine uptake. This includes using visual aids and redesigning immunization cards to make vaccine schedules more understandable and memorable.

2. **Incentives for Vaccination:** Incentive-based interventions have shown varying success, including small financial or material rewards for receiving vaccines. These incentives can effectively increase immediate uptake but require careful consideration to ensure they are culturally appropriate and sustainable.

3. **Reminders and Recalls for Vaccination Appointments:** Mobile health technologies have effectively sent reminders and recall messages, significantly improving vaccination rates. This approach leverages widespread mobile phone use in many LMICs, including Sub-Saharan Africa, to ensure that individuals do not miss vaccination appointments.

4. **Using Social Networks to Encourage Vaccination:** The report highlights the potential of using social norms and community influencers to promote vaccination. Interventions that visibly demonstrate community support for vaccination can motivate individuals to vaccinate their children.

Improving the vaccine supply chain is crucial in LMICs. Behavioral interventions that streamline supply processes and enhance the reliability of vaccine availability can significantly impact overall vaccination rates. This includes developing and implementing technology solutions that better track and manage vaccine stocks.

The landscape of vaccine uptake research is dynamic, with ongoing studies continuously refining our understanding of what works. The BIT report calls for continued investment in research that tests and scales up promising behavioral interventions in different contexts, including those specific to Sub-Saharan Africa.

The BIT's comprehensive analysis provides a critical framework for understanding and addressing the barriers to vaccine uptake in LMICs through a behavioral lens. For Sub-Saharan Africa, these insights are relevant and essential for designing culturally and contextually appropriate interventions. The strategies outlined in the report offer a roadmap for enhancing vaccine uptake in the region, tailored to the unique challenges and opportunities within these diverse communities. This chapter sets the stage for a deeper exploration of specific behavioral interventions and their applicability to the Sub-Saharan African context. It aims to transform insights into actionable strategies that can significantly improve regional health outcomes (Merriam & Behrendt, 2020).

2.7 UNICEF INTERVENTIONS

The research from UNICEF analyzed data for vaccination in children ≤ 5 years old.

The study identified as the target for the intervention three subjects:

1. *Caregivers*
2. *Healthcare workers (H.C.W.)*
3. *The community* (for community, they intend "community" as a geographic area or a group of people sharing at least one common social or cultural characteristic)

For each category of targets, some interventions are proposed:

- **Caregivers**

Provision of information or education; home visits; and non-material incentives (incentives that have no monetary value, for example, social recognition)

- **H.C.W.**

Training and education; material or monetary incentives; and non-material incentives

- **The Community**

They are interested in community interventions generally, also exploring interventions targeting specific community subgroups, including faith-based outreach/outreach using local leaders and outreach to populations on the move

Then two kinds of outcomes are underlined in this study:

intermediate outcomes

- Caregiver knowledge
- Awareness
- Attitudes
- Beliefs and intention to vaccinate
- H.C.W. motivation
- Capacity
- Attitudes and beliefs
- Community awareness and norms

vaccination outcomes

- Uptake
- Coverage
- Complete vaccination
- Up-to-date vaccination
- Vaccination timeliness

To ensure the reliability of findings, the study developed standardized effectiveness statements based on the number of studies identified and the proportion of results in a given direction. Evidence was rated as:

- **Sufficient Evidence** (>20 studies with ≥ 90 percent of studies showing an effect in one direction)
- **Some Evidence** (>20 studies with ≥ 70 percent to <90 percent of studies showing an impact in one direction; or between 10 and 20 studies with ≥ 90 percent of studies showing an effect in one direction)
- **Evidence of No Effect** (>20 studies with ≥ 50 percent to <70 percent of studies showing an effect in one direction)
- **Insufficient evidence to determine** (<10 studies, or between 10 and 20 studies with ≥ 70 percent to <90 percent of studies showing an effect in one direction).

Now, the analysis of the interventions studied in the UNICEF report is explained:

Interventions Targeting Caregivers

- *Caregiver Education*
- *Caregiver Non-material Incentives*
- *Home Visits*

Interventions Targeting Healthcare Workers (H.C.W.s)

- *H.C.W. Training and Education*
- *H.C.W. Non-material Incentives*
- *H.C.W. Material Incentives*

Community-based Interventions

- *Community Collaboration and Outreach*
- *Community Subgroups*

2.7.1 The Effect of Interventions Targeting Caregivers

PROVISION OF EDUCATION OR INFORMATION TO CAREGIVERS

Intermediate Outcomes

The effectiveness of caregiver education or information on intermediate outcomes is based on the results of 11 systematic reviews:

Positive Impact on Attitudes:

- All nine studies reviewed showed a positive effect on caregiver attitudes.
- A meta-analysis of three studies also showed a positive direction, though not statistically significant.

Other Intermediate Outcomes:

- *Intention to Vaccinate*: Four studies and a meta-analysis of two studies showed a positive direction.
- *Knowledge of Vaccines and Schedules*: Four studies and a meta-analysis of four studies showed positive outcomes.
- *Anxiety Reduction*: One study indicated a positive direction.
- *Decision-Making*: Four studies showed positive effects.
- *Perception of Rare Adverse Events*: Two studies indicated positive effects.

Combination Interventions

There is insufficient evidence to determine the effectiveness of combining caregiver education with other interventions to achieve intermediate outcomes. Notable findings include:

- *Attitudes and Beliefs*: One study showed a positive direction.
- *Knowledge of Vaccination*: Four studies indicated positive outcomes.
- *Actual or Intended Behavior*: One study showed a positive direction.

Vaccination Outcomes

The effectiveness of caregiver education or information on vaccination outcomes is based on 37 systematic reviews:

Education Alone:

- Sufficient Evidence from 28 out of 31 studies (90%) indicated positive vaccination outcomes.
- Of 19 reviews relevant to this section, 17 included three or fewer studies.

Combination Interventions:

- Sufficient Evidence from 94 out of 97 studies (97%) showed positive vaccination outcomes when combining education with other interventions.

Association Between Intermediate and Vaccination Outcomes

Few studies reported both intermediate and vaccination outcomes, indicating a need for further research to understand this pathway. Key insights include:

Effectiveness in Low and Middle-Income Countries (L&MIC): Education interventions may be more effective in L&MIC due to lower baseline education levels.

Several factors impact the effectiveness of caregiver education on vaccination outcomes:

- Format and Duration:

- Discussion formats are more effective than written formats but are costlier and time-consuming.
- Short-duration interactions (1–10 minutes) significantly improve vaccine uptake, while more extended interactions (11+ minutes) do not.

- Delivery of Single vs. Multiple Vaccines:

- Single vaccine education improves uptake more effectively than multiple vaccines.

Format of Education/Information, effective strategies include:

Discussion-based Interventions:

- More effective but recommended for vaccine-hesitant parents due to high costs.

Home-Visiting Campaigns:

- Suggested for persistent non-responders for cost-effectiveness.

Decision Aids:

- Slightly improve vaccine uptake and are most useful where confidence and knowledge are barriers.

Reminders and Information via Letters are effective, but future strategies may leverage technology.

Cultural and Linguistic Appropriateness:

- Materials should be simple and culturally suitable, especially for parents of low socio-economic status.

Vaccine Hesitancy

Effectiveness in Vaccine-Hesitant Populations

Limited evidence suggests a positive impact of education on caregiver attitudes and vaccine uptake in vaccine-hesitant populations. Dialogue-based approaches may be particularly effective.

Other Considerations

Targeting Specific Communities

Educational interventions should be tailored to specific communities, addressing knowledge gaps and utilizing locally constructed interventions. Supply-side constraints should be addressed to match the increased demand for vaccinations.

Negative Findings

One review included studies showing a negative direction for vaccination outcomes, highlighting the complexity of integrating caregiver education into broader childhood illness management strategies.

Examples of Combination Interventions (Box 1)

- Reminders and Schedulers: Telephone and postcard reminders, immunization schedulers.
- Brochures and Posters: Educational materials and community outreach activities.
- Technology-Based Tracking: Computerized tracking and caregiver incentives.
- Face-to-face Information: Social worker-led information sessions and immunization camps.
- Health Promotion Campaigns: Delivered by community health workers, including illness management and community development.

This comprehensive analysis highlights the importance of targeted and context-specific interventions in educating caregivers to improve vaccination outcomes. Further research is needed to refine these strategies and address existing gaps.

NON-MATERIAL INCENTIVES FOR CAREGIVERS

No studies were identified that assessed the impact of non-material incentives for caregivers.

HOME VISITS

Intermediate Outcomes

The effectiveness of home visits on intermediate outcomes is based on limited data:

Combination Interventions:

- There is insufficient evidence to determine the effectiveness of home visits combined with other interventions on caregiver knowledge, though three studies showed a positive direction.
- No data was reported on intermediate outcomes such as attitudes, beliefs, or intention to vaccinate.

Vaccination Outcomes

The effectiveness of home visits on vaccination outcomes is based on 25 systematic reviews:

Home Visits Alone:

- Some evidence suggests that home visits alone can increase vaccination uptake.
- This is based on 11 out of 12 studies (92%) indicating a positive direction from eight systematic reviews. However, the number of studies per review is low (≤ 2), and four additional studies showed unclear or mixed results.
- One meta-analysis found that lay healthcare workers' (H.C.W.s) home visits did not show a significant overall effect. Still, subgroup analysis indicated substantial positive effects when providing specific vaccination advice.

Combination Interventions:

- Sufficient Evidence supports that home visits and other interventions increase vaccination outcomes.
- This is based on data from nine high-quality and seven moderate-quality reviews, showing that 56 out of 59 studies (95%) positively impacted vaccination outcomes.

Barriers Addressed

Home visits can address various barriers to vaccination, making them a critical component of successful interventions, particularly in specific populations:

Geographical, Financial, and Accessibility Barriers:

- Home visits effectively reach remote areas, disadvantaged groups, and low socio-economic populations.
- They are also helpful in addressing cultural barriers. For instance, home visits facilitated access for some Muslim women who observe the purdah system.

Combination Interventions

Combination interventions that incorporate home visits can target the complex nature of vaccination decision-making:

Effective Strategies:

- Successful interventions often include overcoming access barriers (e.g., through home visits), reminder components, parental and H.C.W. education, and partnerships with community-based organizations.
- Engaging community members can increase the acceptability of services, mainly when interventions are selected based on contextual factors and specific barriers.

Recommendations and Challenges

The Community Preventive Services Task Force (CPSTF) strongly recommends interventions that include home visits, but there are notable implementation considerations:

Resource Intensity and Logistical Challenges:

- Home visits are resource-intensive and logistically challenging, making them difficult to implement in resource-poor settings.
- Timing and coordination can also be problematic.

Safety and Security Concerns:

- There are potential safety and security concerns for parents regarding having strangers in their homes.

Examples of Combination Interventions Including Home Visits (Box 2)

- Reminders and Education: Telephone and postcard reminders, immunization schedulers, brochures, intervention area task force activities, posters, bumper stickers, magnets, presentations, and door-to-door education.
- Technology and Incentives: Computerized tracking and reminders, caregiver and H.C.W. education, H.C.W. incentives, caregiver incentives, and home-visiting outreach.
- Face-to-face Interventions: Information from a social worker, immunization camps, and caregiver incentives.
- Integrated Health Promotion: Redesigned immunization cards and center-based education, health promotion for children delivered by community H.C.W.s, illness management, and community development.

This analysis underscores the importance of home visits in enhancing vaccination outcomes, particularly when combined with other interventions to address multiple barriers. Despite the challenges, targeted and context-specific home visit strategies can significantly improve vaccination rates, especially in underserved communities. Further research is needed to refine these strategies and fully understand their pathways to effectiveness.

2.7.2 Interventions Targeting Healthcare Workers (H.C.W.s)

H.C.W. TRAINING AND EDUCATION

Intermediate Outcomes

The effectiveness of H.C.W. (healthcare worker) training on intermediate outcomes is based on limited evidence:

Caregiver Knowledge and Intention to Vaccinate:

- Insufficient Evidence to determine if H.C.W. training alone positively affects caregivers' knowledge or intention to vaccinate.

H.C.W. Outcomes (Skills and Self-Efficacy):

- Insufficient Evidence that H.C.W. training improves H.C.W. outcomes such as skills, confidence in discussing risks, and answering difficult questions.

Vaccination Outcomes

The effectiveness of H.C.W. training on vaccination outcomes is based on 19 systematic reviews:

H.C.W. Training Alone:

- Insufficient Evidence to draw firm conclusions on the effectiveness of H.C.W. training alone, with three studies showing a positive direction.

Combination Interventions:

- Sufficient Evidence that H.C.W. training combined with other interventions (e.g., prompts for H.C.W.s, expansion of services, caregiver education) positively affects vaccine uptake.
- This is supported by 42 out of 45 studies (93%) indicating positive outcomes when combining H.C.W. training with other strategies.

Implementation Considerations

Provider–Caregiver Communication: effective communication between providers and caregivers is crucial:

Participatory Communication:

- Beneficial for hesitant parents as it helps build trust and develop relationships, potentially reducing the likelihood of caregivers seeking unreliable vaccine information.
- Sufficient training is necessary to ensure H.C.W.'s confidence and effectiveness in participatory interventions.

Addressing Vaccine Hesitancy:

- Mixed results in H.C.W. communication training's effectiveness, with some success in addressing vaccine hesitancy but limited understanding of underlying reasons and potential H.C.W. biases.

Information Technology:

- Incorporation of I.T. in training (e.g., multimedia learning applications, smartphone educational apps) can improve H.C.W. counseling skills and reduce workload.

Combination Interventions

The combination of H.C.W. training with other interventions enhances effectiveness:

Diverse Strategies:

- H.C.W. training combined with caregiver education, home visits, material incentives, community outreach, reminders/recalls, and service enhancements.
- Multi-pronged approaches, such as those for migrant children, include service expansion, social mobilization, and community collaboration.

Vaccine-Hesitant Populations, specific strategies are needed for vaccine-hesitant populations:

Limited Evidence:

- Insufficient Evidence on the effectiveness of H.C.W. training on intermediate or final vaccination outcomes in vaccine-hesitant populations, with mixed initial Evidence on H.C.W. and caregiver outcomes and limited positive results on vaccine uptake.

Examples of Combination Interventions Including H.C.W. Training and Education (Box 3)

- Improved Skills and Supervision: Training and supervision in immunization, community health promoters, and strengthening health systems (planning, health information systems, logistics, financing).
- Screening and Policies: H.C.W.s administer screening checklists, provide provider training, and implement policies to remove geographical barriers to vaccine access.
- Supportive Supervision: Guidance provided through supportive supervision enables staff to perform effectively and improve immunization knowledge and skills.
- Provider Reminders and Feedback: Medical chart reminders for providers, monthly provider assessment and feedback cycles, provider education, and client postcard reminder and recall processes.

This analysis highlights the importance of combining H.C.W. training with other interventions to maximize vaccination outcomes. Effective communication and tailored approaches, especially in vaccine-hesitant populations, are critical. Using technology and community-based strategies further enhances the effectiveness of H.C.W. training programs. Further research is needed to explore and optimize these combinations.

H.C.W. NON-MATERIAL INCENTIVES

Intermediate Outcomes

The effectiveness of H.C.W. (healthcare worker) non-material incentives on intermediate outcomes is based on limited data:

Caregiver or H.C.W. Intermediate Outcomes:

- Insufficient Evidence to determine the effectiveness of non-material incentives on caregiver or H.C.W. intermediate outcomes.
- No systematic reviews addressed this matter.
- One primary study, a moderate-quality R.C.T. conducted in a low-income country, reported that public recognition for H.C.W.s and caregivers did not influence home visits.

Vaccination Outcomes

The effectiveness of H.C.W. non-material incentives on vaccination outcomes is based on five systematic reviews:

Non-Material Incentives Alone:

- Insufficient Evidence to determine the effectiveness when non-material incentives are used alone, with only 2 out of 3 studies (67%) showing a positive direction.
- Evidence from six primary studies (five R.C.T.s and one quasi-experimental) showed mixed results, with five studies finding no effect and one showing mixed results.

Combination Interventions:

- Some evidence suggests that non-material incentives combined with other interventions can positively affect vaccination uptake.
- This is supported by 16 out of 17 studies (94%) indicating positive vaccination outcomes when non-material incentives are part of a combination intervention.

Implementation Considerations, motivation, and Incentive Structures

Non-material interventions (e.g., performance feedback, employer recognition, public recognition) aim to achieve behavior change through internal and external motivation:

Cost and Controversy:

- Non-material incentives may be less costly and less controversial than financial incentives.

Sustainability:

- Sustaining performance after the intervention can be challenging if implemented as a standalone project.

Team-Based Goals:

- Combining non-material incentives with team-based goals can positively impact coordination and teamwork among H.C.W.s.
- Health system constraints, such as administrative or supply chain issues, can affect team effectiveness and morale.

Supervision and Feedback:

- Providing supervision with feedback is crucial for ensuring implementation and maintaining motivation.

Examples of Combination Interventions Including Non-Material Incentives for H.C.W. (Box 4)

- Patient Reminder/Recall Systems: Intensive reminder/recall at the patient level and as part of the healthy child clinic process (assessment, feedback, incentives, and information exchange).
- Performance Feedback with Financial Bonuses: Financial bonuses for physicians based on achieving immunization targets and performance feedback. Feedback includes coverage rates, missed immunization opportunities, comparative peer performance information, and hypothetical examples to improve performance.
- Increased Immunization Fees with Feedback: Increase immunization fees for each vaccine administered (paid upfront) and provide feedback to physicians.

This analysis underscores the potential of non-material incentives when combined with other interventions to enhance vaccination outcomes. However, the limited evidence on their effectiveness as standalone measures suggests further research. Implementing non-material incentives should consider sustainability, team-based approaches, and the provision of supervision and feedback to maximize their impact.

H.C.W. MATERIAL INCENTIVES

Intermediate Outcomes

The effectiveness of H.C.W. (healthcare worker) material incentives on intermediate outcomes is based on limited evidence:

Caregiver or H.C.W. Intermediate Outcomes:

- No evidence from systematic reviews was identified on the effect of H.C.W. material incentives on intermediate outcomes.

Three primary studies considered this matter:

- Two evaluated performance-based financing (P.B.F.) and the other fee-for-service.
- Generally, these studies found no evidence of an effect on caregiver or H.C.W. intermediate or service quality outcomes.
- One high-quality cluster, R.C.T., found a significant positive effect of P.B.F. on caregivers' satisfaction with visits to health facilities for children under five (not exclusive to vaccination).
- Ten other comparisons found no effect, and one found a significant adverse impact on the facility's maintenance of an up-to-date immunization register.

Vaccination Outcomes

The effectiveness of H.C.W. material incentives on vaccination outcomes is based on eight systematic reviews and 20 primary studies:

Material Incentives Alone:

- Insufficient Evidence to determine the effectiveness of material incentives when used alone, with only 1 out of 1 study showing a positive direction.

Combination Interventions:

- Some evidence supports using material incentives for H.C.W.s when combined with other strategies.
- This is supported by 10 10 studies (100%) indicating positive vaccination outcomes, plus a meta-analysis of two studies showing a significant positive effect of bonus payments and enhanced fee-for-service paid to outpatient healthcare providers.

Primary Study Findings, performance-Based Financing (P.B.F.):

- One primary study found a significant positive effect of P.B.F. versus usual care.
- Other studies found mixed results (positive and no effect) or no effect.

Implementation Considerations

Types of Material Incentives

Three material incentives were examined: lump sum bonuses, fee-for-service, and non-monetary gifts or awards. These were often reported under performance-based financing interventions for health facilities:

Performance-Based Financing (P.B.F.):

- P.B.F. can stimulate health providers' extrinsic motivation while addressing supply-side barriers if performance bonuses are distributed among H.C.W.s and a proportion is retained by the facility for reinvestment.

- Facilities are likely to develop protocols to support goal achievement, indirectly incentivizing providers to increase their knowledge and improving service quality and quantity.

Design Considerations for Pay-for-Performance (P4P) Initiatives, designing a P4P initiative to increase vaccine uptake requires careful consideration:

Targeting High-Impact Areas:

- In areas with already high immunization coverage, there needs to be more room for the intervention to have an effect. Targeting facilities and locations where there is room for improvement is crucial.

Variable Incentive Value:

- Different facilities face varying marginal costs to achieve service improvement. The incentive value may differ from one facility to another.

Clear Communication:

- Clear communication of the intervention's objectives ensures staff understand and modify their practices accordingly.

Balancing Multiple Incentives:

- If P4P is implemented across multiple services, providers might trade off various incentives within the P4P package, focusing more on perceived profitable services.

Balancing Intrinsic and Extrinsic Incentives:

- Achieving the ideal balance between intrinsic and extrinsic incentives is desirable and an area for further research.

Examples of Combination Interventions Including Material Incentives for H.C.W. (Box 5)

- **Team-Based Goals and Incentives (TBGI):** H.C.W.s were provided with training and material incentives (e.g., utensils, cookware, storage containers) and non-material rewards (certificate of recognition) when teams met their vaccination targets.
- **P4P Scheme:** Financial payments made to health facilities based on target achievement. A proportion of the bonus is distributed among H.C.W.s, with a percentage retained by the facility. Staff received training and supervision.
- **Supply and Demand-Side Interventions:** Interventions addressing vaccine availability and accessibility by combining provider education and incentives with parent education, transportation assistance, and home visits.
- **Quality Improvement Projects:** Incentive payments coupled with quality improvement projects, commissioning of care packages in specific geographical areas, target-setting with information technology for reminder/recall, and follow-up of defaulters.

This analysis highlights the potential of material incentives, particularly when combined with other interventions, to enhance vaccination outcomes. The design and implementation of such incentives must consider sustainability, targeted approaches, clear communication, and a balance between intrinsic and extrinsic motivations to maximize their impact. Further research is needed to explore these aspects comprehensively.

2.7.3 Community-based Interventions

COMMUNITY COLLABORATION AND OUTREACH

Intermediate Outcomes

The effectiveness of community collaboration and outreach on intermediate outcomes is based on the results of four systematic reviews:

Caregiver Attitudes:

- Insufficient Evidence to determine the effectiveness of community collaboration or outreach used alone or in combination, with one study showing a positive direction.

Caregiver Knowledge and Awareness:

- Three studies reported positive outcomes regarding caregiver knowledge and awareness.

Caregiver Attitudes and Beliefs:

- One study reported positive effects on caregiver attitudes and beliefs.

Intention to Vaccinate and H.C.W. Intermediate Outcomes:

- No evidence was identified that assessed caregiver intention to vaccinate or H.C.W. intermediate outcomes.

Vaccination Outcomes

The effectiveness of community collaboration and outreach on vaccination outcomes is based on the results of 26 systematic reviews:

Meta-Analyses:

- Four studies included meta-analyses, with three reporting a significant positive effect on vaccination outcomes. One study found no overall effect, but a subgroup analysis of home visits providing specific vaccination advice showed a considerable positive impact.

Community Collaboration or Outreach Alone:

- Sufficient Evidence supports that community collaboration or outreach alone positively affects vaccination outcomes, with 26 out of 26 included studies reporting positive outcomes.

Combination Interventions:

- Sufficient evidence supports that community collaboration, outreach, and other interventions improve vaccination outcomes. This is supported by 75 out of 76 studies (99%) reporting positive outcomes.

Implementation Considerations, pathway to Vaccination Uptake

Limited data on intermediate outcomes makes the pathway to vaccination uptake need clarification. However, the effectiveness of community collaboration and outreach is attributed to several factors:

Multidimensional Nature:

- Addressing information or service requirements within a local environment.
- Reducing geographical, financial, and accessibility barriers is significant in populations with low socio-economic status and remote areas.

Contextual Specificity:

- Tailor interventions to local community needs and address underlying determinants of health behavior.

Involvement of Community Leaders:

- Effective social mobilization and dialogue facilitation.
- Incorporating local customs and cultural considerations in developing community services.

Collaboration with Community-Based Organizations:

- Utilizing pre-existing service delivery structures and relationships.
- Increasing acceptability of services through the involvement of trusted local leaders as vaccination advocates.

Barriers to Effective Community Collaboration

Challenges to effective community collaboration include:

- Ethnic Fractionalization and Income Inequality: Differences within the community can hinder participation.
- Migration and Poor Supply of Supporting Health Services: Migration and irregular attendance by group members can affect the functioning of community groups.
- Group Dissolution: Ensuring group continuity and engagement requires objective performance data and active participation in planning and evaluation.

Vaccine-Hesitant Populations

One review on vaccine-hesitant populations suggested that targeting community leaders and social mobilization is essential for understanding the target audience and facilitating dialogue. However, there needs to be more evidence to determine the effectiveness of community-based interventions on intermediate or final vaccination outcomes in these populations.

Examples of Combination Interventions Including Community Collaboration/Outreach (Box 6)

- Community–Provider Partnership: Focused on provider knowledge and accountability, practice and system improvements, and community outreach.
- Community-Based Outreach and Tracking: This includes health and immunization education, immunization reminders, follow-up cards/phone calls/home visits, and feedback and incentives.
- Assessment and Referral: Monthly voucher pick-up, outreach/tracking, and parental incentives.

- Community Mobilization: Community leaders supporting mobilization, film presentations, edutainment dramas, computer simulations of viruses, and feedback.
- Comprehensive Interventions: H.C.W. training, health systems improvements, family and community activities.

This analysis underscores the significant positive impact of community collaboration and outreach on vaccination outcomes, particularly when combined with other interventions. Tailored, context-specific strategies that leverage existing community structures and relationships are crucial for maximizing effectiveness. Further research is needed to explore these pathways and optimize intervention designs.

COMMUNITY SUBGROUPS

Intermediate Outcomes

The effectiveness of faith-based community collaboration and outreach on intermediate outcomes is based on limited evidence from one study identified by one systematic review:

- Caregiver Knowledge: There is insufficient evidence to determine the effectiveness of faith-based outreach on caregiver knowledge, though one study indicated a positive direction.
- Caregiver Attitudes and Intention to Vaccinate: No evidence was identified that assessed caregiver attitudes or intention to vaccinate.
- H.C.W. Intermediate Outcomes: No evidence was identified that assessed H.C.W. intermediate outcomes.

Vaccination Outcomes

The effectiveness of faith-based community collaboration and outreach on vaccination outcomes is based on the results of four systematic reviews:

Faith-Based Outreach Alone:

- Insufficient Evidence to determine the effectiveness, with one study indicating a positive direction.

Combination Interventions:

- There is insufficient evidence overall, but 9 out of 9 studies in systematic reviews reported a positive direction when faith-based outreach was combined with other interventions.

Implementation Considerations

Positive Impact of Faith-Based Community Outreach: the limited data available on faith-based community outreach indicates a positive impact:

Involvement of Religious and Traditional Leaders:

- Effective strategy for understanding the target audience and facilitating dialogue.
- Religious leaders can help adapt services to local customs and identify cultural taboos.

Community Engagement: Using trusted local leaders as vaccination advocates can increase acceptance and counteract disinformation.

Examples of Combination Interventions include faith-based Community Outreach (Box 7)

- Education and Registration: Education to H.C.W.s and local people, vaccinators in rural areas registering and educating pregnant women and families, educational films during religious congregations.
- Monthly Assessments and Education: Monthly assessment of health departments, education by village doctors and religious leaders, reporting by village doctors, and supervision.

- Community Volunteers and Action Plans: Volunteers from the village, including religious groups, identify barriers in the community, develop action plans with the community, and hold meetings to educate mothers, heads of households, and leaders.
- Festive Booths and Educational Materials: Booths with a festive atmosphere, booklets, pamphlets, posters, and face-to-face information at booths to encourage immunization for pilgrimage to Hajj.
- Community Mobilization and Edutainment: Community leaders (political, traditional, religious) supporting community mobilization, showing films to the whole community, 'edutainment' dramas, presentations, computer simulations of viruses, and feedback. Events began with prayers.

This analysis highlights the potential benefits of faith-based community outreach, particularly when combined with other interventions. Involving religious and traditional leaders can enhance community engagement, facilitate dialogue, and adapt services to local cultural contexts. However, further research is needed to fully understand the pathways and optimize the effectiveness of these interventions (Hickler et al., 2023).

Capitolo 3

COMBATTING COVID-19 VACCINE HESITANCY IN SUB-SAHARAN AFRICA: TARGETED BEHAVIORAL STRATEGIES

3.1 Case study

This chapter delves into COVID-19 vaccination in Sub-Saharan Africa, focusing on the main enablers of vaccine hesitancy and exploring practical interventions to improve vaccine uptake. In previous sections of this thesis, we analyzed the general context of Sub-Saharan Africa, the epidemiological landscape, and behavioral tendencies regarding health interventions. This chapter builds on that foundation by examining specific behavioral insights and strategies to promote demand for COVID-19 vaccines in the region. Drawn primarily from the "Behavioral Insights to Promote Demand for COVID-19 Vaccines in Sub-Saharan Africa" report by Princeton University in Fall 2021.

COVID-19 has had a profound impact globally, with over 290 million confirmed cases and more than 5 million deaths as of December 2021. Despite Africa's relatively low case and death rates, vaccine uptake remains critically low, with only 11% of the population having received at least one dose of a COVID-19 vaccine, compared to 56% globally. This disparity is exacerbated by significant levels of vaccine hesitancy, driven by a complex interplay of factors, including health concerns, trust in institutions, cognitive biases, social norms, and cultural beliefs.

In Sub-Saharan Africa, misinformation about COVID-19 vaccines has increased, mainly through social media platforms like Facebook and WhatsApp, leading to widespread vaccine hesitancy. The Princeton report identifies five major thematic

enablers of this hesitancy: health concerns and risk perceptions, low trust in institutions, automatic thinking and heuristics, social processes, and cultural and religious beliefs. By understanding these enablers, we can better design and implement interventions to address vaccine hesitancy.

The report suggests a range of online and in-person interventions tailored to these enablers, such as social media advertisements, WhatsApp chatbots, interactive games based on inoculation theory, and community engagement initiatives. These interventions aim to correct misinformation, build trust in vaccines and health institutions, and leverage social norms to encourage vaccine uptake. By focusing on the Sub-Saharan African context, this chapter seeks to fill gaps in existing research and provide practical, context-specific solutions to enhance COVID-19 vaccine acceptance in the region.

The insights and recommendations from the Princeton report serve as a critical component of this thesis, offering a detailed examination of the factors driving vaccine hesitancy and the potential interventions to mitigate it. Through this case study, we aim to contribute to a broader understanding of how behavioral insights can be applied to public health challenges in Sub-Saharan Africa, ultimately supporting efforts to increase vaccine coverage and protect public health in the region (Goncharenok, 2021).

3.2 Hesitancy causes

Here, an overview of the hesitancy causes is proposed, specifically in sub-Saharan Africa:

HEALTH CONCERNS AND RISK PERCEPTIONS INFLUENCING VACCINE HESITANCY IN SUB-SAHARAN AFRICA

Vaccine hesitancy in sub-Saharan Africa is significantly influenced by health concerns and risk perceptions related to COVID-19. These concerns often distort the perceived risks and benefits of vaccination. Factors such as perceived likelihood of infection,

disease severity, and emotional responses (worry, anxiety, fear) play crucial roles. The initial low impact of COVID-19 in Africa led many to believe it was not a significant threat, fostering myths like COVID-19 being non-lethal to Africans or treatable with traditional remedies.

A lack of information exacerbates these issues, with many Africans feeling uninformed about vaccine development. This gap makes them vulnerable to misinformation portraying vaccines as unsafe or unnecessary. Safety concerns, rooted in actual events (e.g., the 1996 Pfizer trial in Nigeria) and misinformation further fuel hesitancy. Myths include fears of infertility, DNA alteration, and conspiracy theories involving microchips and foreign actors.

Misinformation and lack of information lead many to underestimate COVID-19 risks and overestimate vaccine risks. This is evident in varying risk perceptions across regions, with East and Southern Africa showing higher perceived risks than West and Central Africa. Trusted messengers, like healthcare providers, are crucial in dispelling myths and providing accurate information to recalibrate vaccine risk assessments. Proactive "prebunking" strategies and better social media regulation are recommended to combat misinformation effectively.

Health concerns and misinformation contribute to widespread vaccine hesitancy in sub-Saharan Africa. Addressing these issues through trusted communication and proactive misinformation management is essential for successful vaccination efforts (Goncharenok, 2021).

LOW TRUST IN INSTITUTIONS AND VACCINE HESITANCY IN SUB-SAHARAN AFRICA

Low trust in institutions significantly contributes to COVID-19 vaccine hesitancy in sub-Saharan Africa. Historical and contemporary factors drive this distrust, including the legacy of colonialism and past medical abuses. For instance, the tragic 1996 Pfizer trial in Nigeria, which resulted in child fatalities and paralysis, has left lasting scars and fostered skepticism toward new vaccines.

Surveys reveal widespread distrust. An Afrobarometer survey across five West African countries showed that vaccine hesitancy is linked to doubts about the government's ability to ensure vaccine safety. High percentages of respondents in countries like Niger, Liberia, and Senegal believe in prayer over vaccines to prevent COVID-19, reflecting deep-rooted mistrust. Additionally, misinformation plays a crucial role, with many believing that Africans are used as guinea pigs for vaccine trials or that vaccines contain harmful substances.

Trust in information sources varies. The Africa CDC survey found that television and radio are trusted more than government sources, especially among vaccine-hesitant individuals. Misinformation is rampant on social media, which younger people and men heavily trust. This misinformation, spread using sophisticated techniques, undermines trust in institutions responsible for vaccine distribution.

Social identity and in-group bias also influence trust. People are more likely to trust those within their social groups. Studies suggest that individuals are more willing to accept vaccines from in-group rather than out-group sources, highlighting the importance of leveraging trusted local figures in vaccination campaigns.

To combat vaccine hesitancy, it is essential to use trusted messengers like local healthcare providers, religious leaders, and respected international organizations. Proactive strategies include early detection of misinformation and fostering trust in institutions through transparent and inclusive communication. These efforts should be tailored to the specific contexts of different countries and communities, recognizing the diverse factors that influence trust and vaccine acceptance in sub-Saharan Africa (Goncharenok, 2021).

AUTOMATIC THINKING AND HEURISTICS IN VACCINE HESITANCY IN SUB-SAHARAN AFRICA

Automatic thinking and the use of heuristics significantly contribute to the spread of misinformation about COVID-19 vaccines in sub-Saharan Africa. When individuals encounter information online, especially on social media, they often engage in

automatic thinking—absorbing and sharing content without critically evaluating its truthfulness. This process, driven by emotional responses and cognitive shortcuts, leads to widespread misinformation sharing.

Studies by Pennycook and Rand indicate that automatic thinking, characterized by a lack of careful reasoning and reliance on familiarity, is a significant factor in sharing misinformation. They found that prompting users to consider the accuracy of headlines before sharing can reduce misinformation sharing by 51%. Similarly, Rosenzweig et al. found that emotions, mainly happiness and surprise, increase the likelihood of believing and sharing false headlines.

Research in Kenya and South Africa by Wasserman and Madrid-Morales reveals that individuals often share misinformation out of a perceived moral duty, desire to spark debate, or for entertainment, even if they do not believe it. This highlights a disconnect between belief and sharing behavior, suggesting that interventions should target the act of sharing itself.

Educative interventions aimed at promoting deliberative thinking have mixed results. For example, a media literacy program in India could have significantly improved participants' ability to identify misinformation. This suggests that local context and identity-based cognition heavily influence the effectiveness of such interventions. Sometimes, efforts to encourage deliberative thinking can backfire, reinforcing existing beliefs.

Studies also show that people are more likely to trust and share information from in-group members, suggesting that leveraging trusted local figures can effectively combat misinformation. Emotive and evocative content is particularly "sticky" and likely to be shared, as it provokes strong emotional reactions.

To combat automatic thinking and misinformation, interventions should include:

1. **Accuracy Prompts:** Encouraging users to consider the accuracy of information before sharing.

2. **Educative Programs:** Teaching critical thinking skills, though these must be carefully designed to avoid reinforcing misinformation.
3. **Trusted Messengers:** Using local, trusted figures to disseminate accurate information.
4. **Emotional Awareness:** Recognizing the role of emotions in spreading misinformation and addressing it directly.

Addressing automatic thinking and heuristics is crucial for reducing vaccine hesitancy and improving public health outcomes in sub-Saharan Africa (Goncharenok, 2021).

SOCIAL PROCESSES AND VACCINE HESITANCY IN SUB-SAHARAN AFRICA

Social norms are critical in influencing vaccine acceptance and hesitancy in sub-Saharan Africa. Social norms are unwritten rules that people in a group follow, and they can be descriptive (indicating what others do) or injunctive (indicating what others think one should do). These norms shape behaviors by providing cues for acceptable conduct and exerting social pressure.

Healthcare providers can influence vaccination decisions by establishing social norms. By recommending vaccines, they create injunctive norms, and by showing that most patients get vaccinated, they establish descriptive norms. This approach has been practical in other public health contexts, such as promoting toilet use in rural India by associating it with cleanliness and highlighting its prevalence among neighbors.

The Africa CDC's surveys highlight that vaccine hesitancy is higher among young people, city residents, the unemployed, and women. Factors contributing to skepticism include:

- Not knowing anyone who had COVID-19.
- Believing the threat is exaggerated.
- Subscribing to conspiracy theories.

Social networks also significantly impact misinformation spread, creating perceived social consensus through echo chambers on social media.

Effective community engagement, such as Sierra Leone's Social Mobilisation Action Consortium during the Ebola outbreak, shows the power of coordinated, trusted communication. Utilizing local figures like religious leaders and community champions to disseminate accurate information can shift social norms toward positive health behaviors. Door-to-door campaigns and megaphone announcements have also effectively spread precise health information.

Social norms are powerful predictors of health behaviors. Studies show that people are more likely to get vaccinated if they believe others in their reference group are doing so. Descriptive norms inform people about what others are doing, while injunctive norms communicate expectations. For example, young adults' vaccination intentions correlate with their perceptions of what their peers are doing and valuing.

Understanding and leveraging social norms can counteract misinformation and promote vaccine acceptance. Identifying the motivations behind individuals' attitudes toward vaccines is crucial for designing effective interventions. These motivations can range from self-protection to a sense of civic duty.

In conclusion, social processes, particularly the influence of social norms, are vital in addressing vaccine hesitancy. Public health campaigns can encourage vaccine acceptance and counter misinformation in sub-Saharan Africa by using trusted community figures and creating positive social norms (Goncharenok, 2021).

CULTURAL AND RELIGIOUS BELIEFS AND VACCINE HESITANCY IN SUB-SAHARAN AFRICA

Cultural and religious beliefs significantly influence vaccine hesitancy in sub-Saharan Africa. These beliefs shape individuals' identities and worldviews, affecting how they process information and respond to misinformation. This phenomenon, known as cultural cognition, means that people are more likely to accept information that aligns with their cultural or religious beliefs and reject information that contradicts them.

When new information conflicts with an individual's deeply held beliefs, they may use motivated reasoning to justify their beliefs rather than reconsider them. This can lead to a "backfire effect," where efforts to correct misinformation reinforce the original beliefs. For instance, Badrinathan's 2021 study showed that media literacy interventions could backfire, as BJP supporters in India became less likely to identify misinformation after the intervention.

Religious identity is a potent predictor of vaccine skepticism. Rutjens et al. found that self-identifying as religious was more closely associated with vaccine skepticism than political affiliation. This trend is likely relevant in sub-Saharan Africa, a highly religious region.

Two effective strategies are used to counter the adverse effects of cultural cognition: rebranding and using culturally congenial messengers. Rebranding involves framing messages that align with the target audience's identity. For example, religious leaders could frame getting vaccinated as protecting and loving one's neighbor. Using culturally congenial messengers means selecting individuals who share the audience's cultural or religious background to deliver the message, making it more likely to be accepted.

Misinformation often exploits cultural and religious beliefs. For instance, myths such as "COVID-19 is not a serious threat to Africans" or "Traditional tonics will cure COVID-19" are prevalent. Religious leaders, while generally trusted, can be powerful allies in promoting vaccine uptake and vectors of misinformation. Effective intervention involves partnering with trusted religious leaders to disseminate accurate information.

Studies highlight the importance of addressing cultural and religious contexts in vaccine promotion. For instance, the African Youth Survey found that 51% of respondents identified most with their country, while others identified with Africa, their tribe, or their race. Understanding these identity markers can help tailor interventions to specific groups.

Afrobarometer's survey of 6,000 West Africans found that 65% believed prayer was more effective than vaccines in preventing COVID-19, indicating a significant reliance on religious beliefs over scientific solutions. This underscores the need for interventions that respect and incorporate cultural and spiritual beliefs to effectively combat misinformation and promote vaccine acceptance.

In conclusion, addressing cultural and religious beliefs is crucial in tackling vaccine hesitancy in sub-Saharan Africa. Strategies should involve rebranding messages to align with cultural values and using trusted local and religious figures to deliver accurate information. Understanding the cultural and spiritual landscape is essential for designing effective public health interventions (Goncharenok, 2021).

3.3 Targeted Interventions to Combat COVID-19 Vaccine Hesitancy in Sub-Saharan Africa

The section begins by highlighting the importance of addressing misinformation to influence vaccine confidence and uptake. It notes that while misinformation is a significant factor, structural barriers are critical drivers of vaccine hesitancy. A holistic approach addressing structural barriers is recommended for policymakers and practitioners (Goncharenok, 2021).

Personas for Tailored Interventions

The interventions are tailored to five personas based on data collected by the World Bank:

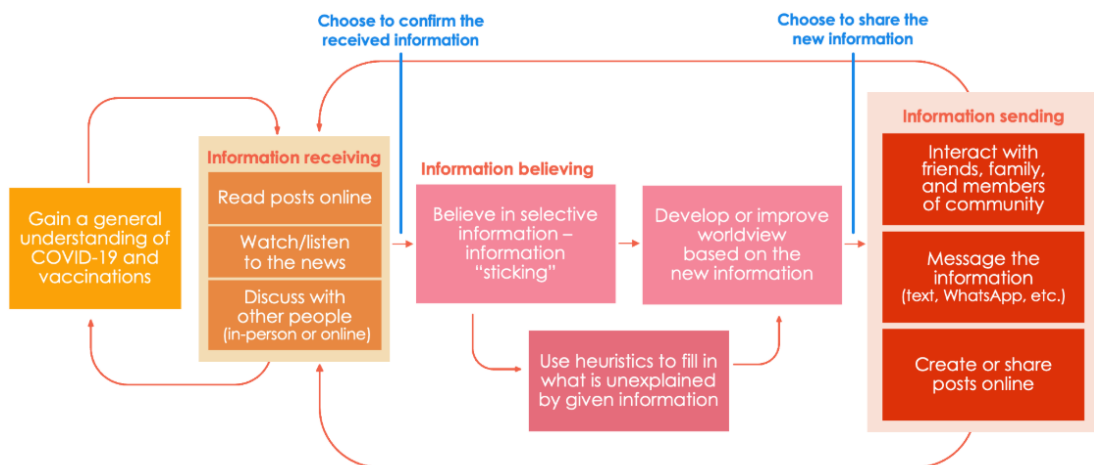
1. **Champions:** Believe vaccines are good, trust institutions, and need information on vaccine access.
2. **Those with Specific Health Concerns:** Risk-averse and reliant on social proof need to target vaccine safety and efficacy information.
3. **Low-Trust Individuals:** Distrust institutions and respond best to social norms and messages from peers rather than official endorsements.

4. **Uninformed or Unaware:** Do not perceive COVID-19 as a threat or believe vaccines are unnecessary, need better information and corrections.
5. **Classically Anti-Vaccine:** Strongly opposed due to political, religious, or cultural beliefs, difficult to sway but may respond to converted former anti-vaccine individuals.

3.3.1 Online and Social Media Strategies

The section proposes various online strategies targeting misinformation at different steps of the information journey (believing, filling gaps, updating worldview, sharing).

These online and social media strategies address social norms, automatic thinking, health concerns, and risk perception. These strategies also tackle low trust and cultural/religious beliefs through prebunking and debunking techniques such as advertisements, chatbots, and inoculation games. Prebunking helps people detect false information and use deliberative thinking, potentially changing worldviews and increasing perceived vaccination risks. Debunking supports double-checking information and promotes social norms around verifying before sharing. Facebook and WhatsApp are the primary platforms, with potential low-cost expansion to Instagram and YouTube.



(Figure 3: Journey map and targeted points for online intervention)

Source: Princeton team, (Goncharenok, 2021)

FACEBOOK ADVERTISEMENTS

1. General Approach: Post-survey ads provide accurate information and refute misinformation, using the EAST framework (Easy, Attractive, Social, Timely) for effectiveness.

2. Targeted Messages:

- Champions: Simple calls to action on how to get vaccinated.
- Those with Health Concerns: Information on vaccine safety, addressing specific myths like infertility concerns.
- Low-Trust Individuals: Personal stories from trusted messengers to improve trust and focus on individual benefits.
- Uninformed or Unaware: Filling information gaps about COVID-19 threats and vaccine benefits.

Sample messages for Facebook advertisements by persona

Target	Sample Messages
Champions	<ul style="list-style-type: none">- COVID-19 vaccines are available throughout town X. Learn how to get yours today.- Be a leader and get your COVID-19 vaccine today. Available at local clinics.- Protect yourself and your loved ones against COVID-19. Get vaccinated today.- Let's get vaccinated and stop the pandemic together. No more lockdowns! Set up an appointment for yourself and your loved ones today. (Insert a link to availability calendar, appointment scheduler, etc. for all advertisements.)
Concerned	<ul style="list-style-type: none">- X people in country A have been vaccinated against COVID-19, with most reporting minor or no side effects. Join them and get yours today.- Why am I getting vaccinated? Because as a mom, I want to protect my children against COVID-19. (Show a mother with her children.)

	<ul style="list-style-type: none"> - Everyone at our center got vaccinated against COVID-19, and we are stronger than ever. Join us and protect yourself. (Show a worker from a local health care center.) - COVID-19 vaccines are as safe as measles vaccines you give your kids.
Low-trust	<ul style="list-style-type: none"> - Why vaccinate? Because COVID-19 vaccines are safe and help me get back to doing things I enjoy / helping people in my community / meeting with the members of my church. (Show a person from town X / nurse from hospital Y / pastor from church Z.) - COVID-19 vaccines were developed quickly without compromising safety. After multiple clinical trials, it is now available for everyone over age X in our country. I got mine already, and I feel confident that it can protect you, too! (Show a doctor.)
Uninformed	<ul style="list-style-type: none"> - Did you know a new COVID-19 variant was detected in Africa? Protect yourself against Omicron. Get vaccinated today. - Did you know you can get COVID-19 again, even if you had it before? Vaccines can help minimize the risk. Get yours today. - X people in country A have suffered from COVID-19; X more unreported cases are estimated. Protect yourself and get vaccinated now.

Source: Princeton team, (Goncharenok, 2021)

Note: Messages should be revised as necessary based on the local context and up-to-date diagnostic results

"STICK IT TO THE MAN" ADVERTISEMENTS

Target younger, educated, urban adults who may distrust institutions by framing misinformation as foreign influence and encouraging autonomy.

ADVERTISEMENTS TO ENCOURAGE FACT-CHECKING

Promote advertisements to create social norms about fact-checking before sharing information, aiming to reduce belief in and sharing of misinformation.

WhatsApp Chatbot: The development of a WhatsApp chatbot will provide real-time fact-checking and accurate information, leveraging the platform's popularity in sub-Saharan Africa. Challenges include user opt-in requirements and the complexity of responses.

Inoculation Games: Utilize the Go Viral game to improve players' ability to detect misinformation and decrease its perceived credibility. The game is introduced at the end of surveys to encourage participation.

Offline or Community-Level Strategies: These strategies are designed for areas with limited internet access, focusing on television, radio, and in-person approaches.

NATIONAL CAMPAIGN

A catchy phrase and tune like "STOP before sharing" to create a social norm against sharing misinformation, supported by pro-vaccine messages from trusted messengers.

UNIVERSITY-LEVEL INTERVENTIONS

Information sessions and inoculation games for university students to provide accurate information and train them to spot misinformation.

COMMUNITY-LEVEL INTERVENTIONS

A comprehensive strategy using pamphlets, text messages, radio campaigns, interfaith dialogues, and live broadcasts of vaccinations to address misinformation at multiple levels.

Evaluation Strategies

The section outlines evaluation strategies for each intervention to measure their effectiveness, including:

1. Facebook Advertisements: A/B testing and follow-up surveys to assess changes in attitudes and intentions.

2. WhatsApp Chatbot: Randomized access to the chatbot and follow-up surveys to evaluate beliefs and attitudes.
3. Inoculation Games: Linking eMBeD survey data with Go Viral game data to assess differential effects on different personas and changes in vaccine intentions.
4. Offline Strategies: Mixed-methods analyses for national campaigns and iterative implementation studies for community-level interventions to inform adjustments.

The interventions proposed are tailored to different personas and leverage both online and offline strategies to address misinformation and improve vaccine confidence in sub-Saharan Africa; with a double focus both on online and online interventions, it is possible to reach both rural and more central areas of the region guaranteeing a sufficient coverage. The emphasis is on a holistic approach considering local contexts and resource constraints (Goncharenok, 2021).

DISCUSSION & CONCLUSIONS

Introduction to the Discussion on Behavioral Interventions for Vaccination in Sub-Saharan Africa

In this final section of the thesis, we delve into the discussion of behavioral interventions, drawing on the analysis conducted in previous chapters. Our focus is on the convergence of general UNICEF interventions and specific COVID-19 strategies within the context of Sub-Saharan Africa. By examining health concerns, trust in institutions, cognitive biases, social norms, and cultural beliefs, we aim to understand how these factors influence vaccine uptake and hesitancy.

Our analysis has highlighted the importance of integrating broad educational campaigns with targeted online tools to create a multifaceted approach to health literacy. By leveraging trusted local figures and healthcare providers, we can enhance the credibility and acceptance of vaccination messages. Moreover, promoting critical thinking through educational programs and interactive tools is essential in combating misinformation. Additionally, utilizing social norm-based messages and culturally tailored communication strategies can effectively address vaccine hesitancy rooted in cultural and religious beliefs.

This discussion will synthesize the insights gained from previous chapters and present a comprehensive evaluation of the effectiveness of these integrated interventions. We will explore how these strategies can be optimized to improve vaccine acceptance and public health outcomes in Sub-Saharan Africa, providing actionable recommendations for future public health initiatives.

Intersecting General and Specific Interventions: UNICEF and COVID-19

In the context of Sub-Saharan Africa, the convergence of general UNICEF interventions with specific COVID-19 strategies offers a robust framework for tackling public health challenges. This intersection not only enhances the effectiveness of interventions but also ensures their applicability and relevance to the unique socio-cultural landscape of the region. The following sections provide an in-depth analysis and argumentation on integrating these interventions to maximize their impact.

1. Health Concerns and Risk Perceptions

- *UNICEF Interventions*: UNICEF has long advocated for comprehensive education campaigns to improve public awareness and understanding of vaccine safety and benefits. These campaigns are designed to provide accurate information and counteract the pervasive myths and misconceptions about vaccines.
- *COVID-19 Specific Interventions*: During the COVID-19 pandemic, targeted interventions such as social media advertisements and WhatsApp chatbots have addressed specific myths and health concerns. These tools are crucial in reaching a broad audience quickly and effectively, particularly in regions where misinformation spreads rapidly via digital platforms.
- *Intersection*: Combining broad educational campaigns with targeted online tools creates a multifaceted approach to health literacy. Broad campaigns lay the foundation of trust and knowledge, while targeted tools can address immediate concerns and misinformation. This dual strategy dispels myths and reinforces accurate information, ultimately improving vaccine acceptance. For instance, a campaign that broadly educates on the benefits of vaccination can be supplemented by WhatsApp chatbots that answer specific queries, thereby reducing the perceived risks and increasing vaccine uptake.

2. Low Trust in Institutions

- *UNICEF Interventions*: Engaging trusted community leaders and healthcare providers has been a cornerstone of UNICEF's strategy to promote vaccines.

This approach leverages community trust to build credibility for vaccination efforts.

- *COVID-19 Specific Interventions:* COVID-19 interventions have emphasized personal stories from trusted messengers and community engagement initiatives. These strategies humanize the message and make it more relatable, crucial in areas with historical distrust in institutions.
- *Intersection:* Leveraging trusted local figures and healthcare providers online and offline ensures that the message reaches a broad audience and resonates personally. For example, community leaders can disseminate vaccine information through local meetings and social media, while healthcare providers can offer credible, science-based reassurances during consultations. This combined approach addresses trust's emotional and rational aspects, making the public more receptive to vaccination messages.

3. Automatic Thinking and Heuristics

- *UNICEF Interventions:* Promoting critical thinking and media literacy has been essential in combating misinformation. By educating the public on critically evaluating information, UNICEF aims to reduce the influence of cognitive biases that lead to vaccine hesitancy.
- *COVID-19 Specific Interventions:* Interactive tools such as inoculation games and accuracy prompts on social media have been utilized to engage the public more interactively and thoughtfully. These tools are designed to disrupt automatic thinking and encourage more deliberative processes.
- *Intersection:* Implementing educational programs alongside interactive tools creates a comprehensive strategy to combat misinformation. Academic programs provide the foundational skills needed for critical evaluation, while interactive tools actively engage users, reinforcing these skills in real-time. For instance, an inoculation game that challenges players to spot misinformation can be supported by a media literacy campaign that explains common cognitive biases, enhancing the public's ability to discern credible information.

4. Social Processes

- *UNICEF Interventions*: Utilizing social norms and peer influence has proven effective in encouraging vaccination. By highlighting the behaviors and attitudes of the majority, these interventions create a perception that vaccination is the socially accepted norm.
- *COVID-19 Specific Interventions*: Campaigns showing that most community members are vaccinated and emphasizing the communal benefits of vaccination have been crucial in promoting vaccine uptake during the pandemic.
- *Intersection*: Using social norm-based messages in community campaigns incentivizes individuals to conform to positive health behaviors. When people see their peers getting vaccinated, they are more likely to follow suit. This approach can be efficient in tightly-knit communities where social influence is strong. For example, publicizing high vaccination rates within a community and showcasing stories of individuals who have benefited from vaccination can create a ripple effect, encouraging more people to get vaccinated.

5. Cultural and Religious Beliefs

- *UNICEF Interventions*: Culturally sensitive communication strategies and engaging religious leaders are pivotal in addressing vaccine hesitancy rooted in cultural and spiritual beliefs. These interventions ensure they are heard and accepted by aligning health messages with cultural values.
- *COVID-19 Specific Interventions*: Reframing vaccination messages to align with cultural and religious values has been an effective strategy during the pandemic. Engaging religious leaders to endorse vaccines and provide accurate information has also helped counteract misinformation.
- *Intersection*: Developing culturally tailored messages and involving religious leaders to promote vaccines directly addresses specific cultural and spiritual concerns. This strategy ensures that health messages are respectful and relevant, increasing their acceptance. For example, framing vaccination as a

communal responsibility and a way to protect loved ones can resonate deeply in cultures that value community and family. Religious leaders can reinforce these messages during sermons and spiritual gatherings, providing a trusted source of information that aligns with the community's beliefs.

By integrating these general and specific interventions, the proposed strategies can effectively address the unique challenges in Sub-Saharan Africa. Combining broad educational campaigns with targeted tools, leveraging trusted figures, promoting critical thinking, using social norms, and respecting cultural beliefs create a comprehensive and robust framework for improving vaccination uptake. This intersectional approach enhances the effectiveness of each intervention. It ensures they are culturally and contextually appropriate, leading to better health outcomes and increased regional vaccine acceptance.

CONCLUSION

The journey of this thesis began with an in-depth exploration of the socio-political, economic, and cultural landscapes of Sub-Saharan Africa to understand the factors influencing health and vaccination policies. Each chapter built upon this foundation, delving into the behavioral interventions, health system challenges, and specific case studies that provide a comprehensive picture of the region's public health dynamics. This conclusion synthesizes the main findings, offering critical observations and actionable insights for future public health initiatives.

Integration of Behavioral Interventions

One of the core themes of this thesis is the integration of general and specific interventions to address vaccine hesitancy and improve health outcomes. Behavioral science offers powerful tools for understanding and influencing health behaviors. By leveraging these tools, we can design more effective public health campaigns that address the unique challenges of Sub-Saharan Africa. The following key points summarize the strategic insights gained:

1. **Health Concerns and Risk Perceptions:** Broad educational campaigns combined with targeted online tools can significantly improve health literacy. This dual approach dispels myths and reinforces accurate information, reducing perceived risks and increasing vaccine uptake. For example, social media chatbots can address specific queries, while broad campaigns build a foundation of trust.

2. **Trust in Institutions:** Engaging trusted community leaders and healthcare providers is crucial for building credibility. Personal stories from trusted messengers humanize the message, making it more relatable and compelling. This strategy addresses emotional and rational aspects of trust, enhancing public receptiveness to vaccination messages.

3. **Cognitive Biases and Heuristics:** Educational programs that promote critical thinking, supported by interactive tools like inoculation games, can combat misinformation. These programs equip individuals with the skills to critically evaluate information, while interactive tools reinforce these skills in real time.

4. **Social Norms:** Utilizing social norms and peer influence can effectively encourage vaccination. Publicizing high vaccination rates and showcasing community members who have benefited from vaccines create a perception of social acceptance, motivating others to follow suit.

5. **Cultural and Religious Beliefs:** Culturally tailored messages and the involvement of religious leaders address specific cultural and spiritual concerns. By framing vaccination as an act of communal responsibility, health messages resonate more deeply with the community's values.

Health System Challenges

The health system analysis in Sub-Saharan Africa highlighted significant disparities in healthcare infrastructure, workforce distribution, and access to services. Key challenges include:

1. **Healthcare Infrastructure:** There is a stark contrast between urban and rural healthcare facilities, with rural areas severely underserved. Investments in healthcare infrastructure, particularly in rural regions, are crucial for equitable health access.
2. **Workforce Distribution:** The shortage of healthcare professionals, especially in rural areas, exacerbates health disparities. Addressing this requires increasing the number of healthcare workers and ensuring their equitable distribution.
3. **Public vs. Private Health Expenditure:** Balancing public and private health expenditures is essential for improving health outcomes. Public expenditure effectively reduces mortality rates, while private spending enhances life expectancy.

Case Studies and Practical Interventions

The case studies on measles, tuberculosis, COVID-19, and hepatitis B vaccinations provided practical insights into the region's vaccination challenges and strategies to overcome them:

1. **Measles:** Despite significant progress, gaps in vaccination coverage persist due to logistical barriers and vaccine hesitancy. Strengthening health systems and community engagement are crucial to achieving measles elimination.
2. **Tuberculosis:** High TB incidence, compounded by HIV co-infection, remains a significant health concern. Addressing stigma and improving treatment adherence are critical for TB control.
3. **COVID-19:** The pandemic underscored the importance of timely and equitable vaccine access. Tailored outreach and education campaigns are vital for improving vaccine uptake.
4. **Hepatitis B:** Low vaccination coverage, particularly among infants, highlights the need for targeted communication and improved vaccine access.

Recommendations for Future Public Health Initiatives

Based on the insights gained from this thesis, the following recommendations are proposed for future public health initiatives in Sub-Saharan Africa:

1. **Integrated Interventions:** Combine broad educational campaigns with targeted tools to address specific health concerns and misinformation effectively.
2. **Community Engagement:** Leverage trusted community figures and healthcare providers to build credibility and trust in vaccination efforts.
3. **Critical Thinking Promotion:** Implement educational programs that promote critical thinking and media literacy to combat cognitive biases and misinformation.
4. **Social Norms Utilization:** Use social norms and peer influence to perceive vaccination as a socially accepted behavior.
5. **Cultural Sensitivity:** Develop culturally tailored messages and involve religious leaders to address cultural and spiritual concerns directly.
6. **Healthcare Investment:** Increase investments in healthcare infrastructure and workforce, mainly in rural areas, to improve health access and equity.
7. **Policy Reforms:** Advocate for policy reforms prioritizing public health funding and equitable distribution of healthcare resources.

By integrating these strategies, public health initiatives can more effectively address the unique challenges of Sub-Saharan Africa, ultimately improving health outcomes and vaccine acceptance across the region. These recommendations serve as a roadmap for crafting impactful public health strategies regarding vaccination in a very lacking context, underscoring the importance of a tailored, inclusive, and evidence-based approach. As we look towards the future, the insights from this thesis highlight the critical need for sustained investment and innovation in public health, ensuring that the progress made is resilient and equitable. Through continued collaboration and commitment, we can aspire to a future where every individual in Sub-Saharan Africa has access to life-saving vaccines and the opportunity to lead a healthy life.

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