



Microbial Macroeconomics: a critical review of New Public Management and mitigation strategies for control and prevention of communicable cancers in a Sub-Saharan African conflict zone. p.1-88 <https://www.doi.org/10.64809/t23244488>

Microbial Macroeconomics:

a critical review of New Public Management and mitigation strategies for control and prevention of cancers associated with communicable neoplastic agents in Sub-Saharan African conflict zones¹

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ABSTRACT:

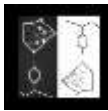
Background: Major goal of Africa Union (AU) Health Security and Sovereignty (AHSS) is reduction of avoidable death and increase in domestic health patronage by 2040. A major lesson learnt from DRC 2026 Ebola outbreak is the crucial role of good governance, particularly for mitigating conflict and insurgencies. Other obstacles to (AHSS) include access to quality healthcare (safe, accurate, and precise treatment or diagnostics). Additionally, diminished productivity or customer service satisfaction, Turn-Around-Times (TAT), healthcare affordability and accessibility are problematic. Finally, poor public utilities and infrastructure which is of major concern, can be attributed to limitations in Science, Technology, Engineering and Mathematics (STEM) integration.

Method: To begin, multiple regression analysis and ANOVA was used to explore stochastic relationships between political shifts in Nigeria and changes in behavior impacting distribution of cancers associated with communicable neoplastic agents (CNA) or communicable cancers. Additionally, critical review adopts a comparative pretest (Ex-Post) and posttest (Ex Ante) time series case study along with Solomon Four-Group approach to determine CNA prevalence and to forecast its mortality rate. Specifically, Coupled Behavioral-Epidemiological Game adapted Impact Models with endogenous fiscal and public policy frameworks created from meta-analysis of socio-economic performance measures, and data in cancer registries was used to characterize obstacles to cancer interventions. Finally, case study findings were used to make recommendations for (AHSS) compliance.

Result: Findings on distribution of cancers associated with Communicable Neoplastic Agents (CNA) or communicable cancers, and indices on Conflict and Insurgencies Lethality (CIL) in Nigeria show Northern and Southern geopolitical zones score: 80% and (>0.5); and (20%) and (< 0.3) respectively. Additionally, in contrast to the South, Northern zones' experience prolonged (>7 years) Internal Displacement of People (IDP) of extremely large sizes (> 2,687,741) along with high unemployment rates (>26.6 per 100).

Conclusion: Nigeria is experiencing an epidemiologic transition (resulting outcome) of cancer due to poor governance (macro trigger). Additionally, reproductive age females in conflict zones are disproportionately affected. Stochastically, prevalence of Human Papilloma Virus (HPV)—Cervical Cancer (CC), Epstein Barr Virus (EBV)—Non-Hodgkins Lymphoma (NHL); EBV—Hodkin Lymphoma (HL); Schistosoma haematobium—Bladder Cancer (BC); Helicobacter pylori—Stomach Cancer (SC) and Human Herpes Simplex Virus (HHV)-8—Kaposi Sarcoma (KS) —HIV are all linked to religious intolerance (Unmeasurable Variable), unemployment, and IDP (Predictors). Furthermore, lethal activities of insurgencies and conflicts (Vital Few) exacerbate the problem by limiting intervention access. Consequently, provision of safe; high-quality public utility infrastructure along with systemic improvements to processes that provide good governance with focus on interfaith and interethnic tolerance along with conditional employment (with government benefits) are needed to productively mitigate adverse trends.

KEYWORDS: Biosecurity, Cancer, National Security, Public Policy, Public Health, Game Theory



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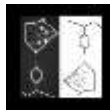


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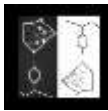
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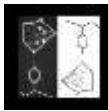
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Introduction: Microbial Macroeconomics

Term biodefense and biosecurity refer to systems and actions taken to protect people, animals, plants, and the environment against biological threats caused by biological agents regardless of whether these threats are natural (climate, environmental, zoonosis, accidental laboratory or research accidents, or deliberate (insurgencies, conflicts, war or terrorism). Descriptively, it's important to note that Infectious diseases (ID) come from the environment. For example:

- Zoonosis: amphibians, reptiles, mammals, arthropods, fish. Also, 60% of these can cause contagion.
- Agriculture (Food)
- Air
- Water

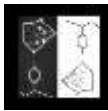
Furthermore, (ID) accounts for approximately 80% of all infections. However, communicable disease (CD) includes all (ID) and diseases transmitted person-to-person. Examples include:

- Ebola
- COVID
- HIV
- Tuberculosis (TB)
- Malaria

Also, (CD) accounts for approximately 20% of (ID). Thus, (CD) is a subset of (ID). Also, all (CD) are (ID) but not all (ID) are (CD). Importantly, all (CD) have cross-border potential. Thus, biosecurity focuses on communicable and infectious disease (CID), and its scope includes the following:

- *Prevention*: (CID) surveillance; vaccination; sanitation
- *Detection*: agricultural, veterinary and laboratory medicine
- *Response*: improvements in emergency medicine
- *Preparedness*: education, outreach; development of public utility infrastructure
- *Recovery*: socioeconomic development programs

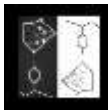
Worth noting, in “Economics: Principle in Action” (O'Sullivan & Steven, 2002), author stated that macroeconomics, unlike other branches of economics, focuses on the role price plays in resource allocation in addition to dealing with *fiscal policy*, *performance measures*, *performance budgeting*, and their impact on government programs and financial systems. In the context of infectious disease. Evidently, his findings suggest macroeconomics is a broad field of study, which is closely related to *new public management*. Historically, macroeconomics can trace its roots to 1933 when the Norwegian economist Ragnar Frisch coined the term to distinguish the individual need from the community's needs. Later in the decade, the concept gained significance after the great depression when the British economist, John Maynard Keynes—



father of Keynesian economics—described causes of the US great depression in macroeconomic terms. In later years, in “A Textbook of Econometrics” (Klein, 1963); and in “On the Theory of Economic Policy” (Tinbergen, 2021), both authors adopted macroeconomic principles to develop practical economic models to better understand relationships between economics and other disciplines. Additionally, In the 1970s, *New Keynesian economics* evolved when investigators like Robert Lucas, Jr. started to question traditional macroeconomics models not derived from assumptions on individual behavior, but rather based on past correlations between classical economics and the *stochastic general equilibrium theory*, which accommodate the role that time and independent events (variables) that impact human behavior like health promotion and epidemiology in addition to the impact demographics have on: economic development, disease, conflict, food distribution, and famine.

Traditionally, distinction between the two different approaches is that *Keynesian economics* focus on public demand, effectively giving the public a say in the outcome of public programs that are implemented by the government. Conversely, supply-side (or neo-classical) economics focus on supply that can effectively reduce public impact on fiscal policies. Neither view is typically endorsed to the complete exclusion of the other, but most schools of thought emphasize one or the other as a theoretical foundation. The significance here is that governmental and non-governmental agencies tend to appropriate fiscal and monetary policies that impact the “best practice” for implementing and evaluating international programs. These policies in turn are driven by economics. Furthermore, according to Keynesian economics, the success of these programs would depend on the “market,” Since most markets in these areas are imperfect, this notion would be disastrous for governments with unpopular yet necessary policies. Therefore, the efficiency outcome of the activities and services, targeting a public good, should be unaffected by the “market,” thus making supply side economics more favorable under these circumstances. Between 1960s and 2000s, earlier investigators conducted studies successfully linking cancers to with environmental factors.

Significantly in 1970s, economical conditions were shown to be linked to chronic disease like cancer. Thanks to these earlier studies, currently, researchers in the field better understand that cancer epidemiology in africa is interconnected with environmental and socioeconomic factors. Also, in “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N, 2008) and “Biological Agents Index: Microbial Macroeconomics” (Olisa N, 2020) author built on previous findings by correlating and quantifying (CID) and (ID) in fiscal, public policy decision-making, finance, and governance with respect to how they influence changes in human behaviors. Here, this study investigates links between the former and later like but not limited to cancers associated with communicable neoplastic agents, herein referred to as “communicable cancers” for simplicity. Some examples include the following: BC, SC, EBV and HL; and HPV. Also this meta analysis tries to understand how distribution of communicable cancers are impacted and/or stochastically linked to public policies (governance) by quantifying performance measures associated with governance like the following: poverty, GDP-PPP, literacy, unemployment in addition to behavioural activities religious tolerance, fertility rates, conflict and insurgencies and subsequently individual displacement of person (IDP).

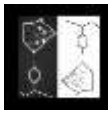


To begin with, concept of biological economics isn't new. In "What is Bio economics: Biological Economics?" (Mohammadian, 2003) author made one of the earliest arguments for links between economics, public policy, quantity and quality in pathology outcomes. More recently, in the "Biological Economics" (Lo, et al., 2018) authors make arguments for the holistic and interconnecting impacts of sociobiology, evolutionary psychology, behavioral ecology, behavioral economics and finance, neuroeconomics, and behavioral genomics. In another account recorded in "Economic microbiology: exploring microbes as agents in economic systems" (Bragazzi, Woldegerima, & Siri, 2024), investigators explore and compare operational role of microbes, and their output, with modern economics. Interestingly, here, unlike in biological economics, microbial macroeconomics studies the roles public and fiscal policy play in the implementation of contagion risk management. Also, microbial macroeconomics is used interchangeably with a technique described in as *bio indexing* in "Biological Agents Index: Microbial Macroeconomics" (Olisa, N, 2020). Furthermore, with respect to medical planning, or implementing biodefense or biosecurity strategies. This case study uses *bio indexing* to develop public policy postures that prioritize end goals or objectives leading to the following impacts:

- Reduction of communicable and infectious disease attack rates,
- Reduction of cancer disease burden,
- Increases in survivability (reduction of mortality).

Earlier in "Overview of Biological Defense against Tuberculosis and the Pandemic Flu in El Paso, Texas" (Olisa N, 2008); and in "Biological Agents Index: Quality Management of Infectious Disease Intervention Programs" (Olisa N, 2008) author highlights the relationship between socio-economic factors and the management of infectious diseases, specifically tuberculosis and pandemic flu in El Paso, Texas. In addition, study explores relationship between fiscal and public policies on prevalence of TB and influenza in several local governments in Texas. Findings conclude that local governments in Texas adopting performance budgeting achieved more impactful TB and influenza interventions suggesting programs with specific goals and execution timeline, achieve more effective and efficient TB and influenza control and prevention and improve healthcare outcomes. In another study, reports in "Cross-Sectional In Silico Analysis of Covid-19 Pandemic" (Olisa N. , 2020), show that human survival to cross-border (CID) outbreaks are influenced more by human behavior than by microbial transmission modes. Additionally, this study provides a framework for evidence-based decision-making in public health and policy. Collectively, these studies show the significant impact of performance-based budgeting and finance in the control, prevention and implementation of public health programs involving (CID).

Interestingly, to understand relationships between socioeconomic variables and disease in "The Samuelson macroeconomic model as a singular linear matrix difference equation" (Sameulson, 2020) and in "Economics: Principle in Action" (O'Sullivan & Steven, p. 77; 2003), early investigators pointed out that macroeconomics is a branch of economics that studies behavior and performance of an economy. Based on these observations, in "Biological Agents Index: Quality Management of Infectious Disease Intervention Programs" (Olisa N, 2008); and in "Cross-Sectional In Silico Analysis of Covid-19 Pandemic" (Olisa N., 2020) author describes



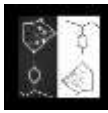
microbial macroeconomics as an essential and indispensable tool used for conducting risk management, analysis and strategic planning for biosecurity (prevention and control of measured or natural release of biological agents) and biodefense (responses and protection against intentional biological attacks). Findings conclude biodefense and biosecurity can be used to achieve the following: preparedness, productivity, quality and safety goals and objectives. Furthermore, investigator came to these conclusions through the use *bio indexing*, pareto analysis and performance budgeting and the use of coupled behavior-epidemiology impact models collectively develop biosecurity and biodefense postures that include the following macroeconomics variables:

- Public policy,
- Governance,
- International affairs and relations,
- Trade and Commerce,
- Public Safety,
- Public Utilities.

Recently, in the following reports: “The Impact of Different Types of Violence on Ebola Virus Transmission During the 2018–2020 Outbreak in the Democratic Republic of the Congo” (Kelly, et al., p. 2021–2029; 2020); and in “Factors that contributed to undetected spread of the Ebola virus and impeded rapid containment” (WHO, 2017); also in “Ebola Outbreaks Public Health Emergencies in Fragile Conflicts Zones and Displaced Populations in Africa” (Oluwasogo, et al., p. 1-15, 2017) author’s collectively explore how conflict and terrorism correlate and in some cases indirectly cause cross-border (CID) outbreaks in Sub Saharan Africa. Findings in these reports suggest medical planners need to strategically develop biodefense and biosecurity postures with specific objectives aimed at reducing the following threats:

- Engineered:
 - Conflict.
 - Climate Change.
 - Terrorism.
 - Laboratory Accidents
 - Microbial Drug Resistance (MDR)
- Nature:
 - Climate Change
 - Earthquakes
 - Floods
 - Famine
 - Microbial Evolution from Zoonosis
 - Microbial Drug Resistance (MDR) from Zoonosis, Agro-based farming

Accordingly, to achieve impactful intervention programs, microbial macroeconomic principles and strategies should be adopted and routinely used by governments, non-governmental organizations, corporations and military—at all levels, to improve biodefense and biosecurity preparedness. Thus, to impactfully shape public perception for better outcomes and to



appropriately influence the right human behaviors needed for change, an agreeable posture for biodefense and biosecurity preparedness against biological agents should contain the following:

- Proactive Objectives
- Reactive Objectives
- Defensive Objectives
- Aggressive or Coercive Objectives
- Symbolic Objectives

In conclusion, a good posture contains processes that protect populations from biological threats and ensure the population or community can respond to, as well as recover adequately from public health emergencies caused by biological agents (CID).

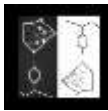
New Public Management

Public Administration can be defined as the development, implementation, and study of government policy. Furthermore, public administration accommodates non-governmental organizations that are not acting out of self-interest. In addition, the process brings scrutiny to the administration of public goods and social equity. Accordingly, public management should be viewed in the context of providing public goods. This process for management has been widely criticized by most western European countries. New Public Management is a form of digital era governance. The process involves the use of information technologies (IT) and generative Artificial Intelligence (AI) by government agencies to manage outsourced government vendors and their activities. Understandably, countries that fall short or lack (IT) or (AI) capabilities would lack the resources to adopt this system. Nonetheless, in highly industrialized countries, regardless of whether democratic, communist or totalitarian,. Specifically, federations like the United States, China, Russia, Japan and EU continue to favor this system of executive governance. At its very core, a basic requirement for this system of management requires its managers to plan strategically.

Strategic Planning

Strategic planning can be defined as an institution's process of defining its goal and direction and in managing, distributing, and assigning its resources to pursue these intended goals and human resources. Consequently, the result will be a strategic plan that can guide managers and implementers on how to define operational and feasible plans that can include, but are not limited to, technology, human resources, logistics, communication, and policy. Before planning programs and interventions, planners should develop a "vision" which defines the institutions needs for the future and reflect future goals. In addition, the institution needs to have a "mission" which should define the institution's direction and purpose.

Finally, institutions should have values which reflect the institution's culture and priorities. The first recommended step for planning and organizing infectious disease intervention programs is to determine and estimate the expected outcomes from the intervention. Secondly,



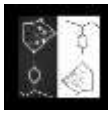
the performers should perform needs and risk assessments to determine inputs (activities) and outputs (services) needed for the program. Once these are determined, a comprehensive policy analysis should be performed on existing guidelines, regulations, and standards needed to establish criteria for future assessments, evaluations, and feedback mechanisms. Also, strategic planning offers a systematic approach for planning. A major advantage is that the process provides clearly stated goals and objectives and laid out activities to meet stated benchmarks or outcomes. One disadvantage of strategic planning is that it is relatively technical and complex in comparison to a regular planning technique. The process can be composed of timelines and other restrictions and can involve complex management processes that use performance measurements. In addition, the problems for using performance measure are increased on account of the difficulties in quantifying outputs from infectious disease impacts in numerical terms. This is important because the success of quality management of biological and information technology platforms depends on “the numbers” or metrics.

Summerly, there are several ways to plan strategically depending on whether the venture of interest is scholarly, business, educational, or military. For the purposes of healthcare planning this study will follow the sequence of developing policies, performing needs and risks assessments, identifying program objectives and activities, developing, or adopting benchmarks and feedback mechanisms, and, finally, developing and initiating program evaluations and assessments. Developing strategies include analysis of the organization and its environment as it is at this moment and how it may develop in the future. A good evaluation or analysis must be executed at an internal level as well as an external level to identify all opportunities and threats of the new strategy. Furthermore, strategic planning can be practiced either formally or informally in the decision processes and should end with clear objectives and solutions, ways to achieve those objectives, a realistic time frame and appropriate feedback mechanisms.

Meritocracy in Government

Hannah Ardent and Michael Young coined the term in 1958 while describing meritocracy as a merit system based on intelligence and effort. Earlier, in “Bringing Managers Back in Managerial Influences on Workplace Inequality” (Castilla, p. 667-964, 2011); and in “The Paradox of Meritocracy in Organizations” (Castilla & Benard, p. 543-676, 2010) also in “Encountering Social Class Differences at Work ” (Gray & Kish-Gephart, P.670-699, 2013). Authors collectively agree that class difference origins of meritocracy can be traced to the Confucius and Aristotle. Also, investigators describe how meritocracy is a form of political philosophy, holding that power should be vested in individuals who merit it.

Furthermore, these researchers explain merits in terms of education, competency, talent, intellectual capability, and experience. Their reports suggest that the most controversial aspect of meritocracy is the definition of the term “merit” which can be biased from a variety of social influences thus creating the question “what constitutes merit?” Undeniably, in federalist democracies, like those of the United States, and Germany have better defined meritocratic systems in part, because there are no provisions for monarchs, dictators or oligarchs in the executive, legislative or judicial branches of government in contrast to democratic systems in Japan and the UK where monarchs participate in Government.



Workforce Selection and Management

Organizing is the process of grouping responsibilities and activities into working units for the purpose of achieving productive, common, and detail goals; clear authority and responsible relationships; goal directed reconciliation of power and authority; clear organizational relationships for the purpose of conflict resolution; reconciliation between individual and organizational needs; prevalence of command unity; and authority delegation. Steps of organizing should include goal reconciliation and statement, review of organizational environment; determine structures needed to reach goals, determination of the degree of centralization, determination of authority relationships, organizational charts, and outlining of job descriptions. Once an organization has been instituted, then its hierarchy or chain of command can be defined.

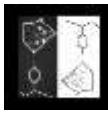
Traditionally, there should be top management, division and department heads, unit supervisors, line or rank and file workers. Some factors that shape the span of the management include type of work, degree of training of workers, organizational stability, geographical location, workflow, qualifications, staff availability, and organizational core values. Most non-hospital health organizations are made up of lines and staff employees. For the most part, staff refers to groups of employees who perform the work of the department or unit and help the line unit in reaching organizational objectives. On the other hand, line refers to those who have direct responsibilities for accomplishing the objectives of the organizations. They usually possess high levels of authority within the institution. Furthermore, in most non-hospital healthcare organizations, there are dual pyramid organization arrangements because of the traditional relationship between scientific researchers, medical staff, social workers, legal departments, advocacy units, and administrative staff. This results in two lines of authority. Ultimate authority and responsibility for management is vested in the governing board. One line of authority is headed by a chief executive officer; the other line of authority is headed by the chief medical officer. In some instances, a “central officer” is appointed to consolidate power.

Matrix Organizations

Matrix Organizations are institutions involving multi-national cooperation and are defined as organizations that involve both functional and product departmentalization. This arrangement involves a chief heading the technical aspects to provide flexible and adaptable organizational structures for specific projects like engineering and research. In addition, there are administrative officers for the managerial aspects and project coordinators that function as the final authority. In addition, workers can be borrowed from functional units and assigned to project units. One major characteristic of these organizations is that the participants tend to be highly trained.

Departmentalization

Departments traditionally serve as adjuncts to specialization. Departmentalization facilitates the coordination process. Patterns associated with departmentalization can be characterized by function, product, territory or geographical boundaries, customer, time or time of day performed, process or technology/specialization, and number or work volume.

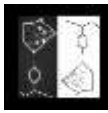


Organizational Charts

An organizational chart is a management tool used for depicting organizational relationships in terms of major departmental function, relations or functions of departments, lines of authority or communication, and positions within departments or units. Reasons for using charts include the following: to review and identify inconsistencies and complexities in the organizational structure, to orient employees, and to perform managerial audits. Charts are limited to that: they only show formal lines of authority; informal lines of communication are omitted. Furthermore, organizational charts need to be updated frequently. Most organizational charts become obsolete after about two years, and proper training is required for their interpretation. Furthermore, they cannot be properly interpreted without support information from manuals or related job experiences. Interestingly, one method for characterizing organization is the use of metaphors like machines, organisms, brains, cultures, political systems, and psychic prisons. According to (Morgan, p 11-15, 1943), when referencing the metaphor of *mechanization* and its characteristics to organizations, the working establishments of the organizations should typify the mechanistic organization.

Additionally, the author notes that organizations should adopt operational scenarios that lack fragmentation on one hand, but that are flexible enough to decentralize and transform so the mission goals or the production process can play itself out in the presence of *wicked problems*. A term coined in “Dilemmas in a General Theory of Planning” (Rittel & Webber, 1973) to describe complex, multifaceted issues that resist straightforward solutions due to their social, political, and environmental intricacies. Also, in “Images of Organization” (Morgan, p 15-17, 1943) authors references Fredrick the Great’s approaches to mechanization of his military, suggesting that unlike most nonprofit organizations, approach of transforming people into “fighting machines” to effectively eradicate idiosyncratic behavior, is not necessarily a bad thing when the mission is dependent on total team activity. Conversely, bureaucratization would be a more realistic approach in matrix organization (Morgan, p 17-24, 1943). Furthermore, unlike nonprofits and the government, military organizations display little or no redundancy between departments and do not encourage their members to think “outside the box.” Again, this is necessarily not a bad thing given the fact that the mission of the military, as opposed to industry, gives greater priority to defense and teamwork, while innovation tends to be “outsourced” to the private sector. Regardless, author points out that nature of an organization, obedience should be the single means to pass through the hierarchy and one route to the top for any worker. Consequently, workers should have a single immediate supervisor because fragmenting actions means that responsibility lies within no single party. The downside would be a workforce that results in *Taylorism*. Here, there is a clear separation of planning and work design in the sense that an organization’s policy can be established to exploit the workers. This should be avoided. A good management system should not foster apathy and lack of stake in the enterprise for the workers.

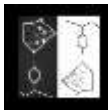
In other words, workers should feel ownership in the venture. Taylorism can manifest in the form of straightforward tasking and precision and the attention to details for planning operations. However, this can be problematic in the sense that there are limitations and specializations when it comes to dealing with a broadened sense of scenarios (Morgan, Images of Organization., p 23,



1943). In some instances, especially in cases where the goal is to grow or transform with the environment, organizations should function like microbial organisms. Here, the operation should consider its environment and the social needs of the workplace (Morgan, p. 33-34, 1943). This can be manifested as an indiscriminate need to blend in. For this form of organization to work, there should be no room for lack of socialization. Furthermore, the organizations should be open to the environment and not hostile to it (Morgan, p. 40-42, 1943). A major downside or obstacle to transformation is the presence of other conflicting systems or *predators* within the environment. Here, some components of the organization, say an institution, can refuse to transform with the collective, resulting in an internal attempt to destabilize the operation. By the same token, development of sub-systems within the organization that do not match those of the parent organization can cause differentiation and integration problems which can, in some cases, work against other systems, resulting in internal conflict.

According to (Morgan, p. 45-51, 1943), organizations should be open systems that need careful management; there is no one best way of organizing. Attention to fitness and alignment is paramount. Furthermore, multiple management approaches may be needed, and the environment should determine the species of organization needed. In the opinion of most investigators and performers, when used well, *Contingency Theory* is perhaps the most effective way to organize. Here, managers can use personnel skills in the art of coordination and conflict resolution to deal with varying subunits which require different management and organizational approaches in dealing with mechanistic, professional bureaucracy, and matrix organizations. The manager can combine bureaucratized structure with a project team structure, and the project team focus. In the process, the manager can deal with the problems of a strong bureaucracy, an insufficiently superimposed internal team, and the consequence of becoming representatives of another unit rather than a member of the project team.

Furthermore, a major advantage of the contingency theory is its ability to neutralize an organizational trend known as *Natural Selection*. Here, collaborative behavior and the Baldwin effect led to the natural emergence of conflict (Morgan, p. 60-64, 1943). In essence, this is a form of entropy, a state where systems tend to naturally disorganize (Morgan, p. 77-104). Finally, organizations can function as humans when certain cultures or traditions affect operations negatively. Also, the aggregation of humans can lead to the development of rules to control individual behavior and look at sub classes within groups for unwritten rules on how to act. In effect, organizations, like humans, participate in group thinking within culture classes resulting in outcomes that can lead to institutional growth or evolution. In addition, humans go about and organize with bound rationality and a desire for negative feedback. So do organizations. In almost all cases, organizations can acquire disabilities in the sense that there are misinterpretations and misperceptions of outcomes by managers. Outcomes from these can have negative effects on organizations in the same way they do on humans (Morgan, p. 84-103). Furthermore, according to (Morgan, p. 155-203, 1943), organizations can function as systems of government and can be characterized by personalization of power as with the US political system, where there is a divorce of personal power and official power since mixing of personal and official power is seen as illicit. Also, conflict is inevitable when people are forced to compete for scarce resources. In addition, central of this conflict is power, and its ability to get others to act in conformance with one's desires. Usually, the resistance to power results in



conflict. In conclusion, according to (Morgan, p. 155-207; 216-236, 1943) loss of imaginative capacity can lead to arrogance of power and can cause organizations to appear shortsighted to their own weaknesses.

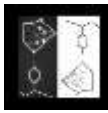
Human Resource Management

In the United States, standards and regulation that govern management workforce are among the best and most desirable standards in the world. These standards are regulated variously by US federal, state, and local government laws. When a US employer situates her workforce outside the US, federal laws tend to apply if corporations are registered in the US. There can be little dispute that US federal workforce laws and standards have made the work environment in the US much desired by the rest of the world. A rule of thumb for human resource managers, whenever employment involves groups of US and international employees- implement US standards for human resource management to both US and non-US employees, even when outsourcing is the case or when employment is needed overseas.

International Affairs

With respect to international relations, tripartite agreement is a new concept in planning a growth center, In “Tripartite Agreement” (Morris, p. 113-114, 1977), author reports that tripartite political agreements have been in existence since time. Adding, in 1920, there was a tripartite agreement between the British Empire, France, and Italy respecting Anatolia. In September 1940, the Axis powers, made up of Germany, France and Japan signed the Tripartite Pact. Earlier, in 1936, the United States, France and Great Britain signed a tripartite monetary agreement. Furthermore, in modern times the term “tripartite” as used in political lexicon was coined and defined by Tannetje Morris in 1977. In her paper, she describes the term as a “complex” agreement between three governments that cover a variety of areas from technical assistance to finance, culture- a three in one cooperation-owned by three governments but which functions as one (Morris, 1977, PP 113-114). Also, partnership should not be limited to state boundaries and involve urban and rural communities (Morris, 1977, PP 113-114). Furthermore, in this millennium, while the philosophy and general principal remain the same, the tripartite agreement is increasingly used by North Atlantic Treaty Organization (NATO), European Union (EU), United Nation (UN), and other “developmental” and “peace and humanitarian” enforcement organizations. The key difference between its use today and its use in the ‘20s is the nature of tactics and strategies used. “Divide and conquer” has been replaced by “proxies,” “outsourcing,” technology transfer and management whilst using best practices of Advanced Game Theories in its implementation. Additionally, tripartite agreements are no longer an agreement between governments. Presently and almost always, to ensure and maximize impact goals, tripartite agreements should contain the following elements or stake holders:

- Industrialized government or multi-governmental organizations which play the role of either, or all the following: project evaluation and assessment, financing, and capacity strengthening emerging (developing) governmental organizations which solely play an enabling role with respect to a desired intervention. It is vitally important they do not implement. Key is that they provide social equity goods and services like the following:



electricity, good roads, water, and perhaps most important-they break down regulatory and public policy barriers, or create laws which can facilitate an intervention

- Local indigenous NGO-the third party-which implements interventions and provides feedback as desired to both governments. The key criterion for choosing an NGO is one that has international accountability by charter with an international body or is registered legally- as an NGO in the country, or in one of the countries funding the intervention. Success or failure of a tripartite agreement is heavily dependent on the matrix described above.

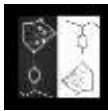
In the past, it was thought that similar agreements would depend on finance and resources. However, *wicked problems* can present serious political and economic barriers to developmental interventions even when there are adequate funding and resources. Thus, this new structure embodies best practices of structuring tripartite agreements and can best be managed by adopting strategies developed using advanced game theory principles.

Pareto Principal

In the 19th century a prominent engineer and economist *Vilfredo Federico Damaso Pareto* developed mathematical efficiency theories stating that approximately 80% of impact, in his case, wealth in Italy, came from 20% of the population. Collectively, in the broader sense, these observations were reported, in “On Pareto studies at the dawn of the 21st century in Tribute to Vilfredo Pareto” (Giovanni , 2009), and in “Interdisciplinary Models In Science” (Rinzivillo , Guglielmo; Pareto, Vilfredo, p. 2017-2222, 1995); but more specifically, recently in epidemiology investigations reported in “Cross-Sectional In Silico Analysis of Covid-19 Pandemic” (Olisa N, 2020), investigator incorporated the Pareto Principle while *bio indexing*, to create geospatial impact models of Covid -19 pandemic based on the survivorship bias.

Survivability Bias

With respect to pathology and infectious disease diagnostics occurs when incorrect correlation diagnosis is made by overlooking “other” less transparent or more difficult to measure (less visible) cohort variables. Regardless, these “less visible” variables can have greater impacts to pathology (survivability) since eliminating treat of the “less visible” or construct validity (human bias) reduces the pathology (increases survivability). Furthermore, in “Abraham Wald's work on aircraft survivability” (Mangel & Samaniego, p. 259-267, 1984) and “Survivorship bias” (Dirk, 2021) investigators explore work of Abraham Walt (who never published his findings). In their paper they report that US military adopted survivorship bias mitigation to reduce aircraft losses by reenforcing downed fighter planes in areas NOT riddled by bullet holes as statistical detected in fighter plans that “survived” battle as opposed to reinforcing areas riddled to bullets. Accordingly, Walds brilliant logic was that the fighter planes only survived battles because the bullets failed to hit the more sensitive areas of the aircraft. Today, survivorship bias mitigation is widely adopted in business, military, finance, and economics and used in financial risk assessment to determine (identify) risky trading practices that may result in financial loss. Based in these assessments reported by (Olisa N, 2008), and reports in “Cross-Sectional In Silico



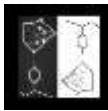
Analysis of Covid-19 Pandemic,” (Olisa N, 2020) uses *bio indexing* and pareto analysis to develop coupled behavior-epidemiological frameworks and models that quantifies CID impact variables in terms of Transmission Rates or (ID) transmission (person-to-person); and Attack Rates or (CID) Transmission (*person-to-person; environment-to-environment, and environment-to-person*). Additionally, *bio indexing* can, if required, determine Survivability (probability of mortality). Furthermore, *bio indexing* adopts Pareto analysis in its algorithms to quantify impacts of each variable no matter how small. Finally, findings show when *bio indexing* , in some cases, biological agents, with extremely high Case Fatality Rates (CFR), can inversely have high survivability depending on adjustment in behavioral and other socio-economic factors. That is, CFR is dependent on “biological:” factors unlike survivability. For example, there is an inverse relationship between an individual’s purchasing power parity (PPP) and pathogens attack rate. The greater the PPP, less the attack rate, and less threatening a contagion. Additionally, this impact phenomenon can account for approximately 80% contagion because both variables can change behavior in ways that significantly reduce disease. This is more than twice the impact of all other mitigation variables (vaccines, sanitation, industrial hygiene) combined. In conclusion, instilling the best preventative practices and behavior in people (implementing best practices, providing and making affordable goods and services that prevent spread of disease) are more impactful than treatment, early diagnostics or environmental mitigations. Interestingly, fiscal and public policies can significantly create political shifts needed to bring about both former and later changes.

Risk Management

According to (Olisa N, 2008; 2010; 2020) and in “Overview of Biological Defense against Tuberculosis and the Pandemic Flu in El Paso, Texas” (Olisa N, 2008), Implementation of microbial macroeconomics and contagion risk Management can be achieved by quantitative and qualitative methods using agreeing correlative and or causal variables. Accordingly, *bio indexing* is broadly defined as the qualitative and quantitative method of using biographic (demographic), biomedical, and biological data to generate comparative analysis of meta-data. Specifically, in microbial macroeconomics, *bio indexing* is used in biosecurity, and biodefense uses political shifts (framework) to couple behavior-epidemiological variables to determine survivability, attack rates and transmission rates as they relate to (CID) and (ID). The first step in performing a risk assessment is to conduct a policy analysis.

Policy Analysis

In “Policy Analysis: A political and organizational perspective” (William, 1978), author reports that in a *pleuritic society*, public policy can be defined relative to policies created by national governments. Also, government policy can thus be defined within the framework of the president's agenda and priorities. Most often these policies are directed at communities in the form of guidelines and protocols. In the United States, government policies are legislated by the United States Congress except for a few presidential decrees and orders. The executive branch of government is tasked with the implementation of policies legislated by Congress. Traditionally, legislative committees, and quasi-judiciary agencies share oversight and regulate government agencies while the United States constitution directs the judiciary to best interpret the scope and

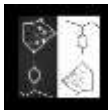


meaning of the law. Interestingly, the free press, is perhaps, the fourth unsung “linkage institution.” That is key in instituting transparencies in all three other branches. Consequently, a free press plays a vital role in governance. Fundamentally, the balance of power in the United States government has been maintained in this way for over 200 years. Also, somewhere in this *iron-triangle* are advocacy groups; political action committees (PACs), and *internet media influencers*. Arguably, these groups further link communities to the government, thus they are more commonly referred to as *linkage institutions*. Some examples include private companies and corporations, non-profit organizations, multi-media news groups, etc. Given this framework, policy can be defined as a “plan of action” that guides decisions, which in turn lead to achievable rational outcome(s). Also, governments, private sector companies, corporations, and academic institutions have policies.

In conclusion, policy can mean the decision- making process and can include the identification of programs and development of budgets and fiscal priorities and the determination of the impact these choices may have on a targeted community. Similarly, According to Patton and Sawicki (1993, pp. 2-7), systematic procedures or policy analysis methods can be used to tackle current policy problems. Consequently, the methods used could involve quick analysis or planning or a more systematically searched kind of analysis or policy analysis. In addition, several skill sets are associated with planning and policy analysis. In previous studies, some investigators (Patton and Sawicki, 1993, pp. 8-23) have detailed the learning methods associated with policy analysis and planning, citing learning to recognize specific basic methods and their quick application and competency of using the methods in design and analysis, in addition to the communication of results as key steps. The authors state the key practical principles for being policy analysts are as follows:

- (1) To learn to focus quickly on central decision criterion of a problem.
- (2) To strongly consider the type of policy actions that can be taken.
- (3) To avoid using tools because a particular method of analysis is favored.
- (4) To learn to deal with uncertainty.
- (5) To quantify variables numerically and emphatically.
- (6) To make an analysis simple and visible.
- (7) To check the facts.
- (8) To learn to advocate the position of others.
- (9) To present the client with analysis and not decisions.
- (10) To push the boundaries of analysis beyond the “policy envelope”; and finally,
- (11) To make absolute decisions, but rather to make rational and complete analysis.

In “An introduction to the policy process: Theories, concepts, and models of public policy making” (Birkland, ,2005) author determined that there was a lack of consensus on the definition of policy. Furthermore, other investigators in “Policy analysis: a political and organizational perspective” (Jenkins1978) observed and stated that quote “a policy is a set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation where those decisions should, in principle, be within the power of those actors to achieve.” This quote implies that policy making may be a process, and not simply a choice. In addition, other authors define policy in terms of actions of



government and the intentions that determine those actions and the outcome of the struggle in government over who gets what or who makes the political decisions for implementing programs to achieve societal goals. Also, in “Handbook of public administration” (Peters & Pierre, p. 11-38, 1993); and “Policy design and the development of policy indicators” (Peters, 1987) the opinion held by investigators is that public policy is the sum of government activities, whether acting directly or through agents, as it has an influence on the life of citizens. Finally, they also state that policies can be defined as miscellaneous and distributive policies when they are stated in terms of executive government agencies or are constitutive and regulative in terms of legislative agencies. Also, miscellaneous policies may also be used to refer to official legislation, guidelines, or broad ideas in political manifestos and pamphlets. On a cautionary note, implementing policy may have unexpected results in consequence of gaps in existing policy, stemming from a policy.

Policy Analysis Process

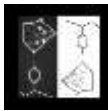
There are six basic steps involved in *policy analysis*:

- Define or identify the problem,
- Establish evaluation criteria,
- Identify alternative policies,
- Evaluate alternative policies,
- Characterize and communicate alternative policies,
- Monitor and implement the policy.

Regarding content, policies should be developed through official written documents with standard formats in terms of its purpose statement, applicability and scope, effective date, responsibilities to include oversight and/or governance structures, regulations, and requirements, and relevant history and justifications. Also, policies should include clear definitions of complex issues. Furthermore, when administered effectively, policy goals can vary widely according to the institution and scope for which they are designed. Generally, policies are administered to limit unintended effects and counter intuitive outcomes and consequences within the organization or communities and environment. Collectively, this is known as *complex adaptive systems*. Good policy should promote positive feedback. Conversely, due to the nature of these complex adaptive systems, it may not be possible to perform assessments on most feasible impacts of a given policy. Nonetheless, political scientists use *policy cycles* or the “*stagiest approach*” as a tool for analyzing the impact of policy items. The process involves agenda setting, policy formation, decision-making, policy implementation, policy analysis, and evaluation. Finally, good policies should contain the goals of the institution.

Needs Assessment

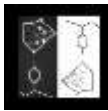
One of the greatest threats to assessing needs for socio-economic, biosecurity, and biodefense are social problems also referred to as wicked problems. Accordingly, one way to identify needs is through studying the existing policy process and social problems. Social problems can be found



hidden in stories, symbols, labels, medals, typology, ethics, and epistemology. When searching for social problems, the analyst must weigh between what is just and fair in addition to making considerations for utilitarianism and equity. Once identified, a goal can be explained in terms of its final cause and purpose as an explanation of the natural phenomena (Teleological) or in respect to moral obligations (Deontological). In “A Theory of Justice: Revised Edition” (Rawls, 1999) reports that “needs” should be in league with the society (social contract theory). In other reports described in “Leviathan” (Hobbes, 2024) author talks about the implementation of the “state of nature” concepts. His concept describes the state of nature as a world without governance institutions where everyone fights each other to protect liberty and safety. Furthermore, he states that the *sine qua non* function of the government is to maintain safety and peace. Also, In “Reception to Lockes Politics” (Goldie , 1999), author suggests that John Locke takes a more positive view of the contract theory and argues that humans have “natural rights” and government must be limited so they do not violate “natural rights.” Furthermore, he points out that one of the fundamental problems in public administration and international relations is the predominant concern of equity. Finally, he concludes by pointing out thinkers like Karl Marx and referring to this significant reservation as the “social product.” Starting with his writings on dialectical materialism, he suggests that its solution be one of collective bargaining.

Interestingly, equity was not an external matter for early scholars in the field. To begin with in “The Study of Administration” (Woodrow, 1887), former US president reports that governments should be institutionalized with abilities to decentralize. In addition, perhaps without knowing it, he laid the foundation for the discernment of power and the adaptation of policy implementation. Furthermore, philosophically, in “The utilitarian background” (Viner, Bentham , & Mill: , 1949), authors suggest this equity problem may lie in the use of welfare economics, individual freedom, and the utility of maximization of the sum of the individual efforts in the society for the greatest good, for the greatest number (teleological theory). In conclusion, as we see today, one of the consequences of rational theories has been technology implementation, privatization, and outsourcing by governments in developed democracies that use these tools as the center stage when it comes to addressing the “equity” question. See (Foster & Young, 1990).

With respect to the scientific inquiry model, in “How to Think about Social Problems: American Pragmatism and the idea of planning” (Blanco, p. 24, 1994) author favors the use of technology, where needs are unknown, to address commonly agreed goals. In other words, the use of technology, when in comparison with human effort, can minimize risk and reduce cost, thus justifying its need. There are plenty of examples of this model being used by the United States government in the global war on terror and in its goal to expand humanitarian programs in developing economies. In addition, on a cautionary note, there are many cases where known technologies cannot match with agreed goals creating what is known in politics as a pluralistic paradigm, and even worse, leading to “wicked problems.” This is usually the case when unknowns and goals cannot be agreed on. Furthermore, examples can be found in Middle Eastern countries after the “Arab Spring” in 2011. In conclusion, countries like Tunisia, Syria, Egypt to name a few continued to struggle with democracy in ways like Iraq and Palestine and in the Darfur area of Sudan during the Gulf War after 911 attacks on the United States. Also, *Wicked problems are a threat to national security* and the welfare and equity of mankind.

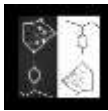


Notwithstanding, recommendation section of this review will address and provide management solutions for social problems. For now, the main goal of the needs assessment is to achieve *Pareto superior* conditions. This is a high bar to set, however, in most cases, as a result, an outcome tends to be Pareto optimum. In “Advocacy and pluralism in planning” (Davidoff, 1956), author describes how the *pro bono* planning (analyst role) should be an advocate of equity and justice, and that the key to realizing this goal is empowerment. Separately, in “Stochastic evolutionary game dynamics” (Foster & Young, 1990) authors report analysts should look for equitable solutions to achieve cooperation, which can create benefits (core) that need to be distributed according to equitable rules. In other words, you must pay for what you use. Interestingly, these investors in early studies show that stochastically, human behavior with respect to impact on biological outcomes can be quantified relative to coupled relationships. Importantly, referencing aspects of “game theory” the planner's goal is for productive and cost-effective completion between players or stakeholders. Maximum benefit and need can only be achieved when the system or program functions in this way. As simple as it sounds, fundamentally, reaching this state can be very challenging.

Needs Assessment Process

The first step to performing needs assessment is for the performer to ask, what needs to be evaluated? The next step is to develop an impact model that depicts administrative standards and objectives that monitor service utilization and coverage as well as organization functions. Traditionally, a health promotion intervention should modify changes in behavior or the environment. Consequently, the next step in performing needs assessment is to define the target population in terms of urban and rural. Metaphorically, urban is used to describe progress and affluence. The term urban development symbolizes an urban “make over” and is frequently used to label projects needed to develop inner cities or slums. Evidently, according to recent studies, in “Evaluation in Practice: A Methodological Approach” (Bingham & Felbinger, 2002)” and in “Evaluation: A Systematic Approach” (Rossi, Mark, & Howard 2004) both authors describe a systematic approach for quantifying and evaluating impact of urban development measures on infectious disease intervention outcomes for health care policy, cost-effective analysis, and report that performance of quasi-judicial reviews can be problematic due to existence of numerous holistic perspectives and the need to articulate them to stress a single underlining theme.

Earlier, in “How to Think about Social Problems: American Pragmatism in “the idea of planning” (Blanco, 1994) authors explore policies surrounding urban development and its relationships to infectious disease stating they were confronted by “wicked problems” and concluded their analysis should involve the use of branched evaluation techniques. However, one limitation of this inadequacy is that these executive branch agencies and institutions may not be able to effectively justify the need for urban development as a line item in respective budgets for accountability purposes to congress, quasi-judiciary branches of government, or article III courts for the purpose of judicial reviews or appropriations. Furthermore, in “Epidemiologic Transition Theory and Aging: Hispanic Populations of North America and the Caribbean” (Serrow, Cowart, & Camezon 1998); and in “Extending epidemiologic transition theory: A new stage” (Rogers & Hackenberg, 1987); also in “Epidemiologic transition in the United States: the health



Factor in population change” (Omran, , p. 1-42, 1977) numerous investigators of epidemiologic transition measured, quantified and report on the impact of economic development and industrialization on infectious disease using gross domestic products (GDP) of defined locations and corresponding infectious disease prevalence to measure the size of the problem and impact. In addition, these early studies show that a complex range of socio-economic and biological factors are associated with epidemiologic formation.

Needs Implementation Process

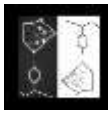
Input, with respect to programs, can be defined in terms of what is needed to implement the program. Some examples include human resources, the operational budget, office space, or computers. Conversely, the output signifies activities or services delivered to accomplish the program goal(s); these can include number of workshops, percentage of clients attended and percentage of referrals. Some problems may arise in selecting the best inputs and outputs. There can be a conflict between individual and collective rationality during this process as well as other unit criteria. To overcome these obstacles, the performer can use paired comparisons, satisficing, lexicographic ordering, non-dominated-alternatives methods, equivalent alternatives methods, standard-alternative methods and matrix scored display or other matrix systems system as described in “Basic Methods of Policy Analysis and Planning” (Patton & Sawicki, p. 340-349; 352, 1993). Also, program outcomes can be identified, measured, monitored, and interpreted using statistics, all for the purpose of making impact assessments and evaluations (Rossi, Mark, & Howard, 2004).

Visualizing Activities (Inputs) and Services (Outputs)

- Ganit Chart: A Gantt chart can be used to compare and weigh desired activities or tasks against measured risks and dependencies. Consequently, the performer can use this arrangement to determine the best pattern or sequence for flow of events or activities.
- Pert Diagram: A Pert diagram can be used to compare internal dependencies between activities or services. Arrows are used to show dependencies. The longest path is the most critical path. When this path is delayed or interrupted, the whole “target” or “treatment” is consequently delayed.

Outcomes

A program’s outcome is the state of the target population or the social condition that the program is expected to have changed. Outcome levels define program changes and effect. See (Rossi et al, 2004, pp. 203-206). The first step in developing measures of program outcomes is to identify what outcomes are relevant for measurement using both stakeholder perspectives and the program impact theory and data from prior research. See (Rossi et al 2004, pp. 208-212; Bingham and Felbinger, 2002, pp. 20-27). Also, there are distinct measurement procedures and properties like reliability validity, sensitivity, and choice of outcome measures. See (Bingham and Felbinger, 2002, pp. 32-43). Furthermore, the adaptation or minimization of these properties reveals the presence of unintended outcomes as reported by (Rossi et al 2004, pp. 213).



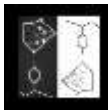
Additionally, an outcome can also be defined as the state of a target population or social conditions that a program is expected to have to change. Accordingly, an outcome level is the status of an outcome in a time. So, the goal of program inputs and outputs is not to function well but to bring about change or desirable outcomes.

Subsequently these outcome levels will define outcome changes and program effect. See (Rossi et al, 2004, pp. 203-206). Finally, for more practical purposes, a program's outcome can be defined in terms of, or in comparison to a controlled population. Also, during the pre-test phase, both treatments and control may have different properties. However, once inputs and outputs are implemented (treatment), in the post-test phase (at the end of intervention or in the absence of an intervention in the case of *Ex ante* analysis or when forecasting in justification of the need for an intervention, the outcome becomes convergent when the treatment group acquires similar properties with the control group over time. Conversely, under some circumstances, both treatment and control can be identical at the pre-test phase. However, overtime a divergent outcome can result in which case the treatment properties would differ greatly. In more complex scenarios, inputs, and outputs, during pre-test phase for a treatment, can be less in comparison to the control. Additionally, the outcome in post-test can surpass those of control. Under these ideal conditions, the program may be said to be cost-effective. Regardless of the outcome, during assessments and evaluation, changes to look for should include changes in cause and effect, rate of change of cause and effect (Mathematical slope), cross patterns or changes, to outcomes when control and treatment intercept. Factors Influencing Outcomes: Some of the factors that determine outcome include stakeholders, whose opinions, can be obtained from client satisfaction surveys, focus groups, participant observation, etc.; program impact studies (evaluations of prior or earlier program outcomes) or prior research; and from unanticipated outcomes or positive and negative externalities. The goal of any program is to bring about change. Assessing the degree to which a program produces these outcomes is a product of the program's inputs and outputs.

In conclusion, unbiased estimates of program validity or lack of validity in the case of selection, secular trends, interfering events, and maturation can best be determined with nonrandomized designs and the use of quasi-experimental impact assessments using procedures like the construction of control groups. This can be achieved by matching, which involves choosing variables to match, and by equating groups by using statistical controls like multivariate statistical techniques and the modeling of determinants of outcome and selection; regression discontinuity designs; reflex controls simple pre-post studies; and time series designs (Rossi et al 2004, pp. 268-297).

History of Program Evaluation

The great depression in the United States brought about a major paradigm shift with respect to the philosophy of government. For one thing, it leveled the *laissez-faire* philosophy that the ideal government is the one with the least involvement in internal affairs. According to Rossi et al, 2005, *program evaluation* is a relatively recent invention and can be used in evaluation research as a social science activity. Evaluation research boomed after the Second World War because of the introduction of several key social programs by government, specifically, because of the *new*



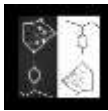
deal initiatives that increased social policy and public administrative practices. Consequently, the era saw the emergence and development of policy and public administrative specialists whose job was the evaluation of private and nonprofit sectors. Technocrats adopted social research methods to increase management effectiveness (Rossi et al, 2004. pp. 1-27). Finally, a major goal of a good evaluation program is its adaptability or transformability (Rossi et al, 2004, pp. 32-37). Furthermore, because of “trickle-down economics,” the downsizing of government and reemergence of *neo-liberalism* during the Regan and Thatcher era caused the government in the US to decentralize power to state and local governments and to outsource programs to the private sector. According to (Olisa N, 2008), microbial macroeconomics, assessments and evaluations are two completely different, but non-opposing processes associated with management. Program or project assessments traditionally refers to the process of gathering data on who, what, when, how, which, how much, gender, etc. from inputs, outputs, and outcomes for the purpose of making improvements in learning—it is an information gathering, organizing and arrangement process. A key method for assessing data involves the collection, aggregation and categorization of data to generate information. Conversely, evaluations build on the information gathered during assessments to generate knowledge (why) and wisdom (how) for the purpose of achieving impact by improving quality (reduction in turnaround time; improvements to customer service); and productivity (cost-efficiency and cost-efficacy).

Project or Program Evaluations

Program theory and impact theory promote the use of service and activities to compare input and output of a program with long and short term expected and or actual outcomes relative to the target population and service arena. Accordingly, a good evaluation question should be shaped by input and output function. According to Rossi et al, (2004, pp. 69), a key criterion for evaluation questions is that they are answerable. However, according to the *theory of failure*, inadequacy in this area can lead to implementation of other failures (Rossi et al, 2004, pp. 71-77). In other words, programs may be well implemented but fail when the program concepts that correspond to the service are faulty. To avoid this, specific questions should represent the concerns of the evaluation sponsor and major stakeholders.

Evaluation Process

Principally, the best practice method for evaluation is by performance budgeting and benchmarking followed by statistical analysis or algorithmic coding. Historically, benchmarking evolved as a private sector management tool and was later adopted by the public sector in compliance with the *Government Performance Results Act*, 1993, as a direct result of the new public administration movement which demanded results oriented and performance-based management. The hallmark of this movement was for the use of quantifiable measures in management and budgeting; citizens become customers in a service or customer satisfaction oriented cost-effective environment. Also, benchmarking can be defined as a point of reference from which measurement may be made. During this process, an entity that serves as a standard is used to measure or judge other entities.



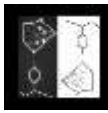
Traditionally, a standardized problem or test can serve as a basis for evaluation or comparison. This standard, or performance level, is established or aspired to by the benchmarking agency as described in “ Benchmarking for best practices in the public sector: Achieving performance breakthroughs in Federal, State, and Local Agencies” (Keehley, Medlin, & McBride, 1997).

To begin with benchmarking is an evaluation process that involves comparisons between treatments (outcomes) on a target with outcomes from a control group. The control group could be historical data: previously collected data in longitudinal or cohort studies. Once collected, statistics can be used to determine whether there is a difference between the treatment and control. Some types of comparisons include the comparison of components in the form of proportions, percentages using pie charts, or comparison of items in terms of size. Frequency distribution can be compared in terms of variations, concentration, or relative frequency using histograms. In addition, benchmarking can be based on correlations in terms of how treatment and control are related directly or indirectly; correlations can be positive or negative using linear or multivariable regression analysis. Furthermore, benchmarks can be based on time series and trends as they occur at different times using time series plotting.

In conclusion, benchmarking is a tool for quality management because it is an efficient way to perform input/output analysis as well as cost-benefit analysis; it is an effective outcome measurement tool for cost-effectiveness analysis. Also, benchmarking can be used for accountability during financial or fiscal (budget) policy analysis for internal legal (statutory) reviews, and for transparent decision making. Organizations can enhance customer satisfaction by continually meeting customer and applicable regulatory requirements to improve their performance and meet customers’ quality requirements. Furthermore, according to early reports, benchmarking is the process of comparing internal performance measures and results against those in the industry or sector as described in “ Evaluation in Practice: A Methodological Approach” (Bingham & Felbinger, p.50, 2002); also in “Benchmarking for best practices in the public sector: Achieving performance breakthroughs in Federal, State, and Local Agencies” (Keehley, Medlin, & McBride, 1997); and in “Benchmarking for best practices in the public sector: Achieving performance breakthroughs in Federal, State, and Local Agencies” (Keehley, Medlin, & McBride., 1997). Also, additionally, in “ (Bingham and Felbinger, 2002, p. 52) Collectively, nearly all investigators, in one form or the other describe five key steps in benchmarking:

- (1). Determine which functions to benchmark,
- (2). Identify key performance variables to measure,
- (3). Identify the best-in-class companies, measure performance,
- (4). Specify programs and actions to surpass,
- (5). Implement and monitor results, and compare

Justifiably, based on these publications, some investigators recommend the use of benchmarking for best practices by governments and private sectors (Keehley, Medlin, & McBride, 1997). Additionally, (Bingham and Felbinger, 2002, p. 48) summarizes that performance management can be achieved through nine key steps.



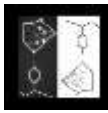
- (1). Define omission and desired outcomes,
- (2). Determine the purpose and scope of project,
- (3). Develop an internal process for analysis,
- (4). Identify stakeholders,
- (5). Choose appropriate performance measures,
- (6). Collect internal data for performance measurement,
- (7). Collect similar data from other or similar industry partners,
- (8). Conduct a gap analysis to determine variations,
- (9). Try and close gaps before monitoring the results and recalibrating findings.

Finally, on this point there are several types of evaluation. Descriptively:

- **Impact Evaluation:** An Impact evaluation employs scientific methods to estimate successful implementations and associated outcomes of policies and programs for decision making purposes by focusing on summative evaluations and end results. Here, the performer is interested in quantifying what is happening to participants and in measuring effectiveness.
- **Policy Evaluation:** A Policy evaluation is often used when big questions arise and involves the use of scientific methods to estimate successful implementations and associated outcomes for policies and programs for decision making purposes by assessing the impact of the problem and determining what changes are evident in the problem.
- **Meta Evaluation:** A Meta evaluation involves the use of scientific methods to estimate successful implementations and associated outcomes using literature reviews to synthesize evaluation of research findings.
- **Process Evaluation:** A Process evaluation involves the use of scientific methods to estimate successful implementations and associated outcomes by testing research validity in design.
- **Program Evaluation:** Program evaluation can be defined as the use of scientific methods to estimate successful implementations and associated outcomes for policies and programs for decision making purposes; it involves the inspection of the basic goals and objectives of a program.

Approach to Program Evaluation

Several approaches can be used in program evaluation to verify, define, and detail problems of interventions. These approaches include a pragmatic approach which describes how policy analysis is conducted when there is disagreement on how an issue or problem is handled or a social-criterion approach where the analyst seeks out expressions of discontent and tries to define social problems that should be solved. See (Patton and Sawicki, 1993, p. 148-151; Rossi et al, 2004, p. 118-121), a third possibility is the scientific approach which relies on rational methodology. Interestingly, the pragmatic approach to program evaluation uses social research methods, i.e., systematic observations and analysis to distinguish worthwhile programs from irrelevant ones. According to Rossi et al, (2004) during the process, the evaluator should ask the following:

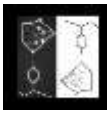


- Is the intervention reaching the target goal?
- Is the intervention implemented well?
- Is the intervention effective?
- Is the intervention well implemented?
- Is the program cost-effective and, or cost-beneficial?
- What practical interventions can be used to improve the problem?
- What are some of the justifications of the social intervention?
- What is the nature and parameters of the problem?

According to Rossi et al, (2004, p. 374-379), *Taylorism* evolved as the solution and need for scientific management. Consequently, in the social and political context, evaluation of activities needs to be performed to conduct good evaluations. Also, evaluators need to assess the social ecology of the arena in which they work, pointing out that there are multiple stakeholders that have interest in the work and outcome of evaluations. These stakeholders range from research centers to federal and state governments, as well as private agencies, universities, and foundations. In addition, having multiple stakeholders can lead to complexities and conflicts. Additionally, as reported by Rossi et al, (2004, p. 390-395), authors conclude that evaluators should create political and evaluation timetables to support the dissemination of results and evaluation of the political process. Also, they report that there are wide variety and diversity in the scope of evaluations; and that this attribute can bring about various consequences.

Furthermore, authors believed that evaluators and stakeholders need to be educated and oriented on the origins of these diversities and cultural differences to minimize quantitative and qualitative differences that may exist inside or outside evaluations. See Rossi et al, (2004, p. 402-405). Notwithstanding, in “The science of muddling through” (Lindblom C. E, 1958); and in “How to Think about Social Problems: American Pragmatism and the idea of planning” (Blanco, P.L, 1994). Investigators report that a good way to achieve these initiatives would be the use of evaluation standards and guidelines. Also, in similar reports, investigations on how to think about social problems and the role of pragmatism note that new ideas and methods do not appear to be the intellectual task of the twentieth century.

Collectively, these investigators propose a rational model of planning as a hallmark of modernity. Furthermore, this form of analysis characterizes organizational settings and performance impacts outputs and outcomes. Additionally, limitation here is that it cannot address issues of cause and effect. Interestingly, the scientific approach offers a more methodological basis for program evaluation. Here, the assumption is one of unbounded rationality. That is, both experimental and quasi-experimental approaches can be adopted. Should this be case, scientific methods are applied, and a high value is placed on precision. The key challenge here is to assess the threats to internal and external validity. Conversely, the pragmatist approach tries to evaluate within the context in which the evaluator works. It is about giving good advice and information to policy makers. Conceptually, it would be more desirable to be less correct than wrong. This notation assumes that the investigator does not know everything (bounded rationality).

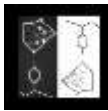


Finally, in reference to the scientific approach, the goal of a good evaluation program is in its adaptability or transformation. See Rossi et al, 2004, p. 32-37; 69. Summarily, the first goal of the rational model which adopts an incremental approach is to find the best objective alternative. Additionally, an internal process analysis can be used to identify relevant factors or components associated with inputs and outputs and to determine how they are related. *Furthermore, this is often achieved through modeling to establish sensitivity and influences.* In addition, benchmarking can be used in policy evaluation when an organization's performance is in focus. There are notable differences between incremental and rational approaches.

- First. The goal of the incremental approach is to find a good enough alternative.
- Secondly. The key assumption in the incremental approach is bound rationality. Conversely, the key assumption of the rational approach is unbounded rationality.
- Thirdly. In the rational approach, policy and politics are independent with respect to their relationship. Conversely, with the incremental approach, policy and politics are intertwined.
- Fourthly. In the incremental approach, the analyst's role is to mitigate acceptable consensual solutions. Furthermore, in the rational approach, the analyst's role is as the scientist applying technical knowledge.

Furthermore, in the rational approach, change is by the root. Conversely, in the incremental model, change is by the branch. Regardless of approach, to formulate and develop evaluation, some questions need to be asked such as which questions the evaluation should ask and what makes a good evaluation. Accordingly, a good evaluation question should be shaped by the functions it must perform. Also, according to Rossi et al, (2004, p.71-77), reason and appropriateness should form the major dimensions of the program performance. Also, a key criterion for evaluation questions is that they be answerable. However, inadequacy in this area can lead to implementation failures. Furthermore, evaluators need to develop a problem statement and decide how to think about a problem through. They also need to delineate boundaries of the problem, develop a fact base, list goals and objectives, identify the policy envelope, display potential costs and benefits, and review the problem statements and how to explain the role of evaluators in diagnosing social conditions and service needs. See Patton and Sawicki, (1993, p. 152-155; and Rossi et al, (2004, p. 103-111). In addition, experts can be used for quick-decision analysis of processes and target populations and the nature of service needs. They can also analyze the need to create valid operational decisions for political analysis and explain the differences between issues papers and first cut analysis using social indicators to identify trends. See Patton and Sawicki, (1993, p. 156-182); and Rossi et al, (2004, p. 112-132).

To begin with. Authors suggest evaluators need to establish goals and detail the processes for establishing evaluation criteria for expressing and assessing program theory. See Rossi et al, (2004, p. 133-139). Also, when using distinct objectives, criteria, and measures, several important economic concepts come into play when implementing program theory and the role of impact theory. In addition, according to Patton and Sawicki (1993, p. 188-208; and Rossi et al, 2004, p. 133-142), these include the free-market model and role of cost, benefits, standing externalities, elasticity, marginal analysis, and equity. Furthermore, according to Bingham and Felbinger, (2002, p. 1-3), process evaluation uses scientific methods for gathering empirical data



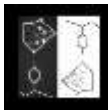
to test hypotheses. During this time. Evaluators should look for broad-based goals and for clearly stated measurable objectives by which the goals can be reached. In addition, evaluations should involve fundamental goals and objectives of the program and a process that involves assessing program activities Bingham and Felbinger, (2002, p. 4-5). According to Bingham and Felbinger, (2002, p. 5-7), impact evaluations refer to impact, outcome, or summative evaluations that are interested in quantifying what is happening and are of two types: one that revolves around assessing an output and another that measures effectiveness. Both focus on measuring outcomes. Meta evaluations, which are basically literature reviews, can be used to achieve these goals. See Bingham and Felbinger, (2002, p. 8). Also, once data is collected, it should be utilized after internal and external factors are validated, corrected for the occurrence of either type one or type two errors, and weighed in for ethical considerations. See Bingham and Felbinger, (2002, p. 10-12). Finally, without question, there are problems associated with outcome evaluations; these include identifying goals and objectives, constructing impact models, measuring impact, and collecting data. Interestingly, according to same authors, this approach is both pragmatic and incremental in the sense that they recommend that program evaluation process should be divided into seven pragmatic stages:

- agenda setting,
- policy deliberation,
- policy formulation,
- policy adaptation,
- appropriation process,
- policy implementation,
- and policy program evaluation.

In conclusion, in the rational phase of the approach recommended, meta evaluations can be used to select agenda. Afterwards, policy evaluations are conducted rationally or pragmatically before policy deliberations are made. Also, between the fifth and sixth stages, impact evaluations are performed after appropriations and before policy implementation, followed by process evaluation after implementation.

Approach to Efficacy Evaluations:

To begin with. Efficiency analysis (cost benefit or cost effective) may be dependent on untested assumptions or require partially available data. However, efficacy an analysis can be conducted prospectively or *ex ante* during the planning and design phase of an initiative or retrospectively (Patton and Sawicki, 1993, p. 257-259). An *ex-ante* efficiency analysis is important for programs that are difficult to abandon due to extensive commitment needs in funding and time. *Ex post* efficiency analysis, on the other hand, is useful after a program has been in place for a time and has been demonstrated to be efficient by an impact evaluation. In addition. This application rests on dubious assumptions and should be limited to utility; the program must have independent or separable funding (cost can be separated from those of other activities); the program should be ahead of its developmental stage and should have certain effects. Furthermore, the programs' impact and magnitude should be known or easily estimated; benefits should easily translate into

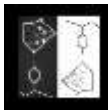


monetary terms, and decision makers should consider alternative programs as reported in “Evaluation: A Systematic Approach” (Rossi, Mark , & Howard; p. 336; 361-362, 2004). Also, Cost benefit analysis requires estimates of both tangible and intangible aspects of a program and both direct and indirect cost estimates as reported in (Bingham & Felbinger, Evaluation in Practice: A Methodological Approach, p. 182, 2002). Conversely, efficacy analysis, at least *ex post* analysis, is an extension rather than an alternative to impact evaluation. In other words, it would be impossible to develop *ex post* analysis for programs whose impact is unknown or inestimable according to (Rossi et al, 2004, pp. 338; Bingham and Felbinger, 2002, pp. 182). Also, authors report that the first step in conducting cost benefit analysis is assembling data through agency fiscal records, target cost estimates, and through cooperating agencies. Additionally, the second step would be to measure costs and benefits. This can be achieved monetarily using money measurements, using market valuation, econometric estimation, posing hypothetical questions, and observation of political choices. See Rossi , Mark , & Howard, (2004, p.338). Furthermore, in “ Economics of Planning” (Heikkila, p. 1-228, 2007) author reveals that cost, and benefits can also be measured using shadow prices or accounting prices which are defined as derived values for goods and services that are supposed to reflect their true benefits and costs to society. Finally, other methods include use of opportunity costs, secondary effects or externalities, distributional considerations, and discounting or the use of time-point patterns in estimating cost and benefits. See Rossi, Mark, & Howard, 2004, p. 359-361). The third step in the analysis of cost and benefit is to compare both attributes.

In conclusion, cost effective analysis, unlike the cost benefit analysis, allows evaluators to compare the economic efficacy of program alternatives when interventions are not aimed at common goals. Also, cost effective analysis can be viewed as an extension of cost benefit analysis to projects with achievable goals. Additionally, it is based on the same principle and uses the same techniques as the cost benefit analysis. However, in contrast to cost benefit analysis, it does not require that benefits and costs be reduced to a common denominator. Rather, a program’s effectiveness is related to both non-monetary or monetary (dollar) value of costs (Bingham and Felbinger, 2002, pp. 179). Furthermore, in cost-benefit analysis, outcome is measured strictly in currency. While in cost effective analysis, programs with similar goals are evaluated and their costs compared. Eventually, efficiency is determined by comparing costs for units of outcome (Rossi et al, 2004, pp. 62-363; and Bingham and Felbinger, 2002, pp. 197). Concluding, cost benefits look at outcome in terms of benefits, and cost efficacy in terms of efficiency.

Cost-Effective and Cost-Efficient Analysis

- Kaldor-Hicks Efficiency: Kaldor-Hick’s efficiency theory stresses *Pareto Efficiency* where an outcome is more efficient if at least one person is made better off and nobody is made worse off. Under Kaldor-Hick’s efficiency, an outcome is more efficient when individuals impacted by an intervention are better off and could theoretically compensate those that are worse off because of an intervention.
- Opportunity Cost: or the shadow price, is the net revenue forgone by rejecting an alternative use of resources such as time, money, or facilities.



- **Cost Benefit Analysis:** is derived from Kaldor-Hick's efficiency theories. The following are basic assumptions to Cost-Benefit analysis:
 - (1), Each costs-and-benefit unit must be converted into a common measure; preferably the dollar (\$) since this sign is the standard international currency against which most currency values are measured.
 - (2), Cost and benefits being analyzed should be quantified and miniaturized.
 - (3), The performer should seek to determine the value of service, product, or activity benefits relative to costs. Also, cost benefit analysis can be used *ex-ante* and *ex-post*. Regrettably, one limitation of cost benefit analysis is that it is not designed to solve problems.
- **Cost Benefit Ratio:** If the sum of cost outweighs the cost of benefits the decision rule is NOT to go on. Also, in a favorable cost benefit analysis, benefits should always outweigh cost. The ratio should always be less than one.

$$\frac{\sum \text{benefits}}{\sum \text{costs}} > 1$$

- **Net Present Value:** Net present value estimates the future cost of goods or services. As a socio-economic tool, cost benefit analysis can be used to aid social decision making and ably assist and justify the need for program interventions. Here, evaluations are in terms of the public's willingness to pay (benefits) or willingness to pay to avoid them (costs). Input is typically measured in terms of opportunity costs.

Furthermost, in "Cost-Benefit analysis: and ethical critique" (Kelman, p. 74-82, 1981) investigators report that when performing cost-benefit analysis, monetary values may also be assigned to less tangible effects such as the various risks which could contribute to partial or total project failure; loss of reputation, market penetration, long-term enterprise strategy alignments; etc. This is especially true when governments use the technique to decide whether to introduce business regulations, build a new road, or offer a new drug on the state healthcare. Also, in the case of the latter, a value must be put on human life or the environment; often, this causes great controversy. According to the cost-benefit principle, cost-benefit calculations should involve the use of time value of money formulas. This is usually done by converting the future expected streams of costs and benefits to a present value amount.

$$NPV = B_0 - C_0 + \frac{C - B_{t+1}}{(1+R)^1} + \frac{C - B_{t+2}}{(1+R)^2} + \dots + \frac{C - B_{t+n}}{(1+R)^n}$$

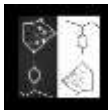
C= costs

B= Benefits

R= interest rate

n= year

About interventions to manage contagions, one application of cost-benefit analysis in program planning is to determine if the rate of return of interventions is feasible. The accuracy of the



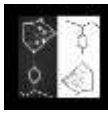
outcome of a cost-benefit analysis is dependent on how accurately costs and benefits have been estimated. A major consequence of an inaccurate cost-benefit analysis may be an increase in risk in planning because inaccuracies of the size documented are likely to lead to inefficient decisions as defined by Pareto and Kaldor-Hicks efficiency as collectively described in “Mega projects and risk: An anatomy of ambition” (Flyvbjerg, Bruzelius, & Rothengatter, 2003); and in “How accurate are demand forecasts in public works projects? The case of transportation” (Flyvbjerg, Mette, Skamris, & Buhl, p. 131, 2005); also in “Underestimating costs in public works projects: error or lie?” (Flyvbjerg, Mette, Skamris, & Buhl, , 2002). Another limitation of cost-benefit analysis is in the determination of which costs merit inclusion in an analysis (the significant cost drivers). This controversial decision often leads to conflict among stakeholders. Furthermore, in “Cost benefit analysis: Theory and application” (Tevfik, , 1996); and “Evaluation in Practice: A Methodological Approach” (Bingham & Felbinger, p.197, 2002) authors report that cost effective analysis is a form of economic analysis that compares the relative expenditure (costs) and outcomes (effects) of two or more courses of action. Here, the following are basic assumptions made in cost-effectiveness analysis:

- Firstly, it assumes that the program is making a difference in the outcome.
- Secondly, it investigates how many inputs and outputs may be efficiently achieved, and which costs are attached to them for reaching different levels of the desired outcomes.

Furthermore, cost related analysis deals with whether the technology being used to make a difference costs the least by adopting an *ex-post* evaluation tool. Additionally, in the pharmaceutical industry, cost-effectiveness of a therapeutic intervention is the ratio of the total cost of the intervention relative to the measure of its effect. Here, cost refers to the resource expended for the intervention, usually measured in monetary terms. For example, the cost of introducing antibiotics and vaccines in developing countries can outweigh the measured effects. Also, according to current data and the epidemiological transition theory, infectious diseases in developed countries are on the decline. Consequently, manufacturing practices that profit from economies of scales can be more cost effective for the production and sales of expensive, high-quality antibiotics and vaccines in poor countries. In monetary terms, at \$ 1 or less, new vaccines for malaria, COVID, or AIDs in a market of six billion would be more cost effective to manufacture than selling the same product at \$ 3,000 in the US—thereby justifying investment in artificial intelligence (AI)—based technologies like proteomics, genomics and bioinformatics. For example, in this case, computational genomics and proteomics can replace cloning. AI can be used in pharmacology, toxicity analysis, and pharma kinetics, molecular diagnostics, and automation. Finally, cost-effectiveness is usually expressed as an incremental cost-effectiveness ratio or the ratio of change in costs to the change in effects. This incremental approach makes the method ideal for use in performing rational program evaluations.

Game Theory

From a manager’s stance, game theories promote *pareto optimality* by ensuring individual players or workers avoid conflict when they compete for scarce resources. Perhaps, one way of achieving this is using *Hick’s criterion*; that is: most of the less fortunate workers or

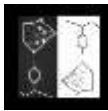


communities are prepared to make offers or concessions to the more fortunate workers or communities to prevent negative changes in the bottom line of more affluent communities. Alternatively, the more fortunate can be encouraged, through incentives and coercion, to forgo positive changes that would decrease welfare of the less fortunate. When implementing the game theory, or advanced versions with multiple players, or goals. Managers need to consider the opportunity costs of stakeholders, the absolute level of income, and income distribution. In addition, managers should consider the net positive values of private property and private income relative to the environment. *Satisficing* as a trade-off should be considered in negotiations with stakeholders.

Performance Budget

According to Bingham and Felbinger, performance measurements and benchmarking can be used to bring about effective management and to change the focus from management to results. The authors define performance measures as the results act. See Bingham and Felbinger, (2002, p. 45) or the comparisons of ideals as described by Patton and Sawicki, (1993, p. 224). Here, authors distinguish performance measures from performance evaluation stating that evaluations tend to be performed by people from outside the agency. See Bingham and Felbinger, (2002, p. 46). Furthermore, other investigators have proposed the use of crosscutting as a quick “evaluation fix” as well as the identification of alternatives as a means of improvement. See Patton and Sawicki, (1993, pp. 74; 227). Collectively, most investigators agree that *performance-based management describes the process utilizing performance measures, goals, and information to achieve quality*. Also, performance measures can be used in budgeting or to measure intervention outcomes. Additionally, performance measures can also be used to assist organizations to determine whether they are meeting program and agency objectives and purposes (Behn, The magical performance system., 2005). Furthermore, some scholars have argued that good performance systems do not exist (Behn, Adrenaline rush, 2005) and that performance measures are imperfect and require a great deal of work to produce (Hatry, 2007). Nonetheless, in “Resistance to measurement” (Behn, 2005) author reports that performance targeting can be useful to increase workplace motivation

Finally, it is stated that that outcome measurements can be used to improve agency accountability (Hatry, 2004). In conclusion, effective performance budgets should include monthly or weekly targets and emphasize agency activities, objectives, and accomplishments rather than the purchase of resources as reported in “Fiscal administration: Analysis and applications for the public sector” (Mikesell, 2003). Also, authors concludes that there should be measure beneficial results and outcomes— a critical first step in strategic planning, an observation also described in “ Fiscal administration: Analysis and applications for the public sector” (Mikesell, 2003). Traditionally, budget processes are often driven by cost estimates and have been structured to facilitate and control spending at the expense of resource allocation. See “ Fiscal administration: Analysis and applications for the public sector “ (Mikesell, p. 186, 2003). Also, performance measures outline the cost and effectiveness of accomplishments. On the downside, performance measures can expose a public agency to criticism and therefore create opposition to their implementation within organizations. In addition, at present, performance measures are being used in public health management in a variety of ways. For instance, in



infectious disease eradication programs like tuberculosis (TB), intervention projects can improve quality of care. See “Overview of Biological Defense against Tuberculosis and the Pandemic Flu in El Paso Texas” (Olisa, N. 2008). Secondly. By using performance measures, local public health care systems are targeting the identification of ineffective TB interventions that need remedy and best practices for education and treatment interventions. See “The Utility of a Broader Conceptualization of Organizational Identification: Which Aspects Really Matter?” (Van Dick, Wagner, & Stellmacher, 2004). Finally, with respect to TB intervention programs in the United States, different local, and state government health departments have adopted the use of different performance measures in their *logic*, behavioral, and environmental matrices with the aim of reducing TB disease prevalence. See “Policy Analysis” (Dye, 1976).

Performance Measures

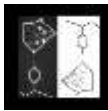
To begin with, performance measures can be used to measure program outcomes using observable characteristics. Additionally, an outcome can be something very tangible that is easy to measure when the concept is one-dimensional. Alternatively, multi-dimensional outcomes can be harder to measure. In such cases, the measurements of multi-dimensional outcomes can be achieved using scales (normalization, standardization) or an index, which work better with interval and ratio variables. Scales, on the other hand, assume that the weight across variables is the same. Also, a good index should meet standards of reliability, validity, and sensitivity. Furthermore, reliability means that the measure produces the expected result repeatedly. Finally, validity is the measure of what is considered the intended outcome, while sensitivity is the measure in the change or cause in variation of an outcome. In conclusion, statistics can be used to determine whether there is a difference in measurement. Also, in most cases, stakeholders or sponsors prefer tangible and meaningful measurements like profit and loss, time, cause and effects, or policy scenarios as defined by various game theories.

Nigeria Case Study:

a critical review of New Public Management and mitigation strategies for control and prevention of cancers associated with communicable neoplastic agents in Sub-Saharan African conflict zones

Brief History of Governance in Nigeria

Currently, according to the World Bank, United Nations Educational and Scientific Organization (UNESCO) and International Monetary Fund (IMF), in 2024, Nigeria ranked third largest economy in Africa; the most populous (with 230 million) and 37TH of 54 countries in human capital and educational performance (literacy). Additionally, as a former British colony, Nigeria gained independence in 1960. Ever since, there have been ongoing insurgencies and conflict in all geopolitical zones. See **Figure 1.** and **Table 1.** This case study tries to understand how political shifts change behavior in ways that impact distribution of cancers associated with



communicable neoplastic agents (communicable cancers). To achieve this meta-analysis on select socio-economic performance measures linked to governance and cancer registries in Nigeria was conducted. Afterwards, using a behavior-epidemiological framework to create models, multiple regression and ANOVA. Also, at the end of this study our findings were used to recommend fiscal, public policy and public health mitigations.

Figure 1. Map of Nigeria Political Zones and Armed areas of Conflict.¹

North-East-(NE)

Adamawa State
Bauchi State
Borno State
Gombe State
Taraba State
Yobe State

North-West-(NW)

Katsina State
Kebbi State
Jigawa State
Kaduna State
Kano State
Sokoto
Zamfara State

North-Central-(NC)

Benue State
Kogi State
Kwara State
Nasarawa State
Niger State
Plateau State
Federal Capital Territory-
(FCT) Abuja

South-West-(SW)

Ekiti State
Lagos State
Ogun State
Ondo State
Osun State
Oyo State

South-East-(SE)

Abia State
Anambra State
Ebonyi State
Enugu State
Imo State

South-South-(SS)

Akwa Ibom State
Bayelsa State
Cross River State
Delta State
Edo State
Rivers State



Notes:–

¹According to “Armed Conflict for the Territory of Nigeria” (Courtesy. EUAA, 2018)

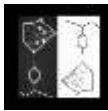
¹ Map dated 2018

Table 1. Demographic and Biographic Governance Timeline of Nigerian Chief Executives. ¹

					Total
President(s)/ Prime Minister(s) (1960-2026)	Northern [NE NW]	[NC]	Southern [SW]	[SS SE]	
Number	6 (40%)	3 (20%)	3 (20%)	3 (20%)	15
Total Governance (Years)	27 (40.9%)	18 (27.2%)	14 (21.2%)	7 (10.6%)	66
Christian	0 (0%)	1 (16.7%)	2 (33.3%)	3 (50%)	6
Islami	6 (66.6%)	2 (22.2%)	1 (11.1%)	0 (0%)	9
Tuareg; Fulani Origin	4 (100%)	0 (0%)	0 (0%)	0 (0%)	4
Hausa; Gwari; Kanuri; Angas Origin	2 (25%)	3 (75%)	0 (0%)	0 (0%)	5
Yoruba Origin	0 (0%)	0 (0%)	3 (100%)	0 (0%)	3
Igbo; Ijaw Origin	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3

Notes:—

¹ Findings from *Ex-post* data source (1960-2026) analyzed show relationship between political shifts in governance withing Nigeria geopolitical zones based on demographical, biographical, time spent in officer



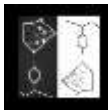
Brief History of Nigeria Cancer Registry, Pathology, and Laboratory Medicine

According to “History of Histopathology (Anatomical Pathology) in Nigeria: Models, Mentors, Memories, and Milestones,” (Idowu & Obafunwa, 2022, p.1-66), first hospital established in did so in Lagos Island General Hospital in 1893. Also, first qualified Nigeria medical doctor qualified in 1858. In the beginning, histopathology and anatomic pathology were established during the British colonial era by George Miller Edington (1916-1981) who also co-founded the Nigeria cancer registry along with the first indigenous cancer treatment center in Ibadan. Additionally, between 1957 through 1966 a group of 12 Nigerians domestic and foreign trained pathologists are credited for pioneered histopathology, anatomic pathology along with laboratory medicine. Furthermore, these men are also credited as being first generation of Nigerian Pathologists—the pioneers—most of whom obtained all or part of their basic medical qualification and, or post-graduate training locally at the Yaba Higher College, Lagos; University College Ibadan; overseas in the UK, or entirely in UK and Germany. Finally, regardless, collectively they were all simultaneously awarded fellowships by the Medical Council of Pathologists (FMCPPath) in Nigeria in 1970, and West African College of Pathologists (FWACP) in 1976.

Distinctively, with respect to “communicable cancers” like (HIV) associated (HHV-8); and (EBV) associated Hodgkin Lymphoma (Hodkins Disease) discussed here; earlier studies explored differences in frequencies of tumors between two ethnologically related population groups of American and Nigerian Negros of different demographics. On this subject, report in “Malignant Tumors in American Black and Nigerian Children: A Comparative Study” (Olisa, Chandra,, Jackson, Kennedy, & Williams, 1975, p.1-2) concluded that environmental factors can be responsible for ethology of some neoplasms. Additionally, in “Hodgkins Disease in American Negros. Histologic Classification of the Disease in 143 untreated Patients, and Age Distribution” (Olisa, Kennedy, Kish, Lanava, & Williams, ,1976, p.1-3), findings formed the basis for this studies associations of disparities and environmental variations in the aggressive distribution of (HL) within the black race. Finally, this research occurred during the infancy of epidemiologic transition research—revolutionary at the time. In conclusion, these early findings on cancer burden withing the black populatuon was performed by two pioneering Nigerian pathologists, A. O Williams (1935-2017) and E.G Olisa (1927-2015).

Quality of Cancer Treatment and Detection in Nigeria

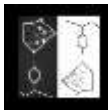
Briefly, based on current estimates from International Agency for Research on Cancer (IARC), between 2022 through 2050 global cancer burden is projected to rise by over 75%. Significantly, 9.7-18.5 million people or about 85% of these new cases will result in death as reported in “Global cancer burden growing, amidst mounting need for services” (WHO, 2024). In Africa, 1.1 to 2.1 new cases million new cases are expected by 2030. Also, amongst the top five cancers (breast, prostate, cervical, colorectal, and liver) reported, two — cervical and liver cancers, are associated with CNA. Other CNA-cancers typical to Nigeria include Kaposi Sarcomas (HHV-8), Bladder (*Schistosoma haematobium*), Stomach (*Helicobacter pylori*), Nasopharyngeal (EBV)



Hodgkins Lymphoma (EBV) and Non-Hodgkins Lymphoma(EBV). Importantly, disproportionately, 50% of women are at risk of developing either breast or cervical cancers in their lifetime. This study specifically looks at communicable neoplastic agents (HPV, HIV, HHV-8, and EPV) linked to environment-to-person transmissions associated with internal displacement of people (IDP), sanitation, sexual activity, and water quality and distribution. Accordingly, the term communicable cancers will be used in this study to describe these cancers in some sections.

As reported in “Nigeria: Global Cancer Observatory” (IARC, 2022); and “Current Status of Cancer Diagnosis and Treatment in Nigeria” (Ogunniyi, et al; 2025), in 2022, Nigeria recorded approximately, 127,763 new cancer cases and 79,542 cancer deaths. Accordingly, based on these statistics this study tries to understand factors associated with distribution and burden of CNA-cancers and best ways to mitigate its threat to Nigerias National Security and cross-border potential. Furthermore, other studies in “Diagnosis of cancer in the South and North of Nigeria: duration and causes of delay” (Fayehun, Apenteng, Umar, & et, al, , 2025); “Cervical cancer survival in a resource-limited setting-North Central Nigeria” (Musa, et al., 2016); “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N. , 2008) collectively explore cancer risk management in developing countries. Specifically, with respect to impacts of detection accuracy and need for safety and quality oversight. Problematically, on the diagnostic side, the gold standards in cancer testing is biopsy and immunohistochemistry. Here, reagents involved need very strict temperature control. Also, laboratory scientists and pathologists needed periodic training and credentialing to keep up with testing standards, equipment, device maintenance and imaging. Collectively for these reasons, in sub-Saharan Africa, but Nigeria specifically, early diagnosis and treatment of most cancers are problematic. Consequently the process is characterized by delays, misdiagnosis or patients being treated before their cancer type is known. Also, disparities and low quality and safety for impactful and accurate cancer diagnosis and treatment can be attributed to following key factors:

- In 1960, for every pathologist, there are 10 million people in Nigerians. In more recent reports, in 2025, there are approximately one pathologist to one million people in Nigeria. Conversely, in in US and EU, for every pathologist, there are 15,000 people .
- Medical equipment devices are inadequate (poorly calibrated for precision and accuracy) or unavailable.
- There is lack of technical expertise to make calibrations or repairs.
- The public utility infrastructure is inadequate medical logistics with frequent power outages, poor water quality or shortages.
- Patients are unable to afford treatment or diagnosis due to extreme poverty.
- Lab submissions, testing and detection turn-around-times (TAT) do not meet international standards
- Patients lack confidence in modern medicine and medical practices in Nigeria and favor traditional medicines in some instances.
- Total Quality Management and regulatory, credentialing, training, safety, proficiency, and oversight processes and standards are not properly instituted.



Quasi-Experimental Approach, Methodology and Evaluation

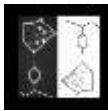
This study adopts techniques described earlier in “Biological Agents Index” (Olisa N, p. 162-166, 2008) to understand role public policies play in the distribution of CNA-cancers in Sub-Saharan Africa conflict zones. Second. Based on findings, best practices for developing strategic postures for mitigation, control and prevention of CNA-associated cancers in conflict zones are recommended. To achieve this, experimentally, a Solomon Four Group approach was adopted. That is, two-group pre-test of Nigeria geopolitical regions:

Group A.	Geopolitical Zones	In-Conflict
Group B.	Geopolitical Zones	Conflict- Free

To determine *Ex post* and *Ex Ante* mortality rate for communicable cancers in Nigeria. To achieve this *Ex-post* comparisons of Group A and Group B were used as the *pre-test* (control). Afterwards, for the *post-test*, quasi-experimentally, mathematical models were used to generate stochastic analysis of *Ex ante* outcomes (impacts) of inadequacies in public policies. In this case, consequences of inaction “no treatment” on distribution on CNA-cancers. To achieve this data on the following performance measures linked to CNA-cancer distribution, behavioral and socioeconomic indicators were collected to establish correlation and or causality:

- Population of Internally Displaced People,
- Terrorism Activity,
- Inter-Ethnic Marriages Rate,
- Inter-Religious Marriages Rate,
- Net Unemployment Rate,
- Net Literacy Rate,
- GDP per capita PPP,
- Net Fertility Rate.
- Cancers with Communicable Neoplastic Agent Etiology
 - Cervical, Anal, Penile, Oral, Throat, Vaginal (HPV/HIV)
 - Liver Cancer (HBV and HCV)
 - Hodgkins Lymphoma; Non-Hodkins Lymphoma and Nasopharyngeal (EBV/HIV)
 - Kaposi-Sarcoma (HHV-8/HIV)
 - Bladder Cancer (*Schistosoma Haematobium*)
 - Stomach Cancer (*Helicobacter pylori*)

Specifically, during quasi experimentation, a stochastic approach was used to mitigate gaps in record keeping and reporting associated with governance in Sub Saharan Africa since randomized protocols are not feasible in the Nigeria research ecosystem opting for comparison groups mathematical furcating to estimating impact. Also, due to the absence of a non-arbitrary zero point needed for estimating interaction of selection retrospectively; by making observation in different time series, an *Ex-ante* efficiency analysis and R-Square statistics was used for regression modelling. Finally, to remedy outcomes postulated *Ex- ante*, a recommendations section follows the conclusion of this study with a “model” posture composition. To justify, as



an overview. Currently, a major problem in fragile economies is the scarcity of data for cancer incidence. For justification, see reports in “Burden of cervical cancer in Northern Nigeria” (Akinfenwa & Monsur, 2018); and in “Cancer distribution pattern in south-western Nigeria” (Awodele, Adeyomoye, Awodele, Fayankinnu, & Dolapo, 2011); also in “Incidence of cervical cancer in Calabar, Nigeria” (Ebughe, et al., 2016); and in “Diagnosis of cancer in the South and North of Nigeria: duration and causes of delay” (Fayehun, Apenteng, Umar, & et, al, 2025). Collectively, authors explore the impact cost has on treatments and diagnosis in Nigeria where the cancer registry is either incomplete or unavailable for most states in Nigeria.

Summarily, to begin with to materialize this study, a holistic, interdisciplinary, comparative and meta-analysis was performed using *Ex post* stochastic data for quantitative and qualitative peer-review of socioeconomic trends like Gross Domestic Product (GDP); Purchasing Power Parity (PPP); literacy rate, interethnic and interreligious marriages. Additionally, data from Nigeria Cancer Registry, along with the geopolitical distribution of top five cancers in Nigeria was reviewed using overlapping timeline to generate *Ex Ante* predictions for CNA-cancer mortality into the year 2040. Furthermore, data on socioeconomic and geopolitical activities, like conflict, rooted in religious intolerance in groups A and B was used to determine variable impact on CNA-cancer distribution. Finally, based on findings, and after review of WHO, ICARP, Nigeria and Africa Union cancer control and prevention policies, needs, activities and services. In conclusion, this study uses its findings to make recommendations by adopting a public policy posture format for suggestions that enables and increases a performer or researchers understanding in ways that improve conflict mitigation and cancer control.

Ethics Considerations

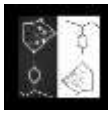
To begin with, to limit and respect cultural, moral and religious values in Nigeria, this study was conducted using meta-analysis derived from highest quality peer reviewed information from recognized African, and reputable international scholars associated with African and or Africa focused institutions. Additionally, authors and contributing works were selected after vigorous vetting for holistic methodologies, innovation, and histories from diverse and representative nonprofit research efforts along with open-source information associated with humanitarian activity. Finally, research material published here has no political, religious or gender biased advancements.

Data Collection

Data used in this study was derived from meta-analysis using Google Scholar key words to search: “cancer in Nigeria” “inter-ethnic and inter-religious marriages in sub-Saharan Africa;” “Nigeria GDP” and “Nigeria PPP” also “conflict in the Sahel;” and “Nigeria literacy rate.”

Data Analysis

Per **Figure 2**; also, in **Table 4**. Meta Analysis showing Coupled Behavioral-Epidemiological Game Farmwork and Model was developed using regression and ANOVA analysis based on



Advanced Game Theory principles. Here, select dependent and independent variables used for qualitative and quantitative stochastic analysis of meta data were driven using methods originally described in “Leviathan” (Hobbes, 2024) but specifically adapted for contagion risk management as reported in “Cross-Sectional In Silico Analysis of Covid-19 Pandemic” (Olisa N, 2020) and earlier in “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N, 2008), a technique commonly known as *bio indexing*. Also, in results section, author reports stochastic methodologies for quantitative and qualitative impact modeling of independent variables like communicable diseases and socioeconomic behavioral dependent variables. Distinctively this study goes further to investigate impact of politics (governance) associated performance measures (dependent variables) like the following: religious tolerance indicators connected to inter-faith and inter-ethnic marriage rates, religious conflict and terrorism activity over timelines that overlap socioeconomic variables (dependent variables) like literacy rate GDP and purchasing power parity to determine time series overlaps that are indicative of correlation and or indirect causation with communicable disease distribution (independent variable) that are directly linked to communicable cancers based on pareto principle outcomes.

Recommendations

In the case of disease control and conflict mitigation, suggestions for public policy postures along with machine learning teaching modules were developed to help stakeholders (players) like governments, cancer patients, victims of religious based conflicts achieve preventative or mitigation goals as needed.

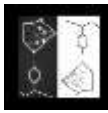
Evaluating Impact

Techniques originally described in “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N, 2008) was adopted for evaluating disease-behavior-socioeconomic trend models. To justify, according to Bingham and Felbinger (2002, pp. 5-7), impact evaluations refer to impact, outcome, or summative evaluations that are interested in quantifying what is happening. These are of two types:

- one that revolves around assessing an output,
- and another that measures effectiveness.

Both focus on measuring outcomes. Meta evaluations are often used to evaluate impact studies and are like literature reviews. These kinds of analysis are considered as qualitative exercises (Bingham and Felbinger, 2002, pp. 8). Here, the criteria needed to perform impact and outcomes evaluation include the following:

- Describe the context (what is the problem?)
- Describe the goal of the evaluation (what is being tested?)
- Describe the research/evaluation design (what does it do?)
- Determine what threats to internal validity can be remedied



- Determine the matching procedure
- Establish the control group
- Decide what can be done to ensure the groups are equivalent

In situations like this, the major threat(s) will be those to selection and outcome. Both are interrelated. Threats to selection will lead to threats to outcome. To avoid or minimize threats to outcome, selections of economic and infectious disease indices in the intervention groups, regardless of geography, should conform to acceptable standards. One way to achieve this is using indices (ratios) to define the selection group. Furthermore, to rule out threats to internal validity (instrumentation, history, maturation, attrition; testing scores, and regression towards mean) the programs measurements should be retrospective (Bingham and Felbinger, 2004). In addition, indices can be used to address social demographic impact, and epidemiological impacts and bias (Orman, 1977). For example, in this study, evaluation, implementation, and the monitoring of the impact of health delivery policies associated with cancer intervention are problematic due in part to estimation of the benefit of outcomes (Krieger et al, 2003). Previous studies show that effective cancer intervention measures—such as monitoring, control, and health delivery—are correlated to cost (Clarke et al, 2006; Currie et al, 2005; Dasgupta and Menzies, 2005). According to Bingham and Felbinger (2002, pp. 10-21), once data is collected, they should be utilized after internal and external factors are validated using one of the following methods: reflexive designs; one-group or two-group pretest and posttest designs, simple time series design, quasi-experimental designs, pretest-posttest comparison group design, experimental design, pretest, and posttest control group designs. Consequently, when identifying goals and objectives the performer should correct data collected for the occurrence of either type one or type two errors.

Extent of Experimental and Non-Experimental Approach

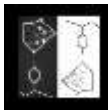
When selecting articles for meta-analysis, the following questions should be asked:

- What needs to be evaluated?
- What are the administrative objectives?
- What are the administrative standards?
- What monitoring services are needed?
- What should the functions of the monitoring services be?

According to (Olisa N, 2008); and (Bingham and Felbinger, 2002, pp. 1-3), process evaluation uses scientific methods for gathering empirical data to test hypotheses. Evaluators should look for broad-based goals and for clearly stated measurable objectives by which the goals can be reached. In addition, evaluations should involve fundamental goals and objectives of the program and a process that involves assessing program activities (Bingham and Felbinger, 2002, pp. 4-5).

Summary questions include the following:

- What statistical techniques did the researcher use to ensure comparability?

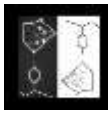


- Was the researcher able to rule out self-selection bias? What about other threats, such as maturation, mortality, history, etc.?
- What can the performer do to improve the evaluation design?
- What can the performer say about issues of external and construct validity?

Also, to achieve this goal, the proposal is for the performer to use nonexperimental designs, preferably quasi-experimentation or anecdotal experimentation, when evaluating infectious disease programs, specifically, post-test-only comparison groups where selection is done through a non-random process (Bingham and Felbinger, 2002, pp. 123). Major threat(s) to validity would be those to selection and outcome. As stated earlier, threats to selection will lead to threats outcome. To avoid or minimize threats to outcome, selections of economic and infectious disease indices in the intervention groups, regardless of geography, should conform to internationally acceptable standards. These indices (ratios) for GDP, PPP (LQ should be used if available) will be used to define the selection group. In addition, it is recommended that the performer use multiple attributes matching to compare impact of economic development on infectious disease in the experimental group.

Finally, this study uses mathematical models and the multiple linear regression equation where the dependent variable is infectious disease prevalence (outcome), and independent variables are relative risk for infection (multiplied by number of ways microbe is spread), inverse of gross domestic product and microbial infective dose), microbial reproductive rate (multiplied by number of ways microbe is spread, and inverse of gross domestic product (or purchasing power parity) and microbial infective dose, as well as infectious diseases incidence (multiplied by number of ways microbe is spread, and inverse of gross domestic product and microbial infective dose). Furthermore, to accomplish group comparability, the performer can benchmark outcome data, which is collected prior to the Average Monthly (periodic) Changes in number of new infectious disease cases per month (period) over a year relative to GDP. Also, comparability can be ensured using the regression model, R-square statistics, regression coefficient, intercept, and autocorrelations as described by Bingham and Felbinger (2002, pp. 132). Also, to rule out self-selection bias and other threats such as maturation, mortality, and history, performers should sample community GDPs and collect Average Monthly (periodic) changes in new cases of infectious disease in these communities randomly. Furthermore, this is typical of quasi-experimental designs (Bingham and Felbinger 2002, pp. 123). However, other forms of bias, like threats to maturation, can be reduced significantly by conducting the study retrospectively and making several observations at different time points (time series) (Bingham and Felbinger, 2002, pp. 123).

In conclusion, and to begin with, data collection, urban communities can be selected based on histories of economic development programs and location. Also, to reduce threats to external validity, performers can use large sample sizes and perform a cohort study of the experimental group. Also, where possible, the non-arbitrary zero point can be used to estimate interaction of selection and treatment, setting and treatment, as well as to history and treatment (Patton and Sawicki, 1993, pp. 131). Previously, in “Overview of Biological Defense against Tuberculosis and the Pandemic Flu in El Paso, Texas” (Olisa N, 2008) uses efficacy analyses to conduct prospectively (*ex-ante* efficiency analysis) during the planning and design phase of an initiative

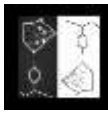


or retrospectively (*ex post* efficiency analysis). *Ex ante* efficiency analysis is important for programs that are difficult to abandon due to extensive commitment needs in funding and time (Patton and Sawicki, 1993, pp. 257-259). *Ex post* efficiency analysis, on the other hand, is useful after a program has been in place for a time and has been demonstrated to be efficient by an impact evaluation. *Ex post* efficiency analysis rests in dubious assumptions and should be limited to utility, the program must have independent or separable funding (cost can be separated from those of other activities). Additionally, programs should be ahead of their developmental stage and should have certain effects. Furthermore, the programs' impact and magnitude should be known or can be easily estimated. Finally, benefits can easily translate into monetary terms. And decision makers should consider using alternative programs as backup (Rossi et al, 2004 pp. 336, 361-362). Summarily, according to Bingham and Felbinger, pretest and posttest are classic experimental designs and consist of two comparable groups: one experimental (or intervention group) and another control. These two groups should not be used interchangeably. Also, true control groups should be formed randomly (Bingham and Felbinger, 2002, pp. 58-60). Randomization can be accomplished by flipping a coin, throwing names into a hat, or using a table of random numbers, etc. After treatment, data on measures of cognitive development from the experimental design and subjects in the comparison group can be taken for analysis (Rossi, 2004, pp. 241-249). Also, the nature of gains of treatment, and durability and the social significance of the data can then be assessed and explained (Bingham and Felbinger, 2002, pp. 61-71; Rossi, 2004, pp. 235).

Criteria for Solomon four group Approach

To begin with, when selecting studies for meta-analysis, the Solomon four-group design two group pretest and posttest design is used to confound or confuse training effects when testing a sample with a treatment by using interaction between pre-testing and training (Bingham and Felbinger, 2002, pp. 79). Additionally, Solomon's four-group design shows whether groups are sensitized by the pretest and quantify the sensitization when it exists. Also, this analysis contains additional sets of comparisons that are not measured initially, resulting in comparisons of policy (Bingham and Felbinger, 2002, pp. 79). Furthermore, the Solomon four-group design is rarely needed for evaluating infectious disease programs but is appropriate in cases when pretest is used and when the effects of this pretest are substantial, for example, in educational (socio-economic) programs. Alternatively, Posttest-only control group design is a variation of the pretest posttest design. It differs in that it omits the pretested group. Here, individuals are randomly assigned to both control and experimental groups (Bingham and Felbinger, 2002, pp. 95). Also, four indicators were used to retroactively study four overlapping groups. The indicators used to qualify meta-groups were:

- Nigeria Regional Socio-economic Indicators
- Nigeria Regional Religious Tolerance Indicators
- Nigeria Regional Violence and Conflict Indicators
- Nigeria Cancer Registry. Shows cancer distribution between (2009-2016) in six geopolitical regions and central Federal Capital Territory (FCT), Abuja.



Extent of Quasi-Experimental Approach

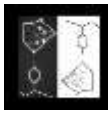
Quasi-Experimental designs employ comparison groups just to do experiments. These include pre-test-post-test comparisons, group design, the regression-discontinuity design, the disrupted-time-series comparison group design, and the posttest-only comparison group design (Bingham and Felbinger, 2002, pp. 107). Furthermore, when nonrandomized designs are preferred, selection and other sources of bias can be estimated by constructing social groups by matching and using statistical controls and using multivariate statistical techniques and selection modeling to determine outcomes (Rossi et al, 2004, pp. 276-287; Patton and Sawicki, 1993, pp. 378-384). When developed correctly, quasi-experimental designs can be used to estimate program effects. These advantages rely on the practicality and situation where randomized protocols are not feasible. Hear, post-test data was supplied by

- World Health Organization
- Scientific peer review publications from leading Regional socio-economic, public health , scientific and medical center globally.

Criteria for Comparison and Non-Comparison Group Approach

To begin with coupled behavioral and epidemiologic impact models using activities, influences, behavior and outcomes was used to make comparisons and determine non-comparisons with respect to relationships, mitigants and group values. The process here involved benchmarking overlapping study groups over a retroactive timeline to create a behavioral model that overlaps cancer incidence with influenced socio-economic trends and the environment as described in “Cross-Sectional In Silico Analysis of Covid-19 Pandemic” (Olisa N, 2020) and “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N, 2008). In justification, according to Bingham and Felbinger, pretest-posttest comparison group design or nonequivalent group design, like pretest-posttest design except those variables or comparisons are not randomly assigned. Additionally, the validity of this quasi-experimental design depends on the extent to which the comparison group resembles the experimental group. There are greater risks for bias in this design. See (Bingham, and Felbinger, 2002, pp. 109; Rossi et al, 2004, pp. 295-297). Furthermore, quasi-experimental design has little strength because, first, the control and experimental groups are alike, and second, there are few threats to internal validity. Also, another major disadvantage is that there are limits to random assignments (Bingham and Felbinger, 2002, pp. 120; Patton and Sawicki, 1993, pp. 378-384). In addition, interrupted time series group comparison test examines how and whether interruption (of treatment or program) affects a social process and whether observed effects are different from processes observed in an untreated group or among different types of treatment (Bingham and Felbinger, 2002. pp. 123; Patton and Sawicki, 1993, pp. 378-384).

Finally, posttest-only comparison group is like the posttest-only control group but differs in that the latter uses a randomly assigned control group (Bingham and Felbinger, 2002, pp. 137). Posttest-Only comparison group is used when evaluation is proposed after the fact. Also, subjects of reflexive design are not so easily defined. In conclusion, these designs are concerned



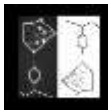
with the evaluation and use of the target group (Bingham and Felbinger, 2002, pp. 150; Rossi et al, 2004, pp.290). Also, the most used form of the reflexive design is the One-group-pretest-posttest design (comparison of before and after data) – this evaluation process can be described as unpowerful and prone to internal validity problems (Bingham and Felbinger, 2002, pp. 153; Rossi et al, 2004, pp. 291). In addition, this design is traditionally used as the last resort test. Secondly, the time series design is often referred to as the single interrupted time series design. It is useful when pre-program and post program measures are available on several occasions before and after the implementation of the program (Bingham and Felbinger, 2002, pp. 169).

Criteria for Program Services and Activities selection

To begin with, according to (Olisa N, 2008); and (Patton and Sawicki, 1993, pp. 2-7), systematic procedures or policy analysis methods can be used to tackle current policy problems. Also, methods they use could involve quick analysis or planning or systematically searched kind of analysis or policy analysis. Additionally, several skill sets are associated with planning and policy analysis. Furthermore, according to (Patton and Sawicki, 1993, pp. 8-23), the performer should adopt methods associated with policy analysis and planning by recognizing specific basic methods and applications like the following: competency of using methods in design and analysis and the communication of results as key steps. Finally, key practical principles for being policy analysts require the following attributes from the performer:

- Learning to focus quickly on central decision criterion of problems
- Thinking about type of policy actions that can be taken
- Avoiding the use of tools because a particular method of analysis is favored
- Learning to deal with uncertainty
- Quantifying variables numerically and emphatically
- Making an analysis simple and transparent
- Checking the facts
- Learning to advocate the position of others
- Presenting the client with analysis and not decisions
- Pushing the boundaries of analysis beyond the policy envelope
- Avoiding making absolute decisions but rather making rational and complete analyses.

In conclusion, a program output consists of activities and services needed to implement a program. Currently, according to (Olisa N, 2008), most policies surrounding urban development and its relationships to infectious disease are confronted by “*wicked problems*.” Consequently, analysis can be performed using branched evaluation techniques as described in “How to Think about Social Problems: American Pragmatism and the idea of planning” (Blanco, 1994); and “The Science of Muddling Through” (Lindblom, p. 79-88, 1958). Performers may have to think out of the box to investigate trends against the current status quo. Additionally, the fundamental question of whether a program works as intended can be answered using the cost benefit or cost-effective analysis as described in “Evaluation in Practice: A Methodological Approach” (Bingham & Felbinger, p.179, 2002). Additionally, according to (Rossi, Mark, & Howard,



p.3310336, 2004) performer should ask and answer the following questions when selecting activities and services:

- Is there a lack of need for efficiency analysis if efficacy of program is very minimal or very high?
- Is there a need for an efficacy program when a program is effective in an imperfect way?
- Is there a need for technical procedures to require methodological sophistication that are unfamiliar to project staff?

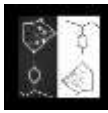
Therefore, different types of controversies may arise from placing economic values on input or output measures; while expressing results of evaluation studies accordingly, performers should selectively take different costs and outcomes into account.

Results and Discussions: Impact Modeling, Meta and Statistical Analysis

Quantifying Political Shifts in Nigeria with Socio-economic Performance Measures

Here, macroeconomics is used as a tool to study and identify mitigants for use in postures that influence human behaviors and performance as it is related to biodefense and biosecurity by specifically quantifying outcomes (quantitatively and qualitatively) that correlate or are causal to Internally Displaced Persons (IDP). Statistically, on the quantitative side, variables associated with governance performance measures are considered. See **Table 3** and **Table 4**. Also see **Figure 4**. Additionally, coupled behavioral and epidemiological frameworks were created and used to understand “why” and “how” political shifts in Nigeria impact the distribution of communicable cancers. See **Table 2** and **Figure 3**. With respect to our findings. To begin with **Table 1** and **Figure 1** outline the history of governance in Nigeria and depicts biographic and demographic details of its leadership at the executive level. Result show that in over 66 years of independence, Southerners of all tribes have occupied 31.8% of the executive leadership timeline; also 83.3% of Southern executives practiced Christianity. Conversely, Northerners occupied 68.1% of the leadership timeline and 16.7% of the Northern leadership in that category practiced Christianity. Expectedly, 88.8% of Northern Executives practiced Islam. Interestingly, Within the Northern leadership space, All Christians leaders, and 12.2% of its Islamic leaders were from the North Central (NC) region. Also collectively, (NC) contributed 27% to the executive leadership timeline. This is significant because in **Figure 2** and **4**, finding show political shifts in Northern regions, combined with extremes in socio-economic performance measures to include unemployment, and religious intolerance have significantly contributed to behavioral shifts like specific types of terrorism activity leading to massive IDP settlements. Also see **Table 3** and **4**.

Furthermore, with respect to seven socio-economic performance measures examined, NE, NW, and NC Nigeria, during the same time frame, ranked amongst the 15 states with the lowest GDP-PPP; literacy rate; unemployment rate; and ranked amongst the 15 states with highest fertility



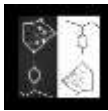
rate; terrorism index; and populations of internally displaced people; whilst at the same time having the heaviest burden (80%) of distribution of communicable cancers. See **Figure 2** and **Table 2**. Collectively begging the question(s).

- (1). Are there stochastic relationships between politics and behavior that adversely impact distribution of communicable cancers in conflict zones?
- (2). In this scenario, what are the potential mitigating factors for improved cancer prevention and control in conflict zones?

Characterizing Behavioral Changes linked to Socio-economic Performance Measures

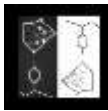
Figure 2 and **4** along with **Table 3** and **4** summarizes relationships between religious intolerance and terrorism with other socio-economic indices like unemployment. To begin with, while terrorism is ongoing all over Nigeria, its activity index, which measures the lethality of terrorism, stochastically decreases from North to Southern Nigeria along with the number of (IDP). Additionally, terrorism is one of the several ongoing destabilizing behavioral factors in Nigeria. Here, data reported reflects the analysis of a groundbreaking study in “A Bipartite Network Analysis of Terrorism in Nigeria” (Corradi, Felmlee, & Gartner, p 795-829, 2025). Furthermore, investigators looked at ties between two different types, such as people and events (in this case, terrorist groups and their terrorist acts) to better understand, comprehensively, terrorism dynamics, that can be used in counter terrorism. Finally, authors conduct extensive policy analysis on Nigeria mitigation measures. In conclusions, authors find that quantification and characterization of conflict and insurgencies in Nigeria can be uniquely characterized by one form, or the other with respect to underlying attributes of networks. Similarly, in “Understanding Terrorism and its challenges to the National security of Nigeria” (Piate, p.2992; 2025) author expored complex nature of identifying, reporting and mitigating terrorism in Nigeria in the contex of its geopolitics. Similarly, also see “Nigeria's Boko Haram and Ansaru - Council on Foreign Relations” (Sergie & Johnson, 2014).

Collectively, these investigators agree that there are numerous players in terror groups most of which cooperate with intelligence and logistics. Also, according to “Terrorism in Nigeria: A Critical Analysis” (Agashi, p47-53 2020), between 2002 through 2019, Nigeria governments approach combating its terrorism problem by mostly adopting ideological and is insubstantial methodologies. Additionally, recently in “Terrorism in Nigeria: Exploring the causes and the rise of Boko Haram” (Makai, , p 2087–2103, 2024) and in “Understanding Terrorism and its Challenges to National Security in Nigeria” (Piate, , p. 2992-4618; 2025) authors conclude the rise in Boko Haram and other insurgencies are deeply rooted in political corruption, socio-economic instability and other economic issues. Finally, while different accounts disagree with respect to motive. Most scholars agree, to achieve peace and sustainability, Nigeria needs to adopt a holistic ideology that combines a robust approach which includes improvements in governance and promotion of socio-economic development of the type leading to the inclusion of international cooperation.



Additionally, in “Inter-marriages and National Unity in Nigeria” (Olugbemi, , p.365-377, 2022) the investigator reports that inter-ethnic marriages among various ethnic groups in Nigeria have ameliorated tribal and religious tensions. In effect this study advocates for encouragement of inter-ethnic and inter-tribal marriages as a way to overcome the challenges of tribal agitations and religious conflict pointing out that inter-ethnic and inter-tribal marriages activities are highest in (NC) Nigeria. Similarly, in “Explaining inter-ethnic marriage in Sub Saharan Africa” (Bandyopadhyay and Green, p627-643, 2021) authors explain that these activities were extremely low during colonial era until 2014 due to strong tribal barriers and rural dominance. However, rates have been tripling since 2016 due to the following reasons: increases in urban migration, education and internet exposures that result in less cultural resistance. Furthermore, according to (Olugbemi, p.365-377; 2022), younger population embrace inter ethnic marriages by as much as 64% in large cities like Lagos, Abuja, and Port Harcourt while displaying strong inter-ethnic marriage rates consequentially in (SE) and (SS). Also this investor reports the greatest rate increase is in (NC). Also see similar reports in “Socio-Cultural Impact of Inter Ethnic Marriages in Nigeria” (Ewelum, p 7-15, 2016). Furthermore, in perhaps one of the longest and most comprehensive studies on the topic, reports in “Population Dynamics of Religious Affiliation” (Garenne, 2025), was based on studies spanning 1930 and 2020. Here, authors report that population growth rates of Christians and Muslims were dynamic. Additionally they observe net increases in fertility was a significant factor intolerance since muslim-christian intermarriages and conversion was in the increase amongst women. This observation was corroborated in “Fertility Rate: Nigeria” (OFB, , 2024), where authors report that in the North of Nigeria, between 1960 to 2020, high fertility rates may have been responsible for sharp increase in the Islamic faith in Nigeria. Finally, decline of African traditional religions have been suggested to contribute to the observation. Also, authors suggest inter-ethnic and inter-religious marriages accounted for increases in the spread of Christianity in (NC) and decline in or as they put it quote “fluctuations of Muslim religions as main affiliation, as consequence.”

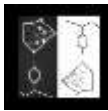
Interestingly, between 1980 and 2010, both monotheist religions shared approximately half of the population. However, since 1995 the growth rate of the Muslim population became higher than that of the Christian population. In particular, population growth in the Northern part of the country, was mainly Muslim, and was outstanding—as some investigators have suggested, these trends could have serious implications in the future, and in particular, could lead to demographic imbalance between the two groups, and can could raise serious environmental issues, especially in the North, and could have numerous political and social consequences. More compelling, in an earlier study reported in “Inter-ethnic and inter-faith marriages in sub-Saharan Africa” (Crespin-Boucaud, , p1-37, 2018) investigators had report limited changes in inter-ethnic marriages between 1960 and 2010, but that evidence suggests that urbanization and changes in social norms about marriage would drive increase in the share of inter-ethnic marriages. However, these investigators also believed that inter-faith marriages would remain rare, which indicates that religious cleavages are either extremely salient or that partners convert before marrying. Worth noting, in **Table 3**, we report in addition to lower, net GDP-PPP, and literacy rates, some researchers believe these collective activities have led to the genesis of terrorism, but specifically, Boko Haram who blame western schools as the convergence point for Christian



conversions; inter-ethnic and inter faith unions, (Sergie & Johnson, 2014). Regardless, and minimally, an indisputable fact according to reports in “Refugees and Internally Displaced People: Nigeria” (OFB, 2025)” also, in “IDP Atlas Mobility Tracking - North-Central and North-West Nigeria” (ReliefWeb, (as of June 2024), 2024); to include reports in “Global Data Institute Displacement Tracking Matrix” (UN, IOM, 2023) and in “Health and Social Assessment of Internally Displaced People (IDP) in Nigeria” (Etikan & Ogunjesa, , p. 2-4., 2019) Unanimously, observers and investigators agree the total number of Nigeria IDP in 2025 was approximately 3,702,022. This is significant because reports agree between 1971 and 2025, based number of IDP displacements in Nigeria, terrorism acts conducted by Boko Haram and its network between 2002 and 2017, by far outways those of Fulani Extremists and its associated networks between 2021 in 2024 and by so, making the combination of Boko Haram and Fulani Extremeists the most lethal terrorism groups in Nigeria.

Impact of Internal Displacement of People, and Unemployment on Distribution of Communicable Neoplastic Agents and Their Associated Cancers (Communicable Cancers)

To begin with, there is precedence for impacts of terrorism and communicable disease. In “Boko Haram insurgency: implications for public health” ((Omole, Welye, & Abimbola , 2015) investigators report on dire impact of insurgencies and terror on healthcare delivery in Northern Nigeria with respect to communicable diseases like polio. Specifically authors stress harms done to water supply, sanitation, and food safety particularly in IDP camps with women and children. Similarly these findings were echoed by (Magaji, et al., 2017); (Yusuf I, Ochicha, & Haruna, 2017) and (IARC, 2022). Additionally, in Terrorism in “Nigeria: A Critical Analysis” (Agashi, 2020); and in “Terrorism in Nigeria: Exploring the causes and the rise of Boko Haram” (Makai, 2024) collectively, investigators strongly suggest the major short coming of terrorism and conflicts in Nigeria are establishments of IDPs. Furthermore, here, in this study, See **Figure 5A** and **5B**, findings show statistically, in any given environment, prolonged and increased IDP population, along with persistent unemployment are extremely strong predictors for epidemiologic transition of communicable cancers. Justifiably, in “Mapping of Human Displacement by Boko Haram in Nigeria from 2009 to 2021” (Omogunloye, et al. p73-85, 2023), authors conclude that Boko Haram insurgency hotspots concentrate in (NE) Nigeria, but also conducts fewer and more dispersed attacks in locations in (NC) and (NW). Finally, recently, in “A Bipartite Network Analysis of Terrorism in Nigeria” (Corradi, Felmlee, & Gartner, , p 795-829, 2025), authors suggest major terrorism organizations in Nigeria, like Boko Haram, Fulani Extremists collaborate with networks all over Nigeria for logistical and intelligence support. These findings are significant as suggested in “Understanding IDPs in Nigerian Cities” (Roberts and Lawanson, , 2023) where authors explored IDPs in (NE) Nigeria and concluded they mostly settled in larger cities in (SW), (SS), and (SE) suggesting these particular movements by extreme Boko Haram violence may have contributed to clandestine infiltrations into IDP groups found in Lagos, Ibadan, Onitsha, Port Harcourt and may explain why their networks remain strong in these region.

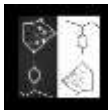


With respect to cancer distribution, numerous investigators have suggested that this pattern of close contact human settlements and IDP movement described in “The Spatial Distribution of Internally Displaced Persons (IDPs) in Africa” (Avwunudiogba and Dung, 2021) threatens biosecurity. Preceding, according to reports in “The Impact of Different Types of Violence on Ebola Virus Transmission During the 2018–2020 Outbreak in the Democratic Republic of the Congo” (Kelly, et al., p. 2021–2029; 2020); also in “Factors that contributed to undetected spread of the Ebola virus and impeded rapid containment” (WHO, 2017); and in “Ebola Outbreaks Public Health Emergencies in Fragile Conflicts Zones and Displaced Populations in Africa” (Oluwasogo, et al., p. 1-15, 2017). Collectively, all three investigators conclude, based on similar studies conducted in Sub Saharan Africa, that armed forces and terrorism don’t effect the distribution of communicable and infectious diseases (CID) directly but rather worsen outbreaks by disrupting health systems and impeding intervention. Additionally, investigators report that conflict weakens health infrastructure leading to prolonged and or increasing disease transmission along with population displacement. Furthermore, their findings suggest that restricted access by armed groups and distrust for governments fighting insurgencies along with misinformation further worsens the problem.

Cancer Morbidity and Mortality in Nigeria

Based on reports in “Population-based Cancer Registries” (Jedy-Agba, et al., P. 16., 2012) investigators explored the distribution of invasive cancers in Abuja and Ibadan concluding that in both males and females. Findings show that when aggregated for all ages, and sexual orientation, communicable neoplastic agents were implicated in two thirds of the top five cancer in both Ibadan and Abuja. Also, in “Insights Into the Rising Cases of Cancer in Nigeria (Rabiu, Isah, & Muhammad, p. 001-004, 2023), authors used findings from (HBCR) in Kano to report that (CC), (PC), and (BC) make up the top-three new cases and death resulting from cancers in Kano. Interestingly, investigators report rapid increases in mortality, along with new and old cases of (KS) in Northern Nigeria. Worth noting, 10 years prior, (CC) was not listed among the top-10 cancers in the area suggesting agreements with reports described in “Cancer Incidence in Nigeria: A Report from Population-based Cancer Registries” (Jedy-Agba, et al., p. e271–e278, 2012). Findings further suggesting that patterns of cancer distribution in (ABCR) is homogeneous with trends in Kano. This begs the question of why (CC) is increasing exponentially, as a top-five cancer in Nigeria? The answer may come from an earlier study in “Cervical cancer and sanitation components in the municipalities of the state of Mato Grosso do Sul: would it be a question of poor water quality?” (Silva, Machado, & Nunes, 2022); also in “Correlation of menstrual hygiene management with cervical intraepithelial neoplasia and cervical cancer” (Singh, Rajput, & Jaiswar, , p. 1., 2023). Here investigators suggest a link between poor sanitation and the communicable neoplastic agent, HPV strain that causes (CC). Interestingly, investigators point out that non invasive strain, over-time, mutates and adapts to the cancer accounting for the 10-15 year lag phase prior to detection of (CC) in females observed in Kano according to accounts reported in “Burden of cervical cancer in Northern Nigeria” (Akinfenwa & Monsur, 2018).

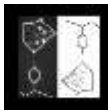
Furthermore, reports in “Burden of Cancer in Plateau State, Central Nigeria: A 27-Year Report from a Tertiary Hospital-Based Cancer Registry” (Mandong, et al., p.2 and 3; 2018)



investigators suggest that in tropical Africa infections such as HBV (hepatitis B virus), HCV (hepatitis C virus), *H. Pylori* (helicobacter pylori), HHV8 (human herpes virus 8), may occur at high rates due to limited sanitation and other environmental factors but also poverty. Additionally, in “Cancer distribution pattern in south-western Nigeria” (Awodele, Adeyomoye, Awodele, Fayankinnu, & Dolapo, 2011), and in “Incidence of cervical cancer in Calabar, Nigeria” (Ebughe, et al., 2016) collectively, investigators report similar findings. Also with respect to Communicable Neoplastic Agents and their distribution, reports in “Kaposi Sarcoma among HIV Infected Patients in Lagos University Teaching Hospital, Nigeria: A 14-Year Retrospective Clinicopathological Study” (Akinde, et al., 2016); also in “Current Status of Cancer Diagnosis and Treatment in Nigeria” (Ogunniyi, et al., 2025), and in “Diagnosis of cancer in the South and North of Nigeria: duration and causes of delay” (Fayehun, Apenteng, Umar, & et, al., 2025) collectively investigators show progressive associations between increases in HIV with limitations in resources and unemployment. With respect to Northern Nigeria, other investigators report in “AIDS-associated Kaposi's sarcoma in Sokoto, Nigeria” (Mbah, Abdulkareem, & Panti, p. 181-184, 2008); and in “AIDS-associated Kaposi's sarcoma in Northeastern Nigeria” (Kagu, Nggada, Garandawa, Askira, & Durosinmi, p. 1069-74., 2006), that (KS) was uncommon in (NW) Nigeria in 2008, and by pattern, effected both males and females since 2006. In conclusion, the the meta-analysis of current cancer burdens in Nigeria suggest an ongoing epidemiologic transition between the Northern and Southern geopolitical regions.

Limitations to Collecting and Reporting Data on Communicable Cancers in Nigeria

With respect to the Nigeria situation, At this time, as reported in **Table 3** and **Figure 3** significant portions of the Nigeria Cancer registry website was under construction. Accordingly, data used in this study was obtained primarily from published Nigeria Cancer Registry findings. Consequently, *post-test* and control data was limited to information collected between 2009 through 2016 and obtained from reports in “Cancer in Nigeria: 2009 – 2016 [Internet]. Nigeria: Nigerian National System of Cancer Registries” (FMH, 2021. Updates on Cancer Registration in Nigeria. 2021); also from reports made in “Nigeria National Cancer Registry” (FMHN, 2026). Currently, for the purposes of our study we report there are no HBCR or PBCR in the following Nigeria States: *Yobe, Taraba, Benue, Kebbi, Niger, Bauchi, Zamfara, Katsina, Jigawa*. Also, structurally, in Nigeria, data on cancer morbidity and mortality along with descriptions of its distribution are centrally provided by the Nigeria Cancer registry. Interestingly, except for *Ekiti* and *Ebonyi* states, which have a population-based cancer registry. At the time of this study most of the public data on cancer mortality and morbidity are hospital based. Furthermore, nearly all reporting cancer registries in Nigeria are single or multiple hospital based. For example, some of the largest cancer registries like the one in Lagos, Ibadan and Abuja consist of 2-3 hospitals reporting while other states have a single reporting entity. Finally, It's not uncommon for patients to migrate from smaller states to larger medical hubs for cancer treatment, thus consequently creating reporting bias. Nonetheless, in most cases the migration remains within their geopolitical regions.



Accordingly, when adjusted for population densities and per capita GDP-PPP all registries record as urban, cosmopolitan, and affluent (above Nigeria average) population with respect to socio-economic trends varying mainly by different ethnicities. That is, hospitals in Abuja, based on its geography attend patients mostly from (NC), (NW), and (NW). Also, Jos is a very strong (NC) hub, while patients in (SW) gravitate to *Lagos* or *Ibadan*; in the (SS) to *Benin*, *Port Harcourt*, *Calabar*, or *Yenagoa*; in (SE) *Enugu*; or *Akwa* but for the most part, due to higher population densities and shorter distances or native language barriers, it's not uncommon for patients in (SS) and (SE) to overlap jurisdictions; while at the same time, based on reports in "Insights Into the Rising Cases of Cancer in Nigeria" (Rabiu, Isah, & Muhammad, p. 001-004, 2023) there are no public cancer registries in (NW), and (NE).

Additionally, cancer data is principally reported by hospital-based registries located in *Kano*, *Maiduguri* and *Sokoto*. Also, patients in (NE) and (NW) utilize overlapping registries depending on the availability of specialists and costs. Consequently, for the purpose of this study, (SS-SE) and (NW-NE) have been sampled indistinguishably as a single unit. Additionally, some investigators point out that cancer registries situated in *Calabar* (SS), and *Ekiti* (SW) are some of the youngest in the country (established in 2012). Furthermore, While *Ibadan* remains the oldest cancer registry (established in the 1960s). Principally, all other registries were established between 1960 and 2017. Finally, demographically, cancer patients in Abuja consist predominantly of a mix between non-Christians and Moslems, and IDPs. This is significant because this study investigates impact diversity, behavior, fiscal, and public policies have on cancer distribution, and achieve this by comparatively analyzing uniform and overlapping trends and indicators associated with each variable found in each geopolitical zone. Also, by prioritizing the use of retroactive data (*Ex port*) this study was able to generate mortality forecast (*Ex Ante*) based on stochastic relationships, causalities and correlations between effects of politics on human behavior, and the impact that in turn has on communicable cancer distribution. (*bio indexing*).

In conclusion, with respect to communicable cancers, overwhelmingly authors report that married women with secondary school level education; between ages of 47-56; 27-36; 37-46; working in government and are in monogamous (opposed to polygamous) marriages in Kaduna were at the greatest risk for (CC). Also, given that cervical cancers develop from precancerous changes over 10-20 years of exposure, findings show initial exposures at ages between 7 and 17. Also authors also point out that (CC) prevalence was (6.5%), in Kaduna, and (6.0%) in Kano but way lower that (54.5%) in Maiduguri. The common agreement amongst investigators in Nigeria is that (CC) prevalence of abnormal smears in Northern Niger was significantly higher than those found in Spain (5.7%), and Southern Italy (3.1%). These findings suggest Nigeria still faces immense challenges in improving cancer diagnosis and treatment based on assessments made by (Ogunniyi, et al., Current Status of Cancer Diagnosis and Treatment in Nigeria., p. 1; 2025). Also, current immunization efforts against (CC) are not effective based on morbidity and mortality reports perhaps due to low qualities associated with its testing, treatments and overall health administration and are subject participation.

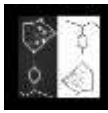


Figure 2. Summary of Meta Analysis showing Coupled Behavioral-Epidemiological Game Farmwork and Model developed from Regression and ANOVA Analysis

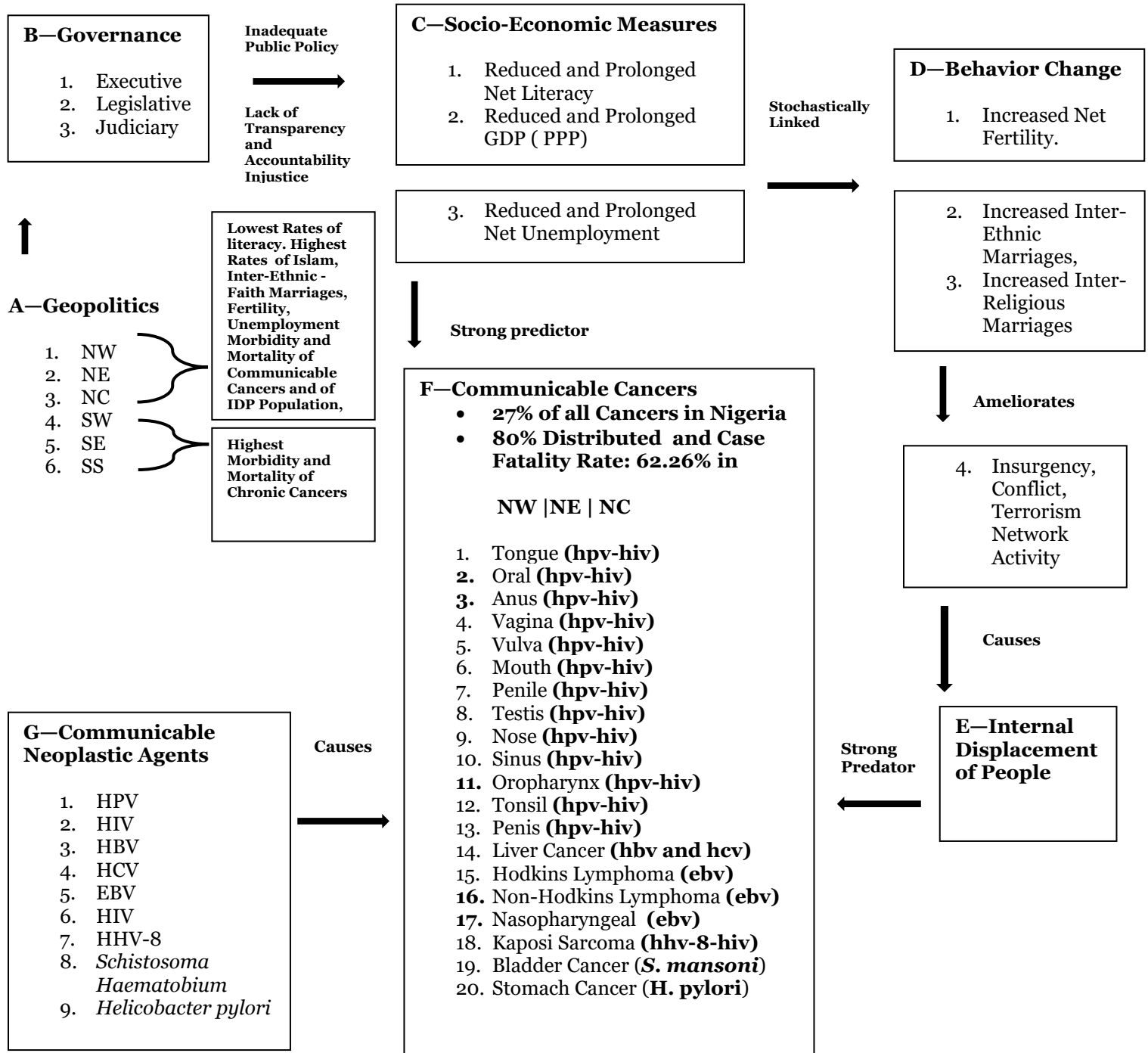



Table 2. Distribution and Burden of Communicable Cancers across Nigeria Geopolitical Zones

X ⁸ = Top Five Cancers by Region in Nigeria								
Cancer Type	Risk Factor	²Communicable Neoplastic Agent	Nigeria	Southern Nigeria		Federal Capital Territory and Central Nigeria	Northern Nigeria	
				[South -East]	[West]		[East]	[West]
Breast ¹	Lifestyle; Nutrition; Environmental Exposures; Genetics	N/A	X	X	X	X		X
Prostate²	Lifestyle; Nutrition; Environmental Exposures; Genetics	N/A	X	X 509 (23.2%)	X 416 (18.8%)	X 917 (41.9%)		X 349 (15.9%)
Cervical 3 Cancer (CC); to include Tongue/Oral; Anus; Vagina; Vulva; Mouth; Penile/Testis; Nose; Sinus; Oropharynx; Tonsil; Penis	Conflict; Population Displacement; Early Sexual Activity; Water Sanitation; Poverty	HPV; HIV coinfection	X	X 1,819 (9.6%)	X 1,818 (9.6%)	X 2,018 (10.6%)		X 13,358 (70.3%)
Non-Hodgkins Lymphoma⁴ (NHL) / Hodgkins Lymphoma (HL) /Nasopharyngeal Cancer (NC);	Conflict; Population Displacement; Sexual Activity; Poverty	EBV; HIV coinfection	X	X	X	X		X
Liver⁵	Environmental and Water Exposures to Hepatitis B & C, aflatoxins	Hepatitis B and C	X	X	X	X		X



Colorectal⁶ (CRC)	Lifestyle; Nutrition; Environmental Exposures; Genetics	<i>Fusobacterium nucleatum</i>	X	X	X	X	X
Stomach Cancer (SC)⁷	Conflict; Population Displacement;; Water Sanitation; Poverty	<i>Helicobacter pylori</i>	X	90 (15.5%)	91 (15.7)	249 (49.2%)	150 (26%)
Bladder Cancer (BC)⁸	Conflict; Population Displacement;; Water Sanitation; Poverty	<i>Schistosoma haematobium</i>	X	146 (6.6%)	37 (1.7%)	262 (11.8%)	1,779 (79.9%)
Kaposi Sarcoma (KS) and other unidentified Skin cancer⁹	Conflict; Population Displacement; Sexual Activity; Poverty	HHV-8; HIV coinfection	X	136 (7.4%)	224 (12.3%)	260 (14.2%)	1,472 (80.4%)

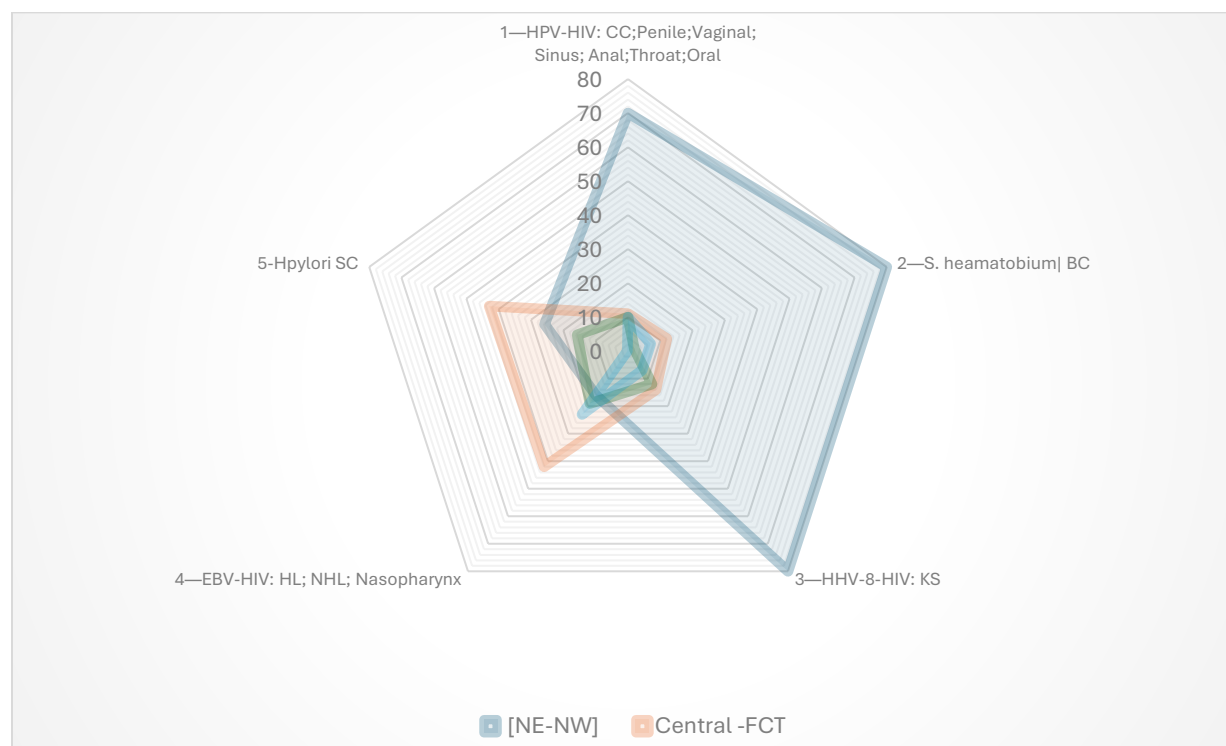
Notes:–

^{1,2,3,4,5:} Top Five Cancers in Nigeria according to (IARC, 2022); (Sung, et al., 2021) and (Ogunniyi, et al., 2025).

^{3,4,5,6,7,8,9} Findings from *Ex-post Data Source analyzed (2009-2024)* show cancers associated with CNA in Nigeria



Figure 3. Political-Shift Structured Game Model showing Epidemiologic Transition of Communicable Cancers across Nigeria Geopolitical Zones. ⁶



Notes:—

⁶ 3^D Model generated with Microsoft Excel, Version 2606. Microsoft Corporation. <https://www.microsoft.com>

^{1,2,3,4,5} *Ex post* data collected between (2009-2026) show approx.. 27% of all cancers in Nigeria are associated with CNA

^{1,2,3,4,5} *Ex post* data collected between (2009-2026) show approx.. 80% of all cancers in Nigeria associated with CNA are distributed in NW |NE|NC geopolitical zones

^{1,2,3,4,5} *Ex post* data collected between (2009-2026) show approx. 20% of all cancers in Nigeria associated with CNA are distributed in SW |SE| SS geopolitical zones

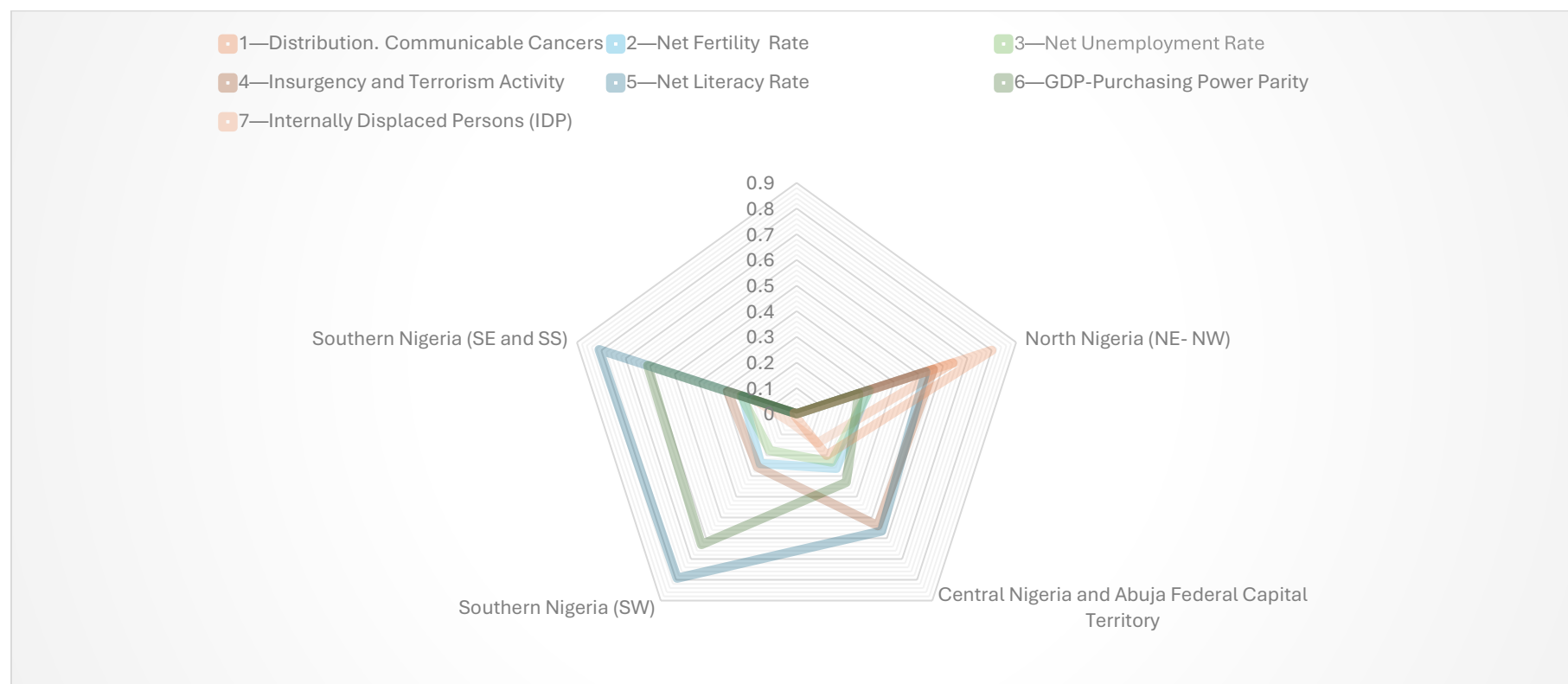
**Table 3.** Performance Measure of Socio-Economic and Behavioral Indicators associated with Political Shifts across Nigeria Geopolitical Zones between 2009 and 2024.

Socio-Economic Behavioral Indicators	Nigeria				
	Southern		Central and Federal Capital Territory	Northern	
	[SS	SE]		[NE	NW]
IDP (2009-2024) ¹	≤ 50,000		≤ 50,000	617,425	2,070,316
Rate Terrorism Activity Index (2009-2024) ²	28.6%		25.7%	53.9%	58%
Rate Religious Composition (2020) ³	2.7-Islam 95.4- Christian 1.9- Other		^A 47.1-Islam 51.9- Christian 1.0- Other	^B 47.1-Islam 51.9- Christian 1.0- Other	^C 94.9-Islam 4.5- Christian 0.6- Other
Rate Increase Per 1000 (2010-2018) Inter-Ethnic Marriages Inter-Religious Marriages ⁴	87/ 1.1		87/ 1.1	87/ 1.1	87/ 1.1
Net Unemployment Rate (2011) ⁵	22.7		17.7	23.3	29.9
Net Literacy Rate Per 100 (1990-2020) ⁶	80.9		79.2	56.5	53
GDP Per Capita PPP Per Year in (USD) (1990-2020) ⁷	6081.6		6312.8	3306.6	2555.3
Net Fertility Rate Per 100 (1990-2021) ⁸	21.7		24.0	26.3	29.4

Notes:—^{1,2,3,4,5,6,7,8} According to “Nigeria Demographic Statistics” (NBS, 2010-2022)



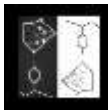
Figure 4. ⁸Coupled-Behavioral-Epidemiological Game Model Showing Stochastic Relationship between Political Shifts Behavior, Socio-Economic Measures (Endogenous Variables) and Communicable Cancer Distribution across Nigeria Geopolitical Zones.



Notes:—

⁸ 3^D Impact Model generated Microsoft Excel, Version 2606. Microsoft Corporation. <https://www.microsoft.com>

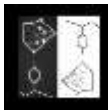
^{1,4,7,3,4,5} Statistically ($p \leq 0.05$). ($R^2 \geq 0.89$), *Ex post data collected between (2009-2026)* show Insurgency and Terrorism Activity, along with persistent and high IDP populations and low net unemployment rates in Nigeria geopolitical zones are high predictors of high distribution of cancers associated communicable neoplastic agents in NW|NE|NC Nigeria geopolitical zones

**Table 4.** Coupled Behavioral-Epidemiological Game (Framework)

Group	A	B
Nigeria Geopolitical Zone	NE NW NC	SW SE SS
Political Shift	(1). Majority Moslem. (2) Leaning Christian (3) Increasing Inter-Ethnic Inter-Religious Marriages. (4) Mid-High Teir Insurgency and Terrorism Activity	(1). Majority Christian. (2) Leaning Christian . (3) Increasing Inter-Ethnic Inter-Religious Marriages Ratio 1:1 (4) Mid-Low Teir Insurgency and Terrorism Activity
Statistical Predictors	(1) Prolonged (>7 Years): IDP > 2,687,741 population size. (2) Unemployment ≤ 26.3 Per Year	(1) IDP ≤ 100,000 population size. (2) Unemployment ≥ 20.2 Per Year
Communicable Cancer ¹ Burden in Geopolitical Zone	0.8 (80%)	0.2 (80%)
Ratio Communicable Cancer ¹ to Top 5 Cancers: Cancers Associated with Communicable Cancers In Geopolitical Zone	0.27 (27%)	0.27 (27%)

Notes:—

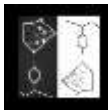
¹**Technically, Cancers are not contagious.** The term communicable cancer generalizes cancers caused by communicable neoplastic agents which intern refer to viruses, bacteria, and parasites that are known to cause cancers. This study suggests controlling their distribution can control outcomes associated with cancers they cause.



Forecasting Communicable Cancer Mortality in Nigeria

As described in **Figure 6**. Here, it is reported that statistically, strongest predictors for distribution of epidemiological transition of communicable cancers in Nigeria are population and duration of IDP, combined with unemployment. Accordingly, due to limitations to collecting and reporting data on communicable cancers in Nigeria, This study adopted a *pretest (Ex Port)* and *posttest (Ex Ante)* approach by analyzing information on mortality from communicable cancers associated with CNA in Group A— conflict associated and Group B—conflict free geopolitical zones in Nigeria between 2009-2022 (control population). Specifically, the following cancers (CC), (LC), (KC), (SC), (BC), (NHL), (HL) and (NC) were analyzed to determine their mortality a study control (*Ex Port*) to make predict forecast (Ex Ante) using ANOVA and Regression statistics based on coupled behavioral-epidemiologic frameworks reported in **Table 4**. And **Figure 3**. Using techniques earlier described by (Olisa N. , Cross-Sectional In Silico Analysis of Covid-19 Pandemic, 2020); (Olisa N. , Biological Agents Index: Quality Management of Infectious Disease Intervention Programs, 2008). Furthermore, in this study, the archive projection, following general and cancer specific assumptions will apply when establishing stochastic relationships during the creation of ccoupled behavioral-epidemiological game framework.

1. No institutional intervention,
2. Existence of interventions and mitigations with limited impact,
3. Low quality healthcare (treatment and diagnosis),
4. Unsafe work environments,
5. Existence of limited or poor public utilities infrastructure,
6. With respect to (KS). Reports in “Kaposi's sarcoma in Nigeria” (Onunu, et al., p.264-7, 2007) investigators suggest that (KS) maybe under, or miss reported as (NMSC) due to overlapping clinical presentations and diagnostic limitations suggesting that 70% of cancer pateints in Nigeria may face some form of misdiagnosis during their care.
7. With respect to (CC), several reports in “Cervical cancer survival in a resource-limited setting-North Central Nigeria” (Musa, et al., 2016); and in “Cervical cancer prevention and control in Nigeria: mapping and review of policies” (Okolie, Beek, Patel, Ndikom, & Joshi, 2025); also in “Cancer in Kano, Northwestern Nigeria: A 10-year update of the kano cancer registry” (Yusuf I, *etl al.*, p 81-93, 2017). Finally, in “Prevalence of Squamous Intraepithelial Lesion among Women in Kaduna State, Nigeria” (Magaji, et al., p-94-98, 2017) authors collectively point out that 80% of worldwide deaths from cervical cancer come from sub-Saharan Africa. Also, of the authors suggest that in Nigeria there are 14000-20000 new cases yearly with 9659 deaths yearly and with 26 women dying daily.
8. With respect to all cancers, to begin with, according to (IARC, 2022); and in “Global cancer statistics” (Sung, et al 2020) GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries in 2021 and determined top five cancer in Nigeria are breast, prostate, cervix, colorectum and NHL. Additionally, reports show, in the top five cancers in Nigeria, two are associated with CNA. Furthermore, in “Current Status of Cancer Diagnosis and Treatment in Nigeria” (Ogunniyi, et al.,2025) and (FMH, Cancer in Nigeria: 2009 – 2016 [Internet]. Nigeria: Nigerian National System of Cancer



Registries; 2021. Updates on Cancer Registration in Nigeria., 2021) investigators conclude that breast, prostate, cervical , colorectal and NHL remain the top 5 cancers in Nigeria. Finally, suggest colorectal cancers share the top five spots depending on geopolitical region. See (Sung, et al., 2021). In either case *Fusobacterium nucleatum* and Colorectal Cancer” (Li, Shen, & Xu, , p. 1115, 2022) were investigators argue that *Fusobacterium nucleatum*, an oral anaerobic gram-negative bacillus can colonize into the colon tissues through bloodstream infection. Also, they have been found to be involved in both the occurrence and metastasis of colorectal cancer (CRC) through regulating immune response, virulence factor, oncogenic microRNAs, intestinal metabolites, DNA damage and other mechanisms begging the question. Why isnt colorectal cancer a top five cancer in Nigeria? Until this question is answered, here we assume *Fusobacterium nucleatum* to be a risk factor in CRC. Accordingly, colecttral cancer for the purpose iof this study will not be characterizes a communicable Cancer nor will will this study assume it has a communicable neoplastic agent.

Predictive Modeling and Lenear Regression Analysis

To begin with, **Figure 3 and 4.** Displays an impact model based on posttest (*Ex post*) (2009-2024) data (control population) showing effects political shifts have on socio-economic measures in different Nigeria geopolitical regions. Specifically, model was determined mathematically, based on the methodology described in “Cross-Sectional In Silico Analysis of Covid-19 Pandemic” (Olisa N. 2020); and “Biological Agents Index: Quality Management of Infectious Disease Intervention Programs” (Olisa N, 2008) with respect to relationships of variables studied. Stochastically, we find that if:

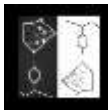
Group	Conflict / Insurgency Lethality (CIL) Score ¹	Geopolitical Zone
A	> 0.5 (50%)	(NW); (NE), (NC)
B	< 0.3 (30%)	(SW), (SE), (SS)

And if:

X = Public or Fiscal Policy Performance Measure. (Independent, Predictor Variable)
Y= Distribution of Communicable Cancers (Dependent, Outcome. Variable)

Where:

Y₁ = Cervical Cancer (CC) caused by Human Papilloma Virus (HPV)
Y₂ = Liver Cancer (LC) caused by Hepatitis B and C
Y₃ = Hodkins Lymphoma (HL) OR Non-Hodgkins Lymphoma (NHL) caused by Espin-Barr Virus (EBV)
Y₄ = Kaposi Sarcoma (KS) caused by HIV associated with Herpes Simplex Virus-8
Y₅ = Bladder (BC) caused by *Schistosoma haematobium*



Y_6 = Stomach (SC) caused by *Helicobacter pylori*

Also, Where:

X_1 =Net Fertility.

X_2 =Frequency of Internally Displaced People,

X_3 =Rate Terrorism Activity ,

X_4 =Rate Net Unemployment

X_5 =Rate Inter-Ethnic Marriages,

X_6 =Rate Inter-Religious Marriages,

X_7 =Rate Net Literacy,

X_8 =Rate GDP per capita PPP

X^9 =Rate Communicable Cancers

Statistically, it follows that:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

Then:

β (outbreak constant) = Governance. Defined by impact of fiscal or public policy. Quality of β will determine predictability and magnitude intervention outcomes.

Also:

ϵ (error term) = Defined by proclivities associated with conflict mitigation and healthcare implementation process. Higher the productivity, quality and safety associated with the process, the lower the error term.

Accordingly:

$$\beta_3 X_3 = \beta_0 + 1/\beta_4 X_4 + 1/\beta_5 X_5 + 1/\beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \epsilon$$

Therefore, the final regression equation (best fit) adopted by our models is :

$$Y = \alpha + \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_4 X_4 + \beta_5(X^{-1}_5) + \beta_6(X^{-1}_6) + \beta_7(X^{-1}_7) + \beta_8(X^{-1}_8) + \epsilon$$

(1)..... Calculating Prevalence of Cancer Associated with Communicable Neoplastic Agents (communicable cancers) in Nigeria

Cancer² Prevalence (C_{2016 All Cancers}): 17,000

Cancer⁴ Prevalence (2016 CNA) = 4,590

Cancer⁴ Prevalence (2016 CNA-GroupA) = 3,672

Cancer⁴ Prevalence (2016 CNA-GroupB) = 918

Also,

Cancer³ Prevalence (C_{2022 All Cancers}): 127,763

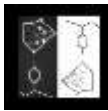
Cancer⁴ Prevalence³ (2022 CNA) = 34,496

Cancer⁴ Prevalence³ (2022 CNA-GroupA) = 27,597

Cancer⁴ Prevalence³ (2022 CNA-GroupB) = 6,899

Additionally,

Initial Case Increase (2016-2022) = 110,763



Time Passed 2022-2016 = 6 years

Annual Growth Rate: $(110,763 / 6) = 18,460.5$ cases per year

Furthermore,

Remaining years: 2040-2022 = 18 years

Total Leaner Growth: $184,60.5 \times 18 = 332,289$ cases

2040 projection : $127,763 + 332,289 = 460,052$

Accordingly,

Cancer⁴ Prevalence (C₂₀₄₀ All Cancers): 460,050

Cancer⁴ Prevalence³ (2040 CNA) = 124,215

Cancer⁴ Prevalence³ (2040 CNA-GroupA) = 99,372

Cancer⁴ Prevalence³ (2040 CNA-GroupB) = 24,843

(2)Calculating Mortality from cancers associated with communicable neoplastic agents (communicable cancers) in Nigeria.

Cancer³ Mortality (C₂₀₁₆ All Cancers): 9,569

Cancer⁴ Mortality (2016 CNA) = 2,608

Cancer⁴ Mortality (2016 CNA-GroupA) = 2,086

Cancer⁴ Mortality (2016 CNA-GroupB) = 522

Additionally,

Cancer³ Mortality (C₂₀₂₂ All Cancers): 79,542

Cancer⁴ Mortality (2022 CNA) = 21,476

Cancer⁴ Mortality (2022 CNA-GroupA) = 17,181

Cancer⁴ Mortality (2022 CNA-GroupB) = 4,295

Furthermore,

Total Increase: (2016 to 2022) = $79,542 - 9,569 = 69,883$ deaths

Annual Increase: (Slope) $69,883 / 6 \text{ years} = 11,647.17$

Remain Years to 2040: 2040-2022 = 18 years

Linear Projection; $79,542 + (11,647.17 \times 18) =$

Therefore,

Cancer⁴ Mortality (C₂₀₄₀ All Cancers): 289,191

Cancer⁴ Prevalence³ (2040 CNA) = 78,082

Cancer⁴ Prevalence³ (2040 CNA-GroupA) = 62,465

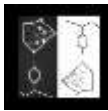
Cancer⁴ Prevalence³ (2040 CNA-GroupB) = 16,615

(3).....Calculating Case Fatality Rates

CFR (%) = $[\text{Total Death} / \text{Total Cases}] \times 100$

Therefore Since,

Prevalence (CNA 2016) = 17,000



And,

$$\begin{aligned} \text{Mortality}_{(CNA\ 2016)} &= 9,659 \\ 9659/17000 \times 100 &= \text{CFR}_{(2016)} = 56.82\% \end{aligned}$$

Additionally,

$$\begin{aligned} \text{Prevalence}_{(CNA\ 2022)} &= 127,763 \\ \text{Mortality}_{(CNA\ 2016)} &= 79542 \\ 79542/127763 \times 100 &= \text{CFR}_{(2022)} = 62.26\% \end{aligned}$$

Furthermore,

$$\begin{aligned} \text{Prevalence}_{(CNA\ 2040)} &= 460,052 \\ \text{Mortality}_{(CNA\ 2016)} &= 28,9191 \\ 289191/460052 \times 100 &= \text{CFR}_{(2040)} = 62.86\% \end{aligned}$$

Notes:—

¹ See Table 3 and 4. and reports in (Corradi, Felmlee, & Gartner, 2025)

² According to Yusuf I, Ochicha, & Haruna, p. 88 and 89., (2017) and (Magaji, et al., p. 94, 95, and 96., (2017)

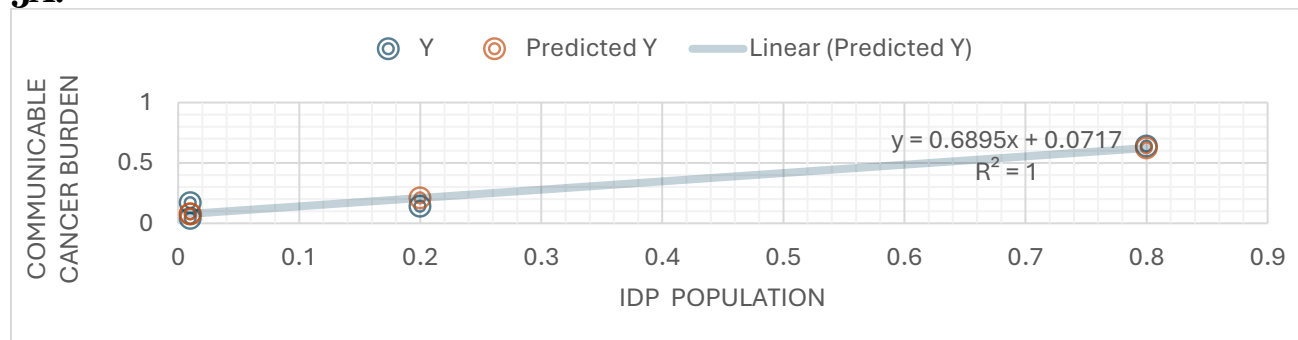
³ According to (IARC, 2022); Sung, et al., (2021) and Ogunniyi, et al., p. 4., (2025)

⁴ See Findings reported in **Figure 3**. Results in this critical review show approximately 27% of all new cancers in Nigeria are CNA. Also 80% CNA cancers occur in conflict zones; while approximately 20% occur in conflict-free zones.



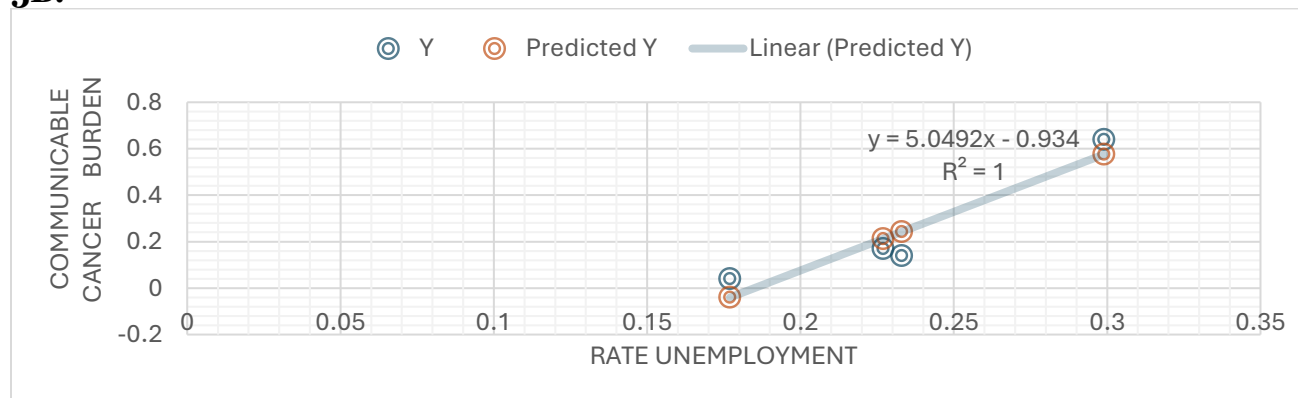
Figure 5. Regression^{1, 2} and ANOVA Analysis showing combined and persisting clusters of (A) IDP geospatial distribution and (B) Rate Unemployment are best socio-economic predictors for Epidemiological Transition of Communicable Cancers in Sub-Saharan Africa.

5A.



$R^2 = 0.93$
Adjusted $R^2 = 0.895$
Standard Error = 0.086
Significant F = 0.035
X variable t Statistic = 5.1
 $P < 0.05$
Graph Scale = 0.1 : 2,000,0000

5B.



$R^2 = 0.89$
Adjusted $R^2 = 0.840$
Standard Error = 0.107
Significant F = 0.054
X variable t Statistic = 4.1
 $P < 0.05$
Graph Scale = 0.1 : 1000

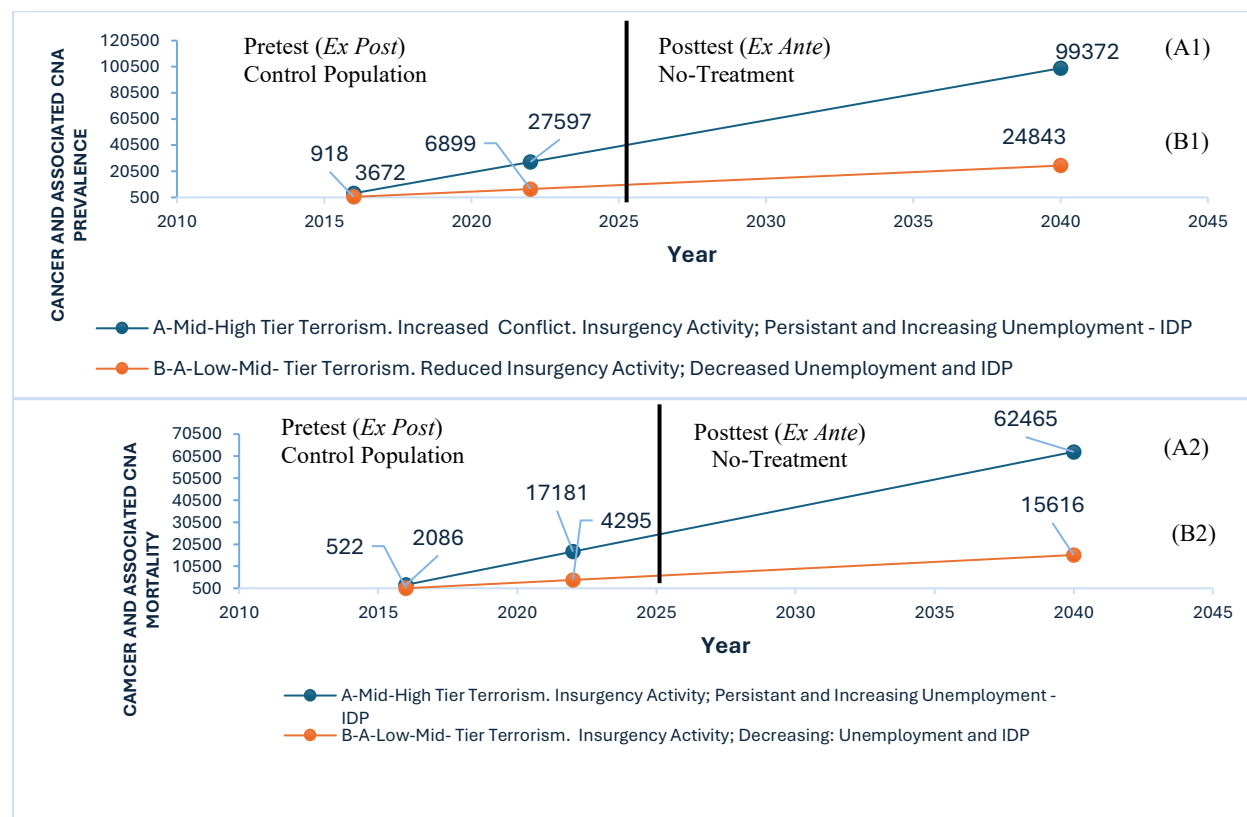
Notes:—

¹Statistical Analysis performed with Regression ToolPak. Version 2606 (2026). Microsoft Corporation. <https://www.microsoft.com>

² See Table 2 and 3 and Figure for explanations. Also see *Predictive Modeling and Linear Regression Analysis* in Results and Discussions: Impact Modeling, Meta and Statistical Analysis for statistical and mathematical explanations.



Figure 6. Coupled Behavioral-Epidemiological Game-Theoretical Model ^{1, 2, 3, 4} for CNA-Cancer Prevalence and Mortality in Nigeria Geopolitical Zones: Showing Four-Group⁵ Pre-Test (*Ex post*) control and No-Treatment Populations; and Post-Test (*Ex Ante*) Control and No-Treatment Populations.



Notes:—

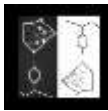
¹Statistical Analysis performed with Regression ToolPak. Version 2606 (2026) Microsoft Corporation. <https://www.microsoft.com>.

² See **Table 4** and **Figure 4**. For Impact Modeling. Also See Modeling and Linear Analysis section for Predictive Modeling Calculations

³Without productive intervention, in 2040, in Northern Nigeria, communicable cancer mortality is projected at approx. 62,456 people (up from 17,181 in 2022)

⁴Between 2015 and 2022, there has been 24,843 New and old cases of communicable cancer in Northern Nigeria. Number is projected to 99,372 by 2040 without productive intervention.

⁵ Descriptively, Groups: (A1) and (A2): NW | NE | NC: CIL= >5.0 also, and Groups: (B1) and (B2): SW | SS | SE: CIL= <3.0

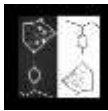


Conclusion

To begin with findings here show in Nigeria, cancers associated with communicable neoplastic agents (communicable cancers) are going through epidemiologic transition. Additionally findings show while communicable cancers make up 27% of all cancers, approximately 80% of the epidemiologic transition or distribution of communicable cancers (resulting outcome) occur in areas experiencing ongoing conflict and insurgencies (vital few variable). Furthermore, characteristically, while conflicts and insurgencies occur throughout Nigeria in all geopolitical zones, results show a minority of socio-economic performance measures can be used to predict distribution of communicable cancer transitions based on quality of governance (macro trigger) in Nigeria. Specifically, net unemployment rate; along with the size, and persistence of internally displaced people, are the best predictor for communities with highest risk for communicable cancers. Finally, overwhelmingly, disproportionate burden of the following communicable cancers: Cervical, NHL, HL, KS, Liver, Bladder, and Stomach in Northern Nigeria are associated with associated communal neoplastic agents HPV, EBV, HHV-8 in Northern and Central Nigeria has been in the making over long time and linked to lack of implementation of adequate public and fiscal policies (unmeasurable variables) leading to conflicts and insurgencies (macro trigger) which have resulted in significant individual persons displacement. Consequently, our findings suggest the dominant driver in our observations (unemployment and IDP) is poor governance which over time have resulted in environmental and socio-economic conditions like poverty, over crowding, lack of healthcare access, inadequate public utilities, water works, hospitals that have indirectly contributed to cancer burden.

Without Productive Intervention, Mortality from Communicable Cancers will get much worse

In conclusion. Top five cancers in the Northern part of Nigeria are breast, cervical, Kaposi Sarcoma and prostate Jedy-Aba et al p. 5; 7, and 16., (2012); Yusufu et al p. 88, and 89 (2017); and Magagi et al p. 94, 95 and 96 (2017). Also, According to Oguniyi et al p. 2 (2025); and Rabiou et al p. 2 (2023) colon cancer is also a major problem in some mainly Southern and North Central regions. To further support these conclusions, using (PBCR) data, in “Insights Into the Rising Cases of Cancer in Nigeria” (Rabiou, Isah, & Muhammad, p. 001-004, 2023) explored, and reported on how low literacy, absence of cancer registries and poverty all contribute to increases in cancer in (NW) and (NE) Nigeria. Also, according to infectious disease and oncology experts in “Contagious Cancers” (Welsh, 2011); and “Gordon Wilson Lecture: Infectious Disease Causes of Cancer: Opportunities for Prevention and Treatment” (Howley, 2015) investigators report that approximately 20% of cancers are caused by infectious or communicable neoplastic agents. In agreement with these findings, here this study has determined that activities like terrorism and conflicts along with natural disasters leading to IDP poses the greatest threat to distribution of communicable cancers based on outcomes of ANOVA and regression analysis. Also, to address these problems, sociology scholars have reported that inter-ethnic and inter-faith marriages, long term, may have the strongest reversal effect and impact on conflicts and insurgencies in Nigeria. At the same time other investigators



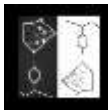
have determined that to address high cancer mortality rates, intervention programs should aim to increase GDP-PPP, while at the same time reduce unproductive revenue losses. Finally, **Figure 6.** summarizes the finding in impact model forecast. *Results show over-three fold increases in both new and old cases (prevalence) as well as in mortality are projected from 2022 to 2040 with respect to communicable cancers in Nigeria geopolitical zones experiencing lethal conflict and insurgency outcomes (CIL score >5.0).*

Problems

According to Africa Health Security and Severity (AHSS) Agenda: Africa's public utility infrastructure is below international standards in terms of quality, and the maintenance of quality. Consequently absence of these systems are detrimental to economic development and, when combined with limitations in antitrust, intellectual property and property laws; will severely compromise Africa's health security and sovereignty in addition to restricting its private sector investment.

To begin with, in "Capture and corruption in public utilities: The cases of water and electricity in Sub-Saharan Africa" (Auriol & Blanc, 2009) and "The impact of public infrastructure investment on South Africa's economy: evidence from social accounting matrix and computable general equilibrium-based approaches" (Mbanda & Bonga-Bonga, 2024) authors concluded that increase in public economic infrastructure could help address the unemployment problem that exacerbates poverty in South Africa. This is significant because indirectly, poverty is tied to healthcare access, as well as to safety, and high ability to afford quality treatment and detection with respect to precision, and accuracy in instrumentation and devices. Accordingly, availability of high quality public utility infrastructures are prerequisite to attracting private sector financing. Additionally, in "Does infrastructure really explain economic growth in Sub-Saharan Africa?" (Kodongo & Ojah, 2016,) authors suggest that poor infrastructure along, with quality, diminished economic growth indirectly. Also in "Effect of Infrastructure and Foreign Direct Investment on Economic Growth in Sub-Saharan Africa" (Nketiah-Amponsah & Sarpong, 2019) authors argue that governments in Africa should significantly improve infrastructure to attract and maximize impacts of foreign direct investments in ways that spur economic growth.

Furthermore, more importantly, some reports in "Adoption of Antitrust Laws in Developing Countries: Reasons and Challenges" (Waked, 2016) and in "The Effectiveness of Proposed Antitrust Programs for Developing Countries" (Rodriguez & Williams, 2017) make distinctions between antitrust violations in developed and developing countries and recommend that countries in Africa adopt antitrust laws to prevent government officials in Africa, and other elites from monopolizing means of production in ways that are detrimental to the overall economy. In conclusion, collectively majority of findings reported by most scholars specializing on impacts of infrastructure and consumer laws have on healthcare quality suggesting that besides "crowds-in" investments, institutional quality without intellectual property rights, and anti-trust laws fail to attract capital in developing and fragile economies. Also, they stress the importance for governments to create enabling environments. Also, in "Private Sector Investment in

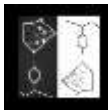


Infrastructure in Sub-Saharan Africa Post-COVID-19: The Role of Law” (Edobor, 2022), author concluded, based on the covid-19 pandemic, that legal protection was probably the most enabling factor for attracting private investment.

According to Nigeria National Cancer Control Plan and Cancer Control Agenda : Future Qualitative Studies are Needed to determine robust policy that address conflict and its impact on healthcare access. Additionally, to achieve AHSS, high quality and safe public utility infrastructure must be instituted to attract FDI investors along with the institution of precision and accuracy with respect to treatments and cancer detection.

To begin with in “Infrastructure in Africa” (Bond, 2017) and in “ Infrastructure, Economic Growth and Poverty Reduction in Africa” (Jerome, 2012), collectively, investigators suggest the quality and state of safety of infrastructure is critical for economic development programs aimed at increasing GDP. Additionally, research in Nigeria and South Africa show that energy infrastructure not only attracts FDI but result in cost efficiencies needed to operate quality healthcare. See (Nketiah-Amponsah & Sarpong, 2019). Additionally, other studies in Kenya and Ethiopia suggest improvements in mass transportation ease healthcare access in rural areas. See (Kodongo & Ojah, 2016). Furthermore, in “Nigeria National Cancer Control Plan” See. (NFMH, p. 1-67, 2018-2022) and in “Implementing Nigeria National Cancer Control Plan and Cancer Control Agenda” (MI, , 2024) authors describe National Strategic Center Control Plan (p. 2023-2027) launched by National Institute for Cancer Research and Treatment (NICRAT) to improve diagnosis and treatment access in six geopolitical zones in Nigeria but interestingly reports fail address impact conflicts and insurgencies have to cancer control, prevention and mitigation. See. (FMH, Nigeria National Cancer Control Plan, 2023-2027). Finally, Nigeria Federal Ministry of Health in 2023 launched a massive campaign in 2023 to vaccinate over 12 million girls against HPV, the virus that causes cervical cancer without contingencies to mitigate factors that may limit access of manpower and supplies. Also, not surprising, since the implementation of this mass vaccination. Morbidity and mortality for cervical cancer have been on the increase suggesting there are major issues with implementation of public health policies in healthcare administration perhaps exacerbated by poor public utility infrastructure, consumer laws and public safety.

In conclusion, Nigeria Cancer Health Fund (CHF) provided up to \$1500 USD for indigent patients to cover chemotherapy and radiation (Ogunniyi, et al., 2025) without plans in place to mitigate limiting public security factors and their contingencies. According to (Olisa N, 2008), impact of mitigations to confront outcome of proliferation of infectious disease in underdeveloped communities depend on services and activities (or their lack of) in areas such as conflict, agriculture, and manufacturing. In other words, deprive a community of peace, high standards of living, and or food, and you will most likely inflict or increase the prevalence of infectious disease. Also, outcome (infectious disease) and activities, like health promotion, are



related (linearly and exponentially) to traditional activities and services that eradicate infectious disease.

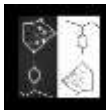
Recommendations

According to Africa Health Security and Severity (AHSS) Agenda: Future Qualitative Studies are Needed to determine robust policy that address conflict and its impact on health quality and safety with respect to precision and accuracy of healthcare access, treatments, detection.

To begin with, according to Africa CDC in “Africa’s Health Security and Sovereignty agenda: a new way forward” (Kayesa, 2025); in five pillars, issued a robust vision a call for action of its goal to obtain financing for use to improve health security and sovereignty by developing its domestic workforce and striking new partnerships. Summarily, the call is to shift into New Public Health Order (NPHO) characterized by 70% decrease in health aid for Africa since 2021. Consequently, according to the Africa CDC, as reported by Regional Surveillance and Outbreak Network (RISLNET), outbreaks in Africa has surged by 70% due to decreases in GDP but in part as a result of increases in regional conflict. Exacerbating the problem, Africa, with a population of approximately 1.5 billion, imports 90% of its health commodities. Finally, through its Incident Management Support Team (IMST) Africa CDC proposes to sustainably finance its management of epidemics through the Africa Epidemic Fund (AEF) while obtaining domestic innovation from public and private sectors. Descriptively, through this arrangement, 50% Africa health security is proposed to be derived from member states national budgets and the rest from community based support within Africa. Also, to achieve these goals, the objectives are for Africa to consolidate demand, regulation and to pool purchasing to make manufacturers viable and sustainable. Also, to embrace digital transformation for efficiency and productivity and to encourage local manufacturing through the Africa Medicines Agency (AMA) aiming for 60% vaccines development by 2040 with pledged financing assistance from Vaccine manufacturing accelerator teams in Europe, Afreximbank, and Africa Development Bank.

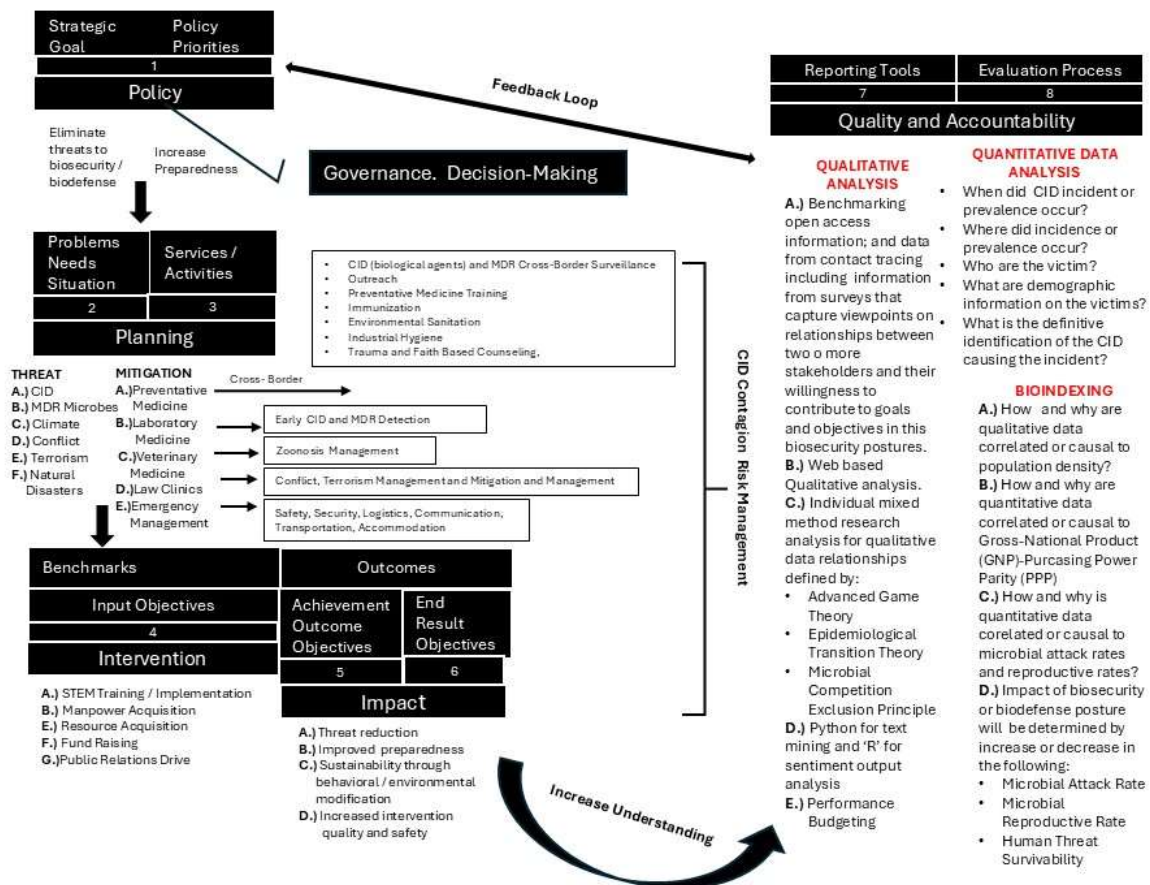
Additionally, the agenda identifies five challenges. Financing gaps; heavy reliance on domestic aid; limited local manufacturing capacity for medicines, diagnostics and government vulnerabilities like fraud, ghost workers, mistrust along with misinformation and ambiguities in intellectual property laws. Also, to remedy these problems, Africa (CDC) calls for strong political commitment, increased innovation undoing strategies, secondary public finance and management, the launching of accountability frameworks use of Starlink Corporation to ensure connectivity across health systems in Africa and the lobbying of activities to AHSS. See Figure 4. on features for postures that mitigate geopolitical, environmental, and socioeconomic threats to the delivery of safe, productive and high-quality healthcare. Also, one way to secure safety, increase delivery turnaround times (TAT), while achieving healthcare quality in hostile environments is the use of artificial intelligence and automation.

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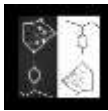


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Figure 6. Posture for Sustainable Biosecurity and Biodefense Preparedness



Finally, while implementation of primary healthcare provision has been very effective in most developing communities, its impact has been slow to develop. To remedy this problem, fiscal policies, embedded in macroeconomics, and applications with foundations in game theories, and New Public Management can be used to boost community outreach towards embracing information technology, and biotechnology, while attempting to reduce infectious disease and



increase food supply. See **Figure 6** for an outline of posture for sustainable biosecurity and biodefense preparedness. Additionally, with respect to conflict, democracies rarely go to war with others.

In conclusion, according to (Olisa N. , Biological Agents Index: Quality Management of Infectious Disease Intervention Programs, 2008), economic development as a macro-trigger, is extremely cost-efficient way to reduce the occurrence of infectious disease, conflict, and hunger. Also, implementation turn-around times (TAT)—can be a major and key laboratory efficiency and productivity monitor. Currently, molecular assays provide less complications and challenges for automation. However, necessitated bacterial cultures and plate reading are more challenging processes. Accordingly, improve (TAT), **Figures 7, 8, 9, and 10** recommend machine learning models for detection of key bacterial infections in the clinical diagnostic laboratory.

Role of Machine Learning and Artificial Intelligence.

To begin with it's nearly impossible to eliminate bacterial plate reading and the speciation information it generates with respect to Microbial Drug Resistance (MDR), and Antimicrobial Drug Resistance (AMR). First step to correctly read (identify) and interpret bacterial culture plates starts with properly collecting (using the right material), storing (adopting optimal temperature and timely refrigeration) and then transporting patient micro bacterial samples from the home, clinic and, or hospital to the laboratory for proper labeling and collection. Second step, which is also extremely important, is proper streaking for isolation and or confluent growth on proper selection and or identification media to optimize identification. Finally, the performer would have to adopt different criteria in reading the plates depending on the human source (body site or fluid) from which the sample is collected. This is important for the following reasons:

- Host parasite relationships exist between different human organs and tissues. The nature of this relationship dictates that some organisms are normal flora on some sites of the body but can become pathogenic if the migrate to other sites.
- Some environmental (or community acquires) pathogens can cause pathology regardless of tissues the encounter.
- Opportunistic pathogens can cause pathology when underlying disease persists.

Clearly, due to its complexity, a more productive and safer alternative to plate reading is automation and (AI). Additionally, without this tool, the performer needs to be familiar and experienced with diagnostic microbiology to read and interpret microbiology plates **Figures 7, 8, 9, and 10** for recommended machine learning modules that can ably assist in achieving Total Laboratory Quality Management and Safety.



Figure 7. Machine Learning Module: Wound (Routine); Stool and Blood Microbial Culture Reading

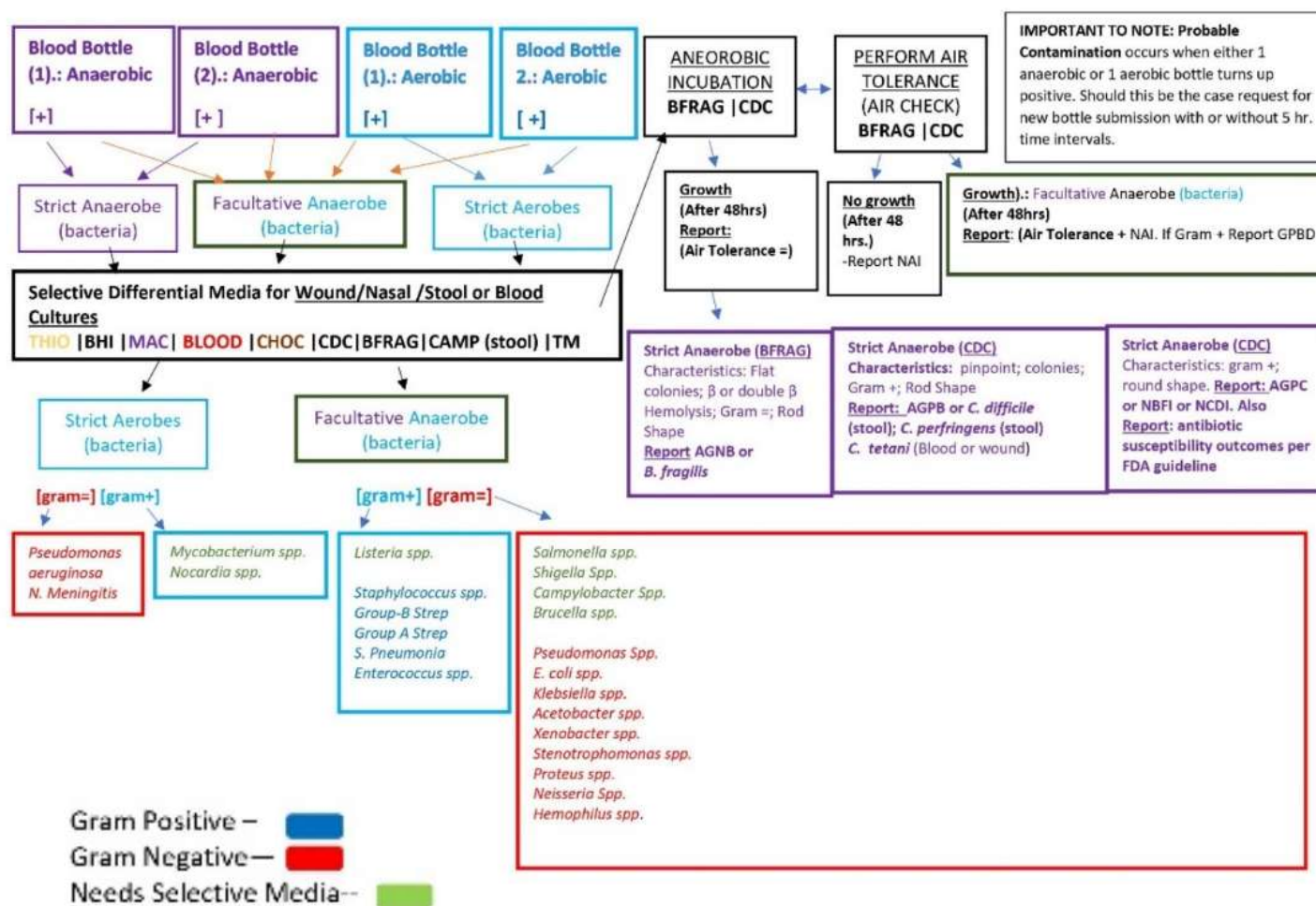




Figure 8. Machine Learning Module: Upper and Lower Respiratory Microbial Growth Culture Reading.

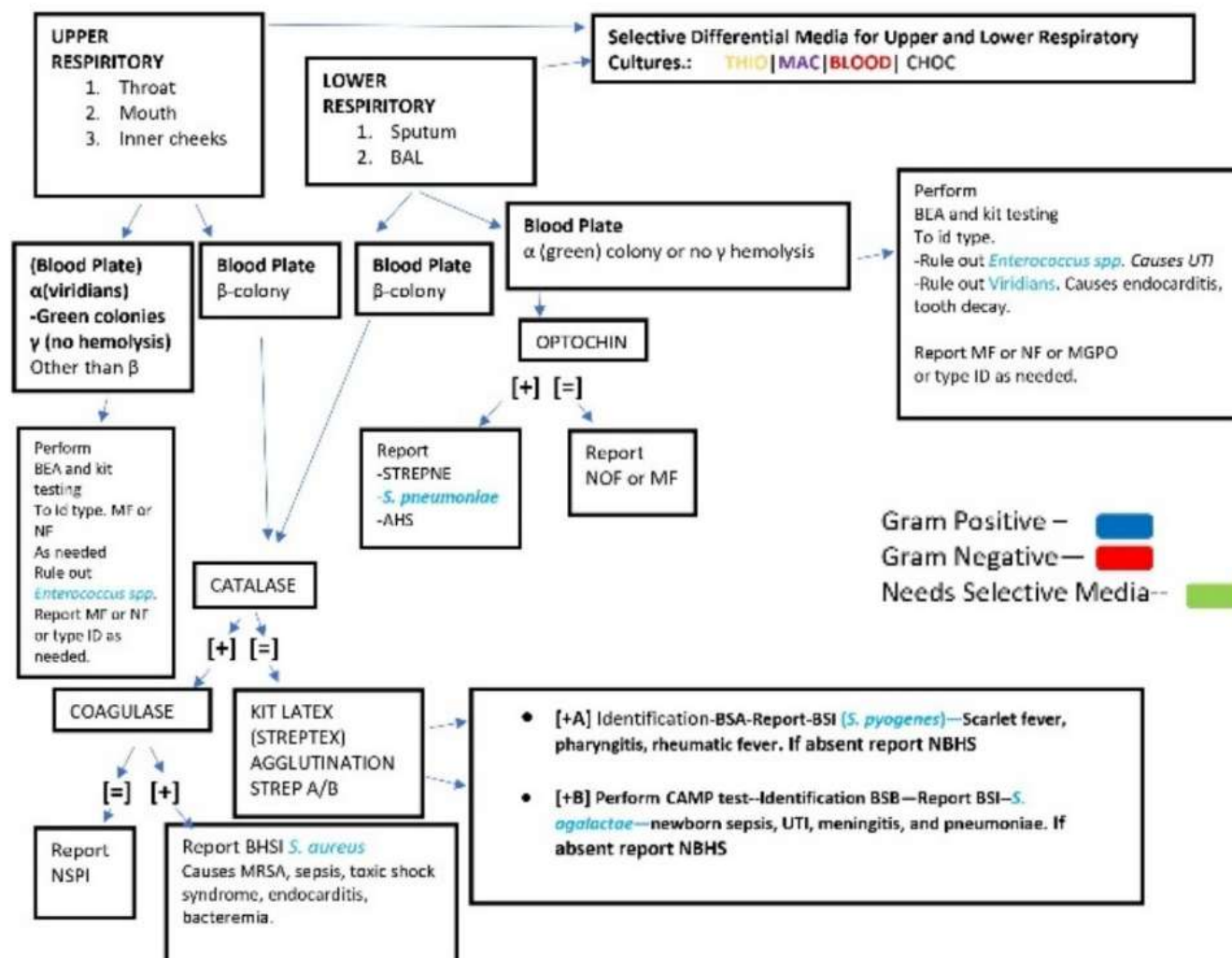




Figure 9. Machine Learning Module: Urine Microbial Growth Culture Reading.

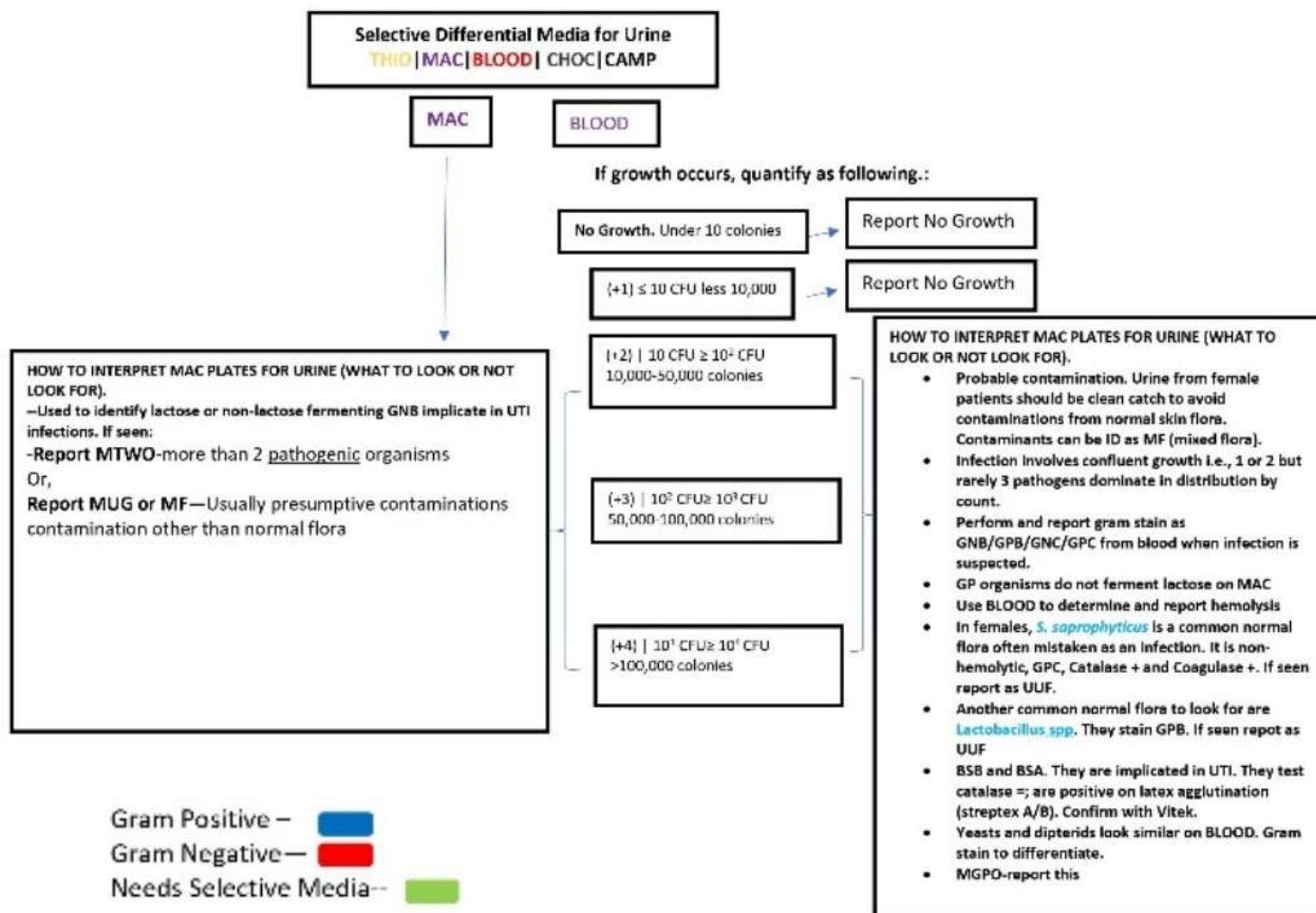
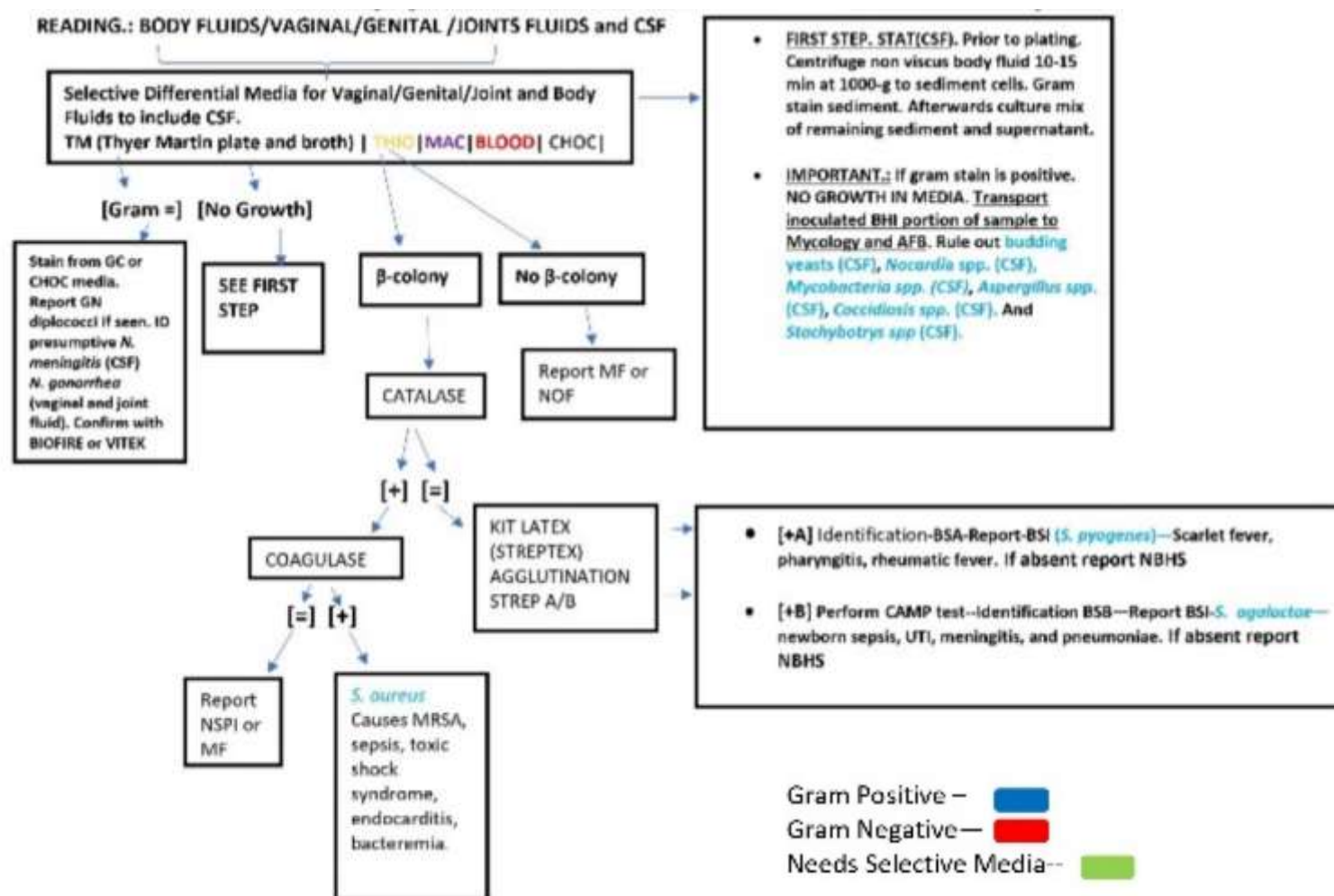
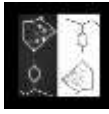




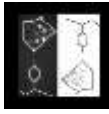
Figure 10. Machine Learning Module: Body Fluids, Vaginal, Genital, Joint Fluids; CSF Microbial Growth Culture Reading.



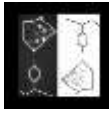


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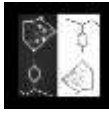
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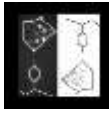
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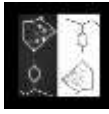
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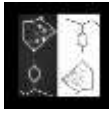
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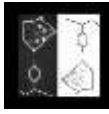
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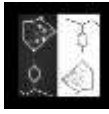
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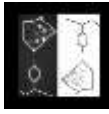


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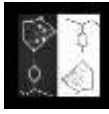
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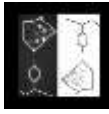
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Acronyms

AI— Artificial Intelligence	NC— North Central
AHS— Alpha Hemolytic Streptococcus	NE— Northeast
AGNB— Anaerobic Gram-Negative Bacteria	NGO— Non-Governmental Organization
AGPB— Anaerobic Gram-Positive Bacteria	NG — No Growth
AGPC— Anaerobic Gram-Positive Cocci	NCDI — No Clostridium difficile Isolated
AGT— Advanced Game Theory	NBH— No Beta Hemolytic Strep Isolated
	NBHSI— No Beta Hemolytic Streptococcus Isolated
BC— Bladder Cancer	NGTD— No Growth To Date
BSI— Group B Streptococcus Isolated	NSPI— No Significant Pathogen Isolated
BSA— Beta Hemolytic Streptococcus, Group A	NHL— Non-Hodgins Lymphoma
BHSI — Beta Hemolytic Streptococcus Isolated	NOF— No Organisms Found
BSB— Beta Hemolytic Streptococcus, Group B.	NW— Northwest
CNA— Communicable Neoplastic Agents	PRC— Probable Contaminant
CID— Communicable and Infectious Disease	
EBV— Espen Barr Virus	STEM— Science Technology Engineering and Mathematics
	SC— Stomach Cancer
FDI— Foreign Domestic Investment	SE— Southeast
FWACP — Fellow West African College of Pathologists	SW— Southwest
FMCPath — Fellow of the Medical College of Pathologists	
	TAT— Turn Around Time
	TB— Tuberculosis
HIV— Human Immune Deficiency Virus	UUF— Usual Urinogenital Flora
HHV-8— Human Herpes Simplex Virus-Strain 8	UTI— Urinary Tract Infection
HPV— Human Papilloma Virus	
	WHO— World Health Organization
GNB— Gram Negative Bacillus	
GPDB— Gram Positive Resembling Diphtheroid	
HL — Hodkins Lymphoma	
IARC — International Agency for Research on Cancer	
ID— Infectious Disease	
IDP— Interdentally Displaced People	
IT— Information Technology	
KS— Kaposi Sarcoma	
MF— Multiple Flora	
MUG— Mixed Urinogenital Growth	
MGPO— Multiple Gram-Positive Organisms	
MTWO— More than two Organisms	
NAI— No Anaerobes Isolated	
NBF— No Bacillus Fragilis Isolated	