Building Evidence on National Malaria Data Repository as a decision support tool of Use of Data for decision making in Malaria Programme, Nigeria

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Statement of Own Work

I, **Ibrahim Kassim Maikore** confirm that the work presented in this thesis in my own. Information has been derived from other sources, I confirm that this has been appropriately referenced and indicated in the thesis.

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Abstract

Several decision-support tools for use in the health sector exist to address barriers to data-informed decision making in many malaria-endemic countries, including Nigeria. However, the evaluation of such decision support tools is still scanty. As part of the drive to help reduce malaria in high burden countries, the WHO has identified data for decision-making as a key area to achieve impact. In response, Nigeria has established a functional national malaria data repository (NMDR) with programme tracking dashboards launched in 2020. This study presents an evaluation of the short-term evidence of the NMDR as a decision support tool at the national level during the development of the last Global Fund (GF) funding request and the national malaria strategic plan (NSP) in Nigeria. The specific objectives of the research are: 1) to review the national level use of data for developing the 2014 – 2020 national strategic plan and 2018 – 2020 global fund funding request prior to the implementation of the NMDR, 2) to evaluate how the NMDR facilitates the use of evidence in the development of the 2021 – 2023 Global Fund funding request at three months post-NMDR deployment and 3) to assess how the NMDR facilitates the use of evidence for the development of the 2021 – 2025 strategic plan at nine months post-deployment of the NMDR.

This research adopted a retrospective policy analysis using qualitative assessments of key informant interviews, participant observations, and document analysis. To obtain a baseline of data availability and use prior to the NMDR deployment, I carried out a document review of the previous strategic documents and correspondences during the document development. Next, I carried out a periodic evaluation of the use of evidence for decision making within the GF funding request, which was submitted three months post-NMDR, and the NSP, which was submitted six months post-NMDR deployment.

The primary outcome of the evaluation demonstrates that the NMDR bridges the gap of availability of data and facilitates the use of data during the two strategic documents development. Even though data availability has improved over the past few years, it is still essential to have the right tools to make the data more accessible. This study has attempted to demonstrate the effect that the NMDR tool can have. However, it also points out that there is still a lot of work to achieve a satisfactory level of evidence used for decision making in the country.

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Acronyms and Abbreviations

ACT	Artemisinin-based Combination Therapy
CORPs	Community Oriented Resource Persons
DfID	Department of Foreign International Development
DPH	Department of Public Health
DHIS2	District Health Information System version 2
DrPH	Doctor in Public Health
DQA	Data Quality Assessment
EBPHP	Evidence Based Public Health Practice
FMoH	Federal Ministry of Health
GTS	Global Technical Strategy
GAC	Grant Approvals Committee
GF	The Global Fund to Fight Aids, Tuberculosis and Malaria
GMP	Global Malaria Programme
HBHI	High Burden to High Impact
HPTF	Health Policy Analysis Triangle Framework
HSRP	Health Sector Reform Programme
HTA	Health Technology Assessment
ITC	Information Technology and Communication
IVM	Integrated Vector Management
IPTp	Intermittent Preventive Treatment in pregnancy
IRS	Indoor Residual Spraying
IDSR	Integrated Disease Surveillance and Response
ITN	Insecticide Treated Nets
LGAs	Local Government Areas
LLIN	Long Lasting Insecticidal Nets
LSHTM	London School of Hygiene and Tropical Medicine
MOP	Malaria Operational Plan
MSH	Management Sciences for Health
MDGs	Millennium Development Goals
MPAC	Malaria Policy Advisory Committee
MPR	Malaria Programme Performance Review
M&E	Monitoring and Evaluation
NCH	National Council on Health
NMCP	National Malaria Control Programme
NMEP	National Malaria Elimination Programme
NMSP	National Malaria Strategic Plan
NMDR	National Malaria Data Repository
NSDP	National Strategic Development Plans
NSHDP	National Strategic Health Development Plan
NSP	National Strategic Plan
NGOs	Non-Governmental Organisations
OCA	Organisational Capacity Assessment
OPA	Organisational and Policy Analysis
PMI	Presidential Malaria Initiatives
PPMV	Proprietary Patent Medicine Vendors
PR	Principal Recipient
RDT	Rapid Diagnostic Test
RSSH	Resilient and Sustainable Systems for Health
RSI	Research Study I
RSII	Research Study II

RBM	Roll Back Malaria
SMC	Seasonal Malaria Chemoprevention
SDA	Service Delivery Area
ULMO	Understanding Leadership, Management and Organisation
UN	United Nations
USAID	United States Agency for International Development
WHO	World Health Organisation
WT	Writing Team

PREFACE: Integrating Statement

The yearning towards achieving a robust health care delivery system is insatiable and putting efforts to actualise that remains at the forefront of my career. Career development, especially in the field of preventive medicine, requires not only commitment, focus and hard work but also a sound knowledge base. Therefore, requisite training in public health is paramount and pursuing a doctorate program would be key in reducing some of the suboptimal low impact shown in public health interventions across the world. I decided to pursue a DrPH to better equip myself with research skills and prepare for a leadership role in policymaking in the near future. I believe the degree will provide me with the required skills and knowledge that will enable me to make a difference in world health policymaking.

During a preliminary interview with the Head of the Disease Control Department, Professor James Logan, I was able to identify and discuss my aims and objectives for undertaking the DrPH programme which includes developing a broader understanding of public and the multi-dimensional aspects of malaria health systems strengthening, being able to apply my current knowledge and skill set to real-world health challenges and have the opportunity to plan and implement a research project overseas. Upon acceptance, I enrolled in the DrPH programme in October 2014 as full-time student. Based on my research preference and background, I got a supervisor in the Department of Disease Control of the faculty of Infectious and Tropical Diseases. The DrPH programme has three components: taught modules, organisational policy analysis (OPA) project as Research Study 1 (RS1) and 'mini' research as the Research Study 2 (RS2).

Taught Modules and Transferrable Skills

The face-to-face taught modules spanned from October to December 2014 with class size of 12 fellow DrPH students. The cohort were from a broad range of backgrounds, including healthcare, advocacy, management and academia working within the public, private and charitable organisations. The taught modules undertaken included Evidence Based Public Health Practice (EBPHP) and Understanding Leadership, Management and Organisation (ULMO). The Evidence Based Public Health Practice module allowed me to learn how evidence such as academic research and literature is acquired and issues around and the importance of its quality. The module gave me a foundation in understanding how data or evidence is translated into policy and practice. Coming from a clinical background, I have always assumed that non availability of evidence or research from a particular field is the main challenge for evidence-informed decision making. Participation in this module and successful completion of the two assignments provided me with a detailed insight and

understanding of the dynamic relationship between availability of evidence and its use in policy formulation and practice. I am now also able to identify other equally important factors as the actors, content, context, and process described in Walt's policy analysis triangle that could facilitate or impede use of data for decision-making continues to develop.

The ULMO module provided a critical understanding of different leadership styles in managing public health programmes. It succinctly presented how people work and behave in organisations, including the nature of power and politics and how this affects leadership and managerial decision-making. Coming from African setting, I used to think that opinions or views coming from any leadership positions should always form part of the direction in decision making, which is a view that is heavily influenced by African cultural practices. However, the ULMO module taught me that such leadership style affects sound decision-making, which could lead to inefficiencies or poor uptake of interventions. I also learned to apply stakeholder analysis to understand the position of interest and power of various actors involved in a project, which could allow the team conduct advocacy to change certain actors' position with high power with low interest to high power with high interest. The module assessment exposed me to the application of many organisational theories and management tools.

The ULMO module organised a three-day residential development workshop in Yorkshire which was anchored by a professional coach. It provided me with a focused, insightful and comfortable environment to reflect and learn about personality traits, team building skills, and personal development plans. The exercises allowed me to understand my strengths and weaknesses while doing my job and how to undergo extra training and coaching sessions to improve. I understand how we need to balance a team with persons having various skills and experiences to achieve the desired result. A leader will require strong skills to identify and assign specific tasks based on staff strengths. I also identified future career aspirations in leadership, project management and teaching within malaria surveillance, monitoring and evaluation and public health intervention.

Organisational Policy Analysis (Research Study I)

The OPA provides a platform for the students to gain practical experience and study policy and management practices adopted by a public health institution to deliver its mandate. Also, it aims to contribute to the chosen organisation's ability to achieve its goals through recommendations based on the findings of the study. My OPA aimed to evaluate how the use of evidence to inform decision-making and policy development process in National Malaria Elimination Programme, Nigeria, compared with the intended programme theory. My interest in the NMEP emerged because of its coordinating role in malaria and the new focus towards achieving pre-elimination and reducing

malaria-related death to zero targets set by the Programme in 2020. The National Malaria Strategic Plan 2014 — 2020 prescribes that optimal impact depend on the deployment of multiple preventive measures [1] and to ensure success; it is essential to base decisions on concrete evidence.

The study used Weiss's (1979) models to assess evidence in making decisions and policy and Walt's health policy analysis triangle to ascertain the relationships between various components in policy and decision-making. This study adopted a retrospective policy analysis using qualitative assessments of key informant interviews, non-participatory observations, and document analysis. I interviewed 14 stakeholders involved in technical support and policy development at the national level.

The OPA identified a prioritised set of strategic and actionable recommendations communicated to NMEP through a formal report. The recommendations contained within the report were accepted such as scale up of insecticide monitoring sites to generate local data that would inform use of data for decision making. As part of the recommendation, I advised on malaria surveillance which subsequently informed the research objectives of my research work for RSII.

The most challenging aspects of the OPA was defining its core objectives and ensuring that the project effectively met the academic requirements of the DrPH programme and expectations of my supervisor to form part of the preliminary work in a DfID grant he was coordinating. Since it was my first time conducting a qualitative study alone, I encountered several challenges with the interviews and transcribing them. Each planning and implementation phases of this OPA provided a valuable opportunity for personal reflection, constructive feedback from key stakeholders and transferrable skill development. Overall, these transferable skills and the completion of the taught modules provided a theoretical grounding and practical foundation for the RSII.

Research Project (Research Study II)

The final element of the DrPH programme involved planning and implementing an independent research project and producing a thesis. My initial research plans changed a couple of times and became more focussed towards the end of the programme. In November 2016, my supervisor left LSHTM, and I was assigned a new supervisor in April 2017. I presented to my new supervisor the proposal I developed with the first supervisor. The first proposal was to explore the use of mobile technology for confirming malaria RDT results and collecting data from health facility rather than LGA in Nigeria. The project was to demonstrate how mobile technology can be used to improve quality of care and quality of routine data through collection at source. I proposed the use of the Deki Reader, a device developed by Fio Corporation in Canada, for the project. However, to use the

Deki reader, there was need to pay a subscription fee to the Fio Corporation to obtain the devices and have access to the software and data collected through the tool. The subscription fee was very high, and I could not secure funding for the study, therefore the Fio Coporation suggested that I waited until they got approval for a project to deploy the device in Nigeria and then I can have access to those devices. Their proposal seemed logical, however, at the time their project was not due to start. Since at that point I had already lost about a year without starting my research work after paying tuition fees, I decided to go on an interruption of study for one year. During my interruption of study, it became evident that working with the Deki Reader was not going to be possible after all. I started exploring other research options which included doing a health technology assessment or a time motion study. My supervisor was changed again at this point, and I decided to extend my interruption of study for a further six months until I was assigned a new supervisory team.

In the meantime, I had returned to Nigeria to resume work at NMEP where I was employed before starting the DrPH. I was heading the team at NMEP to develop the NMDR as a measure to address the issue of non-availability of data and strengthen malaria surveillance in Nigeria. This work presented a new research opportunity and I put together a proposal to evaluate the use of the NMDR. My new supervisory team approved the proposal, and I went ahead with the research work which is presented in this thesis. The research study provided an opportunity to conduct research in a setting where the findings could be used to improve the use of data for decision making.

The Doctor of Public Health Programme has provided me a unique opportunity for knowledge and skill acquisition, personal reflection and professional development. Exposure to different management tools, qualitative data analysis skills, as well as the ongoing, constructive feedback from my supervisor, mentors and peers has helped me to develop and gain confidence in my own capabilities and recognising how these can be nurtured and applied. Overall, my participation in the Doctor of Public Health Programme has been a rewarding and challenging experience as well as an intrinsic, personal and professional journey of self-discovery.

Chapter 1: Introduction

1.1 Thesis Framework

The purpose of this research project is to address the evidence gap relating to the effectiveness of a decision support tool in strengthening use of evidence for decision making in the national malaria programme in Nigeria and this question is explored throughout this thesis.

This thesis is comprised of five chapters, which are serially arranged. The thesis report started with an introduction, which defined the research structure and presented the current body of knowledge. The introductory chapter provided a definition and classification of evidence, decision makers and use of evidence in decision making. It then discussed the relationship between research, evidence and policy formulation. Finally, it described the typologies of translating research evidence into policy and practice. A systematic review was conducted to assess the types and effectiveness of decision support tool in strengthening decision making in disease control programs. Three studies identified as part of the review were analysed for quality and the findings described according to tools utilised. The chapter concluded by describing and providing context for the malaria surveillance system implemented by the national malaria programme in Nigeria.

The second chapter describes background work, motivation for the study and outlines the aim and objectives of the research. The chapter presents the background work done in developing and operationalising National Malaria Data Repository (NMDR) in Nigeria. It presents the scoping work done in understanding the district health information system database and outlines the details of the development process. The second chapter concludes by outlining the study objectives and rationale for undertaking this research work.

The third chapter presents a systematic and detailed account of how the study was planned and implemented. It describes the project organisation, methods for the qualitative data collection, implementation of the research, the processes, data analysis and approach for the pre-and post NMDR comparison of development of Global Fund (GF) funding requests and malaria national strategic plans (NSP).

The study results were presented in the next two chapters, four and five. Chapter four describes the findings from evaluation of the development processes of GF funding requests pre-and post NMDR implementation. Similarly, chapter five presented the findings from evaluation of the development processes of malaria strategic plans pre-and post NMDR implementation. Each results chapter presented the findings from the document review, non-participatory observations, and key informant interviews. The results included using illustrative quotes and explanatory text, enabling

these findings to be discussed with comparison between collective and divergent views that emerged. In the final section of each of the two result chapters, comparison of data use for decision-making pre- and post-NMDR in each step developing the strategic documents were analysed to ascertain the short-term evidence of the NMDR.

The last chapter summarises the key findings of the study in the context of similar interventions from previous literature. The wider implications, recommendations and areas for further research are also proposed in this chapter. The initial section of the discussion reviews the key results of the study, examining the existing literature and comparing the short-term evidence of the NMDR before and after implementation. The strengths and limitations of the research are also explored. Recommendations for advocacy, policy development and further research are proposed based upon the barriers and facilitating factors to the NMDR use. In the concluding section a reflective, personal account of the student's journey as a Doctor of Public Health Candidate is presented.

1.2 Evidence, Decision Makers and Use of Evidence in Decision Making

There are several definitions of evidence in the literature. However, its meaning remains consistent across the different sources. One definition of evidence is how people or systems generate, interpret and evaluate information and knowledge [2, 3]. Another definition by Buse et al. is that "evidence is any form of knowledge, including, but not confined to research, of sufficient quality to be used to inform decisions" [4]. Other sources of evidence include any form of intelligence gathering activities, opinion polls, the results of consultations and administrative data [5].

Dobrow et al. have categorised constituents of evidence into philosophical-normative orientation and practical-operational orientation. The philosophical-normative describes evidence as information that has verifiable sources, is unconstrained by context and is quality dependent. The philosophical-normative also describes the explicit methods of evidence generation. The field of medicine has embraced a similar approach, which is evidence-based medicine (EBM) at the individual-clinical level. In contrast, practical-operational orientation is context-based, temporal, subjective and describes evidence more with its relevance, applicability, and generalisability. It is applicable at population policy level as is the case in NMEP. The practical-operational orientation suggests evidence and context are mutually inclusive. The stakeholders, context, and the process of decision making are factors other than the quality of research evidence that can influence process and outcomes of decision-making [6].

The process of decision-making involves the triangulation of three main components — the stakeholders or decision-makers, the decisions they make, and the evidence they use. The

triangulation of these components has an impact on the success of creating an evidence-based decision. There are frameworks that guide the process of making decisions which encompass all three components mentioned earlier.

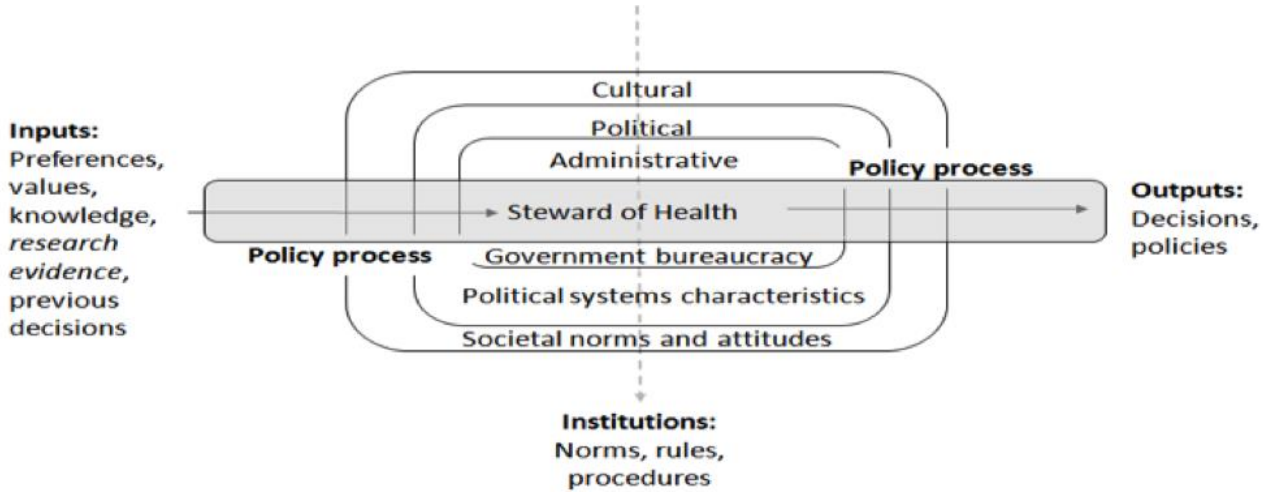

Figure 1 Framework for an institutional Analysis of Policy Processes at National Government Level Source: ***[7]***

Figure 1 shows one example of such framework that has been described by Ettelt et.al. (2014) as the process of using evidence to inform policy making.

It shows that research evidence and other factors are input to the policy process. The influences of the stakeholders and norms, as well as rules and procedures of the institution shape the evidence into decisions and policies [7]. It is essential to establish a relationship between the quality of data and the demand and supply of the data. Another critical factor in decision-making is to establish a consensus on the decisions made by all the stakeholders [8]. The process of decision-making using quality data is paramount in any public health setting. The use of information for decision-making occurs at various health system levels; system management, planning, advocacy, health service, and policy development [9-11]. Setting out to making an evidence-based decision in programs like the National Malaria Elimination Programme (NMEP) in Nigeria will require consideration of all components to achieve a robust decision.

The cultural, political and administrative factors within the framework from Ettelt et.al. (2014) can play the role of either barriers or drivers to use of evidence for decision making. For example, one of the hypotheses presented by Ettelt et.al. (2014) is to understand if the culture of a particular society expects policy making to be informed by evidence. In NMEP, the factors from the framework play different roles in different settings. There are instances where the political factor hinders the use of evidence if doing so will lead to a decision that does not align with political interests. In other instances, it is the system of government bureaucracy ensures the established coordination

framework aids in analysing evidence and ensuring its use in practice. The results of this study will demonstrate clear examples of these factors acting as barriers and drivers to evidence use in decision making. Chapter 5 discusses these points in more details.

1.3 Understanding the Relationship between Research and Policy

A broad range of evidence from research to routine surveillance, amongst other sources are appropriate for use in policy decisions. However, there are frequent disagreements about what qualifies as 'evidence' and how it should be used [4]. Also, empirical studies have demonstrated that the availability of research findings does not always guarantee its use in policy and practice [12, 13]. Researchers agree that the use of research evidence is a complex and multifaceted process [2, 12]. How the evidence is used varies at different levels of implementation. For example, at the national level, research findings are used to inform policy options. At the sub-national levels, the results are used to make specific decisions, such as ensuring the full supply of the commodity to a service delivery area. Consequently, the type of research to be commissioned will typically be guided by the level at which the evidence will be used [4].

There exist typologies that pin down how research findings are used in decision making [12]. For instance, there are broad classes such as instrumental use and conceptual use. Instrumental use deals with how policy and practice directly impact the use of research. For conceptual use, research is complex and indirect, resulting from policymakers and practitioners' knowledge, understanding, and attitudes. Weiss, in 1979, reported on the existence of links and overlap in the use of research with more simple typologies. Weiss in 1979 has also elaborated research use into seven different types: Knowledge-driven model; problem-solving model; interactive model; political model; tactical model; enlightenment model; and research as part of the intellectual enterprise of society [14].

Weiss's problem-solving model is defined by Nutley as "Research helps policymakers find a solution to a particular problem. Researchers and policy makers agree on the nature of the problem and the goals achieved, and social science provides evidence and ideas to help clarify a way forward drawing on existing research or commissioning new work" [15]. This approach fosters collaboration between researchers and policy makers and can be especially useful in a situation where there is insufficient evidence relating to a problem.

Nutley defines Weiss's knowledge-driven model as "Basic research identifies knowledge of potential value to the policy or practice community. Applied research tests this knowledge out in real world contexts, research-based technologies are developed and implemented, and research use occurs" [12]. In this approach, the researchers anticipate the future need for a particular research work and

then go ahead to conduct this research. The policymakers use knowledge derived from previous research work to inform their policy decisions [14].

Other models include the interactive, where policy makers actively search for knowledge to support their work in an interactive manner with researchers and other key players in the political process. Whereas in the political model, political opinions are fixed, long-standing and research is unlikely to have a direct influence on decision and policy development process. Similarly, in the tactical model, research findings are irrelevant. However, research is being done to further delay or avoid taking action. In enlightenment model, research use is cumulative and gradual in the public policy sphere. Research use percolates over time from indirect routes such as interest groups, media to influence both problem and its solution into policy paradigm shift. The science policy theme is when policy interest stimulates a wider societal concern and policy makers to offer funds for its further research [14].

However, Weiss broadened and extended the simple typologies by emphasising the routes and processes through which research influences public policy [12]. Weiss' 'four I's' framework identified institutions (organisations) as the essential component shaping public policy and use of research [14]. Others include interests, ideology, and information. Institutions here refer to organisations where policymakers use procedures and rules, which would eventually influence their interests, ideologies, and information regarding decision-making [14].

Dominant research use based on the Weiss model as applied to the context of the NMEP in Nigeria varies depending on the context of the policy change process. For example, the dominant strategy for a drug treatment policy change in 2005 was the problem-solving model, while another drug treatment policy change in 2013 fits the knowledge impel action model. These differences are a result of unique circumstances surrounding the two policies change, which outlines the relationship between research and policy formulation. Specifically, in 2002, WHO made a recommendation for a policy change from the use of chloroquine to artemisinin combination therapy (ACT) for the treatment of uncomplicated malaria due to widespread resistant to chloroquine. However, NMEP and stakeholders resisted this policy change until evidence, which showed resistance to chloroquine, was available from a locally conducted drug therapeutic efficacy test. NMEP eventually changed the treatment policy in 2005. This policy change fits the problem-solving model because the local evidence was generated as a solution to the lack of willingness of the country to adopt the change. However, in 2013, the adoption of policy change from the use of quinine to artesunate for the treatment of severe malaria was smoother and faster. This policy change involved the local actors, which are the Nigerian university researchers, in the generation of evidence to inform the change.

The use of knowledge generated from the therapeutic efficacy study for quinine and artesunate follows the knowledge impel action model.

In Nigeria, the NMEP is responsible for the creation and adoption of malaria related policies and recommendations. It is important to involve the NMEP in decisions regarding generation of evidence used for policy recommendations to ensure seamless adoption of such policies as seen in the two examples outlined above. For this research work, it is important to understand the scope of the NMEP and how the malaria surveillance system works in Nigeria. The next section briefly describes the NMEP and its malaria surveillance system.

1.4 Background on the National Malaria Elimination Programme in Nigeria

1.4.1 Malaria Context in Nigeria

1.4.1.1 Population at risk and prevalence

Malaria is endemic in Nigeria with 97% of the population living in areas of high malaria risk and an estimated 3% living in malaria free highlands. Nigeria accounts for 25% of the malarial disease burden globally [16].

Nigeria is one of the two countries (the other being Ghana) that reported the highest absolute increases (about 6%) in cases of malaria in 2018 compared with 2017. The burden in 2018 was similar to that of 2017 in all other countries, apart from in Uganda and India, where there were reported reductions of 1.5 and 2.6 million malaria cases, respectively, in 2018 compared with 2017. However, Nigeria recorded the largest reduction in Malaria deaths from about 400,000 in 2010 to about 260,000 in 2018, Malaria-related deaths account for up to 11 % of maternal mortality, 25% of infant mortality and 30% of under-5 mortality. The disease overburdens the already-weakened health system by contributing up to 60% of outpatient visits and 30% of hospital admissions [17].

In 2018, Malaria Parasite Prevalence amongst children under 5 was 36.2% by RDT and 22.6% by microscopy. The prevalence varies greatly from 57.1% (by RDT) in children of the lowest wealth quantile to 10.7% (by RDT) in children of the highest wealth quantile [18]. There was also a wide range in prevalence based on the mothers' education status.

Parasite prevalence was higher in children under 5 living in rural areas (47.2% by RDT) compared to those of urban area with a prevalence of 22.3% by RDT [18].

1.4.1.2 Malaria Transmission and Geographical Variation

Nigeria has various ecological zones with vegetation changing from Sahel savannah in the far north followed by Sudan savannah merging into Guinea savannah in the middle belt, then Rain Forest in

the south and Mangrove Forest in the coastal areas. In the northern part of the country, transmission is higher during the short-wet season as compared with the low transmission during the long dry season. In the central and southern parts of the country, transmission is stable and uniform throughout the year [16].

1.4.1.3 Epidemiological trends and implication for prioritization of available resources

There is evidence of some progress with respect to reduction of intensity of malaria transmission in Nigeria, over the last 15 years. Prior to 2010, it was estimated that approximately 30% of the population lived in areas of high to very high transmission intensity and 67% in the moderate transmission zone [16]. However, there is now evidence of a progressive divergence of in-country variation in malaria endemicity. Bayesian model-based geo-statistical methods were used to interpolate in space and time, age-corrected malaria point prevalence data in children 2 – 10 years old, to provide a prediction of malaria risk across Nigeria for the years 2000, 2005, 2010 and 2018. As of 2010, 85% of Nigerians lived in areas supporting meso endemic transmission, about 15% lived under conditions of hyper-holoendemic and there are small pockets suggestive of hypo endemicity. Although the basis for these changes may be multifactorial, they nevertheless mirror the period after the RBM Abuja declaration in 2000 and progressive increase in available resources and large-scale deployment of malaria control materials (LLINs and ACTs) in the country.

1.4.2 Purpose of National Malaria Elimination Programme

The NMEP is domiciled in the National Malaria and Vector Control Division under the Department of Public Health in the Federal Ministry of Health (FMoH), organised into seven branches, is responsible for setting Nigeria's malaria control targets and agenda, development of national malaria control policy, strategies, guidelines, plans and coordination frameworks [19].

The NMEP uses political governance and executive leadership to inform its decision-making processes. Furthermore, it coordinates the activities of partners and other stakeholders on malaria control activities, provide technical support to implementing bodies including states, Local Government Areas (LGAs), and stakeholders; mobilise resources, monitor and evaluate progress and outcomes in malaria control efforts. The development of the National Malaria Policy is a significant leap towards the scaling up of all effective and evidence-based malaria interventions in the country. In the past, each intervention has its policy, which made it cumbersome and necessitated the consolidation of the existing thematic policy issues into a single policy instrument to steer malaria programme interventions across the country [16].

1.4.3 The National Malaria Strategic Plan

In the last two decades, Nigeria and her partners have committed significant human, financial and material resources to reduce malaria burden and to work towards achieving a malaria-free status. The overall objective of many of the earlier plans was to rapidly scale up interventions to achieve the reduction of the burden of disease or mortality due to malaria by agreed percentages. The goal of the National Malaria Strategic Plan 2014 – 2020 was to reduce the malaria burden to under 5% and malaria-related mortality to zero. Although the goal was not achieved, there was a substantial reduction in the prevalence of malaria from 42% in 2010 (NMIS, 2010) to 23% in 2018 (NDHS, 2018). The vision for the 2021 – 2025 is to have *a MALARIA free Nigeria*. The mission is to provide equitable, comprehensive, cost-effective, efficient, and impactful malaria control interventions through transparent, accountable, client-oriented, community-owned and multisectoral approaches that contribute to a strengthened health system. Whilst the goal is to achieve a parasite prevalence of less than 10% and reduce mortality attributable to malaria to less than 50 deaths per 1,000 live births by 2025. The five objectives are to:

1. Improve access and utilization of vector control interventions to at least 80% of the targeted population by 2025. Core technical strategies here include expanding universal access to insecticide treated materials. This will involve sustained mass distribution of Long Lasting Insecticidal Nets (LLINs), significantly scaling up Indoor Residual Spraying (IRS) and expanding larval source management (larviciding and environmental management).

2. Ensure provision of chemoprevention, diagnosis, and appropriate treatment for 80% of the target populations at risk by 2025. This will be through a massive scale-up in the availability of facilities for parasitological confirmation (RDT and/or Microscopy), promoting availability of appropriate antimalarial medicines through free, subsidized or commercial systems at all levels (including the private sector and community systems) of health care delivery in the country. There will also be support for Intermittent Preventive Therapy (IPTp) and Seasonal Malaria Chemoprevention (SMC). Policies will be updated as necessary and there will be systems in place to ensure quality of diagnostic products.
3. Improve generation of evidence for decision making and impact through reporting of quality malaria data and information from at least 80% of health facilities (public and private) and other data sources including surveillance, surveys, and operations research by 2025. This will be with stronger emphasis on the use of ICT platforms and deployment of the DHIS and HMIS. The use of SMS platforms for feeding information from the peripheral facilities to central systems will be introduced. Supervision and coordination activities to enhance completeness of reporting from facilities will be strengthened. Capacity on M&E will

emphasise the special pre-elimination needs in surveillance and reporting. A robust M&E framework has been developed to guide the scheduling of data collection processes.

4. Strengthen coordination, collaboration, and strategic partnership to promote efficiency and effectiveness of malaria control activities towards achieving at least 75% improvement from baseline using a standardized Organisational Capacity Assessment (OCA) tool. Building on the existing gains of the partnership arrangement, Programme management will promote human capacity development, ensure public, private partnerships in facilitating availability and use of antimalarial commodities and strengthening of governance with the use of electronic dash board.
5. Improve funding for malaria control by at least 25% annually through predictable and innovative sources to ensure sustainability at federal and sub-national levels.

This Malaria Strategic Plan (NMSP, 2021 – 2025) is implemented through the existing health system structures at the facility and community levels and regarding the guiding principles and the priorities of the National Health Strategic Development Plan, 2018 – 2022, the High Burden, High Impact (HBHI) approach and the evidence from epidemiological stratification conducted. The need for multi-stakeholder and multisectoral coordination and collaboration at the Federal, State, LGA, Community and Household levels to deliver on the priorities of this plan has been highlighted at every stage of the plan development process.

1.4.4 Health Information System in Nigeria

The revised Health Information System (HIS) policy and the HIS Strategic Plan 2014 – 2018 provide the framework for the collection, collation, analysis, storage, dissemination and use of health and health-related data. In line with this policy, the DHIS 2 is the platform for routine health facility data collection from public and private primary and secondary facilities at national and sub-national levels. The department of Planning Research and Statistics is responsible for overseeing and building capacity for data management within the Ministry of Health [20].

The Health Data Governance Council (HDGC), chaired by the Honourable Minister of Health, serves as the coordinating body that provides oversight and governance for health information and to foster the use of data for decision making. The Health Data Consultative Committee (HDCC) is the operational arm of the HDGC. Both the HDGC and HDCC are replicated at the State and LGA levels [20].

1.4.5 Malaria Surveillance System in Nigeria

The demand for strong monitoring and evaluation (M&E) system, including the associated country capacity to track progress and performance accurately, evaluate the impact and ensure

accountability, has heightened lately as more focus is made in this area by WHO, Bill and Melinda Gate Foundation, and key donor nations. Recent efforts towards strengthening information infrastructure have led to the development of the District Health Information System version 2 (DHIS2). This platform is aimed at the collection of health data and aggregation for analysis purposes to support decision-making. The latest version, DHIS 2, has been adopted by 30 countries in Africa, Asia, Latin America, and the South Pacific. Countries with adopted DHIS 2 as their nationwide HIS software include Nigeria, Kenya, Tanzania, Uganda, Rwanda, Ghana, Liberia, and Bangladesh [21, 22]. The quality of data in the DHIS2 and other similar systems is dependent on the quality of data that feeds into it from the facilities and aggregated at the subnational levels. In the few times that the policymakers attempt to use the data for decision-making, poor actions result from bad data [23, 24].

Nigeria's current malaria surveillance landscape is comprised of multiple data generation pathways, each for different programmatic purposes. Of the five malaria-related passive disease surveillance systems, the most notable are the routine health management information system (HMIS) and the Integrated Disease Surveillance and Response (IDSR) system. Nigeria adopted IDSR in parallel to the routine HMIS surveillance system in 1998 to capture weekly data on nationally notifiable diseases, including malaria. The objective of this coordination was to provide accurate, consistent, and relevant data and information on a weekly basis to policymakers and stakeholders at LGA, state, and national levels for effective decision making and epidemic disease detection and response. Further, IDSR intended to integrate and harmonize various software, data collection forms, standards, and case definitions in order to prevent inconsistent information and maximize efforts among all disease prevention and control programmes and stakeholders across the country. Nigeria currently does not have any active disease surveillance systems in place for malaria [25].

The Nigeria surveillance landscape has evolved from being a disease specific system, to the current more harmonised HMIS over 10 years as shown in figure 1. The data collection begins with paper-based reporting of patient data, including the diagnostic results, at the facility level, which is aggregated monthly by facilities and reported monthly to the LGA. LGAs then enter the facility level HMIS data electronically into the DHIS platform [26]. Both the state and the NMEP have access to view these data and provide quality audits, but they do not generate primary data. LGA, state, and national program members have access and can analyse and use these data for programmatic decision-making and quality assurance. Analysis of surveillance for programmatic decision-making and quality assurance is done predominately at the LGA, state, and national levels; it is uncommon at the facility level. The landscape analysis conducted in 2018 to understand how malaria

surveillance is conducted in Nigeria showed that data analysis and use at the LGA level were rare and inconsistent [25]. Although routine data quality assessments linked with on-the-job-mentoring and supportive supervision at the point of care has been shown to improve data [27].

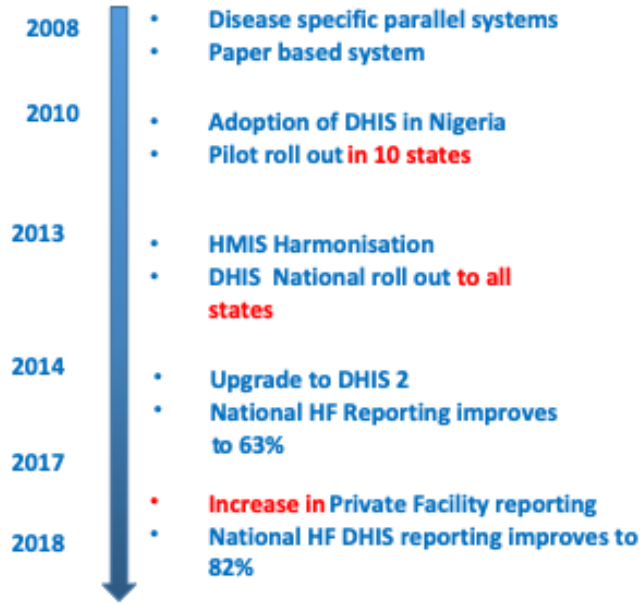

Figure 2 Flow Chart of Health Management Information System Progress in Nigeria

At the state level, data was traditionally used for commodity forecasting, resource mobilisation, advocacy, and sensitisation. At the national level, NMEP analysed data electronically to evaluate data quality and malaria disease trends. Nationally, the Department of Planning, Research, and Statistics used all health surveillance data—beyond malaria—to advise the ministry on health trends, policies, priority setting, resource mobilisation, and responses. NMEP used malaria-specific data from HMIS to; provide feedback to states related to surveillance activities, address data quality audit (DQA) findings, identify and resolve programming issues, and for policy, decision making, and resource mobilisation. Feedback and sharing of results with various stakeholders occur quarterly [25].

Community-based care through integrated Community Case Management (iCCM) is a curative treatment to children at homes within communities for malaria, pneumonia and diarrhoea and identification and referral of new born requiring further medical attention [28]. Data from this intervention, for example, Community Oriented Resource Persons (CORPs) and proprietary patent medical vendors (PPMVs), are often missed through this reporting pathway [25]. As a result, data from these entities are often excluded from the central HMIS repository. Secondary, tertiary and private health facilities report via a separate, less streamlined procedure, resulting in substantial missing data from these facilities [29]. Data from other non-routine implementations such as

entomological monitoring and drug efficacy studies are also reported separately. These disparate databases and not always connected make it hard to see the entire data picture and as a result, important data is missed which hinders the ability to make effective decisions [30]. These types of problems are part of why WHO reported malaria surveillance as weakest in high burden countries including Nigeria. Nigeria was said to submit on average 20% of the data on malaria services rendered in both the public and private sectors [29]. There is a gap that can be addressed with interventions that are targeted at bringing data together for use with decision support tools [23].

One intervention identified to address this gap is the establishment of the National Malaria Data Repository (NMDR) by NMEP [31]. The development of the NMDR is further detailed in chapter 2 to provide a context for the tool, the various activities, and factors that influenced the development process. However, data generation, collation, and entry into DHIS would require continuous strengthening to harness the benefit of NMDR maximally.

To measure the impact of decision support tools such as the NMDR, there is need for evaluation of such tools. Currently, the data showing impact of such tools are insufficient especially for decision support tools in public health programmes [12]. As part of this research work, I carried out a systematic review of studies that measure the impact of such tools was carried out to establish the extent of this field. The next section provides the results for the systematic review showing the few published studies.

1.5 The impact of the decision support tools (dashboards /visualisation) for decision making in public health programs: a systematic review

The demand for strong monitoring and evaluation system, including country capacity to track progress and performance accurately, evaluate impact and ensure accountability has heightened lately in light of recent substantial investments from Nigerian Government and donor nations. Recent efforts towards strengthening information infrastructure have led to the development of the District Health Information System version 2 (DHIS2). This is aimed at collection of health data and aggregation for analysis purposes to support decision-making. The latest version, DHIS 2, has been adopted by 30 countries in Africa, Asia, Latin America, and the South Pacific. Countries that have adopted DHIS 2 as their nationwide HIS software include Nigeria, Kenya, Tanzania, Uganda, Rwanda, Ghana, Liberia, and Bangladesh [21, 32]. The quality of data in the DHIS, as well as in other similar systems, is as good as the data that feeds into it from health facilities in the subnational levels. In the few times that the policy makers attempt to use the data for decision making would result in poor actions as a result of bad data.

Existing evidence on the impact of evidence in decision making in disease control programs in Africa is limited and inconclusive [23]. Although there are good number of studies showing effectiveness of dashboards or visualization in supporting decision making for clinician in the hospitals [33]. This systematic review seeks to describe and assess the types and effectiveness of decision support tool in strengthening decision making in disease control programs. Also, to establish promoting factors that govern the relationship between the use of evidence and decision making.

1.5.1 Search Strategy

The systematic search conducted between 5th August and 30th November 2020 on electronic bibliographic databases of Health Systems Evidence, Web of Science and Medline identified studies published from 1946 – 2020. Scopus and Google Scholar were searched as an additional database; however, no relevant paper was found. The choice of databases ensures that the studies will be identified from the health domain. The searches did not include filters on year of publication, hence the results included papers as far back as 1946. Computer aided tools for decision support have been in existence since the 1960s when companies such as IBM started using computers to implement information management systems [34]. The decision for not limiting the search by historical time-constraints is to obtain any relevant study on the use of computer aided decision support tools in health-related domains.

The main search terms are included in Table 1. Systematic searches were conducted by combining every possible combination of four categories of keywords (main search terms) including their synonyms and related terms. The reference lists of key full-text articles included in the review were checked for any potentially eligible studies. The systematic procedure substantiates that the literature search comprises all published studies on the relationship between the use of repository, dashboards or visualisations and the use of evidence for decision making. The aim of the review was to consider decision support tools for any disease programme, therefore no specific disease was used as part of the search terms. A total of 238 studies were found from the search and table 1 shows the number of studies found in each database.

Table 1 Search strategy used in the literature search

Database	Search Strategy	Results
Medline	(Evidence or Data). Mp. and (Decision Making/ or Decision Making, Computer-Assisted/) and (Dashboard or Data Visualisation or decision support tool).mp.	104
	Filters; Full Text available; Publication year from 1946 – 2020; English language.	

Health Systems Evidence	("Evidence" OR "Data") AND ("Decision Making/" OR "Decision Making, Computer-Assisted/") AND ("Dashboard" OR "Data Visualisation" OR "decision support tool")	76
	Filters; Full Text available; Publication year from 1950 – 2020; English language.	
Web of Science	Evidence AND Decision Making AND Decision support tool	58
	Filters; Full Text available; Publication year from 1970 – 2020; English language.	
	Total	238

The search results were exported to Endnote, where five duplicates were excluded. The abstract and titles of the studies were manually screened to select relevant studies and 35 were excluded. The 35 excluded articles were papers from other scientific domains other than the health domain. 198 full text articles were assessed for eligibility and only five were found to be relevant. Out of the excluded studies, 118 were reporting on computer aided tools in clinical settings and not disease programmes. Figure 2 shows the other criteria that were excluded. The quality of the five eligible studies were assessed using Critical Appraisal Skills Programme (CASP) [35] checklist and only three studies were deemed fit for inclusion. The result of the quality assessment and data synthesis are provided in the next section.

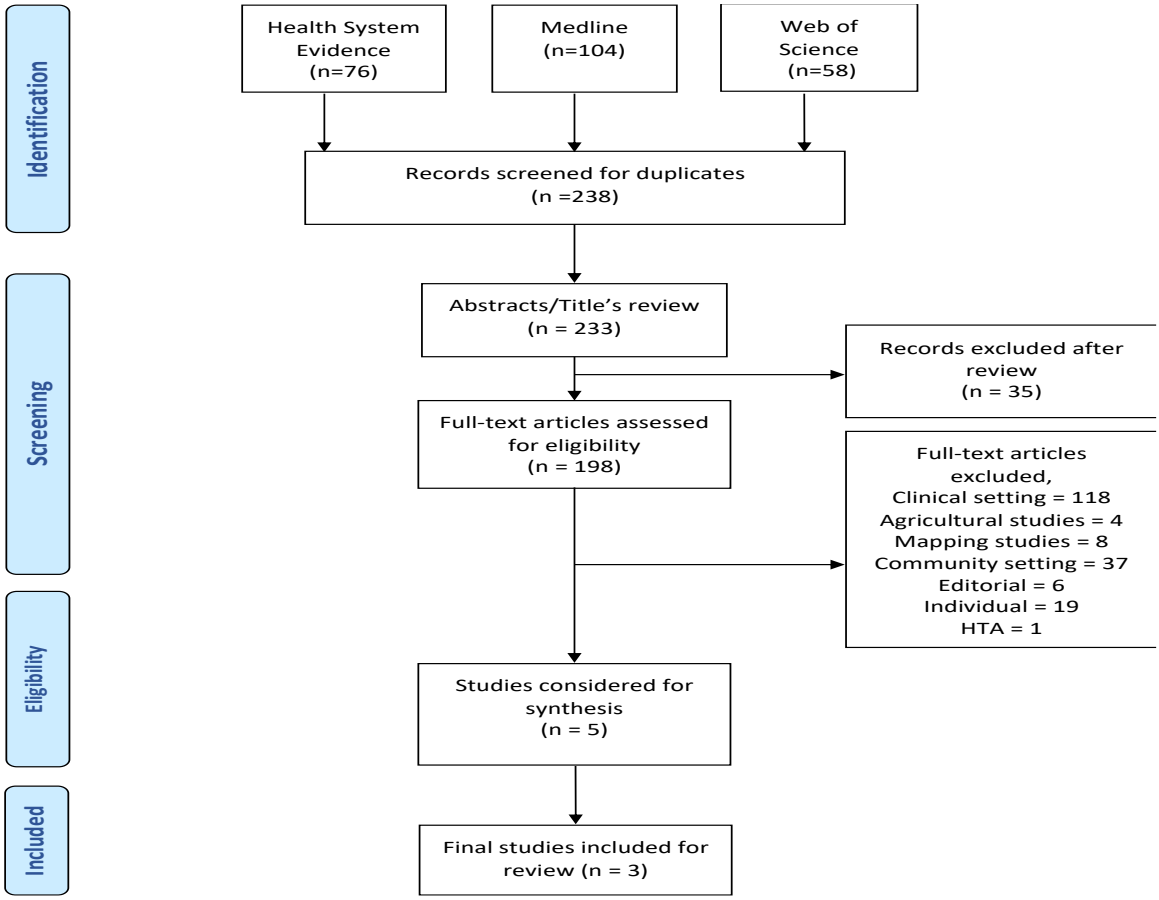

Figure 3 Flow diagram of Study Selection and Exclusion

1.5.2 Data synthesis and analysis

The CASP checklist provides a set of 10 questions to assess the quality of qualitative studies. Since all three studies considered for synthesis were qualitative studies, the tool was used to assess the quality. The result of this assessment, using the checklist is provided in Appendix 1. Based on the results, the three studies were included in the data synthesis.

Descriptive data synthesis was used to summarise the results of the studies. Appendix 2 shows the tool used for the data synthesis. The tool shows the characteristics of the studies, which include the research objective, study setting, methodology, and summary of findings. The findings reported are focused on how the effectiveness of the decision support tool was measured, what the study participants reported as feedback on using the tool, and whether the study carried out a robust evaluation.

1.5.3 Summary of findings

The three studies selected were carried out between 2013 and 2018. All the studies used qualitative study designs using key informant (in-depth) interviews and self-feedback schemes with stakeholders assessing the effectiveness of the decision support tools deployed. Two of the studies were carried out in African countries and the Middle East with a focus on specific disease control

programs [15] while the third study was conducted in Canadian public health programs [36]. The specific countries and disease programs assessed in Africa and Middle East were; HIV in Kenya [15], and Schistosomiasis and Malaria in Mali, Uganda, and Yemen [37].

Nutley et al. carried out a study to determine the impact of District Health Profile (DHP), a decision support tool, on decision making at the district level. The study assessed the process of implementing the DHP tool, its effect on data-informed decision making at the district level, as well as factors that influence the use and non-use of the tool. The DHP tool was developed as a solution for integrating data from various health programmes, primarily HIV, at the district level [15]. The DHP tool was designed to answer 11 health priority questions to enable informed service delivery decisions [15]. Nutley et al. carried out in-depth interviews with ten DHP tool users and three non-users in six districts. The participants included district health information and records officers, district medical officers of health, and district AIDS and STI control officers. The results of the evaluation suggested that the DHP tool had a positive effect on data analysis, review, interpretation, and sharing at the district level [15]. All the respondents, who were users of the tool, stated that the DHP tool-assisted them to target existing services in need of improvement and to plan future services, thus positively influencing program improvement [15]. The three non-users of the DHP tool cited the following barriers to the use of the DHP tool: the need for further training, lack of support from supervisors, conflicting priorities [15]. Lack of infrastructure and lack of value placed on the data were also cited as barriers by both users and non-users [15]. Nutley et al. concluded that by focusing on programmatic questions, the DHP tool was able to meet the specific information needs of district-level decision makers [15]. They however, acknowledged that the small sample size of the qualitative assessment of the tool was a weakness and there was need for a more thorough and longer-term evaluation.

Standley et al. carried out research to create a web-based application for decision-making support in integrating disease control programmes. The web-based application was a modelling application that provided a predictive analysis of the effectiveness of integration of schistosomiasis and malaria control, taking into consideration the local conditions and practical constraints. The study also carried out an initial validation of the tool to show its value in providing decision-support to end-users. For the validation, Standley et al. solicitated for feedback from partners of the disease programmes. They reported that responses from the validation were strongly-positive and the participants confirmed the usefulness of the web-based application in providing recommendations a priori during decision-making [37]. The feedback from the partners also provided recommendations on how to improve the model in the application by expanding it to include parameters such as

resource management for the implementation of control interventions. The recommendations will be helpful in future work to make the application better for the optimisation of the integration of vertical disease control programs [37]. One drawback of the assessment by Standley et al. is that it was an initial validation of the tool, therefore, there is need for a more robust evaluation.

Yost et al. carried out a study in collaboration with three Ontario public health departments in Canada to evaluate the effectiveness of knowledge translation and exchange interventions in developing capacity for evidence-based decision making. Several tools were used to support the decision-making processes and Yost et al. provided an overview of those tools and an evaluation of their usability [36]. Some of the tools were created for the study while some existing tools were adapted and used. The tools reviewed were developed to support public health professionals as they work through seven steps for evidence-based decision making. These seven steps, which are define, search, appraise, synthesis, adapt, implement, and evaluate, were identified, and developed by the National Collaborating Centre for Methods and Tools [36]. Yost et al. carried out a qualitative analysis using a case study approach for the evaluation. They conducted a total of 37 interviews with participants from different specialities ranging from public health professionals to management and frontline staff. The participants provided descriptions on how the tools were used within the health departments and made suggestions for improvement. The results of the evaluation showed that the tools were perceived as valuable for advancing and sustaining evidence-informed decision-making. The participants generally agreed that the tools eased the process of decision making “by increasing efficiency, providing a concrete process to follow, providing guidance on searching for research evidence, and documenting their work”. Yost et al. concluded that knowledge and awareness of these tools may assist other health professionals in their efforts to implement the evidence-informed practices [36].

Overall, the three studies in this systematic review found positive associations between decision support tools and the use of data for decision making in various public health programmes. Two of the studies, Nutley et al. and Standley et al. had limitations and the common theme was lack of robustness in the evaluation. This can be attributed to the fact that the studies did not solely focus on evaluating the tools. All the studies reported the process of development of the tools and the evaluation was just one aspect of it, with Standley et al. only carrying out a lightweight evaluation. While carrying out this systematic review, these three papers were the only papers found that evaluated decision support tools for public health disease programmes, which highlights the gap in the literature for such evaluations. The need for more of such evaluations supports the motivation for the research work presented in this thesis.

1.6 Research aims and objectives

The overall aim of this study was to determine the effectiveness of the national malaria data repository (NMDR) in improving the use of data for strategic decision-making at the national level.

The specific objectives of the research are:

1. To review the national level use of data for developing the 2014 – 2020 national strategic plan and 2017 – 2019 global fund funding request prior to the implementation of the NMDR.
2. To assess how the NMDR facilitates the use of evidence in the development of the 2020 – 2022 Global Fund funding request three months of post-NMDR deployment.
3. To assess how the NMDR facilitates the use of evidence for the development of the 2021 – 2025 strategic plan 9-months post-deployment of the NMDR.

1.7 The relevance of the Study

This DrPH study will measure how the NMDR affected the use of evidence in decision making in the malaria programme. A core obstacle is that the data required to make decisions based on malaria surveillance have been fragmented in multiple data silos distributed across geographic regions. These multiple fragmented sources of data are a major threat to the availability of adequate malaria data in identifying disease trends and planning for effective interventions. This has impacted programming as the country has encountered difficulty in the past to provide appropriate evidence-based malaria data during the submission of the funding request, and this has likely continued to undermine the success in reducing malaria burden in the country. The gap necessitated putting in place a malaria data repository and dashboard, which will ensure data from routine and non-routine HMIS are housed in a database. The aim of the NMDR in Nigeria is to provide a database and analytical dashboard for all national-level malaria information. The assumption is that the improved accessibility and visualisation of data instrumental in planning, monitoring and evaluating effective interventions, will improve the evidence-based policies for implementation of effective malaria control in Nigeria. It is expected that the NMDR will equip the NMEP and supported states with a decision support system and dashboard that takes into cognisance the increasing variations in malaria burden in different parts of the country, expose key contextual issues, especially as malaria interventions will require more than before close support of the broader health systems as the burden reduces.

Chapter 2: Development and operationalisation of National Malaria Data Repository in Nigeria

2.0 Overview

This chapter provides the context and rationale for the tool, the preliminary work that informed the development of the tool and the different implementation phases. For this research work, which aims to evaluate the NMDR, it is important to understand the context of the tool and how it was developed.

2.1 Rationale and approach for developing the NMDR

In 2015, the WHO launched the 2016 – 2030 global technical strategy (GTS) for malaria. The document clearly outlines the goal of reducing malaria case incidence and death by at least 90% from their 2015 level [38]. The document describes transforming surveillance into a core intervention. It further reiterates that strengthening the HMIS can help national malaria programmes to direct resources to the most affected populations, identify gaps in programme coverage, detect outbreaks, and assess the impact of interventions to guide changes in programme orientation [38, 39].

Advances in information technology and communications (ITC) offer prospects of increased timeliness of reporting, better sharing of data (between information systems and different levels of a health system) and enhanced data analyses [40]. The use of ITC can optimise and improve procurement and supply management, early warning systems, and the mapping of gaps in service delivery [40]. There are currently about 20 African countries using the DHIS for collecting, storing, and analysing data [41]. The DHIS is an open-source data management tool that has evolved over the years to accommodate country-specific needs [41, 42]. In November 2018, the WHO launched response mechanisms to get the high burden to high impact (HBHI) countries, including Nigeria, back on track the GTS targets. The document recommends establishing a functional NMDR with programme specific tracking dashboards [43]. The data repository is structured with sub-national geocoded data that can support national and subnational operations, policies and strategies, progress reviews and impact evaluations. Several dashboards have been launched, such as the Alliance for Malaria Prevention (ALMA) scorecards, Global Fund country coordinating mechanism tracking dashboards, United States President's Malaria Initiative (PMI) dashboards called Malaria Data Integration and Visualisation for Eradication (M-DIVE) in their supporting countries [44]. Progress reports from the ALMA implementing countries like Kenya are showing good uptake of

these dashboards [45]. For example, the use of a scorecard to track domestic financing in Garissa county, Kenya, showed increased budgetary allocation of about $16 million over five years [45].

The non-availability of a mechanism for an integrated malaria data analysis and automated generation of customised outputs is likely to create challenges for stakeholders to use data for decision-making [46]. The NMEP in collaboration with WHO, has initiated a project to develop an integrated malaria data repository. The objective of this project was to develop a platform that can validate, store, maintain and reproduce all malaria data. The platform is designed to automatically generate regular malaria bulletins and dashboards and provide an automated alert system to track sudden changes in cases that will strengthen the response system.

The scope of the NMDR development involves several activities which were divided into a preliminary work and data mapping phase and then three implementation phases. Borner et al. [47] recommends five key process steps for the construction of data visualization tools which are similar to the phases of the NMDR development.

The first step in Borner et al. is the identification of stakeholders and obtaining their insight and needs for the tool. These activities will then be followed by acquiring the best dataset that will support subsequent analysis and visualization. Step 2 is to carry out the analysis which can include data cleaning (e.g., identify and correct errors, duplicate data, deal with missing data, anomalies, unusual distributions) and data transformations [47]. The preliminary work and data mapping presented in section 2.2 corresponds to Borner et al.'s steps 1 and 2 respectively.

Step 3 is the actual visualization which involves selecting the visualization type and putting the records into graphic symbols for display as dashboards. Steps 4 and 5 involves deploying and interpreting the output of the visualization tool [47]. Steps 3 to 5 corresponds to the three implementation phases in section 2.3.

2.2 Preliminary work and Data mapping

The primary stakeholders identified during the preliminary work for the project include the Management Sciences for Health (MSH) through the Global Fund and PMI funding. Other stakeholders included are the DPRS, Malaria Consortium, Catholic Relief Services, Nigerian Meteorological Agency, National Space Research and Development Agency, and Health Information Systems Program among others. For the preliminary work, NMEP held a workshop with all the identified stakeholders to obtain their insight on the need for a visualisation tool and gather requirements for the tool. The preliminary work also identified the DHIS2 as the primary data source

for the NMDR since it contains the most comprehensive routine data set on malaria indicators in the country.

National Malaria Elimination Programme, in collaboration with the WHO country office, embarked on a comprehensive facility-level data management and analysis for the period 2014 – 2017. This comprehensive analysis of routine malaria data from the DHIS was carried out to form the basis of the data mapping. The data mapping exercise identified the important malaria data elements that will be visualised through the NMDR. The NMDR was developed from the same open-source software as the DHIS, therefore, the data capture functionality and user interface design are the same. The data structures for malaria routine data on the two platforms are also the same, which makes it easier to extract malaria data from the DHIS for use in the NMDR. The comprehensive analysis also identified areas where improvements can be made to the quality of the routine data on the DHIS before the NMDR was rolled out. The process for the comprehensive analysis and some examples of the findings are summarised below.

Health Facility level malaria-related data (outpatient attendance, fever cases, malaria testing, and treatment) for the period of January 2014 to July 2017 was downloaded from the DHIS database as comma-separated values files (.csv). This was then imported into Stata 13 (Stata Corp LLC) for data management processes. The processes included preparation of data into appropriate shapes (long and wide), identification of duplicates by facilities and monthly reports, and identification of outlier, missing, and illogical data by a variable within each facility. A facility was defined as a duplicate if, despite having a unique identifier, the exact name appeared more than once in the same village (Ward). New variables were generated for malaria reporting, which were defined as the submission of a monthly report with at least one malaria variable completed, and consistent reporting defined as the submission of at least 80% of expected reports within a given period.

The results of the analysis identified some data quality errors which includes missing or illogical data. For example, over 23% of the facilities reported more fever cases than outpatient attendance, 20% reported more testing than fever cases, 30% reported more test results than the number of tests, and more than 31% reported more malaria treatment administered than the number of positive test results. Other examples of data quality issues identified are that the DHIS allows data duplication and automatically captures zero data value as a null value, which will look like it is a missing value. These data quality issues means that there is need for a revision of the database design for the DHIS to improve the data quality. However, there are other data quality issues that occur while collecting and collating the data into the health facility registers. These data quality issues that occur before recording into the DHIS are difficult to identify and resolve.

The data obtained from the DHIS was cleaned and afterwards, 18,680 (64.7%) monthly records were found to be valid. This exercise shows that even after a data cleaning process, the volume of HMIS data that is available for use is significant enough for analysis. Therefore, routine HMIS data, despite its challenges, remains a valuable data source for Nigeria, and thus its use for evidence-based decision making is encouraged.

The requirements for the malaria dashboard were gathered during the stakeholder engagement in the preliminary work and based on the results from the comprehensive analysis. During the preliminary workshop, the Malaria Programme from Ghana were invited to share their experiences and lessons learnt during the development the NMDR in their country. The Global Malaria Programme (GMP) have also developed a generic template for the NMDR for countries to adopt and this was considered during the requirements gathering. A decision was taken at the plenary to present the information on the dashboard according to the malaria thematic areas. The dashboard consists of five pages which are: Morbidity and Mortality; Prevention; Case Management; Surveillance, Monitoring and Evaluation; and Health Systems. Decisions are usually taken within subcommittees of each of the malaria thematic areas, therefore the NMDR should be able to provide the required analysed data for making decisions easily at that level.

During the workshops, the discussions were carried out in subgroups that were formed based on the malaria thematic areas. The stakeholders participated in their relevant thematic area groups (some stakeholders belong to more than one thematic area). The discussions informed which malaria data elements are important and how the analytics should be displayed on the dashboard. The consensus recommendation was to have a dashboard that shows charts, graphs and tables summarising both the routine and non-routine data. However, within some of the thematic area discussions there were disagreements on the number of indicators to display on the dashboard. Some believed it was sufficient to have a snapshot of the data to make decisions whereas others felt there was need to include as much information as possible. The project steering committee explained to the stakeholders that the NMDR is a tool which behaves like a living organism that will continuously evolve based on the data need of the users. Therefore, the consensus was to initially include only programme indicators and more can be added in the future based on need.

The data quality issues identified from the DHIS also gave an indication for the inclusion of a data validation rule in the NMDR. This is to ensure that data quality issues are identified and flagged so that it can be addressed at the health facility level and LGA levels.

2.3 NMDR Implementation Phases

After the preliminary work and data mapping exercise, the next stage was the actual building and deployment of the NMDR. This was done in three phases, which are discussed in this section.

2.3.1 Phase One: District Health Information Synchronisation with NMDR

Phase one involved a review of the malaria repository data, data cleaning and analysis, pipelines, designing the dashboard and creation of iterative mock-up designs, and finalisation and deployment.

The platform was developed to allow a seamless link to the national DHIS2 database to extract selected malaria-related data elements at scheduled intervals. The platform also allows automated routine extraction of selected data from partners who are already routinely collecting and storing malaria service delivery data in web-based databases. For example, routine private sector and community service delivery data from partners can be extracted and integrated into the new platform [43]. In phase one, the development of data entry forms for routine malaria programme data entry to be used by malaria partners was also completed. This data ranges from malaria partners' details of implementation coverage to malaria service delivery data that is not currently captured by the HMIS, for example, LLIN mass campaign, Seasonal Malaria Chemoprevention (SMC) data, etc. The new malaria repository is to ensure that all routine (DHIS & non-DHIS) and non-routine malaria data are integrated and housed in one place.

2.3.2 Phase two: Integration of Non-HMIS Malaria Data into NMDR

In phase 2 of the project, simple interactive dashboards were designed and developed to display selected routine malaria indicators based on the incorporated routine and non-routine data. The data displayed through the dashboard first goes through cleaning and analysis modules which are based on agreed criteria from the SME key stakeholders. STATA-based analysis code for this advanced analysis were written by NMEP with support from WHO during preliminary and data mapping work done. Modules to conduct similar analyses were required to be developed in the repository to enable a scheduled automated and dynamic analysis. The dashboard design was created to accommodate web-based triggers and filters to drill down facilities based on established rules similar to what Cassim et. al described [48].

2.3.3 Phase three: Advanced Analytics and Custom Communication

In phase 3 of the project, the development of the business intelligence component, which includes an automated system for generating routine malaria bulletins and push notifications, was carried out. Thresholds were defined by WHO for generating alerts and push communication to prior agreed

recipients. To set the thresholds, the model compares the values of malaria variables for each month across years to determine changes in indicators. For example, to establish a threshold for January 2016, values from January 2013 were compared to January 2014 and 2015, and the threshold was set as above or below two standard deviations. Electronic notifications in the form of push emails to key decision-makers were also established. The goal of the automated generation of the bulletin was to enable improved communication with stakeholders and increase coverage of the target audience across national, zonal, and state levels. The e-bulletin as shown in figure 3 is intended to provide the NMEP with an efficient means of communicating information to health sectors and partners with regards to promoting implementation guidelines and services or launching new guidelines, including information on special offers and promotional campaigns. These additional activities were also carried out in phase 3; building the NMEP's capacity and that of other selected personnel to be able to solely handle routine management and maintenance of the repository, developing a training manual and guide on the operationalisation of the platform, piloting the first demonstration of the bulletin and training of users.

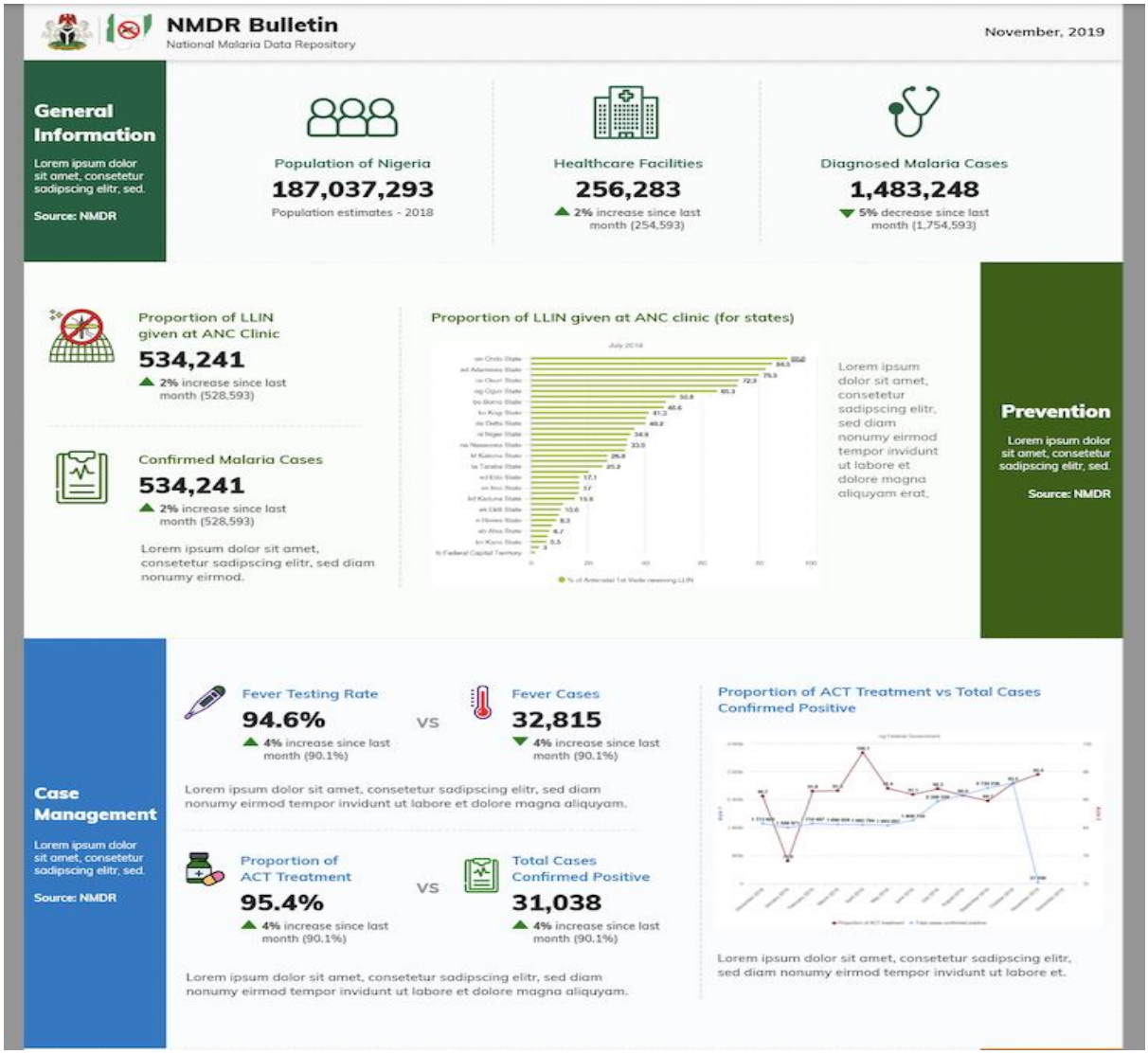

Figure 4 Sample Bulletin from the NMDR

This integrated malaria data repository is intended to effectively support documentation and update of data in a timely and accurate manner, draw up timely reports, and improve communication for malaria programme donors and stakeholders.

In summary, this chapter described the rational and process for the development of the NMDR and sets the scene for the research work in this thesis. The research evaluated the NMDR to assess how it enabled the use of data for document development after it had been deployed and used for three months and then a second evaluation after nine months. The next chapter describes the methodology of the research in details.

Chapter 3: Methods

3.0 Study Design

This research adopted a retrospective policy analysis using qualitative assessments of key informant interviews, participant observations, and documents analysis. This research is an evaluation to assess the short-term use of data from the NMDR to make decisions at the national level during the development of strategic documents. This chapter describes the research framework, which consisted of the various data collection and data management approaches and the framework used for analysing the data. The chapter explains how the data collection was carried out and addresses the three research objectives.

3.1 Research Framework

The research framework describes the process of data collection and analysis to address all the research objectives. Figures 3 and 4 shows an overview of the framework. To address objective one of this research, I carried out a document review of the previous strategic documents and correspondences to establish the pre-NMDR deployment status of access and data use. This formed the baseline assessment for objectives two and three. To address objectives two and three of this research, I carried out a periodic evaluation of the use of evidence for decision making at the national level post-implementation of the NMDR to correspond with the submission deadline for the strategic documents. The GF Funding Request was due in April 2020, which was three months post-NMDR deployment, while the NSP was due in September 2020, which was nine months post-NMDR. This research was building evidence to measure effectiveness if the NMDR promoted the use of data in the short-term and, if so, how data was used for strategic decision making while comparing it with retrospective review of the pre-NMDR documents development process.

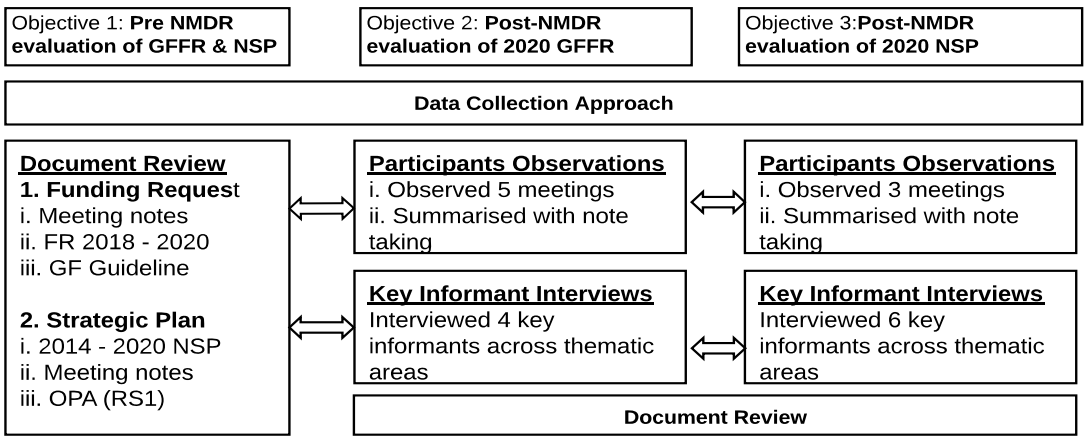

Figure 5 Framework Showing Data Collection Approach

Objective one involves evaluating the processes and documents that were developed before this research work was commissioned. Therefore, a retrospective analysis was required. To collect data on the use of data for developing strategic documents pre-NMDR, I carried out document analyses. One of the documents I reviewed was my OPA because the findings provided background on selection of mapped stakeholders, 2014 – 2020 NSP development process and culture of decision making in NMEP. I have described the OPA in chapter seven (7). For objective one, I also carried out a document review on the GF funding request for the 2017 – 2019 funding cycle, the 2014 – 2020 NSP, and other key documents. The detailed list of the documents I analysed and how I did the analysis is in section 3.3.3.1. The focus was to assess the availability and accessibility of evidence and any factors that influenced the use of evidence for decision-making. I used a data extraction form (appendix 3) with pre-defined categories of data to collect from the document reviews.

The data collection for objectives 2 and 3 started with observing meetings during the two documents development processes. I observed meetings and workshops held virtually and physically and used a field note-taking template to collect data. After the development processes for both the GF funding request and the NSP, I conducted key informant interviews using the relevant stakeholders in the meetings. I then carried out a document review of the two current strategic documents, minutes of meetings, email communications, recordings of online meetings, and other key document reports. I used a data extraction form (appendix 3) to carry out the document reviews (see section 3.3 for details).

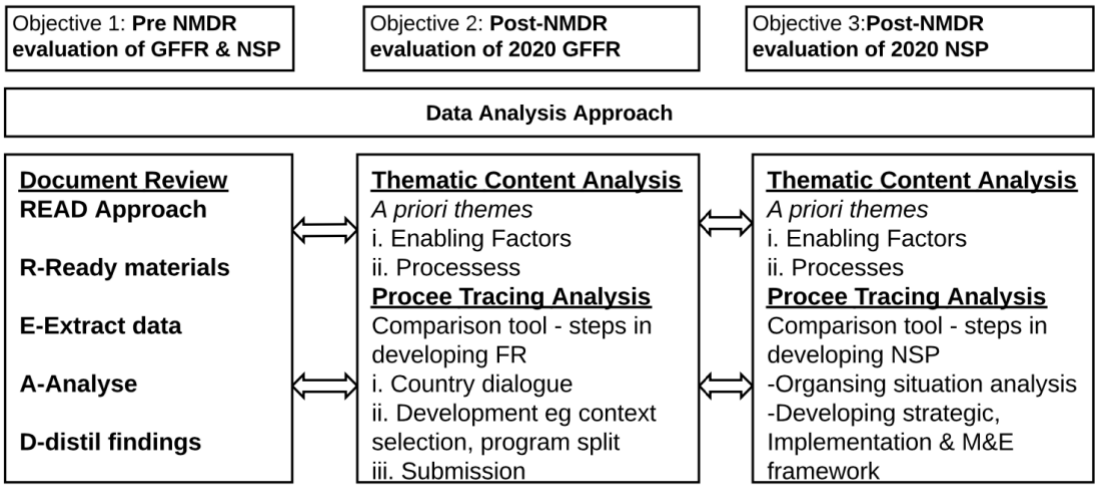

Figure 6 Framework Showing Data Analysis Approach

For the data analysis, I used *a priori* thematic areas for coding and NVivo to map key findings from interviews into the relevant themes. I then analysed the results from the various observations and document reviews and correlated those with the findings of the interviews (see section 3.4.1 for

details). I carried out analysis similar to process tracing [49] using a tool that I developed based on the steps involved during the document development processes to identify data used, type of data, data sources used. I used the tool to compare the level of access and data use for pre-and-post-NMDR deployment, and I specifically checked if the NMDR provided data for the post-NMDR document development. Section 3.4.2 provides details of the comparison tool for the process analysis.

3.2 Study setting

For this research, the evaluation was conducted at the national level of the Malaria Programme. At the national level, staff and partners are responsible for setting Nigeria's malaria control targets and agenda, developing national malaria control policy, strategies, guidelines, plans and coordination frameworks. The NMEP uses political governance and executive leadership to inform its decision-making processes. The culture of use of evidence for decision-making is also becoming increasingly prominent as justification to track disease progression and guide in channelling the scarce resources for impact [50]. The research objectives set to gather evidence of data use at the national level and evaluate how NMDR facilitated it. The GF funding request, as well as the NSP, are developed at the national level. Therefore, this study uses the process of developing the two documents as case studies. The key documents that are then evaluated from the case studies are described here.

3.2.1 Global Fund Funding Request

I reviewed the GF Funding Request for 2017 – 2019 (Objective 1) and 2020 – 2022 (Objective 2) funding cycles. The GF makes smart and effective investments in the fight against HIV, tuberculosis, and malaria through a unique partnership-based funding model. The funding model, which continuously evolves based on new needs, learning and realities, recognises that the only way to end epidemics of the three diseases is by working together. The partnership includes the Global Fund, governments, civil society, people affected by the diseases, technical partners, the private sector and other partners [51].

The GF funding cycle runs in three-year periods that directly correspond with the donor replenishment periods. In each funding period, the GF allocates donor funds to eligible countries. Countries then create a funding request to apply for their funding after engaging in an inclusive consultation at the country level. After technical review and approval, countries implement their grants [51]. Evaluation and oversight continue throughout implementation to monitor progress and performance. Nigeria is categorised among the 25 High Impact countries requiring more than $250 million allocations due to its high disease burden. Other countries are categorised into Core and Focused depending on disease burdens and allocations [52].

3.2.2 National Strategic Plan

The 2014 – 2020 (objective 1) and 2021 – 2025 (objective 3) NSP were also reviewed. The annual planning and financing for health are guided by the priority areas of the National Strategic Health Development Plan (NSHDP). It is noteworthy that malaria control occupies a significant part of this plan under Priority Area 5 of the Strategic Pillar Two [20]. The NSHDP and the National Malaria Strategic Plans are operationalised through the respective annual operational plans [20, 30].

The current NSHDP for 2018 -2022 serves as the key guiding document for developing the new NSP 2021 - 2025. It outlines specific predetermined objectives and interventions for controlling endemic diseases, including malaria and sets clear targets for the National Malaria Programme. Objective 14 of the NSHDP seeks to "reduce morbidity and mortality significantly due to Malaria and move towards pre-elimination levels" [20]. It represents a significant alignment with the strategies outlined in the current NSP and provides the direction for the Nigeria Malaria Strategic Plan, 2021 – 2025.

3.3 Data collection

This research used a mix of data collection approaches, including observations of the document development procedures, key informant interviews, and document reviews. For objective 1, because of the retrospective nature of the analysis, the only approach I used was the document review. However, for objectives 2 and 3, I used all three methods, with the first being observations, followed by the key informant interviews, and finally, the document reviews. The document reviews objectives 2 and 3 consolidated the findings from the observations and interviews. The use of mixed methods for data collection allowed a rich set of findings to be collected through various perspectives of the researcher and the stakeholders. This section provides a detailed explanation of how the data was gathered through the different approaches and a description of the data sources, the meetings observed, and the documents reviewed.

3.3.1 Document development process observation

I carried out observations while developing the 2020 – 2022 GF Funding Request and the 2021 – 2025 NSP. Several meetings and workshops were held during the development of the two documents; however, due to the COVID-19 pandemic and the country restrictions on physical meetings, most of the meetings were held virtually. One advantage of the virtual meetings was that they were recorded, and I was given access to these recordings. This facilitated the data gathering as I was able to obtain any information I may have missed while taking notes. Since NMEP was my place of work, with the leave of my direct supervisor, I limited my participation in daily activities during the data collection. While observing the development process, I ensured that I took an observation role only and did not

contribute to the discussions. The role of the observer allowed me to review the meetings through a research lens.

I observed three meetings and one workshop each during both document development processes. Table 2 summarised the key official meetings and workshops from the development of the GF Funding Request (objective 2) and NSP (objective 3).

Table 2 Showing List of Meetings and Workshops attended during the Development of GF funding request 2020 – 2022 and NSP 2021 - 2025

Description	Participants	Date	Type of event/ comments
Global Fund Funding Request Development			
RMC MEETING to review and provide an update on the FRs to the EXCO and general CCM	CCM members and GWT	Sunday, 15th March 2020	Meeting (Virtual)
Joint review meeting to address GF-CT comments	GWT	Sunday 22nd March 2020	Meeting (Virtual)
Meeting to deliberate issues identified by TRP and agree on how to address them	GWT	3rd July 2020	Meeting (virtual)
A follow-up meeting to the one held on 3rd July 2020 to address feedback from TRP on joint malaria & RSSH FR	GWT	17th July 2020	Meeting (virtual)
Nigeria Malaria Grant Negotiation	GF-CT and GWT	16th – 18th September 2020	Workshop (Face-to-Face/Virtual)
National Strategic Plan Development			
Planning meeting on the development of Strategic Plan	Nigeria malaria stakeholders	15th May 2020	Meeting
Malaria programme review (MPR) findings dissemination	Nigeria malaria stakeholders	30th June 2020	Meeting
Entry meeting/orientation meeting for NMSP development	NMSP writing team	3rd August 2020	Meeting

NMSP development workshop	NMSP writing team	11th – 29th August 2020	Workshop

(RMC=Resource Mobilisation Committee, CCM=Country Coordinating Mechanism, FR=Funding Request, GRT=Grant Writing Team, GT-CT=Global Fund Country Team, TRP=Technical Review Panel)

During these meetings, the participants held discussions regarding the content of the documents under development, and they request supporting evidence for such discussions. I focused on observing the processes during which the participants required evidence and the sources of the data they used. I made observations of how the NMDR was used to obtain data and made notes of any factors that influenced or hindered data from the NMDR and other sources.

I designed a field note-taking tool in MS Word, which I used to record during the meetings. The tool consisted of fields to record details about the meeting, including meeting name, date, venue, and key stakeholders present. The tool also has fields to record issues raised, who raised the issues, the action required for the issues, and general notes. A sample of a blank field note-taking tool is provided in appendix 4.

3.3.2 Key Informant Interviews

This section describes the sampling, sample size and the approach for the key informant interviews, and the semi-structured interview technique.

3.3.2.1 Sampling

I selected the key informants for the interviews based on their role during the development of the GF 2020 – 2022 Funding Request and the 2021 – 2030 NSP. The NMEP decision making architecture was previously been mapped as part of my OPA and informed the selection of the participants of this study [53]. The decision-making architecture categories stakeholders into technical advice, consultative, and policy endorsement groups whose roles comprise generating evidence, providing technical advice, making consultations, and statutory group involved in policy/strategy endorsement. The use of data during the development of both the funding request and the NSP was primarily under the purview of the key stakeholders in the technical advice and consultative groups. Therefore, I targeted more stakeholders from these two groups and fewer stakeholders from the policy endorsement group. Specifically, I purposively selected the key informants for the interviews to include NMEP head of the branches, representatives from implementing partners, and donor organisations (objectives 2 and 3), the NMEP logistics manager (objective 2), the NMEP NSP coordinator and national consultants (objective 3).

3.3.2.2 Sample size

I carried out ten key informant interviews with participants from across the various NMEP decision-making groups. Some of the key informants from the technical advisory group were interviewed twice as they participated in the two strategic document development processes. Table 2 shows the total number of stakeholders invited to participate in the study and the number who were interviewed, categorised based on their organisational role. The interviewers were invited through sending emails, follow up telephone calls and reminder emails. All 14 stakeholders responded to the invite and agreed to be interviewed and 10 where eventually interviewed. For the four remaining stakeholders, after several attempts to find a suitable time to carry out the interviews, we could not agree on an appropriate time that was convenient for them and fitted within the timeframe of the study.

Table 3 Showing List of Participants by their Organisational Roles

Organisational Roles	Number of Participants Invited		Number of Participants Interviewed	
	Funding Request	Strategic Plan	Funding Request	Strategic Plan
NMEP Staff	2	4	2	3
Donors	1	1	1	1
Consultants	1	3	0	2
Implementing Partners	2	0	1	0

To assess objective 2, I interviewed four participants, which comprise two participants from the NMEP and two participants from partners. To assess objective 3, I interviewed six participants, including three participants from NMEP and three participants from partners. Five participants that were invited that work in the monitoring and evaluation thematic area were interviewed.

3.3.2.3 Semi-structured interviews

I conducted semi-structured interviews with participants identified in section 3.3 above. I designed an interview guide for the key informant interviews; this guide is provided in appendix 5. For the interview process, I started by providing the participants with information about the study and asked if there were willing to participate. After providing the opportunity to ask questions and check their comprehension of the research, I obtained their written consent before initiating the interviews. I also obtained written consent to record the interviews and use anonymous quotes from the interviews while reporting the results. The interviews lasted between 45 minutes and one hour.

The semi-structured interview guide consisted of questions regarding the background of the stakeholders, general use of data for decision making culture, how they used data, and how they accessed data. The background questions provided information such as the stakeholders' institution, role at the institution, and their current involvement in the policy-making processes. The data access questions determined if the stakeholders had access to the data they needed/wanted to make decisions, how they accessed such data and asked their views on the adequacy of data access. The data use questions focused on obtaining information about how the stakeholders used the data they had accessed from the NMDR. The data use questions specifically targeted how and if the data in the NMDR was used for justifying funding in the funding request (objective 2), making recommendations on intervention mixes in the MPR report, and supporting the adoption of the recommendations into strategies for the intervention mixes in the National Strategic Plan (objective 3). I designed the semi-structured interview to allow for the inclusion of additional questions as the need arises during the interview so that I could ask follow-up questions. I adapted and modified the interview guide from the LINK project evaluation protocol [54] and my OPA [53].

The timeline for the interviews was three months post-NMDR deployment for the Funding Request (objective 2) and nine months post-deployment for the NSP (objective 3). I started the interviews immediately after the documents were submitted in both cases.

3.3.3 Document Review

To address objective one and enrich the findings from the observations and key informant interviews, I carried out a systematic document analysis using the READ approach. The READ approach is a systematic approach for document analysis in health policy research and consists of the following steps: ready your materials, (2) extract data, (3) analyse data and (4) distil your findings [55]. I used the READ approach, which gives practical guidance on conducting document analysis to ensure that there is rigour in the review process. In this section, I explained how I carried out the first two steps of the READ approach related to data collection. In section 3.4, I will define the following two steps, which are the data analysis.

3.3.3.1 Ready your materials

For this step, I identified and acquired the documents I require to address the different research objectives. I wrote to the NMEP to request access to digital copies of the required policy documents, and all the requested documents were provided. During the interviews, where the responders mentioned a specific document of interest that was not part of the original list, I asked for access to a digital copy. In most cases the participants were willing to share the document. Below are brief

descriptions of the key documents I included in this review. Table 4 shows a list of the documents reviewed for each research objective.

Table 4 Showing List of Documents used for Analysis

S/N	Objective 1: To **review the national level use of data for developing the 2014 – 2020 national strategic plan and 2017 – 2019 global fund funding request prior to the implementation of the NMDR**	**Access Status**
1	National Malaria Strategic Plan 2014 – 2020, Monitoring and Evaluation plan, Business plan	Yes
2	GF Funding Request 2017 – 2019	Yes
3	Malaria Programme Review 2012	Yes
4	Minutes of meetings	Most
5	OPA report	Yes
S/N	Objective 2: To evaluate how the NMDR facilitates the use of evidence in the development of the 2020 – 2022 Global Fund funding request 3-months post-NMDR deployment	Access Status
1	GF Funding Request 2020 – 2022	Yes
2	Minutes of meetings	Most
3	Email correspondence	Most
4	Recordings of virtual meetings:	Most
5	Technical Review Panel feedback and response	Yes
S/N	Objective 3: To assess how the NMDR facilitates the use of evidence for the development of the 2021 – 2025 strategic plan 9-months post-deployment of the NMDR	Access Status
1	National Malaria Strategic Plan 2021 – 2025	Yes
2	Minutes of meetings	Most
3	Email's correspondence	Most
4	Recordings of virtual meetings	Most
5	Malaria Programme Review 2019	Yes

3.3.3.2 Extract data

For each of the documents I reviewed, I read the content thoroughly, including the annexes. I created structured review templates using Microsoft Word as data extraction tools (see appendix 3 for the data extraction tool). The relevant information I extracted from the documents using the tool

includes the kinds of evidence used, the sources of evidence, and if the source of evidence is the NMDR, then which type of data was used during the document development process.

For GF funding requests documents, I extracted information about the sources of evidence used in relevant sections of the document from the country context and the lesson learned sections to determine if evidence from available data, including implementation reports, are used for decision making. I also extracted information regarding the considerations made for the deployment of interventions at the subnational level. I pulled data on the risk priority and evidence used for assessing the risks from the implementation framework section.

For the MPR documents, I extracted the sources of evidence used to inform the country context, the epidemiology and performance review sections. I also pulled information from the recommendation section to ascertain the considerations in guiding for prioritising intervention mixes at the subnational level.

For the NSP documents, I extracted the sources of evidence used to inform the recommended strategies from the country context and current situation analysis sections. I also extracted information that shows the degree of spatial granularity of data use, for example, in subnational stratification of intervention mixes.

For all the other documents, I also extracted information that describes the use of evidence, the sources of the evidence, and how evidence from the NMDR was used to develop the strategic documents. The other documents, such as the reports of geospatial analysis, provided concrete examples of the kind of data used from the NMDR.

3.4 Data management and analysis

Data management began with the design of the research instruments. I made all efforts to ensure that the study variables were operationalised to reflect the study's objectives. I designed and used systematic data collection tools such as document review and data extraction template for meeting observation and interview guides. The interviews were recorded digitally and kept on a password-protected computer, which can only be assessed by the researcher and, where necessary, the supervisory team. Once the interviews were transcribed, I deleted the audio recording of the interviews. I used the services of an expert transcription company to do the transcription. I used the notes I took during the interview and audio files to check the transcription quality, which I found sufficient. I then asked the stakeholders to review the responses I intended to use as anonymous quotes for validation. The data extraction tools I used for the observations and document reviews were also managed on the same secured computer as the transcribed interviews.

Sections 3.4.1 and 3.4.2 describe the two approaches for data analysis approaches I used to carry out thematic content analysis [56, 57] and process tracing analysis [58].

3.4.1 Thematic content analysis

Prior to the commencement of the data analysis, I outlined *a priori* thematic areas for coding purposes as basic theme grouped to address objectives of the study. The thematic areas include stakeholders involved, access to NMDR, availability, and data readiness as "enabling factors". Other themes include how the data was used and crucial steps in decision making during the development of documents under the processes as describe by Attride-Stirling [56]. Figure 4 is a mind map used for the data analysis, which outlines the *a priori* thematic areas as the organising and global themes. NVivo was used to find and catalogued themes to see connections between themes and move toward analytical insight for the transcribed interviews. NVivo mapped key findings from the interviews to the relevant thematic areas. As a quality check measure, I manually verified the correctness of some of the mapping by analysing the transcripts.

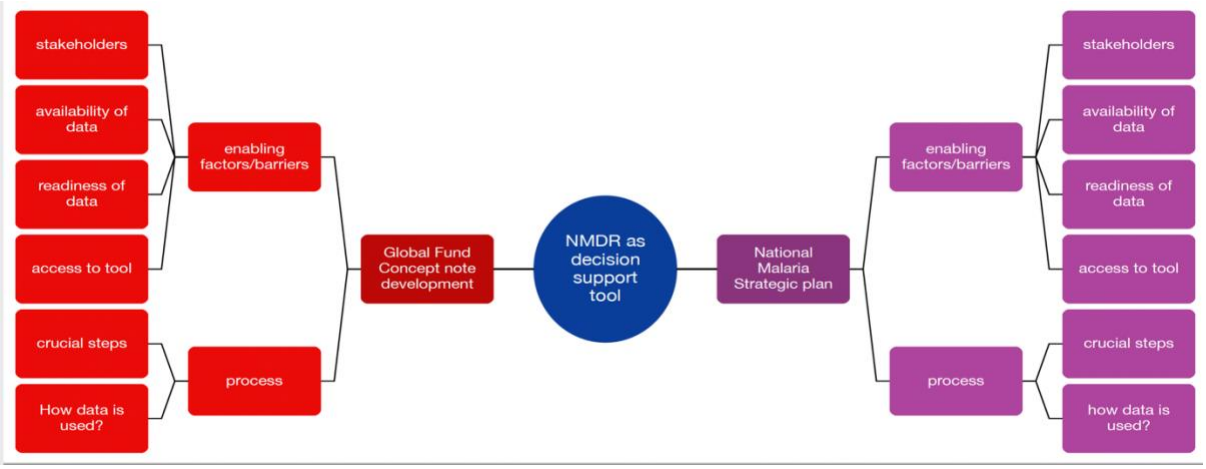

Figure 7 Showing Mind Mapping of the Thematic Codes from NVIVO

I also analysed the findings from the observations and triangulated the results with the NVivo analysis. The data extraction tool I used for recording the observations was designed to be consistent with the core themes applied in the NVivo analysis. I also analysed the data extracted using the document review extraction tool, which is the third step in the READ approach [55]. The document analysis complemented the NVivo and observation analysis as it also considered the same thematic areas. During the study of the various findings, more themes that were not previously defined emerged. The additional themes included sources of data, perceptions and challenges using the NMDR.

3.4.2 Process tracing analysis

The process-tracing analysis was based on the findings from the thematic analysis. I described the results using a tool I developed based on the steps involved in developing the two strategic documents. With the help of the tool, I explained how data access and use changed during pre-and post-NMDR document development. For the Funding Request, I described and compared the use of data before and three months post-implementation of the NMDR (objectives 1 & 2). For the Strategic Plan, I described and compared data use before and nine months post-implementation of the NMDR (objectives 1 & 3). In this research, I explained possible confounders of the result that showed the change in data usage. I developed separate comparison tools for the two documents (see sections 3.4.2.2 and 3.4.2.3). The following section explains the comparison tool and the approach I used to measure and compare data access and usage in the steps of the document development processes.

3.4.2.1 The comparison tool

The comparison tool described how, and which data was used during the steps that typically require data usage. I used the tool to evaluate the data usage levels for each of the activities described with the tool. I coded three levels of data usage: (1) inadequate data use, (2) some data use and (3) good use of data. The evaluation metrics to determine the different levels are based on three criteria: the availability of correct data, accessibility of the data, and data usage. To qualify the availability of the right data, I considered the existence of data with the following characteristics: accurate and complete to ascertain quality, most recent data and local data. I determined the accessibility of the data by checking how easily the stakeholders were able to find and retrieve the data. The data usage was simply checking if the data was used for that specific step or not. For each of the document development step, I carried out the evaluation by completing the following assessment tool shown in Table 5.

Table 5 Showing Assessment Tool for Evaluating NMDR

Document development step: Specific activities:	
Evaluation Metric	Response
1. Is the right kind of data available?	Yes/No
2. Is the data accessible?	Yes/No
3. Is the data used in this step?	Yes/No

The scores for all three metrics determined the level of data usage for each step; if all the metrics have a positive response, then the score is 'good use of data'. If two metrics have a positive response, then the score is 'some data use'. Finally, if only one or none of the metrics have a positive response, then the score is 'inadequate data use'.

Since this research was evaluating how the NMDR facilitated the use of data, I determined that the main role of the tool was to give easy access to data. Therefore, I carried out the second level of assessment to check the part of the NMDR by comparing the pre-and-post-NMDR responses for the accessibility metric. For each step with a negative response to the accessibility metric in pre-NMDR, I checked if the response turned positive in the post-NMDR and whether the data was accessed through the NMDR. It is possible to access data through other means, so by checking this, I used descriptive inference to explain the causality of the NMDR in providing access to the data.

3.4.2.2 Assessing levels of data use for Global Fund Funding Request development

The tool to compare data for the Funding Request before and three months after deployment of NMDR is based on the steps involved in the document development process. The development of GF application proposals goes through different stages that usually take 6 to 9 months. The first stage is for the GF to launch the funding opportunity with an allocation envelope to each country, stating the available amount to be accessed. The application will then feature a differentiated process that requires governments to develop a funding request according to their needs and specific context [51]. Each application will then require different review and approval processes, including meeting the country coordinating mechanism eligibility and dialogue within in-country stakeholders. The RBM partnership typically supports countries by organising orientation and mock review workshops to have a good proposal [59]. Details of how to carry out each step, including the right kind of data to use where necessary, are in the guideline for developing the funding request. I used the comparison tool to score and compare the level of data usage pre-and-post-NMDR as explained in section 3.4.2.1.

3.4.2.3 Assessing levels of data use for National Malaria Strategic Plan development

Similarly, the comparison tool for the NSP was based on the steps in the development process. The tool was used to compare data usage before and nine months after the deployment of the NMDR. The development of both NSPs occurred in a series of seven steps, which are: organise and prepare the planning process (Step 1), conduct situation analysis (Step 2), develop a strategic framework (Step 3), develop an implementation framework (Step 4), develop M&E framework (Step 5), finalise and adopt the strategic plan (Step 6) and disseminate strategic plan and mobilise resources (Step 7). For this comparison, the focus was on the first five steps, which are the only ones that typically required data usage. The comparison tool described which data was used and how the data was

used to carry out the activities in the five steps. To identify the activities with data requirement, I reviewed the WHO manual, which specified the steps and details of the activities involved in each step. The manual also selected the appropriate data and sources of the data where the activity required data. The comparison tool was used to score the level of data usage based on the evaluation metrics described in section 3.5.2.1 and compared any changes in the levels between the pre-and-post-NMDR processes.

In the following two chapters, the results of the data analysis and the comparison of data usage pre- and post-deployment of the NMDR are presented.

3.5 Research Project Ethics

In keeping with considerations for human subject's research, all regulations and standards established by LSHTM Ethics Committees and Nigerian Health Research were maintained. I then obtained approvals with reference number 19200 (appendix 6) and NHREC/01/01/2007-12/05/2020 (appendix 7) from the respective committees. I also got informed written consent from each participant before the interviews. Before the observatory meetings, I received verbal consent that allowed passive participation and note-taking.

I administered information sheets and consent forms to individual participants, which assured that their involvement is voluntary, and I will treat their responses with the utmost confidentiality. I identified anonymous quotes from participants with a unique study identification number and date of interview; I used these to emphasise specific points in the report. As the study involved a small number of participants, I paid particular attention to preserving their confidentiality. I separated the participant names from the unique study identification numbers at the end of the study. Therefore, no data could be linked back to individuals.

Chapter 4: Results of evaluation of the NMDR in promoting the use of evidence during the development of The Global Fund Funding Request and the National Strategic Plan

4.0 Overview

This chapter describes the results obtained for this study, which show the role the NMDR played in terms of use of evidence during the development of the Global Fund Funding Request and the National Strategic Plan. The chapter presents the result in two main sub sections that correspond to the two document developments. Each subsection describes the results of the data collection from two time periods, pre-NMDR and post-NMDR. The sub sections then present analysis that compare the use of evidence between the two time periods to measure if there is any change and whether the NMDR contributed to this change.

4.1 The Global Fund Funding Request

This section presents the results from the interviews, document review and participant's observations to assess if data was used during the development process of the funding request and the factors that influenced the use of data. The section also presents the results that highlight how the data from the NMDR was used, the challenges with the use of data in general and whether or not the NMDR addressed these challenges in the short term.

4.1.1 The process of developing the Global Fund Funding Request

The Global Fund funding request application process requires several steps, as outlined in the Applicant Handbook 2020 – 2022 [51]. The steps include preparation for the next funding cycle, the allocation, developing the funding request and the set of activities that happens after submission to ensure approval (Figure 6). The Global Fund country team (GF-CT) conducts capacity-building workshops for representatives from countries to ensure compliance with the guideline and successful application.

Nigeria commences the preparation of the next funding cycle in the second year of implementation. The country coordinating mechanism will task the implementers – principal recipients (PR) [60] across HIV, TB and malaria portfolio – to present the status of implementation vis a vis financial report. This process initiates the series of meetings as part of country dialogue across all stakeholders. NMEP being a PR develops a plan for submission targeting Window 1[1] to avoid interruption of transition to the next grant implementation period.

[1] Window 1 refers to the first opening for Funding Request submission usually in March of the application year

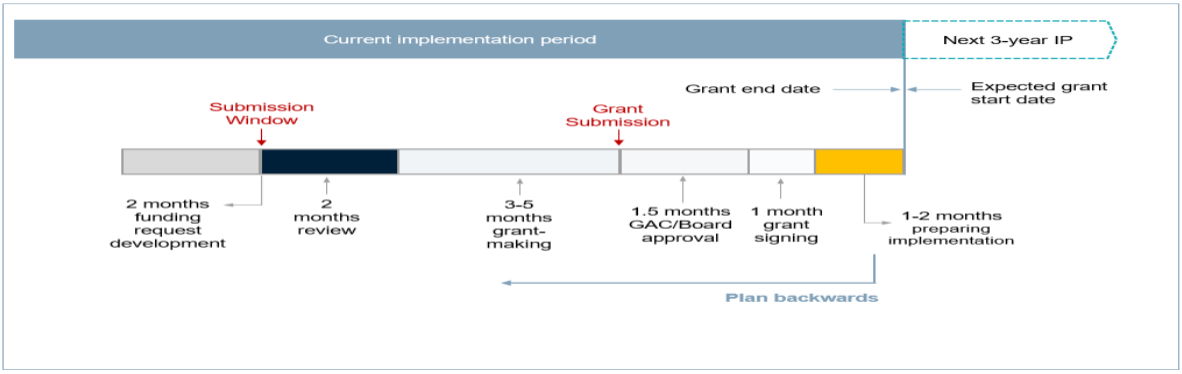

Figure 8 Global Fund Funding Request Development Process Source: [48]

The country usually conducts epidemiological trend analysis to ascertain the current status or uses the results from program reviews if it coincides with the application period. The findings are incorporated into the funding request, especially lessons learned for optimisation of the next grant. Through the Global Malaria Program (GMP) and the other stakeholders, the WHO provides technical assistance where writing consultants are engaged to support countries in the application process. The next step is when the GF-CT shares the allocation letter with details on replenishment, preferred interventions to be deployed, and how countries can meet the eligibility criteria for matching funds for domestic financing. The letters also outline the catalytic investments and portfolio categorisation across the three diseases. The letter will also suggest the preferred application approach with options of changing if certain conditions are met.

As outlined above, the application process commences with drafting a writing team (WT) and country dialogue meetings through the country coordinating mechanism (CCM) will confirm the Program split between the allocation letter and joint funding requests by disease area. The WT will ensure the funding request is aligned with strategies in the NSP and other country support plans. After submission, the technical review panel (TRP), which is an independent body, assesses the document for technical soundness and allocation of resources to the most impactful interventions. Usually, the TRP sends back the application with comments on improving the documents with a turnaround of two months. The TRP will then approve the funding request to commence grant-making. The grant-making will delve into details by developing implementation plans with budgets and performance frameworks from the strategies outlined in the funding request. From there, GF-CT will present the funding request to the Grant Approvals Committee (GAC) in the global fund board for approval and grant signing. The overall process from submission of the funding request to grant signing may take nine months or longer in some cases, depending on the length of grant-making.

4.1.2 Pre NMDR use of data during the development of the 2017 – 2019 Global Fund Funding Request

To understand how data was used during the development of the 2017 – 2019 Funding Request, this study analysed the Funding Request, supporting documents, minutes of meetings that happened during the document development and email correspondences. The analysis addressed part of objective one to establish pre-NMDR use of data. This section reports on the result of the document analysis, which identified the data and the sources of the data used in the development of the funding request. The analysis also identified some challenges regarding access to the data faced by the team and other issues that arose as a result of the lack of use of data for some of the processes.

4.1.2.1 The data used and sources of the data

The findings from reviewing the Funding Request documents and notes from meetings during the development show the process was based on available evidence. Over the years, there have been deliberate efforts to improve access and evidence to set priorities for the GF investment, so the use of data was not surprising. For programs to be positioned to maximise impact, their design must be grounded in the country's epidemiological, operational, social, political and economic realities or regional context and draw on lessons learned from previous implementation periods. There were discussions obtained from meeting notes that presented the kind of evidence used, which included uptake of interventions, epidemiological impact and lessons learned from the previous implementation to guide the deployment of interventions for the most impactful results. The 2017 – 2019 funding request document describes the lessons learnt from the previous implementation in section one of the document, which provided the context of the proposal.

Findings from reviewing the meeting notes also show discussions on how best to ensure the selection of GF priority states for deployment of interventions. In the discussions, decisions were taken to carry out the prioritisation exercise by ranking the states based on a suitability index [60]. The suitability index consists of variables like the disease burden estimates, coverage indicators, vulnerability to re-emergence of malaria, socio-economic index, and previous GF investment in the states. The disease burden was estimated by eliciting the state-specific prevalence rate for malaria from the 2015 malaria indicator survey (MIS) and factoring in the state-specific population estimates [61]. The assessment of the coverage indicators involved obtaining data about household ownership of mosquito nets, uptake of intermittent preventive treatment during pregnancy and health facilities reporting rate onto DHIS2. The coverage indicators data were obtained from MIS 2015 and the DHIS2. The assessment of section two of the funding request uncovered information about the states selected through the prioritisation exercise. The detail of the prioritisation exercise was in the

states selection section in the document, which describes all the suitability index variables and sources of the variables [60].

Another finding from the assessment of the discussions of the meeting and the review of section two of the funding request document is regarding the gap analysis. The gap analysis required a need assessment for the country on the various interventions while overlaying with available resources to understand the gap to guide the funding request. For example, the commodity needs for ACTs and RDTs were determined by analysing data on malaria cases and fever cases, respectively, while controlling for factors like reporting rate, potential changes in health-seeking behaviour, population changes and impact of previous vector interventions. The malaria cases and fever cases were obtained from routine data on the DHIS2.

Section two of the funding request make reference to the performance framework table for setting the testing and treatment targets for the 2017 – 2019 implementation period. These two targets were set based on data from the previous years on the DHIS2.

In summary, the level of data use was appreciable during the 2017 – 2019 Funding Request development. However, there were some challenges which will be discussed in the next two sections. The majority of the data was obtained from the DHIS, and MIS 2015 reports to inform analysis such as the gap analysis and GF state prioritisation.

4.1.2.2 The challenges of Use of Data

During the document review, this study identified some challenges with the use of data during the document development. One of the challenges that were prominent in the notes of the meeting was the availability of data. Due to the rising need for more evidence in setting priorities for the GF investment, there was a lot of discussions around how to access data. In addition to access to the data, the discussions raised awareness of the lack of current data. This analysis showed instances where there was no choice but to use outdated data because the new version was not available. For example, most of the evidence used to ascertain and prioritise intervention was collected three years prior to the implementation period. Therefore, some of the baseline targets set in the performance framework proved to be difficult to achieve, while others seemed easy.

There were also instances when the current data existed, but it was not easy to access. For example, the Global Fund does gap-filling with its financing; therefore, there is a requirement to demonstrate domestic financing for Nigeria to justify the continued investment. Analysis of the meeting notes revealed that obtaining budgeting documents and evidence of expenditure from the sub-national

level to demonstrate the domestic financing was not possible because there were no proper records for such data.

4.1.2.3 Challenges Resulting from Lack of Data Use

Another challenge found in the review of meeting notes is the lack of district-level stratification to determine the most impactful interventions to optimise the selection of interventions. This necessitated selecting interventions to be guided by other factors such as available resources or donor preferences during the document development. The lack of data use also gave rise to other issues, for example, the programme split for systems strengthening which were heavily debated in the meetings. Global Fund has a grant that supports resilient and sustainable systems for health (RSSH), which aims to strengthen systems across the three diseases, which are Malaria, TB and HIV. There were a lot of discussions on the programme split for the grant documented in the meeting notes. This review also analysed the letter of allocation from the Global Fund, which recommended 10% of funding allocations to the RSSH grant in the 2017 – 2019 cycle. The argument found in the meeting notes was that the contributions of the 10% did not take into consideration the different programmes' specific needs. For example, the malaria programme requires all health facilities to report into DHIS2 and commodity distributions to the last mile than any other programme. Although the funding allocation for the malaria programme was more than others, after considering the 10% contribution from malaria, the funding needs still exceeded what was made available for malaria-related systems strengthening. The other specific program-related need like procurement of a gene expert machine for TB programme requires more resources but would add little or no value in strengthening the malaria health system.

4.1.3 Post-NMDR use of data during the development of the 2020 – 2022 Global Fund Funding Request

To understand how data was used during developing of the 2020 – 2022 GF Funding Request while factoring in the role of the NMDR in the process, this study analysed documents, carried out observations in meetings and conducted interviews with relevant stakeholders. This section presents the results from the data collected that describes the use of the data in general, including data obtained from sources other than the NMDR. The results then further describe the data used from the NMDR and how it addresses some of the data issues that existed before implementing the tool.

4.1.3.1 Use of data during the development process

The responses from the interviews confirm that data was used during the development of the 2020 – 2022 Global Fund Funding Request (FR). The respondents describe the use of evidence as one of the factors, such as the availability of funding, that contributed to the development process.

> *"Yeah, so basically, we looked at the availability of fund, we looked at the evidence... where we have very strong evidence that is worth, we dig into that. However, whatever we are doing irrespective of it should be within the cost of fund approved for the country"* **Implementing Partner**

The evidence used was mainly from surveys and service utilisation data from DHIS2. Although, there were concern raised on the quality of routine data. Other data sources include policy documents like the NSHDP and National Agency for Food and Drug Administration and Control.

> *"… So, they are so*[many] *survey documents, but we also have routine data from the DHIS, malaria information system, or health information system. There is a lot of argument for the core M&E people. Uh, they don't tend to quiet* [agree with routine data on DHIS]*; uh, they are not too comfortable with the results, but though it's been improving over time, so they use that too. We also have a number of studies..."* **NMEP Staff**

> *"Yeah, so basically, we use MIS, I have mentioned NDHS, then we equally use the Nigerian National Health Policy 2016..., and NSHDP… We also made reference to the NAFDAC document where applicable because... So, we [also] try to make reference to the Federal 99 constitution of Federal Republic of Nigeria… we use UN women … So, basically, these are the documents I can remember that we used, but there are more…"* **Implementing Partner**

A review of the funding request and the meeting notes show how data was used to carry out the programme needs assessment. This assessment used data from the implementation of the Resilient System for Sustainable Health grant to guide the Program split. The allocation of resources to system strengthening issues were prioritised for cross-cutting interventions and focused on optimisation of resources for each disease programme. The available evidence showed that malaria and HIV programmes would benefit more from these cross-cutting interventions; therefore, these programmes alone contributed to the RSSH funding. The details of the contributions to the RSSH funding and a justification for the contributions are in section one of the funding request.

The document review and responses from respondents also show that there has been some improvement in the availability of data over the years, which may have influenced its use during the development of the current funding request. However, having more data available is just one factor; without the right tools to easily access the analysed data, it will be difficult to use it. For example, the results in the previous section of the 2017 – 2019 Funding Request have demonstrated that even though data on domestic financing existed, it was not readily accessible for use during the document development.

The respondents identified some challenging factors that may hinder the use of data in developing the FR, especially if the data is to be obtained from external sources. One of the factors is having to

rely on desk officers, custodians of the data, who are often slow to respond to a data request. Another factor is the bureaucracies involved when sharing data across organisations.

> *"… The only difficulty might be maybe the desk officer responsible for guarding those data might not be too quick to respond or depending on the data sharing policy between organisation... In-information on vector surveillance was not in the program that we needed to get from another organisation that had implemented in the past. Meaning we had to write to them and following up with series of text messages and calls before they reverted."* **NMEP Staff**

In summary, the respondents mostly agree that data was used during developing the 2020 – 2022 Funding Request despite some reporting that the use of data was not a critical component. The respondents also identified some challenging factors with the use of data in terms of getting easy access to the data. The next section will show responses that describe examples of how the data from the NMDR was used.

4.1.3.2 The use of data from the NMDR

One of the rationales behind the development of the NMDR was to increase data access and subsequent use in developing policy documents. To assess the use of the NMDR during the development of the Funding Request, it was important to determine if the relevant stakeholders had access, the right knowledge and the necessary skills to use the tool. The outcome of the interviews shows that the relevant stakeholders had access to the NMDR and were familiar with the main functionalities of the tool. The following responses indicate that the stakeholders agreed that the tool was useful and demonstrated an awareness of the kind of data, both routine and non-routine, that were available through the NMDR. The responders also agreed that the NMDR made data more readily available to decision-makers.

> *"Yes. So, NMDR, as I mentioned, is very useful because you try to collect... It is a data bank for all malaria-related activities. So, even though we have, um, one or two things to add to improve on it, it has been helpful that-in such a way that you can be able to access non-routine data, and this is the first time actually in the country that we have a platform like that that gives you information about non-routine data and routine data and including surveys. So, it has been very, very helpful, and we will continue to build on it to improve access to more data because one of the biggest challenges is getting data to feed into that, but we will continue to improve on that."* **Implementing Partner**

> *"… the national malaria repository, that has made it easier for many users. So, what that malaria repository helps us do is to put up all this data we are having challenges and harmonise them together to a high level. And whoever that wants to take the decision or make any decision and looking for data can easily log in or go in through the malaria repository, data repository and see what routine data and non-routine for use..."* **Implementing Partner**

However, there was an opinion that the NMDR required some improvements, although this opinion also indicated that the need for improvement did not deter the use of the tool. The observation of

meetings revealed a divergent view from a few participants who believed that the NMDR was still under development; therefore, they could not use it until fully operational. This could indicate a lack of understanding that the development of IT tools such as the NMDR does not need to be at 100% before it can be launched and used for obtaining data for data-informed decision making.

This analysis shows how the NMDR was used during the development of the Funding Request. During several meetings, the stakeholders discussed the decision to use the tool to obtain relevant data wherever they established the need to carry out an analysis that will require such data. During the interviews, the responders also mentioned that they used the NMDR to obtain data.

> *"So, the NMDR provided basically the data, the framework where the developers and the program went to pull data."* **NMEP Staff**

Some examples of data use from the NMDR were identified from the FR and meeting observations. These include carrying out a gap analysis, intervention mix analysis and the development of the performance framework. For the programme gap analysis, the team determined the number of commodities needed to be budgeted for in the FR by analysing historical routine health facility data from the NMDR and household campaign data for LLINs. The data from the NMDR included routine malaria variables like the reporting rate, fever cases, testing rate and treatment with ACTs. The household campaign data are population estimates and LLIN campaign data from campaign reports. The intervention mixes featured in the FR were based on geospatial analysis, which utilised data from the NMDR and other data points from survey data. For example, the decision to scale up seasonal malaria chemoprophylaxis to more states was based on analysis that looked at data for rainfall distribution and malaria cases from the NMDR. The criteria for a state's eligibility for the scaleup are 60% of rainfall occurring within 3-4 months of the year and parasite prevalence of more than 5%.

During the development of the funding request, the routine data from the NMDR, which shows the performance of indicators from previous years, were used to inform setting the targets for the 2020 – 2022 performance framework. For example, graded testing rate and treatment of ACTs were set based on the trend from the previous implementation with mark up to reflect projected improvement.

> *"And then for the information we have on the performance framework for the routine, which is from the HMIS, we pull data from the National Malaria Data Repository."* **NMEP Staff**

> *"Then we also get, um, indicators from the NMDR on, um, case management for testing to know those that, um, had suspected malaria cases that presented at the clinics or hospitals. And of those that presented, how many of them had parasitological tests either by microscopy or [RDT].*

And of those who-those cases that had his parasitological testing, how many of them tested positive. All of these indicators and their proportions are derived from the National Malaria Data Repository and plugged into the performance framework." **NMEP Staff**

Other components of the NMDR and the type of data that the responders found useful for the exercise include the expenditure analysis to show domestic investment in the malaria programme.

"But we also have, in terms of program management, like expenditure analysis of malaria, which is also very, very good. At least you can log into that and see how funding support has been coming into the country by specific donors or partners, as the case may be. So, I think these are areas... and we are still adding more to it, which is also good for the NMEP team." **Implementing Partner**

"Additionally, there is also, um, an aspect that tracks government spending. If I want to know what fraction of the budget has the government... What fraction of budget has been committed to health on malaria, I can just go to the repository to, um, look at that specific, um, data." **NMEP Staff**

The main motivation for using the NMDR as a data source includes the ease of use, quick access to the data and how the tool provides a platform for data visualisation for both routine and non-routine data in one place.

"It has been very useful, um, because in the past, if I needed data for the LLIN mass campaign, I would need to write to either the implementer or the IVM branch to provide me with that data. And most times, when you write to them, maybe they are in the field, trying to do some activity, and the epileptic nature of the network may not allow them to respond as timely as possible. Then now, I can comfortably go to the National Malaria Data Repository to pull, um, data on LLIN mass campaign…" **NMEP Staff**

In addition, the GF has recognised the NMDR as one of the main sources of data for malaria programming. This gives the users confidence in using data from the tool as the GFs recommendation gives it more credibility.

"Other places now, for example, Global Fund, some of the data sources are being listed as the NMDR. So that shows you that the value that it will bring is recognised as one of the national data sources that you can use as a means of verification if anything happens, to know what achievements have been done. You can go there and pick from there." **Donor**

However, few responses stated that instead of evidence, the funding organisations play a crucial role in decision-making in setting direction in the funding request.

"Most of the time, the organisation that pays actually dictates the tune. Even though er, we often talk about sustainability, the ownership that is owned by the state, each state is not able to provide adequate funding. So, they actually, they play according to the dictates of the organisation that's financing it. But the degree to which the organisation is financing it hold it or hold on to it depends on that organisation. Some organisations, they are-they are happy to spend

money, but they still operate from the background, while some, they want to dictate everything since they're spending the money. So, I think the crucial step there-step there is the funding."
Consultant

A situation that seems to support the assumption of funding organisations' desires being more influential in decision making than data is the decision to continue with funding in the existing GF states. The WT selected those states during the previous cycle using a suitability index, but no such analysis for selection was carried out for the 2020 – 2022 FR. There were arguments in the meetings that some of the state's statuses may have changed, rendering them no longer eligible to be included. However, the counterargument was that the three-year span between the previous cycle and the current one is not long enough to make enough impact such that it is safe to remove funding. There was a fear that any progress made in such states may suffer a setback if the funding is prematurely stopped.

In summary, the results show that data from the NMDR was used during the development of the 2020 – 2022 FR. The responders found the tool valuable, and the GF even recognises it as a source of data.

4.1.4 The pre-and-post-NMDR implementation comparison of data accessed and used in 2017 – 2019 and 2020 – 2022 Funding Requests

The results of the study show how data was used during the development of the GF FR both before and after the implementation of the NMDR. This section compares the study findings shown in figure 7 to identify if there is a change in data access and use. The comparison is based on how data was used in the various activities of the document development steps. In section 4.1, we have already discussed the details of the activities involved in each step. The comparison gives examples of activities that typically should be based on data and an assessment of the level of data use. Briefly, the levels of data use pre-specified *1) good use of data, 2) some data use*, and *3) Inadequate data use.* In section 4.1, we have already discussed the details of the activities involved in each step.

4.1.4.1 Comparison of the use of data in 2017 – 2019 and 2020 – 2022 Funding Requests

Figure 7 compares data to use during the FR development for 2017 – 2019 and 2020 – 2022.

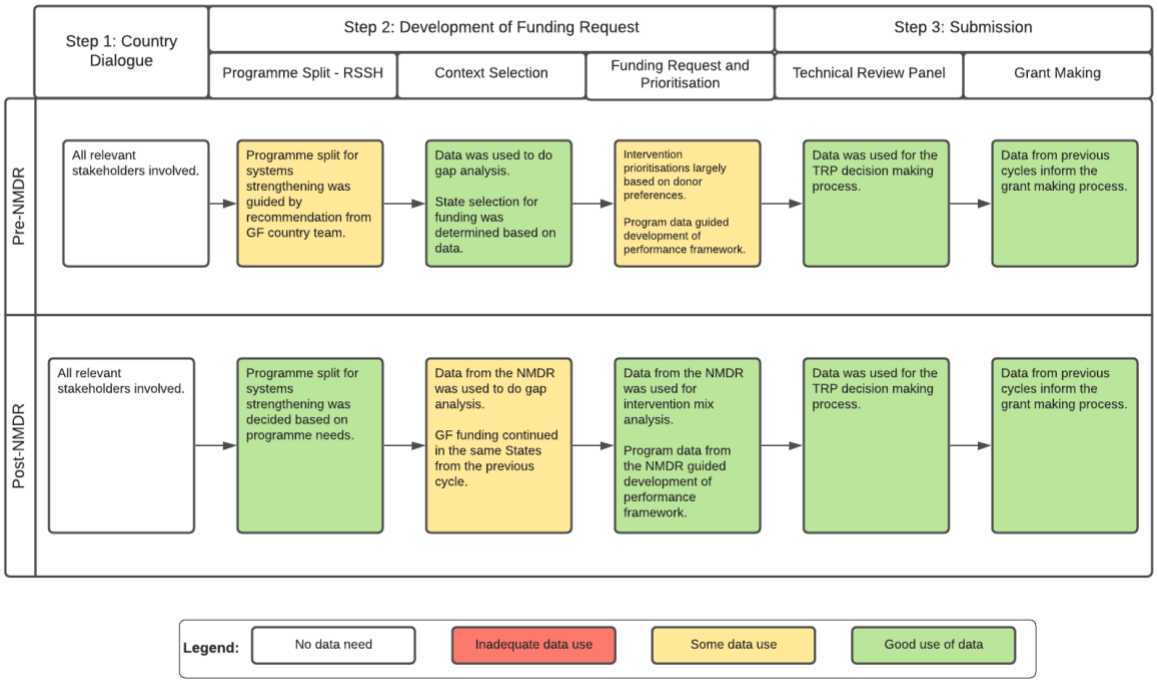

Figure 9 shows the comparison of the use of data in 2017 – 2019 and 2020 – 2022 Funding Requests

In step 1, for the 2017 – 2019 and 2020 – 2022 processes, all the relevant stakeholders participated in the country dialogue, and there was no need to use data for that step.

The second step consisted of activities like the programme split for systems strengthening, context selection, funding request, and prioritisation. For the programme split in the 2017 – 2019 process, the GF country team recommended that all programmes contribute 10% of their funding allocations to RSSH. This recommendation was not based on any analysis that identified the programmes' specific needs to justify the 10% contributions. As a result, the score of this analysis for the programme-split activity of pre-NMDR was *'inadequate data use'*. Whereas for the 2020 – 2022 process, the funding contributions from malaria to the RSSH were based on the programme needs and scope. The use of data to do a programme needs assessment in the post-NMDR gave a score of *'good use of data* for that activity. It is worth noting that the data used in the programme need assessment was not obtained from the NMDR.

In the second activity of step 2, which is the context selection, for both the 2017 – 2019 and 2020 – 2022 processes, the WT used data to identify programmatic and financial gaps. The gap analysis is to determine the "why" behind the funding request. Data for the gap analysis in 2017 – 2019 was obtained from household surveys, and for the 2020 – 2022 development, the WT used data from the NMDR.

In the context selection, the states that will receive funding were identified. The WT used data to do the prioritisation exercise which informed the States' decisions in 2017 – 2019. However, for the 2020 – 2022 cycle, the GF did not do a prioritisation exercise but rather continued the funding in the states from the previous cycle. Although there was data from the NMDR which indicated changes in malaria prevalence in the states, this did not influence the state selection in 2020 – 2022.

Since data was used for the two sub-activities of context selection activity assessed in this analysis, the context selection for the pre-NMDR had a score of '*good level of data use'*. This score reduced to '*some data use'* for the context selection in post-NMDR since data was not used to inform the decision in one of the two sub-activities.

For the funding request and prioritisation activity, during the pre-NMDR process, the donors had some level of influence over which interventions should be prioritised. Whereas during the post-NMDR process, intervention mix analysis was conducted to inform the deployment of interventions. For example, the deployment of SMC was expanded from four to ten states when the intervention mix analysis indicated the eligibility of those states. The WT used data from the NMDR for the intervention mix analysis. In both the pre-and-post-NMDR processes, program performance data guides the setting of targets for program implementation and oversight. For 2020 – 2022, data for the performance framework was also from the NMDR.

The score for the pre-NMDR was '*some data use'* since one of the sub-activities ties in the funding request, and prioritisation activity was based on donor preference and not guided by data. In the post-NMDR, the score improved to '*good use of data'* when all the funding request and prioritisation activity decisions were based on analysis guided by data.

For the final step, which is the submission, there are the TRP activities and grant-making activities. The TRP used data in its decision-making process for both the 2017 – 2019 and 2020 – 2022 processes. The TRP always bases its recommendations on evidence that is available at the time of review. During the 2020 – 2022 review, there was an improvement in data availability, which prompted the TRP to use it for reviewing the funding request. For example, insecticide resistance monitoring data was available at scale to inform the deployment of viable insecticides used for LLIN; thus, the TRP requested this data during the review process. In this final step, the grant-making process was based on the lessons learned from the grant-making in the previous cycle. For both the pre-and-post-NMDR TRP and grant-making, the score for the analysis of data use was *'good use of data'*.

4.1.4.2 Summary of differences highlighting improvements or not as a result of NMDR

In summary, the findings of this study and the comparison of the pre-and-post-NMDR development of the FR demonstrate that the tool has had an impact in making data more accessible, thereby encouraging the use of data. Even though data availability has improved over the past few years, it is still important to have the right tools that will make access to the data easier.

The development of the FR before the NMDR implementation had a good level of data use; I have cited several instances where data from the DHIS2 was utilised. Figure 7 does not show any activity from the FR steps that had inadequate data use. The NMDR was launched three months prior to the development of the FR, and this study shows that afterwards, there was an improvement upon the culture of data use with the NMDR making it easier to access data. The NMDR gives access to the DHIS2 data through a more user-friendly interface with tools for visualisation. Importantly, the tool restricts the data points to malaria-relevant data points, thereby reducing noise from the rest of the data on the DHIS2.

An example of an improvement of data access with the NMDR was seen in domestic financing data. Before implementing the NMDR, this data existed in the different States in a very distributed fashion which made it very challenging to access. The NMDR has an expenditure analysis feature that shows domestic investment in the malaria programme and donor funding.

4.2 The National Strategic Plan

This section presents the results from the interviews, document review and observations to describe how the NSP was developed, identify if data was used during the development process of the past and current strategic plans and the factors that influenced the use of data. The chapter also presents the results that highlight how the data from the NMDR was used, the challenges with the use of data with respect to the development of the NSP in general and whether or not the NMDR addressed these challenges.

4.2.1 Framework for analysing the use of data during the development of NSP

To understand the use of data in developing the NSP, I present the different steps involved during the process to establish the analytical framework. Figure 8 shows an overview of the different steps involved during the development of both the NMSP 2014 – 2020 and 2021 – 2025 plans. The first five steps are where data use activities were carried out; therefore, the focus was on assessing those specific steps.

Figure 10 shows steps in developing a strategic malaria plan Source: [59]

The WHO AFRO team published the revised manual for developing the national malaria strategic plan (NSP) in 2019 [62]. The steps in the revised manual are similar to the previous manual, which guided the development of the 2014 – 2020 NSP. The main difference between the two manuals is that the malaria program review (MPR) is no longer part of the strategic plan development process but rather an independent exercise that generates an output that can be used in the situation analysis of the strategic plan. The new manual does not mandate the use of the MPR, but if it is available to include it in the situation analysis. The current WHO manual outlined seven steps required to develop an NSP [62].

The first step is organising and preparing the planning process, which involves obtaining approval from the ministry of health (MOH), setting up a steering committee by thematic areas and appointing a facilitator to guide the process. Stakeholder analysis is also required in this step to understand relevant actors' behaviour, intentions, interests and how these may be leveraged in the development of the NSP [30]. Technical assistance and gathering of information are required to support the development process.

The second step is conducting a situation analysis which involves a review of epidemiology, entomology, policy and management framework. A malaria program review that was done in the last two years was used in lieu of the WHO guideline. A strengths, weaknesses, opportunities and threats (SWOT) analysis and progress assessment towards national, regional and global targets were conducted – programme review and validation.

The third step is developing a strategic framework, which involves outlining the programme vision, mission, strategic direction and policy priorities. It also involves using available evidence to develop NSP goals and SMART objectives.

The implementation framework in step 4 involves developing a work plan with its budget, implementation arrangements and resource mobilisation plan. Developing an M&E framework in step 5 involves developing a performance framework with a data management system and coordination mechanisms. The finalisation and adoption of the strategic plan and the strategic plan dissemination and resource mobilisation are the final steps.

The guiding principles for effective NSP development should ensure country ownership and leadership through inclusiveness and coordinated partnership with relevant stakeholders. The NSP usually puts a structure to ensure accountability of the investment and assessment of achievement to ascertain progress.

4.2.2 Pre NMDR use of data during the development of the 2014 – 2020 NSP

To understand how data was used during the development of the 2014 – 2020 NSP, document reviews were carried out on the Strategic Plan document, minutes of meetings, reports from technical working groups, and discussions via email. I also reviewed the OPA report submitted as my research study 1, where I carried out a detailed analysis of the NSP development process. This section presents the results from this analysis using the framework of the NSP development steps. The results describe how, and which data was used along with the sources of data and challenges with data use.

4.2.2.1 Step 1: Organising and planning

As part of the requirements for developing the strategic document, there was a need to gather the necessary data to carry out a situation analysis in the initial stage and make this data available to the relevant stakeholders. During the 2014 – 2020 strategic plan development process, most of the data on epidemiological impact and intervention coverages from routine and non-routine sources was distributed, and access to the data was challenging. The OPA and meeting notes review highlighted instances where the document development team faced the challenges of access to data. For example, non-routine data such as the LLIN distribution campaign data were held in various computers owned by different campaign participants. Whenever any data is required, it was difficult to identify the right person to ask. In most cases, it was reported to take long to get access to the data, and in few cases, it was impossible to get it at all.

4.2.2.2 Step 2: Situation analysis

The next step of the NSP development process involved doing the situation analysis, which required a lot of data to understand the current situation in the malaria programme and inform the recommendations that will eventually go in the strategic document. The document review of the situation analysis section of the strategic plan showed several instances where the epidemiological impact and intervention coverages were outdated or incomplete. An example of outdated data was the malaria prevalence and the LLIN coverage data available obtained from the 2010 MIS. There was a major scaleup of the LLIN campaign where over 60 million LLINs were distributed between 2010 and 2013. However, after the scaleup, there was no data to show the outcome and impact of the intervention. A review of the meeting notes showed that when the team needed data on the change in disease burden for the situation analysis in 2013, they had to use the outcome/impact data from 2010 MIS.

The document review also indicated instances of the use of incomplete data. An example of the use of incomplete data for the situation analysis was the data for service utilisation, such as malaria tests and treatment with ACTs in health facilities. The country runs a parallel system of collecting service utilisation and surveillance data on malaria from the health facilities, which was supposed to address some of the challenges of incomplete data. The health facilities are mandated to report their data through the HMIS; however, the data collection tool for HMIS only collects data on cases and deaths (surveillance) for malaria. In an attempt to fill this gap, the malaria programme developed a new tool. It required the health facilities to provide service utilisation and surveillance data using this tool alongside the existing HMIS tool. The first challenge was insufficient funding to implement this new tool in all the health facilities in the country, which means the data collected on those key malaria indicators were incomplete. The parallel system was a good attempt to solve incomplete data issues;

however, this system led to new challenges. In section 2.1, the preliminary work and data mapping findings as part of the development of the NMDR were reported, which shows challenges of the incomplete, illogical and other data quality errors. The preliminary work showed that personnel at health facilities became overwhelmed with completing multiple data collection tools, and as a result, both tools were poorly used.

4.2.2.3 Step 3: Develop a strategic framework

Despite the challenges with obtaining data for the situation analysis, a review of meeting notes showed that the stakeholders completed the process. However, the outcome of the situation analysis was not the only factor they considered when developing the strategic framework. An analysis of the OPA report clearly shows that there was political influence in setting the goal of the NSP. In 2013, health ministers from the West African region met and proposed developing a robust malaria intervention plan for elimination. The Nigerian Minister of Health then issued a directive to the malaria programme, which necessitated including the aspiration to achieve pre-elimination status by 2020 in the NSP 2014 —2020 [16]. The OPA captured the views of stakeholders who were concerned that pre-elimination status would not be realisable if targets were not set to match the current disease burden and available resources [53].

4.2.2.4 Step 4: Develop an implementation framework

The review of the strategic plan and publications from the WHO showed that recommendations from the situation analysis and the WHO guided setting the strategies to achieve programme objectives during the development of the implementation framework. For example, the decision to implement SMC was guided by the WHO recommendation to commence SMC in the sub-Sahelian region of Africa. Another example is the recommendation from the situation analysis to use mobile devices in health facilities to improve data reporting on the DHIS2 platform. This recommendation was based on evidence of the positive impact of mobile devices in improving data reporting rates in other countries. A review of the meeting notes shows that although the criteria used for the selection of interventions aligned with WHO recommendations, the country did not carry out a structured analysis to determine the suitability of those interventions, considering the peculiarities of the local setting.

4.2.2.5 Step 5: Develop Monitoring & Evaluation Framework

The fifth stage of NSP development was the development of the M&E framework. To set targets in the performance framework, there is a need for data that shows recent outcome and impact level indicators, which were lacking in step 2 of the exercise. A review of the strategic plan showed that the data used to inform the situation analysis was mostly from the 2010 MIS which was four years out of date. In the meeting notes, there was discussion that revealed despite the scale-up of LLIN

distribution, there was no assessment to ascertain coverage and impact level indicators to inform the target setting. There were also some issues identified with setting the target for achieving the pre-elimination status by 2020. To achieve the pre-elimination status, there was the need to have below 5% parasite prevalence in 2020, from a baseline of 42% prevalence in 2010. An analysis of the OPA report shows that some stakeholders believe there is a need to have high aspirations when developing and setting targets. In contrast, others thought it is important to be realistic and consider the available resources when setting targets.

4.2.3 Post-NMDR use of data during the development of the 2021 – 2025 NSP

This section present the results of the interviews, document reviews and observations carried out to understand the overall use of data and assess the role of the NMDR during the 2021 – 2025 malaria strategic plan development process.

4.2.3.1 The role of data in developing the strategic plan

This section presents the results that address how data was used in general, the factors that influenced or hindered the use of data, and the stakeholders' general perception of the NMDR.

4.2.3.1.1 The use of data in general

The interview respondents agreed that using evidence in the development of the strategic plan has improved in this cycle. The majority of respondents reported the use of evidence during the development of the strategic plan. The respondents also indicated that evidence is a critical element that drives the strategic plan development process. The following responses show these views:

> *"I think the most critical point is data. You need to have the evidence to be able to drive that process."* **Donor**
>
> *"I think what lead other factors towards the strategic direction within the process, I think is the new evidence that could be available during that time; and so, which is more mainly driven by WHO from the side it."* **Donor**
>
> *"Yeah, the biggest role is, there are two I see. One is who coordinates that process, and then the second is the data that would be generated to inform whatever policies or decisions that we need to take."* **NMEP**
>
> *"Because if there is no data, all that we are doing will just be on just assumption, assumption, there will be too many assumptions. But I can tell you that the- the last review we we did in MPR, to be frank with you, we have a lot of data, and data play a big role for that review compared to the review we did before that one. Because I also witnessed the midterm review of 2017."* **NMEP Staff**

The push to renew the strategic plan is guided by evidence that shows the need to either change tactics or maintain the programme's strategy. During the mid-term or end-term review, the available evidence shows the status and any deficiencies in achieving the strategic objectives.

> *"Basically, the end-term or the mid-term would review what areas you have deficiencies. But these are looked at in terms of data. So, what is the evidence available to say whether you are achieving or not achieving, or you are just stagnating or going down, and then what do you need because of the strategic direction would be, or what would need to be done which will depend on what the results are saying in terms of data, what is coming out from those reviews"* **Donor**

Although the popular opinion among the respondents is that data is widely used for decision-making and plays a critical role in developing the strategic document, a few respondents posit that data played a little or no role in decision making.

> *"Data does not play a very important role in driving policies, unfortunately."* **Consultant**

Some responders mention the issue of donor organisation having more influence over setting strategies than the evidence or the country's specific needs.

> *"So many at times these funds are tied to specifics, and that makes it very difficult because sometimes those specifics might not speak to the problem of their country. It just answers the need of the funder. And that is-- it's not really too good for us. But many at times, when the funding is not coming from your own pocket, you are now obligated to do as told by the funder. The other thing that might be a major challenge for us is the fact that, like we said, paucity of internal funding."* **Consultant**

> *"Because if there are funds, whether the evidence is there or not, we will still go with the funding priority. So, funding priorities is one. The second is the government's strategic vision, both at the national and the state level."* **Consultant**

Additional findings indicated that even when data is used for a decision, the data source is publications from different settings or countries that have different contexts to the applying country or setting.

> *"And, sadly, we rarely use our own local data, locally generated data to make decisions…So, we will depend on data published, for instance, by the World Health Organisation, by the USAID, and other bilateral and multilateral organisations"* **Consultant**

The respondents identified using external data as one of the biggest factors that can hinder the implementation of policies based on those kinds of evidence.

4.2.3.1.2 Factors that influenced/motivated the use of data

The NMDR has been live since August 2019 but was launched in February 2020 with the training of non-M&E members in June 2020. Therefore, some responders perceived the time between the

implementation of the NMDR and expected to use the tool is short. Therefore, it was difficult to obtain responses from the interviews that speak to how available the tool is. Despite this, some responders understood the tool's aim and were able to provide feedback on the users perspective of the tool. Some of these responses are:

> *"Um, of-it wasn't ready in very ready when we were doing the malaria program* [review] *with you, but it has been very useful for us when we were doing the strategic plan development. Um, it has data from different sources pulled together, and an avenue is provided for you to be able to access them and, I will do carry out the analysis with them, print them out, share them, and so on. So, I-I'm looking forward to hearing from the consultants that we hired to help... engaged, I mean to help in the development of the Malaria Strategy Plan would benefit Immensely from the Repository."* **NMEP Staff**
>
> *"There is no-- the quality in assessing those data much like that. Because the-- I can say the-the routine data, we got it through the DHIS, as I mentioned earlier. And also, the program has the... The program has a data repository, for which the-the data, the malaria data repository is like a data bank for the-for the program where the whole data brought from routine and non-routine data are being archived."* **NMEP Staff**
>
> *"That all the data we are using were being archived in NMDR. So, it played an important role, because if those data are not being archived or they are not being stored in somewhere, we would find it difficult to-to get them, or we would suffer a lot before getting those- those data."* **NMEP Staff**

In summary, the majority of the responders believe that the use of data is a driving factor during the development of the strategic plan. A few disagreed and cited other factors, such as donors having more influence than the use of data during the NSP development process. Most responders also stated that making data readily available and accessible will motivate the use of the data.

4.2.3.1.3 The general perception of the NMDR

To assess the use of the NMDR and how it influences data use, it is important to understand that the relevant stakeholders were able to access and use the tool. The interviews and observations revealed that they had the right level of access, relevant training and a good perception of the tool's usefulness.

The NMDR is based on the DHIS, which provided the relevant stakeholders with a platform that provides a similar interface to what they are already familiar with, making it easier to access. Additionally, to access the platform, all the stakeholders require is a username and password, which is also similar to the national instance platform. The easy access method makes it readily available to anyone who requires access. The respondents reported that having a familiar interface with easy access to anyone who needs it has encouraged the use of the NMDR. This view is well articulated in the following response:

"Then the other element is that you can send it to anyone, and anyone can log in and should be able to get the data if you are to do a little activation or anything. So that gives that sense of availability and the ease of use." **Donor**

Several responders mention the features that enable data to be obtained from the NMDR. This shows a good level of understanding of how the tool can be used to obtain data. In terms of the usefulness of the NMDR features, most responders cited several features that they found useful, including the programme management and analytics components.

"But we also have, in terms of program management, like expenditure analysis of malaria, which is also very, very good. At least you can log into that and see how funding support has been coming into the country by specific donors or partners as the case may be". **Implementing Partner**

When asked about the advantages of the NMDR, the respondents stated that providing all the malaria data for Nigeria in one place like the NMDR will go a long way in encouraging the use of data for decision-making on malaria. The availability and ease of access to data were major advantages of using the NMDR. They also cited some advantages of using the NMDR over other tools like the HMIS/DHIS2.

"You can download it [data], you can do your modelling pieces on it. So it is that method of having control of what we are doing, that we do not have to rely on other people." **Donor**

"Yes. So, I am just trying to see if I can pick that immediately, but one of the things that I think the NMDR has more advantage to me than the NHISM or any other data is the fact that for me as a PSM person, I get to know the coverage, the stock on hand or the number of facilities been covered with actual supply of commodities than the, and again I think I saw on that MDR …Malaria Data Repository … while for NHMIS I think I didn't see that very clear." **NMEP Staff**

"Yes, at first, to be candid, when I first saw the idea, let us have the Malaria Data Repository, I asked myself we have the DHIS and the PSM site we have the NHLMIS (Nigerian Health Logistics Management Information System). So, the first question that came to my mind, why do we need Malaria Data Repository? But when we were taken through the demo, I got to know that yes, we need more of Malaria Data Repository than any other thing. Why? The analytical aspect of it is what made me know, within a snapshot, you would be able to see what the entire programmes are doing, unlike the DHIS that would speak more of the M&E and other related things, would not go deep into that, and I haven't seen the analytical there, but I have seen the analytics on NHMLIS, and it's not as robust as the Malaria Data Repository is from the demo." **NMEP Staff**

During the development of the strategic plan, the NMDR was available to the right people, and they reported that it was easy to access and found it useful. Some of the stakeholders reported accessing the NMDR to obtain different kinds of data to inform the development of the document. However, a few reported that even though they were aware of the tool, they felt it was relatively new; therefore, they see potential usefulness in the future but did not use it for this process. Those who used the tool were impressed with how easy it makes data available to them.

4.2.3.2 Use of data from the NMDR in developing the NSP

The NMDR was rolled out nine months before the development of the 2021 – 2025 Strategic plan, and how the tool was used during the development of the document was assessed. The section uses the framework described in section 5.1 to present how the stakeholders used data from the NMDR in each step of the development process. There were some activities where data was obtained from sources other than the NMDR and those are indicated.

4.2.3.2.1 Step 1: Organising and planning

In this step, it was observed that the data required for situation analysis, such as malaria cases, deaths, and disease prevalence, were readily available from the NMDR. The data available in one place made it easy to access for the next step, which is the situation analysis. The responses from the interviews also emphasise that the required data was available from the NMDR. The responses also showed an understanding that making data available was one of the major roles of the NMDR.

> *"So, it's [NMDR] creating a platform for ease of access of all these reports and data that are needed. So, wherever you are, you could just sit in the comfort of your office. You don't need to make any call; it's just to click on those locations and get."* **NMEP Staff**

> *"I think the role is making data available. To me, that is the major. Making data available so that you have evidence of what you are doing so you don't have to start running for people, give us data, give us data*." **Donor**

4.2.3.2.2 Step 2: Situation analysis

In step 2, the situation analysis on epidemiology and review of the previous NSP were conducted. During the meeting observations, it was noted that the descriptions of the malaria parasite, vector distribution, dynamics of transmission and burden (morbidity/mortality) were based on evidence generated during the program review. The interviews revealed that the stakeholders used data from the NMDR for program review.

> *"... But I told you that we use it* [NMDR] *for program review. Apart from the program review, we even do the quarterly review and annual review if you want to develop the strategic plan..."* **NMEP Staff**

For the first time, the country conducted a stratification, mapping and intervention mix analysis which is a main step in developing the plans to reduce burden. Since Nigeria is one of the 11 high burdens high to impact (HBHI) countries, the analysis was conducted to support the NSP development [63]. The exercise provided a specific guide on the deployment of interventions by subnational level. This is a departure from the one-size-fits-all approach to the targeted deployment of the most impactful interventions based on location. One of the main steps of HBHI response is epidemiological stratification to understand the geographic location, parasite prevalence, malaria incidence and mortality rates among children under five.

The meeting observation and review of meeting notes show that the computation of the malaria incidence was done using LGA aggregate data from HMIS through the NMDR [43]. The data points of prevalence and mortality were obtained from household surveys. The parasite prevalence, incidence and mortality data were combined with climate variables to produce estimates of parasite prevalence per year by LGA while overlaying uptake of interventions by locations using a geospatial approach. Section 4 of the strategic plan shows the proposal of certain interventions based on the results of this epidemiological stratification.

The WHO launched the global technical strategy 2016 – 2030, which set goals and targets towards aligning with the sustainable development goals [38]. During the meetings, the stakeholders used the global strategy to provide direction in developing the NSP. A review of the NSP manual shows that there is a requirement for country achievements to be assessed in the context of global, regional, and national targets. The comparison of the country targets is discussed in step 5.

4.2.3.2.3 Step 3: Develop a strategic framework

The establishment of the NMDR made it possible to proceed with the stratification exercise. In step 3 of the document development, the impact modelling, which is part of stratification, guided setting the strategic document goals. It was observed during the meetings that the impact modelling used routine and non-routine data from the NMDR to set the parameters for mathematical modelling. The modelling process was conducted to measure the impact of the proposed scenarios. For example, the predictive model was used to create a highly effective coverage scenario. In this scenario, the model assumes that if all interventions were below 80%, coverage will have to increase to at least 80% within 212 days from the commencement of the plan to achieve the reduction of malaria burden to pre-elimination status by 2025 [63]. The scenario assumes that there will be a scale-up of intermittent preventive treatment in pregnancy, case management, SMC and LLIN coverages. Other tested scenarios include business as usual, an increase of intervention coverages by 10%, 20% and 30% from the 2020 baseline levels.

4.2.3.2.4 Step 4: Develop an implementation framework

In this step, one of the activities is the intervention mix analysis, which was done using WHO guidelines for targeting malaria interventions. Depending on the intervention types, various WHO recommended interventions were used to develop targeted intervention strategies. In the interviews, the respondents describe how the NMDR helped in carrying out the stratification.

> *"So, in terms of driving our strategy, where we intend to be in terms of reducing mortality due to malaria in the year 2025, these documents, the Malaria Data Repository helped us a lot … how we would now go directly to hit the nail on the head instead of applying our resources blindly. It has given us direction as to these are the areas where your commodities are going; these are the*

areas where you need to channel your intervention too. So, it's more like a summary of what is called in management the Pareto Theory where it helps us now know where we would now use 20% of our efforts to achieve 80% of results. So that is just the summary of what the MDR (Malaria Data Repository) is doing during the Strategic Development." **NMEP Staff**

The observation of meetings also shows how the NMDR provided the data used in geospatial analysis to provide a list of intervention mixes by LGAs. For example, one of the recommendations was to substitute mass distribution of LLINs in an urban setting with other vector control interventions such as targeted distribution of LLINs, indoor residual spraying or larval source management in the 16 cities. Data that shows the adaptation of vector dynamics due to urbanisation and non-use of LLIN among urban dwellers informed this recommendation. Another example is the recommendation to expand the deployment of SMC to more locations. The exercise was to expand to 383 LGAs from 272 across 19 states. Malaria incidence data from the NMDR showed that 60% of cases were occurring within four months of high rainfall in certain LGAs. Therefore, the recommendation was to include those LGAs in SMC deployment. Document reviews and observations show that the intervention mix analysis used local evidence to inform interventions based on available resources. The NSP document describes all these intervention mixes in the implementation framework section.

4.2.3.2.5 Step 5: Develop an M&E framework

The observations of meetings show that outcomes of the impact modelling were considered in setting targets in the M&E framework. For example, to set the performance target for coverage indicators, the stakeholders considered the baseline of the current status of the coverage indicators along with the assumption that there will be an increase to at least 80% within the first year. The targets were set to the corresponding years up to 2025. During the meetings, there were discussions to obtain routine data from the HMIS and survey data from the NMDR to determine the baseline of the coverage indicators. Document review of the HBHI targeted malaria response from the WHO shows that global malaria targets were available for comparison to country-specific targets. In the meetings, the malaria targets were compared to the global malaria programme targets to ensure they were within a realistic boundary when developing the NSP.

4.2.4 The pre- and post-NMDR implementation comparison of data used in 2014 – 2020 and 2021 – 2025 NSP

The study results show how data was used during the development of the two NSP documents, both before and after the implementation of the NMDR. This section compares the study findings shown in figure 9 to identify if there is a change in data use and whether or not the NMDR has made data available. The comparison is based on how data was used in the various activities of each document development step.

4.2.4.1 Comparison of the use of data in 2017 – 2019 and 2020 – 2022 Funding Requests

In step one, structured stakeholder analysis was not conducted during both the pre-and-post-NMDR NSP development. The data used for situation analysis for 2014 – 2020 was scattered; therefore, gathering it took a lot of time and energy. Contrarily, after the implementation of the NMDR, the data was made available in one repository, which made the situation analysis for 2021 – 2025 easier and faster. Since regardless of the access method, data was used for both pre and post NMDR situation analysis, but data was not used to do stakeholder analysis. Therefore, step one had a score of *'some data use'* for both the pre-and post-document development.

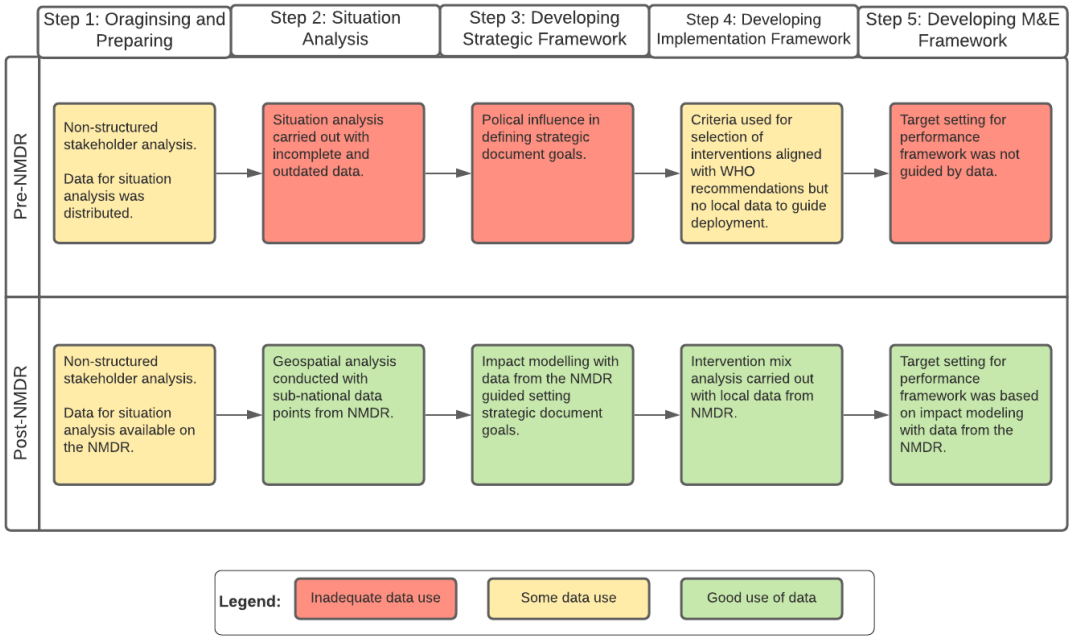

Figure 11 Showing Comparison of use of data in 2014 - 2020 and 2021 - 2025 Strategic Plan

In step 2, during the pre-NMDR document development, the data used for the situation analysis was outdated and incomplete. In addition, the subnational geospatial analysis was not carried out during pre-NMDR because there were only a few malaria data points available. The NMDR houses multiple surveys and routine malaria data points, enabling the geospatial analysis to guide stratification and intervention mix analysis in the 2021 – 2025 strategic plan. The activities analysed in step 2 did not use data for pre-NMDR. Therefore, the score was *'inadequate data use'*, while the activities had *'good use of data* for post-NMDR.

In step 3, the strategic document goals for 2014 – 2020 were based on political influence. However, during the 2021 – 2025 strategic document goals, the stakeholders carried out impact modelling using data obtained from the NMDR to guide the process. Due to the lack of data used for setting

goals in pre-NMDR, the score for this step is *'inadequate data use'*. There was *'good use of data'* in this step for post-NMDR.

In step 4, during the development of both the 2014 – 2020 and 2021 – 2025 strategic plans, setting the strategies for achieving programme objectives was guided by data. In the pre-NMDR development, the situation analysis and evidence of intervention successes in other countries were factored in the implementation framework. The criteria used for selecting interventions aligned with WHO recommendations, but there was no structured analysis to determine the suitability of the intervention in different locations. The use of non-local evidence alone to inform the selection of interventions gave this step a score of *'some use of data'.* During the post-NMDR development, a comprehensive intervention mix analysis was carried out to guide selecting the most suitable interventions to propose in the implementation framework. The result of this study showed that there was more intricate use of data in post-NMDR compared to the pre-NMDR, where the intervention mix analysis was carried out using locally derived data. Therefore, the score for post-NMDR was '*good use of data'.*

In step 5, during the development of the performance framework for 2014 - 2020, the targets used were not set based on evidence but rather the desire to move to pre-elimination level by 2020. As a result, the annual progress targets were determined based on linear reduction to achieve the pre-elimination level. Therefore, the score for this step in pre-NMDR was *'inadequate data use'*. For post-NMDR development, to set targets in the performance framework, impact predictions using mathematical modelling were carried out using data obtained from the NMDR. Additionally, the post-NMDR malaria targets were compared to the benchmark of the global malaria programme targets to ensure they were within a realistic boundary. For this step in post-NMDR development, there was a good level of access to the required data, and it was used; therefore, the score was *'good use of data'*.

The activities in steps 6 and 7 of the strategic document developments, which involve finalising, adopting, dissemination and resource mobilisation, do not require the use of data; therefore, were excluded those steps in the comparison.

4.2.4.2 Summary of differences highlighting improvements or not as a result of NMDR

In summary, the findings of this study and the comparison of the pre-and-post-NMDR development of the strategic documents demonstrate that the tool made data more available in the short term, thereby encouraging the use of data. As seen in the cases of steps 1 and 2 of the strategic document developments, the data required to carry out situation analysis was distributed or unavailable pre-NMDR implementation. But in post-NMDR, the data was available via the tool. There was political

influence in steps 3 and 5 in carrying out analysis and predictions based on methods that do not use data in the pre-NMDR stage. However, the availability of the data post-NMDR facilitates the stakeholders to base their decisions on evidence generated from the data.

Chapter 5: Discussion

5.0 Overview

This chapter presents a discussion of the findings from the data analysis reported in chapter 4.

A number of decision-support tools for use in the health sector have been developed to address some of the barriers to data-informed decision making [64]. However, the evaluation of the implementation of electronic applications as a decision support tool is still scanty [65]. This study presents short-term evidence of the use of the NMDR as a decision support tool during the development of two key documents related to the malaria policy framework in Nigeria. The main outcome of the evaluation demonstrates that the NMDR bridges the gap of availability of data and facilitates the use of data during the two strategic documents developed within one year of implementation. The findings are in keeping with Nutley et al. [15] that shows pulling data into one place from multiple fragmented data systems would not only improve data-informed decision making but also provides an important experience of how to identify and meet information needs [15]. The NMDR tool was designed to address several of the common barriers to the use of data for decision-making experienced at the national malaria program. These barriers include the fragmentation of data reporting, the proliferation of indicators, poor data quality, insufficient data feedback, data feedback in formats that are difficult to understand, insufficient review and interpretation of data, and insufficient use of data to monitor and improve programs [66, 67]. Many of the benefits and experiences cited by responders suggest that for the short term the NMDR was in use at the time of this research, it has helped in alleviating some of these barriers.

The comparison of the pre- and post-NMDR development of the Global Fund funding requests and the strategic plans demonstrate that the tool has had an impact on making data more accessible, thereby encouraging the use of data. Even though the availability of data has improved over the past few years, it is still important to have the right tools that will make access to the data easier. A unique strength of the NMDR, among other features, that was highlighted in the interviews and observations, is that it brings data from multiple sources together. The result of this study shows that by bringing data together, NMDR increases the availability of data and has the potential to save users significant time that would have been spent retrieving and merging different data sets. The development of the FR before the NMDR implementation had a good level of data use; this thesis cited several instances where data from the DHIS2 was used. This supports the finding that software tools that provide access to data can improve the use of the data.

The findings of this research mostly portray the NMDR and its uses in a positive light; however, there was one concern raised by a few participants. Although they agreed to the values of the tool, some felt that since it was rolled out nine months prior to the development of the NSP, it was not ready enough to be used. This view was reported by people that are not in the surveillance, M&E thematic area. The study showed that participants who have years of experience in M&E had a better understanding of the tool as a means of bringing data together from multiple sources. This is the nature of their work, and with the challenges they face in gathering data, they had a better appreciation for the NMDR. Similar to those who believe the tool was not complete enough, some participants assumed the tool was still under development, and they needed to wait until all the functionalities had been rolled out before they could use it. However, the reality is that the tool should continually evolve and change to capture ever-changing user requirements and to improve upon existing functionalities based on user feedback. Such is the nature of ITC decision support tool, as stated by Yost et al. [36]. There are some other NMDR features for which the impact can only be measured after the tool has been used over a longer timeframe than when this evaluation was carried out. An example of such a feature is the data validation dashboard that can be used for improving data quality. In addition, a later evaluation will also allow more users to be familiarised with the tool and, as such, can give more objective feedback.

The need for the development of the NMDR was identified by the WHO during the rollout of the HBHI strategy to accelerate progress against malaria. This idea was welcomed by the NMEP and relevant stakeholders because over the years; there has been an increasing demand for data accessibility to support data-informed decision-making in Nigeria [25]. The NMEP had been battling to identify solutions to the issue of lack of availability of data, with previous interventions such as launching DHIS2, data quality assessment visits, and capacity building at the subnational level not having much progress [25]. However, there were concerns by some participants regarding data quality issues. Specifically, how could the NMDR address problems with accuracy and completeness of the data that occur at the Health Facility level when the data was recorded in the registers. Such poor data is added to the DHIS which is used by the NMDR without any hint that there are problems. This is a challenge that is beyond the scope of the current version of the NMDR.

Nigeria was the first country to launch the NMDR among the 11 HBHI countries. Some of the potential users of the NMDR were involved in the development processes, and this gave them a sense of ownership over the tool. Research has shown that when the potential users of an IT system have a sense of ownership from the inception of the tool, they are more likely to adopt it [23]. This can explain those stakeholders' initial enthusiasm over the NMDR, which was observed in this study.

For the few sceptics, we observed that they were not part of the development team, and this may have resulted in their poor understanding of the tool. Although it was observed that those stakeholders were trained on how to use the tool and had the value of the tool explained to them, they were still not very excited about using it. In addition, their lack of participation in the development may have led to a feeling of lack of ownership hence leading to a more negative attitude towards the tool. The interviews show that the sceptics believed that even before the NMDR, Nigeria had a sufficient level of data usage. This is another factor that may have contributed to their lack of enthusiasm as they may have a feeling of "why change what already works?". Unless such individuals adopt and use the tool for some time. In those cases, it is after they adopt and use the tool for some time that they can appreciate there were some deficiencies in their former approaches, especially in accessing the data. They can reflect from limestone theory of the use of research evidence and knowledge impel action for decision making [12].

This research also has findings that point out that there were other factors, apart from the NMDR, which motivative the use of data during the development of the documents [13]. As mentioned previously, there was a good level of data used during the pre-NMDR development of the FR. The main difference after the implementation of the NMDR was that the data was made more available, and it was easier to access through the tool. The story was slightly different during the pre-NMDR development of the strategic plan, where there was less use of data compared to the GF FR. This difference could be attributed to the experiences and expertise of the main stakeholders responsible for the development of the two documents. The exercise for developing the FR is closely monitored and guided by the GF Country Team, who demand the use of evidence to justify the decisions that were included in the document. One of the major requirements for approval of the FR was the use of evidence to guide the funding request development. In the technical review stage, the panel may request evidence where it is missing and can recommend a rejection of the grant, which has been done in the past. This experience likely makes the stakeholders more vigilant about using evidence to recommend interventions during the FR than the NSP development. The data they needed was automatically sought out regardless of whether it is available in a repository or not, so the NMDR simply makes the process easier. In situations where the relevant data was not available, or the intervention is new but has been implemented in other countries, then non-local evidence was used to guide the decisions.

However, the use of non-local evidence was not only in situations where local data was not available. During the interviews, some of the responders raised concerns over the level of influence from international partners preferring to use non-local evidence over local evidence. There were

concerns those interventions that are proposed based on global evidence to support ideas, such as the choice of LLIN versus IRS as vector tool, might not fit well with the local needs of targeted interventions in Nigeria. The international partners, on the other hand, consider global evidence to be sufficient, especially if it is obtained from WHO guidance or other standardised body of evidence. The theory of knowledge impels action does not always apply, and the availability of the data alone is not sufficient to use it for decision making without overlaying it with context and processes as stated in Walt's policy analysis triangle [4]. This is a finding that will be important to explore in further research work.

In this study, the participants expressed concerns on how the priorities of donor agencies usually go unchallenged. As a result, the national stakeholders may face structural challenges in influencing decision-making processes, given how established processes and systems prioritise particular ideas and actors. In this study, some participants thought that the most influential role in developing the strategic documents is played by the preferences of donor organisations rather than evidence as corroborated by Mutero et al [68] and Ludovica et al [69]. The reality is that there are factors other than evidence that play a significant role in decision making in the NMEP [53] . Malaria control involves a number of technical activities for prevention and treatment, with different geographic, temporal or population-specific needs. Many decisions on malaria control are made without complete or perfect information, so it is natural to have an interplay of various factors, other than evidence, guiding the decision processes. Based on Weiss's model, findings also show that NMEP has some political influence in the development and adoption of the policy, as also concluded in Tesfazghi et al. study [70].

The government in Nigeria highly influences the political environment within which the NMEP exists, and in most cases, the organisation does not have any power to change the situation [19]. A typical example is the growing political focus on a global goal of malaria elimination, and Nigeria was feeling the pressure to fit in with the hype. One move made by the FMoH was to change the name of the malaria programme from the National Malaria Control Programme to the National Malaria Elimination Programme. This could become a problem if the country was not ready for this move-in reality. All donor agencies are looking for value for money [1] and setting unrealistic goals can make them reluctant to put their money in the programme. The increase in availability of data either through the NMDR or other tools can improve and encourage data use, but it will not completely remove the effect that other factors have in the decision-making process that sometimes led to evidence being downplayed or ignored.

There is a need for more push which in recent years is coming from the international community to encourage the use of data [71]. Ultimately, while it is essential to establish coordinating bodies and administrative structures and systems, there may be a need for more explicit reflection or consideration of the nature of how those systems function and the sources of evidence on which decision are based [46]. In addition to thinking about the specific epidemiology or effectiveness of interventions, stakeholders, including donors and government agencies, may wish to reflect on the structures and processes through which decisions are made. Such structures may end up shaping the intervention strategies prioritised regardless of evidence, and they may also dictate which pieces of information, or which relevant actors might be excluded from the process. Countries have developed a range of decision-making and advisory bodies to inform policy decisions about which interventions to apply, when, and where [23, 72]. Yet while these systems are required to facilitate and legitimate decisions in malaria control, the established structures may also privilege certain voices or ideas. The establishment of tools such as the NMDR are good first steps to provide impartial sources of evidence. This study has attempted to demonstrate the effect that such a tool can have, however, it also points out that there is still a lot of work to be done to achieve a satisfiable level of evidence usage for decision making in the country. Section 6.3 highlights some policy implications and recommendations to support the ambition of supporting increased data usage.

One of the findings of this study that demonstrates an example of a hindrance to the proper use of data in strategic documents was the lack of current data. The lack of current data may arise as a result of misalignment in the timings for data collection from surveys like the MIS and the timing for writing the strategic documents such as the Funding Request. For example, MIS is done every five years while funding request is as frequent as every two years. This unavailability of current data is usually not noticed until it is needed to develop some document or take some decision, as that is when the data is sought out. Perhaps the problem is the reliance on surveys as the main data sources, whereas routine data could be processed and used in strategic documents or to make decisions. For instance, during the development of the 2014 – 2020 NSP, instead of using the most recent parasitaemia level after a massive scale-up of LLIN between 2010 and 2013, the MIS data from 2010 was used to carry out the situation analysis for determining coverages. The reason for using the outdated data was because, at that time, no tool collected and stored the LLIN campaign data in a format that was easily accessible so that it could be processed and used for the situation analysis. This issue stresses the importance of the main argument of this thesis that the key value of the NMDR was putting data in one place. The NMDR ensures that different variety of routine and non-routine data are available, properly maintained and if any data is outdated, then the need for

updating it through conducting impact assessment becomes clear even before any need for the data used in any document arise.

In the case of the NSP, the findings of the study show that there was significant change in the culture of use of data during the post-NMDR development. The results show that the NMDR contributed to this change by making the data more available. However, there were other important factors to consider, such as the geospatial analysis, intervention mix analysis and predictive impact modelling which further sharpens the use of data for decision making.

Chapter 6: Conclusion

6.0 Overview

The chapter also provides a conclusion for the thesis in by describing the research limitations, outlining future research work, and explaining some policy Implication. The chapter also provides a set of strategic and operational recommendations for the malaria programme.

6.1 Research Limitations

There are strengths in this research study, along with potential limitations regarding the methodology and my position in NMEP.

6.1.1 Position in NMEP

The NMEP was my usual place of work when this research was conducted, which can be a basis for both strengths and limitations of the study. My position within the organisation had ensured that the right people were selected and interviewed with informed consent. My position in the NMEP made it more comfortable for the participants to accept the request for participation. It has also reduced the risk of potentially interviewing insignificant participants. The participants were more willing to share their thoughts and state the exact situation in their responses; as they know, I have a good knowledge of the processes within the organisation. However, my position in NMEP could also be a limitation since I may likely influence the responses; being part of the team developing the NMDR could influence the respondents to give me a positive connotation introducing acquiescence bias. Also, my prior knowledge of the procedures when interpreting responses could introduce personal bias into the results.

To minimise acquiescence bias, most of the participants interviewed hold senior positions, which helps provide a level of equality, empowering them to be more objective in their responses. I also trained a proxy who interviewed one participant to avoid any potential influence on their responses

to whom I was a direct line manager. To minimise personal bias, I had limited participation in daily activities during the data collection and the analysis; I adopted a reflective stance to try and reduce the effect of biases in the analysis [73]. The willingness of participants to engage could result from the assurance of confidentiality and anonymity in reporting the findings.

6.1.2 Methodology

The use of open-ended interviews can be considered a subjective method of collecting data as it relies on quotations from individuals. This study is in a highly specialised field, and the views and assessments of the individual participants are likely to depict only part of the picture. The desire to protect jobs, bureaucratic procedures and recall biases may also affect the results.

A wide range of participants with different roles were interviewed to minimise the subjectivity of open-ended interviews and improve the data gathering process. In each of the assessment stages, different participants were invited for the interviews to include more comprehensive views. Other approaches used in this research to minimise bias include respondent validation and data triangulation during analysis [74].

6.2 Future work

This research study was conducted 3-months after NMDR implementation for GF FR and 9-months after for the malaria strategic plan to measure the short-term impact. Another evaluation after an extended period of two to three years after the implementation of NMDR would enable the assessment of longer-term impact of NMDR on use of data for decision making. An extended period after implementation of the NMDR will accommodate attitudinal and behavioural changes and will allow enough time in measuring impact while controlling for all biases. Based on Kotter's theory of change, specific long-term impact measures of interest would benefit from going through the eight phases to determine the actual impact [75].

This research project was limited to assess the short-term effectiveness of NMDR during the developing GF funding request and malaria strategic plan. A similar study could be undertaken to examine the impact on other strategic documents such as the malaria operational plan (MOP) for PMI/USAID, concept note for world bank project, memoranda submitted to national council on health[2] (NCH). A wider range of document development analysis will help to determine whether the

[2] This is the main national forum for ratifying national and state health policy, and for engaging in national policy evolution. The NCH meets biannually, under the auspices of the Federal Minister of Health. State Health Commissioners participate, along with senior federal and state ministry of health officials.

same effect and generalisable outcome is observed compared to this study. This research focused on how the NMDR facilitates in bringing together data into one place however, in further research it would be useful to examine the impact of other features of the tool like the visualisations in supporting decision making and business intelligence for early warning and response towards strengthening the malaria surveillance systems. This further study would also allow the opportunity to explore the impact of the NMDR among officers at the subnational level and ascertain the feedback mechanisms in improving quality of data.

This research was based on a qualitative design impact study, however as an alternative, or in comparison, a longitudinal study design using quantitative data collection approach such as time motion studies [76] could be conducted to measure the impact of NMDR. It would be considered incomplete to collect quantitative data to ascertain impact of NMDR, nevertheless, using activity logs from backend database to count number of clicks while overlying time stamps and Likert scale questions to measure opinions of responders quantitatively. Such an approach may improve research reliability and enable wider generalisations to be formulated.

This research project has identified how the priorities of donor agencies usually go unchallenged as an important issue. In the first instance, further research is necessary to understand the magnitude and nature of donor influence in setting in-country priorities while ignoring local evidence for decision making as reported in this study, this may be followed by testing strategies for mitigating the negative impact. Research on identifying donor influence in setting priorities is a sensitive area where perception of the stakeholders based on which sides they stand, could affect the findings. It is therefore recommended that both quantitative and qualitative assessments are employed to examine the country-specific dimensions of donor influence by a neutral assessor.

6.3 Policy Implication and Recommendations

This section discusses the implications of the research project and proposes a set of strategic and operational recommendations for the NMEP in Nigeria. The recommendations are transferable and relevant to other malaria programmes in the HBHI countries. In light of the study findings, the following recommendations are made for policy.

6.3.1 Complete Roll out of NMDR at Subnational Level

The findings of this research mostly portray the NMDR and its uses to improve the use of data for decision making in a positive light which was likely due to its timely implementation at the national level concerning developing the GF FR and NSP. The NMDR tool was designed to address several of

the common barriers to the use of data for decision-making experienced at both national and state-level malaria programmes. These barriers include the fragmentation of data reporting, the proliferation of indicators, poor data quality, insufficient data feedback, data feedback in formats that are difficult to understand, insufficient review and interpretation of data, and insufficient use of data to monitor and improve programs. Many of the benefits and experiences cited by responders suggest that the NMDR successfully addressed these barriers. Similarly, most respondents opined that the NMDR would help address challenges of data quality and the use of data in decision making.

The complete rollout of the NMDR at the states and district level is needed, potentially targeting staff responsible for data collation, aggregation, analysis and dissemination at local government councils (districts) in Nigeria. Such personnel may be particularly disadvantaged in data management and analysis skills, which would limit their deliverables and subsequently affects the generation and reporting of data from the health facilities (service delivery area).

6.3.2 Implement Health Technology Assessment

This research has findings that point out that other factors, apart from the NMDR, motivate the use of data during the development of strategic documents. During the interviews, some of the responders raised concerns over the level of influence from international partners, preferring to use non-local evidence. The fears that interventions proposed based on global evidence to support ideas, such as LLIN versus IRS as vector tool, might not fit well with the local needs of targeted interventions in Nigeria [77].

Practical interventions such as establishing a health technology assessment (HTA) team to generate local evidence to support in-country decision-making would reduce the perceived influence from the international community as demonstrated in pursuing an evolving market using LLIN as a case study [78]. The implementation of HTA will require establishing a team involving key stakeholders to operationalise the six blocks of HTA [79]. Block one requires setting the scene, which consists in identifying upcoming problems that HTA can inform. The initial demand might be for specific small and isolated decision problems. This block will require the preliminary work that will be done. Block two requires compiling the best data for any tool under review. Block three is setting a transparent and consistent process of HTA. This will require institutionalising the priority-setting processes that suit local settings, political contexts and decision problems. This requires a bit of time to implement and the involvement of the government. Block four is building capacity to support HTA, which involves identifying the government staff that might implement HTA and impact them with knowledge requisite. This will also require a lot of time and financial resources to complete [77]. Block five is ensuring political commitment. This largely depends on the readiness to formalise an agency through legislation and long-term financial commitments. Block six is making HTA an

inclusive process. It involves identifying and including relevant stakeholders, such as patient groups and industry. This can be done with full implementation of the blocks mentioned above [80]. Operationalising HTA in Nigeria will address whether any tool can work in the country, does the government need it, and can the country use it effectively (illustrated in Figure 10) as documented to work in similar settings Li et. al [77].

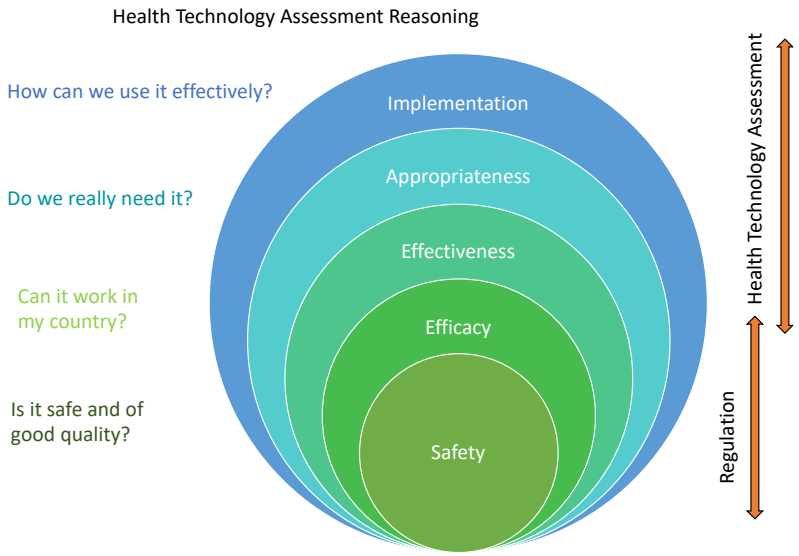

Figure 12 Showing Health Technology Assessment Reasoning Source:

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Appendix 1: Quality Assessment Tool

Questions	Study	Response	Comments
Was there a clear statement of the aims of research?	Nutley 2013	Yes	DHP tool was developed to address DIDM and data quality issues as a stop gap
	Standley, 2018	Can't tell	It is a presentation of proof-of-principle method with corresponding prototype tool
	Yost et al., 2014	Yes	Tools developed to support PHP in 3 canadian PHDs to develop capacity for evidence-informed DM
Is a qualitative methodology appropriate?	Nutley 2013	Yes	Yes, but other data collection approaches such as participants observations would have been used
	Standley, 2018	Yes	To large extend the qualitative can address the tool component but don't think the modelling part
	Yost et al., 2014	Yes	Yes, it's a knowledge translation and exchange intervention to identify and apply tools for use in EIDM.
Was the research design appropriate to address the aims of the research?	Nutley 2013	Yes	Qualitative design was used and in assessing impact of these tools, it seems adequate
	Standley, 2018	Yes	It's a mix method with quantitate method using qualitative approach for feedback analysis
	Yost et al., 2014	Yes	Qualitative analysis was used to assess the perceived usefulness and usability of the tools
Was the recruitment strategy appropriate to the aims of the research?	Nutley 2013	Yes	Convenience sampling was used to recruit participants which is adequate
	Standley, 2018	Yes	Adequate to address the tool for decision support
	Yost et al., 2014	Yes	
Was the data collected in a way that addressed the research issue?	Nutley 2013	Yes	In-depth interview approach using open-ended questionnaires were used which is appropriate
	Standley, 2018	Yes	
	Yost et al., 2014		
Has the relationship between researcher and	Nutley 2013	Yes	Independent interviewer was used to collect data
	Standley, 2018		

participants been adequately considered?	Yost et al., 2014		
Have ethical issues been taken into consideration?	Nutley 2013	Can't tell	Although trained interviewer was used but no mention of consent obtained…
	Standley, 2018		
	Yost et al., 2014		
Was the data analysis sufficiently rigorous?	Nutley 2013	Can't tell	Little info on analysis and contrasting views
	Standley, 2018		
	Yost et al., 2014		
Is there a clear statement of findings	Nutley 2013	Yes	Improved DIDM and information needs
	Standley, 2018		
	Yost et al., 2014		
How valuable is the research?	Nutley 2013	Yes	Option can fill gap in transitioning to HIS
	Standley, 2018		
	Yost et al., 2014		

Appendix 2: Data Synthesis Tool

Study	Research Objective	Setting	Participants	Methods	Main findings
Nutley et al. 2013	To determine the impact of District Health Profile (DHP), a decision support tool, on decision making at the district level. The study assessed the process of implementing the DHP tool, its effect on data-informed decision making at the district level, as well as factors that influence the use and non-use of the tool.	Kenya All programs (primarily HIV)	Ten DHP tool users and three non-users in six districts which consist of district health information and records officers (DHIROs), district medical officers of health (DMOHs), and district AIDS and STI control officers (DASCOs).	In-depth interviews using open-ended, semi-structured questionnaire administered by a trained qualitative expert	Findings from the in-depth interviews suggest that the DHP tool had a positive effect on data analysis, review, interpretation, and sharing at the district level. All respondents (who are users) stated that the DHP tool assisted them to target existing services that needed improvement and to plan future services, thus positively influencing program improvement. The three non-users cited the following barriers to the use of the DHP tool: need for further training, lack of support from supervisors, conflicting priorities. Lack of infrastructure and lack of value placed on the data were also cited as barriers by both users and non-users.

Standley et al., 2018	To create a web-based application for decision-making support in integrating disease control program. The web-based application is a modelling application that provides a predictive analysis of the effectiveness of integration of schistosomiasis and malaria control, taking into consideration the local conditions and practical constraints. This study also aims to provide an initial validation of the value of the web-based tool in providing decision-support to end-users.	Mali, Uganda, and Yemen Schistosomiasis and malaria programme	Partners in Schistosomiasis and malaria endemic countries	Solicited for feedback from the partners (specific method is not mentioned in the paper)	The responses from the participants confirms the usefulness of the web-based application to provide recommendations a priori during decision-making. The feedback from the partners also provided recommendations on how to improve the model in the application by expanding it to include parameters such as resource management for the implementation of control interventions. The recommendations will be useful in future work to make the application better for the optimization of the integration of vertical disease control programs.

Yost et al., 2014	To evaluate the effectiveness of knowledge translation and exchange interventions in developing capacity for evidence-based decision making. This paper provides an overview of tools used in three Canadian public health departments and a usability evaluation of the tool.	Canadian Institutes of Health Research	Participants from different specialities ranging from public health professionals to management and frontline staff of the	Used a case study approach for the evaluation. Carried out 37 interviews with the participants	Decision makers provided descriptions on how the tools were used within the health departments and made suggestions for improvement. Overall, the tools were perceived as valuable for advancing and sustaining evidenced-informed decision making. Knowledge and awareness of these tools may assist other health professionals in their efforts to implement evidence-informed practice.

Appendix 3: Data Extraction Form

1.1 Document Review for Global Fund Application Request

Sections	Use of evidence? Y/N? If Yes, sources	Strategies deployed by subnational level Y/N?	Use of implementation reports?	Remark
1. Summary of country context **a. Malaria burden** **b. Vulnerable populations** **c. Description of Health systems** **d. Nigeria response to Malaria**				
2. Past implementation and lessons-learned **a. GF Specific** **b. From other donor investments**				
3. Funding request **a. Disease specific request by thematic interventions**				
4. Key implementation risks				
5. Priority above allocation				

1.2 Document Review for National Strategic Plan

Sections	Use of evidence? Y/N? If Yes, sources	Strategies deployed by subnational level Y/N?	Use of implementation reports?	Remark
1. Summary of country context **a. Country profile** **b. Malaria program and the health system** **c. Institutional framework** **d. RBM Partnership**				
2. Current Situation **a. Malaria program review** **b. By thematic interventions**				
3. Strategic plan **a. Aims and objectives** **b. Strategies and actions by objectives**				
4. Implementation Framework and Budget **a. Core components** **b. Cost outputs** **c. Logical framework** **d. Gap Analysis**				

Appendix 4: Showing a sample field note taking in Meetings and Workshops

Stakeholder	Issues raised	Action required	Comments
	•	•	
Global Fund	•	•	

Observer's comments:

Appendix 5: Stakeholder Interview Guide

1. **Background**
   - 1.1. Name
   - 1.2. Gender
   - 1.3. Position
   - 1.4. Type of institution you work for.
   - 1.5. Tell me about your background and the work you do in your current role/position/job
2. **Development of strategic documents in general**
   - 2.1. Can you describe to me the process by which malaria program strategic documents are meant to be developed and agreed: Probe further if not mentioned for the process, committees involved and their roles, key actors (both within and outside of these committees) and what are their various roles?
   - **2.2.** In the process that you have just described – what would you consider to be the crucial steps? Who plays the biggest role and, in general who carries the most weight in influencing the decision-making process?
   - **2.3.** Which are the most common sources of evidence that are used by policy makers to help inform their decisions? Are there difficulty in accessing the data? How is the data used?
   - **2.4.** Aside from these sources of evidence, what other factors come into play in decision about strategic plan (e.g. recommendations from WHO, pressure from donors, donations from foreign governments, lobbying from interest groups, concerns about community acceptability/implementability).

Thinking now about a recent development of 2020 – 2022 GF concept note or malaria program review or malaria strategic plan 2021 —2030.

3. **Malaria Strategic plan 2021 – 2030 and malaria policy or 2020 – 2022 GF Funding Request**
   - 3.1 What was your role in the _____ and your contribution?
   - 3.2 What sources of information were used for the current funding request/plan?
   - 3.3 How were each used for the decision?
   - 3.4 In your opinion, what were the key factors influencing decisions about malaria strategy in the plan (sources of evidence, funds available, etc)
   - 3.5 How were the decisions made and who were the key decision makers?
   - 3.6 Are there any targets set in the current plan, which are not achievable within the given timeframe?
   - 3.7 Have you heard of national malaria data repository (online platform for malaria data)? If yes when did you first hear of it?
     - 3.7.1 Have the national malaria data repository been useful to you?
       - 3.7.1.1 How?
       - 3.7.1.2 And why?
     - 3.7.2 Which data in the NMDR were particularly useful and why? For what purpose did you use these data?
     - 3.7.3 Have you used these data in any other way, even if not directly?
     - 3.7.4 Was there anything or anyone that you would say encouraged you to use this platform?
     - 3.7.5 Were there any barriers that you had to overcome in order to use this platform? What barriers? Why were they there? And how did you overcome

them?

3.7.6 Were there any barriers to your using the data in the platform that you were not able to overcome?

4. To **wrap up**, going back to decision making in GF concept note/MPR/Strategic plan development could you just summarize for me:

4.1 Which actors, (people and institutions) are instrumental/influential in the strategic change process?

4.2 What role do you think the NMDR played in facilitating decision-making to stratification of burden and deployment of intervention mixes strategy?

4.3 Overall which three factors do you think have the greatest influence on decisions in use of evidence in adopting a new intervention strategy?

Thank you for your time and do you have any questions for me?

Appendix 6: London School of Hygiene & Tropical Medicine Ethics Committee Approval

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636

www.lshtm.ac.uk

Observational / Interventions Research Ethics Committee

Dr Ibrahim Maikore
LSHTM

16 April 2020

Dear Ibrahim

Study Title: Use of Malaria Data Repository to Strengthen Use of Data for Decision Making in Malaria Program, Nigeria

LSHTM Ethics Ref: 19200

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant. **Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Other	Nigeria Health Ethics		
Other	Public Health Research		
Protocol / Proposal	NMDR Evaluation Protocol_29:01:2020	29/01/2020	Version 1
Investigator CV	Cv_Maikore	29/01/2020	Version 1
Protocol / Proposal	Document Review Template_30:01:2020	30/01/2020	Version 1
Information Sheet	Consent_Form_30:01:2020	30/01/2020	Version 1
Protocol / Proposal	InterviewGuide_	04/02/2020	Version 1
Information Sheet	Information Sheet	15/04/2020	Version 2
Covering Letter	Cover Letter	15/04/2020	Version 1
Protocol / Proposal	Participant Observation Guide	15/04/2020	version 2

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,

Yours sincerely,

[redacted]

Professor
Jimmy
Whitworth
Chair

ethics@lshtm.ac.uk
http://www.lshtm.ac.uk/ethics/

Appendix 7: Local Ethics Approval

National Health Research Ethics Committee of Nigeria (NHREC)

Promoting Highest Ethical and Scientific Standards for Health Research in Nigeria

Federal Ministry of Health

NHREC Protocol Number NHREC/01/01/2007-26/04/2020
NHREC Approval Number NHREC/01/01/2007-12/05/2020
Date: 12 May, 2020

Re: Use of Malaria Data Repository to Strengthen Use of Data for Decision Making in Malaria Program, Nigeria

Health Committee assigned number: NHREC/01/01/2007

Name of Student Investigator: Ibrahim Maikore
Address of Student Investigator: DrPH Student
Infectious & Tropical Medicine
Disease Control
Email: ibrahim.maikore@lshtm.ac.uk
Tel: +2348036204750

Date of receipt of valid application: 26/04/2020
Date when final determination of research was made: 12-05-2020

Notice of Expedited Committee Review and Approval

This is to inform you that the research described in the submitted protocol, the consent forms, advertisements and other participant information materials have been reviewed and *given expedited committee approval by the National Health Research Ethics Committee.*

This approval dates from 12/05/2020 to 11/05/2021. If there is delay in starting the research, please inform the HREC so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study.* In multiyear research, endeavour to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the HREC. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code.

The HREC reserves the right to conduct compliance visit to your research site without previous notification.

Signed

[redacted]

Professor Zubairu Iliyasu MBBS (UniMaid), MPH (Glasg.), PhD (Shef.), FWACP, FMCPH
Chairman, National Health Research Ethics Committee of Nigeria (NHREC)