frontiers | Frontiers in Tropical Diseases

TYPE Brief Research Report
PUBLISHED 18 February 2026
DOI 10.3389/fitd.2025.1733305

OPEN ACCESS

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RECEIVED 27 October 2025
REVISED 25 November 2025
ACCEPTED 28 November 2025
PUBLISHED 18 February 2026

CITATION
Caulker V, Jalloh M, Musoke R, Squire JS, Vandi M, Sahr F, Ndolie M, Ameh G, Kainwo L, Gbandeh S, Kanu JS, Sandi R, Jalloh MB, Bamayange S, Sheriff FM, Massaquoi M, Koroma OB, Wango R, Chamla D and Njeru I (2026) Designing a focused and impact-oriented second strategic National Action Plan for Health Security in Sierra Leone, 2025: process, best practices, and lessons learned. *Front. Trop. Dis.* 6:1733305. doi: 10.3389/fitd.2025.1733305

Designing a focused and impact-oriented second strategic National Action Plan for Health Security in Sierra Leone, 2025: process, best practices, and lessons learned

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Introduction: The National Action Plan for Health Security (NAPHS) is a country-owned, whole-of-government, and all-hazards strategic plan for strengthening health security. In 2025, Sierra Leone developed its second NAPHS (2025–2029). We share the process, lessons learned, and best practices adopted during the process.

Methods: This was an observational, qualitative descriptive study that was conducted between June 2024 and April 2025. It was guided by the 2024 WHO NAPHS implementation toolkit, and data were collected through direct observation and documentation of key activities undertaken during the NAPHS development process. Additional information was collected from key informants drawn from stakeholder groups that participated in the process. These data were collected using a semistructured questionnaire administered via an online Google Form.

Results: The NAPHS development process was led and coordinated by the National Public Health Agency, and all One Health sectors, partners, academia, and civil society participated in the process. The process demonstrated strong national ownership, multisectoral engagement, systematic documentation, evidence-based planning, and alignment with national priorities. Lessons included the importance of early planning, stakeholder communication, sustainable financing, and conducting end-term NAPHS evaluation. The 5-year plan was estimated to cost USD 91.6 million, with 29% of funds required for the initial 2 years secured. The cost of developing the plan was $75,000.

Conclusion: Sierra Leone's experience demonstrates that even in resource-constrained settings, a nationally led, evidence-based, and prioritized approach to health security planning is feasible and impactful. We recommend adequate resource mobilization to ensure the plan is implemented successfully.

KEYWORDS

National Action Plan, health security, best practices, NAPHS, lessons learned

1 Introduction

The coronavirus disease 2019 (COVID-19) and the Ebola pandemic of 2013–2016 provided several lessons that are crucial in preparing for and responding to future pandemics (1, 2). Countries that had resilient systems with strong primary health and surveillance systems, multisectoral coordination, communication and community engagement systems, flexible financing, and adaptability in reallocating resources were able to respond better (3–6). Diagnostics, therapeutics, and vaccines for COVID-19 were developed rapidly and at scale through collaboration of academia, federal agencies, and industry, often through public–private partnerships (7).

The above lessons continue to remind us of the need to implement the International Health Regulations (IHR 2005), which is the key vehicle for countries to set up systems for better preparedness. The International Health Regulations constitute a binding legal framework for 196 states parties, aimed at preventing, detecting, and responding to public health emergencies of international concern (PHEIC) and other health threats (8). To monitor IHR implementation, the Joint External Evaluation (JEE) process was introduced in approximately 2014 as part of the IHR Monitoring and Evaluation Framework (MEF) to assess the countries' core capacities for health security, identify gaps, and guide the development of National Action Plans for Health Security (NAPHS) (9).

The first country to conduct the JEE in the WHO African Region was Tanzania in 2016, and this was soon followed by Sierra Leone, which also conducted the assessment in the same year (10). By April 2022, all 47 countries in the WHO African region had conducted at least one Joint External Evaluation (11). Once countries have conducted the JEE, they are then expected to develop the NAPHS. While JEE reports are usually published and available online, many countries do not publish their NAPHS documents or their experience in developing and implementing the plans. Publishing the NAPHS work allows countries to learn from one another and hence help to build the growing evidence of best practices.

Based on the country's JEE in 2016, Sierra Leone's first NAPHS covering 2018–2022 was formulated in 2017 with the goal of strengthening prevention, detection, and response functions in line with IHR requirements (12). A second JEE conducted in 2023 revealed that despite implementing approximately 65% of the activities in that NAPHS, Sierra Leone's JEE scores improved only modestly, indicating persistently weak health security capacities in several technical areas such as national laboratory system, biosafety and biosecurity, antimicrobial resistance, infection prevention and control, chemical events, radiation events, points of entry, health service provision, and food safety (13).

This experience is not unique to Sierra Leone, as many countries have reported limited progress despite implementing NAPHS or similar plans. Key factors for the limited progress include overly broad or vague activity lists, limited alignment with real assessment gaps, weak prioritization, poor adaptation of lessons from prior assessment tools, disconnects between strategic plans and operational realities, insufficient integration with national health strategies and budget cycles, and inadequate monitoring of outcome-level change (14, 15).

In recognition of these persistent limitations, the World Health Organization developed a refined Strategy for NAPHS (2022–2026), which emphasizes accelerating development, implementation, and monitoring; incorporating lessons from IHR assessments and other MEF tools (such as simulation exercises, after-action/intra-action reviews); aligning plans with national health strategies and budget cycles; and strengthening monitoring of long-term outcomes and impacts (16). According to the WHO, NAPHS should be country-owned, built on a whole-of-government and One Health all-hazards approach, bringing together sectors, partners, evidence, and resources to target both short- and long-term priorities (17).

Alongside the Strategy, the WHO released in 2024 an implementation toolkit for NAPHS, intended to help countries assess their capacities, develop strategic and operational plans, and implement and monitor the plans. The tool also guides countries on how to translate high-level strategic priorities into feasible, targeted, and outcome-oriented action plans (18). The toolkit aims to assist in selecting priority actions that are evidence-based, sequenced, costed, aligned with national systems, and capable of improving measurable indicators such as JEE technical area scores.

This paper describes the process by which Sierra Leone developed its second NAPHS (2025–2029), emphasizing the lessons learned, best practices adopted, and challenges encountered in ensuring that the plan is both focused and impact-oriented. By sharing this process, we aim to contribute to the growing evidence base on how countries can improve health

security planning that results in measurable improvements in IHR capacities, especially in resource-limited settings.

2 Materials and methods

2.1 Study design and setting

This was an observational, qualitative descriptive study aimed at documenting the process, best practices, lessons learned, and challenges encountered during the development of the second NAPHS 2025–2029 for Sierra Leone. The NAPHS development process was guided by the 2024 WHO NAPHS implementation toolkit (18) and was conducted and documented from June 2024 to April 2025.

2.2 Data collection

Data were collected through direct observation and documentation of key activities undertaken during the NAPHS development process. These activities included multiple workshops to develop, prioritize, and cost planned activities. The tools and templates used for the NAPHS development process were derived from the 2024 WHO NAPHS implementation toolkit (18). In addition, the updated WHO IHR Benchmarks digital tool (19) was used to autogenerate a draft NAPHS, while an Excel costing tool template was provided by the WHO Regional Office for Africa.

To document each activity conducted, trained rapporteurs completed a standardized reporting template within 1 week of activity completion. The template captured the activity name, dates, justification, objectives, participants, facilitators, outputs, and budget. Rapporteurs received training to ensure consistency in data capture and to minimize observer bias. These reports served as the primary data source for this study.

To complement these reports, additional information was obtained from key informants drawn from stakeholder groups that participated in the process. Data were collected using a semistructured questionnaire administered via an online Google Form (Supplementary File 1). The questionnaire was voluntary and collected information on national ownership, stakeholder engagement, best practices, lessons learned, challenges, and recommendations for future processes.

2.3 Data analysis

The data analyzed were predominantly qualitative, drawn from the documented activity reports and key informant responses obtained through the Google Form. A team of five members of the NAPHS planning team reviewed and synthesized the data manually to identify common themes as described by Braun and Clarke (20). The main variables of interest included activities undertaken during the NAPHS development process, dates and costs of each activity, best practices, lessons learned, challenges, and recommendations for future improvement. Data were analyzed at the aggregate level, and no personal identifiers were analyzed.

Responses collected from key informants through the Google Form were exported into Microsoft Excel for organization and then analyzed thematically. Thematic analysis involved familiarization with the data, coding of key concepts, and identification of emerging patterns across responses. Codes were grouped into broader themes that reflected participants' perspectives on the study objectives. Representative quotations were used to illustrate key themes and ensure that findings captured the diversity of views among informants. The data analyzed were then triangulated with the activity reports and used to write this paper.

3 Results

3.1 Stakeholder participation

The NAPHS development process followed the One Health approach with all key sectors represented such as human health, animal health, environment, water and sanitation, security, finance, and civil society, among others. Approximately 100 participants participated in the process at various stages, and the majority (65, 65%) were from government organizations, while the rest (35, 35%) were from non-state organizations. The government participants were drawn from 14 government ministries, departments, and agencies, while the non-state organizations were from 12 organizations representing UN agencies, non-governmental organizations (NGOs), civil society, and academia. The ratio of participants from government and non-state organizations was considered fair representation based on the One Health stakeholder landscape in the country.

Approximately 40 people who participated in the NAPHS development process were invited via email to respond to the key informant questionnaire, of which 12 responded, representing a response rate of 30%. Those who responded were from the following organizations: National Public Health Agency, Ministry of Health, Ministry of Agriculture and Food Security, World Health Organization, and ICAP. The majority of those who responded said they were actively involved in all the stages of the NAPHS process. Most also reported that the overall process was well coordinated and fully owned by the government and that the majority of the stakeholders participated in the process, except the private sector.

3.2 The NAPHS development process

The development of Sierra Leone's second NAPHS (2025–2029) was conducted between June 2024 and April 2025. The process included a sequence of nine structured steps/activities as shown in Figure 1. The first step was the formation of a multisectoral eight member NAPHS planning team that conducted stakeholder mapping and developed a roadmap of all the activities that needed to be conducted. The planning team also conducted a thorough desk review of existing assessment reports, e.g., Joint

External Evaluation (JEE), Universal Health and Preparedness Review (UHPR), State Party Annual Self-assessment Reports (SPAR), Simulation Exercises (SIMEX), After-Action Reviews (AARs), and Intra-Action Reviews (IARs). The subsequent steps were conducted in a series of four workshops, with each having specific outputs. The use of standardized reporting templates facilitated systematic documentation across all activities/steps, as shown in Figure 1.

The first workshop was held for 5 days and had an end-term evaluation of the first NAPHS (2018–2022) conducted (Figure 2) as well as a SWOT analysis of the health security situation in the country. During this workshop, a draft strategic NAPHS was autogenerated using the WHO benchmarks digital tool. There was a choice of updating the old NAPHS or autogenerating a draft from the benchmarks tool, which already had the country's 2023 JEE report. Based on the NAPHS end-term evaluation and the JEE outcomes, the old NAPHS was considered too broad and non-specific, and hence, a decision to use the benchmarks tool was preferred.

Past assessments showed that the country had not made significant improvement in JEE scores: 61% of the JEE indicators had limited or no capacity in 2016, and this remained more or less the same at 62% in 2023. Using the autogenerated draft plan and the 2023 JEE recommendations as a starting point, the objectives and target scores for each of the 56 JEE indicators were agreed upon for midterm (2027) and end term (2029). In general, the country decided to increase the JEE score by two levels for those indicators that were at level 1 (no capacity), increase by two levels for those indicators that were at level 2 (limited capacity), and increase by one level for those indicators that were at level 3 (developed capacity). For those indicators that were at level 4 (demonstrated capacity), the decision was either to sustain or increase to level 5 based on the feasibility of sustainability.

Based on the JEE objectives and target scores, the proposed 900 generic strategic actions/activities in the draft plan were reviewed alongside the 95 specific JEE recommendations from the country report. These activities were contextualized and prioritized to only those that had an impact on the JEE target scores and addressed immediate country priorities based on other reports, such as the UHPR and other assessments. Special focus was given to technical areas that had underperformed in the past due to funding and human resource challenges, such as antimicrobial resistance, national laboratory system, food safety, biosafety and biosecurity, chemical events, and radiation events. Therefore, technical areas that had a low JEE score had more proposed activities in order to move them to the desired two-level improvement.

In total, 257 strategic actions were selected for implementation (approximately three to five activities per indicator based on the desire for change). Though the prioritized activities were more than the 167 in the previous plan, it was found necessary to have better-defined activities that were measurable and realistic based on lessons learned from the first NAPHS.

The second workshop was conducted for 4 days by a multisectoral team of 20 that was drawn from the various stakeholders. This team reviewed the first NAPHS (2018–2022) that had expired and updated it to capture the outputs and discussions of the first workshop of the second NAPHS (2025–2029). Specifically, the team developed a Word version of the draft NAPHS that captured the various chapters and sections based on discussions from the first workshop: background/context, country

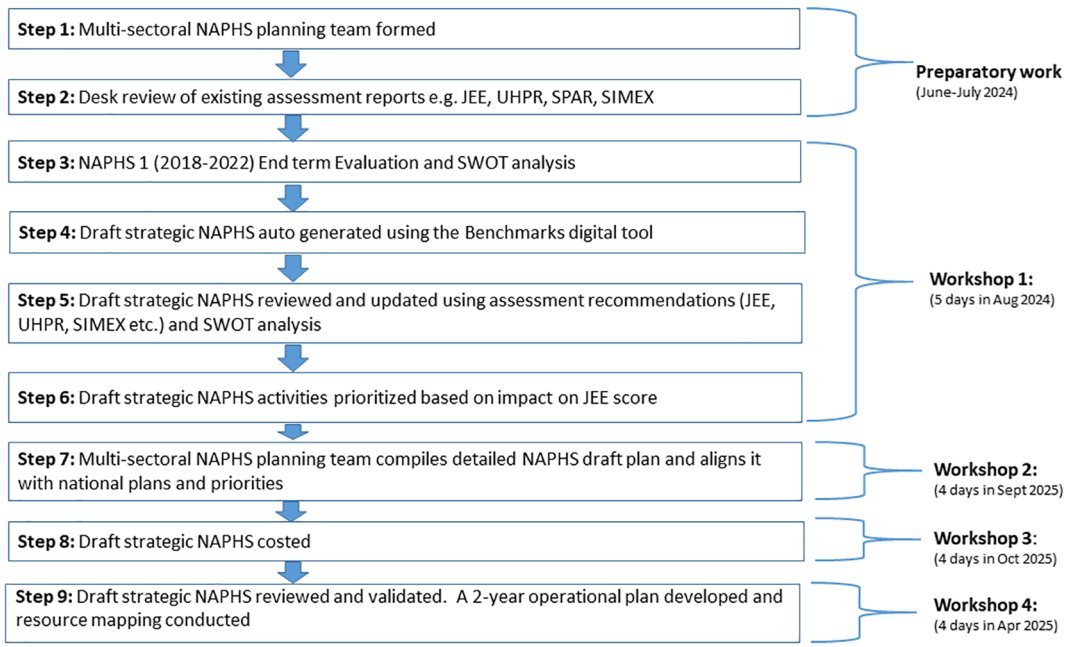

FIGURE 1
The NAPHS development process in Sierra Leone, 2024-2025.

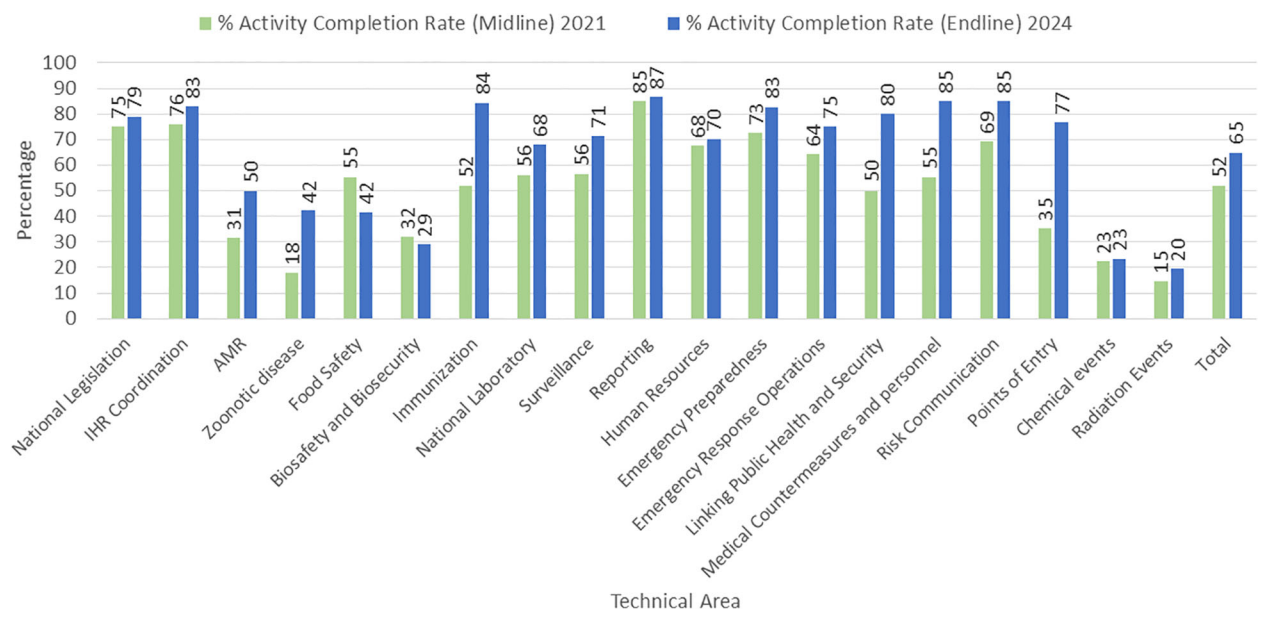

FIGURE 2
Midterm and endterm evaluation status of first NAPHS, 2018-2024, Sierra Leone.

IHR assessments, SWOT analysis, vision, mission, objectives, core values, methodology, strategic actions agreed on, implementation/governance plans, etc.

A third costing workshop was held for 4 days and was attended by 70 participants. During this workshop, 905 detailed activities (subactivities) were generated and costed from the 257 prioritized strategic actions. The total cost of the 5-year plan was $91.6 million, with only approximately 21% of the funding available. The technical areas having the highest contribution to the cost were immunization (16.4%), infection prevention and control (14.5%), and surveillance (13%). The least cost contributors were health equity and human rights (0.2%) and linking public health and security authority (0.3%).

The fourth and final workshop was held for 4 days by 70 participants to validate the costed plan. During this workshop, the teams also developed a 2-year operational plan (2025–2026) and conducted a resource mapping for it. The total budget for the 639 detailed activities that were prioritized for the first 2 years (2025–2026) was $42,398,480, of which only $12,104,780 (29%) was available by the time of finalizing the plan. Of the 639 prioritized activities, 23% were fully funded, 10% were partially funded, while 68% had no funding, as shown in Figure 3.

3.3 Best practices identified

Key informants highlighted several best practices that contributed to the success of the NAPHS process (Table 1). Strong government ownership was frequently emphasized, with the National Public Health Agency of the Ministry of Health providing leadership and oversight throughout. Broad stakeholder engagement, involving all the 19 technical areas of the JEE/NAPHS with participants drawn from more than 15 MDAs and 15 non-state actors (UN/NGOs/CSOs/academia, etc.) ensured a multisectoral perspective. The use of standardized templates and tools from the 2024 WHO NAPHS toolkit promoted consistency in documenting workshop outcomes. Evidence-based planning and prioritization of activities based on national priorities and JEE and other assessment recommendations ensured a focused plan with a lean budget.

To facilitate objective monitoring of the plan, midterm and endterm JEE targets were included unlike the first NAPHS. Partner coordination was cited as critical in avoiding duplication and ensuring alignment of technical support. Additionally, a 2-year operational plan was developed, and resource mapping was conducted to enable gaps to be identified for resource mobilization. Lastly, equity, gender, and human rights are very important pillars of social inclusion. Since gender was already included as an indicator in the NAPHS, an extra technical area known as "equity and human rights" was added in addition to the usual 19 technical areas in order to champion for equity, human rights, and social inclusion in the country.

3.4 Lessons learned

The NAPHS process generated important lessons for future planning. First, early planning was identified as essential to ensuring the timely development of NAPHS. For example, there was a 2-year gap between the end of the first NAPHS (December 2022) and the start of the second NAPHS (January 2025) due to delayed planning. Although the JEE assessment was done on time (March 2023) after the expiry of the previous NAPHS, there was more than a 1-year time lag between the JEE assessment (March 2023) and the start of the second NAPHS development process (June 2024). The main

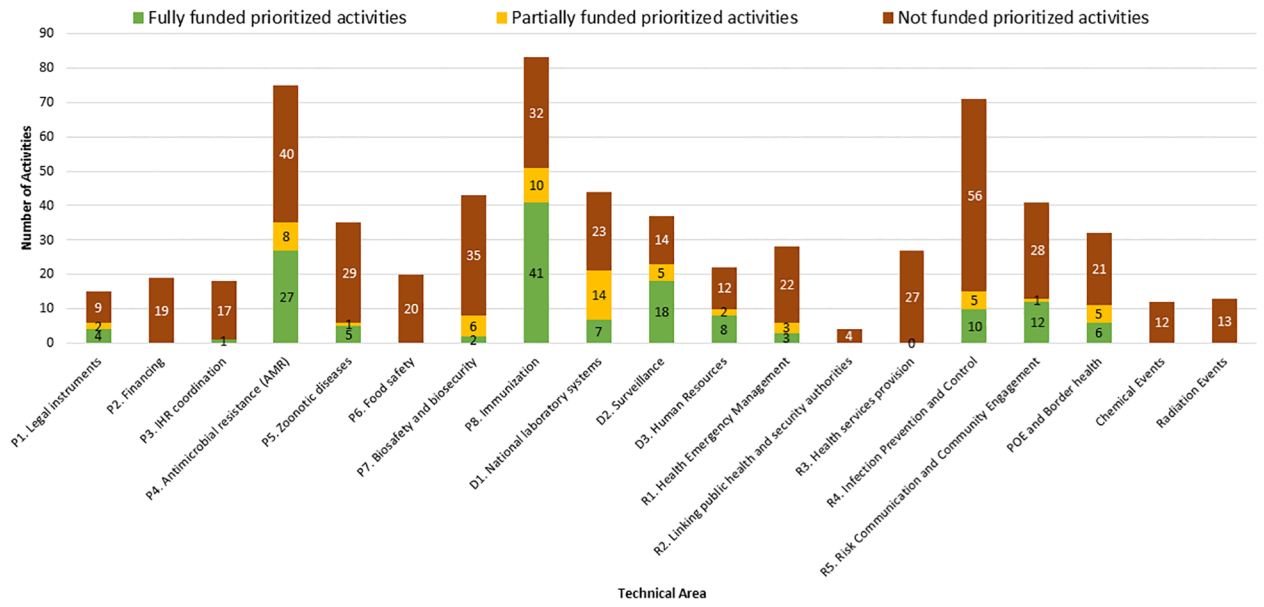

FIGURE 3
Status of funding for NAPHS prioritized activities for the first two years, 2025-2026, Sierra Leone.

reason for this delay is that the JEE report was officially published by the WHO in November 2023 (8 months after the assessment), but the country did not come to know about it until March 2024. To ensure the NAPHS planning process can start on time in the future, the WHO needs to fast-track the JEE publication process and also ensure timely communication to the countries.

Second, continuous communication with stakeholders, including regular updates, maintained momentum and fostered inclusivity during the planning process, and this should be institutionalized.

Third, the NAPHS mid- and end-term evaluations showed that activity completion was high, but this did not match the low JEE

TABLE 1 Best practices identified during NAPHS development, Sierra Leone.

Theme	Description	Sample quotes from stakeholders
Strong government ownership	NPHA led the process and chaired workshops; there was a strong government ownership	"This time, the process was fully nationally driven and led by NPHA"
Broad stakeholder engagement	Involvement of >15 MDAs and >15 other institutions across sectors (UN, NGOs, CSOs, academia) ensured a One Health approach	"The inclusiveness of all stakeholders"
Use of standardized templates and tools	Use of the 2024 WHO NAPHS toolkit and costing tools made the process easy and ensured comparability with other countries	"The process was guided by WHO tools that made it easy"
Evidence-based planning	Used recommendations from NAPHS evaluation, JEE, UHPR, SIMEX, etc. to guide the planning	"Review of the previous NAPHS through the midline and endline evaluation"
Prioritization of activities	Only activities that had an impact on JEE scores directly or indirectly were selected, hence ensuring a lean budget	"The prioritization workshop to select activities with a JEE impact was helpful"
Inclusion of equity and human rights	Equity and human rights was added as an extra costed technical area	Not applicable
Inclusion of mid-and end-term JEE targets	Midterm and end-term JEE targets were included in the plan to aid in the prioritization of activities	"Unlike the first NAPHS, this time mid and end term JEE targets were included"
Donor/partner coordination	Joint technical support by partners avoided duplication	"Technical assistance from WHO and other partners made the processes efficient, collaborative, and impactful."
Alignment with national priorities and plans	Prioritized activities were aligned with national health priorities and international obligations (IHR, JEE)	"Continuous collaboration and consultations across technical areas in one venue and reference to national plans"
Resource mapping	A 2-year operational plan was developed and resource mapping was conducted to identify gaps and support resource mobilization	"During prioritization, activities were mapped to existing projects and funding gaps identified"

capacity improvement due to misalignment of activities. Activities selected for NAPHS should therefore be based on their potential impact on JEE. Fourth, the multisectoral NAPHS workshops were conducted in the same venue with small groups of 2–4 technical areas in close proximity. This allowed for seamless consultation and collaboration across technical areas. Fifth, capacity building, particularly training of rapporteurs, was found to improve the quality and timeliness of documentation. Lastly, the NAPHS development coincided with the United States Government funding freeze in early 2025, and alternate sources of funding had to be sought to complete the process.

3.5 Cost of developing the NAPHS

The total direct cost of developing the NAPHS plan was $75,000. This was the cost of the four workshops that were conducted to develop the plan and comprised venue costs, travel allowances, and stationery.

3.6 Recommendations for future NAPHS development

Stakeholders proposed a range of recommendations to strengthen future planning cycles: Start the NAPHS planning process immediately after JEE is conducted, establish a dedicated budget line for NAPHS planning and monitoring to ensure a coordinated approach by all sectors, enhance district-level and private sector involvement, and institutionalize the identified best practices and lessons learned into the national planning process including the use of the WHO NAPHS implementation toolkit and costing tool which were found to be very useful.

4 Discussion

The development of the second NAPHS in Sierra Leone took approximately 10 months and was led by the National Public Health Agency, which was established in 2023. Only very few countries have published their experience for the first NAPHS, and Sierra Leone is probably the first country to publish its experience on the development of the second NAPHS. The NAPHS process in Sierra Leone was evidence-based and was guided by the gaps identified in the 2023 JEE (13) as well as the recommendations of other assessments, including the 2023 UHPR (21). The UHPR is a new global peer review mechanism for health security, and Sierra Leone was the second country in Africa and fifth globally to have conducted it. Unlike other countries, the use of UHPR recommendations to guide the NAPHS process was therefore considered unique for the country. UHPR is a voluntary, transparent, Member State-led peer review mechanism that focuses on high-level strategic capacities for health security (22).

The Sierra Leone NAPHS development process was well aligned with global best practices and standards, including the NAPHS country implementation guide (17), the WHO strategy for NAPHS 2022–2026 (16), and the updated WHO IHR benchmarks tool (19). Sierra Leone used the IHR benchmarks tool to autogenerate a draft strategic plan that proposed activities based on its baseline JEE score and target for the next 5 years. However, the proposed activities were found to be too many, and the country had to vet every activity and only keep the ones that had a direct or indirect impact on JEE scores.

The use of the 2024 WHO NAPHS implementation toolkit, which is relatively new, was also found to be very useful in guiding the process and ensuring it was systematic, as each step has a template that can be adapted by the countries (18). The NAPHS process was also aligned with the broader national development priorities and governance frameworks such as the Medium-Term National Development Plan 2024–2030 (23) and the National Health Strategic Plan 2021–2025 (24). The plan is also aligned with the 2025 Sierra Leone National Health Summit, which discussed a broad range of priorities, including accelerating Universal Health Coverage and the critical role of partnerships in embedding health security measures in national plans (25). Aligning NAPHS to national priorities has also been documented by other countries, such as Tanzania (26).

NAPHS is a complex process that involves multiple stakeholders, both national and international, to be able to build the required global health security capacities (27). Sierra Leone, therefore, used the One Health multisectoral approach in the development process, as this has been found to be effective even in other countries such as Uganda (28) and Pakistan (29). One of the lessons learned from Sierra Leone and Uganda in the first NAPHS is that countries tend to select very many or broad non-specific activities, which are then very difficult to implement (14, 30). The NAPHS end-term evaluation in Sierra Leone showed that although many activities had started, many of them were not completed. In addition, there was little impact on the JEE score of 2023 compared to 2016. This is why the country decided to prioritize activities based on impact on JEE during the development of the second NAPHS.

One of the effects of selecting broad activities or non-prioritization is that costing becomes a challenge. For example, an analysis done in 2023 found that only 11% (9/82) of countries that had completed a NAPHS included costed line-item data (e.g., budget information) within published materials (31). Due to poor prioritization, the cost of the first NAPHS (2018–2022) for Sierra Leone was very high compared to other countries. For example, the cost of the country plan was USD 290 million compared to Tanzania ($86.6 million) and Cameroon (USD 87.7 million) (26) (32). The lessons learned over time, including the outcome of the mid- and end-term NAPHS evaluation, enabled better prioritization for the second Sierra Leone NAPHS (2025–2029), whose total cost was USD 91.6 million. Despite the smaller budget, only approximately 21% of the plan had funding available, and this calls for continuous resource mobilization for successful implementation.

A few challenges were encountered during the NAPHS development process. Though the NAPHS process was planned to take 6 months, the process took approximately 10 months because the validation workshop was affected by the USG funding cut in early 2025, and alternate sources of funding had to be found. The issue of continuous resource mobilization for planning and NAPHS implementation is therefore very important, and the country has already started mobilizing funds, including the successful application of the Pandemic Fund that has been implemented in the country since April 2025. Another challenge was the underrepresentation of some stakeholders, such as the private sector and regional or local governments/authorities at subnational level (due to financial constraints), and this may have overlooked certain perspectives in the planning. The latter part of the planning process also coincided with the mpox outbreak, which also diverted attention as some personnel were deployed to the field.

The main limitation of the study was the few number of key informants who responded to the online questionnaire. Though there were respondents from the government, UN, and some NGOs, a bigger representation of stakeholders, including civil society, would have given a better and enriched perspective. The self-reported questionnaire may also have been affected by recall bias since the survey was done 5 months after the planning process was completed. The effect of the recall bias was minimized by triangulating the findings with the activity reports.

5 Conclusion

NAPHS is a critical tool for IHR implementation and for strengthening health security systems. Sierra Leone's experience demonstrates that even in resource-constrained settings, a nationally led, evidence-based, and prioritized approach to health security planning is feasible and impactful. Institutionalizing such approaches within government systems and financing frameworks will sustain health security gains and resilience. With only 21% of the funding available for the 5-year plan, we recommend that adequate domestic and external resource mobilization be conducted to ensure full implementation. In addition, cross-cutting issues such as equity, gender equality, human rights, governance, and accountability to the beneficiaries should be addressed and prioritized.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

VC: Methodology, Conceptualization, Investigation, Writing – original draft. MJ: Validation, Project administration, Writing – review & editing, Methodology, Investigation, Conceptualization. RM: Writing – review & editing, Methodology, Supervision, Resources, Project administration, Conceptualization. JS: Validation, Conceptualization, Writing – review & editing, Methodology. MV: Writing – review & editing, Supervision, Methodology, Conceptualization, Validation. FS: Supervision, Conceptualization, Validation, Writing – review & editing. MN: Conceptualization, Investigation, Writing – review & editing, Validation, Methodology. GA: Resources, Methodology, Writing – review & editing, Conceptualization, Supervision, Funding acquisition. LK: Writing – review & editing, Investigation, Methodology, Conceptualization. SG: Investigation, Writing – review & editing, Conceptualization, Methodology. JK: Conceptualization, Investigation, Writing – review & editing, Methodology. RS: Methodology, Conceptualization, Investigation, Writing – review & editing. MBJ: Writing – review & editing, Investigation, Methodology, Conceptualization. SB: Methodology, Supervision, Conceptualization, Writing – review & editing. FS: Investigation, Methodology, Conceptualization, Writing – review & editing. MM: Conceptualization, Methodology, Writing – review & editing, Investigation. OK: Writing – review & editing, Investigation, Methodology, Conceptualization. RW: Writing – review & editing, Methodology, Conceptualization. DC: Methodology, Resources, Conceptualization, Writing – review & editing. IN: Writing – original draft, Formal Analysis, Investigation, Data curation, Methodology, Visualization, Validation, Conceptualization.

Funding

The author(s) declared that financial support was not received for this work and/or its publication.

Acknowledgments

We sincerely thank the staff of the Sierra Leone National Public Health Agency; Ministries, Departments, and Agencies; development partners; and all other stakeholders who participated in the process of developing the NAPHS.

Conflict of interest

The authors declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

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