

Vanuatu Integrated Health Research Agenda 2025



Ministry of Health
Vanuatu Government
Republic of Vanuatu



Burnet



Ministry of Health
Vanuatu Government
Republic of Vanuatu



Burnet

The Vanuatu Integrated Health Research Agenda **2025**



Consultation feedback report identifying the top research priorities in health and climate change and health according to the Vanuatu Ministry of Health and key stakeholders.

Prepared by the Vanuatu Ministry of Health and Burnet Institute

The Vanuatu Integrated Health Research Agenda 2025

Prepared by:

Geoff Chan, Jane Greig, Caroline van Gemert: Burnet Institute

Florita Toa, White Tougen, Wendy Williams: Vanuatu Ministry of Health

Please contact Florita Toa (ftoa@vanuatu.gov.vu) or Caroline van Gemert (caroline.vangemert@burnet.edu.au) with any queries.

We acknowledge the cooperation and contributions of the individuals who participated in consultations conducted as part of this project.

This activity was made possible through the WHO Climate Change, Health and Ethics Initiative, which was supported by Wellcome Grant 306679/Z/23/Z.

Suggested citation:

Vanuatu Ministry of Health and Burnet Institute. 2026. The Vanuatu Integrated Health Research Agenda 2025. Burnet Institute, Melbourne, Australia.

Burnet Institute
85 Commercial Road
Melbourne, Victoria, Australia, 3004
t + 61 3 9282 2111
e info@burnet.edu.au

Ministry of Health
Private Mail Bag 9006
Port Vila, Vanuatu
t + 678 33081

Burnet has offices or representatives in Australia, Papua New Guinea, Myanmar and Vanuatu, and contributes to research and public health programs in many other countries across Asia, the Pacific, Africa, Europe, and North America.

Contents

Contents	3
Acronyms	4
Executive Summary	5
Background	5
Consultation process	5
Results	5
Next steps	10
Introduction	11
Background	11
Project and governance	13
Consultation process	14
Stage 1: Brainstorming	14
Stage 2: Ranking	15
Stage 3: Consolidation	15
Number of participants by Stage and topics identified	17
Prioritised research topics	18
Family Health	18
Communicable diseases	22
Non-communicable diseases	29
Health systems research	34
Next steps	41
Annexes	42
Annex 1: Committee membership	42
Annex 2: Full list of health research topics, in order of ranking	43
Annex 3: Full list of climate change and health research topics, in order of ranking	50

Acronyms

4Ds	Description, Delivery, Development, Discovery
AMR	Antimicrobial resistance
ANC	Antenatal care
BBV	Blood borne virus
BCG	Bacille Calmette–Guérin (BCG vaccine)
CGM	Continuous glucose monitoring
DR-TB	Drug-resistant tuberculosis
GBV	Gender-based violence
GDP	Gross domestic product
GIS	Geographic information system(s)
HIV	Human immunodeficiency virus
HPV	Human papillomavirus
IOM	International Organization for Migration
LGBTQI+	Lesbian, gay, bisexual, transgender, queer/questioning, intersex and related identities
NCDs	Non-communicable diseases
NGO	Non-government organisation
NTD	Neglected tropical disease
PLHIV	People living with HIV
PTSD	Post-traumatic stress disorder
R	R statistical software
REDCap	Research Electronic Data Capture
RMNCH	Reproductive, Maternal, Newborn, and Child Health
RPS	Research prioritisation score
STI	Sexually transmitted infection
TB	Tuberculosis
VHW	Village health worker
VHRS	Vanuatu Health Research Symposium
WASH	Water, sanitation and hygiene
WHO	World Health Organization

Executive Summary

Background

A national health research agenda is a strategic tool that guides research investment by identifying priority knowledge gaps and aligning research with population health needs. By promoting locally generated evidence, a health research agenda supports evidence-informed policy, planning, and service delivery, particularly in resource-constrained settings. In 2024, the Vanuatu Ministry of Health initiated the development of its first national health research agenda, integrated with a climate change and health research agenda, to strengthen national research coordination and relevance.

Vanuatu's dispersed archipelagic geography, combined with a young, predominantly rural population and limited health system capacity, creates a complex health profile and ongoing service delivery challenges. Persistent infectious diseases and a growing burden of non-communicable diseases continue to challenge service delivery, while gaps in local data and research capacity limit effective decision-making. Climate change further intensifies these challenges through more frequent and severe extreme weather events, impacts on food and water security, changing disease patterns, displacement, and growing mental health needs. Climate change thereby places additional strain on an already fragile health system.

In response, the Integrated Vanuatu Health Research Agenda systematically identifies and prioritises research needs across health systems, disease prevention and control, service delivery, and climate–health interactions. The Agenda seeks to support locally led, policy-relevant research; strengthen national research capacity; and align research efforts with national strategies and development priorities. This consultation feedback report outlines the process used to develop the Agenda and presents the resulting priority research areas to support coordinated, evidence-based action to improve health outcomes and resilience in Vanuatu.

Consultation process

A three-stage consultation process was used to identify, rank and consolidate prioritised research topics to be included in the Vanuatu Integrated Health Research Agenda. Separate consultations were held for the development of a Health Research Agenda and a Climate Change and Health Research Agenda.

Stage 1 involved multi-sectoral workshops where stakeholders from health, climate, animal health, fisheries, academia, non-government organisations, and development partners brainstormed priority research topics across four domains and defined rationales, considerations, and research types. Stage 2 involved a smaller group of stakeholders scoring the full list of topics against agreed criteria, with results analysed and ranked using weighted prioritisation scores. Stage 3 comprised facilitated discussions with the Ministry of Health to consolidate and finalise the research agenda.

Results

The final ranked lists of research topics by domain are presented here (including sub-domains and climate change specific research questions).

Family health

Top 5 research topics for: Reproductive, maternal and child health

1. Research on why sexual health education and family planning services are not preventing unwanted pregnancies
2. Research on underlying drivers of maternal and neonatal mortality (including late presentation)
3. Research on the reasons for late presentation for antenatal care (ANC)

4. Research on how many unwanted pregnancies occur and expectant mother practices when unwanted pregnancies occur
5. Research on new solutions for improving childhood development by integrating childhood development assessment and referral into routine child health visits

Top 5 research topics for: Immunisation and vaccine preventable diseases

1. Research on solutions to reach and vaccinate children who are not fully immunised
2. Research on new solutions to increase cervical cancer screening coverage and access to treatment with a focus on inclusion and equity
3. Research on reasons for low uptake of HPV vaccination
4. Research on why birth dose coverage of Hepatitis B vaccination is low compared to BCG
5. Research on the sequelae of meningitis

Top 10 research topics for: Climate change and family health

1. Research on water, sanitation and hygiene (WASH) and menstrual hygiene needs during natural disasters (including people with disabilities)
2. Research on the impact of climate disasters on routine childhood vaccination coverage
3. Research focus on assessing the impact of climate change on health and nutritional needs of school-aged children and adolescents: challenges and adaptive strategies
4. Research into the best way to ensure continuity of ANC during health emergencies
5. Research on maternal nutrition challenges due to climate-related food shortages
6. Research on the effectiveness and feasibility of micronutrient powder interventions (MNP) before and during disasters
7. Research into the minimum standards at emergency evacuation centres for Reproductive, Maternal, Newborn, and Child Health (RMNCH)
8. Research into access to contraception during emergencies: barriers, needs and gaps
9. Research on infrastructure solutions to maintain maternal health service access during climate events
10. Research on climate-induced stress, anxiety and depression in pregnant/postpartum women

Communicable diseases

Top 5 research topics for: Antimicrobial resistance (AMR), environmental health and One Health

1. Research on solutions to reduce AMR in the community and in health facilities
2. Research on the prevalence of AMR in different pathogens and the associated burden of mortality and adverse health outcomes
3. Research on human antibiotic consumption practices and their implications for AMR
4. Research on One Health risk factors (animal, human and environmental) for AMR emergence
5. Research on knowledge, attitudes and practices relating to leptospirosis among the population

Top 5 research topics for: HIV, STIs and blood borne virus

1. Research to measure the true burden of HIV and others STIs
2. Research on solutions for providing hepatitis B screening and treatment in remote settings
3. Research on the burden of syphilis and resulting morbidity and mortality, including among infants
4. Research on the sexual health needs and care seeking-behaviours of seasonal workers from Vanuatu in Australia and New Zealand while overseas and on return
5. Research on the burden of hepatitis B among children and the general population

Top 5 research topics for: Neglected tropical diseases

1. Research on the burden of rheumatic heart disease

2. Research on the gaps and barriers to timely notification, reporting and investigation of diseases, especially for notifiable diseases and neglected tropical diseases
3. Research on the burden of neglected tropical diseases including the impact of climate on neglected tropical disease burden
4. Research on community and health worker knowledge, attitudes, practices and behaviours relating to neglected tropical diseases, including how these have been affected by health promotion and health campaigns
5. Research on how integrated neglected tropical disease programmes affect access to care, service delivery, and health outcomes in targeted communities

Top 4 research topics for: TB¹

1. Research on the challenges in finding drug-resistant TB cases
2. Research on barriers and enablers for effective TB contact investigation and uptake of preventive therapy
3. Research on the burden of TB and the determinants of TB transmission
4. Research on why there are low rates of TB treatment adherence

Top 5 research topics for: Vector-borne diseases

1. Research on changes in malaria burden and transmission due to climate change
2. Research on knowledge, attitudes and practices relating to malaria among the population
3. Research on safe, acceptable solutions for achieving radical cure for patients with Vivax malaria
4. Research on solutions for decentralising malaria elimination interventions from provinces to health facilities
5. Research on the effectiveness of implementation of long-lasting insecticide treated nets and indoor residual spraying in controlling malaria

Top 10 research topics for: Climate change and communicable diseases

1. Research on how climate shocks impact access to HIV prevention services for people experiencing gender-based violence
2. Research focus on investigating the hidden HIV risk and surveillance gaps amid climate vulnerabilities
3. Research on factors that strengthen the resilience of HIV testing services in the face of climate disasters
4. Research on understanding the influence of climate and cultural barriers to condom use among adolescents
5. Research on evaluation of predictive models for disease outbreaks using climate data
6. Research that integrates meteorological and health information to support real-time disease surveillance
7. Research on epidemiological modelling of disease outbreaks in relation to climate variability
8. Research on mapping disease hotspots in relation to climate trends and extreme events.
9. Research on how changing temperatures and rainfall patterns affect the spread of vector-borne, water-borne, food-borne and neglected tropical diseases
10. Research focus on mapping climate responsive management of mosquito breeding sites in Vanuatu.

¹ There were only 4 questions identified for this health area

Non-communicable diseases

Top 5 research topics for: Mental health and neurological conditions

1. Research on morbidity and mortality due to marijuana use and the factors that influence substance use
2. Research on the prevalence and burden of mental illness
3. Research on solutions for early recognition and diagnosis of stroke
4. Research on the burden and effect of conditions that are comorbid with stroke
5. Research on the health burden of epilepsy and the risk factors for deaths relating to epilepsy

Top 5 research topics for: Non-communicable diseases (NCDs)

1. Research on lifestyle changes and trends that affect the prevalence of NCDs in different groups
2. Research on what NCD services can feasibly be provided at different levels of the health care system
3. Research on referral and follow-up practices and their implications for appropriate care for NCDs
4. Research on whether and why people do not take their medications to control NCDs
5. Research on solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes

Top 5 research topics for: Nutrition

1. Research on nutritional choices and nutritional value of available foods and their relationship with non-communicable diseases (NCDs)
2. Research on the health and nutrition needs of school-aged children and adolescents
3. Research on rates of obesity and chronic inflammation among people of working age
4. Research on solutions using local food systems to increase food security for resilience to disasters and climate change
5. Research on the associations between island kai kai and health and nutritional status of those consuming island kai kai

Top 10 research topics for: Climate change and non-communicable diseases

1. Research on the impact of climate change on the prevalence and management of diabetes in Vanuatu through its impact on food security, health infrastructure, and population displacement
2. Research on understanding the mental health burden linked to climate change
3. Research on the incidence of climate change-related mental health conditions
4. Research on how climate-driven lifestyle changes and socio-economic shifts affect non-communicable disease prevalence among diverse population groups
5. Research on what are the health consequences of increased frequencies of storms, floods and landslide including injuries, displacement and mental health impacts
6. Research on how climate change related stress, displacement and loss of livelihoods will affect mental wellbeing, including anxiety, depression and post-traumatic stress disorder
7. Research on how climate change influences nutritional choices, the nutritional value of available foods, and their relationship with the burden of non-communicable diseases
8. Research on the effectiveness and adequacy of existing mental health interventions in response to climate change-related impacts
9. Research on climate-resilient solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes
10. Research into understanding the impacts of disasters on household nutrition and food practices

Health systems research

Top 5 research topics for: Health equity and vulnerable groups

1. Research on the levels of health literacy in the population for different diseases and health conditions
2. Research on the health care-seeking behaviours and preferences of groups that are disadvantaged or marginalised in terms of accessibility and inclusivity of health services
3. Research on the needs of people with disability and the health and other services required to support them
4. Research on how well health services meet the needs and preferences of different communities and patients (in terms of acceptability, inclusiveness)
5. Research on the burden and impact of acquired disability on persons with disability and their families

Top 4 research topics for: Health information systems²

1. Research on the impact of utilisation of health information on planning of health services, service delivery and health outcomes
2. Research on the performance of different health information systems and combinations of health information systems in relation to potential needs of the Ministry of Health and partners for policy and planning
3. Research on the extent and reasons for inaccurate reporting of health information system data
4. Research on the reasons for slow and ineffective uptake of electronic health data systems

Top 5 research topics for: Health systems

1. Research on the effectiveness of the village health workers program
2. Research on the vulnerability to and impact of climate change on the Vanuatu health system in terms of infrastructure, workforce, response capability, recovery, access and strategy
3. Research on solutions for reducing the need for referral and the cost of referral without compromising patient care
4. Research on solutions to improve the quality and coverage of required services
5. Research on how best to allocate funding to maximise health impact

Top 4 research topics for: Health workforce³

1. Research on the human resources required to deliver the health strategy and the associated costs
2. Research on new solutions to meet the in-service training needs of the health workforce
3. Research on the health workforce training and capacity development needs in different facilities and parts of Vanuatu
4. Research on whether current nursing and midwifery training methods are effective in giving trainees the skills they need

Top 5 research topics for: Other health topics, not included above

1. Research on how traditional medicines and beliefs impact on patient behaviours
2. Research on new solutions that use or account for traditional medicine and beliefs to improve service acceptability and patient practices
3. Research on the burden and risk factors for asthma

² There were only 4 questions identified for this health area.

³ There were only 4 questions identified for this health area.

4. Research on the role of population movement in the spread of infectious diseases within Vanuatu and neighbouring countries
5. Research to understand the long-term impact of surgery on patient quality of life

Top 10 research topics for: Climate change and health systems

1. Research on the vulnerability and adaptive capacity of the Vanuatu health system to climate change impacts across infrastructure, workforce, service delivery, recovery, access, and governance
2. Research on human resource gaps and barriers in climate-health workforce development
3. Research on strengthening health information systems to support climate-resilient planning and timely health responses
4. Research on what health services are needed in different parts of Vanuatu and the resources and facilities needed to provide them
5. Research on future government health system costs associated with the impacts of climate change
6. Research on climate and health financing policies in Vanuatu and comparable contexts
7. Research on government structures and their impact on climate-health policy effectiveness
8. Research into approaches for maintaining continuity of health services during emergency health workforce mobilisation
9. Research into the application of geographic information system (GIS) technologies for real-time mapping of disease outbreaks linked to climate events
10. Research on Climate-Resilient Health Systems: Ensuring Continuity and Quality of Essential Services During Facility Failures

Next steps

Through a structured, three-stage consultation process involving a wide range of stakeholders, nationally relevant and user-informed health research priorities were identified for Vanuatu. This process emphasised the needs of health system decision-makers, service providers, and communities, and strengthened alignment with national policy and planning priorities. To maintain relevance and responsiveness to emerging health and climate challenges, it is recommended that this priority-setting process be repeated every five years, with regular review to incorporate new evidence, emerging risks, and areas where research needs have been sufficiently addressed.

Introduction

Background

What is a health research agenda?

A health research agenda is a strategic document used by countries to identify knowledge gaps and priority areas for health research, aiming to guide future research efforts and ensure that public health decision-making uses locally generated evidence. The aim of a health research agenda is to support researchers and policymakers to effectively target research that has the greatest potential public health benefit.

The World Health Organization (WHO) emphasises that each country has a responsibility to develop its own health research agenda, reflecting the health needs of its population within its specific social, political, and environmental context⁴. This approach helps ensure that research activities are relevant, coordinated, and aligned with national priorities.

In addition to ongoing health challenges, countries must also respond to emerging and cross-border issues that require national and collaborative research efforts, such as climate change. For countries highly vulnerable to climate-related impacts, locally generated evidence is essential to support adaptation planning, disaster preparedness, and health system resilience in the face of increasing cyclones, sea-level rise, extreme heat, and changing disease patterns.

Low-income and middle-income countries often face multiple challenges in developing research capacity, including limited resources, difficulties training and retaining researchers, and the influence of donor-driven research agendas. These factors can weaken national research priorities and divert attention from locally relevant health needs. A health research agenda helps address this by guiding the use of finite resources towards research that maximises public health impact and advances health equity.

In many low-income country settings, health research priorities focus on epidemiological, implementation, and operational research (Figure 1). This reflects the need to better understand the local burden and determinants of disease, as well as to improve the efficiency, effectiveness, and equity of health systems and interventions within specific contexts.

Health profile and issues in Vanuatu

Vanuatu is an archipelagic nation located approximately 1,750 km east of Australia, comprising 83 islands across more than 12,000 square kilometres. Administratively, the country is divided into six provinces: Malampa, Shefa, Penama, Tafea, Torba, and Sanma. The capital city, Port Vila, is located on the island of Efate in Shefa Province, while the second-largest urban centre, Luganville, is situated on Espiritu Santo Island in Sanma Province.

In 2023, Vanuatu's population was estimated at approximately 320,000. The population is based predominantly in rural areas, with around 74% living outside urban areas, and is relatively young, with just over one-third aged under 15 years. Vanuatu is classified as a lower-middle-income country by the World Bank, with a gross domestic product (GDP) per capita of approximately US\$3,515 in 2023. The economy is largely driven by tourism, agriculture, and fisheries, while remittances from ni-Vanuatu living overseas contributed around 13% of GDP in the same year.

⁴ World Health Organization. The WHO strategy on research for health [Internet]. Geneva; 2012 [cited 2024 Aug 21]. Available from: https://iris.who.int/bitstream/handle/10665/77935/9789241503259_eng.pdf?sequence=1

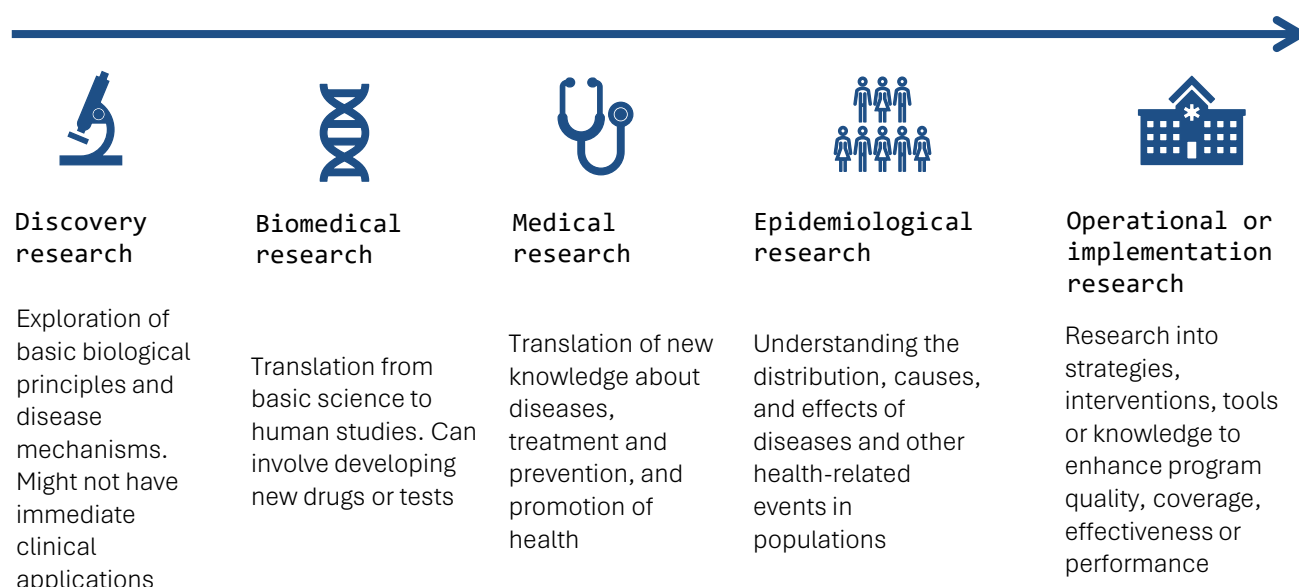


Figure 1: Spectrum of Health-related research from early discovery through to public health implementation research

The Government of Vanuatu is the primary provider of health services nationwide. The public health system is structured across four service levels: two referral hospitals, 34 health centres, 91 dispensaries, and 245 community-supported aid posts⁵. A small private health sector operates mainly in the urban centres of Port Vila and Luganville, complemented by a limited range of services delivered by non-government organisations, faith-based organisations, and community-based providers.

According to the 2018 World Health Organization Universal Health Coverage and Sustainable Development Goal country profiles, Vanuatu has relatively low coverage of essential health services and limited health system capacity and access⁶. Significant challenges persist in the prevention and control of infectious diseases and non-communicable diseases (NCDs). In particular, high rates of raised blood pressure and limited access to improved sanitation remain major public health concerns.

Climate change health profile and issues in Vanuatu

Climate change is one of the most significant and rapidly intensifying public health challenges of the 21st century. Its impacts are already evident through changing patterns of infectious diseases, more frequent and severe extreme weather events, threats to food and water security, worsening nutritional outcomes, population displacement, mental health stressors, and increasing pressure on fragile health systems. These impacts are not evenly distributed: low-income and climate-vulnerable countries face disproportionate risks despite contributing least to global greenhouse gas emissions.

Vanuatu is consistently ranked among the countries most at risk from climate-related hazards. Its geographic dispersion across 83 islands and limited infrastructure heighten exposure and vulnerability to climate impacts. A predominantly rural and young population further challenges health service delivery, disaster response, and long-term resilience⁷. The national economy is heavily dependent on climate-sensitive sectors, including agriculture, fisheries, and tourism. As a result, climate variability and

⁵ United Nations Population Fund. Health Facility Readiness and Service Availability (HFRSA) Assessment: Republic of Vanuatu. 2021 May.

⁶ World Health Organization. Universal Health Care and Sustainable Development Goal Country Profile: Vanuatu. 2018. Available from: <https://apps.who.int/iris/handle/10665/272329>

⁷ The World Bank. Country overview: Vanuatu [Internet]. 2023 [cited 2023 Jul 27]. Available from: <https://data.worldbank.org/country/VU>

extreme weather events have cascading effects on livelihoods, food security, income stability, and population health.

Vanuatu is regularly affected by tropical cyclones, flooding, drought, and progressive sea-level rise. These hazards generate both immediate and long-term health consequences. Changes in rainfall and temperature influence the transmission of vector-borne diseases such as malaria and dengue. Flooding and damage to water and sanitation infrastructure increase the risk of water-borne diseases. Crop losses and supply-chain disruptions following extreme events contribute to food insecurity and malnutrition, particularly in rural and remote communities. Rising temperatures increase the risk of heat-related illness and may exacerbate respiratory conditions. Recurrent disasters, displacement, and loss of livelihoods also contribute to growing mental health burdens. At the same time, extreme events place additional strain on an already resource-constrained health system through infrastructure damage, workforce disruption, and interruptions to medical supply chains.

National policy frameworks recognise these risks. The Vanuatu National Climate Change and Disaster Risk Reduction Policy (2016–2030) and the Vanuatu Health Sector Strategy (2021–2030) identify climate change as a significant and escalating threat to population health and call for integrated approaches to adaptation and resilience. However, the capacity to generate robust, locally relevant evidence on climate-health interactions remain limited. Strengthening national research systems and systematically prioritising climate and health research are therefore critical to informing policy, guiding investment, and protecting the health of current and future generations in Vanuatu.

Project and governance

In 2024, the Vanuatu Ministry of Health established the Vanuatu Health Research Agenda Committee (see Annex 1 for membership) to work towards developing Vanuatu’s first health research agenda, integrated with a climate change and health research agenda. The aim of the Vanuatu Integrated Health Research Agenda is to systematically identify and prioritise the health research needs of health care workers, public health officers, policymakers, and other key stakeholders in Vanuatu, and to translate these priorities into a coordinated national framework that informs research funding, partnerships, and evidence-based policy and planning decisions for health. The Burnet Institute was requested to support the development of the Vanuatu Integrated Health Research Agenda and successfully obtained funding through the World Health Organization in 2024. The Vanuatu Health Research Agenda Working Group was established to oversee the consultation and documentation, comprised of members of the Vanuatu Health Research Agenda Committee and the Burnet Institute.

Consultation process

A three-stage consultation process was used to identify, rank and consolidate prioritised research topics to be included in the Vanuatu Integrated Health Research Agenda. Separate consultations were held for the development of a health research agenda and a climate change and health research agenda.



Figure 2 of the three-stage consultation process

Stage 1: Brainstorming

Stage 1 consisted of a brainstorming workshop. The health-focused agenda workshop included stakeholders from the health sector including clinical, public health, community, and health system support personnel, policymakers, private clinicians, and non-government organisations. The climate-change and health focused agenda workshop included stakeholders from the health sector, climate change agencies, animal health sector, fisheries sector, non-governmental organisations (NGO), academic institutions and development partners.

During the workshop, participants were provided an explanation of the research agenda process, how to categorise research using the 4D approach (see below), consultation to determine the values and criteria that should be used to guide prioritisation, and facilitated sessions to brainstorm the most important research topics top put forward for ranking (see Figure 3).

Categorisation of research

The Child Health and Nutrition Research Initiative ‘4Ds’ framework was used for the systematic approach to categorising research, with the Ds referring to: description, delivery, development and discovery research⁸.

- “Description” Research included research that assessed the burden of health problems in the population of interest and aimed to understand its determinants, typically achieved through epidemiological research.
- “Delivery” Research included research questions that allowed researchers to optimise health status of the population using the means that are already available. This is typically achieved through implementation research, operational research and/or health policy and systems research.
- “Development” research is focused on improving health interventions that already exist, but could be made more effective, affordable or sustainable.

⁸ Rudan I. Setting health research priorities using the CHNRI method: IV. Key conceptual advances. J Glob Health. 2016 Jun;6(1):010501.

- “Discovery” research included all research questions that would lead to innovation, i.e. generation of new knowledge to develop entirely new health interventions.

Values

Participants agreed that the key values to guide development of the research agenda should be that research should be ethical, country owned, assist in public health priorities, inclusive, help in planning and policy in public health issues, and engage the community.

Criteria

Participants agreed that the following criteria that should be used to score the research topics:

1. Magnitude of the health problem
2. Responsiveness to the Vanuatu Health System Strategy
3. Equity
4. Usefulness or size of the knowledge gap.

Stage 2: Ranking

Stage 2 involved consultation with a smaller group of stakeholders and decision makers to score the full list of research topics to comprise the health research agenda and the climate change and health research agenda. A webform developed in REDCap⁹ was used to score research topics. Participants scored each research topic against the criteria agreed upon in Stage 1.

After scoring was complete, the data were analysed in R (version 4.3.1). Weighted and unweighted research prioritisation scores (RPS) were calculated for each research topic. The scored research topics were then ranked using the weighted RPS. A higher RPS indicated a higher priority for the research topic.

Stage 3: Consolidation

Stage 3 consisted of a series of facilitated discussions with representatives of the Vanuatu Ministry of Health to consolidate the findings and decide on how the ranked research topics should be developed into a research agenda. It was determined that the top 5 research topics for each sub-domain should be presented in addition to the top 10 for each climate change and health domain. Annex 2 and Annex 3 includes the full ranked list beyond the Top 5 and Top 10 lists by domain (if not already stated).

⁹ REDCap (Research Electronic Data Capture) is a secure, web-based application used for building and managing online surveys and databases, primarily for research studies.



RD 1: Family health

- Maternal mortality and neonatal deaths
- Child health including immunisation
- Adolescent health
- Menstrual hygiene
- Sexual and reproductive health
- Family planning
- Intersection between climate change and family health



RD 2: Communicable diseases research

- Tuberculosis (TB)
- Sexually transmitted infections (STIs) and blood borne viruses (BBVs)
- Malaria and vector borne diseases
- Neglected tropical diseases (NTDs)
- One health
- Emerging infectious diseases
- Intersection between climate change and communicable diseases



RD3: Non-communicable diseases

- Environmental and nutritional health
- Chronic non-communicable diseases
- Mental health and neurological disorders
- Violence and social harm
- Injuries and accidents
- Other priority health issues including disability and traditional medicine
- Intersection between climate change and non-communicable diseases

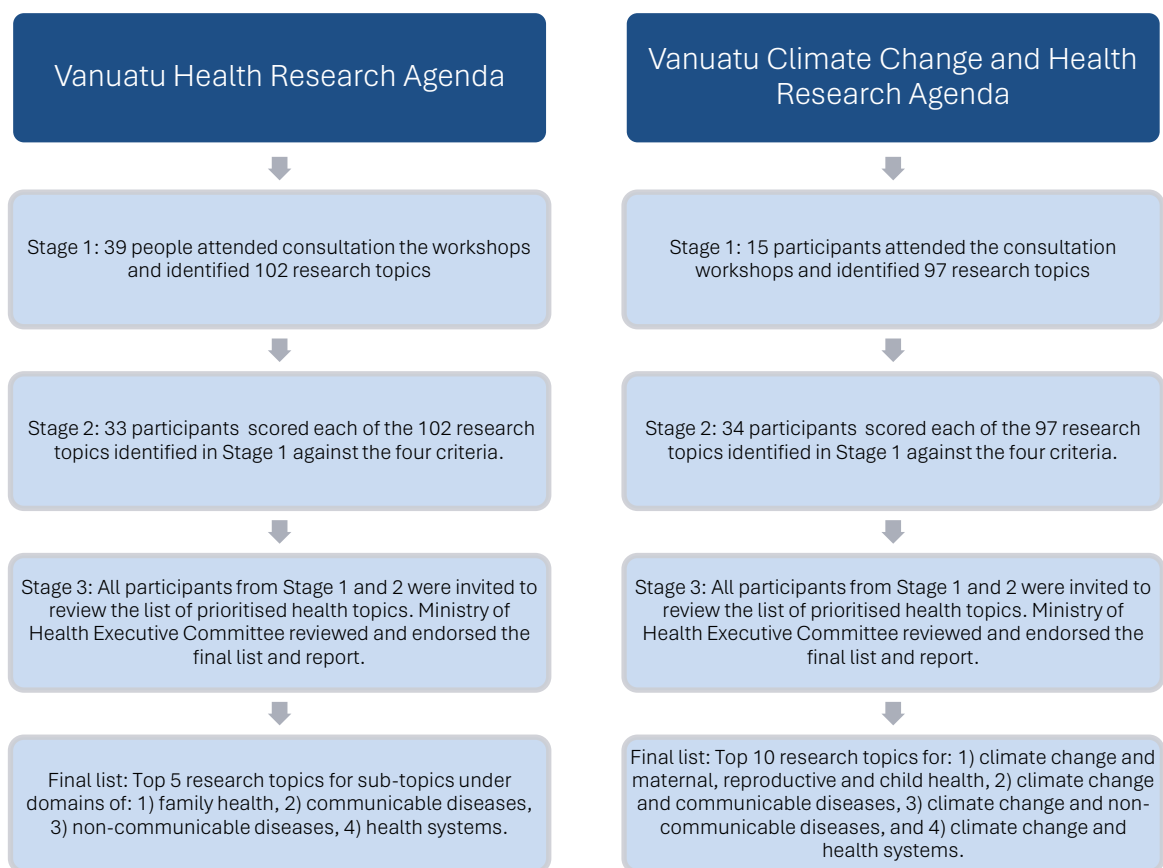


RD 4: Health systems research

- Health technologies
- Health information systems
- Human resources for health
- Leadership, management and governance
- Health financing
- Inequities
- Intersection between climate change and health systems research

Figure 3. Research health domains and sub-domains presented to participants during stage 1 to frame the topic brainstorming

Number of participants by Stage and topics identified



Prioritised research topics

Family Health

Top 5 research topics for: Reproductive, maternal and child health

Rank	Topic	Rationale
1	Research on why sexual health education and family planning services are not preventing unwanted pregnancies	Despite reported availability of sexual health education and family planning services, unwanted pregnancies remain common. Research is needed to understand barriers to effective use—including service quality, stigma, social and family influences, and health-worker attitudes—so that services can be redesigned to better meet client needs and reduce unintended pregnancies. <i>Specific considerations:</i> Service side factor (such as health worker attitudes towards young people), stigma, family beliefs. Looking at coverage and utilisation of services as well as uptake among those who do access services <i>Research type:</i> Delivery
2	Research on underlying drivers of maternal and neonatal mortality (including late presentation)	Maternal and neonatal mortality remain critical concerns, but the underlying social, behavioural, and health-system drivers are not well understood. Late presentation to health services is frequently observed, yet the reasons behind this pattern require further investigation to inform targeted interventions and reduce preventable deaths. <i>Specific considerations:</i> Remote communities <i>Research type:</i> Description
3	Research on the reasons for late presentation for antenatal care (ANC)	Many women present late for antenatal care, attend only once, or do not return after an initial visit, reducing opportunities for timely prevention and management of pregnancy risks. Understanding the perspectives of mothers, health-care providers, and the health system is necessary to identify barriers and improve timely antenatal care uptake. <i>Specific considerations:</i> Remote communities <i>Research type:</i> Delivery
4	Research on how many unwanted pregnancies occur and expectant mother practices when unwanted pregnancies occur	Although abortion is not legal in Vanuatu, unwanted pregnancies still occur, and there is limited evidence on how frequently this happens or how women manage these situations. Understanding the prevalence of unwanted pregnancies and associated practices is essential to inform reproductive health policy, service delivery, and prevention strategies. <i>Specific considerations:</i> Remote communities <i>Research type:</i> Description
5	Research on new solutions for improving childhood development by integrating childhood development assessment and referral into routine child health visits	Many children with developmental delays or disabilities are not identified early and therefore miss opportunities for timely support and intervention. Integrating developmental assessment and referral into routine child health visits may improve early detection and access to services. Research is needed to identify effective and feasible models for integration. <i>Specific considerations:</i> Models where assessment is integrated into immunisation visits <i>Research type:</i> Development

Top 5 research topics for: Immunisation and vaccine preventable diseases

Rank	Topic	Rationale
1	Research on solutions to reach and vaccinate children who are not fully immunised	A proportion of children remain partially or not fully immunised, increasing the risk of vaccine-preventable diseases. Research is needed to understand where and why children are missed and to identify effective strategies to reduce missed opportunities for vaccination and improve equitable coverage. <i>Specific considerations:</i> Includes a focus on evaluating missed opportunities for vaccination. <i>Research type:</i> Development
2	Research on new solutions to increase cervical cancer screening coverage and access to treatment with a focus on inclusion and equity	Cervical cancer screening coverage is uneven, with lower uptake among disadvantaged and harder-to-reach populations. Research is needed to identify and test solutions that improve access to screening and timely treatment, while addressing barriers related to equity, inclusion, and service delivery. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
3	Research on reasons for low uptake of HPV vaccination	Uptake of human papillomavirus (HPV) vaccination has been lower than expected following its introduction. Limited understanding of beliefs, knowledge, and concerns among adolescent girls, families, and health-care workers may be contributing to low coverage. Research is needed to identify barriers and inform strategies to improve uptake. <i>Specific considerations:</i> Potential climate change impact on ability to deliver services (e.g. cold chain more challenging) <i>Research type:</i> Delivery
4	Research on why birth dose coverage of Hepatitis B vaccination is low compared to BCG	Coverage of the hepatitis B birth dose is consistently lower than coverage of the Bacillus Calmette–Guérin (BCG) birth dose, with variation across provinces. Understanding operational, provider, and caregiver factors driving this difference can inform strategies to improve timely hepatitis B vaccination at birth. <i>Specific considerations:</i> Midwives; mothers <i>Research type:</i> Delivery
5	Research on the sequelae of meningitis	Meningitis can result in long-term physical, sensory, and cognitive impairments, but the extent of these outcomes is not well documented. Understanding the burden and types of sequelae is necessary to inform follow-up care, rehabilitation services, and support for affected individuals and families. <i>Specific considerations:</i> Sequelae: physical, sensory and cognitive <i>Research type:</i> Description.

Top 10 research topics for: Climate change and family health

Rank	Topic	Rationale
1	Research on water, sanitation and hygiene (WASH) and menstrual hygiene needs during natural disasters (including people with disabilities)	Inadequate WASH facilities during disasters negatively affect menstrual hygiene, dignity and health, particularly for women, girls and people with disabilities. Research is needed to identify inclusive WASH and menstrual hygiene needs and inform appropriate emergency responses. <i>Specific considerations:</i> Includes disability-inclusive WASH, accessibility of facilities and psychosocial well-being <i>Research type:</i> Delivery
2	Research on the impact of climate disasters on routine childhood vaccination coverage	Climate-related disasters disrupt routine vaccination services increasing the risk of vaccine-preventable diseases. Research is needed to understand the extent of vaccination disruption and identify strategies to maintain and restore coverage in affected areas. <i>Specific considerations:</i> Includes missed or delayed vaccinations in disaster and low-coverage settings <i>Research type:</i> Description
3	Research focus on assessing the impact of climate change on health and nutritional needs of school-aged children and adolescents: challenges and adaptive strategies	Climate change affects the health and nutritional needs of school-aged children and adolescents through food security, heat exposure and service disruption. Research is needed to assess these impacts and identify adaptive strategies to reduce long-term health consequences. <i>Specific considerations:</i> Includes nutrition, education disruption and community-based adaptation strategies <i>Research type:</i> Description and Delivery
4	Research into the best way to ensure continuity of antenatal care (ANC) during health emergencies	Disruptions to antenatal care during emergencies increase the risk of maternal and neonatal morbidity and mortality. Pregnant women in disaster-prone and remote areas are more likely to miss essential care. Research is needed to identify effective delivery models that ensure continuity of ANC during health emergencies. <i>Specific considerations:</i> Includes a focus on mobile clinics, telemedicine, community health workers and barriers to access during emergencies <i>Research type:</i> Delivery
5	Research on maternal nutrition challenges due to climate-related food shortages	Climate-related droughts and crop failures increase food insecurity affecting maternal nutrition and pregnancy outcomes. Research is needed to understand the impact on pregnant women and identify effective interventions to mitigate nutritional risk during climate shocks. <i>Specific considerations:</i> Includes food aid, nutrition education and maternal nutritional status <i>Research type:</i> Description and Development
6	Research on the effectiveness and feasibility of micronutrient powder interventions (MNP) before and during disasters	Childhood malnutrition often increases during emergencies due to food insecurity and service disruption. Micronutrient powders may reduce this risk, but evidence on their acceptability, use and feasibility before and during disasters is limited. Research is needed to assess their effectiveness and implementation. <i>Specific considerations:</i> Includes acceptability, correct use, supply chains and pre-positioning in disaster-prone areas <i>Research type:</i> Delivery

Rank	Topic	Rationale
7	Research into the minimum standards at emergency evacuation centres for Reproductive, Maternal, Newborn, and Child Health (RMNCH)	Insufficient access to basic utilities and services at evacuation centres can compromise sexual and reproductive, maternal and child health during displacement. Research is needed to define minimum standards for utilities and health service accessibility to protect RMNCH outcomes during emergencies. <i>Specific considerations:</i> Includes water, sanitation, lightning, privacy and access to essential RMNCH services <i>Research type:</i> Description
8	Research into access to contraception during emergencies: barriers, needs and gaps	Access to contraception is frequently disrupted during emergencies, increasing the risk of unintended pregnancies and poor maternal outcomes. Research is needed to understand the scale of unmet need, barriers to access and gaps in family planning services during crises. <i>Specific considerations:</i> Includes adolescents, displaced populations and emergency SRH service models <i>Research type:</i> Delivery
9	Research on infrastructure solutions to maintain maternal health service access during climate events	Climate-related damage to infrastructure and transport limits access to life-saving maternal health services in remote and island communities. Research is needed to assess climate-resilient infrastructure and transport solutions that support service continuity. <i>Specific considerations:</i> Includes floating clinics, solar-powered health posts and emergency transport systems <i>Research type:</i> Delivery
10	Research on climate-induced stress, anxiety and depression in pregnant/postpartum women	Climate-induced disasters increase stress, anxiety and depression among pregnant and postpartum women with consequences for maternal and child health. Research is needed to assess mental health impacts and identify effective support systems during and after emergencies. <i>Specific considerations:</i> Includes community-based support, tele-counselling and service uptake <i>Research type:</i> Description, Delivery and Development



Communicable diseases

Top 5 research topics for: Antimicrobial resistance (AMR), environmental health and One Health

Rank	Topic	Rationale
1	Research on solutions to reduce antimicrobial resistance (AMR) in the community and in health facilities	AMR increases treatment costs and limits the availability of effective medicines, particularly in resource-constrained settings. Identifying practical solutions is essential to preserve treatment options and protect vulnerable populations. <i>Specific considerations:</i> All citizens, particularly immunocompromised individuals and infants <i>Research type:</i> Development
2	Research on the prevalence of AMR in different pathogens and the associated burden of mortality and adverse health outcomes	AMR is associated with increased mortality, longer illness duration, and poorer health outcomes. Understanding the prevalence of resistance across pathogens and its health burden is necessary to guide treatment guidelines and public health priorities. <i>Specific considerations:</i> All citizens but especially immunocompromised and infants <i>Research type:</i> Description
3	Research on human antibiotic consumption practices and their implications for AMR	Antibiotic use in animal health and agriculture appears to be limited in Vanuatu, suggesting that human antibiotic consumption may be a key driver of AMR. Understanding how, when, and why antibiotics are used by people can help identify opportunities to reduce inappropriate use and slow the development of resistance. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
4	Research on One Health risk factors (animal, human and environmental) for AMR emergence	Antimicrobial resistance emerges through interconnected human, animal, and environmental pathways. Identifying One Health risk factors for AMR is necessary to understand how resistance develops and spreads and to support coordinated prevention and control strategies. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
5	Research on knowledge, attitudes and practices relating to leptospirosis among the population	Leptospirosis is an important cause of illness in Vanuatu, yet community awareness appears to be low. Understanding population knowledge, attitudes, and practices can inform targeted prevention strategies, risk communication, and behaviour change interventions. <i>Specific considerations:</i> None identified <i>Research type:</i> Description

Top 5 research topics for: HIV, STIs and blood borne virus

Rank	Topic	Rationale
1	Research to measure the true burden of HIV and others STIs	Reported HIV prevalence is low compared with the prevalence of other sexually transmitted infections, but it is unclear whether this reflects true epidemiology or limited access to HIV testing. Improving estimates of the true burden of HIV and other sexually transmitted infections will help identify missed cases, particularly among priority populations, and guide targeted prevention and treatment efforts. <i>Specific considerations:</i> Limited access for younger populations. Key populations in Vanuatu (as defined by the Global Fund) include men who have sex with men, transgender people, and sex workers <i>Research type:</i> Description
2	Research on solutions for providing hepatitis B screening and treatment in remote settings	Geographic isolation and limited health infrastructure restrict access to hepatitis B screening and treatment in remote areas. Research is needed to identify feasible, sustainable delivery models that can expand access to diagnosis and care for underserved populations. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
3	Research on the burden of syphilis and resulting morbidity and mortality, including among infants	Syphilis remains an important public health concern due to its serious health consequences, including adverse pregnancy and infant outcomes. Understanding the prevalence of syphilis and its associated morbidity and mortality is essential to inform screening, treatment, and prevention strategies. <i>Specific considerations:</i> Outcomes of exposure to syphilis. Prevalence of syphilis <i>Research type:</i> Description
4	Research on the sexual health needs and care seeking-behaviours of seasonal workers from Vanuatu in Australia and New Zealand while overseas and on return	Seasonal workers may face increased risk of sexually transmitted infections and blood-borne viruses while overseas, as well as barriers to accessing health services during travel and on return. Understanding prevalence, risk behaviours, and care-seeking patterns is necessary to design appropriate prevention, testing, and treatment services for this mobile population. <i>Specific considerations:</i> Focus on sexually transmitted infections and blood-borne viruses, including gonorrhoea. Includes assessment of prevalence, risk, and service needs <i>Research type:</i> Delivery
5	Research on the burden of hepatitis B among children and the general population	There has been no recent population-based survey of hepatitis B in Vanuatu, limiting understanding of current prevalence and geographic variation. Updated data among children and the general population are needed to identify transmission patterns, regional hotspots, and priority areas for prevention and treatment. <i>Specific considerations:</i> Cross-sectional survey among children and the general population; identification of differences in hepatitis B prevalence across islands and detection of hotspots <i>Research type:</i> Description

Top 5 research topics for: Neglected tropical diseases

Rank	Topic	Rationale
1	Research on the burden of rheumatic heart disease	Rheumatic heart disease is a leading cause of preventable cardiovascular disease in the Pacific region, particularly among children and young adults. However, its prevalence, severity, and impact are not well described in Vanuatu, limiting the ability to plan prevention, early detection, and long-term care services. <i>Specific considerations:</i> Young people <i>Research type:</i> Description
2	Research on the gaps and barriers to timely notification, reporting and investigation of diseases, especially for notifiable diseases and neglected tropical diseases.	Timely disease notification, reporting, and investigation are essential for effective outbreak detection and response. Identifying gaps and barriers within existing surveillance and reporting systems—particularly for notifiable diseases and neglected tropical diseases—can guide improvements to strengthen public health action. <i>Specific considerations:</i> Focus on notifiable diseases and neglected tropical diseases <i>Research type:</i> Delivery
3	Research on the burden of neglected tropical diseases including the impact of climate on neglected tropical disease burden.	Neglected tropical diseases continue to cause illness and disability, yet their true burden in Vanuatu is not fully understood. Climate change, changing weather patterns, and natural disasters may influence transmission, disease distribution, and the effectiveness of control efforts, underscoring the need for updated burden estimates and climate-sensitive analysis <i>Specific considerations:</i> Impact of changes in weather patterns, climate change and natural disasters. Includes the impact of climate on responses/interventions and how that then affects burden/transmission. Leprosy as a specific NTD of interest <i>Research type:</i> Description
4	Research on community and health worker knowledge, attitudes, practices and behaviours relating to neglected tropical diseases, including how these have been affected by health promotion and health campaigns	Community and health worker knowledge, attitudes, and practices influence prevention, early care-seeking, and adherence to treatment for neglected tropical diseases. Assessing how health promotion activities and campaigns have shaped understanding and behaviour can help refine messaging and improve program effectiveness. <i>Specific considerations:</i> The Tanna community was indicated as being high priority for this research topic. Including assessment of knowledge, attitudes and practices on NTDs. Specific health promotion campaigns include mass drug administration campaigns, Action for Health Family tool kits <i>Research type:</i> Delivery
5	Research on how integrated neglected tropical disease programmes affect access to care, service delivery, and health outcomes in targeted communities	Integrating neglected tropical disease programs aims to improve efficiency, coverage, and community experience of services. Research is needed to understand how integration affects communities, including access to care, acceptability, service quality, and overall disease outcomes. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

Top 4 research topics for: TB¹⁰

Rank	Topic	Rationale
1	Research on the challenges in finding drug-resistant TB (DR-TB) cases	<i>Research type:</i> Drug-resistant tuberculosis cases have only been reported from one province, raising concerns that cases in other provinces may be going undetected. This may reflect weaknesses in DR-TB case-finding systems, diagnostic access, or care-seeking behaviour among people with tuberculosis. Research to identify challenges in current DR-TB case-finding practices is needed to determine whether undiagnosed cases exist and to inform strategies to strengthen detection across provinces. <i>Specific considerations:</i> Different provinces <i>Research type:</i> Delivery
2	Research on barriers and enablers for effective TB contact investigation and uptake of preventive therapy	Tuberculosis contact investigation and preventive therapy are critical strategies to reduce transmission and prevent future disease. However, gaps in implementation may limit their effectiveness. Understanding barriers and enablers within existing delivery systems will support improvements in coverage, quality, and uptake of contact investigation and preventive therapy services across different settings. <i>Specific considerations:</i> Focus is on preventive therapy for contacts of existing TB patients. Need to consider how contact investigation and preventive therapy services are provided in different provinces <i>Research type:</i> Delivery
3	Research on the burden of TB and the determinants of TB transmission	Accurate estimates of tuberculosis burden and an improved understanding of the factors driving transmission are essential for effective planning and resource allocation. Limited or outdated data constrain the ability to prioritise interventions and target high-risk populations and settings. Research is needed to describe the current burden of tuberculosis and identify key determinants of ongoing transmission. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
4	Research on why there are low rates of TB treatment adherence	Treatment adherence is essential for curing tuberculosis, preventing ongoing transmission, and reducing the risk of drug resistance. Currently, there is limited data on adherence rates and the factors influencing treatment completion. Research to understand adherence patterns and underlying barriers can help determine whether targeted interventions are needed to improve treatment outcomes. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

¹⁰ There were only 4 questions identified for this health area

Top 5 research topics for: Vector-borne diseases

Rank	Topic	Rationale
1	Research on changes in malaria burden and transmission due to climate change	Recent increases in malaria cases may be linked to climate change, including changes in temperature, rainfall, and extreme weather events. Understanding how climate change has influenced—and is likely to influence—malaria transmission and disease burden is essential to support future planning, risk mapping, and climate-responsive malaria control and elimination policies. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
2	Research on knowledge, attitudes and practices relating to malaria among the population	Community knowledge, attitudes, and practices play a critical role in malaria prevention, care-seeking, and treatment adherence, yet these factors are not well understood in Vanuatu. Collecting regular, population-level data can inform the design, targeting, and evaluation of malaria interventions and health promotion strategies. <i>Specific considerations:</i> Knowledge, attitude and practices survey on malaria among the population (every 3 years) if possible, implemented by local agencies with population research capacity <i>Research type:</i> Delivery
3	Research on safe, acceptable solutions for achieving radical cure for patients with Vivax malaria	Radical cure is needed for vivax malaria. However, it is reported that many patients don't complete 14 days of primaquine. Alternative regimens and models for their delivery that are safe, acceptable and tolerable need to be investigated to get higher rates of completion for treatment of the liver stage. <i>Specific considerations:</i> Use of high dose primaquine for 7 days or intermediate dose for 14 days; community-level interventions, patient follow-up, use of single dose tafenoquine; G6PD testing. Operational research to increase compliance to Primaquine (high dose 7 days or intermediate 14 days) for achieving radical cure for patients with Vivax malaria. Determine the impact of high or intermediate primaquine dose (7 or 14 days) regimen on vivax relapses <i>Research type:</i> Development
4	Research on solutions for decentralising malaria elimination interventions from provinces to health facilities	The current centrally driven malaria elimination model limits timely reporting and rapid response. Decentralising malaria elimination activities to health facilities may improve responsiveness and sustainability, but effective models for decentralisation have not been established. Research is needed to assess the feasibility, capacity requirements, and workload implications of decentralised service delivery. <i>Specific considerations:</i> Implementation research on the feasibility of decentralising malaria elimination interventions from provincial health teams to health facilities (HF). Capacity and workload of HF staff, aid posts / village health workers payment <i>Research type:</i> Development
5	Research on the effectiveness of implementation of long-lasting insecticide treated nets and indoor residual spraying in controlling malaria	Long-lasting insecticide-treated nets and indoor residual spraying are core malaria interventions that require substantial financial and human resources. However, malaria vectors with significant outdoor biting behaviour may reduce the effectiveness of these interventions. Additional evidence is needed to assess their impact and to guide optimal allocation and use of resources. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

Top 10 research topics for: Climate change and communicable diseases

Rank	Topic	Rationale
1	Research on how climate shocks impact access to HIV prevention services for people experiencing gender-based violence	Climate-related shocks increase gender-based violence, while biological vulnerability, power imbalances, and trauma reduce the ability of affected individuals to access HIV prevention services, creating compounded and under-researched HIV risk. <i>Specific considerations:</i> Population: adolescents/young women, PLHIV, people with disability. Interventions: integrated HIV-GBV services, trauma-informed care. Outcomes: service access, uptake or prevention tools <i>Research type:</i> Development
2	Research focus on investigating the hidden HIV risk and surveillance gaps amid climate vulnerabilities.	Low reported HIV prevalence in some settings may obscure underlying risk behaviours and gaps in HIV testing and reporting, particularly where climate impacts disrupt routine surveillance and access to services. <i>Specific considerations:</i> Populations: sexually active groups. Considerations: access to HIV testing in climate-affected contexts. Outcomes: testing coverage, case detection. <i>Research type:</i> Description
3	Research on factors that strengthen the resilience of HIV testing services in the face of climate disasters	Climate disasters disrupt fixed health services, reducing HIV testing access and delaying diagnosis and treatment; understanding resilience factors is critical to maintaining continuity of testing and care. <i>Specific considerations:</i> Populations: adolescents, PLHIV, remote communities. Interventions: mobile testing units, community outreach. Outcomes: testing uptake, early diagnosis, linkage to care <i>Research type:</i> Development
4	Research on understanding the influence of climate and cultural barriers to condom use among adolescents	Climate-related damage to health infrastructure and condom distribution points disrupts access to condoms, worsening already low condom use among adolescents and increasing the risk of HIV, other sexually transmitted infections, and unplanned pregnancies. <i>Specific considerations:</i> Population: adolescents. Climate context: Damage of condom dispensers due to disasters. Interventions: condom education, youth-friendly services, peer outreach. Outcomes: condom use rates, STI/HIV incidence, pregnancy rates <i>Research type:</i> Delivery
5	Research on evaluation of predictive models for disease outbreaks using climate data	Evaluating predictive models that use climate data is necessary to identify reliable approaches for outbreak forecasting and to strengthen preparedness and response planning. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
6	Research that integrates meteorological and health information to support real-time disease surveillance	Linking meteorological data with health surveillance systems can enable earlier detection of climate-sensitive disease outbreaks and improve the timeliness and effectiveness of public health responses. <i>Specific considerations:</i> None identified <i>Research type:</i> Development

Rank	Topic	Rationale
7	Research on epidemiological modelling of disease outbreaks in relation to climate variability	Modelling the relationship between climate variability and disease outbreaks supports predictive capacity and strengthens public health forecasting and preparedness. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
8	Research on mapping disease hotspots in relation to climate trends and extreme events.	Mapping the relationship between climate variability, extreme events, and disease hotspots enhances predictive capacity and strengthens public health preparedness. <i>Specific considerations:</i> GIS with VMGD hazard layers; health-facility catchments; travel time/friction surfaces; validate with recent outbreaks. <i>Research type:</i> Description
9	Research on how changing temperatures and rainfall patterns affect the spread of vector-borne, water-borne, food-borne and neglected tropical diseases	There is limited local evidence on how changing temperature and rainfall patterns influence the transmission of vector-borne, water-borne, food-borne, and neglected tropical diseases, limiting targeted prevention and response. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
10	Research focus on mapping and climate responsive management of mosquito breeding sites in Vanuatu.	Mosquito breeding surges are driven by climate-related factors such as urban and peri-urban water storage practices and post-storm debris accumulation. These conditions increase vector populations and heighten the risk of disease transmission following extreme weather events. Mapping breeding sites and testing climate-responsive management strategies can strengthen local capacity to anticipate and reduce outbreak risks. <i>Specific considerations:</i> Larval habitat surveys + remote sensing; community clean-up trials; test low-tech interventions; integrate into municipal bylaws <i>Research type:</i> Delivery

Non-communicable diseases

Top 5 research topics for: Mental health and neurological conditions

Rank	Topic	Rationale
1	Research on morbidity and mortality due to marijuana use and the factors that influence substance use	Marijuana use may contribute to a range of adverse health outcomes, including mental health effects, impaired cognitive function, and risky behaviours, particularly among young people. However, the extent of morbidity and mortality associated with marijuana use in Vanuatu is not well understood. Research is needed to describe the health burden and to identify social, behavioural, and environmental factors influencing substance use, in order to inform prevention and harm-reduction strategies. <i>Specific considerations:</i> Links between marijuana use and mental health; patterns of use among young people; effects on cognitive function. <i>Research type:</i> Description
2	Research on the prevalence and burden of mental illness	Reliable data on the prevalence and burden of mental illness are needed to understand population needs and service gaps in Vanuatu. Estimating the burden of mental illness can support evidence-based planning, resource allocation, and scaling of mental health services by the Ministry of Health and government partners. <i>Specific considerations:</i> None identified <i>Research type:</i> Description.
3	Research on solutions for early recognition and diagnosis of stroke	Early recognition and timely diagnosis of stroke are critical to improving survival and reducing long-term disability. Delays in recognising symptoms and accessing care may contribute to poor outcomes. Research is needed to identify feasible interventions to improve early detection and referral within communities and health services. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
4	Research on the burden and effect of conditions that are comorbid with stroke	Stroke outcomes are strongly influenced by comorbid conditions such as hypertension, diabetes, heart disease, and substance use. Understanding the prevalence and impact of these comorbidities can inform integrated prevention and management strategies to reduce stroke incidence, complications, and mortality. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
5	Research on the health burden of epilepsy and the risk factors for deaths relating to epilepsy	Epilepsy can cause significant health, social, and economic impacts for individuals, families, and carers, and is associated with preventable mortality. Limited data on epilepsy burden and the risk factors for epilepsy-related deaths constrain effective prevention and care. Research is needed to identify the scale of the problem and modifiable risk factors to inform targeted interventions. <i>Specific considerations:</i> Burden includes the impact on people with epilepsy as well as their families and carers. Emphasis on preventable deaths and the risk factors for such deaths <i>Research type:</i> Description

Top 5 research topics for: Non-communicable diseases (NCDs)

Rank	Topic	Rationale
1	Research on lifestyle changes and trends that affect the prevalence of NCDs in different groups	The prevalence of NCDs among young people appears to be increasing compared with previous generations. Understanding changes in lifestyle behaviours—such as diet, physical activity, substance use, and sedentary behaviours—and how these trends differ across population groups is essential for explaining shifts in disease patterns and informing targeted prevention strategies. <i>Specific considerations:</i> Young people <i>Research type:</i> Description
2	Research on what NCD services can feasibly be provided at different levels of the health care system	There are plans to decentralise non-communicable disease services to improve access and continuity of care. However, feasibility may vary depending on infrastructure, workforce capacity, equipment, and resources at different levels of the health system. Research is needed to determine which services can be safely and sustainably delivered at each level to guide effective service planning and implementation. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
3	Research on referral and follow-up practices and their implications for appropriate care for NCDs	Effective management of NCDs requires well-functioning referral and follow-up systems between lower-level health facilities and higher-level or specialised services. Gaps in referral pathways or follow-up can lead to delays in care, poor continuity, and suboptimal outcomes. Understanding current practices and their implications is necessary to strengthen referral systems and improve quality of care. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
4	Research on whether and why people do not take their medications to control NCDs	Poor adherence to long-term medication limits effective control of non-communicable diseases such as diabetes and hypertension. Even when services are available, patients may not take medications as prescribed. Research is needed to identify the factors influencing adherence and inform effective interventions. <i>Specific considerations:</i> Diabetes <i>Research type:</i> Delivery
5	Research on solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes	Regular diabetes monitoring is essential but often constrained by access, cost, and convenience. Research on technologies such as personal continuous glucose monitoring devices can assess their feasibility, affordability, and potential to improve disease control and patient experience. <i>Specific considerations:</i> A study into the use of personal continuous glucose monitoring (CGM) devices for diabetes management- accessibility, affordability, cost-effectiveness and acceptability <i>Research type:</i> Development

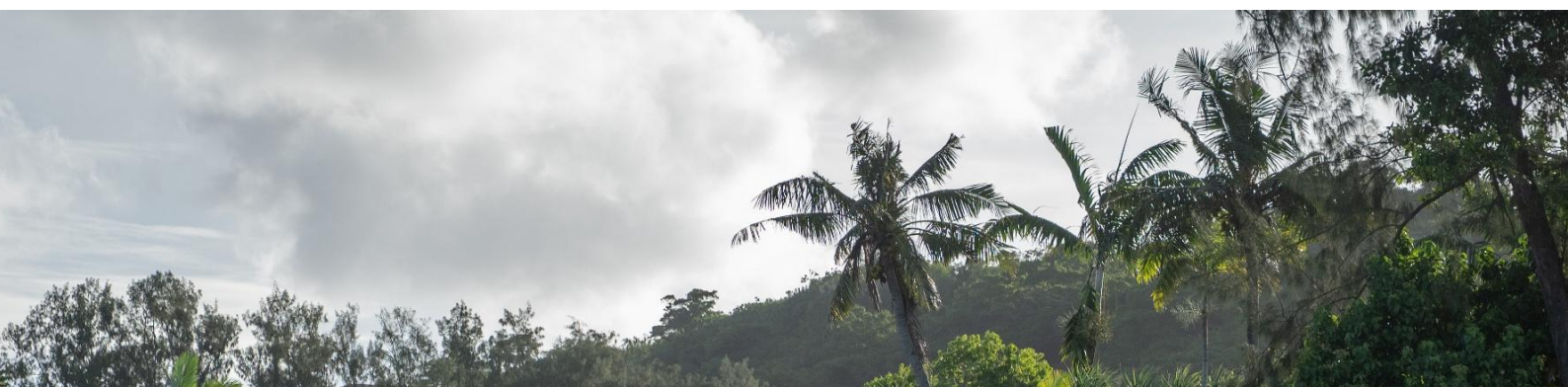
Top 5 research topics for: Nutrition

Rank	Topic	Rationale
1	Research on nutritional choices and nutritional value of available foods and their relationship with NCDs	Understanding dietary behaviours and the nutritional quality of foods available in Vanuatu—including both local and imported products—is essential to address diet-related non-communicable diseases. Evidence on consumption patterns and food composition can guide policy, regulation, and targeted nutrition interventions. <i>Specific considerations:</i> What are the acceptable/ standard levels of carbohydrates, sugar, salt, hydrogenated fats etc. in imported food products for Vanuatu? <i>Research type:</i> Description
2	Research on the health and nutrition needs of school-aged children and adolescents	There is limited evidence on the nutritional status, dietary intake, and health needs of school-aged children and adolescents in Vanuatu. Better understanding these needs will support the design of effective school-based and community nutrition interventions, particularly for vulnerable households. <i>Specific considerations:</i> Single parent households. Climate change might affect seasonal patterns of nutrition <i>Research type:</i> Delivery
3	Research on rates of obesity and chronic inflammation among people of working age	<i>Research type:</i> Obesity and chronic inflammation are key risk factors for non-communicable diseases, yet data among working-age adults are limited. Understanding the prevalence and patterns of these risk factors is necessary to inform workplace-based prevention strategies and broader population health planning. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
4	Research on solutions using local food systems to increase food security for resilience to disasters and climate change	Following disasters, reliance on imported staple foods such as rice and tinned fish may undermine nutritional quality and increase long-term dependence on food aid. Strengthening local food systems could improve food security, dietary diversity, and resilience to climate change and future shocks. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
5	Research on the associations between island kaikai and health and nutritional status of those consuming island kaikai	Island kaikai is widely promoted as a healthy traditional diet, yet its nutritional composition and health effects are not well defined. Research is needed to clarify how different forms, preparation methods, and consumption patterns of island kaikai relate to metabolic health outcomes. <i>Specific considerations:</i> Outcomes of interest: type 2 diabetes and triglyceride levels. Does island kaikai contribute to Type 2 Diabetes and increased triglyceride levels? Is island kaikai healthy? When is island kaikai healthy? When is island kaikai unhealthy? <i>Research type:</i> Description

Top 10 research topics for: Climate change and non-communicable diseases

Rank	Topic	Rationale
1	Research on the impact of climate change on the prevalence and management of diabetes in Vanuatu through its impact on food security, health infrastructure, and population displacement	Climate-related food insecurity, infrastructure damage, and population displacement can disrupt diabetes prevention, treatment, and continuity of care. Research is needed to understand how these factors affect diabetes outcomes and to identify strategies to maintain effective care in climate-affected settings. <i>Specific considerations:</i> None identified <i>Research type:</i> Description & Delivery
2	Research on understanding the mental health burden linked to climate change	Climate change may contribute substantially to the population burden of mental health conditions, but the scale of this burden is not well defined. Understanding the overall burden is critical for health system planning, service prioritisation, and resource allocation. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
3	Research on the incidence of climate-related mental health conditions	Estimating the incidence of climate-related mental health conditions is needed to identify high-risk groups and key risk factors. This evidence can inform early prevention, preparedness, and targeted mental health responses following climate events. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
4	Research on how climate-driven lifestyle changes and socio-economic shifts affect non-communicable disease prevalence among diverse population groups	Climate change and associated socio-economic shifts can influence physical activity, diet, and living conditions, affecting non-communicable disease risk. Understanding these changes across population groups is important for targeted prevention and health promotion. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
5	Research on the health consequences of increased frequencies of storms, floods, and landslides, including injuries, displacement, and mental health impacts	Frequent climate-related hazards such as storms, floods, and landslides disrupt communities, causing direct injuries, displacement, and long-term mental health impacts. Strengthening local resilience through food security measures—such as reliance on locally grown and preserved foods—reduces dependence on disrupted imports and supports recovery during prolonged crises. Linking health outcomes with climate shocks provides evidence to guide preparedness and response strategies. <i>Special considerations:</i> Map resilient crops (island kaikai), preservation methods, seed banking; test community gardens and storage innovations; women's groups and youth clubs as delivery partners; track diet diversity. <i>Research type:</i> Description
6	Research on how climate change related stress, displacement and loss of livelihoods will affect mental wellbeing, including anxiety, depression and post-traumatic stress disorder	Climate-related disasters such as cyclones, floods, and displacement disrupt livelihoods, housing, social networks, and cultural connections, increasing the risk of anxiety, depression, and post-traumatic stress disorder. Understanding these impacts is essential to inform targeted mental health and psychosocial support for vulnerable populations. <i>Specific considerations:</i> Longitudinal cohort in disaster-affected provinces, validated, culturally adapted screening tools with referral pathways; stratify by displacement

		status and livelihood; integrate brief psychosocial support and GBV safeguards; coordinate with the National Disaster Management Office for event timelines <i>Research type:</i> Description
7	Research on how climate change influences nutritional choices, the nutritional value of available foods, and their relationship with the burden of non-communicable diseases	Climate change is likely to reduce access to fresh, nutrient-dense foods and increase reliance on imported, ultra-processed foods, potentially worsening diet quality. Research is therefore needed to understand how climate-driven changes in food availability and nutritional value are shaping dietary choices and contributing to the growing burden of non-communicable diseases in Vanuatu. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
8	Research on the effectiveness and adequacy of existing mental health interventions in response to climate change-related impacts	Existing mental health interventions may not fully address the needs arising from climate-related stress and trauma. Evaluating their effectiveness and identifying gaps can guide improvements and adaptation of services for climate-affected populations. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
9	Research on climate-resilient solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes	In Vanuatu, climate-related disasters such as cyclones and floods often disrupt food supply chains, leading to reduced dietary diversity during lean seasons. This increases the risk of malnutrition and exacerbates non-communicable diseases (NCDs) such as diabetes. Strengthening climate-resilient monitoring systems for diabetes patients is essential to ensure continuity of care when access to imported foods, medicines, and health services is interrupted. By improving the quality, accessibility, and convenience of monitoring, health systems can better manage diabetes outcomes and reduce vulnerability during and after climate shocks. <i>Specific considerations:</i> Household Dietary Diversity Scores (HDDS) across seasons; link to market access and prices; identify practical diversification strategies <i>Research type:</i> Development
10	Research into understanding the impacts of disasters on household nutrition and food practices	In Vanuatu, disasters such as cyclones, floods, and landslides disrupt food supply chains, damage gardens, and reduce access to diverse diets. These shocks often force households to rely on imported staples or emergency rations, leading to declines in dietary diversity and increased risks of malnutrition and non-communicable diseases (NCDs). Understanding how disasters affect household nutrition and food practices is critical for designing climate-resilient strategies that strengthen local food systems, promote preservation and storage of local foods, and reduce dependence on vulnerable imports. Evidence from this research will guide policies and community interventions to improve nutrition security during and after disasters. <i>Specific considerations:</i> Cross-sectional/longitudinal diet–health studies; biomarkers (iron, vitamin A, lipids); cultural acceptability and preparation methods <i>Research type:</i> Description



Health systems research

Top 5 research topics for: Health equity and vulnerable groups

Rank	Topic	Rationale
1	Research on the levels of health literacy in the population for different diseases and health conditions	Health literacy is widely perceived to be low, but there is limited evidence on its extent and variation across diseases and population groups. Measuring health literacy levels can inform the design of communication strategies, service delivery approaches, and interventions to improve understanding, self-management, and health outcomes. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
2	Research on the health care seeking-behaviours and preferences of groups that are disadvantaged or marginalised in terms of accessibility and inclusivity of health services.	Certain population groups face barriers to accessing inclusive and appropriate health services, increasing vulnerability to poor health outcomes. Understanding health care seeking-behaviours, preferences, and barriers among marginalised groups can inform the development of more accessible, respectful, and inclusive services. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
3	Research on the needs of people with disability and the health and other services required to support them	There is limited information on the types of disabilities present in the population and the health, rehabilitation, and social services required to support people with disability. Improved understanding is needed to support service planning, advocacy, and the development of inclusive, coordinated service models. <i>Specific considerations:</i> Inclusivity. Rehabilitation services. Assistive devices. Occupational therapy. Social work. How much disability, what types of disability and service and support implications. <i>Research type:</i> Description
4	Research on how well health services meet the needs and preferences of different communities and patients (in terms of acceptability, inclusiveness)	Health services may not adequately reflect the diverse needs, preferences, and expectations of different communities and patient groups. Assessing acceptability and inclusiveness can help identify gaps and guide improvements to ensure services are welcoming, equitable, and person-centred. <i>Specific considerations:</i> Thinking about gender, disability, age, physical location <i>Research type:</i> Delivery
5	Research on the burden and impact of acquired disability on persons with disability and their families	Acquired disability can have substantial social, economic, and psychological impacts on individuals and their families, yet these effects are not well documented. Understanding the burden and lived experience of acquired disability can inform support services, social protection measures, and policy development. <i>Specific considerations:</i> Financial costs, opportunity costs, missed schooling, mental health, quality of life <i>Research type:</i> Description

Top 4 research topics for: Health information systems¹¹

Rank	Topic	Rationale
1	Research on the impact of utilisation of health information on planning of health services, service delivery and health outcomes	Health data are routinely collected, but it is unclear how effectively this information is used for planning, service improvement, and decision-making. Understanding how health information is used—and whether it leads to better services and health outcomes—can help strengthen evidence-informed practice within the health system. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
2	Research on the performance of different health information systems and combinations of health information systems in relation to potential needs of the Ministry of Health and partners for policy and planning	Multiple health information systems are in use, but their relative strengths, weaknesses, costs, and ability to support decision-making are not well understood. Evaluating system performance and identifying which features best meet policy, planning, and operational needs will support more efficient and sustainable health information system design in the Vanuatu context. <i>Specific considerations:</i> Specific interest in whether current systems improve decision for action and health outcomes. Evaluation should include considerations of cost and benefit. Maintenance should be considered in addition to upfront development / deployment costs. Meeting information needs could include research to: (1) articulate data and information needs; (2) evaluate whether (and why/why not) data generated by specific system(s) can be used to make decisions; (3) whether these decisions can be acted upon; and (4) whether health outcomes have improved as a result. These are measures of information system performance that are almost impossible to review without more in-depth study. <i>Research type:</i> Development
3	Research on the extent and reasons for inaccurate reporting of health information system data	Inaccurate or inconsistent reporting reduces confidence in health data and limits its usefulness for planning and monitoring. Understanding the extent of data inaccuracies and the reasons they occur can inform targeted improvements in data quality, reporting processes, and staff support. <i>Specific considerations:</i> Research on disparities between monthly HIS summary forms and in-facility tally sheets and patient register <i>Research type:</i> Delivery
4	Research on the reasons for slow and ineffective uptake of electronic health data systems	<i>Research type:</i> Despite widespread smartphone use, adoption of electronic health data systems remains limited. Identifying technical, organisational, and user-related barriers can guide more effective design, training, and implementation strategies for digital health systems. <i>Specific considerations:</i> Variation by gender, disability, age, physical location <i>Research type:</i> Description

¹¹ There were only 4 questions identified for this health area

Top 5 research topics for: Health systems

Rank	Topic	Rationale
1	Research on the effectiveness of the village health workers program	Village Health Workers (VHWs) play a critical role in delivering basic health services and health promotion at community level, yet the overall effectiveness and value for investment of the programme are not well documented. Research is needed to assess whether the VHW programme improves health outcomes and livelihoods, and to identify factors influencing performance, motivation, retention, and potential career pathways. <i>Specific considerations:</i> Value for investment in the VHW program, including whether the VHW program is improving health and livelihoods. Program effectiveness in terms of VHW roles, motivation and retention and possible career progression. Specific focus on effective health promotion activities/roles for VHW <i>Research type:</i> Delivery
2	Research on the vulnerability to and impact of climate change on the Vanuatu health system in terms of infrastructure, workforce, response capability, recovery, access and strategy	Climate change is expected to place increasing pressure on the health system through damage to infrastructure, workforce disruptions, increased service demand, and more frequent disaster response and recovery needs. Understanding system-level vulnerabilities and impacts is essential to inform climate-resilient health planning, investment, and policy. <i>Specific considerations:</i> pertaining to our 71 Area Councils <i>Research type:</i> Description
3	Research on solutions for reducing the need for referral and the cost of referral without compromising patient care	Patient referral is essential for specialised care but presents financial, logistical, and equity challenges for both patients and the health system. Research is needed to identify alternative models—such as decentralised services, task-sharing, or improved referral pathways—that can reduce unnecessary referrals and associated costs while maintaining quality and safety of care. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
4	Research on solutions to improve the quality and coverage of required services	Community feedback indicates concerns about the quality and availability of health services. Research is needed to identify gaps in service delivery and to test solutions that can improve service quality, coverage, and responsiveness to community needs. <i>Specific considerations:</i> Needs to include the role of partners who provide services, including private clinics <i>Research type:</i> Development
5	Research on how best to allocate funding to maximise health impact	Limited health resources must be allocated efficiently to achieve the greatest possible health gains. Research is needed to assess how recurrent and donor funding can be allocated or reallocated to better meet population health needs and improve health outcomes. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

Top 4 research topics for: Health workforce¹²

Rank	Topic	Rationale
1	Research on the human resources required to deliver the health strategy and the associated costs	Health workforce shortages are a major constraint to delivering the national health strategy, yet the number, mix, and distribution of staff required—and the associated costs—are not well defined. Research is needed to inform sustainable workforce planning, budgeting, and prioritisation of training and deployment. <i>Specific considerations:</i> Sustainability of workforce development plan. Priority areas for training. Adequacy of the role delineation policy <i>Research type:</i> Development
2	Research on new solutions to meet the in-service training needs of the health workforce	Gaps exist between the current skills of health workers and the competencies required to deliver quality services. Identifying and testing innovative, feasible approaches to in-service training is necessary to ensure the workforce can respond effectively to population health needs. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
3	Research on health workforce training and capacity development needs across facilities and parts of Vanuatu	Training and capacity gaps are likely to vary by cadre, facility type, and geographic location, but their extent is not well understood. Identifying these gaps is essential for planning targeted in-service training and ensuring equitable skill distribution across the health system. <i>Specific considerations:</i> This pertains especially to health workers who are already employed, i.e. in-service training needs more than pre-service <i>Research type:</i> Description
4	Research on whether current nursing and midwifery training methods are effective in giving trainees the skills they need	The quality of care provided by nurses and midwives depends on the effectiveness of pre-service and in-service training approaches. Evaluating current training methods can identify areas for improvement and support reforms that strengthen practical skills and service quality. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

¹² There were only 4 questions identified for this health area

Top 5 research topics for: Other health topics, not included above

Rank	Topic	Rationale
1	Research on how traditional medicines and beliefs impact on patient behaviours	Traditional medicines and beliefs play a significant role in shaping how people understand illness, seek care, and follow treatment advice. These practices can influence acceptance of biomedical services and adherence to management plans. Understanding their impact on patient and health care worker behaviours can help identify ways to improve service delivery and communication. <i>Specific considerations:</i> Care seeking, treatment taking on the side of patients. Health care worker practices as they influence patients <i>Research type:</i> Delivery
2	Research on new solutions that use or account for traditional medicine and beliefs to improve service acceptability and patient practices	Strong community acceptance of traditional medicine and beliefs presents an opportunity to improve the cultural acceptability of health services. Research is needed to identify safe, respectful ways to integrate or acknowledge these practices to enhance trust, engagement, and uptake of health services. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
3	Research on the burden and risk factors for asthma	Asthma can cause significant morbidity, but its burden and key risk factors are not well defined. Understanding prevalence and environmental and household risk factors is necessary to inform prevention strategies and improve management. <i>Specific considerations:</i> Open fires for cooking/heating as a risk factor <i>Research type:</i> Description
4	Research on the role of population movement in the spread of infectious diseases within Vanuatu and neighbouring countries	Population movement between islands and across borders may contribute to the spread of infectious diseases. Understanding these mobility patterns and associated risks can inform surveillance, preparedness, and targeted disease control measures. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
5	Research to understand the long-term impact of surgery on patient quality of life	Some individuals experience long-term disability following surgical procedures, but the extent, causes, and impacts on quality of life are not well understood. Research is needed to assess outcomes, identify potentially preventable causes of disability, and inform improvements in surgical care and rehabilitation. <i>Specific considerations:</i> None identified <i>Research type:</i> Description

Top 10 research topics for: Climate change and health systems

Rank	Topic	Rationale
1	Research on the vulnerability and adaptive capacity of the Vanuatu health system to climate change impacts across infrastructure, workforce, service delivery, recovery, access, and governance	Assessing system-wide vulnerabilities and adaptive capacity will inform targeted adaptation strategies and guide investments to strengthen climate resilience across the health sector. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
2	Research on human resource gaps and barriers in climate-health workforce development	Understanding workforce constraints related to climate and health will inform recruitment, training, retention, and long-term workforce planning for climate-resilient service delivery. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
3	Research on strengthening health information systems to support climate-resilient planning and timely health responses	Stronger health information systems improve decision-making, surveillance, and emergency response during climate-related events, enhancing overall system resilience. <i>Specific considerations:</i> None identified <i>Research type:</i> Development & Delivery
4	Research on what health services are needed in different parts of Vanuatu and the resources and facilities needed to provide them	Climate-related hazards such as heatwaves, cyclones, floods, and landslides frequently disrupt health service delivery. Power cuts and transport delays threaten the potency of vaccines and limit access to essential medicines, while damaged infrastructure reduces the availability of critical services. Understanding the specific health service needs across different islands and communities and the resources and facilities required to meet them is vital for building a climate-resilient health system. This research will provide evidence to guide equitable resource allocation, strengthen service continuity, and ensure that lifesaving interventions remain accessible even during climate shocks. <i>Specific considerations:</i> Temperature monitoring (remote loggers), solar direct-drive fridges, passive carriers, generator fuel planning; contingency SOPs; maintenance capacity; performance audits after extreme weather. <i>Research type:</i> Description
5	Research on future government health system costs associated with the impacts of climate change	Estimating future climate-related health system costs is essential for budget planning, fiscal sustainability, and prioritising investments in preparedness, adaptation, and response. <i>Specific considerations:</i> None identified <i>Research type:</i> Description
6	Research on climate and health financing policies in Vanuatu and comparable contexts	Policy analysis can identify strengths and gaps in current financing arrangements, supporting reforms that strengthen emergency readiness and sustainable climate-health investment. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery

Rank	Topic	Rationale
7	Research on government structures and their impact on climate-health policy effectiveness	Households displaced by disasters such as cyclones, floods, and landslides often face service disconnection, new environmental exposures, and heightened social risks. These challenges reveal gaps in governance and coordination across sectors, which directly affect the effectiveness of climate-health policies. Strong government structures are essential to ensure that displaced populations maintain access to health services, safe housing, and social protection. By examining how governance arrangements influence climate-health policy outcomes, this research will provide evidence to strengthen institutional resilience, improve service delivery, and reduce vulnerability during and after climate shocks Special considerations: Cohort or repeated cross-sections of displaced vs. non-displaced; service access audits; WASH and shelter assessments; MHPSS screening with referral; GBV safeguards; track return/reintegration outcomes. <i>Research type:</i> Description
8	Research into approaches for maintaining continuity of health services during emergency health workforce mobilisation	Emergency response often diverts staff from routine services, risking disruptions in essential care. Research can inform strategies to maintain service continuity during climate shocks. <i>Specific considerations:</i> None identified <i>Research type:</i> Delivery
9	Research into the application of geographic information system (GIS) technologies for real-time mapping of disease outbreaks linked to climate events	Spatial analysis using GIS can enhance early detection, improve targeting of interventions, and support rapid, evidence-based response to climate-sensitive disease outbreaks. <i>Specific considerations:</i> None identified <i>Research type:</i> Development
10	Research on Climate-Resilient Health Systems: Ensuring Continuity and Quality of Essential Services During Facility Failures	Strengthening facility resilience through redundancy in power, water, and communications ensures uninterrupted delivery of essential health services during climate-related hazards and supports rapid, evidence-based response <i>Specific considerations:</i> Structural and non-structural safety audits (power, water, drainage, roof, comms); cold-chain resilience; access routes; redundancy (solar, generators, satellite comms); prioritised retrofit plan with costs <i>Research type:</i> Delivery



Next steps

The Vanuatu Health Research Agenda and the Vanuatu Climate Change and Health Research Agenda together provide a clear, nationally endorsed set of priorities to guide future research. The next phase must focus on translating these priorities into coordinated, funded, and locally led action that strengthens health outcomes and system resilience.

First, wide dissemination of the combined agendas is essential. Sharing the research priorities with government ministries, provincial health offices, civil society organisations, academic institutions, and development partners will help align research activities and ensure that future studies respond directly to nationally identified needs. Researchers working in Vanuatu and internationally are encouraged to seek funding and design studies that align with these priorities.

Second, to maximise impact, the research priorities should be embedded within relevant national policies, strategies, and operational plans. This includes health sector strategies, climate change adaptation plans, disaster risk reduction frameworks, and sectoral plans related to environment, water and sanitation, and development. Integrating research into existing planning processes will strengthen the use of evidence in decision-making and ensure that findings inform programme design, service delivery, emergency preparedness, and long-term system strengthening.

Effective implementation will require strong coordination. Establishing or designating a coordination mechanism—such as a technical working group led or convened by the Ministry of Health—would support collaboration across sectors including health, environment, meteorology, water and sanitation, and agriculture. This mechanism could oversee implementation of the research agenda, monitor progress, facilitate partnerships, and promote ethical, culturally appropriate, and community-engaged research that reflects local priorities and knowledge systems, including Indigenous knowledge.

Sustainable financing remains a critical gap. There is currently no dedicated, ongoing funding stream to support health research or climate change and health research in Vanuatu. Consideration should therefore be given to establishing a pooled funding mechanism, coordinated by the Ministry of Health and partners, to support implementation of high-priority research. Such a mechanism should prioritise locally led studies and provide ni-Vanuatu researchers with access to funding, mentorship, and protected time to undertake research aligned with national priorities.

Strengthening local research capacity is central to the success of both agendas. Investment is needed in training, mentorship, and institutional development to enable ni-Vanuatu researchers and public health practitioners to design, lead, and translate research into policy and practice. Collaborations with regional and international partners are encouraged, where they support co-design, shared leadership, joint authorship, and data sovereignty, and contribute to sustainable skills transfer and long-term capacity building.

Finally, the research agendas should be regarded as living documents. A formal review every five years (or more frequently if possible) is recommended to ensure that emerging health challenges, climate-related risks, new evidence, and shifting national priorities are reflected. Periodic reporting on research undertaken, funding secured, capacity strengthened, and policy or programme impact achieved will support accountability and continued relevance.

Through these next steps, the research agendas can evolve from priority-setting exercises into sustained, coordinated, and locally driven programmes of research that strengthen Vanuatu's health system, improve population health, and enhance resilience to current and future health and climate challenges.

Annexes

Annex 1: Committee membership

Membership of the Vanuatu Health Research Agenda Committee

Dr Philippe GUYANT, WHO

Dr Minado PAUL, Vila Central Hospital

Posikai Samuel TAPO, Ministry of Health

Graham TASSO, Vila Central Hospital

Florita TOA, Ministry of Health

White TOUGEN, Ministry of Health

Dr Caroline VAN GEMERT, Burnet Institute

Dr Sale Tamata VUROBARAVU, Vila Central Hospital

Wendy WILLIAMS, Ministry of Health

Membership of the Vanuatu Health Research Agenda Working Group

Kali AMEARA, Burnet Institute

Geoff CHAN, Burnet Institute

Dr Jane GREIG, Burnet Institute

Aleesha KALULU, Burnet Institute

Florita TOA, Ministry of Health

White TOUGEN, Ministry of Health

Dr Caroline VAN GEMERT, Burnet Institute

Wendy WILLIAMS, Ministry of Health



Annex 2: Full list of health research topics, in order of ranking (RPS)

Rank	Weighted RPS ¹³	Topic
1	1.426	Research on why sexual health education and family planning services are not preventing unwanted pregnancies
2	1.369	Research on underlying drivers of maternal and neonatal mortality (including late presentation)
3	1.360	Research to measure the true burden of HIV and others STIs
4	1.357	Research on the reasons for late presentation for ANC
5	1.353	Research on solutions to reduce antimicrobial resistance in the community and in health facilities
6	1.353	Research on the effectiveness of the village health workers program.
7	1.347	Research on the challenges in finding drug-resistant TB cases
8	1.345	Research on solutions to reach and vaccinate children who are not fully immunised.
9	1.345	Research on lifestyle changes and trends that affect the prevalence of NCDs in different groups
10	1.338	Research on what NCD services can feasibly be provided at different levels of the health care system
11	1.337	Research on the prevalence of antimicrobial resistance in different pathogens and the associated burden of mortality and adverse health outcomes
12	1.331	Research on new solutions to increase cervical cancer screening coverage and access to treatment with a focus on inclusion and equity
13	1.330	Research on barriers and enablers for effective TB contact investigation and preventive therapy
14	1.321	Research on referral and follow up practices and their implications for appropriate care for NCDs

¹³ Research Prioritisation Score

15	1.318	Research on reasons for low uptake of HPV vaccination
16	1.316	Research on whether and why people do not take their medications to control NCDs
17	1.311	Research on how many unwanted pregnancies occur and expectant mother practices when unwanted pregnancies occur
18	1.309	Research on the vulnerability to and impact of climate change on the Vanuatu health system in terms of infrastructure, workforce, response capability, recovery, access and strategy
19	1.304	Research on morbidity and mortality due to marijuana use and the factors that influence substance use
20	1.299	Research on the burden of TB and the determinants of TB transmission
21	1.299	Research on the burden of rheumatic heart disease
22	1.288	Research on solutions for providing hepatitis B screening and treatment in remote settings.
23	1.283	Research on nutritional choices and nutritional value of available foods and their relationship with non-communicable diseases (NCDs)
24	1.282	Research on the impact of utilisation of health information on planning of health services, service delivery and health outcomes
25	1.282	Research on human antibiotic consumption practices and their implications for antimicrobial resistance
26	1.281	Research on why there are low rates of TB treatment adherence
27	1.280	Research on changes in malaria burden and transmission due to climate change
28	1.279	Research on the gaps and barriers to timely notification, reporting and investigation of diseases, especially for notifiable diseases and neglected tropical diseases.
29	1.276	Research on the burden of syphilis and resulting morbidity and mortality, including among infants.
30	1.267	Research on the prevalence and burden of mental illness

31	1.264	Research on solutions for reducing the need for referral and the cost of referral without compromising patient care
32	1.259	Research on the health and nutrition needs of school-aged children and adolescents
33	1.257	Research on one health risk factors (animal, human and environmental)
34	1.255	Research on solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes
35	1.252	Research on solutions to improve the quality and coverage of required services
36	1.251	Research on the performance of different health information systems and combinations of health information systems in relation to potential needs of the Ministry of Health and partners for policy and planning
37	1.240	Research on how best to allocate funding to maximise health impact
38	1.239	Research on solutions for early recognition and diagnosis of stroke.
39	1.239	Research on why required health services are not delivered or are delivered with inadequate quality
40	1.234	Research on how traditional medicines and beliefs impact on patient behaviours
41	1.228	Research on the burden and effect of conditions that are comorbid with stroke.
42	1.228	Research on what health services are needed in different parts of Vanuatu and the resources and facilities needed to provide them
43	1.226	Research on the levels of health literacy in the population for different diseases and health conditions
44	1.225	Research on new solutions that use or account for traditional medicine and beliefs to improve service acceptability and patient practices
45	1.223	Research on the impact of regular kava consumption on health
46	1.220	Research on factors that contribute to high prevalence of hypertension

47	1.216	Research on health seeking behaviours for sepsis, including potential factors that could increase more timely health seeking
48	1.216	Research on the burden of neglected tropical diseases including the impact of climate on neglected tropical disease burden.
49	1.214	Research on the sexual health needs and care seeking-behaviours of seasonal workers from Vanuatu in Australia and New Zealand while overseas and on return.
50	1.211	Research on knowledge, attitudes and practices relating to leptospirosis among the population
51	1.210	Research on the health care seeking-behaviours and preferences of groups that are disadvantaged or marginalised in terms of accessibility and inclusivity of health services.
52	1.206	Research on the extent and reasons for inaccurate reporting of health information system data
53	1.206	Research on rates of obesity and inflammation among people of working age
54	1.202	Research on the reasons for slow and ineffective uptake of electronic health data systems
55	1.200	Research on the needs of people with disability and the services (health and other sectors) that are needed to meet those needs
56	1.197	Research on the burden of hepatitis B among children and the general population.
57	1.196	Research on reasons for low uptake and completion of syphilis treatment among persons diagnosed with syphilis
58	1.193	Research on solutions to improve the management of end stage kidney disease
59	1.190	Research on solutions using local food systems to increase food security for resilience to disasters and climate change
60	1.190	Research on community and health worker knowledge, attitudes, practices and behaviours relating to neglected tropical diseases, including how these have been affected by health promotion and health campaigns
61	1.180	Research on the human resources required to deliver the health strategy and the associated costs
62	1.180	Research on why birth dose coverage of Hepatitis B vaccination is low compared to BCG

63	1.177	Research on the burden and risk factors for asthma
64	1.176	Research on the associations between island kaikai and health and nutritional status of those consuming island kaikai
65	1.172	Research on knowledge, attitudes and practices relating to malaria among the population
66	1.165	Research on why monitoring and evaluation of health policy implementation is not being done
67	1.162	Research on the effectiveness of current syphilis management models used in Vanuatu
68	1.159	Research on how well health services meet the needs and preferences of different communities and patients (in terms of acceptability, inclusiveness)
69	1.157	Research on safe, acceptable solutions for achieving radical cure for patients with Vivax malaria
70	1.153	Research on the burden and impact of acquired disability on persons with disability and their families
71	1.150	Research on the relationship between poor oral health and heart disease
72	1.148	Research on new solutions for improving childhood development by integrating childhood development assessment and referral into routine child health visits
73	1.144	Research on allocations of funding that will maximise health impact
74	1.141	Research on the need, demand, supply and satisfaction with assistive devices and commodities for persons with disability.
75	1.135	Research on acceptable solutions for midwife and nurse management of hepatitis B in pregnancy.
76	1.134	Research on varied diets that provide suitable nutrition for persons with different conditions, and solutions to improve the quality of health care worker advice on diet
77	1.133	Research on new solutions to meet the in-service training needs of the health workforce
78	1.133	Research on the health workforce training and capacity development needs in different facilities and parts of Vanuatu

79	1.130	Research on the health burden of epilepsy and the risk factors for deaths relating to epilepsy
80	1.126	Research on the role of population movement in the spread of infectious diseases within Vanuatu and neighbouring countries
81	1.125	Research on the sources of funding for health in Vanuatu and the shortfall between needs and the funding from different sources
82	1.117	Research on solutions that encourage more timely care seeking for different diseases and health conditions
83	1.114	Research on midwife and nurse knowledge, attitudes and practices in managing syphilis in pregnancy.
84	1.112	Research on the effects of neglected tropical disease integration for communities that are the target of this integration
85	1.104	Research on solutions to minimise and manage complications and sequelae of stroke.
86	1.097	Research on the burden of and risk factors for metabolic dysfunction in the population
87	1.097	Research on whether current nursing and midwifery training methods are effective in giving trainees the skills they need
88	1.091	Research on barriers to uptake of modern methods of contraception
89	1.081	Research on the genetic and epigenetic adaptations to modern lifestyle changes and their implications for health and predisposition to disease
90	1.079	Research on solutions for decentralising malaria elimination interventions from provinces to health facilities
91	1.073	Research on the sequelae of meningitis
92	1.072	Research on health needs and access to health services for seasonal workers and their children
93	1.054	Research on the experiences of different groups in the health workforce and the barriers and challenges they face, with a focus on gender, disability and ethnicity
94	1.050	Research to understand the long-term impact of surgery on patient quality of life

95	1.050	Research on methods to assess nursing and midwifery trainees that accurately reflect their likely performance once employed
96	1.033	Research on the effectiveness of implementation of long-lasting insecticide treated nets and indoor residual spraying in controlling malaria.
97	1.019	Research on solutions to increase effective use of insecticide treated nets
98	1.002	Research on the quality of life of people with Parkinson's disease and their families and carers.
99	0.999	Research on solutions to procure quality-assured malaria rapid diagnostic tests and to monitor their quality
100	0.941	Research on solutions for building infrastructure and expertise in neuroscience services and research.
101	0.920	Research on why students are or aren't motivated to enrol in nursing and midwifery training
102	0.850	Research on health care worker knowledge and attitudes in provision of health care to those with less equitable access to inclusive to health services- with emphasis on persons with disability and the LGBTQI+ community.

Annex 3: Full list of climate change and health research topics, in order of ranking

Rank	Weighted RPS14	Topic
1	1.899	Research on WASH and menstrual hygiene needs during natural disasters (including people with disabilities)
2	1.899	Research on the impact of climate disasters on routine childhood vaccination coverage
3	1.890	Research focus on assessing the impact of climate change on health and nutritional needs of school-aged children and adolescents: challenges and adaptive strategies
4	1.881	Research into the best way to ensure continuity of antenatal care (ANC) during health emergencies
5	1.876	Research on maternal nutrition challenges due to climate-related food shortages
6	1.871	Research on the effectiveness and feasibility of micronutrient powder interventions before and during disasters
7	1.810	Research into the minimum standards at emergency evacuation centres for RMNCH
8	1.706	Research into access to contraception during emergencies: barriers, needs and gaps
9	1.609	Research on infrastructure solutions to maintain maternal health service access during climate events
10	1.516	Research on climate-induced stress, anxiety, and depression in pregnant/postpartum women
11	1.511	Research on the impact of heatwaves and cyclones on birth outcomes
12	1.152	Research on how climate shocks impact access to HIV prevention services for people experiencing gender-based violence
13	1.093	Research focus on investigating the hidden HIV risk and surveillance gaps amid climate vulnerabilities.
14	1.079	Research on factors that strengthen the resilience of HIV testing services in the face of climate disasters

¹⁴ Research Prioritisation Score

15	1.037	Research on the impact of climate change on the prevalence and management of diabetes in Vanuatu through its impact on food security, health infrastructure, and population displacement
16	1.036	Research on the incidence of climate-related mental health conditions
17	1.036	Research focus on understanding the mental health burden linked to climate change
18	1.034	Research on understanding the influence of climate and cultural barriers to condom use among adolescents
19	1.031	Research on climate-related lifestyle changes and socio-economic trends that affect the prevalence of NCDs in different groups
20	1.026	Research on what are the health consequences of increased frequencies of storms, floods and landslide including injuries, displacement and mental health impacts
21	1.020	Research on the vulnerability and adaptive capacity to the Vanuatu health system to climate change impacts across infrastructure, workforce, response capability, recovery, access and strategy
22	1.020	Research on how climate change related stress, displacement and loss of livelihoods will affect mental wellbeing, including anxiety, depression and post-traumatic stress disorder
23	1.020	Research on nutritional choices and nutritional value of available foods and their relationship with the burden of non-communicable diseases
24	1.019	Research on the effectiveness and adequacy of existing mental health interventions in response to climate change-related impacts
25	1.014	Research on strengthening health information systems to support climate resilient planning and timely health responses
26	1.014	Research on what health services are needed in different parts of Vanuatu and the resources and facilities needed to provide them
27	1.014	Research focus on human resource gaps and barriers in climate-health workforce development
28	1.014	Research on climate-resilient solutions for improving the quality, accessibility and convenience of monitoring of patients with diabetes
29	1.013	Research into understanding the impacts of disasters on household nutrition and food practices
30	1.009	Research on future government health system costs associated with the impacts of climate change

31	1.009	Research on climate and health financing policies in Vanuatu and comparable contexts
32	1.009	Research on evaluation of predictive models for disease outbreaks using climate data.
33	1.009	Research on government structures and their impact on climate-health policy effectiveness
34	1.008	Research on how we make sure the health services are not disrupted due to health workforce mobilization during health emergencies
35	1.008	Research into nutrition education in schools to promote climate resilient healthy eating
36	1.003	Research into Integration of VMGD and MOH/HIS/VBD data for real-time disease surveillance.
37	1.003	Research into application of GIS technologies for real-time mapping of diseases outbreaks linked to climate events
38	1.002	Exploring opportunities to scale up mental health services and first aid for mental health in vulnerable communities
39	0.997	Research on epidemiological modelling of disease outbreaks in relation to climate variability.
40	0.997	Research on mapping disease hotspots in relation to climate trends and extreme events.
41	0.997	Research on climate resilient health systems: ensuring continuity and quality of essential services during facility failures.
42	0.996	Research on how will changing temperatures and rainfall patterns affects the spread of vector-borne, water and foodborne illness and NTDs
43	0.996	Research focus on strengthening laboratory systems for early detection of climate-sensitive diseases (e.g. dengue, leptospirosis) in the context of climate change
44	0.991	Research on the associations between island kai kai and health and nutritional status of those consuming island kai kai
45	0.991	Research on organisational resilience and workforce empowerment during climate related health emergencies
46	0.991	Research on one health risk factors (animal, human and environmental)

47	0.991	Research focus on mapping and climate responsive management of mosquito breeding sites in Vanuatu.
48	0.991	Research on the burden of neglected tropical diseases including the impact of climate on neglected tropical disease burden.
49	0.991	Research about the best approaches to TB prevention in evacuation centres
50	0.991	Research on how various demographic, socioeconomic and cultural group perceive climate change and its health impact
51	0.991	Research into exploring traditional coping mechanism and community resilience to climate stress
52	0.991	Research on how climate related displacements (short and long term) affect public health, including access to healthcare, sanitation, and mental health services
53	0.991	Research focus on surveillance and identification of zoonotic diseases in Vanuatu in a changing climate.
54	0.991	Feasibility studies on sustainable technologies (e.g., solar-powered clinics, rainwater harvesting).
55	0.990	Research into how immunization program can integrate climate resilience into their operations planning/ strategies
56	0.990	Research on resilience of vaccine cold chain systems in the face of climate change
57	0.985	Research on changes in malaria burden and transmission due to climate change
58	0.985	Research on the role of population movement in the spread of infectious diseases within Vanuatu and neighbouring countries
59	0.985	Research focus on Stakeholder analysis of One Health implementation.
60	0.985	Research on solutions using local food systems to increase food security for resilience to disasters and climate change
61	0.985	Research into the development of climate resilient agricultural food systems to support agricultural livelihoods and nutrition in communication in a decentralized approach
62	0.985	Research into sustainable ways fisheries and community access to fish supply in a changing climate. (Also provides data on contact supply of fisheries to communities)

63	0.985	Research on how will increase in temperature and heatwaves affected morbidity and mortality especially among vulnerable populations
64	0.985	Research on individual behaviours change for improved nutrition in the context of climate change
65	0.985	Research on the best ways to deliver risk communications on climate change and health.
66	0.985	Research into leadership models and role alignment in climate-health governance
67	0.984	Research focus on assessment of health facility vulnerability to climate events.
68	0.984	Research into the Impact of climate change on food security (ocean and land based)
69	0.980	Assessing food accessibility and nutrition value of foods in various climatic conditions and seasons
70	0.980	Research focus on case studies of successful early warning systems in similar Pacific Island contexts.
71	0.980	Research on temporal analysis of disease incidence before, during, and after extreme weather events.
72	0.980	Research on the impact of climate change on MDR TB
73	0.979	Research on how indigenous knowledge and local expertise be integrated into climate change and health communication efforts
74	0.979	Conduct operational research on malaria activities conducted in provinces in the context of climate change
75	0.979	Research on the impacts of climate change on nutritional value and production capacity of land-based agriculture in Vanuatu
76	0.979	Research into the impact of climate change on the nutritional value of fish and seafood in Vanuatu
77	0.978	Research on the effectiveness of implementation of long-lasting insecticide treated nets and indoor residual spraying in controlling malaria
78	0.978	Research on varied diets that provide suitable nutrition for persons with different conditions, and solutions to improve the quality of health care worker advice on diet.

79	0.974	Research on community and health worker knowledge, attitudes, practices and behaviours relating to neglected tropical diseases, including how these have been affected by health promotion and health campaigns
80	0.973	Research on knowledge, attitudes and practices relating to leptospirosis among the population
81	0.973	Research on the effects of neglected tropical disease integration for communities that are the target of this integration
82	0.973	Research on access and availability of healthy kakae (traditional and nutritious foods) in the context of climate change.
83	0.968	Research to know if climate change contributes to the burden of yaws
84	0.968	Research on climate-linked emergence of Angiostrongyliasis Cantonese's and its impact on animal/human neurological health in urban and coastal areas.
85	0.967	Research focus on Evaluation of pilot One Health programs in the Pacific region.
86	0.967	Research focus on strengthening community engagement for climate resilient malaria elimination in Vanuatu
87	0.967	Research on Community-based participatory research on One Health awareness.
88	0.967	Research on the impact of climate change on family violence
89	0.967	Research into the impact of climate change on dietary diversity in Vanuatu.
90	0.967	An assessment of the impact of the provision of satellite internet to remote health care facilities
91	0.962	Research on the impact of human movement on NTDs
92	0.962	Research focus on assessing the impact of climate change on fisheries and food security, particularly on health and wellbeing of communities dependent on fisheries for food and livelihood
93	0.962	Research focus on investigating the zoonotic and climate-driven dynamics of Brucella Canis in urban dog populations and implications for human health.
94	0.956	Research on the impact of climate change in substance use

95	0.956	Research to know if climate change contributes to the burden of scabies
96	0.955	Research on knowledge, attitudes and practices relating to malaria among the population
97	0.944	Research to know if climate change contributes to the burden of worm infection