# An integrated framework for early detection, prevention and management of infectious diseases


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- Limited dialogue between climate and (health) community
- Climate information not well understood and targeted – community, policy
- Limited provision of climate services in developing countries
- Traditional top-down communication not effective – Feedback is essential
- Health education needs to be sensitive to cultural and social needs
- Use of digital communication not fully utilised

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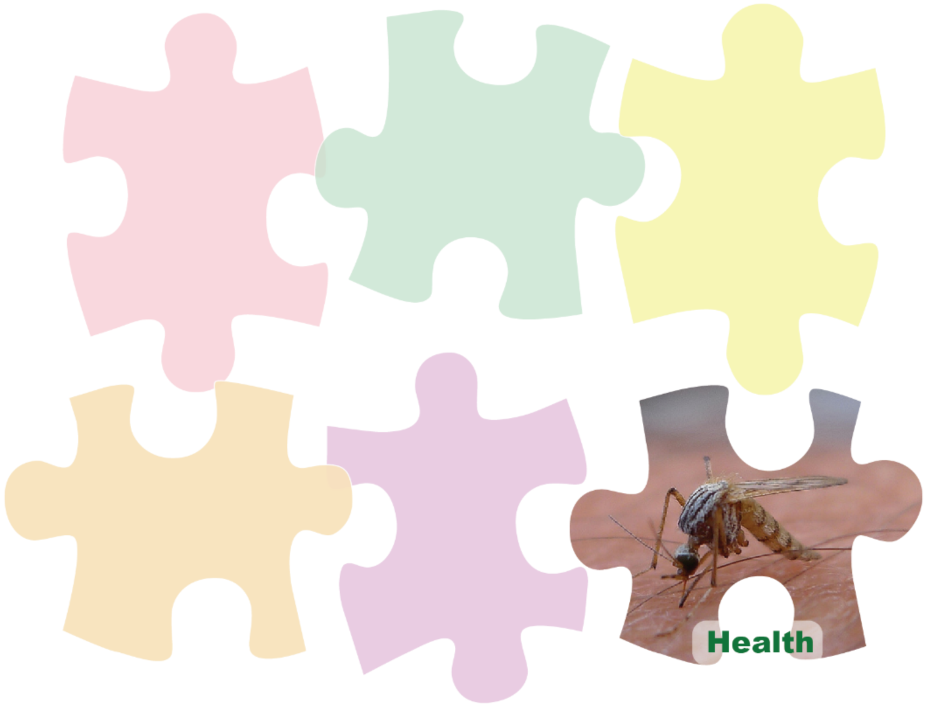

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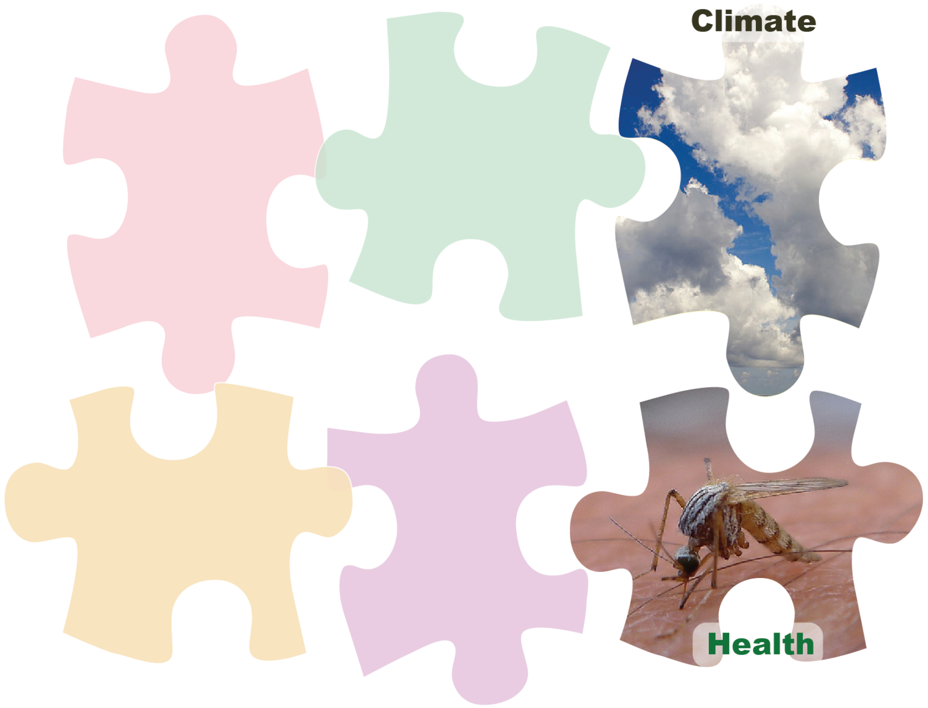

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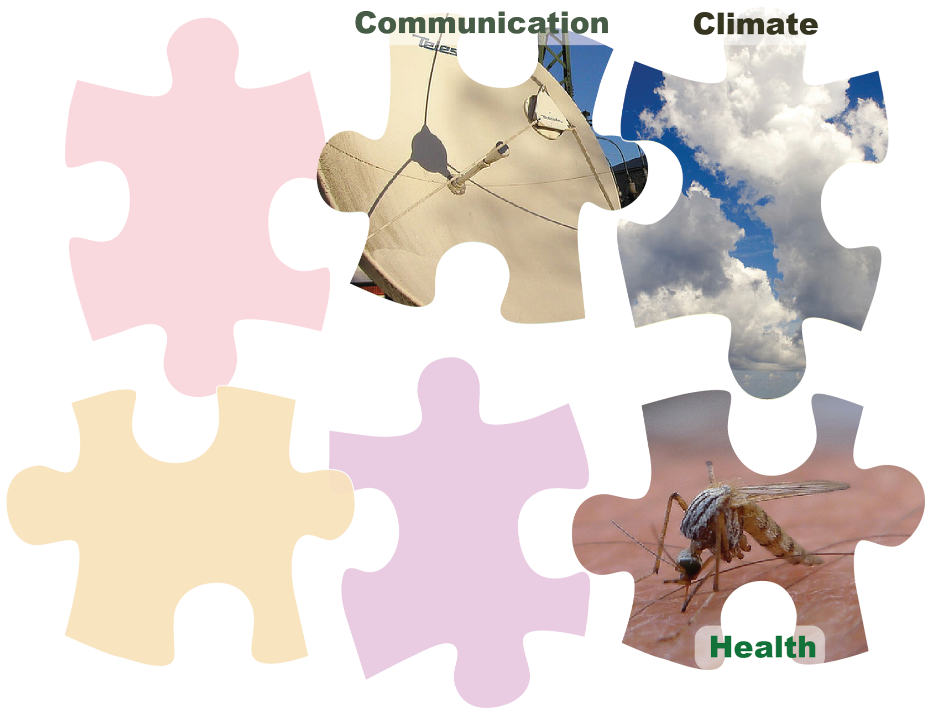

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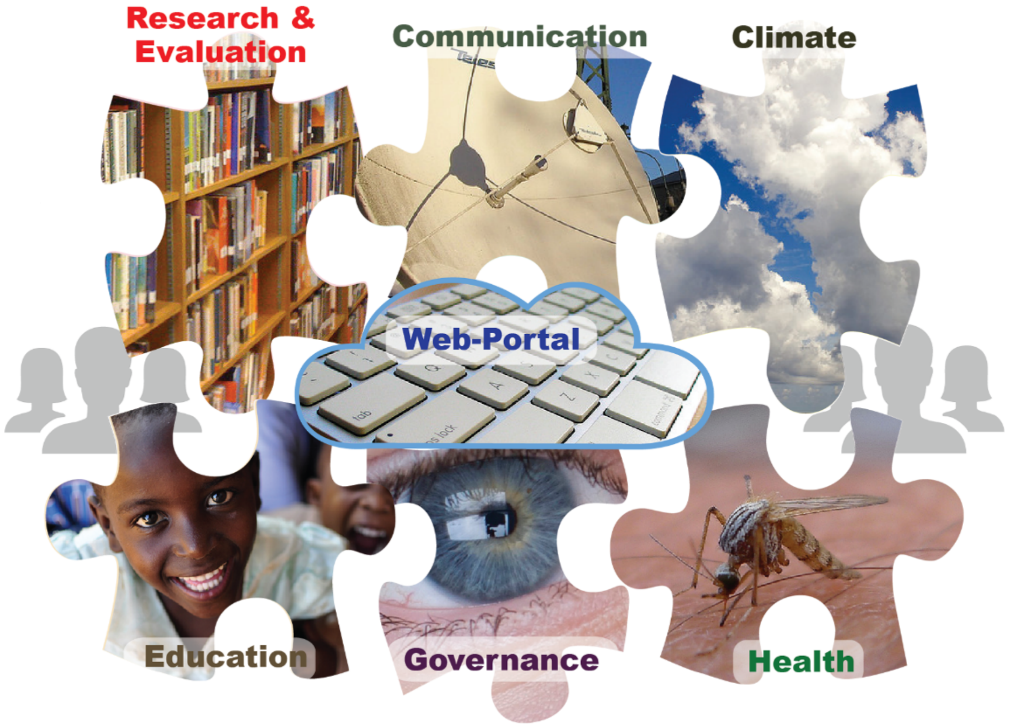


# Web Portal

**Website**

Interface for administration and dissemination

**Web-Service**

Content repository, data feeds, synchronisation of offline content

*Core of all educational communication activity, information assimilation, retrieval, research and feedback activities.*

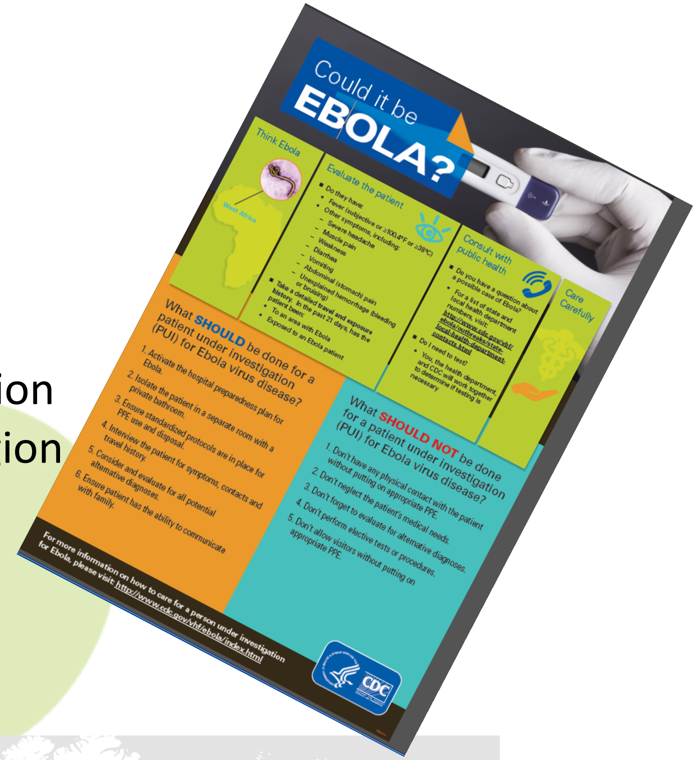
# Health

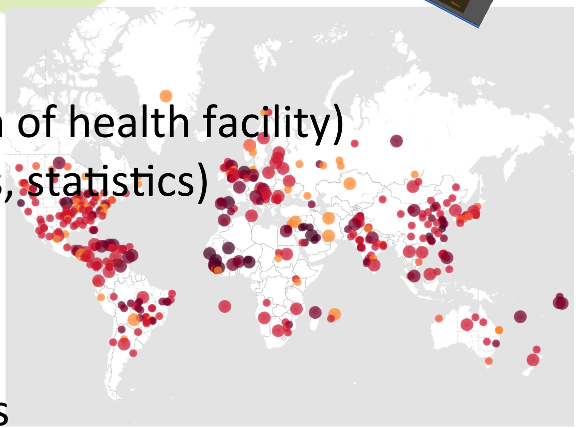
**Disease Database**
- Literature, epidemiology, aetiology, mode of transmission
- Risk profile of climate sensitive diseases x country x region

**Health Services**
- Prevention and control, treatment

**Disease Surveillance and Early Warning**
- Spread of diseases, rapid diagnostics
- WHO's Communicable Disease Global Atlas
    - Data Query (reports, charts and maps)
    - Interactive mapping (map of diseases, location of health facility)
    - Maps and Resources (documents, publications, statistics)
- Ethics, national and local laws, cultural sensitivity

**Climate and Health impacts**
- Direct impacts
- Changing pattern of vector and water born diseases



Tarawa (Kiribati)

| Lead-time (months) | Jan-Mar | Feb-Apr | Mar-May | Apr-Jun | May-Jul | Jun-Aug | Jul-Sep | Aug-Oct | Sep-Nov | Oct-Dec | Nov-Jan | Dec-Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | -2.1 | -1.7 | -3.2 | 0.3 | -1 | 1.9 | 5.2 | 3.6 | 2.7 | 1.4 | 6.3 | 4.7 |
| 7 | -1.3 | -0.1 | -3.8 | 1.1 | 3.7 | 3.4 | 7.8 | 1.7 | 2.5 | 10.1 | 6.3 | 4.3 |
| 6 | 0.1 | 1.3 | -3.7 | 4.7 | 9.1 | 3.4 | 5.1 | 0.7 | 7.2 | 14.3 | 4 | 2.3 |
| 5 | 3.7 | 2.3 | -1.1 | 8 | 10.2 | 1.5 | 4.9 | 5.6 | 11.3 | 15.9 | 2.6 | 5 |
| 4 | 6.3 | 7.1 | 2.9 | 10.7 | 9.6 | 1.8 | 13.7 | 13.5 | 14.1 | 14.5 | 7.1 | 10.8 |
| 3 | 11 | 14.4 | 6.6 | 13.4 | 8.2 | 9.3 | 27.9 | 14.3 | 11.9 | 19.9 | 14.3 | 14 |
| 2 | 20.4 | 18.3 | 8.7 | 18.3 | 9.9 | 21.5 | 26.6 | 11.7 | 16 | 29.9 | 18.9 | 18.7 |
| 1 | 21.8 | 17.8 | 13.4 | 17.1 | 18.8 | 21.2 | 22.1 | 21.1 | 25.4 | 35.1 | 22.9 | 26.7 |
| 0 | 17.8 | 20 | 14.4 | 18.9 | 24 | 19.[illegible] | 26 | 35.1 | 30.3 | 38.9 | 31.8 | 29.1 |

Honiara (Solomon Islands)

| Lead-time (months) | Jan-Mar | Feb-Apr | Mar-May | Apr-Jun | May-Jul | Jun-Aug | Jul-Sep | Aug-Oct | Sep-Nov | Oct-Dec | Nov-Jan | Dec-Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | -1.2 | -2.5 | -0.8 | -1.2 | 2.5 | -1.9 | -3.1 | -0.2 | -0.7 | -1.9 | -3.3 | 1.9 |
| 7 | 0.2 | 2.1 | 1.8 | -0.6 | 2.1 | -2.7 | -3.8 | -0.7 | -2.2 | -0.9 | 3.9 | -1.9 |
| 6 | 4 | 8.4 | 1.9 | -0.9 | 3.2 | -2.5 | -3.9 | -1.3 | -2 | 2.8 | 2.4 | -0.3 |
| 5 | 9.2 | 9.7 | 3.3 | -0.9 | 4.7 | -1.7 | -2.8 | -2.3 | -0.8 | -1 | 3.3 | 5.7 |
| 4 | 8.9 | 11 | 6.3 | -0.1 | 4.3 | -1.6 | -0.6 | -2.7 | -4.1 | -1.5 | 8.3 | 12.4 |
| 3 | 9.8 | 16 | 8.8 | 0.1 | 1.5 | -4.2 | -1.9 | -3.8 | -1.5 | 2 | 13.4 | 13.6 |
| 2 | 12.4 | 19 | 11.3 | -2.8 | -0.4 | -4.5 | -1.6 | -4.3 | 3.9 | 5.1 | 13.4 | 13.6 |
| 1 | 13.2 | 19.3 | 9.3 | -3 | -0.3 | -3.9 | -1.4 | -3.2 | 5.3 | 5.2 | 13.9 | 15.8 |
| 0 | 13.3 | 16.4 | 6.1 | -1.8 | -2 | -3 | -2.5 | -3 | 4.2 | 9.3 | 17.2 | 16.9 |

Worse than Climatology — As good as Climatology — Better than Climatology

# Climate


## Climate Resource Centres

Rainfall, temperature, wind, RH, ENSO

## Climate Prediction Centres and Services

NHMS,IRI,WMO,ECMWF,BoM

Forecasts of climate extremes, lead-time, forecast skill, drought forecasts

## Climate Related Warning

Heat stress, bushfire, air pollution

Specificity, lead-time, literature, distribution and prevalence

## Climate Change Projection

Literature, geographic distribution and impact on vector-water borne disease

Targeted forecasts to support adaptation

## Climate forecasting can help predict malaria outbreaks

NEW climate forecasting software can help predict outbreaks of malaria, a one-day workshop in Honiara was told.

The workshop, held on Thursday, was organised by the Solomon Islands Meteorological Service.

Funded by AusAID and implemented by the Australian Bureau of Meteorology and a team at the University of Southern Queensland, the project has been building the capacity of the meteorological services of 10 Pacific island countries in climate forecasting.

mate prediction capacity in the Pacific islands, the second phase of the project has focused on studying the impact of climate variability and climate change on various sectors such as health, agriculture, water and renewable energy.

The pilot project in Solomon Islands has been focusing on the link between climate variability and malaria.

Dr Abawi said connecting all the data is like putting together a jigsaw puzzle which has the potential to help combat a serious disease.

ation."

Through analysing data from the Ministry of Health, which detailed the confirmed cases of malaria since 1975 with meteorological data from the Ministry of Environment, Conservation and Meteorology, the team was able to determine that rainfall and temperature has a great influence on the instances of malaria.

"You need a rainy season for the spike in the number of malaria cases but we found that too much rain has the opposite effect and

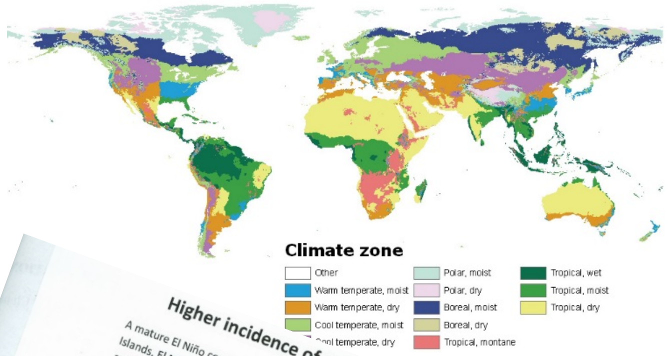
El Nino season using the new software means that the country can prepare for a higher than average number of malaria cases during that wet season well ahead of time.

Jennifer Mitini, Director Supervising of National Health Training and Research attended the workshop with other colleagues and said she is looking forward to working with the Meteorological Services to implement the findings of the pilot project.

"This research has answered one of the burning

Solomon Star August 2010

Climate Zones




### Higher incidence of malaria forecast for this summer

A mature El Niño condition is continuing to dominate in the equatorial Pacific Ocean. In the Solomon Islands, El Niño is usually associated with higher temperatures and less rainfall than the long-term average. These conditions are conducive to a heightened risk of malarial infections for the Solomon Islands during the peak infection period of January to May.

The relationship between the incidence of malaria and climatic conditions is currently being investigated as part of the Pacific Islands Climate Prediction Project (PI-CPP), which is funded by AusAid and administered by the Australian Bureau of Meteorology in collaboration with the Solomon Islands National Health Research and Training Institute. This study has shown that malarial incidence peaks during the January to May period, coinciding with the rainy season in the Solomon Islands. Since an El Niño is currently affecting the Solomon Islands, rainfall in this period is likely to be reduced and temperatures increased across most of the Solomon Islands in coming months. Increased temperatures will result in a shorter breeding cycle for mosquitoes and lower rainfall will reduce the flushing of larvae from stagnant water. These factors are likely to contribute to increased mosquito numbers and a higher rate of malaria transmission occurring this summer in the Solomon Islands.

Authorities are reminding residents to be diligent in taking preventative measures such as use of bed nets, especially during the early morning and evening, and where possible remove potential breeding sites such as stagnant pools of water where mosquitos can harbour. If you have any malarial symptoms such as high fever, please report to your local medical officer.

Contact: Mr Lloyd Tahani, National Meteorological Services, Solomon Islands


# Communication

**Timely Communication of Warnings**

- target audience (health workers, public, government)
- message source (credible, meaningful, appeal)

**Platforms**

- Traditional media, mobile devices (offline/online, websites, social media, forums, SMS

**Health Promotion Material**

**Outbreak Communication**

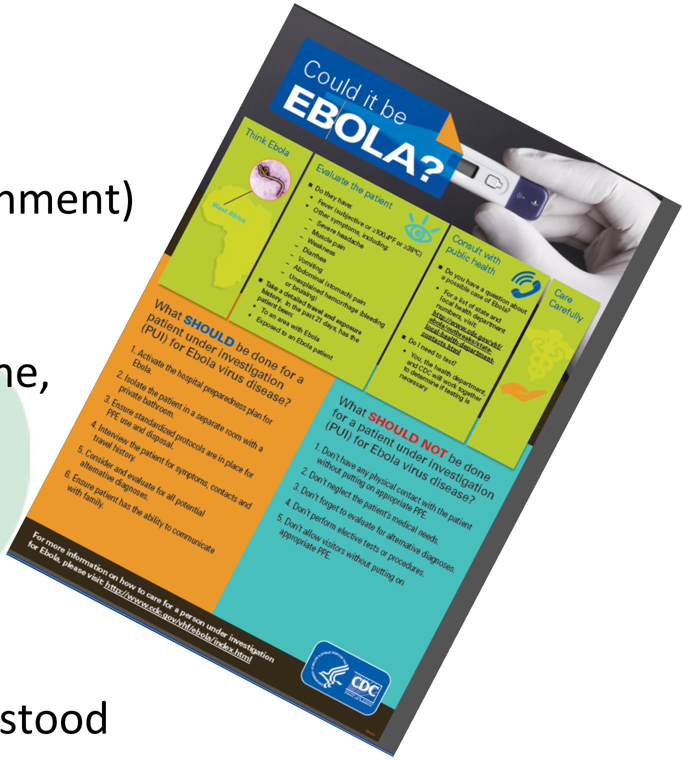
- building trust, mitigation of social disruption

**Behavioural and Social Communication**:

How information is transmitted, perceived, understood and applied by individuals and groups

**Feedback**

- Rapid two-way and multiple-way communication




# Research and Evaluation

**Preliminary Analysis**

- *Surveys, Literature review, Human resources, Organisational capacity to direct resources, health information and intervention*

**Co-Creation**

- Data gathering, ***crowd sourcing***, social media, moderated discussion groups

(games, information, posters, educational material, cartoons)

**Feedback and Evaluation**

Effectiveness of engagement, digital analytics (*qualitative and quantitative data )* economic analysis and behavioural impacts. *Feedback to improve outcome*

# Education

**Cultural Pedagogy**

*Framework for an inclusive education system*

*Content, knowledge creation, cultural interaction, relevance.*

**Community Engagement**

*More likely too participate if needs are addressed*

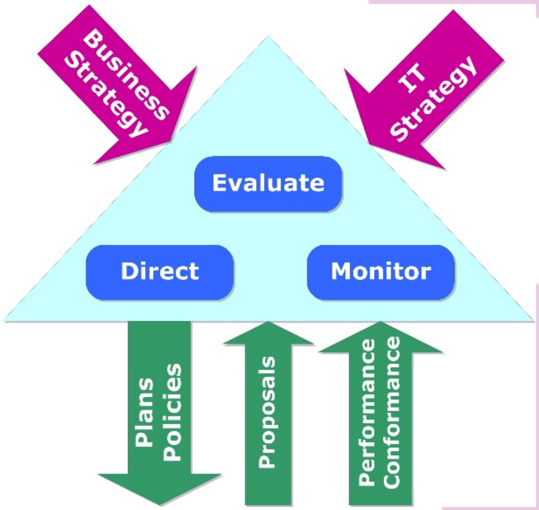
*Motivated to take action*

*Share information with social network, leadership role*

**Sustainability of Health Intervention**

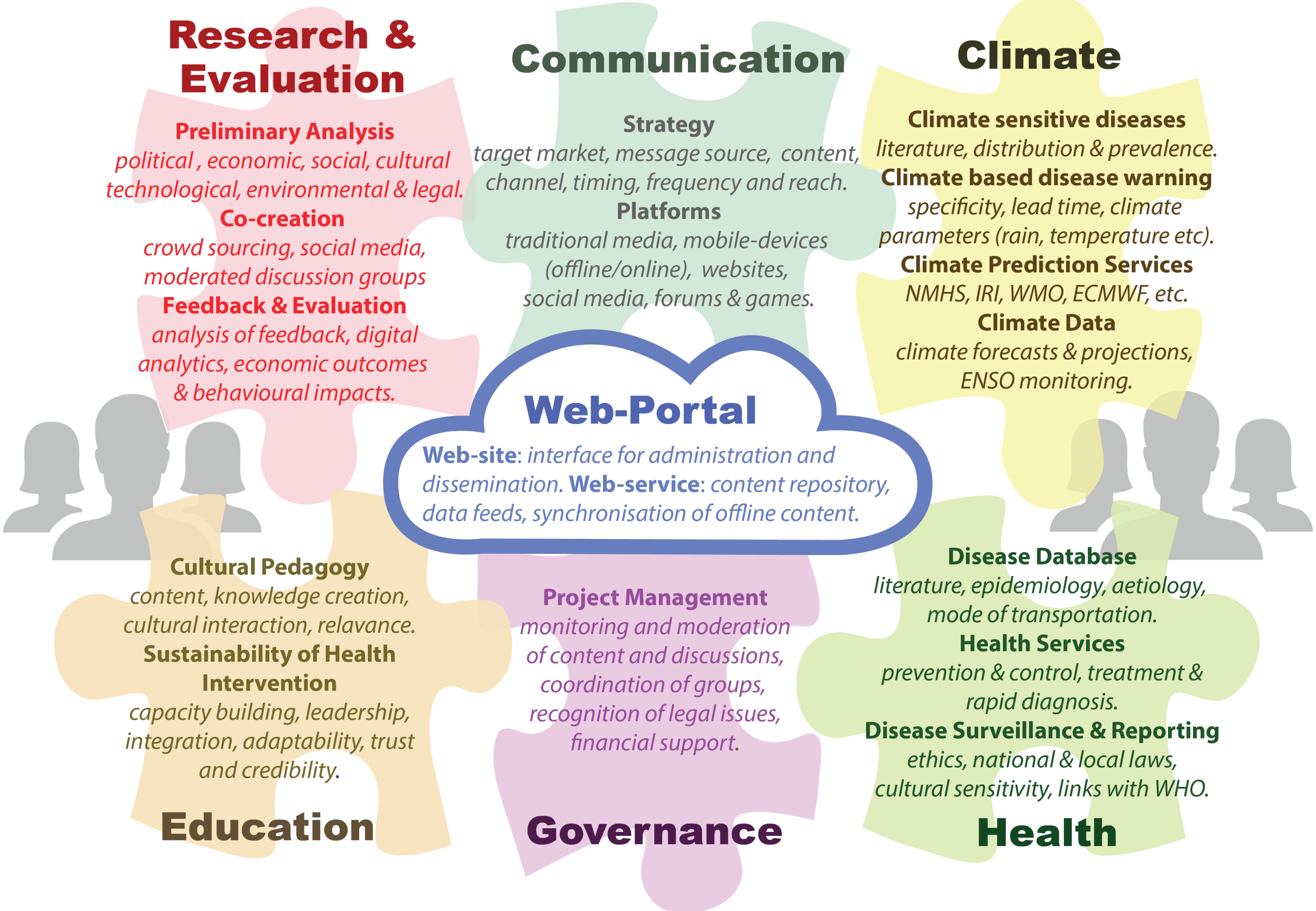
*Capacity building, leadership, integration, adaptability, trust and credibility*

# Governance




**Project Management**

*Monitoring and moderation of content and discussions, coordination of groups, recognition of legal issues, financial support*


Research & Evaluation
Preliminary Analysis
political , economic, social, cultural technological, environmental & legal.
Co-creation
crowd sourcing, social media, moderated discussion groups
Feedback & Evaluation
analysis of feedback, digital analytics, economic outcomes & behavioural impacts.
Communication
Strategy
target market, message source, content, channel, timing, frequency and reach.
Platforms
traditional media, mobile-devices (offline/online), websites, social media, forums & games.
Climate
Climate sensitive diseases
literature, distribution & prevalence.
Climate based disease warning
specificity, lead time, climate parameters (rain, temperature etc).
Climate Prediction Services
NMHS, IRI, WMO, ECMWF, etc.
Climate Data
climate forecasts & projections, ENSO monitoring.
Web-Portal
Web-site: interface for administration and dissemination. Web-service: content repository, data feeds, synchronisation of offline content.
Cultural Pedagogy
content, knowledge creation, cultural interaction, relavance.
Sustainability of Health Intervention
capacity building, leadership, integration, adaptability, trust and credibility.
Education
Project Management
monitoring and moderation of content and discussions, coordination of groups, recognition of legal issues, financial support.
Governance
Disease Database
literature, epidemiology, aetiology, mode of transportation.
Health Services
prevention & control, treatment & rapid diagnosis.
Disease Surveillance & Reporting
ethics, national & local laws, cultural sensitivity, links with WHO.
Health

# An integrated framework for early detection, prevention and management of infectious diseases

***Could such a framework prevent future Epidemic and Pandemics ?***

***(Ebola Pandemic 2014)***

. Was early warning available?

. Does climate has an influence?

. Was intervention timely?

. Cultural Issues

. Communication Issues

# Is Ebola outbreaks linked to climate?

- **Lack of high quality climate data.**

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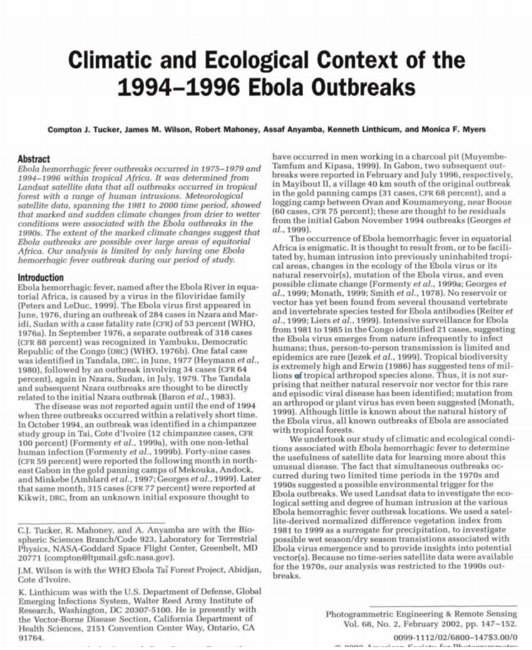
- **Limited research but provides useful leads.**



## Climatic and Ecological Context of the 1994–1996 Ebola Outbreaks

**Compton J. Tucker, James M. Wilson, Robert Mahoney, Assaf Anyamba, Kenneth Linthicum, and Monica F. Myers**

**Abstract**
*Ebola hemorrhagic fever outbreaks occurred in 1975–1979 and 1994–1996 within tropical Africa. It was determined from Landsat satellite data that all outbreaks occurred in tropical forest with a range of human intrusions. Meteorological satellite data, spanning the 1981 to 2000 time period, showed that marked and sudden climate changes from drier to wetter conditions were associated with the Ebola outbreaks in the 1990s. The extent of the marked climate changes suggest that Ebola outbreaks are possible over large areas of equitorial Africa. Our analysis is limited by only having one Ebola hemorrhagic fever outbreak during our period of study.*

**Introduction**
Ebola hemorrhagic fever, named after the Ebola River in equatorial Africa, is caused by a virus in the filoviridae family (Peters and LeDuc, 1999). The Ebola virus first appeared in June, 1976, during an outbreak of 284 cases in Nzara and Maridi, Sudan with a case fatality rate (CFR) of 53 percent (WHO, 1976a). In September 1976, a separate outbreak of 318 cases (CFR 88 percent) was recognized in Yambuku, Democratic Republic of the Congo (DRC) (WHO, 1976b). One fatal case was identified in Tandala, DRC, in June, 1977 (Heymann *et al.*, 1980), followed by an outbreak involving 34 cases (CFR 64 percent), again in Nzara, Sudan, in July, 1979. The Tandala and subsequent Nzara outbreaks are thought to be directly related to the initial Nzara outbreak (Baron *et al.*, 1983).

The disease was not reported again until the end of 1994 when three outbreaks occurred within a relatively short time. In October 1994, an outbreak was identified in a chimpanzee study group in Tai, Cote d'Ivoire (12 chimpanzee cases, CFR 100 percent) (Formenty *et al.*, 1999a), with one non-lethal human infection (Formenty *et al.*, 1999b). Forty-nine cases (CFR 59 percent) were reported the following month in northeast Gabon in the gold panning camps of Mekouka, Andock, and Minkebe (Amblard *et al.*, 1997; Georges *et al.*, 1999). Later that same month, 315 cases (CFR 77 percent) were reported at Kikwit, DRC, from an unknown initial exposure thought to have occurred in men working in a charcoal pit (Muyembe-Tamfum and Kipasa, 1999). In Gabon, two subsequent outbreaks were reported in February and July 1996, respectively, in Mayibout II, a village 40 km south of the original outbreak in the gold panning camps (31 cases, CFR 68 percent), and a logging camp between Ovan and Koumameyong, near Booue (60 cases, CFR 75 percent); these are thought to be residuals from the initial Gabon November 1994 outbreaks (Georges *et al.*, 1999).

The occurrence of Ebola hemorrhagic fever in equatorial Africa is enigmatic. It is thought to result from, or to be facilitated by, human intrusion into previously uninhabited tropical areas, changes in the ecology of the Ebola virus or its natural reservoir(s), mutation of the Ebola virus, and even possible climate change (Formenty *et al.*, 1999a; Georges *et al.*, 1999; Monath, 1999; Smith *et al.*, 1978). No reservoir or vector has yet been found from several thousand vertebrate and invertebrate species tested for Ebola antibodies (Reiter *et al.*, 1999; Liers *et al.*, 1999). Intensive surveillance for Ebola from 1981 to 1985 in the Congo identified 21 cases, suggesting the Ebola virus emerges from nature infrequently to infect humans; thus, person-to-person transmission is limited and epidemics are rare (Jezek *et al.*, 1999). Tropical biodiversity is extremely high and Erwin (1986) has suggested tens of millions of tropical arthropod species alone. Thus, it is not surprising that neither natural reservoir nor vector for this rare and episodic viral disease has been identified; mutation from an arthropod or plant virus has even been suggested (Monath, 1999). Although little is known about the natural history of the Ebola virus, all known outbreaks of Ebola are associated with tropical forests.

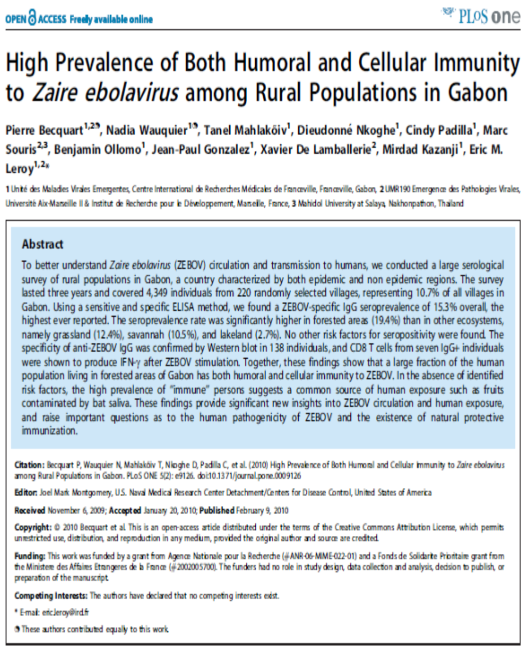
We undertook our study of climatic and ecological conditions associated with Ebola hemorrhagic fever to determine the usefulness of satellite data for learning more about this unusual disease. The fact that simultaneous outbreaks occurred during two limited time periods in the 1970s and 1990s suggested a possible environmental trigger for the Ebola outbreaks. We used Landsat data to investigate the ecological setting and degree of human intrusion at the various Ebola hemorraghic fever outbreak locations. We used a satellite-derived normalized difference vegetation index from 1981 to 1999 as a surrogate for precipitation, to investigate possible wet season/dry season transitions associated with Ebola virus emergence and to provide insights into potential vector(s). Because no time-series satellite data were available for the 1970s, our analysis was restricted to the 1990s outbreaks.

C.J. Tucker, R. Mahoney, and A. Anyamba are with the Biospheric Sciences Branch/Code 923, Laboratory for Terrestrial Physics, NASA-Goddard Space Flight Center, Greenbelt, MD 20771 (compton@ltpmail.gsfc.nasa.gov).

J.M. Wilson is with the WHO Ebola Taï Forest Project, Abidjan, Cote d'Ivoire.

K. Linthicum was with the U.S. Department of Defense, Global Emerging Infections System, Walter Reed Army Institute of Research, Washington, DC 20307-5100. He is presently with the Vector-Borne Disease Section, California Department of Health Sciences, 2151 Convention Center Way, Ontario, CA 91764.

Photogrammetric Engineering & Remote Sensing
Vol. 68, No. 2, February 2002, pp. 147–152.
0099-1112/02/6800–147$3.00/0



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## High Prevalence of Both Humoral and Cellular Immunity to *Zaire ebolavirus* among Rural Populations in Gabon

Pierre Becquart[1,2], Nadia Wauquier[1], Tanel Mahlakõiv[1], Dieudonné Nkoghe[1], Cindy Padilla[1], Marc Souris[2,3], Benjamin Ollomo[1], Jean-Paul Gonzalez[1], Xavier De Lamballerie[2], Mirdad Kazanji[1], Eric M. Leroy[1,2]*

1 Unité des Maladies Virales Emergentes, Centre International de Recherches Médicales de Franceville, Franceville, Gabon, 2 UMR190 Emergence des Pathologies Virales, Université Aix-Marseille II & Institut de Recherche pour le Développement, Marseille, France, 3 Mahidol University at Salaya, Nakhonpathon, Thailand

**Abstract**

To better understand *Zaire ebolavirus* (ZEBOV) circulation and transmission to humans, we conducted a large serological survey of rural populations in Gabon, a country characterized by both epidemic and non epidemic regions. The survey lasted three years and covered 4,349 individuals from 220 randomly selected villages, representing 10.7% of all villages in Gabon. Using a sensitive and specific ELISA method, we found a ZEBOV-specific IgG seroprevalence of 15.3% overall, the highest ever reported. The seroprevalence rate was significantly higher in forested areas (19.4%) than in other ecosystems, namely grassland (12.4%), savannah (10.5%), and lakeland (2.7%). No other risk factors for seropositivity were found. The specificity of anti-ZEBOV IgG was confirmed by Western blot in 138 individuals, and CD8 T cells from seven IgG+ individuals were shown to produce IFN-γ after ZEBOV stimulation. Together, these findings show that a large fraction of the human population living in forested areas of Gabon has both humoral and cellular immunity to ZEBOV. In the absence of identified risk factors, the high prevalence of "immune" persons suggests a common source of human exposure such as fruits contaminated by bat saliva. These findings provide significant new insights into ZEBOV circulation and human exposure, and raise important questions as to the human pathogenicity of ZEBOV and the existence of natural protective immunization.

**Citation:** Becquart P, Wauquier N, Mahlakõiv T, Nkoghe D, Padilla C, et al. (2010) High Prevalence of Both Humoral and Cellular Immunity to *Zaire ebolavirus* among Rural Populations in Gabon. PLoS ONE 5(2): e9126. doi:10.1371/journal.pone.0009126

**Editor:** Joel Mark Montgomery, U.S. Naval Medical Research Center Detachment/Centers for Disease Control, United States of America

**Received** November 6, 2009; **Accepted** January 20, 2010; **Published** February 9, 2010



**Funding:** This work was funded by a grant from Agence Nationale pour la Recherche (#ANR-06-MIME-022-01) and a Fonds de Solidarite Prioritaire grant from the Ministere des Affaires Etrangeres de la France (#2002005700). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

**Competing Interests:** The authors have declared that no competing interests exist.

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These authors contributed equally to this work.

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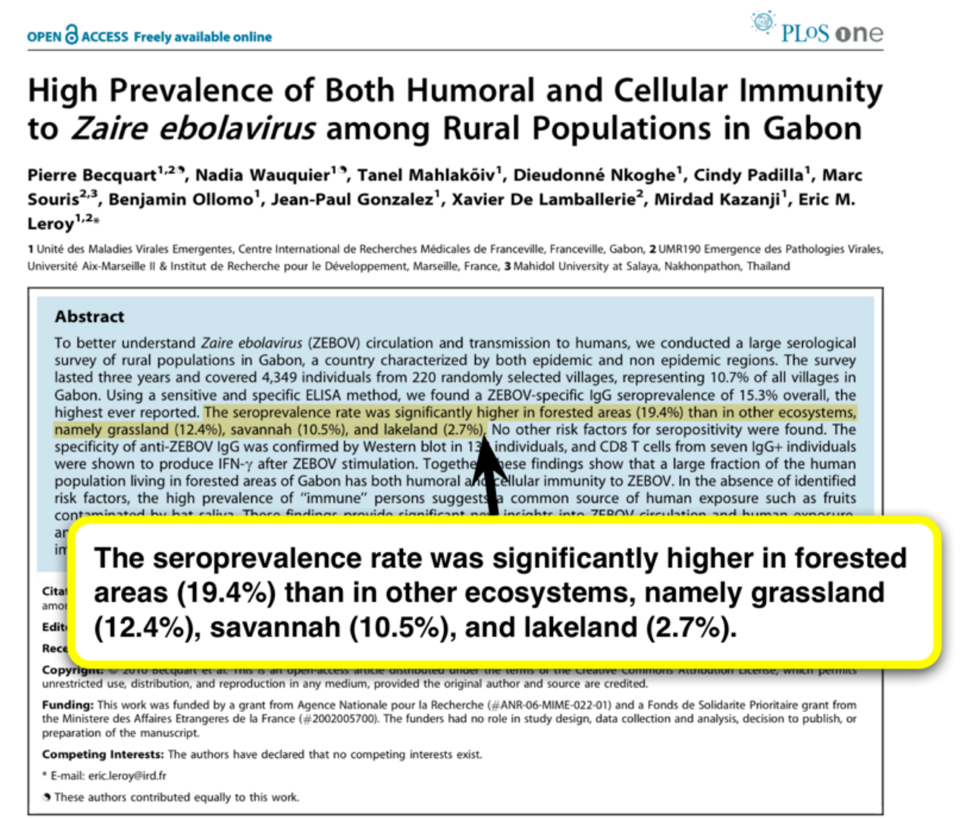
. Outbreaks likely to occur in remote areas mostly forested than other ecosystems.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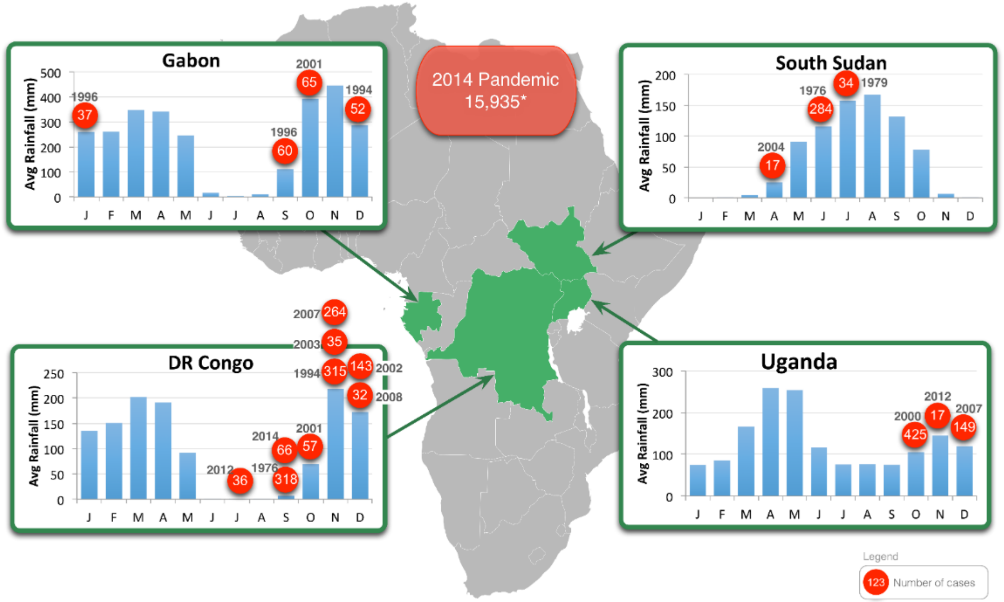
  - Outbreaks likely to occur in remote areas mostly forested than other ecosystems.

  **- Outbreaks mostly occur at the beginning of a wet season and possibly after a sever drought.**



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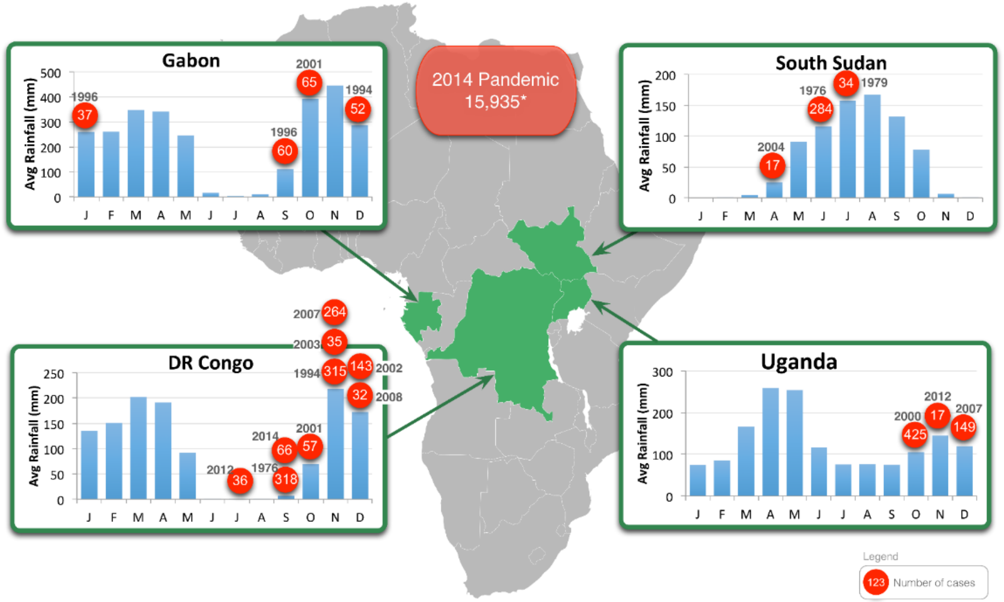

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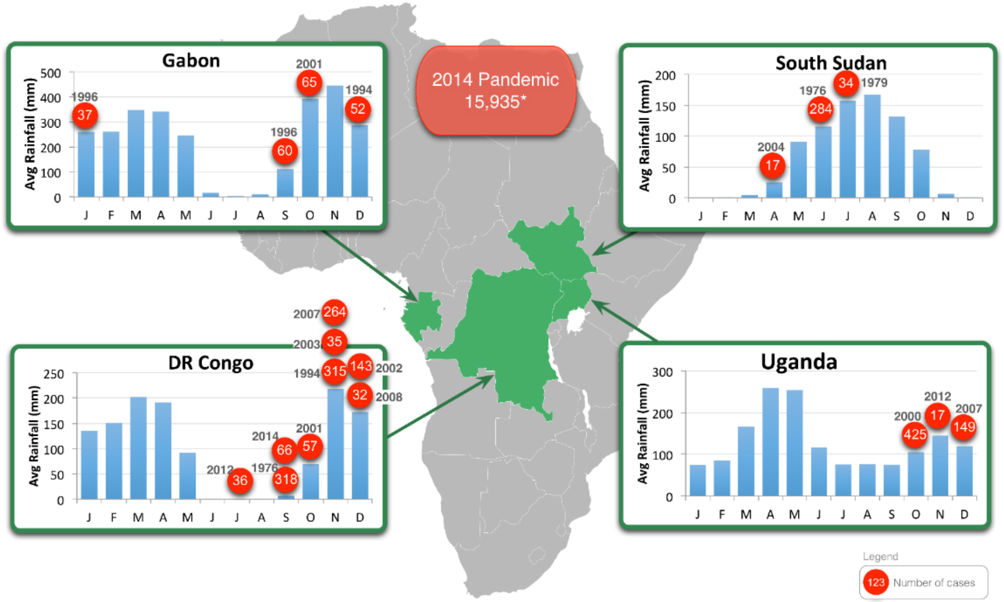
  **Animal outbreaks precede human outbreaks.**



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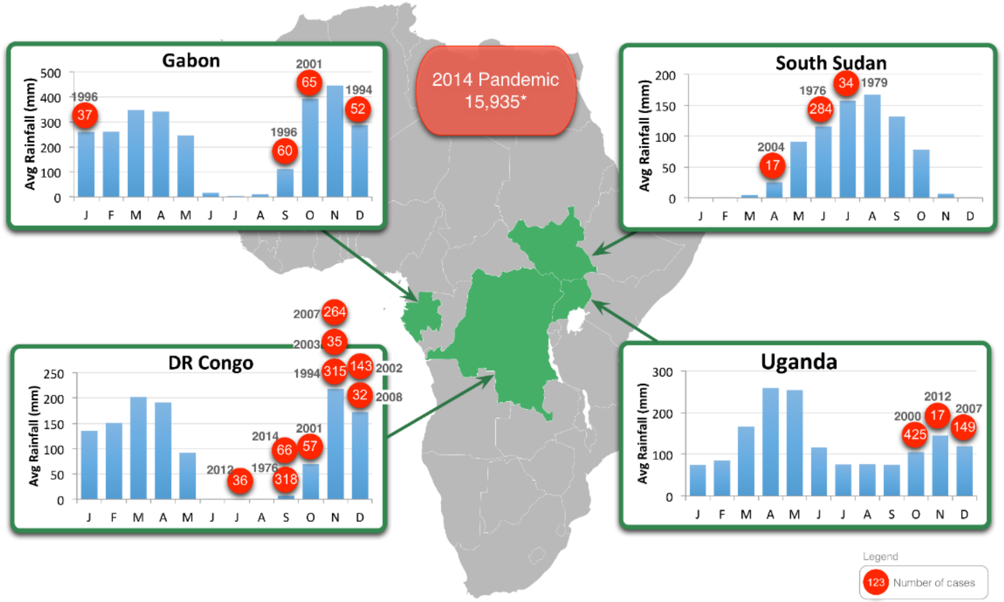


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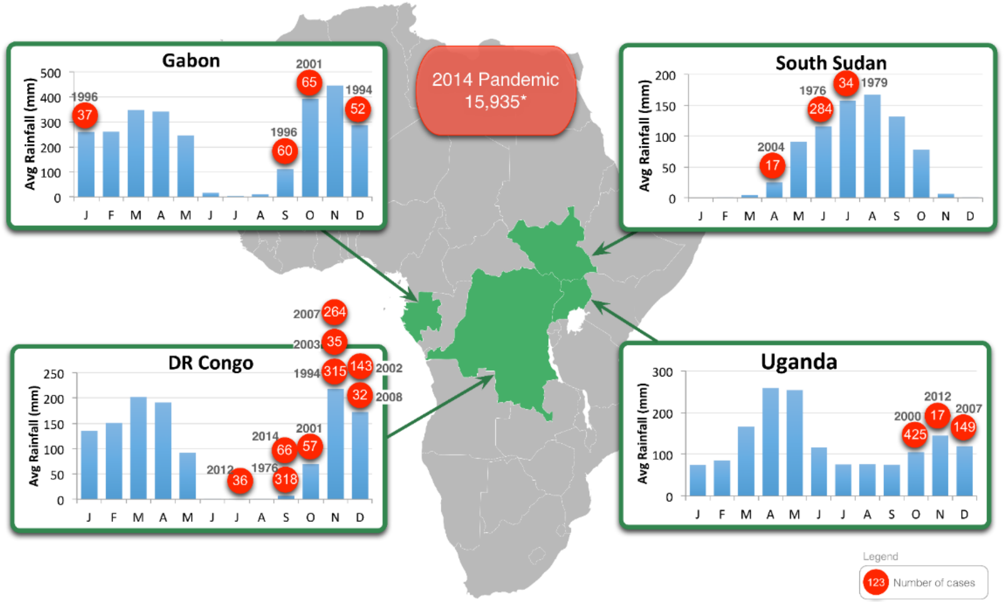


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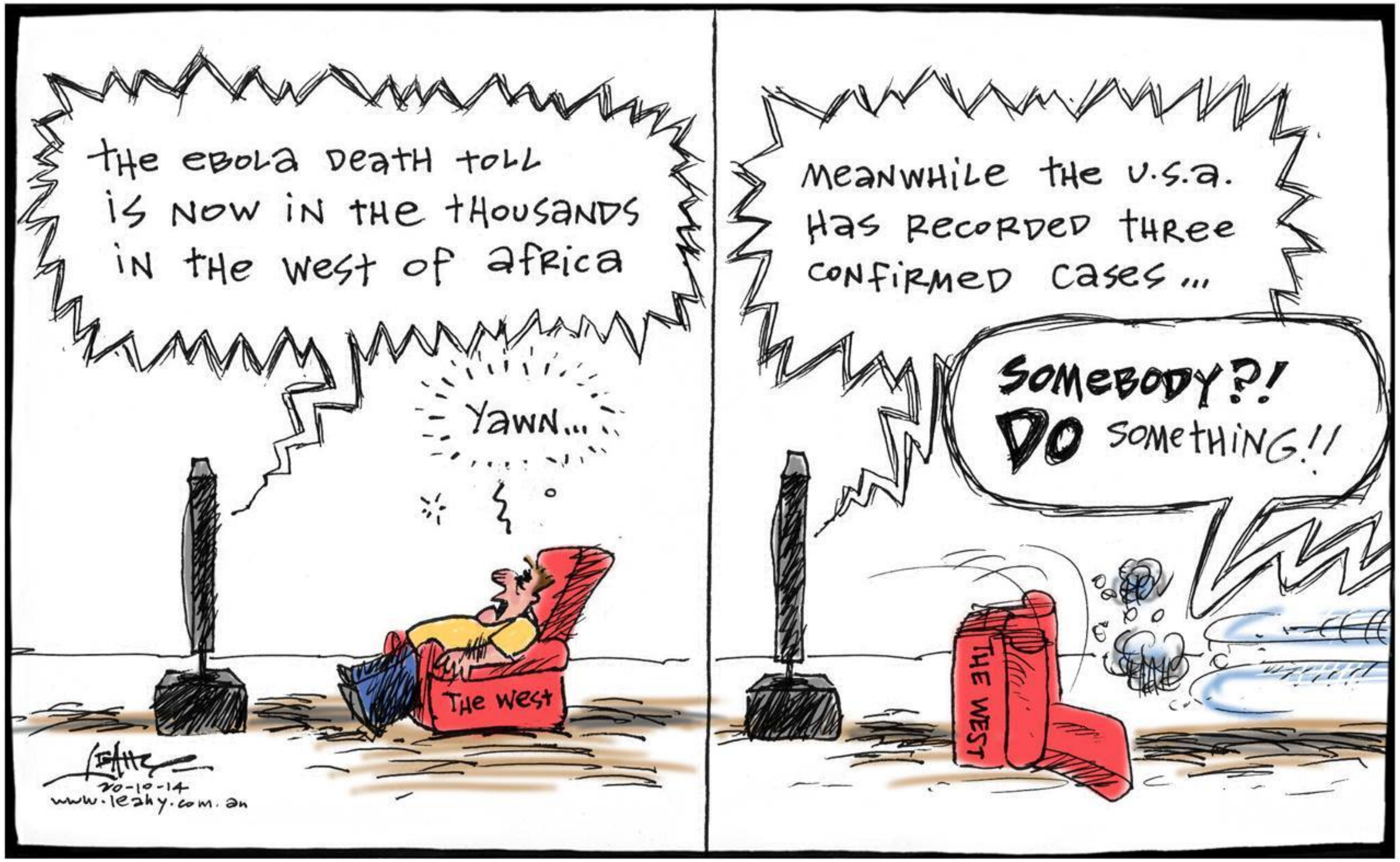
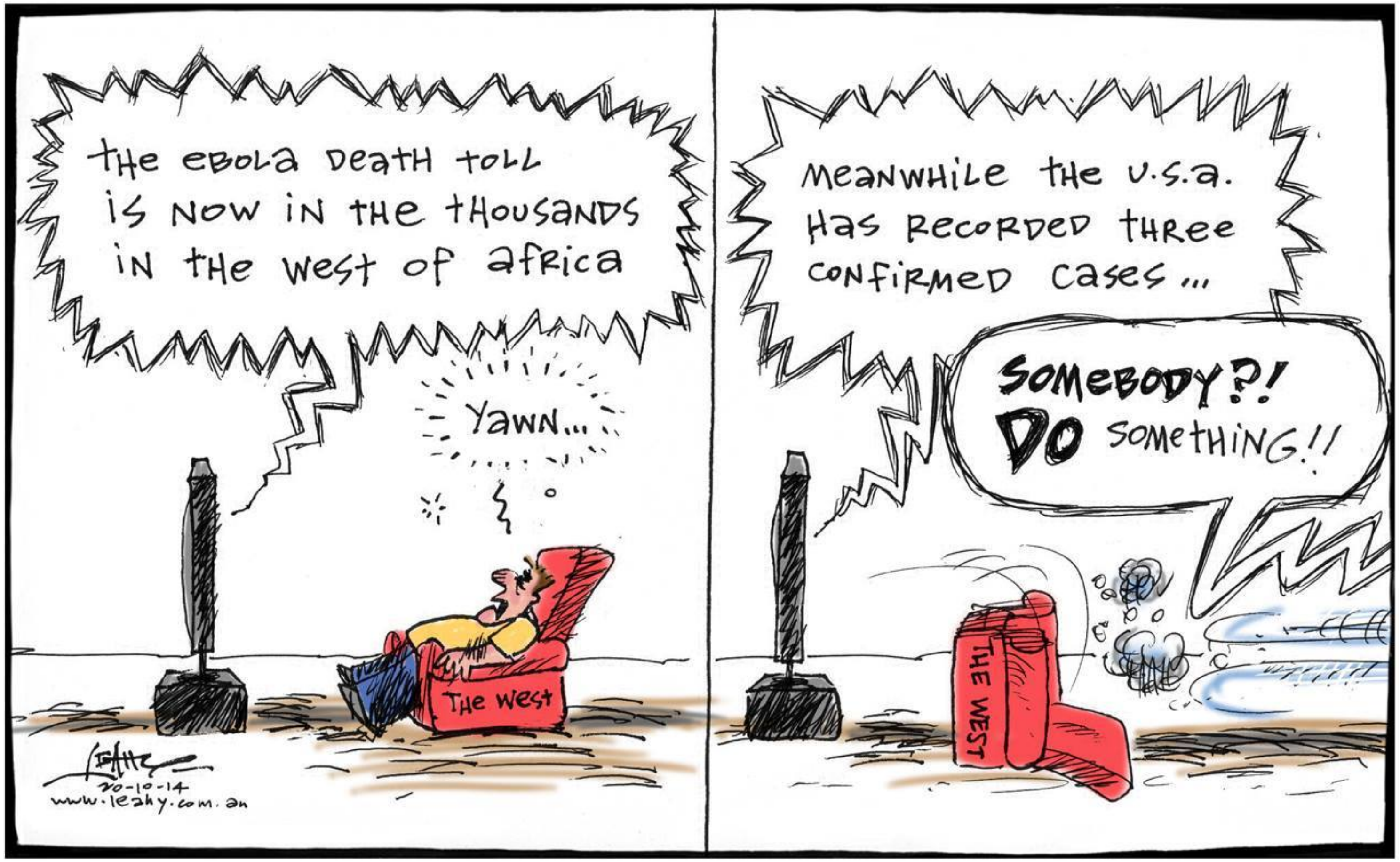
**The web-portal can provide a medium for disease surveillance, reporting, and risk factor monitoring through integration of services from a wide range of disciplines.**


THE EBOLA DEATH TOLL IS NOW IN THE THOUSANDS IN THE WEST OF AFRICA
YAWN...
THE WEST
LEAHY
20-10-14
www.leahy.com.au
MEANWHILE THE U.S.A. HAS RECORDED THREE CONFIRMED CASES...
SOMEBODY?! DO SOMETHING!!
THE WEST




***I hope through this research we can collectively DO SOMETHING and develop solutions to prevent such occurrences in the future - Thank You***