

9

INDEPTH Network: a viable platform for the assessment of malaria risk in developing countries

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Abstract

The INDEPTH Network is an international network currently consisting of 33 demographic surveillance system (DSS) field sites in 19 countries in Africa, Asia and Oceania that collectively monitor over 2,000,000 people at a household level. Each INDEPTH site has a geographically defined population under continuous demographic evaluation, with timely production of data on all births, deaths and migrations. This monitoring system provides a platform for a wide range of health-system innovations, as well as social, economic, behavioural and health interventions, all closely associated with research activities. INDEPTH launched the Malaria Transmission Intensity and Mortality Burden Across Africa (MTIMBA) initiative to generate reliable information that will guide malaria control policies in Africa, as well as to generate new understanding of the relationship between malaria transmission intensity, mortality and the effect of malaria control. The MTIMBA project produces estimates of all-cause and malaria-attributable mortality by age across Africa and documents trends in malaria in INDEPTH sites. INDEPTH now plans to link DSS data to geographical and meteorological data, using remote sensing (RS) and a Geographical Information System (GIS). This will enable much deeper and/or novel insights into parameters that influence the spread of diseases, especially malaria. The meteorological data will complement the DSS data with the introduction of the spatio-temporal fluctuations of temperature, humidity, precipitation, evapo-transpiration and wind. Hence, the different data sets can be used for geo-statistical modelling, mapping and geographical and epidemiological analyses. An INDEPTH environment and health platform has been established with the first initiative to study the relationship between climate variability and the transmission of infectious diseases, focussing on malaria. This paper presents a brief overview of the INDEPTH Network, its MTIMBA project and the proposed research work on climate variability and the spread of infectious diseases.

Keywords: demographic surveillance systems; climate variability; environmental change; malaria transmission

Introduction

INDEPTH is an international network currently consisting of 33 demographic surveillance system (DSS) field sites in 19 developing countries that collectively monitor over 2,000,000 people at a household level. (See Table 1 for list of current

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INDEPTH member sites and Figure 1 for a map showing the distribution of countries with INDEPTH sites.) The INDEPTH Network exists as an independent entity with a Secretariat in Accra, Ghana. The Network utilizes the resources from its development partners (funders/donors) to foster, fund and coordinate cross-site studies, multi-site research and other network-level activities.



Figure 1. Countries with INDEPTH DSS Sites by March 2005

INDEPTH's vision is that it will be an international platform of sentinel demographic sites that provides health and demographic data and research to enable developing countries to set health priorities and policies based on longitudinal evidence. INDEPTH's data and research will guide the cost-effective use of tools, interventions and systems to ensure and monitor progress towards national goals. Its mission is to harness the collective potential of these DSS sites to provide a better, empirical understanding of health and social issues and to apply this understanding to alleviate the most severe health and social changes. INDEPTH's objectives are: to initiate and facilitate cross-site health and social studies and impact assessments in resource-constrained populations; to disseminate study findings to maximize impact on policy and practice; to foster and support capacity building and cross-site collaborations among member sites; and to facilitate the process for donors to fund multi-site health and social research projects in the developing world and especially in Africa and Asia.

Briefly, the key activities of INDEPTH are to:

- cultivate cross-site activity through comparative studies and exchange of experiences on critical common problems;
- generate longitudinal data and analysis that can be used to impact ongoing health and social reforms, inform health and social policy and practice and contribute to governmental, NGO, private and community health efforts;
- broaden the scope of health research by addressing the emerging agenda of non-communicable diseases and aging, accidents, violence and injury, and the problems associated with vulnerable populations;
- continually improve the methods and technologies used by member sites to ensure that all participating groups have access to the most valid and appropriate methodologies available; and
- generate visibility and recognition for INDEPTH and member sites among critical constituencies, including academic, government and international agencies and donors.

Table 1. List of current Network membership

Status	Country	Name	Approximate start date	Age (years)	Population
Africa					
Full member	Burkina Faso	Centre National de Recherche et de Formation sur le Paludisme (OUBRITENGA).	15/02/93	10	150,000
Full member	Burkina Faso	Centre National de Recherche en Santé de NOUNA (NOUNA)	07/01/92	11	70,000
Full member	Burkina Faso	Host Institution: Observatoire de Population de Quagadougou (Quagadougou Urban Health and Equity Initiative, Burkina Faso)	01/02/2002	1	5,000
Full member	Ethiopia	Butajira Rural Health Project	07/01/87	16	40,000
Full member	Gambia	Farafenni Field Station.	07/01/81	22	17,000
Full member	Ghana	Navrongo Health Research Centre	07/01/93	10	140,000
Full member	Ghana	Kintampo Health Research Centre	10/2003	1	145,000
Full member	Guinea Bissau	Bandim Project.	07/01/78	25	101,000
Full member	Kenya	Kisumu Project	07/01/92	11	135,000
Full member	Kenya	African Population Health Research Centre (Nairobi)	09/2000	3	60,000
Full member	Moçambique	Manhica	07/01/96	7	68,000
Full member	Malawi	Karonga Prevention Study	01/10/2002	1	40,000
Full member	South Africa	Agincourt Health and Population Programme	07/01/92	11	70,000
Full member	South Africa	Dikgale Demographic and Health Study	07/01/95	8	8,000
Full member	South Africa	Africa Centre Demographic Information System	01/01/99	4	90,000
Full member	Senegal	Mlomp	01/01/85	18	7,500
Full member	Senegal	Bandafassi	15/01/70	33	11,000
	Senegal	Niakhar	1962	41	29,000
Full member	Tanzania	Ifakara Health Research and Development Centre	07/01/96	7	67,000
Full member	Tanzania	Tanzanian Essential Health Intervention Project (TEHIP) Rufiji Project.	07/15/98	5	90,000
Full member	Uganda	Rakai project.	07/01/89	14	12,000
Asia					
Full member	Bangladesh	Matlab	07/01/1966	37	212,000
Full member	Bangladesh	Health System and Infectious Disease Surveillance (HSID)	15/01/1982	21	127,000
Full member	Bangladesh	Watch Project			90,000
Full member	India	Ballabgarh DSS (All India Institute of Medical Sciences (AIIMS))	1972	31	41,000
Full member	India	Host Institution: Vadu Rural Health Project, KEM Hospital, Pune District, India (Vadu)	01/10/2002	1	64,000
Full member	Indonesia	Community Health Nutrition and Research Laboratories (Purworejo)	07/01/1994	9	18,000
Full member	Thailand	Institute for Population and Social Research, Mahidol University (Kanchanaburi)	2000	3	42,600
Full member	Vietnam	Chilinh Demographic Surveillance System, Hanoi School of Public Health (Chilillab)	1990	13	64,000
Full member	Vietnam	Epidemiological Field Laboratory for Health System Research (Filabavi).	10/15/1998	5	52,000
Full member	Papua new Guinea	Wosera DSS, PNG Institute of Medical Research	2003	1	140,000
Central America					
Full member	Nicaragua	Center for Demographic and Health Research (CIDS), Leon University	2003	1	55,000

The INDEPTH Secretariat supports its member sites in a number of ways. First, it facilitates knowledge sharing among sites. By disseminating data, convening analysis workshops, coordinating multi-site research collaborations, funding cross-site scientific visits and promoting on-site training courses and internships, INDEPTH builds capacity and standardizes research methods across the network. Second, it provides practical tools for sites. These include assistance with website development and dissemination of models for survey design, data processing and analysis, and quality control. Third, it raises the profile of DSS sites among the international policy community by synthesizing and presenting results to governments, international agencies, donors and academics.

A full member of the Network is any demographic surveillance system (DSS)-based site with existing or committed funding, and the DSS site fulfils the following characteristics:

- A geographically defined population is under continuous demographic monitoring, with timely production of data on all births, deaths and migrations – sometimes called a demographic surveillance system (DSS); and
- This monitoring system provides a platform for a wide range of health-system innovations, as well as social, economic, behavioural and health interventions, all closely associated with research activities.

INDEPTH/Malaria transmission intensity and mortality burden across Africa

For many of the INDEPTH member sites, malaria has long been an area of focus. These sites possess significant experience in malaria research and interventions and are collecting a tremendous amount of population-based data in support of various anti-malaria initiatives. The existing foundation of malaria data and expertise combined with the high-level external interest in funding anti-malaria initiatives of proven effectiveness create strong ongoing potential for multi-country malaria studies conducted by INDEPTH.

INDEPTH launched the Malaria Transmission Intensity and Mortality Burden Across Africa (MTIMBA) initiative in 2002 to generate reliable information that will guide malaria control policies in Africa. The objectives of the continental platform are to: 1) generate new understanding of the relationship between malaria transmission intensity, mortality and the effect of malaria control; 2) collaborate with the Roll Back Malaria Initiative at the regional, national and global levels for monitoring and evaluation; and 3) further develop and strengthen Africa's expertise in the field of malaria control, planning and evaluation.

The MTIMBA project has been able to produce estimates of all-cause and malaria-attributable mortality by age across Africa, documented trends in malaria in INDEPTH sites, and is establishing malaria expertise and strengthened methodology in a continental demographic surveillance platform. The work of MTIMBA and that of INDEPTH's broad-based work on causes of death are leading to a publication in the INDEPTH monograph series – Population and Health in Developing Countries (see www.indepth-network.org). INDEPTH support to the MTIMBA project involves extending the causes of death beyond malaria and including sites where malaria is not a public-health problem.

Current achievements of the project include the following: Estimates of cause-specific mortality in Africa are being generated using harmonized Verbal Autopsy

tools; overall, 1,600 mosquito collection nights per month are carried out throughout Africa and will generate for the first time reliable comparisons of malaria transmission intensity across the continent; data on malaria control activities are currently being systematically collected using RBM tools; and an African network of scientists with expertise in the use of harmonized methods in malaria research is emerging.

The Network will extend the use of the existing platform to address other research / policy issues. These include intervention trials against malaria; impact of antimalarial drug resistance / drug policy change on mortality; the mutual impact of Malaria and HIV/AIDS; and the impact of malaria at the household level. Table 2 shows the sites currently participating in the MTIMBA work and the populations under evaluation.

Table 2. Current INDEPTH sites participating in MTIMBA work

SITE	COUNTRY	POPULATION
Manhiça	Mozambique	36,000
Ifakara	Tanzania	55,000
Rufiji	Tanzania	85,000
Navrongo	Ghana	139,000
Obitenga	Burkina Faso	170,000
Nouna	Burkina Faso	55,000
Bandafassi	Senegal	9,000
Bandim	Guinea-Bissau	101,000
Farafeni	The Gambia	16,400
Butajira	Ethiopia	36,000
Kisumu	Kenya	130,000

Extending site capabilities to monitor environmental change

The INDEPTH Network has seen a great potential for its member sites to couple environmental and population surveillance and extend their capabilities to monitor environmental change. To understand the nexus between global environmental change (GEC) and health, surveillance systems that focus on social and spatio-temporal patterns of health effects are needed. Health effects of GEC must be detected early enough so that countermeasures can be developed and tested. DSS data can be linked to geographic and meteorological data, using remote sensing (RS) and a Geographical Information System (GIS). This will enable much deeper and/or novel insights into parameters that influence the spread of diseases. The meteorological data complement the DSS data with the introduction of the spatio-temporal fluctuations of temperature, humidity, precipitation, evapo-transpiration and wind. Hence, the different data sets can be used for geo-statistical modelling, mapping and geographical and epidemiological analyses. There is also the important issue of how local communities adapt to global changes.

The Network has established a platform for environment and health research and its first initiative involves a multi-site study on climate variability and the spread of

malaria at INDEPTH sites where malaria transmission occurs. Data on geographic differences in mortality or incidence of malaria as they can be provided by DSS tend to be related to other variables which show a similar distribution pattern, for example climate data. But due to the multifactorial nature of the causation of most human health disorders there is little published evidence that changes in population health status actually have occurred as yet in response to observed trends in climate over recent decades. As a result of this situation, the occurrence of malaria and its changes are currently investigated in context with the impacts of climate change and variability on ecological and social systems. This investigation requires population-based data of malaria cases and climate data at the regional or local level which can be provided by the INDEPTH Network sites in Africa and Asia that will participate in this research.

The main research focus will be the extent to which climate variability can be a predictor for malaria transmission at INDEPTH sites. The research will aim to generate an early-warning system based on climate variability for prediction of malaria in INDEPTH sites in Africa and Asia in order to facilitate well-targeted and cost-effective preventive response measures to decision-makers.

Specifically, the research objectives of the proposed study are to:

1. Examine associations between climate variability and changes in malaria transmission in the study areas.

We will utilize land-based measurements of temperature, rainfall and humidity over a three-year period from digital weather stations to be established at the study sites. In addition, historical data collected over the last 30 years from national meteorological systems and remote-sensing data will be used.

2. Monitor malaria incidence in children under five in the study areas over a three-year period.

Malaria incidence will be assessed through active case detection.

3. Monitor the effects of land use and land cover on mosquito population dynamics and assess the entomological inoculation rate (EIR) in the study areas over a three-year period.

Mosquito characteristics (e.g. species, age, sex, breeding sites, feeding and resting behaviours and infectivity) will be measured using standard entomological survey methods. Remote sensing will be used to identify land use.

4. Develop and validate models for predicting malaria transmission using the generated data and establish an early-warning system. Both site-specific and generalized models using data from all the sites will be developed.

Conclusion

INDEPTH is committed to harnessing the potential of the world's demographic surveillance initiatives through its trans-continental network of sites. This network generates significant value for both the member sites and external stakeholders who both stand to benefit from the knowledge and resources of the network. By coordinating the activities of individual demographic surveillance initiatives and facilitating ongoing collaboration within the network, INDEPTH can generate new knowledge and insights for critical health and social challenges. It can greatly enhance the efficiency and effectiveness of multi-site research initiatives. The combined influence and credibility of INDEPTH and member sites enable the network to have significant influence on key decision- and policy-makers. INDEPTH will use this

influence to ensure knowledge is disseminated and is translated into improved policy and practice.

INDEPTH studies have the unique advantage of incorporating longitudinal data from multiple sites that are located across different countries, regions and continents. INDEPTH has the unique ability to undertake studies across a broad geography while maintaining the rich longitudinal data that exist at an individual-site level. This capability enables new insights to be drawn from studies that have traditionally been limited to a targeted geographic region. It also enables a new category of multi-site studies to be designed and executed that can generate new knowledge and insights that have previously been unavailable or infeasible. INDEPTH improves the efficiency of the studies by coordinating site activities through the relationships and infrastructure that exist within the network. By creating an integrated network of sites, INDEPTH offers project sponsors with a single, integrated solution for studies that require the identification, selection and coordination of multiple sites.

By utilizing its broad membership base, geographic reach and credibility with the scientific community and governmental bodies, INDEPTH can effectively translate research findings into improved policy and practice.