Public Health Action

International Union Against Tuberculosis and Lung Disease
Health solutions for the poor

VOL 8 SUPPLEMENT 1 PUBLISHED 25 APRIL 2018

SORT IT: MALARIA ELIMINATION SUPPLEMENT

Three parallel information systems for malaria elimination in Swaziland, 2010–2015: are the numbers the same?

Z. Zulu,[1] S. Kunene,[1] N. Mkhonta,[1] P. Owiti,[2] W. Sikhondze,[3] M. Mhlanga,[4] Z. Simelane,[5] E. Geoffroy,[6] R. Zachariah[7]

http://dx.doi.org/10.5588/pha.17.0058

Background: To be able to eliminate malaria, accurate, timely reporting and tracking of all confirmed malaria cases is crucial. Swaziland, a country in the process of eliminating malaria, has three parallel health information systems.

Design: This was a cross-sectional study using country-wide programme data from 2010 to 2015.

Methods: The Malaria Surveillance Database System (MSDS) is a comprehensive malaria database, the Immediate Disease Notification System (IDNS) is meant to provide early warning and trigger case investigations to prevent onward malaria transmission and potential epidemics, and the Health Management Information Systems (HMIS) reports on all morbidity at health facility level. Discrepancies were stratified by health facility level and type.

Results: Consistent over-reporting of 9–85% was noticed in the HMIS, principally at the primary health care level (clinic and/or health centre). In the IDNS, the discrepancy went from under-reporting (12%) to over-reporting (32%); this was also seen at the primary care level. At the hospital level, there was under-reporting in both the HMIS and IDNS.

Conclusions: There are considerable discrepancies in the numbers of confirmed malaria cases in the HMIS and IDNS in Swaziland. This may misrepresent the malaria burden and delay case investigation, predisposing the population to potential epidemics. There is an urgent need to improve data integrity in order to guide and evaluate efforts toward elimination.

Malaria is a global public health problem; in 2014, 214 million malaria cases were reported globally from 97 countries, with 438000 deaths, mostly among children aged <5 years in sub-Saharan Africa.[1]

With the encouraging progress made in malaria control over the last decade, in 2007 the Southern African Development Community (SADC) and the European Union (EU) identified four countries in the southern African region—Swaziland, Namibia, South Africa and Botswana, known as the Elimination 4 (E4)—as moving towards malaria elimination. The move to eliminate malaria in these four countries was widely accepted and country-specific malaria elimination strategic plans were developed in alignment with the SADC strategic framework.[2]

The term 'malaria elimination' is defined as the interruption of local transmission (a decrease to zero incidence of indigenous cases) of a specified malaria parasite in a defined geographic area as a result of deliberate efforts. Continued measures are required to prevent re-establishment of transmission.[3]

Imported cases will continue to occur, and consistent reporting systems are required to act upon and prevent onward transmission. As countries progress towards elimination, finer scale mapping is required and stratification needs to be more specific to facilitate sufficiently precise targeting of interventions, ideally at the locality or the health facility catchment area level.[3] The World Health Organization (WHO) Malaria Elimination Framework 2017[3] emphasises a different malaria elimination continuum that ranges from very high to very low malaria transmission, which differs from the previous phases of control, pre-elimination, elimination and prevention of re-introduction.

A robust surveillance, monitoring and reporting system for confirmed malaria cases is essential for assessing and guiding malaria elimination activities on the ground.[4] There are currently three parallel surveillance systems that capture data on confirmed malaria cases in Swaziland: the Health Management Information System (HMIS), the Immediate Disease Notification System (IDNS) and the Malaria Surveillance Database System (MSDS).

The HMIS compiles monthly data from health facilities and is used for national reporting of all diseases, including malaria. The IDNS serves as an early warning system that captures data on all diseases with epidemic potential and of public health concern, including malaria. The MSDS, on the other hand, is considered the benchmark system for malaria, as it contains comprehensive information on activities related to all four major intervention areas for elimination and captures all confirmed malaria cases, regardless of whether they are reported to the HMIS or the IDNS. The MSDS thus serves as the denominator for all reported malaria cases. It is expected that malaria data contained in all the surveillance systems are similar. This would enhance the appropriate allocation of national and regional resources and timely targeted action.

Discrepancies in the IDNS in relation to the MSDS may delay active case investigation, predispose the population to malaria epidemics and threaten malaria elimination efforts. Discrepancies between HMIS and

AFFILIATIONS
1 National Malaria Control Programme, Ministry of Health, Manzini, Swaziland
2 Academic Model Providing Access to Healthcare (AMPATH), Eldoret, Kenya
3 Ministry of Health, Mbabane, Swaziland
4 Epidemic, Preparedness and Response Unit, Ministry of Health, Ezulwini, Swaziland
5 Strategic Information Department, Ministry of Health, Mbabane, Swaziland
6 Global AIDS Interfaith Alliance, San Rafael, California, USA
7 Operational Centre Brussels, Médecins Sans Frontières, Luxembourg City, Luxembourg

CORRESPONDENCE
Zulisile Zulu
National Malaria Control Programme
Ministry of Health
P O Box 53
Manzini
Swaziland
e-mail: zulisilez@yahoo.com

KEY WORDS
malaria reporting; Health Management Information Systems; malaria surveillance; SORT IT; malaria elimination

Received 11 August 2017
Accepted 10 November 2017

PHA 2018; 8(S1): S13–S17

MSDS data may misrepresent the malaria burden and influence government and donor funding. The country has encountered problems, for example, in reporting to the Global Fund about tuberculosis (TB), human immunodeficiency virus/acquired immune-deficiency syndrome (HIV/AIDS) and malaria, as these systems yielded different figures, raising doubts about data credibility. Ideally, all health facilities should be using both systems—the HMIS and IDNS, and the data therein should match the MSDS.

The 2011 Swaziland Malaria Programme Performance Review (MPR), conducted by the WHO, emphasised the importance of a comprehensive surveillance system, but failed to assess how well the three health reporting systems function together and if the data contained in them matched.[5] A PubMed search revealed no studies from the E4 or beyond comparing the success and effectiveness of parallel surveillance systems at health facility level for malaria elimination.

We aimed to assess if there was any discrepancy between the numbers of confirmed malaria cases reported in the HMIS and IDNS in relation to the MSDS (used as the bench mark). In all health facilities in Swaziland and over a 5-year period (from August 2010 to July 2015), we thus report on 1) the total number of confirmed malaria cases in the MSDS, and 2) of these, the number reported in the HMIS and IDNS, and whether any noted discrepancies were related to health facility level and type.

METHODS

Study design

This was a descriptive cross-sectional study using routine country-wide programme data.

Study setting

General setting

The Kingdom of Swaziland is a landlocked country in southern Africa of approximately 17 000 km^2, and is bordered by South Africa, an E4 country, and Mozambique, a malaria-endemic country. Swaziland is divided into 55 *Tinkhundla* (traditional administrative areas) and four districts. It is estimated that approximately 85% of the population lives within an 8 km radius of a health facility. The health service delivery system in the country, from bottom to top, includes clinics, health centres and hospitals. There are an estimated 1911 nurses working in Swaziland, resulting in a nurse:population ratio of 2:10 000, far below the WHO recommendation for resource-limited settings.[6] Nurses are the primary providers of health care at all facility levels. They are generally responsible for managing high patient loads and for reporting in the surveillance system.

Malaria programme for elimination

Swaziland is a country with low malaria transmission and has a good potential for malaria elimination.[4] The elimination strategy follows national guidelines and includes four major components: 1) effective malaria case management; 2) integrated vector management; 3) comprehensive information, education and communication; and 4) a strong epidemiological and entomological surveillance and monitoring system. Only parasitologically confirmed cases should be given artemisinin-based treatment.[7] The highly mobile population movement to neighbouring countries will always pose a threat to malaria elimination due to the country's porous borders. As malaria elimination is achieved in Swaziland, effective surveillance systems will be critical to prevent re-introduction. Excellent surveillance and response are key to achieving and maintaining malaria elimination.[3]

Surveillance systems for malaria in Swaziland

Malaria Surveillance Database System

The MSDS is housed within the National Malaria Control Programme (NMCP). The system captures all confirmed malaria cases reported to the HMIS and IDNS. Cases not reported to the IDNS and/or HMIS are frequently picked up by the NMCP surveillance team on checking registers during routine visits to health facilities and laboratories. Confirmation of cases requires the obligatory use of malaria rapid diagnostic tests (RDTs) and/or microscopy. When an RDT is positive at health facility level, a blood sample is taken and the slide is stored for secondary confirmation by the NMCP. The NMCP surveillance teams collect the slides during their supervisory visits, and secondary confirmation is performed at a reference laboratory. Any RDT-positive result that is not positive on secondary confirmation is not entered in the MSDS database as a confirmed case. Ideally, secondary confirmation should be performed immediately; where this is not possible, case investigation continues nevertheless.

For this study, the MSDS served as a benchmark system, as it is the most comprehensive data collection system for malaria control in Swaziland. It is also a requirement of the WHO that as a country moves towards elimination, a malaria case-based surveillance system be maintained. Malaria cases entered in the MSDS include only those who were both RDT- and microscopy-positive (on secondary confirmation) or were microscopy-positive on the initial diagnosis at facility level.

Health Management Information System

When a malaria case is confirmed at health facility level, the health care worker (a nurse) records the patient's demographic data in the out-patient register. At the end of the month, summaries, with the number of cases by condition disaggregated by age and sex, are compiled and sent to the regional officer to be entered into the electronic system. The Ministry of Health (MoH) relies on the HMIS to report national data on all conditions as well as to donors and partners, such as the WHO.

Immediate Disease Notification System

All health facilities country-wide are required to immediately report confirmed malaria cases in the IDNS through a toll-free telephone number (977). This serves as an 'alert' for new malaria cases, which then triggers rapid case investigation and response to prevent further transmission. Reporting through this sys-

ACKNOWLEDGEMENTS

This research was conducted through the Structured Operational Research and Training Initiative (SORT IT), a global partnership led by the Special Programme for Research and Training in Tropical Diseases at the World Health Organization (WHO/TDR, Geneva, Switzerland). SORT IT programmes include a teaching component developed jointly by the International Union Against Tuberculosis and Lung Disease (The Union, Paris, France) and Médecins Sans Frontières (MSF, Geneva, Switzerland). The specific SORT IT programme that resulted in this publication was implemented by WHO/TDR, the WHO Global Malaria Programme (GMP), WHO/AFRO, the Operational Research Unit (LuxOR), MSF (Brussels Operational Centre, Luxembourg), the Centre for Operational Research, The Union, University of Nairobi (Nairobi, Kenya), Global AIDS Interfaith Alliance (San Rafael, CA, USA), Academic Model Providing Access to Healthcare (AMPATH, Eldoret, Kenya) and John Hopkins University (Baltimore, MD, USA).

The programme was funded by WHO/TDR, WHO GMP and WHO/AFRO. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflicts of interest: none declared.

tem is mandatory, and allows surveillance agents to trace and investigate malaria cases promptly.

All reported confirmed cases are investigated, and if a case occurs in the malaria transmission area, active case detection is conducted. During active case detection, all persons residing within a 500 metre radius are tested using RDT. All positive RDT results are taken by the NMCP surveillance officers to the nearest health facility, where they are captured in the morbidity register and reported via the two systems (HMIS and IDNS). As the NMCP does not treat these cases at community level, the patients need to be referred to the nearest health facility to be treated and reported.

Study sites

The study sites included all health facilities in Swaziland that diagnose and/or treat malaria cases.

Study population

The study population consisted of all confirmed malaria cases in Swaziland during the period from August to July of each year, starting in 2010 and ending in 2015, i.e., August 2010–July 2015.

Data variables, data sources and analysis

Data variables related to the study objectives were sourced from the MSDS, HMIS and IDNS databases. The MSDS was used as the gold standard to assess discrepancies in the HMIS and the IDNS. Health facility levels included, in rising hierarchy: clinic, health centre and hospital. Health facility types included private and public health facilities.

Data were imported from Excel (Micrsoft Corp, Redmond, WA, USA) to EpiData software (v. 3.1 for entry and v. 2.2.2.182 for analysis, EpiData Association, Odense, Denmark).

Ethics

Ethical approval was received from the Ministry of Health Scientific and Ethics Committee (Mbabane, Swaziland) and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease (Paris, France). As this study used routine anonymised data, the issue of informed consent did not apply.

RESULTS

Discrepancies in the numbers of confirmed malaria cases in the HMIS and IDNS in comparison to the MSDS

Table 1 shows the numbers of confirmed malaria cases in the MSDS (used as the benchmark) compared to the numbers reported in the HMIS and IDNS databases over 5 years. Over-reporting of 9–85% was observed in the HMIS. In the IDNS, the discrepancy in numbers ranged from 12% under-reporting of cases to 32% over-reporting of cases.

TABLE 1 Confirmed malaria cases in the MSDS (gold standard) compared to numbers reported in the HMIS and the IDNS, Swaziland, 2010–2015*

	Confirmed malaria cases		
Period	MSDS *n*	HMIS *n* (%)	IDNS *n* (%)
August 2010–July 2011	525	974 (185)	412 (78)
August 2011–July 2012	366	598 (163)	332 (90)
August 2012–July 2013	404	701 (173)	405 (100)
August 2013–July 2014	660	723 (109)	597 (90)
August 2014–July 2015	613	712 (116)	810 (132)
Total	2568	3708	2556

*As the IDNS was rolled out in August 2010, the years for comparison were from August to July of the following year.
MSDS = Malaria Surveillance Database System; HMIS = Health Management Information System; IDNS = Immediate Disease Notification System.

Confirmed malaria cases and discrepancies in reporting, stratified by health facility level and facility type

Of the 8832 entries in the three information systems (MSDS, HMIS and IDNS), health facility level was not recorded in 193 (2.2%) and health facility type in 104 (1.2%) entries. Of the remaining 8535 entries with complete data, over-reporting occurred at the primary care level (clinic and/or health centre) in both the HMIS and IDNS (Table 2). Under-reporting at hospital level was seen in both the HMIS and IDNS.

DISCUSSION

This is the first study from southern Africa to assess three parallel health information systems at country level for malaria elimination. It reveals major discrepancies in the numbers of confirmed malaria cases reported between the three systems. Discrepancies involved consistent over-reporting in the HMIS and both under- and over-reporting in the IDNS.

These shortcomings have major public health implications for malaria elimination. Under-reporting of confirmed malaria cases in the IDNS, the early warning and rapid response system, could result in delayed case investigation and predispose the population to malaria epidemics. This could threaten progress already made towards malaria elimination. The chief concern as regards the over-reporting seen in the HMIS is that the true malaria burden may be overstated and therefore portray the country as doing worse than it actually is in terms of progress made in achieving malaria elimination.

The study strengths are that we included all health facilities in the country; the data came from routine programme settings and are likely to reflect the ground reality; the data covered a long time-span, of 5 years; and the study adhered to the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) guidelines on the reporting of observational studies.[8] Further-

TABLE 2 Confirmed malaria cases reported in the MSDS, the HMIS and the IDNS, stratified by health facility level and facility type, Swaziland, 2010–2015*

	Confirmed malaria cases		
	MSDS *n*	HMIS *n* (%)	IDNS *n* (%)
Health facility level			
Total	2505	3664 (146)	2470 (99)
Clinic	1408	2582 (183)	1651 (117)
Health centre	248	480 (193)	240 (96)
Hospital	849	602 (70)	576 (67)
Health facility type			
Total	2536	3664 (144)	2528 (99)
Private	1353	2036 (150)	1275 (94)
Public	1183	1628 (137)	1253 (105)

*As the IDNS was rolled out in August 2010, the years for comparison were from August to July of the following year: year 1 = August 2010–July 2011; year 2 = August 2011–July 2012; year 3 = August 2012–July 2013; year 4 = August 2013–July 2014; year 5 = August 2014–July 2015.
MSDS = Malaria Surveillance Database System; HMIS = Health Management Information System; IDNS = Immediate Disease Notification System.

more, the data in the MSDS were used as the benchmark, and, as this database is carefully supervised by dedicated and trained staff, we believe the data used for comparisons are reliable. Finally, this study responds to an identified national and regional operational research priority.

The study limitations are that we had missing data on facility levels and type (albeit minimal, at <3%) and that we did not explore the exact reasons for observed discrepancies between the three information systems. This area merits future qualitative research studies.

These limitations notwithstanding, the findings have a number of policy and practice implications. First, there was considerable over-reporting of confirmed malaria cases in the HMIS. Possible reasons may include 1) cases confirmed using RDT entered into the HMIS at health facility level and which were later found to be false-positive were not entered by the NMCP into the MSDS and were not removed from the HMIS; 2) the inclusion of clinically diagnosed malaria cases (i.e., without RDT and/or microscopic confirmation) in contradiction to national guidelines; and 3) RDT stock-outs, resulting in clinicians prescribing malaria treatment for cases with suspected malaria. Significantly, the HMIS data on confirmed malaria cases are not based on unique patient identification codes, and rely instead on aggregate data. This would unavoidably result in duplicate reporting of malaria cases by health facilities if a patient self-refers (or is formally referred) from one facility to another. The logical way forward to address this problem is to introduce unique identifiers that match those in the MSDS and IDNS. This will also allow data cleaning to be performed and thereby improve data integrity in all three systems. From an operational perspective, it is an urgent operational priority to verify whether there have been stock-outs of RDT supplies and whether clinicians have been adhering to national guidelines. In the meantime, the need for refresher training, closer supervision and mentoring on national malaria guidelines and how the use of each of the three reporting systems within the health facilities should be assessed.

Second, the most likely reason for under-reporting in the IDNS is under-utilisation of the toll-free telephone number (977) by health facility staff. This may be due to telecommunications network problems, overburdened health staff who simply forget to call the number, particularly in busy health facilities, or health staff laxity. The entry of all confirmed malaria cases into the IDNS is of paramount importance for triggering a case investigation to prevent further transmission. Over-reporting in the IDNS is also of concern, as it would imply unnecessary and wasteful case investigations being done. This may be related to false-positive cases in which RDT results are in contradiction with microscopy results.

Third, the launching of malaria elimination efforts brought with it two additional information systems to the HMIS, i.e., the MSDS and IDNS. In any setting, the use of multiple parallel information systems and different data entry platforms is bound to compromise data quality. Put simply, entering more data into more systems will result in more errors.

In other African programme settings, data quality studies have shown discrepancies of 12–24% between paper-based and electronic data systems.[9,10] The discrepancy observed in our setting is considerably higher, reaching 85% in the HMIS and 32% in the IDNS. Ideally, a maximum 5% difference between the systems would seem acceptable. A way forward to improving data accuracy in the HMIS (which should be the backbone of the overall health information system) is to introduce electronic medical data systems at all health facility levels. This should be based on unique patient identifiers, as has been shown in Malawi.[11,12] The need to introduce dedicated data entry clerks to ensure data quality and focal responsibility in overburdened health facilities would also need assessment.

Finally, embracing electronic medical data systems as an integral component of the health system would open a window of opportunity to integrate the IDNS into the HMIS. This transition seems a logical and necessary step towards rationalising the number of existing information systems in the country.

In conclusion, at country-wide level in Swaziland, there were major discrepancies in the early warning and health information systems for malaria elimination. Addressing this operational challenge is vital to 'shrink the malaria map' and to maintain the progress made so far towards malaria elimination.

References

1 World Health Organization. World malaria report, 2014. Geneva, Switzerland: WHO, 2014.
2 Southern Africa Development Community. SADC Malaria Elimination Framework, 2007–2015. Windhoek Namibia: SADC, 2007.
3 World Health Organization. A WHO framework for malaria elimination, 2017. Geneva, Switzerland: WHO, 2017.
4 Swaziland National Malaria Control Programme. Swaziland National Malaria Control Programme strategic plan, 2008–2015. Mbabane, Swaziland: Swaziland Ministry of Health, 2011.
5 Ministry of Health. Malaria programme performance review. Aide memoire. Mbabane, Swaziland: Swaziland Ministry of Health, 2011.
6 African Health Observatory. World Health Organization. Better information, better action for health. Brazzaville, Congo: WHO Regional Office for Africa, 2015.
7 Swaziland National Malaria Control Programme. National malaria diagnosis and treatment guidelines v. 2.1. Mbabane, Swaziland: Swaziland Ministry of Health.
8 von Elm E, Altman D G, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet 2007; 370:1453–1457.
9 Makombe S D, Hochgesang M, Jahn A, et al. Assessing the quality of data aggregated by antiretroviral treatment clinics in Malawi. Bull World Health Organ 2008; 86: 310–314.
10 Gadabu O J, Munthali C V, Zachariah R, et al. Is transcription of data on antiretroviral treatment from electronic to paper-based registers reliable in Malawi. Public Health Action 2011; 1: 10–12.
11 Douglas G P, Gadabu O J, Joukes S, et al. Using touchscreen electronic medical record systems to support and monitor national scale-up of antiretroviral therapy in Malawi. PLoS Med 2010; 10: e1000319.
12 Waters E, Rafter J, Douglas G P, Bwanali M, Jazayeri D, Fraser H S. Experience implementing a point-of-care electronic medical record system for primary care in Malawi. Stud Health Technol Inform 2010; 160: 96–100.

Contexte : Si l'on veut éliminer le paludisme, il est crucial que tous les cas confirmés de paludisme bénéficient d'une déclaration exacte et prompte et soient suivis. Le Swaziland, un pays en cours d'élimination, a trois systèmes parallèles d'information de santé.
Schéma : Une étude transversale basée sur des données du programme national de 2010 à 2015.
Méthodes : Le Malaria Surveillance Database System (MSDS) est une base de données exhaustive du paludisme ; l'Immediate Disease Notification System (IDNS) est destiné à fournir une alerte précoce et à déclencher les investigations des cas pour prévenir la transmission ultérieure du paludisme et des épidémies potentielles ; les rapports de Health Management Information Systems (HMIS) déclarent toute la morbidité au niveau des structures de santé. Les disparités ont été stratifiées par niveau et par type de structure de santé.
Résultats : Une sur-déclaration régulière de 9% à 85% a été constatée dans le HMIS et principalement au niveau des soins de santé primaires (dispensaires et/ou centres de santé). Dans l'IDNS, les disparités sont allées d'une sous-déclaration de 12% à une sur-déclaration de 32% et ceci a également été vu au niveau des soins de santé primaires. Au niveau des hôpitaux, il y a eu une sous-déclaration à la fois dans le HMIS et dans l'IDNS.
Conclusions : Il y a une considérable disparité dans les nombres de cas de paludisme confirmés dans le HMIS et l'IDNS au Swaziland. Ceci peut fausser le poids du paludisme et retarder l'investigation des cas, prédisposant la population à des épidémies potentielles. Il y a un besoin urgent d'améliorer l'intégrité des données de façon à guider et à évaluer les efforts vers l'élimination.

Marco de referencia: Con el fin de eliminar el paludismo, es primordial practicar la notificación y el seguimiento precisos y oportunos de todos los casos confirmados. Swazilandia está en vía de eliminación del paludismo y cuenta con tres sistemas paralelos de información sanitaria, a saber: el Sistema de Información sobre Gestión Sanitaria (HMIS, por *Health Management Information System*), el Sistema de Notificación Inmediata de Enfermedades (IDNS, por *Immediate Disease Notification System*) y el Sistema de la Base de Datos de Vigilancia del Paludismo (MSDS, por *Malaria Surveillance Database System*).
Método: Un estudio transversal con datos del programa de ámbito nacional (del 2010 al 2015).
Métodos: El MSDS consiste en una base de datos exhaustiva; el IDNS se propone aportar una alarma temprana y desencadenar la investigación de los casos con el fin de evitar la transmisión del paludismo y eventuales epidemias; y el HMIS notifica todos los casos a escala de los establecimientos de salud. Las discrepancias entre los sistemas se estratificaron por nivel y por tipo de establecimiento de salud.
Resultados: Se observó una sobrenotificación sistemática del 9% al 85% en el HMIS, sobre todo a escala de la atención primaria (consultorio o centro de salud). En el IDNS, la discrepancia osciló entre una subnotificación del 12% y una sobrenotificación del 32%, en especial al nivel de la atención primaria. A escala de los hospitales se observó una subnotificación en el HMIS y también en el IDNS.
Conclusión: Existen discrepancias notables sobre el número de casos confirmados de paludismo en el HMIS y el IDNS en Swazilandia. Esta situación da una imagen errada de la carga de morbilidad por paludismo y retrasa la investigación de los casos, con lo cual se expone la población a posibles brotes epidémicos. Es urgente mejorar la integridad de los datos, con el fin de orientar las iniciativas encaminadas a eliminar el paludismo y evaluar la repercusión de las mismas.

Public Health Action (PHA) The voice for operational research.
Published by The Union (www.theunion.org), PHA provides a platform to fulfil its mission, 'Health solutions for the poor'. PHA publishes high-quality scientific research that provides new knowledge to improve the accessibility, equity, quality and efficiency of health systems and services.

e-ISSN 2220-8372
Editor-in-Chief: Dermot Maher, MD, Switzerland
Contact: pha@theunion.org
PHA website: http://www.theunion.org/what-we-do/journals/pha
Article submission: http://mc.manuscriptcentral.com/pha