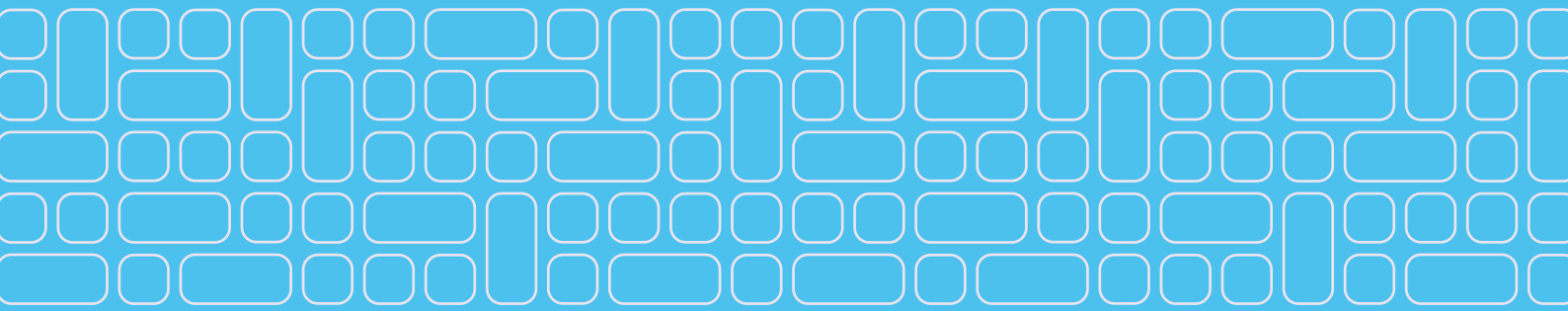


# PanAfrican Medical Journal

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## ***SUPPLEMENT***



*Field Epidemiology in Africa*



# VOL. 10 SUPPLEMENT 01

## FIELD EPIDEMIOLOGY IN AFRICA

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### About AFENET

AFENET is a networking and service alliance incorporated in November 2005 with a mission to improve the health of Africans through strengthening and expanding field epidemiology and laboratory capacity. AFENET's goal is to ensure effective prevention and control of epidemics and other priority public health problems on the continent. The networking alliance consists of 13 member Field Epidemiology and (Laboratory) Training Programs (FELTPs) with operations in 20 countries in Africa. More details about AFENET can be accessed on [www.afenet.net](http://www.afenet.net).

### About PAMJ

The Pan African Medical Journal (PAMJ) is a peer-reviewed, online, open-access medical journal, published with support from AFENET. A highly talented and qualified team of editorial staff with three managing editors and over 700 experienced reviewers from 20 countries manage manuscripts ranging from research papers to commentaries in manifold medical domains like epidemiology, maternal and child health, radiology, clinical medicine, health economy, and nutrition. PAMJ's mission is to create, stimulate, and perpetuate a culture of information sharing and publishing amongst researchers and other health actors of the African health scene in ways that will contribute to: improving availability of health information; a better understanding of Africa specificities and overall; and improving health outcomes on the continent.

# EDITORIAL

## FIELD EPIDEMIOLOGY IN AFRICA

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Key words: Africa, AFENET, field epidemiology, capacity building, FELTPs, IDSR, networks, zoonoses

### Editorial

Field epidemiology involves the application of basic epidemiology principles in real time, at a specific place, and on specific people to solve public health problems especially emergencies. Africa has several opportunities for public health officials to practice field epidemiology as there are frequent disease outbreaks and other public health emergencies. However public health systems in Africa are implemented jointly with health care delivery; there are very few public health professionals (especially physicians) who do not play dual roles of health care delivery and public health practice.

Public health surveillance has been defined as the ongoing systematic collection, analysis, interpretation, and timely dissemination of health-related data to those who are able to take public health action. This definition implies a separation between the public health surveillance workforce and the public health response workforce. However, following the adoption and widespread use of the World Health Organization Regional Office for Africa's Integrated Disease Surveillance and Response (IDSR) strategy, public health surveillance and public health response in Africa are often conducted by personnel, who also perform routine health care, and are therefore overworked. A further complexity to the practice of field epidemiology in Africa is the weakness of the public health (and clinical) laboratory networks which are critical for effective public health surveillance especially for communicable diseases. Additionally, diseases that cross the animal human interface are common and devastating- viral hemorrhagic fevers and other zoonoses are frequent in African countries. Clearly a strategy to develop a public health workforce in Africa which can practice field epidemiology in Africa should include joint postgraduate training of physicians and other health scientists, with public health laboratory scientists and veterinarians. This is likely to strengthen public health surveillance and response in Africa efficiently. It will also augment the current paradigm shift towards 'One health' practice which calls for building inter-disciplinary bridges across the human, animal and environmental health sectors to attain optimal health in a globalised world [1].

Several authors have previously described the lack of health care workers in Africa, particularly the lack of clinical care workers. A few have described the lack of public health workers and pointed out that the unmet need for public health workers is likely smaller than the need for health care workers. In 2008, Scheffler and others estimated that the need for physicians was about 0.55 per 1000 population which translates into 550 physicians per million population [2]. Other authors have posited the need for field epidemiologists to range from 3 to 5 per million population for a country in sub-Saharan Africa [3]. This is a 2 log order of magnitude less than the physician need and may signify an important opportunity for quick progress. Some authors have shown that graduates of field epidemiology training programs in Africa have a 5-year retention of up to 80% [4]. Many of these graduates have gone on to run important Ministry of Health programs because of the nature of their "in-country in-context" training and the fact that all these programs award a postgraduate degree to successful graduates which is necessary for an advancing career path. Putting all these issues together it is possible to suggest that: a) training field epidemiologists in Africa is a smaller task than developing a health-care workforce and b) this training may lead to sustained results for a workforce that is able to implement multi-disease public health surveillance and response holistically. This does not mean that it is easy, or cheap, or that it is more important than developing the health-care workforce but that it may be more manageable.

The authors of the papers in this special PAMJ-African Field Epidemiology Network (AFENET) 5th year anniversary supplement have described how different field epidemiology and laboratory training programs have been developed in several countries with unique country-led and country-owned partnerships. They have also described how these programs have trained physicians and other health scientists, with public health laboratory scientists, and in some cases with veterinarians, in field epidemiology with the intent of using the trainees and graduates to implement and lead multi-disease surveillance and response systems. Other authors have described the development and implementation of AFENET which is a regional service and networking alliance of these programs, based on a novel partnership between training institutions and ministries of health. There is a paper on the early results of the public health laboratory graduates

from the programs and there are papers on the “One Health” training which includes physicians, health scientists, public health laboratory scientists, and veterinarians.

The authors have been candid in the challenges they face as they implement field epidemiology and laboratory training programs and the network to link them. It is our hope that this supplement enables the reader to learn about the unique nature of the

training and practice of field epidemiology in the African context, knowing that these programs will underwrite a significant portion of global health security as the graduates of these programs will be responsible for implementing public health surveillance and response in the context of the revised International Health Regulations and IDSR.

## Acknowledgements

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## THE GENESIS AND EVOLUTION OF THE AFRICAN FIELD EPIDEMIOLOGY NETWORK

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Key words: African Field Epidemiology Network, AFENET, Network

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### Abstract

In an effort to contain the frequently devastating epidemics in sub-Saharan Africa, the World Health Organization (WHO) Regional Office for Africa launched the Integrated Disease Surveillance and Response (IDSR) strategy to strengthen surveillance and response. However, 36 sub-Saharan African countries have been described as experiencing a human resource crisis by the WHO. Given this human resource situation, the challenge remains for these countries to achieve, among others, the health-related Millennium Development Goals (MDGs). This paper describes the process through which the African Field Epidemiology Network (AFENET) was developed, as well as how AFENET has contributed to addressing the public health workforce crisis, and the development of human resource capacity to implement IDSR in Africa.

AFENET was established between 2005 and 2006 as a network of Field Epidemiology Training Programs (FETPs) and Field Epidemiology and Laboratory Training Programs (FELTPs) in Africa. This resulted from an expressed need to develop a network that would advocate for the unique needs of African FETPs and FELTPs, provide service to its membership, and through which programs could develop joint projects to address the public health needs of their countries. A total of eight new programs have been developed in sub-Saharan Africa since 2006. Programs established after 2006 represent over 70% of current FETP and FELTP enrolment in Africa. In addition to growth in membership and programs, AFENET has recorded significant growth in external partnerships. Beginning with USAID, CDC and WHO in 2004-2006, a total of at least 26 partners have been added by 2011. Drawing from lessons learnt, AFENET is now a resource that can be relied upon to expand public health capacity in Africa in an efficient and practical manner. National, regional and global health actors can leverage it to meet health-related targets at all levels.

The AFENET story is one that continues to be driven by a clearly recognized need within Africa to develop a network that would serve public health systems development, looking beyond the founders, and using the existing capacity of the founders and partners to help other countries build capacity for IDSR and the International Health Regulations (IHR, 2005).

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## Introduction

In 2006, the World Health Organization (WHO) indicated that there was a global shortfall of 4.3 million trained health workers, which was most severe in 57 countries, 36 of which are in sub-Saharan Africa. The health-related Millennium Development Goals (MDGs) cannot be achieved in Africa without an adequate health workforce [1]. Investments made through global health initiatives, private foundations, multi- and bi-lateral development agencies have had a diminished impact because of a lack of human and institutional capacity to absorb, deploy and use their funds efficiently [2].

In 1993, the World Health Organization Regional Office for Africa (WHO/AFRO) at its annual Regional Committee (which is the governance body for the organization) meeting in Gaborone, Botswana, called on its Member States to strengthen their public health surveillance systems to address the frequently devastating epidemics that the region was experiencing [3]. Following the Gaborone meeting, and in an effort to strengthen surveillance and response to infectious diseases, WHO/AFRO developed the Integrated Disease Surveillance and Response (IDSR) strategy in 1998 [4-5]. IDSR was endorsed and supported by several partners including the United States (U.S.) Agency for International Development (USAID) and the U.S. Centers of Disease Control and Prevention (CDC). In 2001, as part of their support for IDSR, these partners started investing in applied public health training in several African countries to develop a public health workforce that could implement IDSR with an initial focus on strengthening outbreak investigation and response and related surveillance activities [5].

One of the proven strategies for building public health surveillance and response systems and the workforce to operate these systems is implementation of Field Epidemiology and Laboratory Training Programs (FELTPs) [6-8]. FELTPs build and strengthen public health systems, while simultaneously training future public health leaders. Because FELTP trainees provide service during training, FELTPs create a setting in which evidence-based public health systems that serve communities effectively and efficiently can be established [9]. Without strong field epidemiology capacity, African countries will be unable to build and use disease surveillance and response systems, and remain vulnerable to disease threats. [10].

Field Epidemiology Training Programs (FETPs) were established in Africa to address the critical shortage of epidemiological skills within the public health workforce [6, 9, 11]. The first FETPs in Africa were established in the early 1990s as partnerships between the ministries of health (MOH), universities, district local governments, and other partners as part of the Rockefeller Foundation supported Public Health Schools Without Walls (PHSWOW) project [8, 9, 12-13]. These programs shared experiences, training curricula, learning materials, and staff, and also undertook joint field epidemiology projects. All PHSWOWs, FETPs, and FELTPs are members of the global FETP network, the Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET) which was established in the late 1990s. TEPHINET addresses the needs of FETPs around the world including curriculum and accreditation issues.

The need for a regional applied epidemiology training network in Africa was recognized in the late 1990s because of the peculiarities in the African region [12]. For instance, most programs in Africa tended to have more active involvement of universities or other training institutions compared to FETPs elsewhere because of the need for formally-recognized university qualifications by the graduates for career progression.

African programs also tended to include health services management as part of their curriculum to address the needs of decentralization of health services from national to sub-national levels.

## The Genesis of AFENET

Two meetings were held in 2004 and 2005 in Uganda and Ghana respectively, to develop a vision, mission, and strategy for an African field epidemiology network. The meetings were attended by Program Directors and representatives of MOHs from each of the four existing African TEPHINET member programs at the time [Ghana (a 1-year PHSWOW), Kenya (an FELTP) [14], Uganda (a 2-year PHSWOW), and Zimbabwe (a 2-year PHSWOW)], and partners from WHO, CDC and USAID.

- At the 2004 meeting, participants noted the following needs:
- To strengthen and standardize field epidemiology curricula and training strategies across programs and train critical program staff.
  - To define critical issues for sustainability that include expanding the pool of partners supporting the programs both technically and financially.
  - To add a laboratory component into the training programs to strengthen public health laboratory practice for effective surveillance and response.
  - To share experiences and help other countries in Africa to develop their own FETPs and FELTPs, or be linked into existing ones to address their training needs.
  - To broaden the scope of African FETPs and FELTPs to address other public health priorities beyond infectious diseases.
  - Membership by programs in global networks was not sufficient to support the unique situation of the African continent.

Meeting participants also recognized that global disease initiatives to address polio, malaria, tuberculosis (TB) and HIV/AIDS {e.g., the Global Fund Against TB, AIDS, and Malaria (GFATM)} were using the few existing local public health experts to implement their vertical programs but had not yet contributed significantly to developing new public health experts. Participants at the meeting agreed that it was imperative to develop a regional network that would address these issues including finding ways to encourage global initiatives, other donors and governments to include funding for strengthening of field epidemiology capacity in Africa in a concerted manner.

## Role of partners in the process

After the partners agreed to form AFENET they worked collaboratively to develop ideas into proposals for submission to potential funding partners to expand the FETPs and FELTPs on the continent, as well as establish a secretariat of the new organization to coordinate, mainstream, and advocate for the programs. One such example was a jointly developed proposal to address health systems strengthening which was endorsed by Country Coordination Mechanisms (CCMs) in Ghana, Uganda, and Zimbabwe and submitted to the GFATM. CCMs are the GFATM's tool to promote local ownership and participatory decision-making through their diverse membership that characteristically comprises representatives from both public and private sectors, including governments, multilateral or bilateral agencies, non-governmental organizations, academic institutions, private businesses and people living with the diseases. Although the proposal was never funded, it helped build a strong bond between the programs. The concerted effort as highlighted by the CCM endorsements demonstrated the value of the programs to their countries, and the commitment in host countries to invest in these programs.

Each partner used its unique capabilities to develop AFENET. The MOHs and universities brought their leadership, goodwill, and time commitments, and they agreed to establish AFENET as a network and mechanism for promoting and sustaining the programs. The universities, within which the programs were anchored, signed a Memorandum of Understanding (MOU) to establish AFENET and agreed to collaborate through AFENET to advance field epidemiology capacity within their institutions, countries, and the continent. The MOHs in the founder countries agreed to let the universities sign the MOU which outlined how AFENET resources would be managed within the countries. In each country the AFENET resources were to be managed jointly by the MOH and the university. The universities and MOHs agreed to develop and use AFENET as the principal mechanism for field epidemiology training development in Africa.

WHO was involved in the development of the vision for the organization, and provided technical support especially from the Lyon office during the early development of AFENET. USAID and CDC provided technical input into the organizational strategy, and provided seed funding to establish the AFENET secretariat, as part of the existing mechanisms for outbreak investigation training. USAID, through a contracted organization, supported the development of the governance and leadership framework [15]. In addition to initial technical and financial investments, CDC utilized AFENET as its primary implementing partner for FELTP development in Africa.

## Evolution of AFENET

Since the creation of AFENET, a total of eight new programs have been developed [8]. Since some of the programs serve more than one country (regional FELTPs) another eight countries have since become affiliated with AFENET. The AFENET constitution

describes the membership of AFENET, and the process to achieve membership (by countries and institutions) [16]. AFENET has evolved in its scope, not only networking and supporting FETPs and FELTPs, but developing and implementing public health projects with its membership. Figure 1 shows the countries that currently constitute the AFENET Network. Over the last 5 years, AFENET has recorded internal growth from four to 20 countries from West, East, and Southern Africa and covering a large part of sub-Saharan Africa.



Figure 1: AFENET Member countries

## Organization

Figure 2 describes the governance structure of AFENET. The highest decision making organ of AFENET is its general assembly, which is made up of all the network's members and meets once a year. Every 2 years the general assembly elects the Board of Directors[16]. The Board of Directors is responsible for formulation of policies to govern the operations of AFENET, and oversees the promotion and realization of the vision, mission and objectives of AFENET. The board is advised by an advisory committee consisting of eminent public health experts from around the continent who are invited as-needed. The secretariat coordinates and manages the day-to-day affairs of the organization working in tandem with country coordinators (who are generally FETP, PHSWOW, or FELTP program directors) in each country. Country coordinators are responsible for overall country level implementation and reporting to the secretariat. The secretariat reports to the board at least twice a year. In between board meetings, the secretariat works with established board subcommittees to implement the agreed upon plans and resolutions.

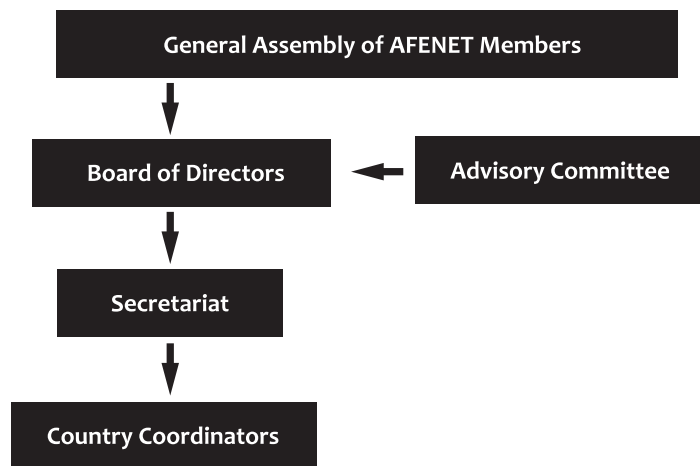


Figure 2: AFENET Governance Structure

## Partnerships

Apart from the internal growth seen as a result of a larger membership (Figure 1), AFENET has recorded significant growth in external partnerships. Beginning with USAID, CDC, TEPHINET and WHO in 2004-2006, AFENET has since added at least 25 partners.

The Division Public Health Surveillance and Workforce Development (DPHSWD) of the Center of Global Health at CDC participated in the founding of AFENET. DPHSWD has brought in other CDC divisions including the Global AIDS Program (GAP) to support the mission of improving public health in Africa through field epidemiology capacity development. CDC has provided technical assistance in several areas for example, in developing training curricula, monitoring and evaluation, and in integrating new areas into FETPs and FELTPs [e.g., veterinary field epidemiology, non-communicable disease, and expanded program for immunization (EPI)]. Other partners include international non-profit organizations, universities in Europe and the US, Foundations, international networks, other US Federal Agencies (e.g., the National Institutes of Health), and the European Union.

Table 1 shows the grants awarded to AFENET from proposals submitted between 2006 and 2011. These exclude sub-contracts or sub-agreements which AFENET was not involved in developing, but was involved as an implementer after they were awarded (e.g., sub-contracts with the Research Triangle Institute (RTI) and CDC Foundation).

**Table 1: Grants written by AFENET and funded 2006-2011**

Focus Area	Submitted	Funding Period	Funding Partner	AFENET Role
Applied Epidemiology Training	2006	5 years	CDC/Department for Health and Human Services (HHS)ø	Lead
Immunization Training for Managers	2007	4 years	Merck Foundation	Sub-recipient
Cholera Surveillance	2009	3 years	Gates Foundation	Sub-recipient
Health Diplomacy Training Nigeria	2009	1 year	Office for Global Health Affairs (OGHA), HHS	Lead
Advanced Epidemiological Research Training	2010	4 Years	European Union	Sub-recipient
Laboratory Systems Strengthening	2010	5 years	CDC/HHS	Lead
Field Epidemiology Training	2010	5 years	CDC/HHSø	Lead
Influenza Surveillance	2010	16 months	WHO	Sub-recipient
Field Epidemiology training in Tanzania	2011	5 years	CDC Tanzania	Lead
Field Epidemiology training in Nigeria	2011	5 years	CDC Nigeria	Lead
Outbreak Investigation	2011	1 year	USAID-RESPOND	Sub-recipient

ø – Substantial funding from USAID to AFENET received through a Cooperative Agreement



Since 2005, AFENET and its partners have been involved in a number of advocacy events including: meetings with various potential donors, and circulation of electronic and print materials. This has resulted in an augmented membership, partnerships, and a growing pool of trained epidemiologists and public health laboratorians. AFENET also holds biennial Scientific Conferences for all the FETPs and FELTP in the network. In 2010 AFENET co-hosted the Global FETP and FELTP meeting with TEPHINET in Cape Town, South Africa

Table 2 shows the number of trainees and graduates from the 2-year programs in AFENET. Programs established after 2006 represent over 70% of current enrolment into FELTPs, FETPs, and PHSWOWs in Africa. Some of the programs receive a large portion of their funding through AFENET, while others are only partially supported by the network.

**Table 2: Number of epidemiologists trained through 2-year programs**

Program	Established	Current trainees	Graduates
Zimbabwe	1993	43	143
Uganda	1994	30	225
Kenya	2004	29	63
South Africa	2007	23	10
Ghana	2007	15	11
Nigeria	2008	52	13
Tanzania	2008	23	11
Ethiopia	2009	38	13
Mozambique	2009	11	0
Central Africa (Cameroon, Central African Republic, and Democratic Republic of Congo)	2010	18	0
Rwanda	2010	15	0
West Africa (Burkina Faso, Mali, Togo, and Niger)	2010	12	0
Total		309	489

## Challenges

AFENET has as its most immediate challenges: communication and language (there are three major official languages in AFENET countries—English, French, and Portuguese), maintaining cohesion among members, and dealing with rapid growth. AFENET has addressed the language and communication challenge by drawing on a wide pool of expertise from graduates and FETP/FELTP faculty who speak the language and understand the culture of a particular country. AFENET has endeavored to engage all stakeholders from the onset when implementing new programs in order to develop a common understanding of the mission to ensure that all activities and programs receive the commitment of all stakeholders.

In a network such as AFENET, different members join with different expectations, and unless expectations are clarified from the outset, this can create room for tension. On the other hand, what members are expected to bring or contribute to the

network must be made clear. As AFENET has grown, the need to address this area has become evident. Over time, we have developed clear documentation that spells out the roles and responsibilities of the network to its members and vice versa. With growth of the network, some members have felt excluded from certain activities, while some have felt overburdened. This is a challenge that needs to be addressed continuously, as a one-size-fits-all solution has not been found. AFENET has had to rapidly build its own internal capacity, as well as that of its members to coordinate and manage a growing portfolio of work.

## Discussion

We have described the origin and evolution of AFENET, an organization that has grown in geographic reach, scope and contribution to public health systems and workforce strengthening in Africa. The founding members and partners of AFENET came together in 2004 and 2005, and used their individual and collective strengths to establish the organization. AFENET and

its membership have employed a competency-based approach to public health training for the various tiers of the continent's health systems. AFENET's creation was driven by the needs of its membership, countries in the region, as well as the public health workforce needs of Africa. This organization is owned by African institutions and continues to exist to serve the interests and needs of its membership and the continent.

The growth in FETPs and FELTPs recorded in the region has been a result of a deliberate effort by programs in the region working within a south-south framework, and with partners from the north to help countries establish these programs. This expansion was borne out of the vision set out by the founders of AFENET in 2004 and 2005. The geographical coverage of AFENET provides an important platform that local, regional and international players in the health sector could leverage to address key health priorities to meet regional and international targets. AFENET has established firm and robust linkages with ministries of health, universities and other health actors that are a foundation for successful health

programs and interventions. The AFENET members are part of the 36 countries that WHO describes as being in human resources for health crisis, and AFENET can be used to address the public health workforce shortages in those countries [1].

Based on the AFENET experience a regional network can address the unique peculiarities in a region in an efficient and practical manner. However the field-based model of training utilized by AFENET member programs, though effective, is resource-intensive. The average cost of training one epidemiologist through the 2 year program offered by FELTPs is approximately \$40,000. Some of the earlier programs (e.g., Uganda and Zimbabwe) have devised various mechanisms for sustainability beyond partner support such as strengthening country ownership (e.g., through advocacy with an emphasis on showcasing the impact of the programs in their respective countries, and reductions in the cost of training). In the short term, there is still need to mobilize external financial resources from donors to support existing FELTPs and FETPs and to develop new ones. AFENET and its members will need to continually innovate, and continue to build partnerships. Programs will need to look both within their countries, as well as externally for support. Internal support could come from trainees (e.g., by paying tuition), MOHs, the private sector and the country's development partners.

## Conclusion

AFENET was developed to address a clearly-recognized need within Africa to develop a network that would serve public health systems development, looking beyond the original founders, and using the existing capacity of the founders and partners to help other countries. Each partner brought their strengths to the table in helping form AFENET and set it on a path of growth and viability. The establishment of AFENET was impelled by the need for FETPs and FELTPs in Africa to work together in a systematic way to address the common and unique needs of Africa and the

African programs. AFENET will need to continue to innovate, strengthen old alliances, and build new ones to continue fulfilling its mission and vision over the next decade and beyond, as part of the regional IDSR strategy and within the global IHR framework to strengthen surveillance and response core capacity development, as well as meeting other disease control and prevention priorities.

## Competing Interests

None declared

## Author contributions

Mukanga D and Tshimanga M: Contributed to development and design of the concept, writing the article, provided important intellectual content and approval of the version to be published. Wurapa F, Binka F, Serwada D, Bazeyo W, Pariyo G, Wabwire-Mangen F, Gitta N. S, Chungong S, Trostle M, Nsubuga P: Contributed to writing drafts of the article, reviewed several drafts, provided important intellectual content, and approval of the version to be published.

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## THE AFRICAN FIELD EPIDEMIOLOGY NETWORK - NETWORKING FOR EFFECTIVE FIELD EPIDEMIOLOGY CAPACITY BUILDING AND SERVICE DELIVERY

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### Abstract

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Because of the severe resource limitations that nations face in dealing with priority public health problems. For a long time, networks have existed on the continent and globally, but many of these are disease-specific with a narrow scope. The African Field Epidemiology Network (AFENET) is a public health network established in 2005 as a non-profit networking alliance of Field Epidemiology and Laboratory Training Programs (FELTPs) and Field Epidemiology Training Programs (FETPs) in Africa. AFENET is dedicated to helping ministries of health in Africa build strong, effective and sustainable programs and capacity to improve public health systems by partnering with global public health experts. The Network's goal is to strengthen field epidemiology and public health laboratory capacity to contribute effectively to addressing epidemics and other major public health problems in Africa. AFENET currently networks 12 FELTPs and FETPs in sub-Saharan Africa with operations in 20 countries. AFENET has a unique tripartite working relationship with government technocrats from human health and animal sectors, academicians from partner universities, and development partners, presenting the Network with a distinct vantage point. Through the Network, African nations are making strides in strengthening their health systems. Members are able to: leverage resources to support field epidemiology and public health laboratory training and service delivery notably in the area of outbreak investigation and response as well as disease surveillance; by-pass government bureaucracies that often hinder and frustrate development partners; and consolidate efforts of different partners channelled through the FELTPs and FETPs by networking graduates through alumni associations and calling on them to offer technical support in various public health capacities as the need arises. AFENET presents a bridging platform between governments and the private sector, allowing for continuity of health interventions at the national and regional level while offering free exit and entry for existing and new partners respectively. AFENET has established itself as a versatile networking model that is highly responsive to members' needs. Based on the successes recorded in AFENET's first 5 years, we envision that the Network's membership will continue to expand as new training programs are established. The lessons learned will be useful in initiating new programs and building sustainability frameworks for FETPs and FELTPs in Africa. AFENET will continue to play a role in coordinating, advocacy, and building capacity for epidemic disease preparedness and response.

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## Introduction

Whereas advances in science and technology have resulted in the development of many life-saving and affordable technologies[1], many developing countries have poor health indices and are unlikely to attain the targets for the health-related Millennium Development Goals (MDGs) and other internationally agreed goals[2]. Sub-Saharan Africa registers the highest global disease burden at 24% despite accounting for only 11% of the world's population[3]. The World Health Organisation (WHO) attributes the poor health indicators to weak health systems and has proposed a health systems framework to counter this problem. The WHO framework consists of six essential system building blocks: service delivery; health workforce; information; medical products, vaccines and technology; financing; and, leadership/governance[4]. An adequate health workforce is central to all the other building blocks.

Of the 57 countries faced with an extreme shortage of health workers, 36 are in Africa [3]. African and Asian countries have an estimated shortfall of 4.2 million health workers[5]. Laboratories are the weakest link in Africa's public health system, affecting timely confirmation and response to disease outbreaks as well as proper diagnosis and clinical care of patients[6].

Despite the marked increase in financial resources made available to low-income countries in the 21st century, many are still grappling with weak health systems. Some have attributed this grim picture to the fact that most of the aid coming to the health sector is earmarked for specific programs leaving some critical areas unfunded and other areas over funded. For example, HIV/AIDS accounts for 30% of the disease burden in low-income countries and receives 46% of donor funding, compared to acute respiratory infections which account for 26% of the disease burden but receive < 2.5% of direct funding[7]. Faced with competing demands, a high disease burden, and limited resources, low-income countries need to devise mechanisms to accomplish much more with the limited resources.

One approach to that has been advocated to maximally use the limited resources is to develop and use partnerships and networks that advance knowledge and technology sharing.

## What is networking?

Several definitions of networks exist. In general, a network is a relational organizational form consisting of individuals, groups or organizations that come together, interact and share resources to pursue a common goal in a coordinated and concerted way[8-9]. If the network is made up of individuals or groups such as teams, divisions, or regional sites within the same organization, it is an intra-organizational network, while if it is made up of organizations then it is an inter-organizational network[10]. Inter-organization networks may be classified into three categories based on the governance type namely: shared governance, lead organization governed, and network administrative organization governed [11].

Members of a network share goals and processes that extend

beyond two organizations to a multitude of organizations that create a unified response to a given phenomenon[12-13]. The key incentive for participation in a network is the opportunity to achieve a goal that otherwise each member would not be able to achieve alone. There is a trade-off between the long-term collective benefits of the networks such as innovation and new product development, community wellbeing, buffering against environmental (e.g., political, economic, market, social) turbulence and the short-term individual pay offs of participating organizations such as attainment of recognition and legitimacy. Participating organizations must have something to add as well as takeaway from the network. Network members retain benefits of remaining formally independent and small while reaping economies of scope and scale through the structure of other organizations [14]. Members have flexibility in terms of resources of time and cost [15], [16], an organization is dependent upon others in its environment to bestow legitimacy and recognition upon it.

## Why public health networks?

Partnerships and networking are proven approaches to addressing public health challenges. Networks help leverage scarce resources to attain a common goal. For example, WHO's Global Laboratory Network, strengthens laboratory support to immunization programs. These laboratory networks include: measles and rubella, poliomyelitis, yellow fever, and human papillomavirus (HPV) networks[17]. Other examples of existing networks are the Global Outbreak Alert and Response Network (GOARN)[18]; the Global Influenza Network (i.e., FLU-LAB); the World Bank-funded East African Public Health Laboratory Network (EAPHLN), whose focus is on strengthening laboratories to improve access to diagnostic services for tuberculosis in the African region; and the Partners in Population and Development Regional Office's three regional networks which promote integrated reproductive health programs in Africa: the East African Reproductive Health Network (EARHN), the Western African Reproductive Network (WARHN), and the Southern Africa Reproductive Health Network (SARHN) [19].

The Training Programs in Epidemiology for Public Health Interventions Network (TEPHINET) is a global network of field epidemiology and allied training programs that was created in 1997 to provide support, peer review, and quality assurance for its member programs [20]. In 2004, field epidemiology training programs in Africa, recognizing that there were areas of need particular to Africa that could be addressed by a regional network, began discussions to setup a network that would address their unique needs and challenges [21]. These programs now constitute the AFENET founding members [22].

Despite having several partnerships and networks in the public health arena in sub-Saharan Africa, a majority are disease specific or narrow in scope, addressing only a few components of the health system. Many of the partnerships are North - South collaborations with very few South - South collaborations.

We describe an inter-organizational network established in

2005 by Field Epidemiology Training Programs (FETPs) and a Field Epidemiology and Laboratory Training Program (FELTP) in Africa [23-24]. The African Field Epidemiology Network (AFENET) is a hybrid of a shared and network administration organization governance network[11]. Member programs work collectively to make strategic and operational decisions under the framework of a General Assembly and a Board of Directors, while a Secretariat under leadership of an Executive Director performs the day to day running of the network, offering both technical and administrative support under guidance of the latter[22]. The General Assembly is the senior governance body and is constituted by all members of AFENET. It elects the eight-member Board of Directors whose composition consists of representatives from the Network (two founder members, one ordinary member, and two member countries), a private sector representative, an eminent member of society with vast public health experience, and a representative from WHO Regional Office for Africa as a non-voting member.

## The African Field Epidemiology Network (AFENET)

The African Field Epidemiology Network (AFENET) was established in 2005 as a not-for-profit regional organization and networking alliance of African FETPs and FELTPs, dedicated to helping ministries of health in Africa build strong, effective, and sustainable programs with the capacity to improve public health systems by partnering with global public health experts. The Network's goal is to strengthen field epidemiology and public health laboratory capacity to contribute effectively to addressing epidemics and other major public health problems in Africa. AFENET currently networks 12 FETPs and FELTPs in sub-Saharan Africa with operations in 20 countries. The Network's Secretariat is based in Kampala, Uganda. AFENET's operations are guided by six strategic priorities described in table 1.

AFENET Secretariat, under the leadership of an Executive Director, has a team of financial, technical and administrative staff organised under four units: Technical Programs, Science and Public Affairs, Finance, and Administration

AFENET's operations are funded by several implementing partners (www.afenet.net). One of these is the United States (U.S.) Centers for Disease Control and Prevention (CDC) which provided the seed funding that has supported AFENET's operations since inception. As a CDC principal implementing partner for FELTPs in sub-Saharan Africa[25], AFENET receives substantial funding from CDC through cooperative agreements to support member programs as well cover networking operational costs. This mechanism enables CDC to play an active role in the implementation of FELTPs through the provision of technical assistance in addition to financial support.

## What gaps does AFENET address?

Field Epidemiology and Laboratory Training Programs (FELTPs) offer a 2-year competency-based training in applied epidemiology and public health laboratory practice. Trainees acquire an array of practical public health skills in disease surveillance and outbreak investigation, data management, monitoring and evaluation of health programs, scientific writing and communication. Approximately 70% of their time is spent in the field, with trainees learning by doing and in the process contributing to public health service delivery in liaison with local health teams.

AFENET supports networking of FELTP trainees by sponsoring their travel to both regional and international scientific meetings and conferences using funds from implementing partners. These meetings provide trainees with opportunities to disseminate their study findings with the wider public health audience, including policy makers, while at the same time interacting with trainees from other programs and public health practitioners.

The establishment of a FELTP is a multi-stage process, the first of which is usually an initial country assessment to assess the feasibility of establishment of a FELTP [25]. AFENET supports African countries to establish FELTPs by participating in the initial country assessment and advocacy activities. Once the program is established, AFENET usually participates in recruitment of personnel; offers administrative, financial and logistical support; resource mobilization; and participates in teaching and other program activities. Logistics management is challenging in many

**Table 1: AFENET's strategic priorities**

Strategic Priorities	Indicator
Field epidemiology capacity development	Critical mass of well-trained field epidemiologists ensuring effective prevention and control of epidemics and other major public health problems.
Public health laboratory capacity development	Well-equipped, staffed, linked and functional public health laboratory infrastructure.
Public health disease surveillance and effective response	Early detection, timely and effective response and reduced mortality from epidemics and other major public health problems in Africa.
Networking and collaboration	Field epidemiologists and laboratories effectively engaged in value-adding collaboration and partnerships.
AFENET's institutional development	AFENET demonstrates good management systems and processes.
Documentation and publication	Regular dissemination of the network's activities in relevant scientific media and the establishment of effective information storage and retrieval mechanisms.

African countries, given the lengthy bureaucratic procedures instituted by governments. AFENET provides an alternate platform that bypasses these procedures and has proved to be a valuable mechanism especially during outbreaks.

Resource mobilization through several approaches is a critical function that AFENET offers its membership. Field Epidemiology Training Programs are a proven approach to addressing public health challenges, but are more resource-intensive than traditional public health training programs because of the field component[20]. AFENET's business development unit, which is responsible for grant writing and management, plays a key role in this process. To date, AFENET has been awarded more than 10 grants (a majority being CDC cooperative agreements, and with major support from the U.S. Agency for International Development [USAID]) to support FELTPs and ministries of health in epidemiology training, responding to outbreaks, strengthening public health surveillance, and public health laboratory capacity. Other methods applied to mobilize resource include advocacy and networking with existing and potential partners.

Over the years, AFENET has widened its international partner base to include other U.S. government agencies, U.S. Foundations, U.S. organizations, WHO, GOARN, the European Centres for Disease Control and Prevention (ECDC), and the European Union. With this support, AFENET continues to work towards strengthening and expanding field epidemiology and laboratory capacity across Africa.

AFENET plays an advocacy role for field epidemiology capacity building in Africa. This is achieved through meetings with potential funders, government officials and academia in countries that have expressed interest in establishing FELTPs, dissemination of reports from the various member FELTPs through newsletters, annual reports and publications, and presentations at meetings/conferences.

The acute shortage of health workers in Africa is aggravated by "brain drain" of its health workers. Available data show that 40% of graduates from medical and allied health schools migrate to other countries [26-27]. It has been reported elsewhere that 85% of graduates from African FELTPs stay and work in their home countries for at least 3 years after completing training [24]. This is very encouraging since FELTPs train a select few every year through the 2-year program, hence it is critical to retain graduates in country or on the continent. In addition to the 2-year training program, FELTPs and FELTPs provide short term in-service training for front-line health workers. Graduates from both programs contribute towards bridging the human resource gap in their respective countries.

AFENET maintains a database of African FELTP graduates using Epi-Track, a customized MS Access™ database, which was developed in close collaboration with CDC. In the recent past, AFENET has been championing the establishment of alumni associations for its member programs as a networking and tracking strategy. The Zimbabwe program launched its alumni association in September 2008. Since then, other programs have followed suit. The Kenya FELTP Alumni Association, with support from AFENET, conducted a grant writing workshop in July 2010. In March 2011, AFENET

supported the Uganda program to hold a two-day symposium for its alumni under the theme of 'One Health', during which a Uganda FELTP Alumni Association governing committee was elected into office. The Kenya and Uganda alumni meetings were funded by CDC and USAID's Emerging Pandemic Threats Program respectively. The Nigeria FELTP also has an active alumni association.

The FELTP graduates database is a valuable pool of human resources that can be called upon by AFENET and its members to address public health challenges in any of its member countries and Africa as a whole. To date, 489 trainees have graduated from African FELTPs. These graduates are available to the WHO Regional Office for Africa (WHO AFRO), GOARN and others responding to infectious disease outbreaks and other health emergencies.

The pool of graduates is augmented by public health experts from member programs and partners; this expertise is shared amongst the membership, for example, as guest lecturers and external examiners for review of trainees' theses.

The public health systems and quality assurance committee of the AFENET Board of Directors is charged with the responsibility of assuring quality of the member FELTPs. Since 2010, annual assessments have been conducted across the various programs and certificates are awarded indicating the programs' level of performance. The committee recommends continuous quality improvement activities which are evaluated periodically.

AFENET membership presents a common platform for addressing African public health issues since it has representation from Anglophone (Ethiopia, Ghana, Kenya, Nigeria, Rwanda, South Africa, South Sudan, Tanzania, Uganda and Zimbabwe), Francophone (Burkina Faso, Cameroon, Central Africa Republic, Democratic Republic of Congo, Mali, Niger, Togo) as well as Lusophone (i.e., Portuguese speaking) countries, namely, Angola and Mozambique. FELTPs within a particular language zone therefore have opportunities to provide support to each other in areas of information sharing and teaching expertise.

The Network allows for implementation of multi-country programs and projects. AFENET already has a platform and mechanism to implement projects across countries. It is able to overcome government bureaucracies that often hinder and frustrate development partners through its strong linkage with ministries of health across the network. This provides value addition to donors interested in multi-country work, while members enjoy participation.

In line with AFENET's key priority of public health disease surveillance and effective response, African FELTPs and FELTPs continue to play a critical role in the roll out the WHO's Integrated Disease Surveillance and Response (IDSR) in Africa[24]. AFENET is also actively involved in International Health Regulations (IHR, 2005)[28], especially cross border issues especially amongst its membership.

## Examples of AFENET's success stories

AFENET plays an instrumental role in helping membership countries investigate and respond to outbreaks in a timely manner. First, through funding from CDC (provided by USAID), AFENET secretariat has funds earmarked for outbreak support which it is able to make available to an affected member country within 48 hours of notification of a disease outbreak through its financial infrastructure across the membership. This allows for timely investigation and response to outbreaks while at the same time providing FELTP trainees with opportunities to practice their newly-acquired skills. Table 2 summarises some of the outbreaks that occurred in the past 5 years that have been investigated by AFENET member programs and highlights the role played by trainees.

Second, AFENET with the support of CDC procures and assembles outbreak investigation laboratory kits which it supplies to its membership[29]. These kits are customised to meet individual country needs such as provision of anti-sera laboratory kits for commonly occurring pathogens. The kit contents include: personal protective equipment, rapid diagnostic tests or point-of-care diagnostics, specimen collection bottles, and transportation media. Through bulk purchasing, the Network enjoys economies of scale and scope. The rapid diagnostic tests help ensure timely confirmation of disease outbreaks and allow for better case management to minimise morbidity and case fatalities.

AFENET's support to Zimbabwe during the 2008-2009 cholera epidemic that affected the entire country is an excellent case study of benefits that accrue from membership to a network. In December 2008 and January 2009, the Zimbabwe Ministry of Health and Child Welfare received support from AFENET to assist in the control of the cholera epidemic. The support was provided through the Zimbabwe FELTP and included oral rehydration salts, gumboots, facemasks, aprons, surgical gloves and laboratory antimicrobial sensitivity testing discs. The donations from AFENET were procured using CDC funds and focused on protecting the frontline health workers and saving lives of cases[29].

Third, the network structure allows for easy sharing of information and resources across the network and with partners. Of particular interest is shipment of laboratory specimens across geographical borders during outbreaks to reference laboratories in Africa and outside the continent. During the 2006-2007 Rift Valley Fever (RVF) outbreak that affected Tanzania and Kenya [30-31], information sharing and technical collaborations between the respective FELTPs in the two neighbouring countries contributed towards timely investigation and containment of the outbreak. Graduates from the Kenya FELTP participated in the 2008 Ebola outbreak investigations in Uganda [32-33]. Through assisting Ugandan counterparts to contain the outbreak, the Kenya public health system's capacity to respond to Ebola and other viral haemorrhagic fevers was strengthened.

The growing network and partnerships that have been built create opportunities for sharing scientific research activities

and findings. Through the regional AFENET conferences held biennially, trainees from the various programs have presented scientific abstracts based on activities undertaken during their training. The last two AFENET Regional conferences were held in Uganda and Kenya in 2007 and 2009, respectively, and the next conference will be held in Tanzania in December 2011.

Beginning in 2008, AFENET, through its partnership with the Pan African Medical Journal (PAMJ) <http://www.panafrican-med-journal.com/>, hosts the editorial office for this journal with the aim of encouraging scientific publication among its membership. Several trainees, alumni and staff from AFENET's member programs have published in the journal on topics varying from pesticide poisoning to HIV status disclosure among women attending PMTCT in Zimbabwe. Three scientific writing workshops have been held to support trainees to develop manuscripts for publication. Starting with the 2011 AFENET Scientific Conference, PAMJ-AFENET scientific writing workshops will be held as part of the pre-conference activities at all AFENET scientific conferences. This journal presents the Network with a forum to share scientific outputs with the wider scientific audience.

In 2009, AFENET collaborated with the Nigeria FELTP, the U.S. Department of Health and Human Services' Office of Global Health Affairs, and Usmanu Danfodiyo University to establish a training program for lower- and mid-level health workers, referred to as "The Health Diplomacy Program". The program has trained 87 health staff in basic epidemiological skills and health leadership and management skills. This initiative has helped strengthen the public health workforce by not only focusing on the top-tier level of management but also focusing on the lower tiers that form the bulk of the health work force.

A number of other types of training programs have been initiated due to networking among partners. For example, AFENET, through the Ghana FELTP, adapted CDC's Sustainable Management Development Program (SMDP), which supports public health leaders and managers by enhancing their management capacity, to the African context and developed the Ghana Management Training Centre. Courses such as Health Management and Information Systems (HMIS) and Improving Management of Public Health Intervention Networks (IMPHI) have been delivered at least annually to participants from member programs like Kenya, Nigeria, Tanzania, Uganda and Zimbabwe with CDC support.

Intra-country networks have also played vital roles in human resource capacity building. The Uganda Immunization Training Program (UITP), for instance, is a collaboration between AFENET, the Uganda Ministry of Health, Uganda National Expanded Programme on Immunisation (UNEPI), WHO and the Task Force for Child Survival. This program, funded by Merck Vaccine Network, has trained over 500 national, midlevel and lower-cadre health staff in Uganda on skills that can improve mother and child survival through better immunization service management.

AFENET is a key champion of public health laboratory capacity building and laboratory systems strengthening, a neglected area in many African nations [6]. Through the AFENET-Lab initiatives,

Table 2: Summary of outbreaks investigations conducted in the AFENET member programs

Program	Outbreaks (Year)	Trainees' involvement
<b>Central Africa</b>	Polio (2011), cholera (2011)	Data collection and analysis, summaries of epidemiological information
<b>Ethiopia</b>	Measles, whooping cough, rabies, anthrax, acute watery diarrhoea, polio, malaria, malnutrition, river pollution (2010)	Determined factors associated with disease (measles), health education (malaria, malnutrition)
<b>Ghana</b>	Measles, H1N1, (2010, 2011), influenza A (2007, 2009), food-borne outbreaks (2010), rabies (2010), whooping cough (2010), meningitis (2007, 2011)	Identified magnitude, source, factors contributing to outbreak and implement preventable and control measures, Influenza: contact follow-up
<b>Kenya*</b>	Cholera (2008, 2009), influenza A, rift valley fever (2006-2007), aflatoxicosis (2007), nodding disease (2010), Leishmaniasis (2010), Meningitis (2007), Rabies (2011), yellow fever (2011)	Surveillance and investigation, Vibrio Cholera Isolation
<b>Mozambique</b>	Measles, cholera, food-borne pesticide intoxication	Case identification, line listing, source investigation
<b>Nigeria</b>	Meningitis (2007, 2009), lead poisoning (2010), cholera (2009, 2010), polio (2011), cerebro-spinal meningitis (2011), RVF (2007), fluosis (2011), Lassa fever (2009, 2011), avian Influenza (2007), diethylene glycol poisoning (2009), leptospirosis	Assess magnitude of outbreak, identify risk factors, provide response activities, health education, case management, lab confirmation (cholera). laboratory confirmation, training of health care workers on the use of personal protective equipment, and community health education (Lassa fever), Identify risk factors, hygiene and sanitation, health education and rodent management (leptospirosis)
<b>Rwanda</b>	Lead -poisoning	
<b>South Africa</b>	Cholera (2009, 2010), botulism (2009), food poisoning (2009), food poisoning (2009)	Case definition, line listing, case identification, community sensitization
<b>Tanzania</b>	Rift valley fever (2010), E. Coli, Pseudomonas aeruginosa, H1N1 in ostriches	Sero-survey of exposed vets (H1N1)
	Rift Valley Fever (2007), measles (2010), cholera (2010, 2011), viral hemorrhagic fever, 2011, bomb blasts (2011),	Immunisation campaigns, index case tracing, health education
	Marburg/Ebola (2007, 2008), Ebola (2011), cholera (2007), anthrax (2007), hepatitis E (2008), malaria (2009, 2010), polio (2010), Yellow fever (2011), dysentery, influenza, plague (2007), meningitis (2007)	Screening, case identification, surveillance, training health workers, training community health workers, health education, sensitization (Ebola), Health capacity to assess disease, community sensitization (anthrax), case identification (hepatitis E), Response interventions, health education, treatment interventions (malaria), Identify causative agent and source of outbreak, Health education (dysentery), Case management, surveillance, laboratory support, contact tracing (H1N1), spraying fleas (plague)
<b>Uganda</b>		
<b>West Africa</b>	Cholera, meningitis, yellow fever, measles (2010)	Index case tracing, line listing, health education, vaccination campaigns (measles)
<b>Zimbabwe</b>	Cholera (2008), anthrax (2008, 2009), malaria (2008), rabies (2008), salmonellosis, dysentery (2010), typhoid (2010), measles (2010)	Source and case identification, control measures, health education, improvement of sanitation, Case finding, education campaigns (anthrax), Characterise outbreak, determine factors associated with disease (measles)

\*The Kenya FELTP trains residents from South Sudan



AFENET has implemented multiple laboratory strengthening activities in different parts of Africa. These include short-course trainings for frontline and midlevel laboratory personnel which have been conducted in Tanzania, Uganda, and Zimbabwe. Further, AFENET has collaborated with CDC and other partners to pilot a basic laboratory information system (referred to as BLIS) in Uganda and Tanzania with the aim of improving storage and retrieval of laboratory data for better patient management and decision making. In 2010 AFENET-Lab, with the support of the International Laboratory Branch of CDC, began assisting several countries to implement laboratory accreditation activities using the WHO-AFRO Stepwise Laboratory Quality Improvement Process Towards Accreditation, known as SLIPTA. Two years after the launch of the WHO-AFRO Stepwise approach, SLMTA (Strengthening Laboratory Management Towards Accreditation)

training activities are underway in over 15 African countries and AFENET has been directly involved in six of these countries namely Angola, Central African Republic, Rwanda, Swaziland, Malawi, Uganda, Tanzania, Zimbabwe. AFENET has also been involved in conducting regional SLMTA Trainer of Trainers (TOT) courses, through provision of technical expertise as SLMTA master trainers. Figure 1 shows progress towards SLMTA implementation in Africa.

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## REGIONAL ROLL OUT

3 years after launch, SLMTA training underway in over 15 countries



Developed by the African Field Epidemiology Network (AFENET): A healthier Africa

Figure 1 : SLMTA Implementation in Africa

## Discussion

AFENET's tripartite working relationship with government technocrats from human health and animal sectors, academicians from partner universities and development partners presents the Network with a vantage point. The Network is able to: leverage resources to support field epidemiology and public health laboratory training and service delivery notably in the area of outbreak investigation and response, disease surveillance; bypass government bureaucracies that often hinder and frustrate development partners during program implementation; and consolidate efforts of different partners that are channelled through the FELTPs by networking graduates through alumni associations and calling on them to offer technical support in various public health capacities as the need arises. While governments tend to have a long-term perspective on national health issues, the private sector often has short-to-medium term investments in health. AFENET presents a bridging platform allowing for continuity of health interventions at the national and regional level while offering free exit and entry for existing and new partners respectively.

Based on the successes recorded in AFENET's first 5 years, we envision that the Network's membership will continue to expand as new programs are established. The lessons learned over the years such as the need for early involvement of key stakeholders (ministries of health and local universities) in design of new programs and projects being key to project success, will be useful in initiating new programs, and building sustainability frameworks for FETPs and FELTPs in Africa. AFENET will continue to play its role in coordinating, advocacy, and building capacity for epidemic disease preparedness and response.

It is our hope that graduates from member programs will help shape public health policy and practice in Africa. AFENET will continue to play a pivotal role in IDSR implementation and support countries to become IHR compliant. As reported in this paper and elsewhere[24], FELTP alumni take up leadership positions at local, regional and international levels. With a membership that covers over 80% of sub-Saharan Africa, AFENET member FELTPs are destined to not only influence public health decision making by providing public health leaders but to also contribute towards other health systems blocks such as service delivery and leadership/governance.

The health work force in Africa is being strengthened through the 2-year graduate FELTP and 2-week-long in-service short courses of: surveillance and outbreak response, lab management, as well as health leadership and management. Service delivery is enhanced through the trainees' performance improvement projects, trainees' participation in outbreak response and other routine public health services during the field component of the training.

AFENET is a key champion of public health laboratory capacity building and laboratory systems strengthening, a neglected area in many African nations. Our role in the roll out of WHO-AFRO's stepwise approach for Strengthening Laboratory Management Towards Accreditation (SLMTA), distribution of outbreak

investigation kits to member countries, and in-service training for laboratory personnel, are all testimony to that.

Despite the above successes, AFENET's continued survival and vibrancy is threatened by at least two challenges. The most notable challenge is the need for a reliable stream of funding to sustain the Network's core priorities and maintain the ever increasing number of member programs. As mentioned earlier, FETPs and FELTPs are resource intensive (the average cost of training one person through the 2 year masters' program is U.S. \$ 40,000) [20]. Moreover, most African governments do not have the capacity to fully shoulder all the costs, given competing health needs. This calls for diversification of the funding base, innovation, and design strategies to attract new partners while sustaining existing ones. Health Systems 20/20, with funding from the USAID, helped AFENET develop a 5-year resource mobilization plan and is currently supporting the establishment of a fully fledged business development unit (currently housed under AFENET's Science and Public Affairs unit), diversification of resource mobilization strategies and funding sources.

As the Network continues to expand, harmonization of individual members' priorities with the collective goals of the network must be considered. Decision making may become difficult given the multiplicity of partners and divergent interests. For example, members may place varying levels of importance on various aspects within their individual program such as academics, research, field service, or improving public health service delivery. Members may prefer to channel resources to address a specific public health priority, or may base priorities on current available funding opportunities. These actions may be inconsistent or incompatible with other members or with the network as a whole. These competing interests must be acknowledged and managed within the context of the network keeping in mind its greater value.

## Conclusion

AFENET presents a versatile networking model that brings together different stakeholders to strengthen African public health systems through field epidemiology and public health laboratory capacity building. Through networking of existing FELTPs and collaboration with development partners, the number of FELTPs has tripled from 4 at inception of AFENET to 12 in 2011, and the number of outbreaks investigated with FELTP involvement has increased. However, there is need for continued support from both development partners and African governments to uphold the highlighted successes and to overcome looming challenges to advancement of field epidemiology implementation in sub-Saharan Africa.

## Abbreviations

AFENET	African Field Epidemiology Network
CDC	Centers for Disease Control and Prevention
EAPHLN	East African Public Health Laboratory Network
EARHN	East African Reproductive Health Network
FELTP	Field Epidemiology and Laboratory Training Program
FETP	Field Epidemiology Training Program
FLU-LAB	Global Influenza Network
GOARN	Global Outbreak Alert and Response Network
IDSR	Integrated Disease Surveillance and Response
IHR	International Health Regulations
SARHN	Southern Africa Reproductive Health Network
TEPHINET	Training Programs in Epidemiology for Public Health Interventions Network
USAID	U.S. Agency for International Development
WARHN	Western African Reproductive Network
WHO	World Health Organisation

## Competing interests

None

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## Authors' contributions

GSN contributed towards conceptualization, data collection, drafting of the manuscript and reviewed the final draft; MD contributed towards conceptualization, drafting of the manuscript and reviewed the final draft; BR participated in data collection, drafting of the manuscript and reviewed the final draft; DM participated in drafting of the manuscript and reviewed the final draft; TM contributed towards conceptualization, drafting of the manuscript and reviewed the final draft; NP contributed towards conceptualization, drafting of the manuscript and reviewed the final draft.

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## CENTRAL AFRICAN FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAM: BUILDING AND STRENGTHENING REGIONAL WORKFORCE CAPACITY IN PUBLIC HEALTH

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Key words: epidemiology, education, training, public health, Central Africa

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### Abstract

The Central African Field Epidemiology and Laboratory Training Program (CAFELTP) is a 2-year public health leadership capacity building training program. It was established in October 2010 to enhance capacity for applied epidemiology and public health laboratory services in three countries: Cameroon, Central African Republic, and the Democratic Republic of Congo. The aim of the program is to develop a trained public health workforce to assure that acute public health events are detected, investigated, and responded to quickly and effectively. The program consists of 25% didactic and 75% practical training (field based activities). Although the program is still in its infancy, the residents have already responded to six outbreak investigations in the region, evaluated 18 public health surveillance systems and public health programs, and completed 18 management projects. Through these various activities, information is shared to understand similarities and differences in the region leading to new and innovative approaches in public health. The program provides opportunities for regional and international networking in field epidemiology and laboratory activities, and is particularly beneficial for countries that may not have the immediate resources to host an individual country program. Several of the trainees from the first cohort already hold leadership positions within the ministries of health and national laboratories, and will return to their assignments better equipped to face the public health challenges in the region. They bring with them knowledge, practical training, and experiences gained through the program to shape the future of the public health landscape in their countries.

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## Introduction

The Central African Field Epidemiology Training Program (CAFELTP) was established in October 2010 to enhance capacity for applied epidemiology and public health laboratory services in three countries: Cameroon (CAE), Central African Republic (CAR), and the Democratic Republic of Congo (DRC). The aim of the program is to develop a trained public health workforce to assure that acute public health events are detected, investigated, and responded to quickly and effectively. CAFELTP is part of the Bill and Melinda Gates Foundation-supported Surveillance in Central Africa (SURVAC) project, which was designed to improve disease surveillance and response with a specific focus on vaccine-preventable diseases in Central Africa.

The Central Africa region has a long history of notable disease outbreaks such as meningitis, yellow fever, measles, viral hemorrhagic fevers (Ebola and Marburg), and monkey pox [1-7]. For example, in the last decade outbreaks of meningitis occurred in Cameroon in areas of the Northwest (2001, 2004), North (2004), Southwest (2004), the Far North (2007, 2009) and Adamawa (2010) [4, 8]. Other nearly eradicated diseases, such as poliomyelitis and guinea worm, have re-emerged in the region to have a significant public health impact. [9-10] HIV/AIDS and tuberculosis are also prevalent in the region [1-3]. Vectors responsible for deadly diseases such as malaria and trypanosomiasis are common in Central Africa. [11-12] Although classical Master of Public Health (MPH) programs are offered in DRC and Cameroon, the focus of these programs is not on field epidemiology and public health laboratory training and, at present, no formal MPH program is offered in CAR. The public health challenges in the region have fueled the need to build workforce capacity to address the unmet need for field epidemiologists and public health laboratory epidemiologists to perform outbreak investigations, surveillance, and research [13].

## Overview of CAFELTP

### History of CAFELTP

The CAFELTP is a sub-regional program established at the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, based in Yaoundé, Cameroun. The mission of the program is to strengthen the public health workforce capacity in Cameroun, Central African Republic and the Democratic Republic of Congo to respond to public health emergencies such as outbreaks, natural disasters, and emerging infectious diseases. Its vision is to strengthen public health surveillance and laboratory systems through 1) developing leadership in public health; 2) educating and training public health professionals in epidemiology and laboratory sciences; 3) supporting public health laboratory services in surveillance and field investigations; 4) supplying technical support and advisory services to key stakeholders such as the MOH; and 5) improving communications and networking within the country and throughout the region.

The program offers two tracks: Field Epidemiology and Laboratory Management. The CAFELTP began with 18 residents in the first

cohort: five each from CAE and CAR, and eight from DRC. Of the 18 residents, 12 follow the field epidemiology track and six follow the laboratory track. Ten of the epidemiology residents are medical doctors and two are veterinarians. The six laboratorians are medical biologists. All didactic courses are conducted at the University of Yaoundé 1, in Cameroon. There are four didactic blocks which account for 25% of the 2-year long program. In between the didactic blocks the residents conduct field activities to learn while offering public health service in their home countries under supervision from the in country stakeholders and the under guidance of the Resident Advisors.

## Funding and Key Partnerships

CAFELTP is a partnership between the Bill and Melinda Gates Foundation (BMGF), the CDC Foundation, the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), the African Field Epidemiology Network (AFENET) and three Central African countries (Cameroon, the Democratic Republic of Congo and the Central African Republic). Though the program is hosted at the University of Yaoundé I, it is integrated within the ministries of health of the three participating countries. CAFELTP is directed by the Director of the Department of Disease Control Unit at the Ministry of Public Health, Yaoundé, Cameroon. Furthermore, Country Directors from CAR and DRC are members of the steering committee and actively participate in the residents' field-based activities by identifying suitable field sites and supervising the residents during their field placements. The program is financially supported by the BMGF and the United States Agency for International Development (USAID). One of the BMGF areas of focus includes vaccine-preventable diseases, neglected tropical diseases, and other infectious diseases. The BMGF has committed to financially supporting 15 residents annually for a period of 5 years. USAID currently sponsors the three veterinary residents from DRC. The program works closely with AFENET and CDC Atlanta to receive technical oversight and administrative support.

## Description of the Components of the Program

CAFELTP is a 2-year public health capacity building training program using the FELTP "learn-by-doing" model. Upon completion of the program, students will receive a Master's of Science degree in Applied Epidemiology or Laboratory Management from the University of Yaoundé I. The program consists of 25% didactic and 75% practical (field based activities). The didactic portion of the program consists of lectures, conferences and seminars, tutorials, local, national and international colloquiums, workshops and congresses. It is organized into modules, with the first module consisting of the core public health courses in epidemiology, laboratory, surveillance, and biostatistics for the first 6 weeks. After completion of these modules, the epidemiology residents are assigned to departments within the ministries of health and agriculture in their respective countries. The laboratory residents are assigned to a national laboratory or other accredited laboratory institution. The residents are supervised and mentored by a senior epidemiologist, a public health specialist, or a laboratory

scientist. The residents are required to do four practical projects over the 2-year period. The duration of the field-based practicum varies from 3 to 4 months at a time. Over the 2-year period, the residents are expected to complete the following requirements: evaluation of a surveillance system, evaluation of a health program, evaluation of a health management project, outbreak investigation, field project, data surveillance analysis report, dissertation, submission of two publishable manuscripts, and presentations at national, regional or international conferences. Table 1 shows the distribution of field sites within the ministries of health.

**Table 1. Distribution of Field Sites within the 3 Ministries of Health**

Country	Name of Sites	Number of Residents
Cameroon	Expanded Program on Immunization (EPI)	2
	Division of Disease Control	1
	National Laboratory	2
	Expanded Program on Immunization (EPI)	2
Central African Republic	Division of Disease Control and Prevention	1
	Bangui Community Hospital (Hôpital Communautaire de Bangui)	2
Democratic Republic of Congo	Expanded Program on Immunization (EPI)	1
	Veterinary Lab at the Ministry of Agriculture	2
	Division of Disease Control	3
	National Research Laboratory	2

## Achievements of CAFELTP

Although the program is still in its infancy, there are several achievements worth noting. During the program's short duration, CAFELTP residents have already participated in six outbreak investigations, including poliomyelitis and cholera in DRC and cholera in various regions of Cameroon. During outbreak investigations, the residents have assisted the Ministries of Health with data collection and analysis, and summaries of epidemiological information. The residents are also involved in weekly surveillance meetings within the departments of disease control in their respective countries. The nature of emerging and re-emerging infectious diseases in the Congo Basin and Central African region makes it likely that the students will have many opportunities to participate and become more proficient in outbreak investigation and response.

The Central Africa Program became the first FELTP to provide the "Strengthening Laboratory Management Toward Accreditation" (SLMTA) training to the laboratory residents in July 2011. This training was conducted in collaboration with the CDC International Laboratory Branch. The laboratory residents received training on managing and improving laboratories and laboratory workforce to meet accreditation standards according to the WHO guidelines. The residents conducted baseline assessments at their assigned laboratories, and identified an improvement project to help the laboratory become accredited in the future. This capacity-building

activity provides the residents with the opportunity to work hand-in-hand with the SLMTA trainers and the laboratory directors and managers toward laboratory accreditation.

### Contributions of CAFELTP to Building Long-Term Sustainability in Public Health

Like the similar West African Field Epidemiology and Laboratory Training Program (WAFELTP), the CAFELTP is addressing public health challenges using a regional approach. In addition to responding to outbreak investigations, the residents have evaluated 18 public health surveillance systems and public health programs, and completed 18 management projects.

These projects include evaluations of public health surveillance systems for measles, maternal and neonatal tetanus, acute flaccid paralysis, and bacterial meningitis. Through these various activities, information is being shared to understand similarities and differences in the region, which can lead to new and innovative approaches for public health response. The program provides opportunities for regional and international networking in field epidemiology and laboratory practice, particularly for countries that may not currently have the resources to host their own program.

Several of the residents from the first cohort already hold leadership positions within the ministry of health and national laboratory in their respective countries, and will return to their assignments better equipped to face the public health challenges in the region. They bring with them knowledge, training and experiences gained to help shape the future of the public health landscape in their countries.

The program also promotes long-term epidemiological and laboratory capacity building when trainees will return to the program as field supervisors, trainers, and mentors to future cohorts, passing on their knowledge to the next generation of public health leaders, and therefore expanding the pool of highly qualified public health professionals in the region. The cross border nature of the program will enhance core capacities for implementation of the revised International Health Regulations in this highly epidemic prone region; the residents can collaborate on outbreaks that cross the borders of the three countries[14-15].

## Sustainability of CAFELTP

Similar to the other more established programs, CAFELTP must confront the inevitable challenges of continued funding and long-term sustainability. A critical issue for developing a long-term sustainability plan is maintaining and continuing the program services after the end of funding. The initial funding from the BMGF is expected to last 5 years from the onset of the program. Ensuring relevant career opportunities are available for graduates is another important issue. The literature shows that a lack of post-graduate training and opportunities for career advancement, low salaries and conditions of services are some of the factors for migration of healthcare workers [9, 10]. However, greater financial incentives, opportunities for professional and personal growth are some of the factors for recruitment and retention of healthcare workers. CAFELTP team along with its partners will work on a career portfolio, which would allow for promotion and salary increase based on candidate qualifications and experience upon graduation from the program. Opportunities in government for highly qualified field epidemiologists and public health laboratorians should be made available.

To be sustainable in the long term, the government entities and institutions in the countries must assume ownership of the program with multi-sector support (i.e., from the ministries of health, ministries of agriculture, ministries of higher education and other institutions). Involvement of the governments in sponsoring residents is a step forward to ensure sustainability of the program. However, the institutions also need to be ready and capable of providing the necessary resources, the administrative environment, and long-term dedication to make field epidemiology and laboratory management training work.

The CAFELTP management team is also working with the CDC country offices in the region and other public health organizations to provide technical and financial support to the program. To ensure that workforce capacity remains in the region, residents are required to sign a contract committing to work in their country's government service for a minimum number of years after graduation (typically 3 to 5 depending on each country's policy).

Strategies for sustainability of the Central Africa program include lower costs, increased efficiencies, and increasing the visibility of the program by marketing the CAFELTP and its results to various stakeholders in the region. For example CAFELTP can endeavor to participate in projects that have a high public health impact, or consider combining all didactics into one session at the beginning to reduce travel costs, or even requiring students to pay some portion of their tuition fees. However, the program trains individuals in one of the most resource-challenged regions of the world and therefore self-funding may not be a reality in the near term. Other options could be to recruit part-time students who are already employed, and who will be able to assume their tuition fees.

The program is working on finding options from multiple sources at various levels. One of these options could be a combination of new funding for categorical programs to combat priority diseases, including the US President's Emergency Plan for AIDS Relief (PEPFAR), the Global Fund to Fight Tuberculosis, AIDS and Malaria, and the Global Alliance for Vaccines and Immunizations (GAVI) Alliance. These programs might contribute

to strengthening human capacity by supporting initiatives such as training programs in field epidemiology. Thus, the training programs can meet and sustain their goals with an added positive effect on countries' abilities to improve health in many areas.[16]

## Challenges

Since its inception in October 2010, the program has been running well despite experiencing some challenges. The scarcity of applied epidemiology and other public health textbooks available in French makes it difficult to provide reference and support materials to the residents. The limited resources available from governments and other donors creates difficulty in addressing critical public health needs and limits the program's ability to recruit and train a critical mass of CAFELTP graduates in the three countries. As a result, at this time it is not possible to ensure an adequate number of well-trained public health staff for deployment when events of public health concern occur. However, there are ongoing efforts to explore strategies to recruit more representatives from the various provinces of each country into CAFELTP.

## Conclusion

In light of the demonstrated public health challenges within the region, the training model of the FELTP will continue to be developed in Central Africa. The limited available resources and integrated nature of health issues has led to the regional strategy currently being implemented. Contributing factors such as underdeveloped infrastructure, limited access to quality health care, limited laboratory capacity, as well as social and environmental influences indicate that some solutions can only be realized in the long term. There is a need to improve the capacity for applied epidemiology and laboratory management at all levels of government. The program is directly meeting the acute need for public health specialists, which will lead to strengthening public health workforce capacity to prevent diseases in the region. As the program becomes more established, strong government and university support will be needed to achieve its objectives. Forums for current residents and alumni to showcase their work will raise awareness of the value of FELTPs to governments and institutions in the region. Public health issues can be addressed by these competently-trained public-health professionals, increase the country's ability to combat AIDS, tuberculosis, and malaria—as well as diarrheal diseases, maternal mortality, and chronic diseases, and to address the International Health Regulations and other disease priorities of the ministries of health [6].

As countries meet the challenge of institutionalizing their programs, the CAFELTP concept may increasingly be recognized as a model for sustainable regional public health capacity development and expansion of FELTPs into other countries in the Central Africa region. The CAFELTP experience indicates that considerable progress in building applied epidemiology program from a regional perspective can be achieved. The program is building international collaborations and training future public-health leaders.

## Author Contributions

GOA, AN, BKI : Contributed to writing drafts of the article, reviewed several drafts, provided important intellectual content, and approval of the version to be published.

CK, FXMK, WG, LM, JPB, JN: Contributed to revising the article for important intellectual content, and approval of the version to be published.

DK, DD, MAD, DM, PN: Contributed to development and design of the concept, writing the article and providing important intellectual content, and final approval of the version to be published.

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## Competing interests

The authors declare that they have no competing interests.

## Tables and Figures

Table 1. Distribution of Field Sites within the 3 Ministries of Health

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## ONE HEALTH CONCEPT FOR STRENGTHENING PUBLIC HEALTH SURVEILLANCE AND RESPONSE THROUGH FIELD EPIDEMIOLOGY AND LABORATORY TRAINING IN GHANA

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Key words: Ghana, public health, One Health, epidemics, Trainees, FELTP, applied epidemiology

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### Abstract

The lack of highly trained field epidemiologists in the public health system in Ghana has been known since the 1970s when the Planning Unit was established in the Ghana Ministry of Health. When the Public Health School was started in 1994, the decision was taken to develop a 1 academic-year general MPH course. The persisting need for well-trained epidemiologists to support the public health surveillance, outbreak investigation and response system made the development of the Field Epidemiology and Laboratory Training Programme (FELTP) a national priority. The School of Public Health and the Ministry of Health therefore requested the technical and financial assistance of the United States Centers for Disease Control and Prevention (CDC) in organizing the Programme. The collaboration started by organizing short courses in disease outbreak investigations and response for serving Ghana Health Service staff. The success of the short courses led to development of the FELTP. By October 2007, the new FELTP curriculum for the award of a Masters of Philosophy in Applied Epidemiology and Disease Control was approved by the Academic Board of the University of Ghana and the programme started that academic year. Since then five cohorts of 37 residents have been enrolled in the two tracks of the programme. They consist of 12 physicians, 12 veterinarians and 13 laboratory scientists. The first two cohorts of 13 residents have graduated. The third cohort of seven has submitted dissertations and is awaiting the results. The fourth cohort has started the second year of field placement while the fifth cohort has just started the first semester. The field activities of the graduates have included disease outbreak investigations and response, evaluation of disease surveillance systems at the national level and analysis of datasets on diseases at the regional level. The residents have made a total of 25 oral presentations and 39 poster presentations at various regional and global scientific conferences.

The Ghana FELTP (GFELTP) has promoted the introduction of the One Health concept into FELTP. It hosted the first USAID-supported workshop in West Africa to further integrate and strengthen collaboration of the animal and human health sectors in the FELTP model. GFELTP has also taken the lead in hosting the first AFENET Center for Training in Public Health Leadership and Management, through which the short course on Management for Improving Public Health Interventions was developed for AFENET member countries. The GFELTP pre-tested the Integrated Avian Influenza Outbreak and Pandemic Influenza course in preparation for introducing the materials into the curriculum of other FELTP in the network.

The leadership positions to which the graduates of the program have been appointed in the human and animal Public Health Services, improvement in disease surveillance, outbreak investigation and response along with the testimony of the health authorities about their appreciation of the outputs of the graduates at various fora, is a strong indication that the GFELTP is meeting its objectives.

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## Introduction

At the request of the Ghana Ministry of Health, the University of Ghana established the School of Public Health (SPH) in October 1994. This is a 1-year course in general public health which awards a Master of Public Health (MPH) degree. The SPH was one of the beneficiaries of the Rockefeller Foundation support to the network of Public Health Schools Without Walls (PHSWOW) in the Africa Region [1]. Graduates of the SPH were found to meet the expectations of the Ministry of Health, as they took up leadership roles at district level. It was however, realized that a cadre of highly-trained epidemiologists with competencies and skills in applied epidemiology and disease control was needed to manage the existing complex of public health emergencies and emerging and re-emerging diseases, such as Severe Acute Respiratory Syndrome (SARS) and Avian influenza.

During the early stages of implementation of the Global Programme for the Control of Malaria, HIV/AIDS and Tuberculosis, the lack of highly trained field epidemiologists became more apparent as the demand for expert management, interpretation and use of disease surveillance data increased. Unfortunately, the MPH Programme did not make provisions for the training of this cadre of professionals. A process was initiated to establish a Field Epidemiology and Laboratory Training Program (FELTP) to address the identified need.

The Ghana FELTP (GFELTP) evolved from an initial collaboration with the United States (U.S.) Centers for Disease Control and Prevention (CDC), through cooperative agreements with the SPH. Activities supported by this cooperation included organization of short courses on disease surveillance, outbreak investigations and response. More than 60 serving district health staff (frontline health workers) and MPH graduates benefited from these short courses over a three-year (2003-2005) period [2]. Parts of the short course materials were later incorporated into the MPH curriculum of the School of Public Health. When, in 2005, the decision was taken to start an FELTP, the task of designing the curriculum was spearheaded by the faculty under the guidance of staff of CDC including staff from the Sustainable Management Systems Development Program (SMDP) [3].

The FELTP curriculum was adapted from CDC's core FELTP curriculum [3]. GFELTP graduates receive a Master of Philosophy (MPhil) in Applied Epidemiology and Disease Control upon completing all university requirements. In addition, graduates receive certificate of competency in field epidemiology. The program was approved by the University Academic Board and the National Accreditation Board in 2007. The program started with an initial cohort of three physicians, one laboratory scientist and one veterinarian. In keeping with the "One health" concept, to mitigate the increasing threat of outbreaks of zoonotic diseases and to further strengthen the laboratory's key role in public health surveillance and response in the country, the trainees/residents were selected from serving staff nominated by the Ghana Health Service, Ministry of Health (physicians and laboratory scientists) and the Veterinary Service Directorate, Ministry of Food and Agriculture (veterinarians).

The vision of GFELTP is to improve the health of the people

in Ghana. The mission is to contribute to addressing Ghana's public health needs and priorities through training and service provision in applied epidemiology and public health laboratory management.

The objectives of GFELTP are to:

Strengthen public health capacity by developing a cadre of health professionals with applied skills in applied epidemiology and laboratory management

Contribute to research activities on priority public health problems  
Improve national capacity to respond to public health emergencies such as disease outbreaks, natural disasters and unusual public health events including those that could be a result of chemical or bioterrorism

Strengthen national surveillance systems through a team approach (physicians, laboratory scientists and veterinarians)

Improve communications and networking of public health practitioners in the country and throughout the Africa Region

## Brief Outline Of The Course

The GFELTP is a 2 calendar-year programme with about 30% course work and 70% field work covering two tracks (i.e., the epidemiology track and the laboratory track). During the first academic year, residents study core courses that cut across the two tracks in the first semester. In the second semester, residents take courses in each of the prescribed track (i.e., epidemiology for medical and veterinary professionals or laboratory for laboratory scientists) and some selected electives to make up for the required 36 credits for the course work. In addition, residents are required to be involved in 16 weeks of field activities made up of 8 weeks at the end of the first semester to undertake evaluation of surveillance systems of selected diseases and 8 weeks at the end of the second semester for analysis of available large datasets on diseases at national or regional levels. In the second year, residents develop their research topics under the guidance of their academic supervisors and mentors. A further requirement is the organization of at least one seminar prior to going for the field work. Ten months of the second year are devoted to field practice and collection of data while providing services to the district/region of assignment. The last two months are used for data analysis and write up of theses. During the 2-year period of training especially when on field postings, residents of the programme join the staff of the Ghana Health Service and Veterinary Service Directorate to investigate and respond to disease outbreaks and public health emergencies. Being mid-career professionals in public service, the residents sometimes lead these investigations, conduct public health interventions and present written and verbal reports to stakeholders with support of their supervisors and mentors.

## Residents

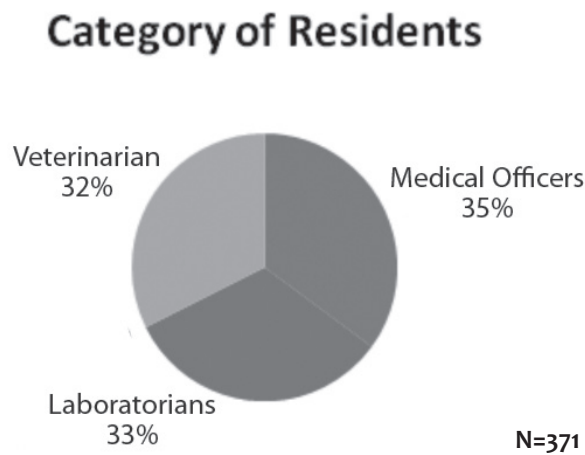
Five cohorts have so far been admitted into the residency programme. The breakdown is as shown in Table 1

**Table 1: GFELTP residents' enrollment by track and training period**

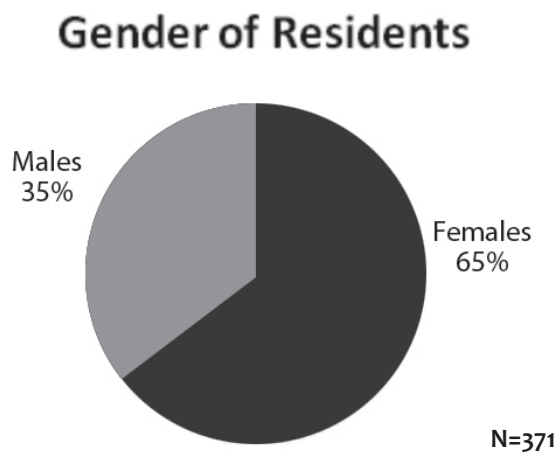
	Number of Residents	Epidemiology Track	Laboratory Track
Cohort 1 (2007-2009)	5	4 (3 physicians, 1 Veterinarian)	1
Cohort 2 (2008-2010)	8	5 (2 physicians, 3 Veterinarians)	3
Cohort 3 (2009-2011)	7	5 (2 physicians, 3 Veterinarians)	2
Cohort 4 (2010-2012)	8	5 (3 physician, 2 Veterinarians)	3
Cohort 5 (2011-2013)	9	6 (3 physician, 3 Veterinarian)	3
<b>Total</b>	<b>37</b>	<b>25</b>	<b>12</b>

The distribution of residents by professional background and sex is shown in Figure 1 and Figure 2

**Figure 1: Proportion of residents by profession**



**Figure 2: Sex distribution of residents**



## The Major Achievements Of The Programme

### Pre-GFELTP Activities

Workshop on Outbreak Investigations for Disease Control Officers, Kintampo Rural Health Training School (May 2003). Graduates of the Training School serve as disease control officers responsible for surveillance and outbreak investigation activities at the district and facility levels of the health system. The workshop was organized to further train the trainee-officers on principles of disease outbreak investigation using modules adapted from the US CDC FELTP training materials.

### Needs Assessment in Five Selected Districts on Integrated Disease Surveillance and Response (IDSR), 16 April – 7 May, 2005

As part of the collaboration between the Disease Surveillance Department (DSD) and the School of Public Health (SPH), a needs assessment to determine the gaps in disease surveillance with emphasis on disease outbreak investigations and response, data analysis and interpretation and capacity development was conducted in five districts in Ghana, namely Asuogyaman, Ketu, Kassena-Nankana, Wassa West and Berekum Districts. Needs assessment tools were developed and discussed by DSD and SPH at an orientation before the exercise commenced. The reports from these assessments were compiled into a composite document for implementation of sensitization workshops for the districts.

### Workshop on Disease Outbreaks, Investigations and Response in Asuogyaman District, 11-15 July 2005.

The workshop had 19 participants, made up of Disease Control Officers, Nurses, Statistician, Midwives, and Medical Superintendent at the Volta River Authority (VRA) Hospital, Medical Assistant and District Director of Health Services. The general objective of the workshop was to give health workers in the district the appropriate knowledge and skills in identifying cases of priority diseases and also process the data and use it for public health action. In addition, core stakeholders such as district assembly members, immigration and custom officers, teachers, information officers, the police and the media were also involved. The specific objectives were to enable participants to:

- Detect priority diseases
- Analyze and interpret data on priority diseases
- Investigate and respond to suspected outbreaks
- Be prepared for disease epidemics
- Investigate and respond to other priority diseases
- Supervise and provide feedback

Be able to monitor and evaluate IDSR implementation  
The workshop employed methods including presentations on Integrated Disease Surveillance and Response training modules, role-playing, group work and field exercises. Similar workshops were organized in Ketu, Upper East and Berekum districts. As a result of these workshops, participating districts reported

improvements in their disease detection, investigation and public health response.

Major activities undertaken by GFELTP residents over the years are summarized as follows:

### Disease Outbreak Investigations

A total of 23 disease outbreak investigations were conducted by GFELTP residents between 2007 and 2011. These include outbreaks on meningitis, influenza (type A), human rabies, food borne diseases, measles, gastrointestinal diseases, Yellow fever, pertussis, cholera and herpes B. The investigation of an outbreak of herpes B virus infection in May 2011 in Techiman and adjoining districts of central Ghana reported this virus as the probable cause of zoonotic encephalitis in Ghana for the first time. The large number of disease outbreak investigations and the timely response that residents of the programme have been able to carry out alongside other Ghana Health Service or Veterinary Service staff to date have appreciably enhanced disease surveillance and response capacity in the country. In particular, the role that GFELTP team of physicians, veterinarians and laboratory scientists played in the investigation and response to the AI outbreak in Ghana in 2007, the multiple outbreaks of rabies in 2009 -2011, and the monkey-associated herpes-B encephalitis outbreak in 2011 demonstrated the great value of the One Health concept and the multi-disciplinary team approach which the GFELTP has adopted.

### Disease Surveillance and Field Studies

As part of end-of-year one field requirements, 31 evaluations of various disease surveillance systems were conducted between 2008 and 2011. They included both communicable and non-communicable diseases. Residents have also analyzed available large datasets for 28 selected diseases at the regional health directorates.

## Scientific Conferences

### TEPHINET Conferences

**Brasilia, Brazil, December, 2006:** Six residents presented abstracts at the 4th TEPHINET Scientific Conference. The presentations were made up of two oral presentations and four poster presentations.

**Kuala Lumpur, Malaysia (November 2008):** During the Fifth TEPHINET Scientific Conference in Kuala Lumpur, Malaysia in November 2008, GFELTP residents presented six abstracts, made up of two orals and four posters.

**Cape Town, South Africa (December, 2010):** At the 6th TEPHINET Global Scientific Conference, Nine GFELTP residents presented three orals and six poster presentations. One of them, Ms. Joyce Der, a cohort-II laboratory track resident was the overall winner in the oral presentation category. She presented the epidemiological and laboratory investigation of a food poisoning outbreak at a popular urban-area food center in the Eastern Region of Ghana.

## African Regional Conferences

Accra- Ghana, December, 2005:GFELTP hosted the 1stAFENET Regional Scientific Conference following the birth of AFENET in August of the same year in Accra Ghana[4]. The residents made five oral presentations and six poster presentations.

Kampala, Uganda- December 2007:Nine presentations were made by GFELTP residents at the 2nd AFENET Regional Scientific Conference in Kampala. Four were orals and five were poster presentations.

Mombasa, Kenya- August 2009:A total of 15 posters and 6 oral presentations were made at the 5th TEPHINET African Regional/3rdAFENET Scientific Conference by GFELTP residents. One of them, Dr Paul Polkuu, a veterinarian and cohort II epidemiology track resident received the runner-up award for the best poster presentation. The presentation was on the investigation of an Influenza-like Illness (ILI) outbreak at a co-educational high school in the Eastern Regional mountains of Ghana.

## EIS Conferences, Atlanta

Two GFELTP residents made presentations at the EIS Conference International Night meetings in 2010 and 2011. The respective presentations were titled; Cross border Rabies Outbreak, North-Eastern Ghana, and Cholera Outbreak in East Akim District, Ghana

## IEA World Congress of Epidemiology

One resident won the International Epidemiological Association bursary award and made a poster presentation titled; Progress Towards Eradication of Poliomyelitis in Ghana: A Review of the Eastern Region at the 19th Annual World Conference in Edinburgh, Scotland in August 2011.

Two other residents had three papers accepted for presentation at the 2011 International Society of Infectious Diseases conference on Neglected Tropical Diseases held in Boston, USA but could not attend due to funding limitations

## Residents Publications:

A paper by a cohort-II epidemiology track resident “Community-wide outbreak of cholera following unhygienic practices by small-scale unregistered gold miners, East-Akim District, Ghana – 2010” was accepted for publication by the Ghana Medical Journal in September, 2011

Four public health articles by residents have been published in two veterinary bulletins and two national daily newspaper columns

## Onsite Field Supervision Mentorship & Public Health Advocacy

In addition to SPH faculty members, selected Regional Directors of Health Services and District Directors of Health Services were oriented from the start of GFELTP to serve as supervisors and mentors for residents at various field sites. In May 2009, a Resident Advisor was appointed for GFELTP. Since then, in collaboration with the Ghana Health Service Public Health Division, he has conducted periodic rounds of visits to residents’ Field Sites. The aims of the visits are to 1), provide mentorship, supervision and tutoring to residents during their field trainings, 2) conduct local stakeholders’ feedback and public health consensus seminars and 3) conduct program advocacy and sensitization meetings with key stakeholders at regional and district levels. Multiple visits have been made to the Eastern, Central, Brong-Ahafo, Greater Accra Northern, Upper West, Upper East, Volta and Western regions. There have been 10 regional stakeholders’ seminars where residents made presentations on projects they undertook in various regions or districts to stakeholders from the community, Ghana Health Service and Veterinary Services Directorate. These fora provided opportunities for feedback, inter-sectoral discussions leading to consensus on public health action and sharing of information on GFELTP activities and opportunities. This novel approach of collaborative training and service at the local level has enhanced public health decision, action and GFELTP visibility at the health system frontline level.

## Improving Management Of Public Health Interventions Workshops

The GFELTP has hosted three workshops on Improving Management of Public Health Interventions. This followed an introductory course to train proposed trainers in 2008. The trainers were Deputy Directors in charge of Public Health at Regional level in Ghana. There were 17 participants and the training was facilitated by CDC, Ghana Health Service (GHS) and GFELTP staff. The first workshop was held from June 22- July 17, 2009 and was targeted at health practitioners in the African Sub-Region. Twenty-two health officials from four African Countries attended the course. Out of the 22 participants, 19 were Ghanaians, 1Kenyan, 1 Tanzanian and 1 Ugandan. All 19 Ghanaian participants were staff from the Ghana Health Service. The course was divided into four modules. These four modules were designed to touch on all aspects of health management. The faculty was made up of sixteen staff from University of Ghana Business School (UGBS), Ghana Institute for Management and Public Administration, AFENET, SPH, and CDC- SMDP.

Modules covered were:

- Leadership, Networking and Advocacy
- Project Planning and Management for Public Health
- Operational Management
- Monitoring and Evaluation for Health Programs

The second workshop was held from 21st June to 16th July 2010 and had a cohort of 16 trainees from Ghana (11), Nigeria (4) and Rwanda (1). Participants from Ghana were staff of Ghana Health Services made up of District Medical Directors and those from Nigeria were made up of lecturers in University, FELTP residents and staff of CDC.

Uniqueness of the course was that during the four-week period,

participants presented project proposals on management of public health interventions at the beginning of the course. They were helped to develop the proposals and implement them over the subsequent three months after the course. All participants were visited by a facilitator once during the three months of implementation. The Ghanaian participants came back for a day to present the results of what they implemented before receiving their certificates. The regional participants were visited by the coordinator and the AFENET focal person for the course in their various countries. Participants made their presentations at a meeting of stakeholders before they were awarded their certificates.

The workshop with the field component was evaluated six months after the first four-week IMPHI course ended. The goal of the evaluation was to determine whether the four-week training led to application of skills on the job as outlined in the curriculum and program objectives. It was a joint evaluation by CDC-SMDP and stakeholders at the School of Public Health in Ghana.

Six months after the 4-week IMPHI course ended all 12 participants who were interviewed for this evaluation reported implementing a change in management practice at their places of work. Only one participant interviewed could not provide any hard evidence for any of the changes she implemented.

The 2011 Edition of IMPHI course was held from August 1 to August 12, 2011. There were 21 participants from Cohorts II, III, and IV Residents of the GFELTP.

- Topics treated at the Workshop were:
- Introduction to Leadership, Vision, Mission
- Personal & Organizational Development
- Grant Proposals Writing
- Report Writing
- Principles of Monitoring & Evaluation Frameworks
- Monitoring & Evaluating a Public Health Programme
- Intervention Evaluation Methods

All participants were issued with certificates.

## Integrated Avian Influenza Outbreak And Pandemic Influenza Course

In collaboration with the USAID/STOP AI Programme, the GFELTP, in May 2010, pre-tested a newly developed set of modules on Integrated Avian Influenza Outbreak Response and Pandemic Influenza in a special two-week training workshop. The purpose of the workshop was to determine the usefulness of these modules in the African setting, with a view of introducing these modules in other FELTPs. The GFELTP has since then adapted materials from the modules into the GFELTP curriculum, and it has been organized yearly with facilitators from the Veterinary Services, School of Veterinary Medicine, National Disaster Management Organization (NADMO) and SPH.

## GFELTP Graduates Strengthening Public Health Workforce In Ghana

GFELTP collaboration with the Veterinary Services Directorate,

Ministry of Food and Agriculture in Ghana has led to the strengthening of the regional epidemiology capacity of the service. Two GFELTP graduates currently serve as the regional veterinary epidemiologists in the Brong-Ahafo and Upper West regions. Two others are awaiting appointment letters to serve as regional epidemiologists in the Central and Volta regions. Similarly, the Ghana Health Service is finalizing formal plans to deploy the GFELTP graduates to fill such positions in the regions. Currently, two of the graduates serve as deputy national program managers for malaria and non-communicable diseases respectively, one as deputy head of the national public health and reference laboratory, three as district directors of health service and de facto regional epidemiologists (See Table 2 below).

## GFELTP Steering Committee

A steering committee made up of representatives from stakeholders (MOH, GHS, Veterinary Services, Laboratory Services, NADMO, CDC, Noguchi Medical Research Institute and SPH) steers the management of the GFELTP to achieve the objectives of the programme. The Committee is chaired by MOH/GHS and it meets every quarter. The meetings are well documented and shared with all members/partners. The committee follows up plans and recommendations through designated members with support of GFELTP secretariat.

## GFELTP assessment

A Matrix Tool for FELTP Assessment was used to do an internal evaluation of the programme and the result presented to the GFELTP Steering Committee. The Ghana FELTP has also gone through assessment by AFENET and awarded Quality Assurance Certificate for 2010

## Placement Of Graduates

**Table 2: The placement of the GFELTP graduates pre and post certification**

<b>COHORT 1</b>		
	<b>POSITION BEFORE TRAINING</b>	<b>POSITION AFTER TRAINING</b>
1.	Medical Superintendent	Deputy Programme Manager (Cancer Programme-NCD Programme)
2.	Public Health Physician	Deputy Programme Manager (National Malaria Control Programme)
3.	District Director (Veterinary Services, Eastern Region)	Regional Epidemiologist (Veterinary Services, BrongAhafo Region)
4.	Biomedical Scientist (National Public Health & Reference Lab-GHS)	Deputy Head (National Public Health & Reference Lab-GHS)
5.	Medical Superintendent	District Director of Health Services West Gonja District, Northern Region
<b>COHORT 2</b>		
	Principal Veterinary Officer (MOFA) Jirapa District, UWR	Deputy Director and Regional Veterinary Epidemiologist (MOFA, Upper West Region)
	Senior Veterinary Officer, (Greater Accra)	Principal Veterinary Officer (Greater Accra)
	Biomedical Laboratory Scientist (Public Health Reference Lab.)	Biomedical Laboratory Scientist (Public Health Reference Lab.)
	Biomedical Laboratory Scientist (Korle-Bu Teaching Hospital, Central Lab.)	Biomedical Laboratory Scientist (Korle-Bu Teaching Hospital, Central Lab.)
	Biomedical Scientist (Regional Hospital, Koforidua)	Biomedical Scientist (Regional Hospital, Koforidua)
	District Director of Health Service, GHS-Dormaa.	Municipal Director of Health Services, GHS-Dormaa.
	Municipal Veterinary Officer, AkimOda	Municipal Veterinary Officer, AkimOda
	District Director, Health Services, Akwapim South - Atibie	District Director of Health Services Akwapim North District, Eastern Region

## Discussion

The genesis and evolution of GFELTP is an example of a national identification of a workforce capacity need and the use of multi-sectoral collaboration with international technical and financial assistance to institutionalize indigenous capacity development in applied epidemiology. The SPH at the University of Ghana is a well-established constituent member of the College of Health Sciences of the University. The MPH program which is the flagship program of the School is thriving well with enrolment from Ghana, the African Region and beyond. The GFELTP was developed as a special program based in the Epidemiology Department of the School. The contribution of the FELTP to the strengthening of the epidemiology curriculum of the MPH program in the SPH has been acknowledged by both graduates and the Ministry of Health at several of the School's annual dissemination forum. The current policy of the Ministry of Health and the Veterinary Services Directorate of deploying graduates of the GFELTP in strategic posts in the national public health service clearly shows the appreciation of the competencies and skills of the graduates.

The outputs of the residents of the GFELTP have demonstrated the scientific rigor that has characterized the field investigations and dissertations that have been produced. Two of the members

of the initial cohort have submitted their upgraded dissertations for the award of PhD in epidemiology as of 2011. The emphasis on scientific writing and communication has also reflected in the oral and poster presentations that residents from the program have made in Regional and Global Scientific Conferences. The graduates of the program have all returned to positions with an evolving career structure that is likely to motivate them to remain in the public health service. As part of the new public health institute model facilitated by the international association of public health institutes (IANPHI) initiative in Ghana, the Ghana Health Service is developing a core public health technical or expert team career path that uses the GFELTP graduates to fill the critical role of epidemiologists at the subnational and national levels as well as along specific disease control or public health program lines. Crossover to public health administration track at the top of the path is an option and defined promotion track in keeping with the national public health service policy has been proposed. There is ample evidence of improved public health surveillance and response as well as evidence-based decision making taking place in the National Health Service following the joint evaluation of surveillance systems, disease dataset analyses, outbreak investigations, public health interventions

with more regular reports, information sharing and periodic stakeholders' public health seminars at all levels. There has been a definite strengthening of the public health workforce and increased networking between programs in Ghana and with other countries[5]. The prospect of increasing support from the local stakeholders should see increasing enrolment in the program as demonstrated by the 2011 enrollment of nine service professionals, the highest number so far of the five cohorts. This should hasten the attainment of the vision and mission of the program.

## Challenges

The major challenge of the GFELTP has been the slow follow up on pledges of the major national stakeholders of the programme in honouring their funding commitments as specified in the Memorandum of Understanding (MOU). This has resulted in limiting the number of qualified residents that could have been admitted into the programme. But from testimonies that all stakeholders have given on various occasions about the value they place on the service provided by graduates of the programme, it is expected that their support should be forthcoming.

At the formal public launching and 1st certification ceremony of the programme on 02 June 2011, the Minister of Health and the Director of Veterinary Services both emphasized their new policy of utilizing the graduates of the GFELTP in strategic positions in the public health system of the country in order to improve the response to existing public health threats and the emerging zoonotic diseases. These pronouncements encourage our optimistic view regarding the programme sustainability based on continuing support from these key indigenous stakeholders.

## Prospects For The Future

There is no doubt that the establishment of the SPH and the subsequent addition of the GFELTP in Ghana has contributed significantly to addressing the competency and skills needs of the public health workforce. This is evidenced by the large number of disease outbreak investigations and the timely response that residents of the programme have been able to carry out to date. In particular, the role that GFELTP team of physicians,

veterinarians and laboratory scientists played in the investigation and response to the AI outbreak in Ghana in 2007 demonstrated the great value of the One Health concept and the team approach, which the GFELTP has adopted. The unique feature of the GFELTP that permits trainees to provide service to the Public Health Service even while still in training has made the outputs of the trainees well appreciated by relevant employers. Consequently, the demand for the course has been growing. As more local stakeholders' support come on board, it is expected that larger numbers of trainees will be admitted into the programme in order to respond to increasing challenges of growing complex of public health emergencies in the country and the Sub-region.

## Acknowledgments

We acknowledge the contributions of our colleagues on the field where our residents serve especially the Ghana Health Service Disease Surveillance Department and Regional/District Directorates as well as the Director of Veterinary Service and the Regional/District Veterinary Offices. We are grateful to Peter Nsubuga from CDC, Atlanta who participated in revising the article for important intellectual content and factual content. The secretarial support of the GFELTP Administrative Staff is acknowledged.

## Competing Interests

None declared

## Author contributions

Wurapa F, Afari E, Ohuabunwo C, Sackey S: Contributed to development and design of the concept, writing the article and providing important intellectual content, reviewed several drafts and final approval of the version to be published.

Clerk C, Kwadje S, Yebuah N, Amankwa J, Amofah G, Appiah-Denkyira E: Contributed to revising the article for important intellectual content and factual content from perspective of service partners, and approval of the version to be published.

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## THE ETHIOPIAN FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAM: STRENGTHENING PUBLIC HEALTH SYSTEMS AND BUILDING HUMAN RESOURCE CAPACITY

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Key words: Ethiopia, Public health training, field epidemiology training program

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### Abstract

The Ethiopian Field Epidemiology and Laboratory Training Program (EFELTP) is a comprehensive two-year competency-based training and service program designed to build sustainable public health expertise and capacity. Established in 2009, the program is a partnership between the Ethiopian Federal Ministry of Health, the Ethiopian Health and Nutrition Research Institute, Addis Ababa University School of Public Health, the Ethiopian Public Health Association and the US Centers of Disease Control and Prevention. Residents of the program spend about 25% of their time undergoing didactic training and the 75% in the field working at program field bases established with the MOH and Regional Health Bureaus investigating disease outbreaks, improving disease surveillance, responding to public health emergencies, using health data to make recommendations and undertaking other field epidemiology related activities on setting health policy. Residents from the first 2 cohorts of the program have conducted more than 42 outbreaks investigations, 27 analyses of surveillance data, evaluations of 11 surveillance systems, had 28 oral and poster presentation abstracts accepted at 10 scientific conferences and submitted 8 manuscripts of which 2 are already published. The EFELTP has provided valuable opportunities to improve epidemiology and laboratory capacity building in Ethiopia. While the program is relatively young, positive and significant impacts are assisting the country better detect and respond to epidemics and address diseases of major public health significance.

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## Introduction

Field Epidemiology and Laboratory Training Program (FELTPs) are competency-based training programs that help build capacity of countries to support and strengthen public health systems and infrastructure [1]. These programs support trainees, also called FELTP residents to develop their skills through hands-on application of epidemiology to real public health issues. For the most part, residents carry out research projects in priority areas of the districts they are attached, often under direct supervision of the local or provincial health leaders [2]. In Africa, these programs formed a networking alliance called the African Field Epidemiology Network (AFENET) in 2005, which consists of 12 programs spread across 20 countries, including Ethiopia [3].

The Ethiopian Field Epidemiology and Laboratory Training Program (EFELTP) is a comprehensive two-year competency-based post-graduate training and service program designed to build sustainable public health expertise and capacity. Established in February, 2009, EFELTP is a partnership between the Ethiopian Federal Ministry of Health (FMOH), the Ethiopian Health and Nutrition Research Institute, Addis Ababa University School of Public Health, the Ethiopian Public Health Association (EPHA), the US Centers of Disease Control and Prevention, [4, 5]. The vision of the program is to create a world class public health system that can support public health surveillance and response to health emergencies in Ethiopia. Its mission is to produce highly trained, competent health professionals that will strengthen public health surveillance and emergency response and improve health in the country [6].

## Country Context

While progress has been made in recent years to improve health indicators, there is a need for improved capacity among public health professionals, particularly in the area of field epidemiology and creating a public health culture of using data for health decision making. Ethiopia has poor health indicators that necessitate for concerted efforts from all health service providers including epidemiologists and other public health providers. Expanded Programme for Immunisation (EPI) coverage, as calculated based on DPT3, stands at 73% [7] and antenatal coverage stands at just over half (52.6%). Ethiopia has one of the lowest life expectancy rates of 41 and 42 years for males and females respectively [8]. The country also has a high maternal mortality ratio of 673/100,000 live births while the infant mortality rate stands at 77/1000 [9]. Ethiopia is at constant risk of disease outbreaks such as measles due to low vaccination coverage, diarrheal and water borne diseases due to poor sanitation and water coverage and malnutrition mostly due to recurrent famines and droughts. Ethiopia also receives an influx of refugees from war torn Somalia and routinely faces both made-made and natural disasters like conflicts and droughts. The country also ranks 7<sup>th</sup> highest among countries with the highest TB burden globally [10].

## Roles of Partners in Program

Each of the program partners has specific roles they play in the program. The FMOH and Regional Health Bureaus provide training field sites, field supervisors and deploy residents in support of their investigations and activities. Addis Ababa University School of Public Health is responsible for the academic content of the program, designing a curriculum, providing classroom and didactic courses, and granting the program's degree. The EPHA channels funding, provides administrative support, and manages materials, supplies, logistics, and travel. The US CDC provides technical assistance and funding through the President's Emergency Plan for AIDS Relief (PEPFAR).

In 2009, EFELTP joined the AFENET Network. By being in the latter, the program benefits from both technical and financial support, and closer linkages with other programs in the Network and all of AFENET's partners. The program has a country liaison officer based at AFENET secretariat who coordinates EFELTP activities in the network.

## Description of Program

The EFELTP program offices are based in Addis Ababa, Ethiopia. The School of Public Health is the hosting institution for the program which is housed in at the Tikur Anbessa Hospital. However, a larger facility with more rooms for teaching, a computer laboratory, library and office is located on the premises of the Zewditu Memorial Hospital. Residents spend about 25% of their time undergoing didactic training and the remaining 75% in the field working within the Federal Ministry of Health and Regional Health Bureaus where they investigate disease outbreaks, improve disease surveillance, respond to public health emergencies, and use health data to make recommendations on setting health policy for the nation (3). There are five field sites (field bases) which are: Bahirdar Field Base (Amhara National Regional State), Mekele Field Base (Tigray Regional State), Oromyia Field Base (Oromyia Regional State), Hawassa Field Base (Southern Nations and Nationalities People's Region), and Addis Ababa PHEM (Public Health Emergency Management) Field Base located at the Ethiopian Health and Nutrition Research Institute in the Federal Ministry of Health.

## Course offered by the program

The program offers courses in epidemiology, biostatistics, surveillance, communications and scientific writing, computer application in public health, public health laboratory methods and bio-safety, health leadership and management and disaster management (see table 1). During residency, residents conduct a number of activities such as outbreak investigations, analysis of surveillance data, evaluation of surveillance systems, participate in collaborative research projects with numerous partners, develop abstracts, manuscripts, and oral or poster presentations for scientific conferences. The findings of such activities are useful in guiding policy and decision making within the FMOH and the respective regional health bureaus. After the training, the residents are awarded a Master of Public Health in Field Epidemiology by the Addis Ababa University School of Public Health.

**Table 1: Course distribution for EFELTP**

Subject	ECTS (European Credit Transfer System)
Basic Epidemiology and Biostatistics	3.5
Field Epidemiology	1.75
Public Health Surveillance	1.75
Public Health Lab methods and bio-safety	1.75
Communication and scientific writing	1.75
Computer application in Public Health	1.75
Management and leadership	1.75
Advanced Epidemiology and Epidemiology of priorityhealth problems in Ethiopia	3.5
Disaster management	1.75
Field Residency I and II	26.25
Projects I and II	37
<b>TOTAL</b>	<b>24</b>

## Achievements and Highlights of the program

### Enrolment and Graduation

The program has enrolled three resident cohorts as of October 2011. Thirteen residents were enrolled in the first cohort in 2009, 22 in the second and 18 in the third cohort of 2011. The first cohort graduates received their degrees in July 2011. They returned to their sponsoring regions where they were re-assigned to new positions where they will use their newly acquired skills to support important public health response and surveillance activities. Such positions include becoming a regional head of Public Health Emergency Management units and regional heads of Integrated Disease Surveillance and Response (IDSR) responsible for disease investigation and surveillance.

### Outbreak investigations done

EFELTP residents have been involved in a number of outbreak investigations during their training. Residents have conducted outbreak investigations on multiple diseases including diarrheal disease, measles, meningitis, whooping cough, rabies, anthrax, vaccine-derived poliovirus, severe malnutrition, drinking water quality, motor vehicle accident surveillance, and nutritional surveillance. During these outbreaks, residents characterized the outbreaks, investigated the sources of the epidemics, offered health education and community sensitization and participated in immunisation campaigns.

### Surveillance activities done

Residents have also been involved in revising disease case definitions, disease reporting guidelines and forms. They have participated in Influenza A quarantine efforts at the international airport, and have routinely furnished the Ministry of Health with disease surveillance updates during outbreaks. Many of their recommendations from their investigations have been implemented including the adoption of mandatory safety belt laws, and provision of water and sanitary facilities during large gatherings at religious and cultural events.

### Conferences attended and publications

Most of the first cohorts have participated in the annual national EPHA Conference, the Ethiopian Medical Association annual conference, the AFENET Regional Conference in Mombasa, Kenya in 2009 and TEPHINET conference in Cape Town, South Africa in 2010 where residents made oral and poster presentations. The program has also started publishing research papers. A summary of the key achievements of the program is shown in table 2. Among the new developments at the program is the introduction of a training course on Global Information Systems (GIS). The program also plans to expand to include at least two more field sites and possibly two other universities.

**Table 2: Summary of Program outputs (Cohort 1 residents and first 12 months of cohort 2 residents)**

Achievements	No.
Outbreaks investigations and response	42
Surveillance data analysis	27
Surveillance systems evaluated	11
Collaborative and other public health projects	23
Accepted abstracts at conferences	28
Program submissions for publication	8
Manuscripts already published	2

### Challenges faced by program

The program has faced a number of challenges. Such constraints include providing adequate mentoring and supervision to residents at regional field bases, challenges with communication and access to information, and lack of transportation to support residents in field work and investigations.

### Conclusion

The EFELTP has provided noticeable improvement in the quality of public health practice in the country. The use of data and improved ability to use the tools of epidemiology to find evidence based answers to urgent health problems is most notable. While the program may be in its early stages, it has scored some positive and significant impacts which are assisting the country to better detect and respond to epidemics and address major public health challenges. Continued engagement and involvement of all stakeholders and program partners is necessary to ensure sustainability and expansion of the program beyond its current

scope. Better coordination with public health related laboratory systems will further enhance the program's impact and additional resources to support field placement and supervision are necessary. The ministry of health should also ensure that priority is given to the program graduates and alumni if Ethiopia is to maximally benefit from the competencies that the program can offer.

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### Competing Interests

The authors declare that they have no competing interests.

### Authors Contributions

**DJ:** Conception and design, acquisition of data, drafting of article, analysis and submission of data, revising it critically for important intellectual content

**GM:** Conception and design, acquisition of data, drafting of article, analysis and submission of data, revising it critically for important intellectual content

**ZH:** Conception and design, acquisition of data, drafting of article, analysis and submission of data, revising it critically for important intellectual content

**AB:** Conception and design, acquisition of data, drafting of article, analysis and submission of data, revising it critically for important intellectual content

**AA:** Conception and design, acquisition of data, drafting of article, analysis and submission of data, revising it critically for important intellectual content

**PW:** Drafting of article, acquisition of data, analysis and interpretation of data

**ON:** Conception and design, acquisition of data, revision for intellectual content, analysis and interpretation of data

**SN:** Conception and design, critically reviewing if for intellectual content, final approval of version to be published

**DJ:** Conception and design, revision for intellectual content

**DM:** Conception and design, acquisition of data, analysis and interpretation of data

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## THE RWANDA FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAM: TRAINING SKILLED DISEASE DETECTIVES

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Key words: Rwanda, field epidemiology, outbreak investigation, FELTPS, public health

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### Abstract

Rwanda still suffers from communicable diseases which frequently lead to epidemics. In addition to other health workforce needs, Rwanda also lacks a public health workforce that can operate multi-disease surveillance and response systems at the national and sub-national levels. In 2009 and 2010 the Rwanda Ministry of Health and its partners from the Government of Rwanda (GOR) as well as the United States (US) Centers for Disease Control and Prevention, the African Field Epidemiology Network, and other partners embarked on a series of activities to develop a public health workforce that would be trained to operate disease surveillance and response systems at the national and district levels. The Rwanda Field Epidemiology and Laboratory Training Program (RFELTP) is a 2-year public health leadership development training program that provides applied epidemiology and public health laboratory training while the trainees provide public health service to the Ministry of Health. RFELTP is hosted at the National University of Rwanda School of Public Health for the didactic training. RFELTP is funded by GOR, the US Presidents Emergency Plan for AIDS Relief and the World Bank; it is managed by a multi-sectoral steering committee headed by the Minister of Health. The first RFELTP cohort has 15 residents who were recruited from key health programs in GOR. Over the first year of implementation, these 15 residents have conducted a variety of field investigations and responded to several outbreaks. RFELTP has also trained 145 frontline health workers through its two-week applied short courses.

In the future, RFELTP plans to develop a veterinary track to address public health issues at the animal-human interface.

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## Introduction

Despite the numerous public health challenges confronting Sub-Saharan Africa, there is limited spending on health [1]. The low level of investment in health is reflected in the low numbers and sometimes absolute lack of certain cadres of health professionals. Indeed, the lack of health personnel is the main constraint to mobilising responses to health challenges [2]. Various reforms in the health sector have not fully addressed the necessary human infrastructure [3]. Building a public health system that is widely accessible, sustainable, and adaptable to emerging health threats has resulted in improved public health in developed countries. In low-income countries, however, these efforts have stalled due, in part, to the lack of well-trained field epidemiologists and public health laboratorians [4, 5].

In Rwanda, the principal causes of morbidity and mortality remain communicable diseases [6]. HIV and malaria place the greatest burden on the health system. The prevalence of HIV infection among the adult population is estimated at 3.0% [7] and the malaria morbidity rate is 18% in the general population (it is 11% in children <5 years) [8]. Other major causes of morbidity include acute respiratory infections, diarrheal diseases, tuberculosis and malnutrition. Rwanda is also frequently confronted with epidemics of cholera, measles, bacillary dysentery, and typhus [9]. Rwanda, like many African countries, does not have sufficient numbers of trained health staff. Most districts have only seven doctors per 100 000 people [7] which is well below the WHO recommended minimum of 10 doctors per 100 000. Similarly the numbers of other cadres of health workers such as nurses, clinical officers, epidemiologists and laboratory staff are also low.

A collaborative rapid needs assessment done in 2009 in partnership by the Ministry of Health (MOH) and various stakeholders revealed that the capacity of health professionals to manage epidemics was inadequate both at central and district levels. The health system's capacity to respond appropriately to the threat of emerging and re-emerging diseases was low and few outbreaks were detected and reported. Laboratory services to identify infections were routinely unavailable, and investigators frequently neglected the importance of laboratory confirmation. Public health laboratory professionals also lacked key skills in epidemiology to support field investigations. Therefore, for the majority of individuals who became ill or died, the causes of death were largely uninvestigated.

To address this major gap in the public health system in Rwanda, the Rwanda Field Epidemiology and Laboratory Training Program (RFELTP) was established. Specifically, the program was established to build capacity to improve disease surveillance, respond to public health emergencies, and provide information for evidence-based decision making to mitigate the health and economic impact of epidemics and other public health events. Also, there was a desire to bridge the traditional divide between field epidemiologists and public health laboratory scientists, as well as to empower laboratories to effectively lead and manage laboratory services within the public health system. For these reasons, the Government of Rwanda (GOR) and its partners adopted the Field Epidemiology and Laboratory Training Program

(FELTP) model of training and established the RFELTP. FELTPs are applied epidemiology training programs that develop a public health workforce that can operate multiple surveillance and response systems and recommend interventions to improve public health [8, 9].

## Description of the program

The RFELTP is a 2-year training program in field epidemiology and public health laboratory practice. Established in 2010, the program is a collaboration among MOH, Ministry of Agriculture and Animals Resources (MoAA), National University of Rwanda School of Public Health (NURSPH), Treatment and Research in HIV/AIDS and other Epidemic Infectious Diseases (TRACPlus), the National Reference Laboratory (NRL), the Rwanda Animal Resources Development Authority (RARDA), the African Field Epidemiology Network (AFENET) and the United States (US) Centers for Disease Control and Prevention (CDC). The program has field epidemiology and laboratory tracks. The goals of the RFELTP are to develop self-sustaining, institutionalized capacity to train public health leaders in field epidemiology and field-oriented public health laboratory practice and to provide epidemiological services to the public health system at national, district and local levels. The program is currently hosted in NURSPH, located in Kigali. RFELTP is integrated with other NURSPH postgraduate programs, follows the university calendar, and utilizes subject matter experts from within the NURSPH, CDC, AFENET, MOH and others institutions as needed.

RFELTP targets graduate health professionals working within GOR institutions. Eligibility criteria for admission includes: a minimum of a bachelor's degree in a relevant field of study such as medicine, veterinary medicine, biomedical sciences, biostatistics, or clinical psychology; 3 years of professional experience in a health-related area; Rwandan citizenship; being an employee of GOR; and a letter of recommendation from an employer. For the first cohort, the selection was done by a panel comprising members of partner institutions. Validation of the process was done by the Quality Assurance Directorate of the National University of Rwanda.

In terms of governance, the ultimate decision-making of RFELTP is the steering committee with membership from MOH, TRACPlus, NRL, RARDA, NURSPH, AFENET, CDC and WHO. The committee is currently chaired by the Minister of Health and meets regularly to make decisions and review progress of the program. The program has an Epidemiology and a Laboratory Resident Advisor who provide technical expertise for program implementation.

Residents spend approximately 25% of their time in class for the didactic sessions and 75% in the field. The didactic component comprises five courses interspersed with field placements over the 2 years of the training. The laboratory and epidemiology tracks share 60% of the five courses. Residents begin with an intensive 6 week introductory course that covers basic concepts of biostatistics, surveillance, field epidemiology and public health laboratory techniques, followed by one-to-two-week short courses that cover other course content over the period of two years. During field placements, trainees are assigned to field sites within GOR where they carry out important public

health activities, including a surveillance system evaluation, dataset analysis, and outbreak investigations. For the first cohort of 15 residents, all field placement sites were at national-level programs, where residents provide services to all levels of the health system. However, future cohorts will spend their first-year field placement at the national level, while the second-year field placement will be at the district level.

To create a critical mass of public health professionals at all levels of the health system with skills in field investigations, since 2009, the program has offered short courses on outbreak detection, investigation and response to district surveillance officers and laboratorians. So far, a total of 145 persons have been trained an average of three persons from every district. These short courses consist of 2 weeks of classroom teaching and three months of supervised field work, where the participants conduct applied learning projects (e.g., outbreak investigations data analyses) that enable them to become proficient. Short-course participants conduct their field work at their respective work station. This training has led to an improvement in the timeliness and completeness of reporting of integrated disease surveillance and response (IDSR) priority diseases at district level.

## Key achievements of the program

Since its inception in May 2010 with 15 residents (Table 1), the program has already made positive public health impact in Rwanda (Table 2). The second cohort of 15 residents will begin the program in October 2011.

All 15 residents currently in the program are employed in the health system at the national level where they are able to apply the skills acquired while in training. Their response to a number of outbreaks in the country has also demonstrated the usefulness of the program (Table 3).

**Table 1: Sex and professional backgrounds of the first cohort of RFELTP residents**

Institution of Origin	Number of residents	Professional background	Gender		Track	
			Male	Female	Epidemiology	Laboratory
TRACPlus	7	Six medical doctors and one biostatistician	4	3	7	0
National Reference Laboratory	3	Three biomedical scientists	2	1	0	3
Rwanda Animal Resources Development Authority	3	Three veterinary doctors	3	0	2	1
Rwanda National Police	2	One medical doctor and one clinical psychology	2	0	2	0
<b>Total</b>	<b>15</b>		<b>11</b>	<b>4</b>	<b>11</b>	<b>4</b>

**Table 2: Summary of Key achievements of the RFELTP, May 2010 to August 2011**

Achievements	Number
Outbreak investigations conducted with appropriate public health response	15
Surveillance systems evaluated	10
Research studies in progress (residents' thesis)	15
Evaluations (Program or Project)	10
Scientific presentations at conferences	6
Publications by the FELTP residents	3
Short courses conducted	4

**Table 3: Outbreaks investigated by RFELTP Residents from May, 2010 to August 2011**

Period	Disease/condition involved	Location	Public health action taken
Jun-10	Cholera outbreak	Nkombo Island, Rusizi District, Western Province	Water chlorination, hand washing and general hygiene education
	Suspected malaria outbreak in Bukora Health Centre catchment area	Bukora, Kirehe District, Eastern province	Review of diagnostic criteria
	Measles outbreak in Bugarama	Bugarama Sector, Rusizi District, Western Province	Vaccination campaign targeting children under 14 years
Aug-10	Typhus fever outbreak in Muhanga prison	Muhanga District Southern Province	Treatment and health education on Hygiene for prisoners
Nov-10	Measles outbreak in Ruheru	Nyaruguru District, Southern Province	Vaccination campaign
	Measles outbreak in Kigali Central Prison	Nyarugenge District, Kigali City	Vaccination and Vitamin A distribution
Mar-11	Typhoid fever outbreak in Mukinga Primary School	Kamonyi District, Southern Province	Hygiene education and for the school cooks
Apr-11	Acute Respiratory Illness in Calcutta Orphan Centre	Nyarugenge District, Kigali City	Health education and case management
May-11	Influenza Outbreak in Mpanga Prison	Nyanza District, Southern Province	Health education and case management
	Influenza outbreak in Miyove prison	Gicumbi District, Northern Province	Health education and case management
	Suspect Ebola case investigation in Nyamata	Bugesera District, Eastern Province	Health education and re-assurance
May-June-11	Measles outbreak Gisagara	Gisagara District, Southern Province	Vaccination campaign
Jun-11	Food borne outbreak in Gahini Secondary School	Kayonza District, Eastern Province	Food safety education for students and cooks
	Food borne outbreak in Rukara College	Kayonza District, Eastern Province	Food safety education for students and cooks
	Typhoid in Nyakinama	Musanze District, Northern Province	Water chlorination and health education on sanitation

The residents have also been actively involved in various disease surveillance activities, including: review of IDSR guidelines, needs assessments, influenza sentinel surveillance, and development of a country epidemic preparedness plan.

The work done by residents has been, and will continue to be, disseminated both locally and internationally at various seminars and conferences. Three were accepted at two different international scientific conferences and plans are ongoing to publish the work of residents in health bulletins and peer-reviewed journals (Table 4).

The RFELTP has been primarily funded by the US President's Emergency Plan for AIDS Relief through CDC; however, the program has also secured some resources through the World Bank's East African Public Health Laboratory Network Project and intends to seek other funding sources. Moreover, the MOH has included the program in the National Human Resources for Health Strategic Plan, 2011-2016 and aims to ensure that the program is sustainable when donor funding ceases.

Currently, the program includes two tracks in field epidemiology and laboratory. There are plans to add a veterinary track in the spirit of a "One Health approach" in which human health, animal health, wildlife and disaster management professionals will be trained to work as one team. RFELTP also plans to expand to include residents from district hospitals in the third and subsequent cohorts to strengthen skills at decentralized levels of the health sector in order to improve timely outbreak detection and response and effective public health surveillance system and management at lowest level of the health system.

The program intends to utilize graduates of the first cohort as field mentors and instructors. This initiative should ensure that subsequent cohorts will have adequate supervision and support while in the field.



**Table 4: Publications submitted to and accepted at International Scientific Conferences**

<b>Title</b>	<b>Name of International Conference</b>	<b>Follow up</b>
Cholera Outbreak Investigation in Nkombo Sector of Rusizi District, June 2010	6th TEPHINET Scientific Conference in Cape Town	Accepted in 2010
Measles Outbreak Investigation, Bugarama sector in Rusizi District, Western Province, June 2010	6th TEPHINET Scientific Conference in Cape Town	Accepted in 2010
HIV/AIDS in Kanombe Military Hospital	3rd AFENET Scientific Conference in Mombasa	Accepted in 2009
The Role of Rapid Diagnostic Tests in the Diagnosis of Malaria at Sites of Varying Transmission Intensities in Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Avian Influenza Preparedness in Rwanda in 2006	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Control of Multi-Drug Resistant Tuberculosis in Rwanda 2005-2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Evolution of CD4+T-Cell Counts in a Cohort of Patients on Anti-Retroviral Therapy in Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Evaluation of the Meteorological Surveillance System in Rwanda, 2011	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Fine Needle Aspirate as a Useful Tool in the Diagnosis of Tuberculous Lymphadenitis	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Free Rabies Vaccination Program Improved Dog Management Skills among Dog Owners in Rwanda, 2006-2009	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Evaluation of the Measles Surveillance System in Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Comparative Evaluation of Two Rapid Field Tests for Malaria Diagnosis in Rwanda, January 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Epidemic Typhus Outbreak in a Rwandan Prison, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Botulism Outbreak among Prisoners in Rwanda, 2009	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Kigali City Solid Wastes Management: A Case-Study of Nyanza Open Landfill Final Disposal Site- Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Comparative Evaluation of Two Rapid Field Tests for Malaria Diagnosis in Rwanda, January 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Evaluation of the Tuberculosis Surveillance System in Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted
Evaluation of Poliomyelitis Surveillance System in Rwanda, 2010	4th AFENET Conference in Dar-es Salaam, December 2011	Abstract Submitted

## Challenges

The RFELTP still has a shortage of local teaching staff, field site mentors and supervisors. This staff shortage is especially acute during supervision of field work. Current residents, by virtue of their positions at the national level, have to do their jobs as well as fulfil the requirements of the program. This strains the residents and creates a challenge to the completion of field work, however it is a short term challenge as the program progresses, the graduates will be able to work more effectively in their jobs and it will also allow for more people to be trained. Sustainability of funding will continue to be challenge, the program will have to look for efficiencies to reduce costs as well as diversify the funding base.

## Conclusion

The Rwanda FELTP has successfully been implemented for one year. Despite its short period of existence, the program has responded to several critical needs of the country as seen in the number of outbreaks investigated and surveillance systems evaluated. The demand for the program has increased gauging from the increased number of applications for cohort two due to start later this year. The knowledge and skills acquired by residents of the program will be invaluable to the country and contribute immensely to improved implementation of health programs in the country. Given the successful launch of the RFELTP and the achievements so far, we recommend that the various partners and the GOR engage in finding ways of sustaining it including developing specific budget lines in their annual budgets.

## Competing Interests

None declared

## Author Contributions

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## PUBLIC HEALTH SYSTEMS STRENGTHENING IN AFRICA: THE ROLE OF SOUTH AFRICA FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAMME

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Key words: Field Epidemiology and Laboratory Training Program, South Africa, public health, outbreak, surveillance, International Health Regulations.

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### Abstract

The South Africa Field Epidemiology and Laboratory Training Programme (SAFELTP) was created in 2006 after recognizing the need to build and sustain the country's human resource capacity in field (applied) epidemiology and public health practice. The programme was formed as a collaboration between the South Africa Department of Health (DoH), the National Institute for Communicable Diseases (NICD), the National Health Laboratory Services (NHLS), the US Centers for Disease Control and Prevention (CDC) and the University of Pretoria. The primary goal of the programme was to produce field-trained epidemiologists equipped with knowledge and practical skills to effectively and efficiently address the public health priorities of South Africa. SAFELTP is a 2-year full-time training, consisting of a combination of classroom-based instruction (30%) and mentored field work (70%). The training places emphasis on public health surveillance, investigation of disease epidemics, public health laboratory practice and communication of epidemiologic information, among other aspects of epidemiology research. At completion, residents are awarded a Master of Public Health (MPH) degree from the University of Pretoria. Since its inception in 2006, 48 residents have enrolled onto the programme and 30 (62%) of them have completed the training. Over the past 5 years, the residents have conducted more than 92 outbreak investigations, 47 surveillance evaluations, 19 planned studies, analyzed 37 large databases and presented more than 56 papers at local and international conferences. In recognition of the high-quality work, at least five SAFELTP residents have received awards at various international scientific conferences during the 5 years. In conclusion, the South Africa FELTP is now fully established and making valuable contributions to the country's public health system, albeit with innumerable challenges.

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## Introduction

The South African Field Epidemiology and Laboratory Training Programme (SAFELTP) was created in 2006 as a collaboration between the South Africa Department of Health (DoH), the National Institute for Communicable Diseases (NICD), the National Health Laboratory Services (NHLS), the United States (US) Centers for Disease Control and Prevention (CDC) and the University of Pretoria. The programme was formed after recognizing the need to build and sustain the country's human capacity in applied epidemiology and the need to foster collaboration between laboratory practice and epidemiology. The program started operation in 2007 and since then there has been a yearly intake.

The program envisions a public health system that promotes wellness in communities through evidence-based decision-making, in line with other FELTPs around the globe [1,2]. The program hopes to achieve this vision by strengthening the epidemiological capacity among health professionals at all levels of the health system in South Africa through mentored competency-based training. The programme also aims to bridge the gap between the health departments and the laboratory services in the control of communicable and non-communicable diseases.

## Description of the programme

The South Africa FELTP is physically located in Johannesburg within the National Institute of Communicable Diseases (NICD) of the National Health Laboratory Services (NHLS), and the program works closely with the national and provincial Departments of Health (DoH) and other partners. SAFELTP is an applied epidemiology and laboratory training programme that provides multi-disciplinary field-based and problem-oriented instruction. SAFELTP is a 2-year full-time training and service program, modeled after CDC's renowned Epidemic Intelligence Service (EIS) [3,4]. Residents spend 30% of the time attending classroom-based courses and 70% performing mentored field duties. The training places emphasis on the application of epidemiological principles in public health surveillance, outbreak investigation, program evaluation, health data management and the role of the laboratory systems in epidemiology, among other public health areas. Graduates from the programme are equipped with hands-on investigative and analytic skills to identify public health problems, plan and execute field-based scientific research, design and recommend effective solutions to the problems, and communicate the solutions to the relevant professionals. At completion, residents receive a Master of Public Health (MPH) from the University of Pretoria.

Field placement sites consist of Provincial DoHs and different programmatic areas within National DoH, NICD, or NHLS and pharmacovigilance unit of the Medical University of Southern Africa (MEDUNSA). In order to accommodate the needs of the fellows and the respective nominating institutions, fellows are placed with their representative institution whenever possible. During the field training, residents acquire practical skills in applied

epidemiology while at the same time providing epidemiological services to the field placement site (DoH, NHLS, etc). The SAFELTP secretariat maintains regular monitoring and appraisal of the field sites to ensure that individual needs of the trainee and the broader objectives of the field placement are met.

One of the aims of SAFELTP is to increase collaboration and strengthen linkages between epidemiologists and the public health laboratorians. Residents who enroll on to the SAFELTP residency program choose one of two areas of concentration, or "tracks": epidemiology track and laboratory track. Both tracks are 2 years long and most modules and field activities are shared between the tracks.

SAFELTP is headed by a Program Director who is supported, technically, by epidemiology and laboratory track coordinators who manage the academic elements of the respective tracks, a field coordinator who oversees the field component of the training, field epidemiologists who provide mentorship to residents and an administrative team that is responsible for the administrative aspects of the program. The overall running of the program is guided by an Advisory Committee made up of partners and experts from the epidemiology community in South Africa and beyond.

## Basic epidemiology short courses

In addition to the 2-year residency program, SAFELTP also offers certificate awarding on-job training courses typically consisting of 2 week-long didactic workshops separated by a 2 to 4 month field project to apply field epidemiology principles to a local public health need. The courses are targeted towards health professionals involved in communicable disease control, disease surveillance, outbreak investigations and data management at various levels of the health system, and can be tailored to meet the specific needs of the requesting institution.

## Relationships within the FELTP

The programme received seed funding from the US government through the President's Emergency Plan for AIDS Relief (PEPFAR) funds. In country, the programme has received financial and in-kind support from various partners, including the Department of Health (DoH), the University of Pretoria, the Department of Agriculture (DoA) and the NHLS. The national and provincial DoH and DoA send their officials who are responsible for surveillance, monitoring and evaluation of priority programs into the SAFELTP with 2 years study leave and after completion of the training retain the trained officials within the system. The departments agree to be the field placement sites, to provide co-supervision of the residents during field activities and projects, to facilitate the participation of residents in outbreak investigation and access to health datasets that belong to the departments. The School of Health Systems and Public Health of the University of Pretoria provides academic support and conducts some of the didactic teachings on public health related modules, biostatistics and demography. The director of the programme is permanently employed by the NICD. During the first three intakes the NHLS sponsored four residents onto the 2-year residency programme per intake.

## Participation in epidemiology networks

SAFELTP is affiliated to international networks of related training programs around the world, notably the regional African Field Epidemiology Network (AFENET) and the global Training Programs in Public Health Interventions Network (TEPHINET). The networks provide trainees with opportunities to share experiences and expertise with trainees from other parts of the world, through conferences and other information sharing platforms. The networks also provide resources for various FELTP core-activities.

South Africa FELTP was the second programme in Africa to include the laboratory component. Consequently the programme is proud to have provided technical assistance to other African FELTPs that subsequently established laboratory tracks namely, programmes in Nigeria, Rwanda and Mozambique.

**Table 1: South Africa FELTP enrolment and graduation rate, 2007-2011**

Cohort	Number enrolled	Number graduated from university	Graduation rate
2007	10	5	50%
2008	9	6	67%
2009	11	8	73%
2010	9	Still in training	-
2011	9	Still in training	-

In December 2010 South Africa FELTP hosted the 6th Global TEPHINET Scientific Conference in Cape Town. The conference was attended by more than 500 delegates from 48 countries, and 249 abstracts (99 oral presentations and 150 posters) were presented. SAFELTP staff and residents played an integral role in the preparation and hosting of the conference.

## Achievements by the programme

As of 2011 the program has enrolled five cohorts (a total of 48 residents). The first three cohorts have completed FELTP residency to date (totaling thirty fellows), and 19 have formally graduated from the University of Pretoria (Table 1).

Of the 30 graduates that have completed FELTP training to date, 24 (80%) have been absorbed within the public health sector in South Africa, mostly within the Departments of Health (11) and the National Health Laboratory Services (12) (Table 2). The programme has also trained two fellows from West Africa (Togo and Burkina Faso). These have returned to their home countries and have also been re-absorbed within the respective public health systems.

FELTP residents and graduates have made valuable contributions in strengthening the response of the various units to disease outbreaks and have also impacted positively on functioning of the surveillance systems and public health programs in their places of work. Among the graduates that are working within the DoH and the DoA, six have been elevated to senior management levels

and are making significant contributions to policy decisions within their departments.

Within the NHLS structures FELTP graduates have been absorbed into the critical epidemiologist positions within the different units and have made significant contributions to the epidemiological analysis of laboratory data and have also been involved in key field investigations throughout the country. Thus these FELTP graduates have made significant in-roads in strengthening the public health laboratory function of the National Health Laboratory Services (NHLS), one of the goals at the inauguration of the FELTP.

Institution category	Number of graduates (N=30)	
	n	%
Provincial Departments of Health	8	27%
National Institute for Communicable Diseases (NICD)	4	13%
National Health Laboratory Services (NHLS)	3	10%
South Africa FELTP	3	10%
National Department of Health	2	7%
Private Research Organizations	2	7%
National Institute for Occupational Health (NIOH)	2	7%
Ministry of Health (West Africa)	2	7%
Local Authority health department	1	3%
Further studies	1	3%
Department of Agriculture	1	3%
Private business	1	3%

## Major public health contributions

### Role during the 2010 FIFA world Cup

In June 2010 during the Fédération Internationale de Football Association (FIFA) World Cup competitions held in South Africa, FELTP staff, residents and graduates played a key role in supporting the national and provincial Departments of Health, NHLS and NICD, in establishing and running a national surveillance system for epidemic prone health conditions and responding to disease outbreaks related to the monumental soccer event. FELTP residents coordinated the collection, collation and epidemiological analysis of surveillance data from centres across the country and took part in the investigation and response to disease outbreaks detected through the surveillance activities.

Prior to the World Cup event, the program conducted two short course trainings for provincial health officials, focusing on strengthening surveillance and outbreak response during the event.

**Table 3: Summary of key achievements of the last five years**

Activity	Frequency
Outbreaks investigations and response	92
Surveillance systems evaluated	47
Research studies done	19
Large data bases analyzed	37
Scientific presentations at conferences	56
Publications by the trainees	26
Short courses conducted	11

### Role in implementation of the International Health Regulations

According to the International Health Regulations 2005 (IHR 2005), countries should strengthen their core capacity for disease surveillance and public health response systems in order to effectively prevent and control the international spread of diseases [5]. Strengthening disease surveillance and public health response are the primary goals of FELTPs, hence the IHR 2005 underscores a need to build and sustain FELTPs, if countries are to make better contributions to global health capacity [6]. In South Africa the FELTP has played a huge role in building the human resource capacity to enhance the implementation of the IHR 2005. In addition to the core curriculum, FELTP staff has assisted the Communicable Diseases Control Directorate of the National DoH in reporting the assessment of national core capacities of the implementation of the International Health Regulations (IHR 2005). On behalf of the University of Pretoria the programme staff have also taken part in trainings on the implementation of the IHR 2005, which are coordinated by the World Health Organization.

### Growing demand for the programme

The demand for enrolment onto the program has significantly grown over the years. Within South Africa the number of people applying for enrolment onto the program has grown from 15 applications in 2007 to more than 40 in 2010 and 2011. Over the past 2 years, the program has also received applications from health professionals in neighboring countries (Botswana, Swaziland and Malawi) and from as far as Liberia in western Africa.

The growth and expansion in the FELTP has also been seen through the growing number of field placement sites for FELTP residents. The programme has established placement sites with DoHs in all the nine provinces, a number of directorates within the national DoH, with local authorities in some urban cities, and within units in the NICD and with some semi-private research organizations. The program has also received a growing number of requests from different organizations to have FELTP residents placed with them. This evidently indicates a rising appreciation of the role of FELTPs within the health system in South Africa.

The programme has also observed an increase in requests for the basic epidemiology short courses. Some provinces are now paying the total costs of the trainings, with the programme staff providing the training. This shows a greater appreciation of

the role of the short courses within the health system whereas the FELTP would previously pay for all the costs in running the courses.

### Challenges in implementing the South Africa FELTP

Strong linkages with universities, health departments and international agencies are critical in building a sustainable FELTP [2,7]. In South Africa the FELTP has received inadequate institutional support from key authorities within the National DoH. This has compromised the sustainability of the programme in a number of ways. Firstly, it has been a challenge for the FELTP to enroll key professionals from the DoHs. The current human resource development policies do not support a 2 year paid study leave for professionals working within the department. This has forced some professionals to resign from their posts to come onto the program, and has compelled some good potential fellows to turn down the offer for training. Such a situation then works against the whole goal of a FELTP, which is to strengthen human resource capacity within the public health system.

Secondly, the FELTP is geographically placed within the NICD, which is considered by most institutions to be a laboratory establishment. This set-up, coupled with weak linkages with the DoH, has often made it difficult for the FELTP to attract key health professionals, particularly physicians, who are not within the laboratory system. For any FELTP to be sustainable academically and financially, the training programme should be incorporated within larger health department structures for human resource planning and development as well as structures for financial planning and budgeting [2,7].

Thirdly, there are no clear career pathways for FELTP graduates within the DoH structures, and the roles that FELTP graduates can play within the health system are not clearly defined. This often results in frustrations among graduates who feel that they are not granted opportunities to apply the skills acquired during FELTP residency. A few FELTP graduates have left the public health system to join private research organizations where they feel their skills will be more useful.

Having dedicated and competent staff at the FELTP secretariat is critical in building a sustainable high-quality FELTP programme. In South Africa the majority of the posts at the FELTP secretariat offer renewable yearly contracts, and the FELTP has experienced

challenges in attracting experienced personnel (public health laboratory specialists and epidemiologists) to fill some of the posts. Most similar institutions offer favorably longer contracts or permanent posts. This compromises the mentoring of residents during field placement; the available staff become too stretched to provide the robust mentorship that FELTP trainees require. This is worsened by the limited technical expertise among field supervisors in some field placement sites.

The FELTP continues to make efforts to engage the various levels of the DoH to rectify these challenges. The programme is in the process of lobbying the DoH so that the FELTP can be included in the department's human resources development strategy.

## Conclusions and way forward

In conclusion, the South Africa FELTP is now fully operational and is making valuable contributions to the country's public health system, albeit with innumerable challenges. The programme is unique in that its secretariat is physically and functionally detached from the structures of the health department. As a result, there has been limited engagement of key stakeholders within the health department, and inevitably this has compromised the growth of the programme. The main lesson that can be learnt from the South Africa situation is that establishing strong linkages with the ministry of health is crucial in building a sustainable high-quality FELTP.

In moving forward, the South Africa FELTP should come up with a broad advocacy strategy, primarily targeting key decision makers within the national DoH, to increase the visibility of the FELTP. The goal should be to advocate for FELTP to be incorporated into the health department's strategic plan for workforce development. As a precursor to the advocacy strategy, the FELTP should consider conducting a comprehensive sustainability analysis in order to streamline the future operations of the programme. This is especially important taking into consideration the constantly

decreasing funding for the FELTP activities. The analysis will also look at strategies to reduce programme related costs, while maintaining the quality of the training.

As part of the advocacy, the programme should put together an all-inclusive marketing tool describing the current and future activities of the programme and outlining how current and potential partners can be incorporated. The FELTP should also strengthen the marketing of the programme in order to attract high-quality residents. Targeted marketing of certain professional groups (e.g., physicians) should be employed. Initially funds will be required to attract the physicians onto the training (in the form of stipends), to match the registrar packages available at various local universities for clinical specialties. When the department of health becomes more engaged, the programme can then lobby for similar registrar posts to be created for physicians who come onto the FELTP.

To support the advocacy efforts, the FELTP should put more effort in showcasing the work done by residents during training, in the form of publications in peer-reviewed journals, presentations at national forums, etc. This will enhance the visibility of the programme. Lastly, the programme should come up with an objective monitoring and evaluation plan which will ensure continuous quality improvement.

## Author Contributions

Lazarus R. Kuonza, Khin San Tint and Bernice Harris: Contributed to writing drafts of the article, reviewed several drafts, provided important intellectual content, and approval of the version to be published.

Immaculate Nabukenya: Contributed to development and design of the concept, writing the article and providing important intellectual content, reviewed several drafts and approval of the version to be published.

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## THE TANZANIA FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAM: BUILDING AND TRANSFORMING THE PUBLIC HEALTH WORKFORCE

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Key words: Field Epidemiology Laboratory Training Program; Tanzania; health workforce; Integrated disease surveillance and response; International Health Regulations.

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### Abstract

The Tanzania Field Epidemiology and Laboratory Training Program (TFELTP) was established in 2008 as a partnership among the Ministry of Health and Social Welfare (MOHSW), Muhimbili University of Health and Allied Sciences, National Institute for Medical Research, and local and international partners. TFELTP was established to strengthen the capacity of MOHSW to conduct public health surveillance and response, manage national disease control and prevention programs, and to enhance public health laboratory support for surveillance, diagnosis, treatment and disease monitoring. TFELTP is a 2-year full-time training program with approximately 25% time spent in class, and 75% in the field. TFELTP offers two tracks leading to an MSc degree in either Applied Epidemiology or, Epidemiology and Laboratory Management. Since 2008, the program has enrolled a total of 33 trainees (23 males, 10 females). Of these, 11 were enrolled in 2008 and 100% graduated in 2010. All 11 graduates of cohort 1 are currently employed in public health positions within the country. Demand for the program as measured by the number of applicants has grown from 28 in 2008 to 56 in 2011. While training the public health leaders of the country, TFELTP has also provided essential service to the country in responding to high-profile disease outbreaks, and evaluating and improving its public health surveillance systems and diseases control programs. TFELTP was involved in the country assessment of the revised International Health Regulations (IHR) core capabilities, development of the Tanzania IHR plan, and incorporation of IHR into the revised Tanzania Integrated Disease Surveillance and Response (IDSR) guidelines.

TFELTP is training a competent core group of public health leaders for Tanzania, as well as providing much needed service to the MOHSW in the areas of routine surveillance, outbreak detection and response, and disease program management. However, the immediate challenges that the program must address include development of a full range of in-country teaching capacity for the program, as well as a career path for graduates.

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## Introduction

In 1998, Tanzania was the first country in Africa to launch the World Health Organization, Regional Office for Africa (WHO-AFRO)'s Integrated Disease Surveillance and Response (IDSR) strategy. An assessment of the strengths and weaknesses of the existing public health surveillance and response systems was conducted, and a plan to improve and integrate these systems was developed [1]. Following this assessment, it was recognised that a competently trained public health workforce was needed to operate the public health surveillance and response systems. The Tanzania Ministry of Health and Social Welfare (MOHSW), WHO, the United States (US) Agency for International Development (USAID) and the US Centers for Disease Control and Prevention (CDC) collaborated through a series of initiatives to strengthen the public health workforce in order to implement IDSR in Tanzania [2]. In 2001, through a USAID/MOHSW supported program, an IDSR implementation team comprising the National Institute for Medical Research (NIMR), Partners for Health Reform (PHRplus), Center for Health and Gender Equity (CHANGE) and CDC was tasked by the MOHSW to implement and improve IDSR functioning in 12 districts as pilot [3-4].

Plans to establish a field epidemiology and laboratory training program (FELTP) in Tanzania were conceived in 2005 by the MOHSW, NIMR and CDC. At this time, three trainees from Tanzania were enrolled in the Kenya FELTP [5] with the plan to have them serve as a foundation to establish a program in Tanzania and to improve IDSR implementation. Subsequently, a working group consisting of representatives of the MOHSW, NIMR WHO, and CDC convened to further develop the plan.

Upon a MOHSW request in 2007, an assessment led by the CDC and the African Field Epidemiology Network (AFENET) was undertaken to identify the country's needs, describe the existing infrastructure and resources that could be leveraged to support the program, and define the elements and resources needed to implement a FELTP in Tanzania.

The Tanzania FELTP (TFELTP) was established in October 2008 as a partnership among MOHSW, the Muhimbili University of Health and Allied Sciences (MUHAS), and NIMR, along with support of local and international partners, principally, AFENET, CDC, USAID, and WHO. The goals of the TFELTP are to strengthen MOHSW capacity to i) conduct public health surveillance and response through IDSR, ii) manage and evaluate national disease control and prevention programs, and iii) strengthen public health laboratory support for surveillance, diagnosis, treatment, and clinical monitoring.

## Country context

Tanzania continues to experience a high burden of endemic diseases, as well as recurrent outbreaks of epidemic prone diseases, including cholera, bacterial meningitis, measles, and Rift Valley Fever [6-10]. Successful implementation of IDSR in Tanzania required a competently trained public health workforce comprised of field epidemiologists working in coordination with

public health laboratory scientists with the support of a networked system of functional reliable public health laboratories. Since 1998, MOHSW has been training frontline health workers in IDSR through short courses on surveillance, outbreak investigation and response. While this provided an introduction and orientation to key epidemiologic principles and skills, this training in itself was insufficient to maintain the required level of epidemiologic capacity. In addition to increasing the value placed on quality data and the ability to collect and use quality data at the facility and district level, the MOHSW determined there was still a need for intensive epidemiology training to produce a cadre of field epidemiologists and public health laboratory managers to lead IDSR implementation at the regional and national levels.

Tanzania faces a shortage of qualified field epidemiologists at all levels. Similar needs exist for public health laboratorians trained in field epidemiology to be effective members of surveillance and outbreak investigation teams at the national and regional levels. Several factors can be attributed to this, including shortage of relevant training facilities [11]. The MOHSW, in its National Health Policy (2007) [12] and its Human Resource for Health Strategic Plan 2008-2013 [13], has emphasized the need to "move towards self sufficiency in manpower by training all the cadres required at all levels from village to national level." To supplement the short-term training provided by the IDSR strategy, the MOHSW worked with partners including CDC and AFENET to develop and sustain a 2-year FELTP program to train public health professionals in applied epidemiology and laboratory management. These staff would be available as national and regional level resource persons to support districts' epidemiological needs.

Before TFELTP was established, there were three master-level courses addressing public health issues, a Master of Public Health (MPH), Master of Arts in Health Policy and Management, and a Master of Science (MSc) in Tropical Disease Control in Tanzania. However, MOHSW recognized that in order to achieve its vision of addressing the public health concerns of the population, the number and type of graduates produced at the time was inadequate to meet the growing needs of the country. The TFELTP will facilitate Tanzania's target of training at least 200 epidemiologists and 100 public health scientists as outlined in its Health Sector Strategic Plan III [14].

## Location and structure of the program

The TFELTP program is housed within NIMR headquarters in Dar-es-Salaam, with additional office space for coordinating field activities being at the MOHSW building (Epidemiology and Disease Control Section). TFELTP is a 2-year full-time program involving approximately 25% class room contact, and 75% field placement. Didactic sessions are held within the NIMR building, and are facilitated by MUHAS, MoHSW and NIMR staff. Classroom time occurs across the two years and is interspersed with field placements and examinations. Residents are attached to field placements at the national level in the first year of training and then the regional level during the second year. During the field placement, residents are assigned to various positions to provide

epidemiologic and laboratory service to the MOHSW under the supervision of a mentor. The trainees travel to various regions of Tanzania for supervised outbreak investigations and field projects.

## Tracks offered and courses delivered

TFELTP offers two tracks, leading to either an MSc in Applied Epidemiology (Epi Track), or an MSc in Epidemiology and Laboratory Management (Lab Track). The degrees are awarded by MUHAS. Table 1, shows the courses offered within each track by semester.

### TFELTP entry requirements

The entry requirement for the MSc in Applied Epidemiology is a first degree (Bachelor's level) in any of the fields of Medicine, Dentistry, Laboratory Sciences, Veterinary Medicine, Pharmacy, Environmental Health Sciences, Nursing or any other health-related field of study. Other eligible disciplines include statistics, demography, biology, food science and public health.

The entry requirement for the MSc in Epidemiology and Laboratory Management is a first degree in the field of Laboratory Sciences, Medical Sciences, Veterinary Medicine, Biological sciences or any other laboratory-related field of study. Applicants for both tracks should have a minimum of two years health related working experience within a government department.

### Other courses offered by TEFLTP

TFELTP conducts a number of short courses that are offered to health workers in Tanzania. Program trainees participate in some of these courses. The courses include:

Three-month short course in basic field epidemiology and outbreak investigation. Two weeks for didactics at the beginning, with remaining period for an applied field project.

Three-month short course in non-communicable disease (NCD) epidemiology and prevention. Two weeks for didactics at the beginning, with remaining period for an applied field project.

**Table 1: TFELTP courses by track**

Semester	Courses	Track
I	Epidemiology and Biostatistics	Both
I	Field Epidemiology and Public Health Surveillance	Both
I	Research Methodology and Computers in Public Health	Both
I	Bioethics	Both
II	Advanced Epidemiology	Epi
II	Fundamental Laboratory Methods	Lab
II	Educational Principles and Practices for the Health Sciences Professionals	Both
II	Dissertation: Proposal development and ethical approval	Both
III	Economic analysis and evaluation	Epi
III	Laboratory Management, Policy and System design	Lab
III	Dissertation: Data collection	Both
IV	Management and Leadership	Both
IV	Dissertation: Data analysis, report writing, examination and dissemination	Both

## Roles of partnerships within TFELTP

The program is governed by a Steering Committee comprising all partners and stakeholders under the leadership of the Chief Medical Officer of the MOHSW. The MOHSW provides the overall leadership for the program including the day to day running of the program through the secretariat. The secretariat is comprised of three ministry of health staff working along with administrative support staff, and program resident advisors.

MUHAS is the primary academic partner for TFELTP. TFELTP courses draw multidisciplinary expertise from within and outside the MUHAS. The university assures the qualification of teaching staff, provides faculty, organizes the assignment of academic supervisors for the residents' thesis research, and awards the degree upon successful completion of the program. Additionally, MUHAS and program staff teach academic courses and oversee research activities for the students and provide expertise in abstract and manuscript writing.

NIMR provides the base of operations for the FELTP, including office space and training rooms. NIMR staff also assist with the academic and technical supervision of residents. NIMR through its centers and stations across the country provides facilities for laboratory, data management, and field site opportunities for the trainees.

WHO provides technical and financial support to the program in areas of outbreak investigation and response, and in collaboration with program staff participate in the planning for outbreak and response activities that address the needs of Tanzania.

CDC Tanzania and the programs it represents are the primary funding partners of the TFELTP through the Global AIDS Program (GAP). Additional support is provided by USAID through the President's Malaria Initiative (PMI). CDC Tanzania is the primary link to the MOHSW, MUHAS, and other partners in Tanzania. CDC

Tanzania staff also provide technical assistance through teaching and mentorship of trainees, as well as arranging opportunities for field work including evaluations and field investigations within its programmatic activities in Tanzania.

CDC Atlanta through its Division of Public Health Systems and Workforce Development (DPHSWD) is the partner primarily responsible for providing technical assistance to the FELTP for training and IDSR implementation. With a 30 year history of implementing applied epidemiology training programs in dozens of countries, DPHSWD uses their experienced staff and links to other parts of the agency and partners to build the program. For the initial 3 years of the program DPHSWD managed the AFENET cooperative agreement through which the majority of TFELTP funding was channelled to conduct the day to day operations. CDC technical assistance included teaching, mentoring, and was also directed towards production and dissemination of IDSR bulletins.

AFENET was involved in areas that assisted in preparing the country for the program including, disease surveillance and outbreak response short courses, identification of key partners for the program, and fundraising. AFENET provides technical assistance to TFELTP through teaching, and links TFELTP to other similar program across Africa, providing a platform for exchange of expertise and networking. AFENET is the primary partner responsible for the administrative and logistical implementation of the program.

### Other partners in the program

The World Bank through the East Africa Public Health Laboratory Network is providing support to the program for two slots in 2011-2012, as well as short courses in epidemiology and laboratory management. The International Association of National Public Health Institute (IANPHI) provides support for NCD field sites and has provided 2 slots in 2010-2012. Ifakara Health Institute provides field sites to the program, and its staff for mentorship. TFELTP is currently working with NIMR and Georgia State University to establish an NCD short course on research.

## Highlights and achievements of the program

### Enrollment

Since 2008, the program has enrolled a total of 33 (23 males, 10 females) trainees. Of these, 11 were enrolled in 2008 and graduated in 2010 representing a completion rate of 100%. The 2009 cohort of 10 is expected to graduate at the end of 2011. Demand for the program as measured by the number of applicants has grown from 28 in 2008, to 40 in 2010, to 56 in 2011.

### Employment of graduates

All 11 graduates of cohort 1 have since found public health related employment within the country. Their distribution is as follows: one with a university, two at the National level of the MOHSW, three at regional level under the ministry of local government, two at TFELTP as faculty, one at Ministry of Health Zanzibar, one at Ministry of Defence, and one at an international NGO. The graduate working with the Zanzibar Ministry of Health currently heads the Epidemiology Unit.

Table 2 shows the types of activities that program residents/trainees are engaged in.

**Table 2: TFELTP program outputs by activity**

Activity	Output/No
Outbreaks investigated and responded to by the program and its trainees	34
Surveillance data bulletins	10
Surveillance systems evaluated	33
Protocol-driven research studies undertaken	33
Program or project evaluations	4
Scientific presentations at conferences	32
Publications by the trainees in peer review journals	5
Number of health workers trained through short courses	140
Number of laboratory quality improvement projects conducted	8
Number of laboratory new technologies/test kits evaluated	3

### TFELTP role in International Health Regulations 2005 Implementation in Tanzania

In 2010, the TFELTP staff and residents participated in the country assessment of the revised International Health Regulations (IHR) core capabilities, and played a key role in the development of the assessment report. Subsequently, program staff have been involved in development of the Tanzania IHR plan. The program staff and trainees have also been involved in the incorporation of the IHR 2005 into the revised Tanzania IDSR guidelines.

### Role in high-profile outbreak investigations

TFELTP residents have been involved and led investigation and response to high profile outbreaks including cholera [15-16], H1N1 [17], among others. Residents were also involved in investigating and responding to a bomb blast in February 2011 in Dar-es-salaam. This demonstrates the service that the program is providing to the country, and the public health leaders that are being developed.

## New developments within TFELTP

TFELTP staff have developed an NCD short course curriculum for regional capacity building for chronic disease epidemiology in collaboration with CDC DPHSWD, University of Copenhagen, and NIMR. The program has identified additional field sites for NCD mentorship of trainees. In 2011, Tanzania was one of five countries selected for CDC's global NCD initiative and conducted the first NCD epidemiology, surveillance, and evaluation two-week short course for medical doctors, TFELTP residents, and other public health staff.

TFELTP is working with the Ministry of Livestock Development on the introduction of special seminars for zoonotic diseases. Based on the one-health principle, the aim of establishing the special seminars on zoonotic diseases is to build a foundation for future development of a Veterinary track which can address priority disease conditions at the animal and human interface, and improve communication and flow of surveillance information from the animal and wildlife sectors to the MOHSW.

## Future plans of the TFELTP

The program seeks to expand enrolment to meet the needs of the public health system in Tanzania. In order to do this, the program will need to expand the available classroom and field facilities, and staff. The key priorities will be to better equip the field sites, and ensure that the field supervisors' skills are continually improved. In order to address the shortage of competent mentors and supervisors for the trainees, one approach will be to explore the use of TFELTP graduates as mentors at the field sites.

Regional and international linkages will be an important avenue to build on the program's early successes. The program will be seeking to open its doors to potential trainees from countries neighbouring Tanzania that do not have programs of their own, Burundi, Malawi, Zambia are examples. This will greatly facilitate progress to improve cross-border collaboration in infectious disease surveillance and implementation of the IHR. Additionally, the program would like to open the NCD short course for training opportunities for regional participants. TFELTP plans to take a leading role in advocacy of IHR 2005 at regional sites within Tanzania where trainees are placed.

Over the next three to four years, the program will need to establish a sustainability plan that guarantees ongoing production of high quality graduates. The plan must not only look inward at the MoHSW as the driver, funder and consumer of TFELTP products, but must also look outwards to development partners, the private sector, and trainees meeting their own tuition as the program begins to mature. This plan development process will require input from the various stakeholders to establish which parts of the program they will be willing to pay for and would find attractive to their own needs and interests. The program will need to continue periodic internal and external reviews to ensure it is meeting its mandate.

One of the immediate challenges that the program must address to assure sustainability includes development of a full range of local teaching capacity for the program. Currently the program depends on external support to teach some of the courses for which there is limited expertise within Tanzania. The program will also need to work with the Human Resource Department of the MOHSW, and other relevant stakeholders to develop a career path for graduates of the program. This career path will be critical for defining job placement and promotion within the government system, an important framework for graduate retention. Finally, the program leadership will need to build on the early success of using an all-inclusive strategy to ensure that old partners remain committed to the program, as new ones join the collaboration.

## Conclusion

The TFELTP was developed out of the Tanzania's need to address pressing public health systems and human resource gaps. As the country's lead agency responsible for health, the MOHSW has driven the development of the program and remained at the pinnacle of leadership to ensure key stakeholders are involved, and the country's needs are addressed.

Over the last 3 years, the program has made a significant contribution to development of expertise for IDSR implementation, and other MOHSW programs and strategies. TFELTP has made important contributions to the training of Tanzania's field epidemiologists and public health laboratorians. While training the future public health leaders of the country, this program simultaneously provides a much needed service by responding to acute outbreaks, evaluating and improving public health surveillance systems, and strengthening disease control programs.

The TFELTP will need to develop a clear sustainability plan that includes both internal and external support (academic and financial) to ensure that Tanzania's public health needs are addressed in the medium to long-term.

## Competing Interests

None declared

## Author Contributions

Mmbuji Peter and Mukanga David: Contributed to development and design of the concept, writing the article, provided important intellectual content and approval of the version to be published, Mghamba Janeth, Mohamed Ahly, Mosha Fausta, Simba A, Senga Sembuche, Moshiro Candida, Semali Innocent, Rolle Italia, Wiktor S, McQueen Suzzane, McElroy Peter, Nsubuga Peter: Participated in writing the article, reviewed several drafts, provided important intellectual content and approval of the version to be published.

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## TWO DECADES OF POST-GRADUATE TRAINING IN APPLIED PUBLIC HEALTH: THE EXPERIENCE AND CHALLENGES OF THE UGANDA PUBLIC HEALTH SCHOOL WITHOUT WALLS

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Key words: PHSWOW, FETP, Postgraduate, training, public health, Makerere

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### Abstract

**Objective:** To describe the experience of the Uganda Public Health School Without Walls in training public health professionals at post-graduate level to offer leadership in planning, delivery of health services and research within a decentralized health system. **Methods:** A case study design was used where published and grey literature were reviewed and synthesized alongside personal communication from key program staff into a narrative of the experience and future challenges for the training program. **Results:** Key to the successes of the program are the 238 program graduates, most of whom have remained in-country to serve at district and national levels of service delivery. Collaborations have been established with government, private, non-governmental and international institutions leading to increased health service provision and research for the improvement of health status of populations and influence on public policy. There is still a lot to do in diversifying the skills mix of graduates and contributing to an ambitious increment from 0.4 to 4.7 public health professionals per 10,000 population; as is currently the case in high-middle income countries. More also needs to be done to promote a culture of publication in an effort to translate public health evidence into policy and practice.

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## Introduction

The evidence indicating that public health professionals are essential for leading health systems and programs into curtailing the global causes of poor health is extensive [1]. It is well known that in order to tackle the burden of ill health at population level, public health professionals are required to strengthen health systems and manage the bottle necks [1-2]. Research and practice efforts have defined the role of the public health profession as that of a multi-disciplinary team of personnel with technical skills and responsibility for leading health systems at all levels to improve health through a population focus [1-3]. In the mid 1980's Roemer argued that it was necessary to increase schools of public health globally from 100 to 450; each to serve, at least, a population of 10 million [4]. At the time, majority of the schools existed as departments or branches within schools or faculties of medicine, pharmacy, dentistry, or veterinary with the majority established in the United States of America [1, 4]. To date, there is an increased number of public health training institutions in low income countries, although in Africa, there is still limited capacity with just over 53 training institutions at postgraduate level, over half with less than 10-member full time faculty, and a total enrolment of under 100 post-graduate students [2, 5].

The health status of the population in Uganda has improved over the past two decades between 1991 to 2010 as measured by two indicators; under-five mortality rate from 203 to 137 per 1,000 live births and maternal mortality ratio from 527 to 435 per 100,000 live births [6-9]. However, during the same time period, the population has nearly doubled from 16.7 million to an estimated 30.6 million people [7]. The population growth may negate the gains in health service delivery and prompts an urgent need to strengthen the public health workforce to operate health systems in addition to provision of essential medicines, supplies and infrastructure [10]. In recognition of the critical need for increasing the number of public health professionals in developing countries, the Rockefeller Foundation in partnership with the School of Public Health and Tropical Medicine at Tulane University initiated the Public Health Schools Without Walls (PHSWOW) program with input from faculty at Harvard and Johns Hopkins Schools of Public Health [11-12]. The PHSWOW concept aimed to design a 2-year Master of Public Health Program to increase capacity in developing countries for training postgraduate level public health personnel that can apply technical, managerial, and leadership competences to run decentralized health systems.

PHSWOW modeled MPH programs in Africa were initiated in Zimbabwe in 1993, Uganda in 1994 and Ghana in 1995.. Public health programs have been since developed with interest in service-provision or practice. A typology of field based public health training programs is described among others by Weis et al and TEPHINET [13-14] as; Epidemic Intelligence Service (EIS) of the Centers for Disease Control and Prevention in USA, the Field Epidemiology Training Programs (FETP) that became apparent in Africa, Asia and South-America after 2000 and the European Programme for Intervention Epidemiology Training (EPIET). Elsewhere, PHSWOW and FETPs are termed Applied Epidemiology Training and Service Programs (AETPs) [15].

To date the Ugandan MPH program modeled on PHSWOW has been successful in achieving its primary objectives. For instance, many of the graduates remain to manage public and private health services [16] with over 85% presence in the about 120 districts country-wide [16]. However, there are new needs for health planning and management of health systems including the use of evidence based public health practice and research. There is a growing need for public health practitioners in the public, private, civil society and international sectors.

Where should current public health training focus? Beaglehole and Dal Poz [17] question whether governments and therefore training institutions should focus on increasing the numbers of the public health workforce, or whether they should in fact focus on broadening the capacity of the public health workforce including; the size, composition, skills mix to enhance performance in dealing with priority health problems. This article contributes to the body of knowledge from the experience of a major post-graduate level public health training institution in Africa.

## Organization of the Uganda PHSWOW

Makerere University School of Public Health (MaKSPH) is one of the four constituents of Makerere University College of Health Sciences (MaKCHS) created in 2007, others are; School of Health Sciences, School of Medicine and School of Biomedical Sciences. MaKSPH is headed by a Dean and has five departments namely; Department of Health Policy, Planning and Management (HPPM), Department of Epidemiology and Biostatistics, Department of Community Health and Behavioral Sciences, Department of Disease Control and Environmental Health and Regional Centre for Quality of Health Care. The PHSWOW is hosted by the HPPM department similar to other post-graduate programs which are run by a designated department. The program is headed by a director and coordinated with the support of other personnel; the academic coordinator, field coordinator, resident mentor and program administrator. Training of post-graduate students draws expertise from the 40 man staff establishment and additional research fellows and honorary lecturers.

The School has a vision of becoming a "Centre of excellence, providing leadership in Public Health". With the mission; "To promote the attainment of better health for the people of Uganda and beyond through Public Health Training, Research and Community service, with the guiding principles of Quality, Relevance, Responsiveness, Equity and Social Justice" [18]

## Program description and scope

About 60% of the PHSWOW training is field based; where students are assigned to districts that provide practicum training through field mentors, supervisors and faculty supervisory visits. These sites host students as part of the district health team and they are mentored to participate and lead district health efforts and research during their stay. The other 40% of the 2-year Masters duration is didactic with courses covering the whole breadth of the public health discipline. It includes the five core public health trainings of epidemiology, biostatistics, environmental health,

health services administration/ management and social and behavioral sciences as described by the US National Academy of Sciences [1]. In addition, other content areas that are covered include; research methods, health informatics, communication, health policy and financing and public health ethics. With the beginning of 2010/2011, trainees have the option to elect additional specialty courses in applied epidemiology, health systems, environmental health or reproductive health.

In the earlier years of the program, training for students was donor-funded from notably, Rockefeller Foundation, WHO, Italian Cooperation including tuition, field placement and scholastic materials, however, in line with development partnership agreements, funding reduced in 2004. The CDC has supported the field work, epidemic investigations and field coordination since 2002.

## Program intake

As of 2011 Uganda program has had 17 cohorts with a total of 238 graduates. In the earlier years following program inception, the annual enrollment averaged 10 up to 1999. The enrollment rose to 18 in 2000, 21 in 2001 and to 36, its highest in 2002. Since then, numbers have ranged between 15 and 24 (average 20), with the target capacity set at 30. There are currently 39 trainees in the program, 21 in year 1 (2011/2012 intake) and 18 in year 2 (2010/2011 intake).

## Outputs – addressing service needs

### Training outputs

The 238 graduates of the program occupy a broad range of positions in the public health landscape both nationally and internationally. In Uganda these range from senior ministry of health management positions, public health program managers, district health managers, NGOs and, private health facilities. Internationally the program's graduates are spread across Africa, Asia, the United Kingdom and Oceania.

### Research outputs

Throughout the 2-year program, trainees are tasked to develop and conduct two short field studies and a dissertation. The field studies should address priority health problems or managerial gaps within the district health system and are vetted by the District Health Officer [19]. The dissertation on the other hand is an academic requirement that undergoes rigorous scientific scrutiny to conform to set standards; scientific merit and contribution to addressing an existing public health knowledge or practice gap. At least two supervisors are allocated per trainee who may later support the trainee into publication of findings. In the past 10 years, trainees have increasingly written manuscripts from their dissertations supported by their supervisors, for example, in the areas of epidemiology [20], health systems [21], maternal health [22-23] and more recently increased involvement with faculty in general research and publication [24]. Publications from students are still limited and this is an output that has not been thoroughly exhausted since there is no standard or benchmark. On the side

of faculty, Nankinga [25] quantified an increase in publications within the Makerere University College of Health Sciences, where the PHSWOW is a key contributor from 100 in 2005 to double the number in 2009. This research potential can be harnessed and trainees mentored through the MPH training to gain the discipline and skills for research dissemination to scientific and policy making fora.

With support from AFENET and other partners to MaKSPH, at least one third of the trainees are involved in dissemination of research findings at regional and international fora. For instance in 2010 five trainees presented at the 14th International Congress on Infectious Diseases in Florida, Miami, three presented at the 59th annual meeting of the American Society of Tropical Medicine and Hygiene in Atlanta, and an additional nine trainees presented at the 6th Global TEPHINET Scientific Conference in Cape Town, South Africa [26-27]. These scientific abstracts present an opportunity for further development into publishable manuscripts if resources could be devoted to this cause.

Graduates of the program have also been engaged in several ground breaking research projects locally and internationally including HIV/AIDS vaccine trials, Highly Active Anti-Retroviral Therapy efficacy studies, medical male circumcision studies, childhood illness research and demographic health surveys [26-27].

### Service provision outputs

MaKSPH collaborates with Ministry of Health (MoH), District Health Offices, District local governments, International and non-governmental organizations in planning and implementation of health programs. MaKSPH has a total of 15 district field training sites where students work with district health teams to identify health problems and address them through evidence based approaches. Students participate in surveillance activities and investigation of disease outbreaks in the districts and the region as a whole including Ebola, cholera, Marburg hemorrhagic fever, meningococcal meningitis, Hepatitis E and nodding disease. In 2010, every trainee was involved in at least one such field activity (Fig 1). Several trainees and graduates were actively involved in the 2001 Ebola epidemic response in Uganda [28]. For example, one of the program graduates, Dr. Mathew Lukwiya, notified the nation and the whole world of this deadly disease [28]. He however, contracted the viral hemorrhagic fever while attending to the patients and later succumbed to the disease. The MaKSPH under MaKSPH-CDC HIV Fellowship Program recognizes the best fellow every year with a Lukwiya Award in his honour.

### Collaborations

The Program has developed collaborative relationships with several multilateral agencies including the World Bank, European Union, the Division for International Development (DFID) and UN agencies like WHO, UNHCR, WFP and Gates Foundation, and National Institute of Health (NIH) As a result of these collaborations, the MaKSPH has a long-standing experience in conducting community and population-based studies in designated study sites/labs including; the Rakai Health Sciences Program (RHSP), the Kayunga Cohort Development (CODE) study of the Makerere University Walter Reed Project (MUWRP), and the Iganga-Mayuge Health Demographic Surveillance Site (HDSS) [26-27].



The Uganda program is a founding member of the African Field Epidemiology Network (AFENET) a networking alliance of all FETPs and PHSWOWs in Africa. The program hosted AFENET in its first year of existence. The Uganda program continues to be an active member of the network and works closely with AFENET in responding to acute public health needs in Uganda and the region at large. With support from AFENET, the MaKSPH and Institute of Tropical Medicine, Antwerp graduates in Uganda formed an alumni association in March 2011. The association is meant to facilitate further linkage between the training institution and the research and practice outputs of alumni. Inadequacy of the linkage between training, research and community service has been identified [2].

MaKSPH has got numerous long-standing capacity building and research collaborations with Universities such as Karolinska Institutet, London School of Hygiene and Tropical Medicine, Harvard School of Public Health, Johns Hopkins School of Public Health, Tulane University, Case Western Reserve University, University of Alberta, Swiss Tropical Institute, Muhimbili University of Health and Allied Sciences, School of Public Health, National University of Rwanda (NUR), University of Western Cape South Africa, Jimma University Ethiopia, Kinsasha University School of Public Health, School of Public Health Moi University, University of Bergen, Norway and other reputable institutions around the world. The collaborations are a means to enhance capacity and effectiveness in research and community service giving opportunities for capacity development to faculty and program staff within projects.

## Future challenges for attention

One key challenge that exists for the program is to address the skills mix of public health graduates. Already, in 2010/2011 academic year, MaKSPH has embarked on a revised curriculum where trainees elect a track in which additional courses are offered; applied epidemiology, health systems, environmental or reproductive health. This is expected to increase the skills mix to match the relevant needs of the health system, however its implementation and outputs deserve attention through process evaluations to assess their effectiveness.

The critical mass for public health training is still far from being achieved considering research and practice needs. As opposed to the current 0.4 public health professionals per 10,000 population in Uganda, there is need to target achieving 4.7 public health professionals per 10,000 population similar to the situation in high-middle income countries [29]. Some authors have suggested that FETPs should train at least 3 to 5 graduates per million inhabitants [30-31] translating into 170 graduates from the Ugandan program. This target has been exceeded without realizing the critical numbers of practitioners. There is need for further research on adequacy and skill mix of public health workforce in low income settings.

Tracking alumni and increasing research outputs of trainees and graduates is another major challenge. Since research in community sites/labs focuses on pertinent policy challenges within health system, students that select an elective should have their dissertation benefit from a natural home within such an existing institutional research lab. On the other hand, student dissertations are currently not accepted to be conducted on

secondary or historical data, yet such data is extremely relevant for evaluation of health interventions. If these conditions are waived, an upsurge in student and faculty research outputs in the form of publications is likely.

The greatest challenge to the training program is that of strengthening field placement in the era of limited partner funding. There are challenges pertaining to student choice of and maintenance of field placement sites due to infrastructural and system development resource needs. We suggest that institutional research sites should be optimally utilized as student field placement labs. We also suggest that the Uganda PHSWOW needs to seek external funding through grants to maintain the quality and number of field sites to ensure that the PHSWOW training continues to address the health priorities of the Ugandan public.

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## Declaration of competing interests

The authors declare that there are no competing interests.

## Author contribution

RT participated in the design, data collection and led drafting of the manuscript. CN participated in the design, data collection and drafting part of the manuscript. NA, DM, ER and WB participated in the conception, design and drafting part of the manuscript. All authors read and approved of the final manuscript.

## Tables and Figures

**Table 1. Number of trainees involved in partner-led field activities, June 2010 – July 2011**

Activity	Date	# of trainees involved in Investigation/ Response	Lead Agency and support partner
Martyr's Day Celebration Medical Surveillance	June 2011	05	AFENET
Yellow Fever Vaccination Coverage Survey, 5 districts in Northern Uganda	May/June 2011	07	WHO
Viral Haemorrhagic Fever Surveillance	March 2011 to date	02	CDC
One Health Central and East (OHCEA) Monitoring and Evaluation, Baseline Survey	July 2011	03	USAID
National Yellow Fever Epidemic Reactive Vaccination (5 districts)	January/ February 2011	05	MoH
Cholera Outbreak Investigation	March 2011	05	AFENET
Anthrax Response Review Meeting	March 2011	05	AFENET
Participatory Epidemiology Investigation of under-five diarrhea in Kisumu, Kenya	October, November 2010	03	ILRI, CDC
Risk Assessment for Anthrax among Game-Reserve Communities	September 2010	02	AFENET/ USAID
Global Health Institute (International Course focusing on ONE HEALTH)	August 2010	03	University of Minnesota
Participatory Epidemiological investigation on Nodding disease	August 2010	02	AFENET/ CDC

Source: Quarterly reports of the MPH PHSWOW to AFENET Secretariat, 2010 – 2011

Key: ILRI – International Livestock Research Institute, MoH – Ministry of Health, Uganda.

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## THE WEST AFRICA FIELD EPIDEMIOLOGY AND LABORATORY TRAINING PROGRAM, A STRATEGY TO IMPROVE DISEASE SURVEILLANCE AND EPIDEMIC CONTROL IN WEST AFRICA

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Key words: epidemiology, West Africa, field epidemiology and laboratory training program, surveillance.

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### Abstract

The West Africa Field Epidemiology and Laboratory Training Program (WA-FELTP) which was established in September 2007, is an inter-country, competency-based, in-service and post -graduate training program in applied epidemiology and public health that builds the capacity to strengthen the surveillance and response system as well as epidemic control in the French-speaking countries where they are implemented.

The overall purpose is to provide epidemiological and public health laboratory services to the public health systems at national, provincial, district and local levels. The program includes four countries: Burkina Faso, Mali, Niger, and Togo with an overarching goal to progressively cover all French speaking countries in West Africa through a phased-in approach. WA-FELTP's 2- year Master's program was launched in 2010 with 12 residents, three from each country, and consists of medical and veterinary doctors, pharmacists, and laboratory scientists. The training comprises 25% didactic sessions and 75% practical in-the-field mentored training. During the practical training, residents provide service to their respective ministries of health and ministries of animal resources by contributing to outbreak investigations and activities that help to improve national surveillance systems at national, regional, district and local levels. The pressing challenges that the program must address consist of the lack of funds to support the second cohort of trainees, though trainee selection was completed, inadequate funds to support staff compensation, and shortage of funds to support trainees' participation in critical activities in field epidemiology practice, and a need to develop a 5-year plan for sustainability.

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## Introduction

The West Africa Field Epidemiology and Laboratory Training Program (WA-FELTP) which was established in September 2007, is an inter-country, competency-based, in-service and post-graduate training program in applied epidemiology and public health that aims at building capacity to strengthen the public health surveillance and response system as well as epidemic control in West African French-speaking countries. The overall goal of Field Epidemiology Training Programs is to enhance public health capacity by developing a cadre of health professionals with advanced skills in applied epidemiology and laboratory management and to provide epidemiological and biological services to the public health systems at national, provincial, district and local levels. The program includes four countries: Burkina Faso, Mali, Niger and Togo with an overarching goal to progressively cover all French-speaking countries in West Africa (1). The WA-FELTP is a partnership between ministries of health, ministries of higher education, ministries of animal resources, and leading universities, research institutions, and reference laboratories in the four countries. Other partners are the World Health Organization (WHO)'s Multi Disease Surveillance Centre (MDSC), the United States (US) Centers for Disease Control and Prevention (CDC), the US Agency for International Development (USAID), the West Africa Health Organization (WAHO), and the African Field Epidemiology Network (AFENET). The WA-FELTP is housed at MDSC and the University of Ouagadougou is the host institute for the Master FELTP, and is also the awarding entity for degrees attained by trainees of the program in academic agreement with the other concerned universities (as an accredited university of the Higher Education Council for French speaking countries - CAMES) (2).

The governing and advisory bodies of the WA-FELTP are: the Steering Committee, the Program Director at MDSC, the Host University Master FELTP Director, and the Scientific Advisory Committee. The focal persons of WA-FELTP in each country are the four Directors of Prevention and Disease Control within the ministries of health of the participating country, and representatives from involved universities, research institutes and reference laboratories.

## Vision And Mission

The program envisions growing into a leading professional training program that advances public health in West Africa and beyond, by addressing their public health needs and priorities through training and service in applied epidemiology and laboratory management.

The program goes beyond training by working with ministries of health and ministries of animal resources in building a sustainable network of highly skilled field epidemiologists and laboratory managers, as well as a roster of frontline health worker field staff who are measurably improving public health services through: a) successful and timely outbreak investigation and response capacity, b) creating functional public health surveillance systems, c) developing functional laboratory capacity, d) evidence-based decision making, enhanced collaboration, networking and research.

## Objectives

The objectives of the program are to strengthen the capacity of public health workers in Francophone West Africa to improve national public health surveillance systems and thereby providing timely response to outbreaks and other public health emergencies. The program also aims to enhance public health capacity by developing a cadre of health professionals with advanced skills in applied epidemiology and laboratory management and to provide public health services at national and sub-national levels.

## Description Of the Programme

The 2-year FELTP program was launched in 2010 with the first cohort of 12 residents comprising three from each participating country, and consisting of medical and veterinary doctors, and medical biologists and a pharmacist from Burkina Faso. WA-FELTP's philosophy is to have epidemiologists and medical biologists learn about the role of the various public health professionals in controlling public health problems. The training comprises 25% didactic sessions and 75% practical in-the-field mentored training. During the practical training, residents provide service to their respective ministries of health and ministries of animal resources by contributing to outbreak investigations and activities that help to improve national surveillance systems at national, provincial, district and local levels. Upon completion residents will receive a Master of Public Health (MPH) degree in Applied Epidemiology (and Laboratory Management for the laboratory scientists) and will be posted to serve in key public health and animal health programs to advance good public health practices in the region. (2) To facilitate MPH degree and short course trainings, the WA-FELTP uses experienced international professors and trainers from the four concerned universities, public health and research institutes, and reference laboratories (including the School of Veterinary Medicine in Dakar, Senegal, the Pasteur Institute of Dakar, Senegal), WHO, and CDC.

Additionally, WA-FELTP conducts a series of short course trainings for public health workers in the participating countries. The short courses provide training in outbreak investigations and the use of evidence-based decision-making in public health. During each short course participants receive a project assignment and they report their findings after 3 months. The project presentations are evaluated by panel of judges who judge the presenters' quality of thought, practicality, and ability to address the problem itself. The overall objective of these courses is to help strengthen the capacity of countries to plan, implement, monitor and evaluate public health surveillance systems for priority diseases (e.g., cerebral spinal meningitis) in the West African Region. Since 2007, the program has trained a total of 121 health professionals through short course trainings conducted from the four WA-FELTP countries. Through its short course trainings, the WA-FELTP is progressively building a roster of skilled health field staff in outbreak investigation and response within the target countries who will contribute to a critical mass of health personnel to be deployed anytime to fight recurrent epidemics in Francophone West Africa (3). WA-FELTP is an excellent example where the "One Health" concept is demonstrated through joint human-animal health training and service in disease surveillance, outbreak investigation and response, epidemiological studies and

public health management/leadership that address priority public health challenges in African countries [4,5].

WA-FELTP offers a pathway to achieve a major goal of the World Health Organization for Regional Office for Africa's Integrated Disease Surveillance and Response (IDSR) strategy, which is to strengthen district-level surveillance capacities for detecting, confirming and responding to priority diseases that afflict African communities, and linking public health surveillance with laboratory support in order to produce relevant and high-quality information for taking public health action[6].

## Achievements/ Highlights Of The Programme

- Adoption of the WA-FELTP program as a degree of University of Ouagadougou
- Validation and adoption of the Master FELTP curriculum by the University of Ouagadougou Scientific Committee.
- Ministry of Education decree to recognize the Master FELTP as the official degree for public health servants in Burkina Faso (and hence for French speaking countries).

## Outbreak response activities

1. Investigation of Cholera outbreaks in Lome, Togo (May 2011) and Niger (September 2010 and August 2011)
2. Investigation of Measles outbreak in Bamako, Mali (March 2010)
3. Meningitis Vaccination campaigns organized by WHO in Burkina Faso (December 2010)
4. Investigation of Yellow fever case in Bobo, Burkina Faso (November 2010)
5. Investigation of Meningitis outbreak in Barsalogo, Burkina Faso (March 2010)

## Surveillance systems and evaluation

1. An evaluation of the measles surveillance system in Mali. Recommendations to the Ministry of Health were formulated to improve data collection and reporting, training of health workers, and the need of increasing the staff.
2. Epidemiological surveillance of contagious bovine pleura-pneumonia in Mali. Residents demonstrated the strengths and weaknesses of the surveillance system, and made some recommendations to the Animal Resources Department for improvement.
3. Epidemiological surveillance system for meningitis in Kolokani, Mali, May 2010.
4. Surveillance of highly pathogenic H5N1 avian influenza in Burkina Faso-2010.
5. An evaluation of the filariasis campaign in Burkina Faso by two residents of Burkina Faso who found out that filariasis is still a problem despite distribution of ivermectin in the country, and recommendations made to the Burkina Faso Ministry of Health.

6. An evaluation of meningitis surveillance data from 2009-2010 in Burkina Faso.
7. An evaluation and organization of electronic database system for the district of Kati in Mali. The residents set up a system which will be used for IDSR implementation, including the Expanded Program for Immunization and outbreak investigations.
8. An evaluation of the surveillance of human and animal rabies in two districts of Togo. The surveillance findings indicated that rabies is still a problem in Togo, and children are the most affected. Also, there is not enough anti-rabies vaccine in Togo, and the reporting system need to be improved as recommendation was formulated by the residents to the official of animal resources.
9. Evaluation of Malaria in Central –East Sanitary Region, Burkina Faso, 2006-2009
10. Evaluation of Meningitis' Surveillance System –Ziniare – Burkina Faso, 2003-2010

## Abstracts Accepted

1. Two abstracts (1 oral and 1 poster) were accepted for the French Society of Public Health Conference, for November 2011 (Lille /France).  
**Oral:** Evaluation du Système de Surveillance de la Méningite –Ziniare, Burkina FASO (Evaluation of Méningites' Surveillance System –Ziniare –Burkina Faso, 2003-2010)  
**Poster:** Evolution of Malaria in Central –East Sanitary Region, Burkina Faso, 2006-2009)
2. An abstract on Rabies in Togo was accepted for the "One World One Health" Conference in Australia that was held in February 2010
3. **Oral:** Surveillance of filariasis in Burkina Faso presented at "Health Science day of Filariasis, Bobo/ Burkina, May 2010"

## Short Courses

The program has trained a total of 121 health professionals through short course trainings conducted from 2007- 2011 as listed below.

1. Outbreak Investigation Short Course in Burkina Faso in 2007 and 2008. Sixty-one participants were trained, including district and regional Medical Officers, Surveillance Officers, Biologists and Pharmacists. The training was followed by presentations of mini projects implemented by participants three months after the short course training occurred.
2. Outbreak Investigation Short Course in Mali in 2008. Twenty district and regional medical officers, surveillance officers, biologists and pharmacists were trained. This was followed by presentations of mini projects after a three month period.
3. Outbreak Investigation Short Course in Lome, Togo, June 2010. Twenty district and regional medical officers, surveillance officers, biologists, pharmacists and veterinarians were trained.
4. Regional Workshop on Pandemic Influenza Preparedness and Response in Central and West Africa was held in Ouagadougou, Burkina Faso in July 2011. A total of 27 participants from eight countries attended including:

FELTP residents, ministries of health and animal personnel. The training focused on key aspects of preparedness and responses to pandemic influenza. Participants of each country identified a mini project topic, and the project will be implemented and reports submitted by the end of 2011.

## Sustainability

The initial successes of the WA-FELTP have been possible so far due to seed funding provided by USAID and CDC and contributions in various forms by the University of Ouagadougou and other partners, including the ministries of health of the four initial countries. Further achievement and support will largely depend on a widened partner base as well as continued funding from respective ministries of health to support future residents from their country to participate in the applied epidemiology program. Although the regional WA-FELTP began with four member countries in Francophone Africa, the desire, once the program is well established and has identified and secured additional funding, is to expand the program to include other Francophone countries throughout Africa through a phased in approach.

**Table 1: Key Achievements of the WA-FELTP**

Achievements	No.
Outbreaks investigations and response	5
Surveillance data publication	6
Surveillance systems evaluated	4
Research studies done	12(thesis)
Evaluations (Program or Project)	2
Scientific presentations at conferences	2
Publications by the trainees	-
Abstracts for AFENET , EIS , and TEPHINET	22
Public health workers trained in short courses	121
Public health projects conducted by short course trainees	91

## Challenges

Despite the initial successes noted, above WA-FELTP is experiencing difficulties particularly in obtaining funding to support the 2-year Master's FELTP beyond the first cohort. This shortfall of funding can be attributed to the prevailing economic difficulties in the global economy and the difficulty in obtaining a wider donor base for the program despite several attempts. However, countries and partners, as well as the host university (University of Ouagadougou) have shown dedicated support for short courses and the Master's program and this support needs to be translated into support for the 2-year Master's FELTP. There is a need for a 5-year plan that will allow a phasing approach to demonstrate program added value and to achieve complete support by governments.

## Conclusion

There is an unmet need for field epidemiologists and public health lab in the West African sub-region. The WA-FELTP program helps to bridge the gaps in the realm of field epidemiology training and the first program of its nature in Francophone Africa. WAFELTP is ensuring that trainees receive intense training on appropriate responses to public health emergencies. The outbreak response and surveillance system evaluation, along with over 100 short course trainees demonstrates that this type of training and program is viable in Francophone West Africa, an area which has a great need for this training and those efforts from national governments and other donors need to be intensified to continue the program. The graduates of this program, like alumni of other FELTPs will play a central role in public health surveillance, disease control, implementation and evaluation of public health programmes (e.g., in malaria , tuberculosis, HIV/AIDS , maternal and child health immunisation program) , and in outbreak investigation and control. FELTP graduates have the potential to be in leadership positions in ministries of health, non-governmental organizations, and other health agencies. They also have implemented cross-border public health surveillance systems that have contributed significantly to reducing transmission of diseases and promoted enforcement of the International Health

Regulations (1&6). In the future, the WA-FELTP is planning to extend the program to other Francophone African countries that are not currently benefiting from participating in the WA-FELTP, and creating an alumni association and scientific journal for submitting articles, and sharing findings. Sustaining the early successes of WA-FELTP will depend on continuation of funding from all the stakeholders.

## Competing Interests

None

## Author Contributions

Mutabaruka E, Ndjakani Y and Namusisi O: Contributed to development and design of the concept, writing the article and providing important intellectual content, reviewed several drafts and final approval of the version to be published.

Sawadogo M, Tarnagda Z, Ouédraogo L, Sangare L, Ousmane B, Mukanga D<sup>3</sup>, Evering-Watley M, Hounton S, Nsubuga P: Contributed to writing the article, revising the article for important intellectual content, and approval of the version to be published.

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## STRENGTHENING FIELD EPIDEMIOLOGY IN AFRICA: THE ZIMBABWE FIELD EPIDEMIOLOGY TRAINING PROGRAM

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Key words: Epidemiology, Education, Training, Public health, Zimbabwe MPH program

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### Abstract

The Zimbabwe Masters in Public Health Program is a 2-year competency based training that consists of classroom teaching (30%) and on the job field training (70%). The MPH program was created in 1993 with the aim of assisting the Ministry of Health and Child Welfare create a permanent capacity to recruit, train, and employ public health practitioners to sustain the public health infrastructure. The MPH program is operated from two sites: the DCM at the College of Health Sciences, of University of Zimbabwe (UZ) and the Health Studies Office (HSO) in MOHCW. The HSO in the MOHCW oversees the operation of field training in collaboration with approved Field Supervisors at the training sites. MOHCW provides field training sites through its eight provincial medical directorates. In addition the health directorates of the major cities in the country are designated field training sites. Since 1993, the program has had 18 Cohorts trained of which three are part-time. The part-time program was initiated in 2008 with an intake of 10 trainees. Since 2003, the full time program has experienced an increase in intake with the highest intake recorded being 16 trainees in 2003. The average intake from 2003 – 2011 has been 12 trainees. A total of 169 trainees have been enrolled in the last 19 years. Of the 143 trainees enrolled by 2009, 136 (95%) have graduated. The part-time program has had one cohort graduating with 5 out of 10 successfully completing the course. Since the launch of the program, the majority of the graduates have filled most of the key public health positions and even so the positions in most of the nongovernmental organisations.

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## Background

Up until 1992, Zimbabwe faced an acute need for post-graduate level public health training. Most public health posts were filled temporarily by expatriate doctors, mainly Dutch public health specialists under a government to government agreement. In addition, Zimbabwean physicians who did serve in public health posts but went overseas for public health training, frequently found themselves ill-equipped to function in local public health settings on return [1]. In response to these training needs, the Ministry of Health and Child Welfare (MOHCW) in partnership with the University of Zimbabwe (UZ), Department of Community Medicine (DCM) and with funding from the Rockefeller Foundation started a Master of Public Health (MPH) program using the Public Health Schools Without Walls (PHSWOW) strategy [1, 2]. The first PHSWOW in Africa was founded in Zimbabwe in 1993 with four trainees. The goal of the MPH project was to produce highly competent multi-disciplinary public health professionals who would assume influential posts in the country's public health structures and tackle emerging and reemerging communicable and non-communicable diseases [1, 3].

Currently the combination of an economic recession, drought, and an HIV epidemic has worsened the disease burden and worsened most public health indicators in Zimbabwe. The MPH program thus aims at assisting the MOHCW to create a permanent capacity to recruit, train, and employ public health practitioners to sustain the public health infrastructure. To accomplish this, an integrated programme of formal class work and a large element of supervised practice in actual public health settings was developed [1].

## Approaches and methods

The MPH program is a 2-year competency based training that consists of classroom teaching (30%) and on the job field training (70%). It is managed through an Advisory Committee chaired by the Principal Director in the MOHCW. The Advisory Committee provides overall stewardship of the programme. Program staff consists of an MPH Coordinator/Director who has an academic post in the DCM, two assistant field coordinators, a financial administrator, two program secretaries and a driver. The program collaborates with the Division of Public Health Systems and Workforce Development (DPHSWD) at the United States Centers for Disease Control and Prevention (CDC), Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET), African Field Epidemiology Network (AFENET), World Health Organisation (WHO), Zimbabwe CDC, and informally with United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP) and United Nations Population Fund (UNFPA).

In 2008, a part-time MPH program was launched due to the demand of the program. The part-time program is a three year program that uses the modular approach where trainees come for classes over a short period of time and go back to their work places that act as field sites for field work.

The MPH program is operated from two sites: the DCM at the College of Health Sciences, of University of Zimbabwe (UZ) and the Health Studies Office (HSO) in MOHCW.

The HSO in the MOHCW oversees the administration of field training in collaboration with field supervisors at the training sites. MOHCW provides field training sites through its eight provincial medical directorates. In addition, the health directorates of the two major cities (i.e., Harare and Bulawayo) in the country are designated field training sites. A number of additional sites have been identified and are operational and currently 15 sites are used for training. These include parastatals such as the National AIDS Council and Zimbabwe Family Planning Council, AIDS and TB unit within the MOHCW, private organizations such as Bindura Nickel Corporation and Organization for Public Health Interventions and Development. Currently, there are 30 active field supervisors for both full-time and part-time trainees. Most of the field supervisors are graduates of the programme and hold the influential positions in the MOHCW. The program continues to explore additional non-traditional field sites among AIDS service organizations, UN agencies and non-governmental organizations for both full-time and part-time trainees.

DCM provides the 6 month didactic component of the programme. The MPH coordinator oversees the organization of the modules and field experience. The classroom lectures are front loaded for the initial 6 months followed by 18 months of continuous field attachment.

The classroom (academic) component is organized into six academic modules (see Table 1). Each module is coordinated by a module coordinator. Some field supervisors also lecture in the program during the didactic sessions. The DCM has two professors who are part of the program. The program receives guest lecturers from other partners such as WHO, Elizabeth Glaser Paediatric AIDS Foundation, MOHCW, CDC, and others. Besides the field coordinators, there is also a pool of highly qualified academic staff within the department of community medicine within which this program falls. Table 1 lists the modules by block.

**Table 1: Zimbabwe FETP Modules**

Block 1	Mod. 1.1 Public Health Philosophy Mod. 1.2 Epidemiology and Field Research Mod. 1.3 Biostatistics & Statistical Computing Mod. 1.4 Health Systems Research
Block 2	Mod. 2.1 Health promotion; Mod. 2.2 Communication skills
Block 3	Mod. 3.1 Communicable & Non-Communicable Diseases Mod. 3.2 HIV/AIDS
Block 4	Mod. 4.1 Epidemiology II Mod. 4.2 Health Services Management
Block 5	Mod. 5.1 Maternal and Child Health & Family Planning Mod. 5.2 Advanced Biostatistics
Block 6	Mod. 6.1 Environmental and Occupational Health

In summary, the 2-year course schedule is organized into two alternating academic and field blocks as shown in Table 2.

including univariate, bivariate and multivariate analysis and finally the interpretation of the different statistical outputs.

**Table 2: Zimbabwe FETP Academic and Field Blocks**

Months	# of Months	Training Description/Location
1st–6th	6	Classroom training (except for short field trips amounting to a month)
7th–21st	15	Supervised field activities
22nd–24th	3	Classroom training (trainees attend revision classes, finalize reports including theses, and take final exams)

Trainees are required to take and pass regularly scheduled tests before they start their field attachments. A final examination for each of the academic courses is taken at the end of the second year of the program. In addition, trainees have a thesis project developed based on one of the field investigations undertaken during the field attachment. This is usually as an extension of one of the field write-up requirements. The MPH thesis requirement is intended to demonstrate the student's ability to independently identify, analyze and solve problems in the field. The thesis contributes 25% of the final course grade.

The field component is achieved through six core activities which are supervised and mentored by field supervisors and field coordinators. These are as follows;

- Outbreak investigation
- Surveillance system evaluation
- Management and health economics analysis
- Program evaluation
- Secondary data analysis
- Field study

The MOHSW offers training facilities in terms of field sites as well as some material resources. At each field site the trainees are being supervised by Provincial Medical Directors and by Directors of Health for those in cities. These directors are graduates of the FETP program. This has helped in sustaining the program.

UZ awards the degree of MPH upon successful completion of program requirements.

### Special short courses

While in the field, trainees attend two courses:

Course in scientific writing. This is a 5 day course designed to impart communication and writing skills to trainees. This prepares trainees for writing of manuscripts for publications and making scientific presentations. In addition they learn how to critique a scientific paper.

Advanced data analysis to prepare trainees for fieldwork. The course normally runs for least two days. A CDC manual on advanced data analysis titled "Sexually Transmitted Infections in Kuwadzana" which was developed based on a study conducted by a Zimbabwe FETP student, is used for this purpose, this case study is used globally by other FETPs and FELTPs. During this course trainees learn how to analyze a dataset starting with the cleaning, performing some logic checks, checking for duplicate records, checking for outliers and the actual analysis itself

### Field support to trainees

Trainees are expected to attend a mandatory monthly conference where they present their field projects and progress. The conference is held every last Friday of the month and is held at the MOHCW headquarters. It is attended by the trainees, field coordinators, field supervisors, faculty, CDC staff, the permanent Secretary of Health, the chairman of the MPH Advisory Committee, Chairman of DCM and other invited guests. It provides a forum for trainees to present results of evaluations done and get a feedback from their peers and from MOHCW officials.

In addition to these monthly conferences, trainees receive quarterly assessments by program coordinators to coach and ensure that trainees are on-course as far as field assignments are concerned.

## Results

Since 1993, the program has had 18 cohorts trained of which three are part-time (see Table 3). The part-time program was initiated in 2008 with an intake of 10 trainees. Since 2003, the full time program has experienced an increase in the intake with the highest intake recorded being 16 trainees in 2003. The average intake from 2003 – 2011 has been 12 trainees. A total of 169 trainees have been enrolled in the last 19 years. Of the 143 trainees enrolled by 2009, 141 (99%) have graduated. The part-time program has had one cohort graduating with five out of 10 trainees successfully completing the course.

**Table 3: Zimbabwe FETP Graduates and Trainees, 1993 - 2011**

Year	Number enrolled		Number graduated	
	Full time	Part-time	Full time	Part-time
1993	4		4	
1994	4		4	
1995	5		5	
1996	7		7	
1997	6		6	
1998	6		6	
1999	8		8	
2000	5		5	
2001	7		7	
2002	9		9	
2003	16		15	
2004	10		9	
2005	13		11	
2006	8		8	
2007	12		11	
2008	12	10	12	5
2009	11	7	9	Still to graduate
2010	14	0	Still to graduate	No intake
2011	12	7	Still to graduate	Still to graduate
Total	169	24	136	5

The table 4 shows some of the employment positions that graduates of the program are holding in the public health sector. By 2011, the three most senior positions in the MOHCW – the Permanent Secretary for Health, Principal Director Preventive Health, and Director of Disease Control and Prevention were

held by graduates of the program. The MPH program has two Field Coordinators who are also graduates of the program. The majority of the graduates have filled the positions in the non-governmental organisations.

Since the program was launched, a number of key contributions

**Table 4: Key Positions held by Zimbabwe FETP Graduates in the Public Health Sector**

Sector	Positions held (as of 2011)	Number
Government National	Permanent Secretary for Health	1
	Principal Director Preventive Health	1
	Directors (Epi and Disease control, ZNFPC, FELTP)	3
	National Malaria Program Manager	1
	Malaria Case Management Focal Person	1
	Laboratory Surveillance Officer	1
	National ART Program Coordinator	1
Provincial Universities	Director – City Health Department	4
	Provincial Medical Directors	3
	Provincial Epidemiology and Disease control Officers	3
	Lecturers/Field Coordinators	3
NGO/UN/CDC	Medical Epidemiologist (SAFELTP)	1
	National Professional Officers (WHO)	3
	Program Managers (Malaria, TB, HIV, Nutrition)	10
	Operations Research Officer	1
	M&E Specialists	4
	PMTCT Technical Officer	2
	Country Director (EGPAF)	1
	Deputy Director – Zim CDC	1
	Chief Executive Officer - NAC	1
	Laboratory Project Coordinator (AFENET)	1
Self employed	Public Health Consultants	1

have been documented that relate to strengthening the public health system in Zimbabwe. Table 5 shows the contributions in terms of outbreak investigations, surveillance and program evaluations, among others. A total of 14 outbreak investigations, surveillance system and program evaluations have been conducted for each. Thirty four publications have been made in peer review journals.

**Table 5: Zimbabwe FETP Contribution to the public health system**

Achievements	No.
Outbreaks investigations and response	141
Surveillance data publication	52
Surveillance systems evaluated	141
Research studies done	141
Evaluations (Program or Project)	141
Scientific presentations at conferences	328
Publications by the trainees	34
Short courses and proportion of cadres trained	14 (154cadres trained)

### IDSR/IHR progress in Zimbabwe and how the program has helped

In September 1998, the 48th Regional Committee for Africa met in Harare, Zimbabwe. Through the resolution AFRO/RC48/R2, Member states adopted the Integrated Disease Surveillance and Response (IDSR) strategy as a regional strategy for early detection and efficacious response to priority communicable diseases for the African region [4].

Zimbabwe carried out an assessment of its surveillance system in 1999 and identified areas where improvements were needed. The assessment contributed to the development of the 2002 Zimbabwe IDSR guidelines which were adapted from the WHO 2000 generic IDSR guidelines.

Following the assessment an inter-country workshop was held from the 30th of October 2001 to 7th November 2001 to adapt the generic IDSR technical guidelines to the Zimbabwe context. This was followed by another workshop from the 19th to the 24th of August 2002 which sought to adapt modules 1, 2,3,4,5 and 7.

In December 2002 and January 2003 two training of trainers workshops were conducted for the northern, southern provinces, central hospitals and MOHCW head office staff. Public health workers from districts, provinces and cities were subsequently trained in IDSR. About 400 public health workers were trained during this first adaptation. Further adaptation of training modules was done in December 2004 to suit health centre level staff who was then trained from 2005 onwards. In addition uniformed forces health personnel were also trained in 2007.

The Zimbabwe FETP led the adaptation process of the IDSR guidelines and has also been actively involved in training of public health workers. IDSR is also included in the MPH curriculum. Trainees carry out surveillance evaluations as one of their core activities for learning and to date 143 evaluations have been conducted and recommendations from these evaluations have helped in shaping health policy within the country.

On 23 May 2005, the 58th World Health Assembly adopted

the International Health Regulations (IHR, 2005) in Geneva, Switzerland through Resolution WHA58.3. The International Health Regulations entered into force on June 15, 2007. In the WHO/AFRO member states it was agreed that the IHR be implemented through IDSR strategy. Based on this, the MOHSW and its partners including WHO and Zimbabwe FETP have had a series of adaptation meetings including revision of modules. There has been training of trainers workshops and subsequently training of the health cadres at all levels.

A number of milestones with regards to implementation of IDSR have been achieved in Zimbabwe. One of the major achievements to note is that in 2004 after the first adaptation, MOHCW won the South African Development Community trophy for having the best surveillance system in the region [5].

## Discussion

The PHSWOW (FETP) is experiencing increased demand throughout the world as the need and expectation for high quality public health services continues to grow. Public health services in many countries, however, are experiencing these greater demands even as resources for public health are diminishing [6]. In Zimbabwe, the demand for enrolment for the MPH program has remained high over the past 10 years. This has been characterised by huge numbers of applications and requests by organisations and institutions to have provisions for those who would want to remain in full employment while studying. As a result, in 2008, the program began a 3-year part-time MPH program in order to meet this demand.

The success of the Zimbabwe MPH program has largely been due to the close collaboration and support from the MOHCW. This support comes in form of office space, funds, stationery, transport and other logistics. Most of the site supervisors are graduates of the program and understands the program structure, field expectations and needs. Zimbabwe still enjoys the presence of these graduates in these positions as reflected in the study conducted in 2010. This review of retention for the MPH cohorts has shown that for Zimbabwe (1993-1997 enrolments), the retention within country was high within the MOHCW (47%) and graduates have these positions at provincial level which are field sites [7]. To maintain this support, the Zimbabwe program has revived the Alumni association and holds yearly meetings with site supervisors to review and re-engage them in the life of the program.

The main achievement of the program is in line with its vision, in that it has managed to produce cadres that now occupy very influential positions within the public health system in the country. The graduates of the program have found employment in a number of sectors including Ministry of Health and Non Governmental Organisations (NGOs). The MPH program has continued to exploit other sources for funding in order to sustain itself, and expand the public health capacity in Zimbabwe. In 2001-2006 the programme used new HIV/AIDS programme-specific funds to strengthen and expand the general public health leadership capacity in Zimbabwe, simultaneously ensuring that they were trained in HIV interventions. As a result, there was an increase in both the numbers of public health professionals

practically trained HIV /AIDS programmes and also HIV / AIDS related positions filled in the MOHCW and other partner organisations [8].

The program has continued to play a critical role in the strengthening of the public health system (i.e., in planning and implementation of the local and national health programs). This has been achieved through the program coordinators and the trainees as they do field activities at the field sites. The trainees under the guidance of the field supervisors and coordinators conduct and respond to outbreaks, evaluate surveillance systems, conduct field studies, carry out program evaluation, carry out secondary data analysis and perform some management and health economics analysis [7].

Findings from various evaluations that have been conducted by the trainees have helped in shaping the Zimbabwean public health policies on several issues including malaria diagnosis, HIV management, communicable disease control (e.g., cholera), prevention of mother to child transmission of HIV program, drug stock management, and surveillance systems.

The MPH program, because of its years of experience, has become a centre of excellence for other young Field Epidemiology and Laboratory (FELTP) programs. In 2009 - 2010 delegations from Ethiopia, Nigeria, and Kenya FELTP programs came to learn and understand how the program runs especially given its unique collaboration between the MOHCW and UZ. Graduates of the program have participated in scientific conferences in country and outside the country.

The program has participated in response to regional public health threats as shown during the 2008-9 cholera outbreaks that affected both Zimbabwe and South Africa.

The Zimbabwe FETP is one of the founding member countries of AFENET. AFENET offers technical expertise to the programme as well as funding and material resources (e.g., for outbreak response). CDC is another key partner to the program. CDC has continued to provide funding and technical support to the program.

## Future plans of the FETP

The following are the future plans for the Zimbabwe FETP

Identifying new field training sites

Seek for alternative funding sources

Maintain the traditional field sites and the team of dedicated field supervisors.

Continue training foreign students.

## Sustainability of the program

The program is involved in designing a strategic plan which will include engaging the MOHWS to try and come up with a budget line item to cover the costs for the program. In addition to this, the program has begun recovering certain costs from the trainees through requesting trainees to pay for their training materials and supplies. The program has continued to engage and encourage

all graduates, through the Alumni association, to be involved in the activities of the program to ensure availability of personnel to teach and mentor trainees.

## Limitations

The program has faced a number of challenges and limitations over the recent years.

The increase in the intake of residents from 13 to 30 has not been matched with an increase in the number of field coordinators in the program as well as field supervisors at the field sites. This has resulted in increased workload for the few faculty members that are available.

Attrition of field supervisors. Because of recent economic challenges in the country, a number of qualified people have moved to partner organisations and outside the country.

The part-time program has managed to graduate only five from the 2008 cohort out of the possible 10. This is because the field supervision is difficult when trainee and supervisor work in different institutions, which is usually the case for part time program. Students from non-governmental sector tend to struggle and some are likely to drop out due to their work overload and the resulting inadequate time for studies.

## Conclusion

The program has continued in its commitment to produce competent and skilled graduates who are ready to assume leadership positions in the MOHCW. Over the years, this has translated into improved response to and containment of outbreaks and health systems strengthening. During training, trainees contributed in the controlling and investigating outbreaks and evaluations of public health systems and programs. Therefore, there is greater need for continued support from government and development partners to ensure program sustainability. The close collaboration between the MOHCW and UZ has enhanced the efforts to realising the mission of the program.

## Author Contributions

Mufuta Tshimanga: Contributed to writing drafts of the article, reviewed several drafts, provided important intellectual content, and approval of the version to be published.

Notion Gombe: Contributed to writing drafts of the article, reviewed several drafts, provided important intellectual content  
Gerald Shambira: Contributed to writing drafts of the article, reviewed several drafts, and provided important intellectual content.

Ndlovu Nqobile: Contributed to development and design of the concept, writing the article and providing important intellectual content.

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## Conflict of Interest

No conflict of interest declared by the authors

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## PARADIGM SHIFT: CONTRIBUTION OF FIELD EPIDEMIOLOGY TRAINING IN ADVANCING THE “ONE HEALTH” APPROACH TO STRENGTHEN DISEASE SURVEILLANCE AND OUTBREAK INVESTIGATIONS IN AFRICA

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Key words: Field epidemiology, one health, disease-surveillance

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### Abstract

The occurrence of major zoonotic disease outbreaks in Sub-Saharan Africa has had a significant impact on the already constrained public health systems. This has, as a result, justified the need to identify creative strategies to address threats from emerging and re-emerging infectious diseases at the human-animal-environmental interface, and implement robust multi-disease public health surveillance systems that will enhance early detection and response. Additionally, enhanced reporting and timely investigation of all suspected notifiable infectious disease threats within the health system is vital. Field epidemiology and laboratory training programs (FELTPs) have made significant contributions to public health systems for more than 10 years by producing highly skilled field epidemiologists. These epidemiologists have not only improved disease surveillance and response to outbreaks, but also improved management of health systems. Furthermore, the FELTPs/FELTPs have laid an excellent foundation that brings clinicians, veterinarians, and environmental health professionals drawn from different governmental sectors, to work with a common purpose of disease control and prevention. The emergence of the One Health approach in the last decade has coincided with the present, paradigm, shift that calls for multi-sectoral and cross-sectoral collaboration towards disease surveillance, detection, reporting and timely response. The positive impact from the integration of FELTP/FELTP and the One Health approach by selected programs in Africa has demonstrated the importance of multi-sectoral collaboration in addressing threats from infectious and non-infectious causes to man, animals and the environment.

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## Introduction

In the last decade, sub-Saharan Africa has recorded major zoonotic disease outbreaks consisting of deadly diseases such as Ebola, Marburg, yellow fever, rift valley fever, plague, anthrax, Lassa fever, pandemic influenza A H1N1, rabies, and brucellosis. Non-zoonotic diseases such as acute diarrheal diseases (typhoid fever, cholera) are also common [1].

Evidence shows that of the almost 1500 diseases now recognized to affect humans, approximately 60% are due to multi-host pathogens characterized by their movement across species lines [2]. In the last three decades, an estimated 75% of emerging human infectious diseases are zoonoses [3]. Additionally, contamination and pollution of the environment has affected its health and sustainability. Environmental degradation continues to create favorable settings for the expansion of existing infectious and non-infectious diseases for both human and animal health [4]. In addition, man and animals are threatened by non-infectious threats such as toxins and chemical contaminants, like the endocrine-disrupting chemicals in the environment [5]. Whereas humans and animals are under threat of emerging and re-emerging infectious diseases and environmental degradation the existing public health systems in many countries, especially poor nations, lack the capacity to manage these needs [6]. Current public health disease surveillance and response systems have not been tailored to facilitate early detection and timely response to disease threats at the human-animal-environment interface [4].

## One Health Approach

The need to address threats from infectious diseases at human-animal-environmental interface necessitates collaboration across the sectors. The “One Health” approach is envisioned as a vehicle to facilitate inter- and cross-sectoral collaboration. One Health has been defined as the collaborative efforts of multiple disciplines working locally, nationally, and globally, to attain optimal health for people, animals, and environment [7]. One Health seeks to combat existing and emerging infectious diseases by strengthening diagnosis, surveillance, response and recovery directed towards natural or intentional threats such as, chemical, toxicological, or radiological hazards. From the inception of the One Health initiative, the call was for building inter-disciplinary bridges to health in a globalised world [7].

There are challenges to the adoption of the One Health approach such as inadequate leadership and advocacy at national and sub-national levels and buy-in from stakeholders like clinicians, veterinary, industrial, and environmental professionals. Success in adopting the One Health approach will require overcoming many other barriers, including changing the mindset of healthcare providers from one of “disease care” to that of prevention, coupled with overcoming inter-professional prejudices amongst professionals from the different sectors.

A number of training programs designed to address disease threats from a preventive angle have been in existence for decades, however, none specifically addressed diseases that occur at human-animal interface. One such program is the field epidemiology and applied epidemiology training program (FETP). FETPs have a proven record of building a cadre of public

health professionals that is able to address local public health challenges and the training curriculum can be adopted to address unique local challenges [8]. A case in point is the introduction of a laboratory track in African training programs referred to as Field Epidemiology and Laboratory Training Programs (FELTP) to build the national and sub-national capacity of public health laboratory services that are essential for multi-disease public health surveillance and response at national and regional levels. FETPs and FELTPs therefore provide a forum for advancing One Health in various countries where the programs are implemented.

## Integrating One Health into FETP/ FELTP

FETPs and FELTPs are 2-year competency-based training programs based on CDC’s Epidemic Intelligence Service model [9]. Their aim is to develop a public health workforce capable of performing outbreak investigations, epidemiological research and surveillance [10]. The training is largely field based with trainees spending about 75% of their time working with health teams at district or provincial levels enabling trainees contribute to service delivery (e.g., identifying solutions to prevailing health problems) while the other 25% of the program time is dedicated to didactic sessions. The design of the training gives trainees an opportunity to understand the prevailing public health challenges at field sites and to interact with community members and professionals from other sectors such as veterinary services and water and environment. FETPs and FELTPs have been at the core of improving the health work force required to provide preventive and curative health care in sub-Saharan Africa where the need for human resource for health is still felt [10,11]. The FETP/FELTP framework lines up well with the One Health approach which promotes collaboration and networking across the human, animal and environmental health sectors. Based on this shared ideology, FETPs/FELTPs provide an opportunity to advance the One Health approach through training which involves joint implementation of activities such as evaluation of surveillance systems, outbreak investigations by trainees from the different sectors. The outcome will be production of a workforce that is equipped to improve service delivery at various levels within the public health system and can advance implementation of multi-disease surveillance and response to disease outbreaks within the context of One Health. This will promote information sharing across the different sectors, thereby improving reporting and timely response to potential public health threats as required by WHO’s International Health Regulations (2005) and Integrated Disease Surveillance and Response strategy (IDSR) [12,13].

Because the One Health practice is relatively new and has not yet been fully comprehended by many public health professionals at various national and sub-national levels both in curative and preventive health care, there is a justifiable need for integration of the One Health approach within FETPs/FELTPs since these programs have attained repute in effectively delivering applied/field epidemiology training resulting in a rapid expansion from four programs in 2005 to 12 FELTP programs spread across sub-Saharan Africa by August 2011. The goal of this strategy is to launch multi-sectoral collaboration with professionals from each of the sectors handling and responding to public health

emergencies with a One Health mindset.

Field epidemiology training programs currently consist of the 2-year postgraduate FETP/FELTPs and the short term competency-based trainings such as the 2-week outbreak investigation short course targeting the frontline health workforce at different levels within the public health system. The trainings conducted in different regions benefit in-service workers from various sectors. The view is therefore to integrate One Health in the curriculum of the trainings.

## Practical demonstrations of One Health practice within FELTP

The Nigerian FELTP presents a good example of a FELTP designed on the One Health premise. The program aims to increase collaboration and strengthen linkages among epidemiologists and laboratorians from human and animal health sectors in the context of One Health. This collaborative effort is operational at state, federal and national levels. The multidisciplinary strategy is utilized to prevent, control and where possible eliminate infectious diseases within a larger ecological context of humans, animals, plants and environment [14].

Additionally, this program provides a unique stage where clinicians (medical doctors and laboratory scientists) train with veterinarians during didactics and in field assignments to respond to public health emergencies. By working in pairs, the trainees

investigate and respond to disease outbreaks and environmental hazards arising from pollution and contaminants like lead. This model program has set the stage for collaboration, multi-disciplinary teamwork and information sharing across sectors created on a One Health foundation. This has improved public health multi-disease surveillance and timely reporting of potential health threats and notifiable diseases. In September 2010, trainees in the Nigerian FELTP were part of multi-disciplinary team that investigated lead poisoning in Zamfara state in North West Nigeria [15]. This was a unique public health problem that affected humans, domestic animals and the environment necessitating the application of the One Health approach in the control effort.

The One Health approach is yet to be integrated into the other African FELTPs. However, the programs have recognized this need due to looming threat of zoonoses like viral hemorrhagic fevers, brucellosis, and epizootics like foot and mouth disease (FMD) and are presently fast tracking the integration process. Some programs have participated in the investigation of zoonotic disease outbreaks and design of prevention programs.

Graduates and trainees from the Uganda program were part of the integral multi-sectoral One Health team that responded to a plague outbreak in 2008 and participated in designing a comprehensive plague control framework that prevented plague outbreaks in north western Uganda in 2009 and 2010. This is a region that had been reporting and recording annual plague outbreaks in Uganda in the last decade [17]. As shown by the graph in figure 1 below there were no cases in 2009 and 2011.

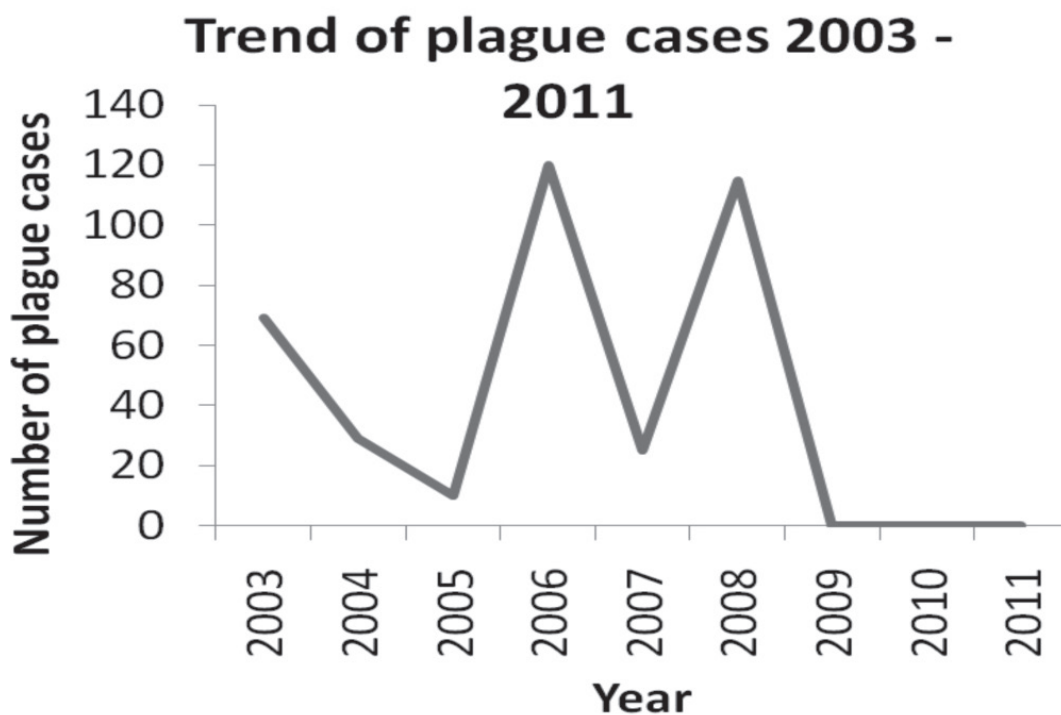


Figure 1 showing trend of plague cases in Northwestern Uganda during outbreaks between 2003 and 2011

Source: Epidemiology and Surveillance Division Ministry of Health Uganda 2010

The Uganda FETP trainees were also part of the multi-disciplinary team that responded to and investigated a yellow fever outbreak in northern Uganda between October 2010 and April 2011. The trainees were at the forefront of responding to an anthrax outbreak in wildlife in Queen Elizabeth National Park-Uganda between June and November 2010. They participated in rapid assessments for laboratory and surveillance capacity, training frontline health workers and community resource persons in anthrax detection and reporting existing, social mobilization and sensitization on anthrax prevention. The residents took lead in setting up One Health participatory disease surveillance monitoring systems for suspected anthrax cases in humans and livestock in communities neighboring the affected national park. The key achievement was the prevention of cross species spread of anthrax from the wild animals; there were no reported human or livestock anthrax cases.

AFENET together with CDC in 2011 started a 1 year post FELTP fellowship training, termed the AFENET CDC Emerging Pandemic Threats One Health Fellowship. The fellowship focuses on, skills building for FELTP alumni working in the government animal and human health sectors [16]. The fellowship seeks to advance the following One Health core competencies: outbreak investigations, surveillance, communication, research, leadership, computer skills, and teaching. Each fellow is required to take lead in conducting field assignments such as outbreak investigation, surveillance evaluation, analysis of surveillance data and writing manuscripts within the One Health context.

Fellows work in pairs (physician paired with either a veterinarian or an environmental health scientist) during the training. The training structure consists of 80% field work during which the fellows take a lead in setting up, evaluating, improving and monitoring disease surveillance systems in human and animal health sectors, investigating disease outbreaks in both sectors, analyzing surveillance data and One Health institutional building and improvement at sub-national levels (district, region/province) through training and supervision of front line health workers and surveillance officers.

The fellows are mandated to provide quarterly feedback of their field activities to their respective ministries and regional heads of public health and veterinary departments. The other 20% of the program is dedicated to didactics consisting of specialized short courses to broaden the fellows' knowledge in science, advanced epidemiology, leadership and management as well as in participatory data collection and analysis techniques.

Field sites comprise ministries of health and agriculture and related regional/provincial offices. Fellows work under the direct mentorship of highly experienced medical and veterinary epidemiologists from human and animal health sectors. The fellows work with their mentors to develop a plan of action addressing public health priorities of both human and animal health sectors with clearly defined timelines, monitoring indicators and deliverables. Fellows submit monthly reports to the fellowship office detailing their various field assignments. Additionally, fellows are required to submit abstracts to regional and international scientific meetings as well as manuscripts to a peer reviewed journal for publication before the end of the program. Other requirements for the fellowship include a thesis from each pair of trainees and a bound volume of their field work. The first cohort of fellows has graduates from Kenya and Uganda

FETP/FELTPs. The fellows are government employees working in the human and animal health sectors who have been granted a one year study leave to participate in this full time program. It is anticipated that at the end of the 1 year training, the Fellowship graduates will become One Health leaders in their respective work stations and sectors at national and sub national levels. Recruitment of fellows is done with participation of the respective FELTP, government ministries of health and agriculture/livestock.

### Key achievements by the One Health Fellowship

The One Health Fellows designed and implemented a novel surveillance system for a mass gathering at the June 3rd Uganda Martyrs' Day celebrations held annually in Uganda. In 2011, the Martyr's Day occurred after an Ebola outbreak was detected in Uganda. The novel system was able to detect suspected cases of viral hemorrhagic fever and these individuals were promptly isolated and investigated, luckily none of them had Ebola. The experience in developing and implementing this public health surveillance system informed Martyr's Day organizers and government of potential public health hazards that are likely sources of disease in the environment. This innovation was recognized by the Uganda Ministry of Health as the launch pad for applying surveillance during similar events that draw large masses of people.

This fellowship program has also taken lead on behalf of Uganda's Ministry of Health to investigate and respond to other public health emergencies. The fellows investigated the public health effects of lightning strikes which were widespread in Uganda between May and June 2011. The strikes were associated human and domestic animal deaths as well as destruction of property like homes. The findings of the survey informed the government on the magnitude of the fatalities, the need to strengthen lightning control and prevention measures like designing and disseminating public health messages about lightning.

The fellows are an integral part of the national multi-disciplinary rapid response team. This team has members from ministries of health and agriculture; wild life, disaster preparedness and other stakeholders like CDC, WHO, and UNICEF country offices and other international and local non-governmental organizations with a mandate to promote public health. The fellows have in this context worked with the national rapid response teams to investigate major disease outbreaks such as the 2011 Ebola Viral Hemorrhagic Fever in Uganda. The fellows are active members in the routine outbreaks monitoring meetings convened by the national multi-sectoral rapid response task force.

The fellows from Kenya are working on improving the surveillance system for zoonotic diseases among the animal handlers in abattoirs in Kakamega Province in Western Kenya. This followed findings from an evaluation of the existing surveillance system that indicated the need for improvement on the system so as to facilitate prevention, early detection and timely response to potential zoonotic disease outbreaks originating from the abattoirs.

## Conclusion

FETPs/FELTPs have played a significant role in strengthening public health multi-disease surveillance systems and response to disease outbreaks in Africa. The continent has been threatened by the emergence of infectious disease outbreaks having strong links with animals, both-domestic and wild while the occurrence of others like the vector-borne diseases has been driven by environmental degradation. The prevention and control of these emerging disease threats calls for modification of strategies geared towards multi- and cross-sectoral collaboration.

The One Health approach demands for collaboration across sectors at national and sub-national levels to strengthen surveillance and response to public health emergencies due to infectious and non-infectious causes such as chemical contaminants. The FETP/FELTP structures in different countries provide an excellent platform for integrating and adopting the One Health approach and practice. The positive impact demonstrated by FETPs/FELTPs which have adopted the One Health approach has proved feasible. This approach will contribute to early detection, timely reporting and response to all public health emergencies of international concern as required of member states by the International Health Regulations.

## Competing interest

The authors declare that they have no conflict of interest.

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## Authors' contributions

BM: Contributed to conception, design, drafting the article, revised the article for intellectual content and approved the article to be published.

SNG: Contributed towards the conception, design, reviewed the article for important intellectual content, and approval of the version to be published.

PW: Contributed towards drafting the article and revising it for important intellectual content, and final approval of the version to be published.

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DM: Contributed towards the conception, reviewed the article for important intellectual content, and approval of the version to be published.

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## PUBLIC HEALTH LABORATORY SYSTEMS DEVELOPMENT IN EAST AFRICA THROUGH TRAINING IN LABORATORY MANAGEMENT AND FIELD EPIDEMIOLOGY

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Key words: FELTP, Tanzania, Kenya, laboratory epidemiologists

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### Abstract

Laboratories are integral to the delivery of quality health care and for public health functions; however laboratory systems and services are often neglected in resource-poor settings such as the East African region. In order to sustainably strengthen national laboratory systems in resource-poor countries, there is a need to train laboratory personnel to work in clinical as well as public health laboratories. In 2004, Kenya, Uganda, Tanzania, and South Sudan began training public health laboratory workers jointly with field epidemiologists in the Kenya Field Epidemiology and Laboratory Training Program (FELTP), and later through the Tanzania FELTP, as a strategy to strengthen public health laboratories. These programs train laboratory epidemiologists through a two-year public health leadership development course, and also offer various types of short course training for frontline staff. The FELTP laboratory graduates in Kenya, Tanzania, Uganda, and South Sudan are working in their respective countries to strengthen public health laboratory systems while the short course participants provide a pool of frontline implementers with the capacity to support the lower tiers of health systems, as well as serve as surge capacity for the regions and the national level. Through training competent public health laboratory workers, the East African ministries of health, in collaboration with other regional partners and stakeholders are now engaged in developing and implementing a holistic approach that will guarantee an overall strengthening of the health system by using well-trained public health laboratory leaders to drive the process. Strengthening public health laboratory medicine in East Africa is critical to improve health-care systems. The experience with the FELTP model in East Africa is a step in the right direction towards ensuring a stronger role for the laboratory in public health.

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## Background

Sub-Saharan Africa carries a massive burden of infectious and non-infectious diseases. However laboratories which would enable clinicians to make accurate diagnoses, offer correct treatment, and address epidemic prone diseases, are ill equipped and poorly resourced [1]. Although laboratories are integral to the delivery of quality health care and for public health functions, laboratory systems and services are often neglected in resource-poor settings such as the countries in East Africa [2]. East African laboratories are also disproportionately affected by staff shortages, poor communication facilities, inadequate equipment, low staff morale, and lack of training [1]. Public health laboratories have almost disappeared in the East African region as they have either been integrated with, or replaced by, clinical diagnostic laboratories [3]. Where public health laboratories exist, they are at the national level only and are characterized by shortages of essential staff and equipment.

In 1998, the World Health Organization (WHO) Regional Office for Africa (AFRO) proposed the Integrated Disease Surveillance and Response (IDSR) approach for improving public health surveillance and response in Africa through linking community, health facility, district, and national levels [4]. IDSR also promotes rational use of resources by integrating and streamlining common surveillance activities. Surveillance activities for different diseases involve similar functions and often use the same structures, processes and personnel [5].

In what has become the largest ever investment to control a specific disease, the United States (U.S.) government initiated the President's Emergency Plan for AIDS Relief (PEPFAR) in 2003. This plan was reauthorized through the Lantos-Hyde legislation in 2010 and is the cornerstone of the U.S. President's Global Health Initiative (GHI) [6,7,8]. PEPFAR aims to provide prevention, treatment, and care to turn the tide of the HIV epidemic that disproportionately affects poor sub-Saharan African countries. The success of PEPFAR and GHI are inextricably linked to the ability to have reliable testing and confirmation of a series of diseases and syndromes through reliable, effective public health and clinical laboratories which are led by well-trained nationals from the countries that are affected by HIV, tuberculosis, and malaria as part of strengthened public health systems that are owned and operated, and led by ministries of health.

In order to build capacity for public health surveillance in public health laboratories in East Africa, a major investment in personnel and equipment for national public health laboratory networks is needed. Additionally, broader knowledge, skills, and competencies in best practices are essential in implementing innovative strategies to improve the quality of laboratory testing in resource limited environments like the East African region. Since the adoption of IDSR strategy, there have been efforts to strengthen the overall national system for the surveillance of diseases including laboratory confirmation of suspected outbreaks in line with the requirements of the revised International Health Regulations. Sustainable progress can only happen if laboratories are represented by laboratory personnel on key decision-making bodies, rather than being represented by other sections of health

care services, such as the pharmacy or radiology section which is the practice in the East African region [3].

In order to strengthen national laboratory systems in resource-poor countries sustainably, there is a need to develop national laboratory strategic plans and policies, establish public-private partnerships, and to ensure effective leadership, commitment and coordination by host governments. Centers of excellence in field epidemiology and public health laboratory practice also need to be developed, or strengthened where they currently exist, and the workforce will need to be developed to operate these new public health systems [4, 9].

Studies have shown that education and training of laboratory personnel improves the quality of test results and clinicians' trust in the laboratory and their subsequent willingness to remain in an under-developed area for a longer time [10, 11]. An efficient laboratory can dramatically reduce waiting time to get results and leads to faster and better health care delivery. One need in public health laboratories today is to develop workers to carry out new and highly complex procedures. These workers must also learn to use new automated testing equipment and master the theories behind the new tests involved while developing new the skills [13].

The Field Epidemiology and Laboratory Training Program (FELTP) is a 2-year, full-time postgraduate applied public health training program for public health leaders [14]. It is modeled after the 60-year-old U.S. Centers for Disease Control and Prevention (CDC)'s Epidemic Intelligence Service, which trains field epidemiologists to operate public health surveillance and response systems in the U.S. and has been adapted internationally as the Field Epidemiology Training Program (FETP) [15]. The FELTP which enrolls laboratory scientists (in the laboratory epidemiology track) in addition to physicians and other health scientists (in the field epidemiology track), was developed as a tool to develop laboratory epidemiologists to operate public health laboratories and networks, and field epidemiologists to operate public health surveillance and response systems. The FELTP is adapted to suit local contexts [16].

FELTPs and FETP have yielded long-term, sustained results by reinforcing a culture of evidence-based practice and providing cadres of competent, motivated public health professionals able to respond to a multitude of public health threats [15]. The laboratory-specific goal of an FELTP is to establish functional laboratory-based disease surveillance systems for priority diseases with an enhanced laboratory capacity to guide outbreak response. The addition of a laboratory training component begins to address the long-standing disconnect between field epidemiology and laboratory practice. FELTPs are meant to build and strengthen public health laboratory networks. FELTP training emphasizes competencies in epidemic preparedness, outbreak investigation and response, emerging infectious disease surveillance, and pathogen diagnostic techniques which are integrated in the field epidemiology and public health laboratories training program.

## Approach and results

The Kenya FELTP was established in 2004 as a collaborative partnership led by the Kenya Ministry of Health (MOH), including the Jomo Kenyatta University of Agriculture and Technology, and CDC with funding from the Ellison Medical Foundation. This program was also tasked to train laboratory epidemiologists from other parts of Africa, including Ghana, South Sudan, Tanzania, and Uganda [13]. Currently, the program trains public health professionals from Kenya and South Sudan.

The Tanzania FELTP was established in 2008 by graduates of the Kenya FELTP. It is a collaborative partnership of multiple stakeholders led by the Ministry of Health and Social Welfare (MOHSW) including Muhimbili University of Health and Allied Sciences (MUHAS), CDC, the African Field Epidemiology Network (AFENET) and the National Institute for Medical Research (NIMR).

Both the Kenya and Tanzania FELTPs place emphasis on provision of service during training, thereby providing real-time results to the host country ministries of health. FELTP trainees in Kenya and Tanzania receive an award of Masters of Science degree upon successful completion of the training.

The Kenya and Tanzania FELTP have limited classroom instruction (25%) with most of the time (75%) spent in field assignments. The laboratory residents undertake courses in field epidemiology, biostatistics, research methodology, scientific communication, public health surveillance, computers in public health, advanced laboratory methods, laboratory management, laboratory methods in the field, and management and leadership. Didactic training sessions are carried out through combinations of presentations, videos, practical exercises, seminars, open discussions, wet laboratory exercises, and university examinations. A thesis is also completed during the second year of residency.

For their field placements, laboratory residents are placed in national and regional or provincial laboratories under the supervision of the Laboratory Resident Advisors who are experienced doctoral level public health laboratory scientists, and mentorship of experienced laboratory managers. The Laboratory Resident Advisors take leadership in guiding, teaching, and supervising the residents throughout the 2-years along with the onsite laboratory supervisors. During the field assignment, the residents conduct evaluations of epidemiologic and laboratory-based surveillance systems, perform disease control and prevention measures including outbreak investigations and design laboratory quality improvement projects. They report their findings to decision and policy makers and also train other health workers.

Upon completion of the program, laboratory epidemiologists are trained to be able to:

- Routinely analyze the quality of laboratory data to identify possible aberrations and trends and recommend improvements.
- Design or evaluate a laboratory-based surveillance system, for example influenza, measles, and tuberculosis surveillance systems.

- Collaborate with field epidemiologists in an outbreak investigation or field-based study.
- Interpret and communicate laboratory results of public health importance to decision makers.
- Use management skills to create or support national and international public health laboratory networks.
- Use quality management systems to provide timely and accurate laboratory services.
- Integrate the core function and capabilities of the public health laboratory into existing clinical laboratories.

## Short courses

FELTPs also conduct short courses for existing laboratory personnel (and surveillance personnel) who are not able to participate in the 2-year program. The topics that are covered in the short courses include basic field epidemiology, biostatistics, disease surveillance, outbreak management, laboratory management, biosafety and biosecurity. The aim of the short courses is to create a pool of frontline implementers with capacity to support the functions of public health laboratories from the lower tiers of the health systems [16]. The short courses are conducted in the form of a 2-week workshop followed by a 3-month applied learning project period, during which time trainees conduct a field project at their worksite. The types of projects that short course participants work on include outbreak investigations, laboratory quality improvements, and surveillance data analysis. After the field work, participants present the project findings to their facilitators, mentors, FELTP staff and residents, partners, and ministry of health policy makers during a 1-day graduation seminar. These short courses have increased the number of health workers that are trained using a competency-based approach to address public health problems. The short courses multiply the effect of the FELTP beyond the small numbers residents that are trained in the 2-year program, given each FELTP cohort are averages 13-15 residents per year, whereas each short course intake is about 30 participants and a FELTP is able to teach at least two short courses per year. Many of the short courses are taught by residents of the 2-year FELTP. Ultimately, the network of short course graduates and 2-year graduates will measurably improve the operation of public health surveillance and response systems in the East African region.

## Output to Public health

The FELTP laboratory graduates have been working in their respective countries to strengthen public health laboratory systems through provision of:

- Timely laboratory confirmation of disease pathogens for surveillance, outbreak response and prevention. Most of the current suspected outbreaks are being investigated by FELTP laboratory graduates and the causative agents are identified in a timely way.
- Policy, standards, and advocacy for quality public and private laboratory services, through supporting the laboratories in the region towards accreditation.
- Training and continuing education for laboratory personnel on surveillance and outbreak investigation through short courses.

- Scientific and managerial leadership in development of public health policy, as evident by existing laboratory strategic plans.
- Research and development capacities.  
Writing and disseminating manuscripts and publications.

## Discussion

The recent focus by ministries of health in East Africa on strengthening health systems and the emphasis on laboratory systems suggest that the opportunity has presented itself for the international community to act now, act collectively, but act differently to ensure sustainability of global health efforts to enhance laboratory networks and systems [12]. The establishment and launching of the FELTPs, together with programs such as Strengthening Laboratory Management toward Accreditation (SLMTA) and the newly-established WHO AFRO laboratory quality improvement process towards accreditation, will provide an impetus to change the future of public health surveillance and response systems in East Africa to include strengthening of the public health laboratories [13].

SLMTA, launched in Kigali, Rwanda as a preparatory initiative to prepare laboratories towards accreditation [17], was developed to promote immediate and measurable improvement in laboratories of developing countries. FELTP graduates and residents

participate in implementing laboratory quality improvement processes using the SLMTA approach and also in training other laboratory professionals on Laboratory Quality Systems (LQS). SLMTA, in combination with LQS training, supports laboratories by improving management and building preparedness for accreditation.

Ultimately a locally recruited, well-trained public health workforce comprising field epidemiologists, public health laboratory epidemiologists, and short course graduates who are able to operate multi-disease surveillance and response systems will provide the basis on which national public health institutions can be built to sustainably prevent and control priority disease conditions in East African countries.

FELTP has contributed to enhancing the public laboratory strengthening component in ministries of health of participating countries, which has led to improved diagnostic and monitoring services, as well as implementation of laboratory quality management systems and initiation of laboratory accreditation process that is taking place in East Africa.

Through FELTPs, East African countries have managed to obtain well trained public health laboratory leaders to drive the process of strengthening laboratory systems. These graduates have been retained in their home countries and the nearby regions to support the laboratory improvement process (table 1).



**Table 1: 2006 to 2010 Graduates of KFELTP and TFELTP Laboratory Track and Their Current Positions**

	<b>Graduation year</b>	<b>Programme</b>	<b>Country of residence</b>	<b>Current position</b>	<b>Organisation</b>
1	2006	KFELTP	Kenya	Program Officer - Comitato Collaborazione Medica	Ministry of Health Somalia
2	2006	KFELTP	Kenya	Head - Laboratory Information Management System; National Public Health Laboratory Services	Ministry of Public Health and Sanitation Kenya
3	2006	KFELTP	Kenya	Lab Resident Advisor	FELTP Rwanda
4	2007	KFELTP	Kenya	National Public Health Biochemistry Lab	Ministry of Public Health and Sanitation Kenya
5	2007	KFELTP	Uganda	Program Officer (Laboratory Quality Assurance) Central Public Health Lab	Ministry of Health Uganda
6	2008	KFELTP	Kenya	Field Coordinator	FELTP Kenya
7	2008	KFELTP	Kenya	Standards Officer	Ministry of Public Health and Sanitation Kenya
8	2008	KFELTP	Tanzania	Director, National Health Laboratory Services	Ministry of Health and Social Welfare Tanzania
9	2009	KFELTP	South Sudan	Deputy Team Leader,	MDTF Health project Eastern, Equatorial state, South Sudan
10	2009	KFELTP	Kenya	Assistant Research Officer	CDC Kenya
11	2009	KFELTP	Kenya	Laboratory Manager	Kenya Army
12	2009	KFELTP	Uganda	Medical Research (Laboratory) Specialist	CDC Uganda
13	2010	KFELTP	South Sudan	Program Manager/SPLA HIV secretariat	Government of South Sudan
14	2010	KFELTP	South Sudan	Senior Inspector of Public Health Laboratories	Ministry of Health Government of South Sudan
15	2010	KFELTP	Kenya	Laboratory Epidemiologist - Eastern Province	Ministry of Public Health and Sanitation Kenya
16	2010	KFELTP	South Sudan	Research Officer, Ministry of Animal Resource	Ministry of Health Government of South Sudan
17	2010	KFELTP	Kenya	Assistant Research Officer	Kenya Medical Research Institute/CDC
18	2010	KFELTP	Kenya	Assistant Lecturer Medical Laboratory Sciences	Mombasa Polytechnic University College
19	2010	TFELTP	Tanzania	Laboratory Epidemiologist	Defence Force Tanzania
20	2010	TFELTP	Tanzania	Laboratory Epidemiologist	Ministry of Health and Social Welfare Tanzania
21	2010	TFELTP	Tanzania	Laboratory Epidemiologist	Ministry of Health and Social Welfare Tanzania
22	2010	TFELTP	Tanzania	Laboratory Epidemiologist	Muhimbili University of Health and Allied Sciences
23	2011	KFELTP	Kenya	Laboratory epidemiologist	Ministry of Public Health and Sanitation

Knowledge and skills of laboratory personnel are fundamental for the implementation of a laboratory quality management system and FELTPs are critical to the improvement of laboratory management in East African countries. The progress of laboratories in East African countries will depend on the efforts made to identify opportunities for creating and streamlining resources to achieve functional national laboratory networks that meet national priorities and support global disease program objectives including training more laboratory epidemiologists. The FELTP laboratory graduates are beginning to build an East African public health laboratory network through their relationships and support from the African Field Epidemiology Network (AFENET). AFENET has a series of laboratory strengthening activities that it conducts with funding from a number of donors including CDC and the Bill and Melinda Gates Foundation.

## Limitations

The FELTP model is still a work in progress in East Africa. The first FELTPs are less than 10 years old and there are several lessons to learn, especially the usefulness of the competencies acquired during the training period. Uganda has yet to develop a fully-fledged FELTP and the results in South Sudan are evolving. Career paths of laboratory epidemiologists will need to be developed, and this depends on having a critical mass of graduates, which also requires sustained funding particularly from the region's ministries of health, which are facing several other challenges. However, the early lessons from the graduates of the public health laboratory component show that this model can be successful.

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## Conclusions and recommendations

Strengthening public health laboratory medicine in East Africa is critical to improve health-care systems. Apart from training of laboratory personnel, laboratory departments should be created within the ministries of health, in tandem with strong leadership and together with involving laboratories in planning stages. The experience with the FELTP model in East Africa is an early step in the right direction towards ensuring a stronger role of the laboratory in public health. Ministries of health in East Africa and the rest of sub-Saharan Africa should consider the FELTP model as one locally-adaptable tool to create the health workforce that can both strengthen field epidemiology and laboratory management in one program that is led and owned by them. Sustained funding of this effort and the development of appropriate career paths will need continued attention from host governments and their donor partners. Ultimately FELTPs can be the basis on which national public health institutions for disease prevention and control can be developed in resource constrained countries.

## Author Contributions

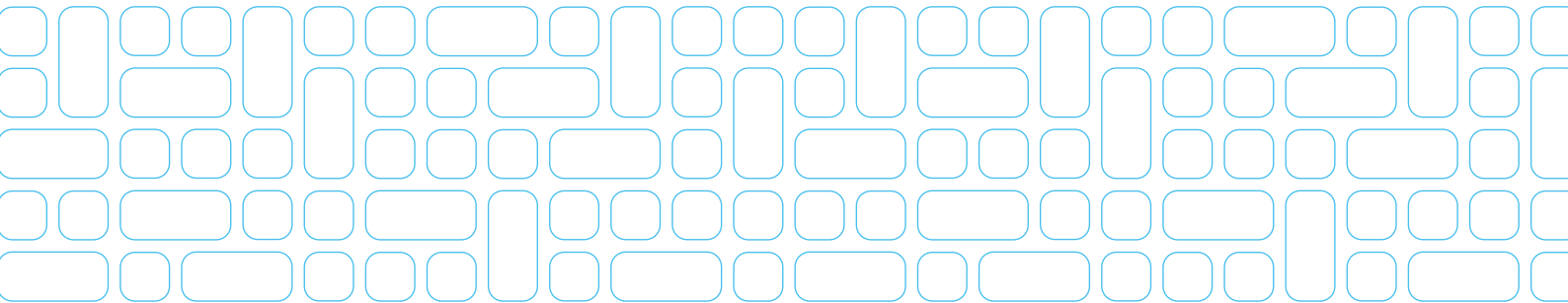
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## Competing Interests

The authors declares that they have no competing interests

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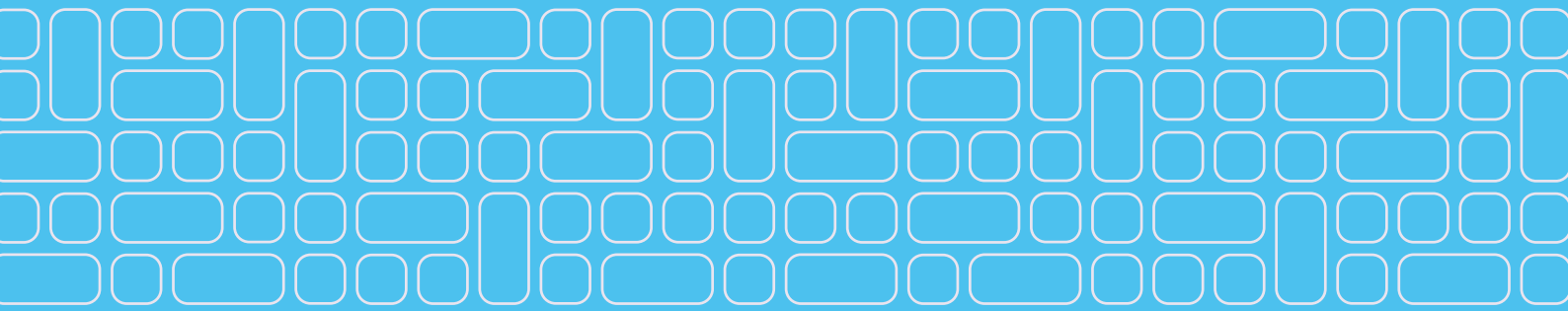
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