

Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

Travis N. Belfonte

4/29/2020

Date

Africa CDC Institute for Workforce Development is Monitoring and Evaluating the
Effectiveness of e-Learning Implementation in Africa

By

Travis N. Belfonte
Master of Public Health

Global Health-Infectious Disease

Scott JN McNabb, PhD, MS
Committee Chair

Africa CDC Institute for Workforce Development is Monitoring and Evaluating the
Effectiveness of e-Learning Implementation in Africa

By

Travis N. Belfonte

B.S., Wake Forest University, 2014

Hubert Department of Global Health

Scott JN McNabb, PhD, MS

Committee Chair

An abstract of a thesis submitted the Faculty
of Rollins School of Public Health of Emory
University in partial fulfillment of the
requirements for the degree of

Master of Public Health in
Global Health-Infectious
Diseases

2020

Abstract

Africa CDC Institute for Workforce Development is Monitoring and Evaluating the Effectiveness of e-Learning Implementation in Africa

By

Travis N. Belfonte

Background: Africa's health infrastructure has made strides, but still has many needs. Many regions lack the workforce capacity to meet the high demand of medical and public health needs. Africa is using new strategies and collaborations to address their public health surveillance (PHS) needs.

Methods: This report reviews the e-Learning implementation developed by the Africa CDC Institute for Workforce Development (IWD). Using monitoring and evaluation methods, an assessment of the evolution of e-Learning and its impact on public health practice in Africa was completed. The Africa CDC (IWD) strives to use e-Learning as an effective and efficient method to training Africa's healthcare professionals to improve health needs. An evaluation was conducted on the four e-Learning courses offered through Canvas: (1) Transforming Public Health Surveillance (TPHS); (2) Antimicrobial Resistance (AMR) (3) Proposal Writing; and (4) Leadership and Management.

Results: Outcomes indicated that the Africa CDC IWD provides strong scientific evidence that e-Learning is an effective method of training health professionals. As health professionals were trained through the learning management system, Canvas, they acquired the necessary skills and competencies to grow in their respective fields. In addition to developing skills, the training program proves to be useful in reducing brain drain within the healthcare community, bridging gaps of global health inequities, and providing a platform for healthcare workers to collaborate and share innovative strategies throughout Africa.

Conclusion: It is recommended that Africa continues to adopt e-Learning methods of training for its healthcare workers to efficiently improve Africa's health infrastructure and well-being. The Africa CDC IWD should continue its collaboration with the African Union (AU) in implementing its e-Learning training for healthcare professionals, but also expand its efforts to other healthcare professionals and students in public health institutions. Lastly, it is also recommended that the IWD use its successful platform to train similar programs existing in Africa and provide outreach in other public health needs beyond the scope of the four pilot courses offered on Canvas.

Africa CDC Institute for Workforce Development is Monitoring and Evaluating the
Effectiveness of e-Learning Implementation in Africa

By

Travis N. Belfonte

B.S., Wake Forest University, 2014

Hubert Department of Global Health

Scott JN McNabb, PhD, MS

Committee Chair

A thesis submitted the Faculty of Rollins School of
Public Health of Emory University in partial
fulfillment of the requirements for the degree of

Master of Public Health in
Global Health-Infectious
Diseases

2020

Table of Contents

Table of Tables and Figures

Acronym List

Chapter 1: Introduction	1
Problem Statement	3
Purpose Statement.....	3
Research Objective	4
Significance Statement.....	4
Definition of Terms.....	5
Chapter 2: Literature Review.....	6
Introduction.....	6
e-Learning (Systems, Advantages, Reviews)	6
Workforce Capacity	12
Brain Drain.....	17
Public Health Informatics	24
Conclusion	27
Chapter 3: Methods	29
Introduction.....	29
Study Site	30
Population Sample	30
Research Design.....	31
Courses Offered	31
Instruments.....	33
Plans for Data Analysis.....	33
Limitations	34
Conclusion	35
Chapter 4: Results.....	36
Introduction.....	36

Participation Feedback.....	39
Conclusion	40
Chapter 5: Discussion	41
Overview.....	41
Implications.....	41
Recommendations.....	45
Clinical Community of Practice.....	47
Field Epidemiology Training.....	49
Conclusion	50
References.....	51

Table of Tables and Figures

Table 1. Africa CDC Institute for Workforce Development Course by Time and Component, 2019.....	37
Table 2. Africa CDC Institute for Workforce Development Transforming Public Health Surveillance Course Registration, by Country and Region, 2019	39
Table 3. Africa CDC Institute for Workforce Development Courses by Representation, 2019 ...	39
Table 4. Africa CDC Institute for Workforce Development Yr-1 Impact to Address Africa’s Health Needs.....	44
Table 5. Africa CDC Institute for Workforce Development Solutions to Meet e-Learning Needs	45

Acronym List

AFENET	Africa Field Epidemiology Network
AMR	Antimicrobial Resistance
AU	Africa Union
AUMS	Africa Union Member States
BRAC	Building Resources Across Communities
CDC	Center for Disease Control and Prevention
CHW	Community Health Workers
CCoP	Clinical Community of Practice
COVID-19	Coronavirus 2019
EHR	Electronic Health Record
EIS	Epidemic Intelligence Service
EMPHNET	Eastern Mediterranean Public Health Network
FETP	Field Epidemiology Training Programs
NFELTP	Nigeria Field Epidemiology and Laboratory Training Program
HER	Electronic Health Records
HIS	Health Informatics Systems
HIV	Human Immunodeficiency Virus
IANPHI	International Association of National Public Health Institutes
ICT	Information Communication Technologies
IWD	Institute for Workforce Development
LMIC	Low- and Middle-income Countries
LMS	Learning Management System
MoH	Ministry of Health
NGO	Non-governmental Organization
NSPH	National School of Public Health
OECD	Organization for Economic Co-operation and Development
PH	Public Health
PHI	Public Health Informatics
PHS	Public Health Surveillance

PWF	Public Health Workforce
SDG	Sustainable Development Goal
TEPHINET	Training Programs in Epidemiology and Public Health Interventions Network
WHO	World Health Organization

Chapter 1: Introduction

Africa remains the continent with the highest rate of undernourishment globally.¹ The continent continues to be severely impacted by food borne illness, zoonotic infections, poverty, natural disasters, social inequity, and infectious disease. Foodborne illnesses cause 137,000 deaths and 91 million illnesses yearly.¹ Many reported affect children, specifically 5 years of age.

As government officials, medical experts, and researchers create new methods of improving African health systems, they developed a central organization to address them. Conceived in 2013, the Africa Centres for Disease Control (ACDC) was developed and launched Jan 2014. Deemed the unit responsible to address Africa Union (AU) health concerns and using public health surveillance (PHS) methods to identify infectious disease threats, the ACDC has increased its capacity to prevent, detect, and respond to health threats across the continent.

In 2018 the Africa CDC stood up the Africa CDC Institute for Workforce Development (IWD). Africa CDC IWD is a subunit dedicated to reforming the current standards in which medical professionals, government officials, and funding partners are trained and engaged with global public needs.

Africa CDC developed an initiative to improve the workforce capacity of healthcare professionals. To achieve this, they created the Africa CDC IWD that incorporates e-Learning. As technology evolves, e-Learning has transformed the way humans are educated and trained. Providing real-time data and updates, easy access, affordability, and the ability for individuals to tailor their learning experience, e-Learning has revolutionized public health. As Africa continues to push for improved health, providing e-Learning to health professionals allows them to improve their professional skills, collaborate with peers, reduce global health inequities, and reduce brain drain.

Using Canvas, an online learning management system, participants access digital content.

Canvas provides the platform and architecture for information so participants can access courses and complete training to improve and obtain skills in areas that are deficient according to the gold standards of public health. During 2019, the ACDC IWD offered four courses to public health professionals:

- (1) Transforming Public Health Surveillance
- (2) Antimicrobial Resistance
- (3) Proposal Writing
- (4) Leadership and Management.

Upon completion of these courses it is hoped they will enhance African health professionals' workforce capacity. Using e-Learning via Canvas provides African health professionals from all regions the opportunity to engage in collaboration with one another using digital connectivity, flexibility in completing course work, and receive real-time data across a global platform.

This program provides an opportunity for health professionals to gain knowledge and impact their communities. As more health workers become trained, it evokes change in other areas of public health. More funding can be provided through proposals and, therefore, improve physical infrastructure like health facilities and laboratories. In addition, as more professionals become trained successfully, recruitment will grow expanding the program and developing other programs. Lastly, participants give themselves a chance to grow within their respective fields (e.g., epidemiology, laboratory workers, physicians, nurses and public health workers).

Problem Statement

Now more than ever, the global health community must strengthen the public health infrastructure. Sub-Saharan Africa (having 11% of the world's population) struggles with poor health infrastructure plus 24% of the global disease burden. In addition to the driving factors (i.e., weak financial markets, political distress, and social inequities), technology and limited access hinder improved healthcare quality. Many healthcare workers (i.e., physicians, nurses, social workers, and public health professionals) have capacity but are limited to technology, lack of facilities, limited supplies, no continued training opportunities, and poor employment. For every 1,000 persons, there are roughly 0.8 workers in Africa's health workforce; this is significantly lower than the global density of five per 1,000 persons.² Furthermore, there is a dearth of research regarding professional workforce needs. Can e-Learning education work on a long-term scale within their fields of work. While some health professionals are afforded the opportunity to receive training, there is little context as to if this is a sustainable means to train and improve the public health infrastructure besides strong indicators stated in existing literature.

Purpose Statement

Exploring the benefits of e-Learning to train and enhance skill sets of Africa's health professionals is critical to the health infrastructure. Exploring the impact of e-Learning on reducing brain drain should be evaluated. Detailed information on short- and long-term implications of e-Learning may provide context for future interventions to strengthen Africa's public health infrastructure. Existing research and programs suggest that e-Learning and modern information and communication technology (ICT) to train African health professionals has

positive outcomes on Africa's public health infrastructure, more specifically in participants' respective regions of work.

Research Objective

To remedy the hardships that African public health professionals face, we must understand the underlying factors leading to brain drain, social inequities, and little-to-no career advancement for health professionals.

The aims of this study are to...

- identify contributing factors African health professionals endure leading to brain drain.
- describe beneficial outcomes of e-Learning to train and develop useful skill sets for African health workers.
- describe critical components needed to improve Africa's public health workforce and reduce social health inequity.
- examine participants' retained knowledge and practical implementation of e-Learning course material in their respective health fields.

Significance Statement

These findings can be influential, providing context for the Africa CDC and leaders within African countries to lean and rely more on e-Learning approaches to train not only its health professionals, but students as well. Conclusions can impact future study designs and strategies within the public health realm, resulting in strengthening Africa's public health infrastructure.

In addition, these findings can ignite further public health training beyond the scope of the Africa CDC IWD. This study can also provide a framework for Africa to develop their own public health workforce capacity using e-Learning, domestic and international collaboration, and developing innovative interventions.

Lastly, monitoring and evaluating will provide science-based evidence to support African health professionals the opportunity to further their knowledge and skills using modern methods to reduce brain drain. It is pertinent to provide the same opportunity and access to high quality data and information that meets global standards to see the potential impact, effectiveness and sustainability of modern training approaches.

Definition of Terms

- **Brain Drain** - the migration or departure from home of an educated professional
- **Community** - strong familial and social ties within neighborhoods, cities and/or countries
- **e-Learning** - receiving educational content via the internet through electronic devices (i.e., computers, tablets, and cellular phones)
- **Global Health** - study, research, and practice of improving health and achieving equity in health for the global community
- **Informatics** - data, information, and knowledge to improve health and healthcare
- **Infrastructure** - physical or organizational framework or structure of a project, community, program or area of focus

Chapter 2: Literature Review

Introduction

To adequately explore and describe the current status of Africa's health infrastructure and health professionals, apparent and underlying factors such as workforce capacity, informatics, training methods and approaches should be reviewed and understood. More explicitly, by highlighting the current equity gaps within the African public health workforce and barriers that exist preventing advancements of Africa's health. In addition, exploring modern methods used to help reduce brain drain as well as enhancing career skills among African health workers should also be a reviewed component.

By gaining an in-depth understanding of the internal and external contributing factors that impact Africa's health infrastructure shortcomings and successes of modern e-Learning approaches can be highlighted and improved. Improving Africa's workforce capacity can lead to the development of other struggling components within the health system by expanding healthcare in urban and rural regions, increasing funding and facility development, and providing modern technology and proper access; therefore, strengthening Africa's health in an efficient and unified manner.

e-Learning (Systems, Advantages, Reviews)

Technology has proven advantageous as time progresses. E-Learning has been used to educate, train, and learn skills related to various topics. Specifically, in global public health e-Learning has been a driving tool to train and educate students and professionals. Using online resources to teach and train large numbers of participants who are in different regions has bridge the gap of inequality by affording fair and equal opportunity to access information and develop skills.

Traditional versus e-Learning in Malawi, Africa

A study conducted in Malawi discusses the comparison of using traditional learning versus a blended approach that incorporates e-Learning. It shows little difference in the knowledge obtained through completion of each program. However, it indicates that e-Learning does provide some advantage over traditional methods. It can be less costly for trainees and program directors as facilities don't need to be accounted for. E-Learning is more flexible for professionals to use and balance within their daily lives as they can set their own pace for learning the digitally provided material. ICT knowledge was relatively the same between both groups. In addition, studies suggest that the time allotted during blended learning could impact one's retention of knowledge and self-confidence in navigating online material. Using a series of questionnaires for participants allowed researchers to assess whether blended learning was well received and easy to use. Questionnaires were used to evaluate: participant characteristics; participants' self-rated ICT knowledge; ICT knowledge; attitudes towards computers, tablets and smartphones; and satisfaction with the course.³

Positive takeaways from the study are that CHWs residing in rural regions are more than equipped to use and navigate blended learning programs which can imply that rural regions of Africa have the capability of using modern methods and strategies to improve poor public health infrastructure. CHWs would be able to receive training while avoiding travel, and despite not having a classroom setting, still can interact and collaborate with their peers through online interactions. Lastly, studies suggest that limitations should be accounted for when conducting similar evaluations. Limited energy particularly affects rural regions, which most of Malawi is.³ The electrification rates are very low with only 10% (37% attributed to the urban region and only 2% to the rural), however solar panels have played a significant factor in providing energy.³

Small class sizes due to poor infrastructures or limited space could play a potential factor in evaluating a limited sample size. Also, both courses were not completed during the same time frame which could have potentially impacted assessments made on participants' knowledge and skills obtained through both learning programs.

Cost Comparison of e-Learning

One of the limitations that exist to improve Africa's public health infrastructure is lack of funding. One of the many questions surrounding the use of e-Learning for training health professionals is how much it costs to implement and is it worth using over traditional learning methods? Using a prospective model, a study was completed to evaluate community health workers within the Sub-Saharan Africa region, as they took courses to expand their knowledge and capacities within their respective fields.⁴ Comparing those who used a traditional method of learning versus blended learning, the study concluded that blended learning methods cost less than traditional methods. Using e-Learning and blended methods saved over \$314 million USD (42% cost reduction) compared to traditional methods⁴. Savings were attributed to reducing cost on paying instructors, transportation, and device selection by trainees. The study suggests that using e-Learning could provide flexibility with scheduling for trainees and increase the standardization of training to a greater audience, efficiently. Lastly, replacing smartphone and tablet that require data plans for those that have Wi-Fi capability should be explored as a viable route to improve and reduce cost of technology use by health professionals.⁴

e-Learning Bridges the Gap in Management & Leadership

A major component in health systems strengthening is leadership and management. However, lack of training limits health professionals to obtain such competency. A systematic review of

the effectiveness of e-Learning for health leadership and management training was published in 2018.⁵

After reviewing the literature and trends within leadership and management, it was suggested that e-Learning could bridge existing gaps in healthcare leadership and management training programs. More specifically; settings of health professionals, types of organization (public or private), and types of healthcare professional were identified as indicators to determine the need and feasibility of training.⁵ Different methods of e-Learning (e.g., online and offline learning, mobile learning, virtual reality environments, serious gaming and massive open online courses) were reviewed.⁵

Use of e-Learning for information and training helps expand the capacity for health professionals. Online training expands the range people can access information to build skills in a timely manner. The study highlights that the e-Learning program also helps develop other skills within the professionals taking the course. Professionals developed meaningful relationships with peers online, are more engaged to the readily accessible information while working at their own pace, and experience a higher sense of stimulation as they develop their cognitive and technical skills.⁵ Developing new leadership and management training, in addition to the skills previously discussed, can transform public health in desired regions across the globe as health professionals demonstrate newly innovative approaches to their peers and expand public health capacities within communities.

Systematic Review of e-Learning in LMICs

While e-Learning has been made possible for many low-and-middle-income countries (LMICs) there is reason to measure its effectiveness. During 10-year span between 2007 - 2017, 52 studies related to using e-learning interventions were reviewed.⁶ Among 12,294 participants, 73% were

pilot studies, in which 45% used questionnaires to evaluate their intervention.⁶ Researchers used the systemic review of e-learning interventions to gain a better understanding of the strengths and weaknesses of such programs in LMICs. To categorize the effectiveness of e-Learning interventions, they used a five level measurement scale which consisted of five variables: individual environment; learning environment; contextual; technology; and pedagogic.⁶

As studies were reviewed, they were characterized as successful, not successful, or non-applicable. Eighty-three percent were deemed as effective interventions.⁶ While results show promise for e-Learning interventions in LMICs, limitations were highlighted. There is still undiscovered literature that should be reviewed to provide further context. In addition, results may vary if studies were evaluated and compared by region and external components that could affect the effectiveness of an intervention, therefore impacting the sustainability of training students and workers.

University of Geneva Public Health e-Learning Master's Program

Lack of a completely competent public health workforce has affected the global community, specifically in sub-Saharan Africa. In 2008, the World Health Organization and the Global Health Workforce Alliance encouraged workers to develop proposals to improve the health workforce development in Africa. As result, a project that encompasses the use of an e-learning Master of Advanced Studies program was used by 10 partnering academic institutions in French-speaking African countries.⁷ Using a 5-step approach that consisted of: assessing the needs of participating countries; recruiting students and tutors for the program; developing the e-Learning program and training workshop; developing learning objectives after reviewing the needs assessment; monitoring students and their performance during the duration of the course, developers implemented and evaluated improving public health learning curricula.⁷ The program

was composed of ten, 2-month modules (including exams and group work) focused on priority health issues by WHO standards.⁷ Upon completion of the program and thorough analysis, the study suggested that the e-Learning was an overall success. With 29/37 students who participated achieved the educational objectives of the program, results indicated that students were engaged and committed to the program; this led to stronger career development and inter-country networking.⁷ For future research, the study suggested reviewing dropout rates at public health institutions and exploring revolving factors that provide clearer context to increasing recruitment and completion of training programs.

Sub-Saharan Africa and Low Resource Use e-Learning for Medical Education

A study explored why e-Learning systems implemented in low resource settings within sub-Saharan Africa remain stagnant and often fall short of their potential to improve healthcare. Of the 49 sub-Saharan Africa nations that consist of one billion people, only 6,000 doctors graduate annually.⁸ The rate is strikingly low when compared to western Europe, who have a fifth the population size yet have nearly 42,000 graduates annually.⁸ The issue doesn't revolve around a lack of programs but the poor quality and standards of them. Researchers stated that there were so many mobile health (mHealth) programs that in 2012 the country of Uganda had to issue an immediate hold on any newly related interventions, but to shift focus and improve the standards of their current ones.⁸ Many interventions do not survive past the pilot phase, which halts and, in many cases, diminishes any progress. This study used its research to provide context for why programs fail. The main problem has shifted from a lack of technology in low resource regions to how to use the technology and retaining e-Learning programs to a global standard. The study highlights that programs have a difficult time truly being analyzed in a high standard, as they are frequently evaluated by participants and by standards of similar programs. This presents validity

issues as many programs are self-designed. To improve current and future e-Learning interventions, this study suggests using a topic-specific database that logs all interventions to retain that all programs are on the same accord.⁸ In addition, they propose using a trusted standardized framework for programs to use when implementing their programs to ensure high quality.⁸ Lastly, they propose having structured programs incorporated within medicals and accredited institutions to create an efficient means of training students and health professionals.⁸

Workforce Capacity

The burden of chronic and infectious disease in Africa continues to grow. Unfortunately, as disease burden rises, the shortage of health professionals continues to rise. Africa contains only 1.3% of the world's public health workforce yet they address 25% of the global disease burden.⁹ With such a large discrepancy, improving the public health workforce capacity has become a leading priority for Africa to improve their disease burden.

Inequities in GH: greatest impediment to health

Studies in 2006 suggested that inequities within the global health workforce are the greatest impediment to health in sub-Saharan African. WHO estimates that 57 countries are critically short on professional health workers, with sub-Saharan Africa accounting for 36 of those.² To adequately meet the public health needs of Africa, they need to improve their workforce by about 140%.² Evaluating contributing factors that have led to the poor public health infrastructure status serves as indicators that there should be more initiative to increase global responsibility, political and financial security, and public-private partner involvement.

Scaling Up Health Workforce

Issues are highlighted here regarding the shortcomings of the global health community. The Task Force set out to challenge countries around the globe to improve their public health systems and efforts by reassessing their health needs and goals. The Task Force strongly suggested improving public health workers skills and assets in order to perform at higher levels. A total of 10 countries (Brazil, Venezuela, Pakistan, India, Bangladesh, Kenya, Tanzania, Ghana, Malawi, and Ethiopia) were evaluated to assess useful components from the past and what new approaches could be developed for the future. According to the 2006 World Health Report there was a shortage of 4.3 million health workers, mostly impacting the poorest regions.¹⁰

Contributing factors to the shortage crisis were attributed to the rise of chronic disease, an aging population, poor working conditions, and international migration.¹⁰ After conducting two panels, the Task Force highlighted that scaling up education and training methods for health workers should be a primary focus for disadvantaged regions. While the Task Force also acknowledged that efforts are being made a priority in developing countries, methods should be modified in a more collaborative effort. Short- and long-term goals for improving the public health workforce should be more widely spread; linking education and training methods. As a means of achieving these goals, countries and health systems need to increase equity through: innovative measures in curriculum designs and delivery; and enhancing quality through providing accreditation and leadership opportunities for public health professionals.¹⁰

Training for PWF at National School of Public Health

South Africa has been one of the few African countries at the forefront of developing innovative approaches to improve the public health workforce. In 2007, their National School of Public Health developed an approach using modern methods to train public health graduate students and

professionals. They reported results of a previous survey conducted in 2001 from 56 countries which stated only 33% of schools offered graduate training in public health, 57% reported no training and 9% never responded.⁹

Using indicators from the reviewed study the NSPH developed a 2-year, 10 course online teaching approach for students to use to obtain and improve their public health skills. The program was composed of 70% online learning and 30% traditional learning. Results from their program compared to other South African institutions that offered public health graduate courses proved to be successful. As they offered an online distance education, their outreach to educate students became larger than other institutions, as only 45% of graduates were South African through the years of 2001 - 2003.⁹ Between the years of 2001 - 2007 there was a reported 202 graduates from the program; within the same timeframe, other South African institutions reported 107, 87, 85, 81, 20, 15, and 6 graduates.⁹ Data suggested that using this type of training and education approach should be implemented across other African public health intuitions to stimulate greater outreach and training of public health students in order to increase the number of readily available public health professionals that have modern skill-sets to combat Africa's disease burden.

Building Workforce Capacity using Blended e-Learning in Namibia & Tanzania

Further supporting literature also suggests that using e-Learning programs can greatly improve the public health workforce in Africa. African countries, Namibia and Tanzania, have used an innovative approach of using e-Learning to build a health workforce capacity for health information systems (HIS). One hundred and thirty-one participants from both countries, researchers were able to observe strong learning trends as they evaluated pre and post-test from the program. There was a reported 70% passing threshold in all three e-Learning modules.¹¹ Also

noted, was the comparison of results from the e-Learning program to previous in-person workshops that were developed by the CDC, indicating a high-quality curriculum and online material. In addition, results showed a strong indication that using e-Learning is cheaper to provide for health workers. The estimated cost per trainee is up to 3.4 times less expensive for those using e-Learning versus those who receive in-person training with the same curriculum content.

Sample costs were also recorded comparing in-person learning to blended e-Learning in Namibia; in-person learning being the most expensive (\$1,042). Online courses (\$342) and tablet-based (\$521) were cheaper in comparison as they required significantly less facility and international training cost.¹¹ Respectively the post-training pass rate was 0.94 for in-person and 0.84 in both online and tablet-based training, which was not considered significant.¹¹ Use of the pilot implementation highlights positive outcomes and improved agendas that can improve the health workforce and its use of HIS, particularly in low-resource settings.

Building Public Health Workforce in Nigeria through Experiential Training

Africa's largest country, Nigeria has adopted a modern approach to improving their public health workforce. After experiencing an avian influenza outbreak the country realized the importance of using a one world one health approach by collaborating with different health sectors to manage and control the outbreak.¹² In 2008 the country implemented a multi-agency, Nigeria Field Epidemiology and Laboratory Training Program (NFELTP), a modern approach model that has been used on an international scale. In comparison to traditional training methods, the experiential approach used a multidimensional style to train professional workers to be adequately proficient in their career task and abilities. Using this model aimed to allow health professionals to be more engaged and hands-on in learning skills by teaching and learning "by

doing”. Nigeria adopted this approach to afford themselves the ability to improve their public health workforce capacity to improve: multi-disease surveillance; response systems; and timely detection.¹²

As reported, Nigeria is comprised of roughly 170 million and 36 states.¹² With a large national community, the NFELTP encourages its graduated trainees and participants to share their skills and assistance to existing national and sub-national surveillance and response systems. Reported success of the program led to gaining further support from government and health development partners, which assisted the NFELTP to push towards their goals and expand into regions beyond Nigeria. The NFELTP suggests that using similar programs that incorporate modern training methods can provide a platform to develop a skilled public health workforce and believe it is a prerequisite to strengthening public health institutions. In expanding access and outreach for health professionals it expands highly skilled public health service throughout Africa.

Lack of Workforce in Morocco

As the world faced the coronavirus (COVID-19) pandemic, Africa’s Morocco health sector faced the challenge of lacking health workers to take care of patients in need. The researcher explained reasons for why Morocco’s healthcare system is poor and how it impacts the lack of available health workers and preparedness for a pandemic such as COVID-19. Many natives were uninsured that stemmed from an inadequate health budget by the government. Public and private sectors played a factor in the poor health infrastructure as well. Despite nearly 70% capacity of available supply, most Moroccans prefer private sectors versus public sectors due to the quality of care they receive and times they wait to receive care.¹³ With limited space and supply this leaves many uninsured. This affected the workforce due to private sectors offering more pay and better work conditions. However, it became a competition and those who weren’t hired often

migrated to other regions. WHO reported that Morocco is one of the 57 countries that had an acute shortage of health workers in their country.¹³ Education was also impacted and unsupported as well. Many paramedical studies fell incomplete or received poor educations which made them inadequate to work at a high level or students develop brain drain and migrate to other regions with higher quality education. In 2017, it was reported that nearly 24% of emigrated Moroccan physicians were practicing in France.¹³

The researcher suggests that Morocco needs to scale up its healthcare system in order to provide and cover its citizens with adequate healthcare. Standards and budgets should also be held to WHO standards and not fall below. In addition, private systems should expand their recruitment standards as well to develop more of a workforce to avoid lacking healthcare professionals. If the quality of care services were to rise in both public and private sectors, Morocco could retain health professionals and provide a high quality of work, resulting in more patients across the board. It is imperative that the country of Morocco develop a robust health system and strategy before the coronavirus truly impacts the African region.

Brain Drain

One of the contributing factors that has led to poor public health infrastructure within developing countries, especially within the African continent, has been brain drain. Many health professionals in Africa suffer from brain drain due to poor economic systems in their countries, outdated facilities and supplies, and low paying salaries. While health professionals migrate to regions that offer better opportunities, it leaves regions with poor health in the same or worse predicament as they lack workers to care for them. Existing literature explores the main and external factors that attribute to brain drain within African countries and strategies used to reduce brain drain.

Strategic Approaches to Managing Migration of Healthcare Workers in Developing Countries

Over the years there has been a shortage of qualitative and quantitative research and data revolving the effects of health professionals migrating. Reasons for the lack of research by national and international health researchers is still misunderstood, however there has been more emphasis on reviewing this global health system. In 2004, researchers investigated attributable factors for why healthcare migrating in developing countries exists and explored suggestive strategies to reduce brain drain. Researchers used a survey that consisted of health workers from five African countries (Cameroon, Ghana, South Africa, Uganda and Zimbabwe) to evaluate their reasons for wanting to leave their country. The top four reasons for migrating resulted in: opportunity to work in a better managed health system; continue and pursue higher level of training or education; wanting a more conducive working environment; and wanting a higher pay and salary.¹⁴ Reasons were more predominant in some countries than others, suggesting that national policies and economic status play a significant role in influencing their health workers. Researchers also highlighted other external influential factors that may be overlooked such as family wealth, in which health professionals are obligated to migrate for higher incomes to support their families in their native country. In addition, countries who are economically stable and rich such as the United States and United Kingdom use strong recruitment tactics to gain health workers as they endure shortages within their health systems as well. Recruiting internationally from low income resource settings comes at a lower cost while having health workers who are equally as capable.

Researchers suggested that in order to reduce brain drain in developing countries, strategies should be more specific to the country and its needs versus using a universal approach. While countries may face the same issue of brain drain and health worker shortages, attributable factors

vary and should be addressed to those specific needs. Countries need to gain a stronger understanding of the qualitative factors that impact their health workers for policy makers to develop effective strategies. In addition, developing strategies to provide and increase financial incentives and stability for health workers should be a priority for countries. Incentive strategies could also be expanded beyond financial compensation, as workers can be offered things such as transportation, supporting staff and teams, as well as training and education opportunities.¹⁴ Lastly, researchers suggested that countries develop agreements that would allow but limit migration. The idea revolves around developing countries agreeing to allow migration of health workers to richer countries who have shortages in return for compensation. As a result, developing countries could use compensation to build their economy, as well as their health system to provide higher training, better facilities and technology for their health workers. As these strategies are carried out with international support, it is suggested that it will boost and revitalize developing countries' economy in the long term.¹⁴

Gravity Model of Physician Brain Drain

Knowing brain drain exists is one just entity of Africa's health infrastructure but understanding the contributing factors that lead to brain drain can provide better context as to why it exists and how to reduce it. Literature from this study explores determining factors of migration by physicians and other healthcare professionals. Using the modules from 2000 - 2016 authors explored the Organization for Economic Co-operation and Development's (OECD) strategies for attracting abroad healthcare professionals from the regions of Asia, Africa, and Eastern and Southeastern Europe.¹⁵ Results also highlighted African health professionals being more inclined to leave for higher pay and to be in less densely medical provider populated areas as they face high patient-to-provider ratios while being underpaid. Upon reviewing results, the study suggests

that some of the main contributing factors that can lead to reducing brain drain are lower unemployment rates, aging population, access to higher-level technology in urban and rural regions, and higher potential income earnings.¹⁵

International Migration of Health Labor: Physicians in South Africa

Much attention is often shown on how much brain drain exists within the African healthcare system, however there isn't much that highlights the strides that have been made and continue to take place. There is literature suggesting that despite existing brain drain, health professionals are willing and have shown to be immigrants within low- and middle-income countries (LMIC).¹⁶ Studies suggest that using net migration (NM) methods can be very useful in gaining more understanding of brain drain and immigration in developing countries. The Organization for Economic Co-operation and Development (OECD) has been a great outlet for which countries are able to recruit healthcare professionals. By improving the health personal data management and reporting system as the Code-related System of the National Health Workforce Accounts, brain drain within African countries can be better evaluated. Lastly, researchers also indicated that despite a slower physician migration rate, South Africa's workforce is still made up of workers from nearly 100 countries.¹⁶ While physician migration has slowed over the years, the need to improve the health workforce remains. There is still a need to address the high demand of workers across Africa even with the retention of its native physicians.

Dropout of Female Volunteer CHW: Dhaka Urban Slums

Community health workers (CHWs) play an intricate role in the development and advancements of public health, especially within rural regions.¹⁷ They are responsible for carrying out program responsibilities and agenda. A study conducted in Dhaka, an urban slum in Bangladesh suffered a high rate of CHW volunteers dropping out, which impacted the program's sustainability. CHWs in Dhaka were used to conduct community-based maternal health interventions. As dropout rates increased, health services provided such as: health education, drug distribution, antenatal visits, referrals and deliveries were reduced significantly. The non-governmental organization (NGO), Building Resources Across Communities (BRAC), researched why dropouts were occurring and the costly implications it had on their maternal health program. Due to the high dropout rate experienced, the program was forced to have a quick turnover rate, replacing volunteers with new ones who weren't completely trained. As a result, this increased the cost of implementing the program as well as recruiting volunteer candidates. This therefore impacted the community by loss of quality service and unmet needs, causing friction between both parties. To reduce the dropout rate, BRAC responded by reviewing their guidelines and expectations to CHW volunteers. In addition, there were more incentives provided to the CHWs to help retain their volunteer services. Incentives included: higher pay for identifying pregnancies and attending deliveries; receiving incentive payment during a single payment-single time to reduce volunteers' displeasures; increased efforts on refresher training; and lastly providing yearly health insurance through BRAC for families consisting of five or more members.¹⁷

Healthcare Worker Shortage Affects Development Goals

While assessments have been made over previous and current approaches to improving global healthcare, not all goals have been achieved. A contributing factor that derails health goals is the unfortunate shortage of healthcare workers in needed regions. It becomes very challenging to strengthen or develop strategies when there aren't enough health professionals in place to carry out the agenda. Lack of workers:

- limits innovative development of strategies.
- reduces collaboration efforts.
- provides inadequate training and growth for current workers.
- prevents the population in need from receiving timely assistance, if any at all.

Reported by WHO, Africa holds nearly 25% of the world's disease burden, yet only holds 1.3% of the world's health workforce.¹⁸ The study identified four "hot buttons" that attribute to the shortage within the health workforce. Insufficient training of health workers was highlighted as during the time of the study (2004), only two-thirds of Sub-Saharan African countries only had one medical school, while eleven countries had none. The health of workers was also highlighted as a contributing factor to the shortage of health workers. Many African workers in the Sub-Saharan African region are performing with poor health conditions themselves. It was reported that between 18 - 41% of the health workforce was infected with HIV.¹⁸ Death of nurses who were from Zambia and Malawi accounted for an alarming 40% of health workers who received training.¹⁸

In addition, those who are health workers tend to experience brain drain and migrate to other countries. According to the study, workers from developing countries such as Ghana, Kenya,

Malawi, and Zimbabwe venture to other African countries that offer higher income and more opportunity such as South Africa and Botswana. In addition, the study suggest that workers are also migrating to other countries such as Australia, Canada, New Zealand, the UK and the United States where healthcare careers are more promising.¹⁸ An estimated 18,000 Zimbabwean nurses work abroad while many physicians in Malawi practice in the English city of Manchester due to more favorable work conditions.¹⁸ Lastly the study suggests that there is an imbalance of healthcare professionals from rural regions to urban regions. It was reported that the city of Dar es Salaam in Tanzania has nearly 30 times more health professionals than that of their rural regions. Also, out of Uganda's surgeons (roughly 100), only five reported to live in outside urban regions of the country.¹⁸

As the study presented many contributing factors to the shortage in the global health workforce, collaborative efforts were suggested to improve the poor workforce status. A summit held in Geneva consisting of policymakers and health experts was used to help develop innovative approaches to improve the global health workforce. A proposal, known as the Mexico Statement, urged other developing nations to allocate five percent of their health-sector funds to finance health systems research.¹⁸ More specifically, the Mexico statement's main driver was that, "Research, has a crucial but under-recognized part to play in strengthening health systems, improving the equitable distribution of high quality services, and advancing human development".¹⁸

Projections for Global Health Workforce Market

A study using an economic model on projected economic growth, demographics, health coverage, all while incorporating health workforce data developed projections for the global health workforce market in 2030. The study used Sustainable Development Goals (SDG)

(developed by WHO) as a measure for comparison with their projections to determine whether the future goals could be achieved. Growth in areas of demand and supply were predicted to be the slowest within low-income countries, which is below the WHO SDG threshold of 4.45 health workers per 1,000.¹⁹ As the study was conducted, it was suggested that the projected need of health workers in 2030 could be reduced by not only just increasing the number of public health workers but improving the means in which we obtain and train them using technology advancements. There was also an effort to highlight the misconception that increasing a country's economic status automatically impacts the improvement and status of health workers.

According to the results of the study, middle income countries are projected to experience the largest and highest increase in demand of the labor market through 2013 - 2020.¹⁹ By increasing investments in technology, professionals would have an opportunity to have greater efficiency and productivity in their fields. The study strongly suggests that improving strategies such as better use of technology, providing skill-development opportunities and reforming institutions could very well be the components needed to alter the trajectory of the future health workforce.¹⁹

Public Health Informatics

Health and medically related information can be intense to sort due to its complexity. Public health informatics (PHI) has provided a great deal of assistance within health information systems (HIS). Within the public health realm, informatics is very useful in data collection, data analysis and action development. Informatics has allowed us to share and receive health related data within real time, resulting in quick responses to health challenges. Because of this, it can provide public health outreach in needed populations in regions that were once deemed difficult to reach. As the global population and new health threats grow daily, the demand for informatics is higher than ever. The use of informatics has improved public health surveillance systems

across the globe. With modern informatics we can quickly identify, monitor, notify and respond to emerging diseases, bioterrorism, epidemic outbreaks and natural disasters globally.

Bridging Informatics

Within the past 20 years health related data collection has evolved within the United States as well as globally. The adoption of using electronic health records (EHR) has transformed the health world tremendously; allowing for data to be systematically recorded in an efficient manner. Currently, EHRs have shifted into new directions as they include patients' access, external physician access and more data sharing protocols. Data sharing protocols have shifted into a "synergistic bridging" idea; in which patients, health facilities and health providers have access to patients' information.²⁰ Using the modern system creates: real-time data, reduces cost, and allows the global community to communicate easily in a timely manner. PHI expands beyond the scope of EHRs. It is viewed as a "systematic application for information, computer science and technology impacting public health practice, research and learning".²⁰

Based on the definition, the study aimed to update previous frameworks and strategies to create a more unifying conceptual framework model to use. The unified framework consisted of using overlapping domains to address the needs for public health informatics and its impact. Overlapping domains consists of: Public Health; Population Health and Social Services Informatics.²⁰ With its development, it provides decision makers with useful information that impact funding for innovative interventions. With the expansion and development of PHI it creates a domino effect on externally interconnected components to improve their services and infrastructure in a sustainable manner for public health.

Health Map

PHI has evolved as technology continues to provide new opportunities for growth and innovation. HealthMap is a great example of PHI's evolution. HealthMap was developed by researchers, epidemiologists and software developers in 2006 in Boston Children's Hospital.²¹ The sole purpose of HealthMap is to monitor disease outbreaks and present free real-time PHS for any emerging public health threats, domestically and globally. The software receives and combines many outlets of data to present real-time health updates for health professionals, government officials, and the general population. Using the core values and framework as any PHI system, HealthMap has been a great resource to improve identifying, monitoring, alerting and responding to all global health related threats.²² HealthMap has also proved to be very accessible as it can be used via computers, tablets and/or mobile phones. As global health professionals collaborate across the globe in different regions, software such as HealthMap serves very useful as a communication and surveillance tool. Consistently updated hourly, HealthMap has provided a unified view of current states of our universal health for health professionals and global citizens.²¹

OECD

The Organization for Economic Co-operation and Development (OECD) is a well-known international organization that strives to develop policies on a global platform to keep countries interconnected with data, opportunities, and technology advancements.²³ Though not limited to health, the OECD provides one of the unique approaches to reduce global inequities, improving economic capacities and providing employment opportunities. Using modern technology and collaborative efforts with 36 partnering countries, the OECD uses education and data analysis to provide real time information on pressing policy challenges around the globe.²³

With use of the data and information we are afforded the opportunity to collaboratively develop innovative strategies to improve global policies revolving the health and wellness of all global citizens. In addition, outreach of the OECD extends beyond the 36 member countries but with 7 other countries as well. The four major outcomes of OECD are to: promote local and regional development; promote health and wellness; accelerate global development; and protecting consumers health and safety.²³ The OECD believes that if they can achieve these outcomes then we can evoke global change for shaping “better lives”. The OECD covers a vast deal of policies making their organization very complex. Specifically related to public health: they review data in order to highlight indicators to improve health systems in many regions, measure and analyze information and communication technologies (ICTs) to improve system productivity and access, and constantly review health policies across the globe to reduce inequities and improve quality of life across all population groups.

Conclusion

Though there is literature focused on the areas discussed (e-Learning, informatics, workforce capacity, and existing programs), there is still a limited amount of research that explores the long-term outcomes and impact of Africa’s public health infrastructure when using e-Learning as an intervention training tool.

Data is limited regarding participants who have completed existing programs that have incorporated modern training methods that include a combination of e-Learning, modern PHI, and collaborative efforts. Further examination of these training methods and their long-term outcomes can help better indicate current approaches being used by the Africa CDC IWD.

The purpose of this study is to explore the outcomes that have occurred within the Africa CDC IWD program in training and educating African health workers. In addition, using their Clinical

Community of Practice to support and prepare medical personnel in Africa for the coronavirus pandemic (COVID-19) will provide further context as how their e-Learning approach expands beyond the scope of training alone. Supporting data and observations will provide a model framework for current and future e-Learning interventions when training and supporting African health professionals to improve Africa's health infrastructure.

Chapter 3: Methods

Introduction

Monitoring and evaluating e-Learning programs is very essential to understanding and determining whether programs being implemented in low resource settings such as Africa are effective. It is also critical to complete observations on e-Learning methods to see if they are beneficial to the progress of improving the health workforce capacity in Africa, as well as improving its overall health infrastructure. Highlighting the methods of research will provide a clearer context to how the IWD program meets its objectives and how it has expanded its e-Learning outreach beyond the scope of using training courses for health professionals.

To evaluate the effectiveness of the e-Learning program implemented by the Africa CDC IWD, it is important to evaluate the programs initiatives but external outcomes as well. Assessing health workers and students beyond the IWD e-Learning program should be completed to evaluate participants' retention and application of their modern skills obtained.

An approach of process evaluation was used to assess the online Canvas program implemented by the Africa CDC IWD. By a process evaluation, it explored the program's conformity to its design, execution of the program's implementation, and to the extent of its reach to the program's participants. Verbal consent and access to data spreadsheets, as well as the online training program on Canvas was acquired by program instructors and developers. In addition, useful information was gained through active participation and observations on weekly invited virtual meetings that were related to monitoring and evaluating the IWD program.

Using content and data from the program we were able to evaluate whether participants were able to use the skills obtained through the courses in a meaningful way in their careers and

respective communities. Accounting for factors such as age, profession and country of residence provided comparable traits and trends that could prove useful in developing higher quality online training programs. Metrics were used and evaluated to identify trends and projected success of the e-Learning program instituted to reduce Africa's brain drain and improve their public health infrastructure.

Study Site

E-Learning promotes and provides a means for participants to access its useful information from remote places that have some form of digital service. This study was not focused on a centralized location as its participants resided and worked in various regions throughout Africa. There was more emphasis on the delivery and access of the e-Learning materials on the Canvas site to participants in their respective regions. While most of the content through the four offered courses was delivered through Canvas online, there were in-person workshops held at Africa CDC locations. All African countries were represented through the first-year implementation.

Population Sample

No participants were individually evaluated throughout this study, which eliminated any needed informed consent. The population observed throughout this research surrounded health professionals and students from all regions of Africa. As the IWD program focused on training African health professionals and students they were the primary population evaluated. There were 243 registered program participants that derived from all five regions of Africa (South, North, Central, East, and West). All African countries were accounted for when reviewing the participant spreadsheet obtained by the Africa CDC IWD. Demographics for participants varied by country of residence, age, profession, educational institutions, and the degree participants obtained.

Each course offered selected participants based upon shared professional experience within that course's topic and outcomes. Participants were able to learn new skills and modern approaches to enhance their workforce capacity at a higher level on global health standards.

Having participants from all regions played a significant factor for the IWD to deliver its e-Learning through all African communities. It also was used as a measure to validate that its online outreach was diversified and could be applicable to all African health workers. Having participants from different health or medical backgrounds was an important component the IWD wanted to have as well to represent all areas of global health expertise. By providing modern skills and knowledge to a diverse health professional population, it would evoke collaboration and innovative strategies to improve Africa's health infrastructure.

Research Design

A systematic review was also completed to review similar findings and projects related to the IWD. In addition, a thorough assessment was completed on using the e-Learning approach on Canvas. Using Canvas as its learning management platform, the IWD created four original training courses for participants to use and improve their public health skills:

Courses Offered

Transforming Public Health Surveillance

- The main objective of this course was to provide context on the history and components that have shaped PHS. In addition, participants were provided the framework to build competency around PHS after being provided training on the uses, elements, data sources, reporting techniques and models of PHS. The course

was designed for PHS specialists, emergency operation center personnel of Africa Union Member States (AUMS).

Introduction to Antimicrobial Resistance

- The main objective of this course was to complete an overview of the history of antimicrobial resistance (AMR) and the risk and burden that are currently faced. By developing skills and strategy tactics to improve AMR diagnostics and PHS, participants were presented the opportunity to achieve competency of AMR. The course was designed for healthcare and public health policymakers in AUMS.

Proposal Writing

- The main objective of this course was to provide participants useful tools and guidance that allowed trainees to strengthen their reviews and writing for proposals. As trainees became competent, they were able to conduct clear and concise ideas to develop proposals for wanted grants and funding from organizations. The primary target audience for this course were health personnel involved in developing proposals within the Africa CDC, National Public Health Institute (NPHI) and Ministries of Health. In addition, members from academic institutions connected to the Africa CDC and NPHI were invited to participate.

Leadership and Management

- The main objective of this course was to adequately train participants in system-thinking, interpersonal, managerial, political and leadership skills that are needed to effectively lead an organization. In addition, with the acquired skills participants develop, they should be able to create positive working atmospheres, reduce brain

drain, and achieve high standards of public health work. Participants were recruited on an invite only basis and were executives at NPHI and Ministries of Health in AUMS.

Instruments

Many instruments were used to conduct a thorough monitoring and evaluation of the Africa CDC IWD's program. As e-Learning is a central focus for the IWD to train public health workers, as most of the observations were conducted through digital outlets. Useful instruments during the monitoring of the Africa CDC IWD e-Learning initiative was the Africa CDC IWD online website, data spreadsheets, and the Africa CDC framework manual for workforce development. Data was observed through obtained spreadsheets permitted through the Africa CDC IWD. With their approval, they provided a means of access to evaluate participants who were enrolled within their development and training course offered through Canvas. In addition, access was granted to the Canvas page in which the Africa CDC IWD used to provide support and training for medical personnel and students within Africa. The Africa CDC IWD used Canvas as its main source to deliver their e-Learning training for African health professionals and students.

Plans for Data Analysis

Each of the four courses was evaluated individually as they all provided different public health training components. Course delivery, course structure and program outcomes were all evaluated as significant measurables through the implementation. Once all courses were completed their numbers were assessed together to observe any noticeable trends or gaps that could be useful for next year's program implementation.

Limitations

The methods of this study are subject to limitations. Due to this being year one of the IWD's implementation, comparative data does not exist. Other literature that was reviewed used other means to train their health workforce by using other course names and target agendas. It is also difficult to measure and compare the success of participants individually as they share different professions, daily responsibilities and live in different regions of Africa.

In addition, there are also uncontrollable limitations that should be accounted for as well. Africa still has a great deal of political turmoil within some of its countries. Many times, this derails a government's priority or agenda. Once priorities are shifted, funding and goals to improve health infrastructures are halted and continue to have limited progress. With participants coming from over 55 countries, they encounter different economic experiences that can impact their careers differently than their course peers.

Resistance from government and officials can prove to be a limitation as well. While many countries are getting on board using modern approaches to train and improve their healthcare, there are some who hold true to traditional methods and reject new innovative approaches.

Presenting useful data and outcomes to leaders and partners is critical to the continuation and growth of the IWD. It is also equally as important to provide the same level of transparency and convincing with community health workers, institutions and the general public to retain their support as well.

Lastly, competitors from other organizations and institutions are a limitation as well. With limited funding available there is quite a bit of competition amongst health programs. Therefore it becomes more challenging for programs such as the IWD to receive funding as they must not

only convince stakeholders and leaders of their program's legitimacy and importance, but also as to why it should be placed as a higher priority than competitors and their agenda.

Conclusion

The primary objective of this study was to explore the dynamics of the Canvas online program used to educate and train African public health workers and to gauge how participants are using and applying the information being presented to them. Participants were evaluated based upon their time and frequency used on Canvas as well as course completion. In addition, participation in virtual meetings was observed to measure external participation outside of Canvas.

Using a multi-approach design, it was possible to evaluate the IWD's training program provided through Canvas. By reviewing all components of the program, a proper assessment could be completed to see if African health professionals are receiving adequate training in their respective fields. Lastly it also provides clear context on how efficient of a learning tool Canvas has been in allowing participants the ability to develop competencies in field epidemiology, informatics, lab sciences and in preventing, detecting and responding to disease.

Chapter 4: Results

Introduction

Providing African health professionals with the highest level of pedagogy to enhance and expand Africa's health workforce capacity was the primary objective of Africa CDC IWD's e-Learning. Data and in-depth overviews of the originally developed courses provided a clearer context to how e-Learning training can impact African health workers. Overall, health professionals who participated in the Canvas e-Learning courses were receptive to course materials and training. Results of the IWD's implementation using Canvas as its e-Learning provider showed to be promising. All courses were completed by their set deadlines with minimal reported digital issues by instructors and participants. The four originally developed courses offered were run one after another: (1) Transforming Public Health Surveillance; (2) Antimicrobial Resistance; (3) Proposal Development; and (4) Leadership & Development.

The Transforming Public Health Surveillance course was offered from May 20, 2019 and ended Jun 14, 2019 (Table 1). The entire course was delivered through the online service of Canvas as it provided useful modules, assignments, and assistance from instructors. Participants were required to complete the course within a month's time frame but could do so at their own pace with unlimited access to Canvas.

The Introduction to Microbial Resistance course was opened from Sep 9, 2019 through Nov 2019 (Table 1). All course content, learning, and delivery was done using Canvas. Participants were allotted six weeks to complete the course within the offered dates.

The Proposal Development for Public Health Research & Programs course was offered from the months of Sep through Nov 2019 (Table 1). While primarily using online delivery methods on

Canvas to deliver e-Learning, this course was blended as there was a three day in-person workshop that participants were required to complete as well. Students were allotted eight weeks to complete the course.

The Leadership and Management course was offered during the Fall of 2019 (Table 1). Using blended methods to provide training and skill development, 75% of course content was delivered online on Canvas while the remaining 25% through students completing an in-person workshop (Table 1). Once registered and started, participants were allotted 6 weeks to complete the course.

Table 1. Africa CDC Institute for Workforce Development Course by Time and Component, 2019²⁴

	Transforming Public Health Surveillance	Introduction to AMR	Proposal Development	Leadership and Management
Dates Course Offered	May 20 - Jun 14	Sep 9 - Nov	Sep – Nov	Fall
Course Delivery	100% Online	100% Online	Blended (7 weeks online, 3 day in-person workshop)	Blended (75% online, 25% in-person workshop)
Targeted Audience	Public Health Surveillance Specialist	Policymakers	NPHI Administrators	NPHI Directors
Time to Complete Course	1 month	6 weeks	8 weeks	6 weeks
Suggested Hours/Week	8	1	6	6
Language of Material	English	English	English	English

1. Africa Union AC. AfricaCDC Training. 2019.

African health professionals seek opportunities for training in order to obtain adequate skills and to advance within their health fields. The IWD provided a high-level curriculum that met global standards for training health workers from any region. For students to be deemed adequately skilled and to receive a certification from the course completed, they must have achieved at least 70 percent of the material and course objectives.

A more in-depth evaluation was completed on the IWD's first course, Transforming Public Health Surveillance. There was a total of 102 enrolled participants who were selected to proportionally represent the African Union (Table 2). The average participant age was 36.2 years from 27 African countries. As all courses, TPHS was used and developed for professionals whose skills aligned with the core curriculum and objectives of the course to provide them the necessary skills to elevate their careers. Participants completed pre and post assessments to measure their knowledge growth from the course training. Pre-course assessment was 58.8% and post-course assessment was 80.2%. Forty-four certificates were awarded to participants with a 62.4% completion average for the pilot course. There was an overall positive feedback by the 34 course evaluations completed by participants. When asked "How much more confident are you in conducting Public Health Surveillance activities?" 56% (19) participants felt very comfortable, 41% (14) participants felt more confident, 3% (1) participant felt neutral. When asked to rate the quality of the e-Learning course for Transforming Public Health Surveillance, 74% (25) participants responded 'excellent' and 26% (9) participants responded, 'very good'.

Table 2. Africa CDC Institute for Workforce Development Transforming Public Health Surveillance Course Registration, by Country and Region, 2019

Region	North	West	East	Central	South
Country	Egypt	Gambia	Burundi	Cameroon	Malawi
	Mauritania	Ghana	Ethiopia	Democratic Republic of the Congo	South Africa
	Morocco	Liberia	Kenya	Gabon	Zambia
	Sudan	Mali	Rwanda		Zimbabwe
	Tunisia	Niger	Somalia		
		Nigeria	Tanzania		
		Sierra Leone	Uganda		
Total=26*(%)	5 (19%)	7 (27%)	7 (27%)	3 (12%)	4 (15%)

1 student participant was from China and was not accounted for in this table ()*

Table 3. Africa CDC Institute for Workforce Development Courses by Representation, 2019²⁴

	Enrolled Students	Countries	Faculty
Transforming Public Health Surveillance	102	27	4
Anti-microbial Resistance	52	50	7
Proposal Development	48	20	4
Leadership and Management	41	35	6

Participant Feedback

The IWD also used the digital tool called Flip Grid. Flip Grid is an online component that is used as a virtual discussion board. Like blog pages or discussion boards, Flip Grid provides a video visual aspect in which participants can interact with one another to create a more personable environment. The IWD used this program to allow instructors and participants the opportunity interact with their peers and provide feedback on course assignments, health related updates and

experiences. During the duration of the Transforming Public Health Surveillance course there were over 1,555 videos posted to Flip Grid with over 2,700 hours' worth of video content. With such a high volume of feedback, it indicates that participants are engaged and willing to communicate and collaborate despite the absence of a traditionally physical classroom setting. Participants were also able to complete course evaluations and share testimonials on their experience of navigating Canvas and completing course work. While many course evaluations were completed, participants also took advantage of using the Flip Grid tool to create video course feedback. The Flip Grid feedback created a valuable component for IWD members and course instructors to view personable experiences beyond what a standardized course evaluation could offer. In addition, it provided useful feedback to further explore the impact courses and training have had on participants individual and career growth.

Conclusion

The Africa CDC IWD showed positive outcomes and achievements through its first year of e-Learning implementation using four courses. As Transforming Public Health Surveillance serves as a completely evaluated model course, with nearly 70% of participants receiving certifications and providing positive feedback of their learning experience and course structure it implicates many things. Results indicate and suggest that: e-Learning is an effective and efficient method to train Africa's health professionals; access to high level pedagogy is achievable in developing countries; participants are engaged and eager to receive adequate training; and the IWD's concepts and methods of using e-Learning can be applicable and useful on other platforms of public health within Africa and beyond.

Chapter 5: Discussion

Overview

With the success and use of e-Learning, it can provide opportunities to achieve growth in other areas for health professionals. While e-Learning has shown to be very useful in training health professionals; it can lead to higher recruitment of health professionals as well as investments from partnerships and African governments. By building a stronger relationship and collaborating with local and international partners it can open the doorways for African countries to gain more funding to improve institutional and research facilities to work on infectious diseases, chronic diseases and other contributors affecting Africa's health infrastructure. Nearly \$106 billion dollars are spent annually on global health research. However, around only four percent (roughly \$4.5 billion dollars) is spent by middle- and low- income countries.¹⁸

As e-Learning can provide various collaboration opportunities, it's important to develop useful strategies to gain more funding and involvement by all participating parties to provide useful resources and supplies for needed regions across Africa. It's also important that healthcare professionals and government officials develop new approaches to use and allocate a higher amount of the global research spending. While e-Learning provides a great outlet and foundation for professionals to gain knowledge and training, it's just as important to improve local facilities in urban and rural regions to create a more efficient work atmosphere for health professionals.

Implications

IWD's developed e-Learning program has provided a new standard for delivering e-Learning in Africa. Use of the Africa CDC IWD program can alter the dynamics in strengthening Africa's healthcare delivery system (Table 4). As programs measure success from a short-term or long-

term perspective. The IWD can deliver on both measures as its healthcare workers are trained and can use their developed skills within a matter of months. While using effective measures, the Africa CDC IWD delivers on addressing all the drivers of e-Learning, a unique factor in which most programs have rarely achieved (Table 5).

Drivers of e-Learning

- Cost-Efficient Training and Education
- Flexible Education Methods
- Effective Innovative Learning
- Internet Participation (i.e., smartphones, tablets)
- Microlearning for Specialized Training
- Emphasis on Online Content Development & Blended Learning
- Engagement from Students, Professionals and Government Officials
- Increased Government Participation and Funding
- Pandemic (prevention, detection, response and treatment)

Using an effective e-Learning implementation provides frameworks for suitable institutions and health programs across Africa that may be on a smaller scale. As the IWD program continues to grow; recruitment for other professionals will follow as well.

In addition, the Africa CDC IWD places a large emphasis on using social media as a platform.

The IWD has outreach platforms on Facebook, Instagram, LinkedIn, Twitter, and WhatsApp.

Used to relay relevant information on global public health matters, it allows African health professionals another opportunity to stay in tune and engaged. Social media also provides an informal means for professionals to engage with one another and contribute to relevant public health topics and spark innovative thinking. The social media also generates free publicity to

viewers and followers of the online accounts. By sharing useful public health information surrounding training, global health advancements and practices it generates interest on a large platform to recruit more health professionals in need of training. As the Africa CDC IWD continues to grow in developing and training public health professionals, using social media will continue to play a role in recruitment of new students from graduate institutions and provide a way for previous students to stay connected.

Table 4: Africa CDC Institute for Workforce Development Yr-1 Impact to Address Africa's Health Needs

Africa Health Needs	Impact
Health Professional Brain Drain	Provides high quality training for health professionals via e-Learning to reduce migration
Limited Access	e-Learning on Canvas, a leading LMS tool, allows students from all regions of Africa to participate in IWD program
No Collaboration	Students selected from all 55 African countries to promote diversity. In addition, students are encouraged to collaborate via discussion boards on Canvas and FlipGrid tool
Affordability	All participants selected to the IWD program are afforded access and online content for free
Low Workforce Capacity	The IWD would serve as a sustainable intervention to train health workers across Africa to improve their skills and careers
Limited Professional Development	IWD students are provided a high-quality pedagogy and useful tools to develop innovative approaches to improve Africa's health through its 4 online courses
Limited Program Accreditation	As health professionals and students' complete program they achieve more competencies
Government Involvement	The Africa CDC IWD select MOH from AU to participate in program Using its <i>Proposal Writing and Leadership & Management</i> courses allows professionals to develop stronger relationships with government officials and improve current/future health policies
Traditional Methods	The Africa CDC IWD adopts modern learning methods of training and improving Africa's workforce and health infrastructure by using online and blended learning methods

Table 5. Africa CDC Institute for Workforce Development Solutions to Meet e-Learning Needs

Needs	Solutions
LMS (Learning Management System)	Used Canvas, an adaptable and customizable learning platform using technology to make teaching and learning more feasible
Mobile Learning	Course content and interactive collaborations were accessible through electronic devices (i.e., computers, tablets, and cellular phones)
Cost Efficient	Free for selected students; Limited travel time to learning facilities, Reduced/Eliminated materials and supplies required for in-person learning
Engagement from students	Offered students discussion and collaborative stimulation through discussion boards on Canvas and the interactive tool FlipGrid
Microlearning	Provided students an “at your own pace” environment through structured courses that have accessible modules, tools, resources
Increased Government Support and Participation	Members of the Africa CDC, African Union and African MOH among the first selected participants in the e-Learning program
Epidemic, Pandemic Crisis	CCoP COVID-19: international platform that used weekly online seminars on Zoom and knowledge hub through Canvas to educate and prepare African health professionals for coronavirus pandemic

Recommendations

While a complete analysis was completed on the TPHS course and indicated e-Learning to be effective in African health professionals, a complete analysis still needs to be completed on the remaining three courses. As all courses from Yr-1 implementation are thoroughly evaluated, it will continue to strengthen the persuasion of other health professionals and African leaders to accept and use e-Learning as the most effective way to train its professionals. It will also provide further evidence that e-Learning is diverse and can be used on multiple public health platforms. As it proves to be more than one-dimensional, it can provide the groundwork to receive more

funding from partners. Lastly, it can provide expansion for opportunities in other public health avenues the need to be addressed in order to improve Africa's health infrastructure.

As Africa consists of many countries, they also share a variety of languages. Africa uses four main languages: English, French, Portuguese and Arabic. There are over 29 African countries that speak French; 21 of them being the official language of the country. The courses and material used in year one's pilot was only delivered using English. future work and use of e-Learning programs it is useful to expand on the use of language translation. The IWD has adjusted its CCoP COVID-19 material on Canvas, as it uses both English and French to diversify information and expand outreach to those who may not be fluent in the universal language of English. As there are many other traditional languages that are still used, discovering other delivery methods on learning management systems could be explored to further expand outreach and informatics to rural African regions.

Another means to increase the growth of e-Learning is to also bridge the gap of modern traditions and modern traditions. The reality is that not all political leaders, investors, and even health experts believe that using e-Learning is an effective tool to train health professionals and students. In addition, those who are doubtful may also be skeptical of the Africa CDC IWD's agenda and motives. Exploring strategies are needed to gain and retain support from health professionals, African leaders and investors. Strategic methods can be displayed through:

Consistency

The IWD program should aim to be consistent in measures and growth with its target population and outcomes. Consistency within the program will provide a strong foundation of evidence that e-Learning reduces cost of training for health professionals, reduces brain drain to increase and

workforce capacity, and an increased skilled workforce therefore leads to more innovative and effective strategies to improve Africa's health infrastructure.

Transparency

Keeping an open line of transparency with experts, leaders and investors is very critical to the success and growth of implementations. As new systems and avenues of healthcare development occur so does a lack of understanding. Supporters should be encouraged to actively participate within the implementation to gain more insight on the outcomes of how e-Learning can transform Africa's health members. Reports typically allow stakeholders and members to stay informed on the program's achievements, trends, modifications, and shortcomings it experiences.

Sustainability

As the IWD implements its program it's important that it uses the elements of consistency and transparency to create sustainability within the Africa CDC and the African health professional community. Many reviewed programs often fail after their pilot implementations, sparking innovative thoughts with little or no outcome. To achieve long term goals, a program must be sustainable. This requires high quality data and materials for participants to have access to. In addition, participants must be able to use acquired skills and training successfully in their respective fields and communities to indicate that e-Learning on Canvas through the IWD's implementation is highly effective.

Clinical Community of Practice

The Africa CDC IWD strengthens its program's efficiency and validity by providing external sources of training and support, and Feb 24, 2020 expanded their efforts by establishing a Clinical Community of Practice (CCoP). Using Canvas as a knowledge hub, the Africa CDC

IWD has recruited many African health professionals, as well as students to subscribe to the e-Learning learning management system (LMS). Using weekly seminars through Zoom and e-Learning through Canvas, the IWD has provided a platform for health professionals to engage and discuss the coronavirus (COVID-19) pandemic. Using this CCoP, Africa's health professionals along with other global health professionals use the seminars and Canvas as a platform to engage in discussions that address concerns, questions, developments and best practices to best prepare for Africa being impacted by the COVID-19 pandemic.

Weekly emails are sent to subscribers to keep them informed and remind them of weekly international webinars. Webinars are usually an hour in length and are composed of panelists who are experts in Using Canvas as its central informational hub for latest evidence-based practices and updates. There are over 4,000 registrants who have access to COVID-19 related content. The Canvas COVID-19 page is updated daily to keep subscribers informed. Data and metrics are published weekly to keep a tracking of weekly growth of subscribers, countries involved, and webinar and knowledge hub activity. In addition, weekly newsletters consisting of posted webinars and other useful content are also published. These weekly posts can be useful for individuals who may have missed recorded webinars and/or would like to refer to information on COVID-19. As the newly developed Canvas site continues to grow the IWD team is also focused on developing strategies to increase awareness, registration and attendance to seminars.

The IWD also uses a messaging app known as Telegram, that allows health professionals and stakeholders to engage in discussions that are related to policies and strategies that may need to be developed to prepare for the COVID-19 pandemic. Telegram offers a multi-communication method that allows a large audience to communicate by means of messaging securely on a global

platform. In addition, the Canvas site allows health professionals to engage with others, using communication tabs to ask questions to experts and peers and the opportunity to collaborate on projects freely using Google Doc. Information on Canvas and the online webinar are offered in both the English and French language. Lastly the IWD offers the webinar and Canvas access free of charge, to eliminate cost as a factor that may deter professionals and students from subscribing.

Field Epidemiology Training

Another area the Africa CDC IWD has its focus on strengthening African public health is within field epidemiology. While there are current programs and organizations that exist within Africa, many don't meet the needs that Africa requires. Field epidemiology training programs (FETP) are used to develop useful objectives that improve outbreak investigations, surveillance, analyses and data interpretation. Existing programs have a low workforce capacity, outdated systems and poor pedagogy methods.

The IWD has been recruited to develop newer and innovative strategies to strengthen FETPs. Using modern methods like training Africa's health workforce, the IWD is incorporating technology to develop high level pedagogy for epidemiologists and students. In addition, the IWD plans on using collaborative approaches with stakeholders such as Africa Field Epidemiology Network (AFENET), Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET), Eastern Mediterranean Public Health Network (EMPHNET) and International Association of National Public Health Institutes (IANPHI) to gain financial support for developing new systems.²⁵

Outcomes of developing FETPs are to: develop quality curriculum for professional and institutions; increase certifications for the health professionals; increase the career opportunities

for FETP students; and to achieve nationally set goals in an effective manner.²⁵ Using flipped classroom and blended learning methods, the IWD feels it can reduce the cost of training, while also increasing the quality of training by delivering high quality content. Using this model, which they refer to as FETP+, can also reduce traditional training time significantly when incorporating blended learning. Lastly by strengthening Africa's FETP system it can help reduce disease mortalities, cases and improve countries' economic growth.

Conclusion

If there continues to be a lack of health professionals and resources in Africa, their poor health infrastructure will continue to weaken. Health communities and infrastructures in Africa should develop innovative e-Learning methods to train the health workforce. Using modern approaches in Africa can improve workforce capacity and health infrastructures efficiently while reducing cost efforts.

By establishing a strong network of participants and support, the Africa CDC IWD can continue its growth by not only training health professionals but by providing support and access through high level e-Learning methods. Useful feedback and continued efforts to monitor and evaluate this implementation is essential for growth and outreach to improve Africa's health workforce and health infrastructure.

References

1. McDonnell T. A Fatal Public Health Problem In Africa That Flies Under The Radar. National Public Radio (NPR) Articles Web site. <https://www.npr.org/sections/goatsandsoda/2019/02/21/696385246/a-fatal-public-health-problem-in-africa-that-flies-under-the-radar>. Published 2019. Accessed.
2. Anyangwe S, Mtonga C. Inequities in the Global Health Workforce: The Greatest Impediment to Health in Sub-Saharan Africa. *International Journal of Environmental Research and Public Health*. 2007;4(2):93-100.
3. Mastellos N, Tran T, Dharmayat K, et al. Training community healthcare workers on the use of information and communication technologies: a randomised controlled trial of traditional versus blended learning in Malawi, Africa. *BMC Medical Education*. 2018;18(1).
4. Sissine M, Segan R, Taylor M, et al. Cost Comparison Model: Blended eLearning versus traditional training of community health workers. *Online Journal of Public Health Informatics*. 2014;6(3).
5. Tudor Car L, Kyaw BM, Atun R. The role of eLearning in health management and leadership capacity building in health system: a systematic review. *Human Resources for Health*. 2018;16(1).
6. Barteit S, Guzek D, Jahn A, Bärnighausen T, Jorge MM, Neuhann F. Evaluation of e-learning for medical education in low- and middle-income countries: A systematic review. *Computers & Education*. 2020;145:103726.
7. Chastonay P, Zesiger V, Moretti R, et al. A public health e-learning master's programme with a focus on health workforce development targeting francophone Africa: the University of Geneva experience. *Human Resources for Health*. 2015;13(1).
8. Barteit S, Jahn A, Banda SS, et al. E-Learning for Medical Education in Sub-Saharan Africa and Low-Resource Settings: Viewpoint. *Journal of Medical Internet Research*. 2019;21(1):e12449.
9. Mokwena K, Mokgatle-Nthabu M, Madiba S, Lewis H, Ntuli-Ngcobo B. Training of public health workforce at the National School of Public Health: meeting Africa's needs. *Bulletin of the World Health Organization*. 2007;950-954.
10. Crisp N, Gawanas B, Sharp I. Training the health workforce: scaling up, saving lives. *The Lancet*. 2008;371(9613):689-691.
11. Rudd KE, Puttkammer N, Antilla J, et al. Building workforce capacity for effective use of health information systems: Evaluation of a blended eLearning course in Namibia and Tanzania. *International Journal of Medical Informatics*. 2019;131:103945.
12. Oyemakinde A, Nguku P, Babirye R, et al. Building a public health workforce in Nigeria through experiential training. *PanAfrican Medical Journal*. 2014.
13. Belabbes S. The Truth about Health in Morocco: No Health without Workforce Development! *Occasional Paper Series* 2020(32).
14. Stilwell BK, Diallo. Zurn, Pascal. Vujicic, Marko. Adams, Orvill. Dal Poz, Mario. . Migration of health-care workers from developing countries: strategic approaches to its management. *Bulletin of the World Health Organization*. 2004;82,8:595-600.
15. Botezat A, Ramos R. Physicians' brain drain - a gravity model of migration flows. *Globalization and Health*. 2020;16(1).
16. Tankwanchi AS, Hagopian A, Vermund SH. International migration of health labour: monitoring the two-way flow of physicians in South Africa. *BMJ Global Health*. 2019;4(5):e001566.
17. Alam K, Khan JA, Walker DG. Impact of dropout of female volunteer community health workers: An exploration in Dhaka urban slums. *BMC Health Services Research*. 2012;12(1):260.

18. Fleck F. Developing countries take a creative approach to R&D. *Bulletin of the World Health Organization*. 2005;83(1)

(4-7).

19. Liu JX, Goryakin Y, Maeda A, Bruckner T, Scheffler R. Global Health Workforce Labor Market Projections for 2030. *Human Resources for Health*. 2017;15(1).

20. Massoudi BL, Chester KG. Public Health, Population Health, and Epidemiology Informatics: Recent Research and Trends in the United States. *IMIA Yearbook of Medical Informatics*. 2017:241-247.

21. Brownstein JF, Clark. . Health Map. 2006.

22. Aziz HA. A review of the role of public health informatics in healthcare. *Journal of Taibah University Medical Sciences*. 2017;12(1):78-81.

23. OECD. OECD: Health *OECD: Organization for Economic Co-Operation and Development*

2020.

24. Africa Union AC. AfricaCDC Training. 2019.

25. Africa Union AC. Africa Centres For Disease AND PREVENTION (AFRICA CDC) FRAMEWORK FOR PUBLIC HEALTH WORKFORCE DEVELOPMENT, 2020-2025. *Africa Centres For Disease AND PREVENTION (AFRICA CDC)* 2019.