

International Infectious Disease Management: A Case Study of Internationalizing Curricula¹

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Abstract

Global perspectives in agriculture are critical to the safety of food and agricultural resources, trade and consumers globally, yet very few opportunities exist for their study. North Dakota State University and Makerere University in Uganda responded to this need by developing a joint Master of Science and Graduate Certificate in International Infectious Disease Management and Biosecurity in 2011. The program requires completion of 30 credits with core courses offered jointly by both institutions. The program is innovative, learner-centered, with student engagement, empowerment and responsibility. There is interdisciplinary learning, problem-based learning and service learning, with cross pollination of teaching methods from both institutions. Graduates of this program will have a better understanding of international agricultural, animal health and biosecurity issues, making them much more viable in today's competitive job market. This unique program within the US and African educational systems is the first US-Africa trans-Atlantic degree addressing integrated disease management and international biosecurity. The following components of the aforementioned program will be discussed: program development; overview of the program; successes; challenges faced; opportunities; and recommendations for the way forward in internationalizing curriculum on two campuses across continents.

Introduction

An increasing interdependence among the nations of the world poses important challenges for today's scientists and policy makers. Food security, transboundary pandemics and bioterrorism are just a few of the global problems that face all nations, yet globalization of research and education has failed to keep pace with these challenges. An international solution is required for this global need. North Dakota State University (NDSU) Department of Veterinary and Microbiological Sciences in partnership with the Faculty of Veterinary Medicine at Makerere University (Mak), Kampala, Uganda developed collaboration to enhance the international content of college curricula and promote globalization of research and education with the intent of providing a globally engaged workforce of scientists. As a first step in this collaboration, NDSU and Mak developed a summer abroad course in 2007, International Animal Production, Disease Surveillance and Public Health. The summer course involves international travel to Uganda for four weeks of experiential learning on topics related to tropical animal production systems; animal health; national control of zoonoses and epidemics/epizootics; biosurveillance and biosecurity; public health practice; and food safety in the tropics in contrast to the US (Ekiri et al., 2013). As a direct result of the success of this initial interaction, NDSU and Mak were awarded a United States Department of Agriculture (USDA) Higher

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Education Challenge grant in 2008-2011 to develop a joint Master of Science (MS) degree in International Infectious Disease Management and Biosecurity.

The MS program is designed for students from any university in the US, Africa or other parts of the world who hold a bachelor's or professional degree with a background in biological, health and related sciences. Persons who do not currently have a background in biological sciences would be eligible for the program after completion of appropriate pre-requisite course work. Students from the US enrolled in the MS program are required to spend time in Uganda to complete the core course, International Animal Production, Disease Surveillance and Public Health. United States and Ugandan students are required to complete at least two practicum credits (one semester) at the partner institution. The strength of the program draws upon faculty at Makerere and research opportunities in Uganda, which complement faculty expertise and research resources at either University. The ongoing collaborative scholarly activities are instrumental in building a foundation for a true partnership.

Need for a Graduate Program in International Infectious Disease Management and Biosecurity

Zoonotic pathogens account for 60% of all known human diseases and 75% of emerging diseases (King, L.J., personal communication). In addition, the World Health Organization (WHO) asserts that 80% of pathogens with potential as biological weapons are of animal origin. The impact of zoonotic diseases on human health can be found on the front page of any newspaper in the U.S. as the popular media alert the public to the current status of H1N1 (Swine Flu) and continued concern that the highly pathogenic avian influenza virus (H5N1) and avian influenza A (H7N9) may spread to humans (Webster et al., 2006; Parry, 2007; Chen et al. 2013; WHO, 2013). The emergence of novel and dangerous zoonotic pathogens is inevitable and the timing and location of their emergence cannot be predicted with any degree of certainty. Protecting the world from transboundary health threats demands a global public health perspective and investment in global public health infrastructure (Domenech et al., 2006).

One way to confront these threats is to amend scientific training curricula to prepare a globally engaged science workforce that can respond to new demands and new roles for these unforeseen challenges. Preparation facilitates successful outcomes in uncertain situations by allowing trained personnel adequate lead time to respond appropriately. In envisioning the future of veterinary medical education, The Foresight Report

(AAVMC, 2007) stated that fundamental changes in the education of veterinarians are required in order to create a system or process that is responsive to future needs. The theme of the 2007 World Health Report was "Global Public Health Security" with the WHO emphasizing the need for collaboration among nations to increase the collective capacity to respond to potential international health emergencies and other public health risks (WHO, 2007). Through its "One World, One Health" initiative, WHO as well as the Food and Agriculture Organization of the United Nations (FAO), US Centers for Disease Control and Prevention (CDC), USDA and the National Wildlife Health Center reinforce the need for an interdisciplinary, international approach to fighting zoonotic diseases (One World One Health, 2004). At the core of the "One World, One Health" movement is the collaboration between veterinary and human health professionals with the intent to manage zoonotic disease transmission. The MS degree in International Infectious Disease Management and Biosecurity (IDM) seeks to prepare students for future careers in multidisciplinary partnerships with organizations such as the CDC, WHO, USDA, the Food and Drug Administration (FDA) and the Africa Field Epidemiology Network (AFENET).

Master's Degree Program Development

Prior to the beginning of the MS degree in International Infectious Disease Management and Biosecurity (MS-IDM), students from various academic backgrounds expressed interest in the program. Data from a straw poll survey of NDSU students (http://www.surveymonkey.com/s.aspx?sm=yGChX3nGpi9hi9_2f_2bM4nXeg_3d_3d) from the following majors (Microbiology, Pharmacy, Zoology, Animal Sciences, Food Safety and Other) showed a strong student interest in this program once it was approved. Of the 117 students surveyed 64 (55%), 32 (27%) and 21 (18%) said Yes, No, or I do not know, respectively, to the question as to whether they were interested in this program if it were approved. The "Other" category of majors was comprised of Health Education, Equine Studies (Pre-Vet), Equine Science, Double major of Zoology and Microbiology and Cereal Science. Results of this straw poll can be viewed at: (http://www.surveymonkey.com/sr.aspx?sm=s600pvXW24WrVe0Z2P8mOk8XMDobcwMsS2a v9LjdoQ0_3d).

In 2008-2011, North Dakota State University (NDSU) and Makerere University (Mak), Kampala, Uganda were awarded \$142,000 from the USDA Higher Education Challenge grant to develop a joint Master of Science Degree curriculum in International Infectious Disease Management and Biosecurity" (MS-IDM) and a Graduate Certificate (GC) and Undergraduate Certifi-

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cate (UGC) in International Infectious Disease Management and Biosecurity (IDM). The IDM program was developed in response to solving the problem of management of infectious diseases particularly trans-boundary animal diseases and zoonoses in the East and Central Africa (ECA) region and globally. This Masters' degree program is unique, implementing the "One World, One Health" concept and offering an international and cross-disciplinary perspective. The program builds on significant accomplishments and partnership activities between these institutions in education and research, including a successful study abroad experience, joint symposia and faculty and administrative staff exchange. The program supports institutional goals in global education and student exchange and recruitment in both institutions.

Overview of MS-IDM Program MS-IDM Program Goals

As part of the MS-IDM training, graduate students from the US are required to spend time in Uganda to complete the core course, International Animal Production, Disease Surveillance and Public Health. Ugandan students are required to complete the above core course in Uganda and at least two practicum credits (at least one semester) at a US partner institution. US and African graduates from the MS-IDM program will directly impact the world by contributing to its protection from emerging and re-emerging infectious diseases. The program format empowers students to make significant contributions in the area of infectious disease management. In addition, the program stimulates collaborative research in trans-boundary animal diseases and zoonoses of regional and global importance among partner US and Africa institutions. Students in this program are provided a rare opportunity for truly international research, educational and cultural experiences. Through these experiences students are able to embrace diversity, challenge dogma and shape the future of infectious disease management. IDM graduates are prepared for careers in international agencies, government, regional or state health departments; all of which contribute to the health of the US, East and Central Africa region and global society as a whole.

MS-IDM Program Competencies

The MS-IDM is a 24-month (5-6 semesters) program that includes at least one summer semester in Uganda when the experiential learning portion of the course is offered. At least one semester must be completed at each university (NDSU and Mak). One additional semester may be added for organized internship. Courses are offered at each university and some courses (including core and elective courses) are offered in distance education format, while others are taught in the

traditional face to face format. A dual degree is awarded; US students receive an MS degree from NDSU while Ugandan students receive an MS degree from Makerere University.

The MS-IDM program has five core competences, each with detailed teaching objectives. The core competences are: (1) principles of international animal production and disease surveillance systems; (2) international health policy and regulations and fundamentals of international trade and microbiological risk analysis; (3) concepts of pathogenesis, prevention and control of disease, as well as integrated health/one medicine which is an innovative concept in the management of infectious disease; (4) tenets of epidemiology, research methods and disease outbreak investigation; and (5) social and cultural perspectives on health. These concepts are necessary for the student to attain mastery in international infectious disease management and biosecurity. The MS-IDM program has five core courses totaling 13 credits. Each of these core courses is supported by a number of electives offered at NDSU and Mak (Table 1). Below is an overview of the five core course goals and expected outcomes.

International Animal Production, Disease Surveillance and Public Health (experiential learning course). This course is the cornerstone for the MS-IDM degree and GC-IDM program. In 2007, North Dakota State University and Makerere University in Kampala Uganda jointly developed the course MICR 379/793 International Animal Production, Disease Surveillance and Public Health, a summer course taught in Uganda (<http://www.ndsu.edu/vetandmicro/students/current/undergraduate/study-abroad-in-uganda/>; http://www.ndsu.edu/dce/classes/study_tours/eperience_uganda_study_tour).

The course puts into context the concepts taught in the other four core courses. Students are directly exposed to African perspectives of animal production and health, public health and food safety and also learn how US systems operate (in comparison to Uganda). Students are expected to draw on experiences and provide practical examples to discuss topics related to the management of transboundary infectious diseases. This course provides for career development opportunities and fosters an international perspective of important issues related to animal production, wildlife, food safety and public health systems. The summer course is held each year during the months of June and July for a period of four weeks. The total cost of the summer abroad course is approximately \$7,000 per student (including program fees, airfare, NDSU tuition, accommodation and meals). Most students use personal funds or loans to meet course costs. Students often conduct fund raising activities to

Table 1. Core and supporting elective courses for the MS degree in International Infectious Disease Management and Biosecurity

Core	Elective	Credits	Institution
MICR 723: International Animal Production, Disease Surveillance and Public Health (Cornerstone course)		3	NDSU, MAK
	SAFE 601*: Food Safety Information and Flow of Food	1	NDSU
	SAFE 602*: Foodborne Hazards	1	NDSU
	SAFE 604*: Epidemiology of Food Borne Illness	1	NDSU
	TAD 7102: Livestock Production Systems and Disease Ecology	3	MAK
	TAD 7104: Surveillance and Risk-based Surveillance	3	MAK
	MPH 7105*: Health Policy and Primary Health Care	1	MAK
MICR 674*: Epidemiology		3	NDSU
	MICR 750: Advanced Topics in Epidemiology	3	NDSU
	MICR724: Applied Epidemiology and Biostatistics	3	NDSU
	TAD 7101: Epidemiology, Applied Biostatistics and Research Methods	3	MAK
	MPH 7102*: Applied Epidemiology 1	1	MAK
	MPH 8201*: Applied Epidemiology 11	1	MAK
TAD 7208: Prevention and Control of Transboundary Animal Diseases		3	MAK
	MICR 660: Pathogenic Microbiology	3	NDSU
	MICR 782: Molecular Microbiological Techniques	3	NDSU
	TAD 7312: Wildlife, Aquatic and Ecosystem Health Management	2	MAK
MICR 722: International Health Systems, Policy and Biosecurity		2	NDSU, MAK
	SAFE 603*: Food Safety Risk Assessment	1	NDSU
	SAFE 606*: Food Safety Crisis Communication	1	NDSU
	SAFE 607*: Food Safety Risk Management	1	NDSU
	VPM 7212: Information Systems in Animal Health and Production	2	MAK
	TAD 7211: Animal Food Value Chains and Food Safety	2	MAK
	TAD 7207: Livestock and Livestock Products Trade and Regulations	2	MAK
MPH 7204*: Social and Behavioral Determinants of Health		2	MAK
	BIOC 720: Scientific Integrity	1	NDSU
	MPH 8106*: Health Ethics and Law	1	MAK
	DDC7105: Living in a Globalized World	1	MAK
	SOC7209: Sociology of Health	3	MAK

NDSU = North Dakota State University, MAK = Makerere University, MICR = Microbiology, TAD = Transboundary Animal Diseases, SAFE = Food Safety Risk Assessment, MPH = Masters of Public Health, BIOC = Scientific Integrity, DDC = Globalization, and SOC = Sociology.

* Course offered in a distance education format.

national health regulations and the potential implications on animal health, human health, global trade and food safety and security. Students are expected to be able to identify international health policy regulations and understand how policy is formulated and how and where regulations are enforced. Also, students are expected to understand the principles of microbiological risk analysis, biosafety, biocontainment and biosecurity. The International Health Systems, Policy and Biosecurity course includes two separate weeks of travel to Washington DC; one week to attend the National Animal Health Policy and Food Security course and another week to attend the Global Health Policy course. During the national course, students visit national agencies including: The American Veterinary Medical Association (AVMA), The Environmental Protection Agency (EPA), The US Department of Agriculture (USDA), The US Government Accountability Office (USGAO), The National Academies of Sciences, The US Congress (The Senate and The House of Representatives), The American Farm Bureau, Food Research and Action Center and The Star Tribune (McClatchy group Newspaper Company).

The National course integrates science, beliefs and policy around a thematic topic that is selected each year. The Global course covers the role of Intergovernmental organizations in Global Health and International Trade. Students engage with intergovernmental agencies involved in animal health, food security and public health such as World Organization for Animal Health (OIE), Food and Agriculture Organization of the United Nations (FAO), The World Health Organization (WHO) and World Trade Organization (WTO), The World Bank and International Food Policy Research Institute (IFPRI). The National Animal Health Policy and Food Security and Global Health Policy courses are team taught by Washington State University (WSU), University of Minnesota and NDSU, with WSU

help offset program costs. In the past, NDSU provided scholarships (\$1,000 to \$5,000 per student) to NDSU students through the NDSU Development Foundation and grant funding from the US Department of Agriculture and the US Agency for International Development (USAID). Past students from other US institutions received up to \$5,000 in grant funds from their institutions to offset program costs. The summer abroad course in Uganda was described in detail by Ekiri et al (2013).

International Health Systems, Policy and Biosecurity. This course provides students with the necessary information to understand local, national and inter-

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as the lead institution. Prior to the two short courses, students from NDSU and Makerere complete two didactic credits at NDSU during the spring semester. The total cost of the two short courses is approximately \$3,300 per student or \$1,650 per student for each one week course. This cost includes airfare, lodging, meals and incidentals. Most students use personal funds and scholarships to meet course costs. In the past, NDSU has provided scholarships to students through the NDSU foundation and grant funding from USAID to offset costs.

Prevention and Control of Transboundary Animal Diseases. This course focuses on the pathogenesis, prevention and control of zoonoses. The management of global zoonotic diseases requires collaboration of physicians, veterinarians and other scientific health related disciplines. Students are expected to understand how microorganisms cause disease and be able to describe strategies for prevention and control. Students are also expected to understand the concept of one-medicine, how one-medicine can be applied to the study of zoonotic diseases and potential pitfalls to collaborating across disciplines. The course is offered in a traditional classroom format.

Epidemiology. This course provides students with an understanding of epidemiologic principles needed to detect, describe and implement disease control measures and provide recommendations for control and prevention of transboundary epidemics. Students are expected to be able to apply epidemiology principles to the investigation of infectious disease outbreaks. The course is offered in both traditional classroom and distance education formats.

Social and Behavioral Determinants of Health.

Different social factors particularly cultures play a significant role in students' perceptions in learning. An awareness of these differences is essential to the management of infectious disease on an international scale. Students are expected to be aware of the different social and cultural perspectives on health. The course is offered in a traditional classroom format. A summary of the five core and elective courses, credits and institution offering each course is presented in Table 1.

MS-IDM Degree Requirements and Examinations

Students in the MS-IDM program can emphasize coursework, research and laboratory or field experience. Two plans are available to provide students flexibility in pursuing different options: Plan A and Plan B formats. Both Plan A and Plan B formats require a minimum of 30 graduate credits, which include thirteen credits of core courses, four credits of practicum and one credit of graduate seminar (Table 2). Plan A includes at least 24 months of full-time study, completing a minimum of 30 graduate credits: at least 16 didactic credits made up of 13 credits of core courses and 3-4 credits of elective courses (agreed upon by the student's advisory committee); 4 credits of practicum evaluated by advisory committee; 1 credit of seminar; and 6-10 credits of research. Overall GPA of 3.0 or higher, a research-based thesis and a final oral defense are required. Plan B includes at least 24 months full-time study, completing a minimum of 30 graduate credits: at least 16 didactic credits (made up of 13 credits of core courses and 8-10 credits of elective courses); 4 credits of practicum; 2-4 credits of creative activity; and 1 credit of seminar. Overall GPA of 3.0 or higher and a final oral defense of creative activity or project are required.

The practicum is a learning opportunity that is not available on the home continent. The topic(s) is (are) related to an aspect of disease management, disease surveillance and eradication, animal husbandry, public health, or regulatory affairs. At NDSU, the practicum can be developed around 1) the NDSU veterinary diagnostic lab, 2) a typical feedlot, 3) the Dickinson Research and

Table 2. Details of Plan A (Thesis) and B (Non-Thesis) Format for the MS degree in International Infectious Disease Management and Biosecurity

Detail	Plan A (Thesis)	Plan B (Non-thesis)
Duration of full-time study	24 months	24 months
Minimum number of graduate credits	30 credits	30 credits
Didactic courses	At least 16 credits made up of <ul style="list-style-type: none"> ▪ 13 credits of Core Courses ▪ 3-4 credits of elective courses (agreed upon by the student's advisory committee) 	At least 16 credits made up of <ul style="list-style-type: none"> ▪ 13 credits of Core Courses ▪ 8-10 credits of elective courses (agreed upon by the student's advisory committee)
Practicum	4 credits (evaluated by advisory committee)	4 credits (evaluated by advisory committee)
Creative activity		2-4 credits
Seminar	1 credit	1 credit
Research	6-10 credits	
Overall GPA	3.0 or higher	3.0 or higher
	A research-based thesis and a final oral defense	A final oral defense of creative activity or project
Time outline		
Semester 1	2 credits research 6 credits didactic courses	6 credits didactic courses
Semester 2	2 credits research 6 credits didactic courses	2 credits creative activity or project 6 credits didactic courses
Semester 3	2 credits research 6 credits didactic courses	2 credits creative activity or project 6 credits didactic courses
Semester 4	1 credit seminar 2 credits research 4 credits practicum*	1 credit seminar 3 credits didactic courses 4 credits practicum
*The students will spend at least one semester abroad and can schedule all the 4 credits of the practicum in one semester or can spread them out and schedule them in more than one semester if they chose to spend more than one semester abroad.		

Extension center, 4) The Centers for Disease Control and Prevention, or 5) the North Dakota Department of Health. At Mak, practicum credits could be developed around 1) National Park activities, 2) Public Health, 3) AFENET projects, 4) Ministry of Agriculture, Animal Industry and Fisheries projects, or 5) field or producer visits. A third alternative for the practicum could be developed around a field experience in partnership with organizations such as OIE, FAO, WHO, USDA-APHIS and CDC. Placement of students is based on student interests matched with interests of faculty and availability of advisors at participating institutions.

The creative activity includes a single project or series of projects. For greater flexibility, each university assigns a faculty advisor/mentor to each student. The advisor/mentor chairs the advisory committee and ensures student progress and the student is free to explore projects in multiple laboratories. Each candidate assembles an advisory committee and must pass a final oral examination. Following a successful defense, the candidate compiles a comprehensive written report of the creative activity that is evaluated by the advisory committee. The precise nature of the individual creative activity is defined by the student working together with the advisory committee. Examples of possible creative components include a comprehensive paper, a portfolio, an integrated field experience such as a report of a specific disease outbreak investigation, or case studies of transboundary and zoonotic diseases in known hot spot areas.

For graduate students that choose to pursue a creative activity in health systems policy and regulation, their practicum may be done at an international disease control agencies like OIE, FAO, WHO or federal agencies like the CDC and USDA under mentorship of a previously identified expert.

Management and Funding of the MS-IDM Program

Administration of the program is primarily handled through the Department of Veterinary and Microbiological Sciences by the Program Director who reports to the Head of Department, who in turn reports to the Dean of Graduate and Interdisciplinary Studies and the Dean of College of Agriculture, Food Systems and Natural Resources at NDSU. Each student has a graduate/advisory committee. One advisor/mentor is assigned from each university and the chair of the advisory committee of a student is the advisor from the home institution where the student is initially registered. At least two additional committee members (agreed upon by the student and major advisor) from either institution are added to the advisory committee. The committee

also includes a Graduate School Representative from NDSU. Thesis or creative components are in English and conform to both graduate schools' regulations. Current regulations/policies at both universities align well. The oral defense can occur at either university.

Students pay an agreed upon tuition rate at each university while taking respective courses. The MS-IDM program is operated using a "study abroad" program model. Students who elect to study at NDSU or Mak for one or two semesters pay regular tuition to home institution (where the student is registered for the program) and transfer credits for the courses taken at the other institution. Courses taken for this program from Mak under the study abroad model are not considered transfer credits and can be included on programs of study without petition. The policy limits transfer of credits to a maximum of 12 semester hours of graduate credit. Spending at least one semester at a foreign institution is a requirement of this program. We anticipate that most students entering this program will have their travel costs covered. In cases where travel funding is not available, students are informed before they are admitted into the program. In the past, NDSU and Mak have provided funding to enrolled students at the respective institutions. Three US students and ten Ugandan students were provided scholarships (tuition and stipend) through grant funding from USDA and USAID.

Graduate Certificate in International Infectious Disease Management

Students have an option of completing the Graduate Certificate in International Infectious Disease Management (GC-IDM) instead of the master's degree. Students who opt for the GC-IDM earn it upon completion of the five core courses totaling 13 credits (Table 1). The theoretical course materials of MICR 723 (International Animal Production, Disease Surveillance and Public Health) are offered in Distance Continuing Education (DCE) format while the experiential learning component of the course is offered in the field in Uganda. Students apply for the GC-IDM by following an application process approved by the Program Director, the Head of Department of Veterinary Microbiological Sciences and the Dean of Graduate and Interdisciplinary Studies at NDSU. At Makerere University, the application process for the GC-IDM is approved by the Program Director, the Dean of the Faculty of Veterinary Medicine and the Director of the School of Graduate Studies.

Successes

The master's degree program in infectious disease management and biosecurity contributes to preparing students for careers in animal production,

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international agencies, government, regional or state health departments; all of which contribute to the health of animals and humans in the United States, East and Central Africa region and global society as a whole. Students in this program benefit from the rare opportunity for truly international research, educational and cultural experiences. From 2011 to date, a total of 14 students have enrolled in the program; ten students from Uganda, three from the US and one from Ethiopia. The MS-IDM program has graduated six students with eight more students projected to graduate by December 2013. The six MS-IDM graduates have been admitted to Medical School (2), or Ph. D programs (2), or have been employed by US State Department of Health (1) and Mak (1). Students have won scholarships from competitive programs such as EcoHealthNet (ecohealthnet@ecohealthalliance.org) for short-term training. Also, students have benefitted from problem-based learning with a service learning component. In June 2012, the first cohort of eight MS-IDM students participated in a community service project in Arizona coordinated by the US Centers for Disease Control and Prevention (CDC) to control Rocky Mountain spotted fever (a tick-borne disease of humans caused by the bacterium *Rickettsia rickettsia*). In 2012, the second cohort of six MS-IDM students participated in a community service learning project in Uganda which involved vaccination of dogs against rabies and education of the local community about the need for rabies vaccination (rabies is a deadly viral disease that can be transmitted from animals to humans through the bite of a rabid animal).

The summer abroad course contributes to producing a broadly inclusive, open minded, world class and globally engaged science work force. Studying international animal production, food safety and public health systems in a different country provides a foundation for tomorrow's global citizens and exposes students to a foreign culture which allows them to challenge dogma. Since 2007 when this course was started, data shows that students are interested in participating in the course; every year students have taken the course. From 2007 through 2012, a total of 86 students from NDSU (33/86 students, 38%) and other higher education institutions in US (24/86, 28%) and East Africa (29/86, 34%) have taken the course. Student majors at NDSU (33 students) have included Microbiology (8 students), International Infectious Disease Management (8), Food Safety/Communication (7), Animal Science (4), Zoology (3), Pre-Vet Medicine (2) and Microbiology/Biotechnology (1). Majors from East Africa have included International Infectious Disease Management (11), Public Health (1), Nursing (1) and working professionals: Veterinarians (6), Mak faculty (6), Public Health (3) and Physician (1).

Challenges Faced

A potential limitation of the master's program is sustainability. All prospective students are informed of the financial requirements of the program when they express interest. For example, they are informed that the summer abroad course in Uganda is expected and an integral part of the masters' program. Students who enroll into the masters' program are therefore expected to pay for this international learning experience. Although many students express interest in the experiential learning portion of the MS-IDM program (summer abroad course), several are limited by cost. The total cost of the summer abroad course is approximately \$7000 per student (including program fees, airfare, NDSU tuition, accommodation and meals). In the past years, the university has provided scholarships to students in amounts of \$1,000-2,500 per student to offset costs. Most students have to use personal funds to meet course costs. A second limitation is fear of distant travel away from home to an unknown country. Some students have never travelled abroad alone and are afraid. The fear may be exacerbated by negative political events in certain regions of the world that may be geographically located close to the destination country, raising security concerns for both parents and students. Other challenges experienced so far include differences in policies at the two institutions, administrative challenges related to joint admission of students, tuition payment and transfer of credits between the two institutions, registration and records keeping and effective communication between the institutions.

As a result of these challenges, a truly joint degree with one certificate offered by both institutions has not yet been achieved. The program is currently being administered as a dual degree with each institution offering its own degree; US students receive an MS degree from NDSU while Ugandan students receive an MS degree from Makerere University. Unlike a joint degree, with a dual degree, each institution offers its own degree and has control over the curriculum and administration of the degree. Students in a dual degree can enroll at one of the participating institutions and receive only one degree from that institution or can choose to get both degrees by fulfilling the requirements at both institutions. Student exchange and transfer of credits still occurs between participating institutions and students pay tuition at the primary institution where they enrolled. Overall, a dual degree allows each institution more flexibility with management of its curriculum.

Opportunities

In spite of the challenges experienced, the benefits of the program have been substantial including testimonies

of personal benefits experienced as a result of the program. The career advancement of the students in the program has been realized as mentioned previously. There are plans to offer the MS-IDM program to all higher education institutions in East Africa and obtain funding from governments of East African countries under the regional grouping of the Intergovernmental Authority on Development (IGAD), an eight-country regional development organization in East Africa. One of the objectives of IGAD is to facilitate, promote and strengthen cooperation in research development and application in science and technology (IGAD, 2013).

Future Direction and Recommendations

In an effort to address the challenges of the MS-IDM program at the institutional level, several plans are being explored. The MS-IDM program administration plans to propose to the North Dakota State Board of Higher Education to modify the current joint MS-IDM program to a dual degree, citing differences in policies at the two institutions. Changing the MS-IDM program from a joint to a dual degree would address most of the current institutional challenges. In a dual degree program, the following elements would be acceptable: (1) each institution would offer its own degree and have control over the curriculum and administration of the degree; (2) students would enroll in one of the programs and get only one degree from that institution or could choose to get both degrees by fulfilling the requirements at both institutions; (3) student exchange and transfer of credits would still occur between the institutions and for MS-IDM program, students could be allowed to transfer up to 12 credits from the other institution; (4) students would pay tuition at the institution where they enroll and in the case of MAK students, they could pay residence fees in order to reduce on the burden of tuition; and (5) a detailed Memorandum of Agreement would be drafted to address issues such as tuition waiver and credit transfer between institutions.

A number of plans are proposed to address issues related to program sustainability. First, the study abroad in Uganda core course which is quite costly could be substitutable with another international course on infectious disease management offered by NDSU in another country or offered by other higher education institutions. Second, the MS-IDM program could be opened up to other higher education institutions, allowing students from those institutions to pay residence tuition. Third, team-teaching of additional courses with partner institutions could be explored, for example currently team taught courses include International Animal Production, Disease Surveillance and Public Health (NDSU and

Mak) and International Health Systems, Policy and Biosecurity (Washington State University, University of Minnesota and NDSU). Fourth, more courses could be converted into distance education format (except the experiential learning experience completed abroad/ in another country) to allow completion of the degree online which would attract a wider audience of students worldwide and generate revenue to manage the program. The long-term goal of the MS-IDM program is to offer most courses in distance education format. Finally, sharing of resources (team-teach courses) with other existing graduate programs at NDSU such as Masters of Public Health would reduce program costs.

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