

PUBLIC HEALTH

Meeting the Needs of Underserved Patients in Western Kenya by Creating the Next Generation of Global Health Pharmacists

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Submitted July 1, 2015; accepted November 16, 2015; published March 25, 2016.

Objective. To describe a novel training model used to create a sustainable public health-focused pharmacy residency based in Kenya and to describe the outcomes of this training program on underserved populations.

Design. The postgraduate year 2 residency was designed to expose trainees to the unique public health facets of inpatient, outpatient, and community-based care delivery in low and middle-income countries. Public health areas of focus included supply chain management, reproductive health, pediatrics, HIV, chronic disease management, and teaching.

Assessment. The outcomes of the residency were assessed based on the number of new clinical programs developed by residents, articles and abstracts written by residents, and resident participation in grant writing. To date, six residents from the United States and eight Kenyan residents have completed the residency. Eleven sustainable patient care services have been implemented as a result of the residency program.

Conclusion. This pharmacy residency training model developed accomplished pharmacists in public health pharmacy, with each residency class expanding funding and clinical programming, contributing to curriculum development, and creating jobs.

Keywords: international health, public health, global health, pharmacy residency

INTRODUCTION

The suboptimal use of the limited health care workforce in low and middle-income countries is one of the bottlenecks in effective health care service delivery.¹ The Institute of Medicine addressed this issue in a special report and recommended improved education and training of health care providers and matching responsibilities to needs and skills as a method to improve global development.² The International Pharmaceutical Federation's (FIP) guidance promotes improving pharmacists' education by shifting the focus from the product to the patient through creation of a curriculum that addresses the needs of the population.³ The importance of training, combined with Purdue University's interest in addressing the health needs of underserved populations all over the world,

served as the primary motivation for the creation of a global health pharmacy residency.

There is a shortage of qualified health care providers and a lack of infrastructure and clinical programs in low and middle-income countries.⁴ One method of addressing the shortage is through shifting some clinical functions to other providers such as pharmacists. While there have been advancements in clinical pharmacy services in the United States and other high-income countries, profound disparities exist in low and middle-income countries in the supply of pharmacists and implementation of clinical pharmacy services.⁵⁻⁸ It may not be enough to increase the number of pharmacists when addressing the shortage. The transition of pharmacy personnel from a dispensing-focused role to a more clinically-focused role may also help ensure the delivery of safer and more effective care. To accomplish this transition, a multipronged approach may be needed that focuses on creating a health care infrastructure that could benefit from greater integration of clinical

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pharmacy services and combining that with training programs to develop the staff to provide these services.

Since 2004, Purdue University College of Pharmacy (PUCOP) has supported the Purdue Kenya Partnership (PKP), a clinical practice site in western Kenya with an advanced pharmacy practice experience (APPE) for PUCOP students and internship experience for Kenyan pharmacist interns.^{9,10} In conjunction with the Academic Model Providing Access to Healthcare (AMPATH), Moi University School of Medicine, and Moi Teaching and Referral Hospital (MTRH), the partnership focuses on addressing health care system barriers that prevent dissemination of high quality care.¹¹ The AMPATH program provides comprehensive services in the public health sector for a rural, underserved population of over 3.5 million western Kenyans.¹² To capitalize further on the many positive gains of this program, in 2011 PUCOP established a Pharmacy Residency in Global Health. The aim of this postgraduate year 2 residency was to develop highly skilled providers in public health pharmacy with the knowledge and training to build sustainable programs focused on addressing health care barriers in resource-poor and resource-rich settings.

DESIGN

The Global Health Residency program is part of the larger organizational structure of the PKP. The residency maintains the same core values that contribute to the success of the partnership and define a guiding vision and mission, distinct to the residency program (Table 1). Each residency class, like the rest of the PKP team, includes pharmacists from both Kenya and the United States.

As the partnership continued to expand care programs and its teaching capacity, the natural progression was to move from training students and interns to developing a residency program that would train future pharmacists

focused on building care programs for underserved populations around the world. The bachelor of pharmacy program in Kenya is a 4-year degree followed by a 1-year internship, which consists of a community, industry, and clinical component. The clinical component of the internship typically concentrates on hospital-based pharmacy dispensing and management. Pharmacists interested in furthering their clinical skills can apply for a master's degree in pharmacy, a 3-year program with the majority of the teaching provided as didactic sessions. In contrast, the 1-year pharmacy residency focuses on clinical training through experiential opportunities under the supervision and direction of pharmacy preceptors.

Development of the residency program began by identifying and acquiring approval of key stakeholders. For the Global Health Residency program, this included the PKP team members, PUCOP administration, and AMPATH and MTRH leadership. Because this was the first pharmacy residency program primarily focused on providing experiential training for clinical pharmacy in Kenya, stakeholders were informed about the need for the program, the objectives of the residency, and the logistics of program implementation. To accomplish this level of agreement and shared ownership, collaboration was required at all stages of development.

The PKP's success is based on a collaboration of partners from the United States and Kenya. In creating the residency program, the PKP drew upon this strength and chose to create the program with the input of the PKP pharmacy team from both nations. The United States perspective provided knowledge of the structure and resources needed to create a pharmacy residency program. The benefits of a residency program were discussed in addition to identifying its difference from the already existing internship program. Partnering with the Kenyan members of the PKP allowed the

Table 1. Purdue University Global Health Residency Vision, Mission, and Values

Vision	Provide the premiere global health residency program for international pharmacy leaders who will establish sustainable health care services.
Mission	To educate international pharmacy residents in a diverse, collaborative environment resulting in innovative health care enhancement and expansion of pharmacy services.
Values	<p>Patients First. Excellent patient care is the first priority and focus of all activities.</p> <p>Investing in Future Leaders. Develop global health champions in pharmacy through mentoring and training.</p> <p>Bilateral Collaboration. Work together in a collaborative, supportive, goal-oriented environment of trust, encouragement, and accountability.</p> <p>Sustainable Impact. Establish programs lasting beyond the tenure of any individual and independent of any single funding source.</p> <p>Sharing Best Practices. Disseminate knowledge and experience through scholarly activities.</p>

program to be more locally relevant and focused on developing areas of interest and perceived deficiency, including clinical program development, research, statistics, and publications. Discussions and decisions about the recruitment process, salary, career trajectory, and integration with the current workforce were conducted in conjunction with standard operating procedures at AMPATH and MTRH. Additionally, approvals from the leadership of both AMPATH and MTRH were obtained. By working together, the PKP created a program that more thoroughly met the needs of the patients and educational desires of the providers and preceptors.

A postgraduate training program aimed at addressing the health care needs of an underserved population was eagerly supported by PUCOP administration. This support aligns with the Accreditation Council on Pharmaceutical Education (ACPE) 2016 Standards that call for schools to support postgraduate professional education.¹³ Through endowments and grants, PKP was able to support one United States resident and three Kenyan residents for the first year (Table 2). In subsequent years, residency cohorts have been comprised of 2-5 residents with continued financial support from grants and an endowed residency position.

When designing the residency, program coordinators ensured it would immerse all participants in the facets of care provided by the PKP team while at the same time, ensuring each resident was prepared to practice and lead initiatives in underserved population settings around the world. Resources such as the American Society of Health-System Pharmacists (ASHP) residency guidelines, the FIP pharmacy workforce reported areas of need, an assessment of Kenya's national goals and the United Nations Millennium Development Goals, and AMPATH patient population needs were consulted to create the program goals and learning objectives.¹⁴⁻¹⁶ The ASHP residency standards provided residency pedagogy and andragogy in resource-rich settings, which were then augmented with information more specific to low and middle-income countries. The residency's objectives built on the Center for Advancement of Pharmacy Education (CAPE) Outcomes for Doctor of Pharmacy Curricula. Concepts from the CAPE Outcomes were used to help form an overarching framework that guided all residency activities.

The global health residency was comprised of four core learning areas: clinical practice, management, research, and teaching. Each area had defined learning

Table 2. Purdue University Global Health Resident Characteristics

	2011-2012	2012-2013	2013-2014	2014-2015	2015 - 2016
Class Size	4	4	5	2	2
Gender					
Female	2	3	3	2	2
Male	2	1	2	—	—
Prior Degree					
BPharm	3	2	3	—	—
PharmD	1	2	2	2	2
Position Before Residency					
PGY1 Residency	—	—	1	1	1
Clinical Pharmacist	—	1	—	—	—
PGY2 Residency	1	—	—	—	—
Pharmacy school or internship	3	3	3	—	—
First year of GH Residency	—	—	1	1	1
Focus Area During Residency					
Information Technology	1	1	—	—	—
Supply Chain Management	—	1	—	—	—
Patient Care	2	1	2	1	1
Student Development	—	1	2	—	—
No Specific Area	1	—	1	1	1
Post-Residency Position					
PhD/Fellowship	1	—	—	1	1
Faculty Position	1	—	—	—	—
Clinical Pharmacist in Global Health	2	2	4	—	—
Ministry of Health/Public Health	—	1	—	—	—
Second year of Residency		1	1	1	1

PGY1=postgraduate year 1; PGY2=postgraduate year 2

goals and objectives related to the skill sets residents should gain while participating in them. In addition to the four learning areas, an emphasis on socio-behavioral sciences was incorporated to help trainees better understand the health determinants of vulnerable populations. The goal of the program was to prepare residents to provide care to underserved populations in resource-poor or resource-rich settings. Practical application of teaching and care was done in a resource-constrained setting in a low and middle-income countries. However, underserved populations exist in resource-rich settings, such as the United States. Therefore, using similar care programs and strategies in resource-rich settings was incorporated through informal discussions and literature reviews.

For the first year of the residency, the recruitment process consisted of PKP members reaching out to pharmacists that had expressed interest in working in public health activities who were dedicated to advancing their knowledge and skills related to the development of sustainable care programs for underserved populations. After the first year, a formalized recruitment process was developed. All applicants completed a formal application process (Table 3). The PKP team reviewed the applications using a rubric and invited a select few for an interview. Due to the travel costs for the United States based applicants, a Skype based teleconference was utilized to complete interviews to ensure the candidates interact with all of the PKP team members while Kenyan applicants participated in a face-to-face on-site interview.

The global health residency was started in July 2011 with four residents (Table 2). It had two program coordinators (one based in the United States and one in Kenya). Each resident participated in the program for a minimum of one year with an optional second year available when funding and interest permitted. To meet the learning objectives and residency goals, each resident participated in traditional 1-month rotation blocks. When planning rotations, the schedule was built six months at a time instead of a full year to ensure the schedule met the demands of the practice site, the resident's research project needs, and

their professional interests. This strategy provided a more flexible schedule for residents, preceptors, and program directors.

Each resident began the year with a 2-3 week orientation where they spent time getting acquainted with the practice site, the PKP team members, and their residency classmates. The orientation focused on showcasing the PKP values and integrating the residents into the team and the new culture. For the United States resident(s), this also meant participation in Kiswahili language learning opportunities and creating a knowledge base for Kenyan medications and tropical medicine disease states. All residents attended a series of lectures that discussed common disease states and management in this environment. As part of orientation, each residency class went on a retreat to help foster teamwork, collaboration, and cultural integration.

One- or 2-month rotations involved longitudinal projects such as service development and research. Core rotations included orientation, inpatient general medicine, ambulatory care I and II, maternal health, and research. These were selected as core rotations on the premise that health care leaders assisting underserved populations need to be clinically nimble and have critical-thinking skills that apply to a variety of environments. The rotations allowed graduates to gain the skills needed to build programs based on patient needs. Each service that offered these core rotations were working to address one or more of the United Nations Millennium Development Goals, which would help graduates think about these health determinants when building future platforms for care.¹⁶ In addition to the core rotations, residents also participated in elective rotations, teaching, outreach programming, and research.

In the last four years of the program's existence, rotation offerings were expanded (Table 4) to accommodate the need for new clinical services, in addition to the need for training in this practice environment. Thus, each residency class developed a sustainable health care service as a longitudinal project to learn what it would take to

Table 3. Global Health Residency Recruitment Process

Kenyan Residents	US Residents
Advertising at schools of pharmacy in Kenya	Advertising on the PKP website
Reaching out to former Purdue Kenya Partnership (PKP) interns	Participating in the American Society of Health-system Pharmacists Midyear Clinical Meeting and Personnel Placement Service
Presenting poster and oral presentations at national conferences in Kenya	Advertising at the American College of Clinical Pharmacy Fellowship and Residency Directory
Word of mouth	Participating in local residency showcases
	Sending an announcement to all colleges/schools of pharmacy in 2011
	Word of mouth

Table 4. Purdue University Global Health Residency Rotations with Activities and Impacts

Rotation Name	Rotation Activities	Impacts
Adult Inpatient Internal Medicine (2011-Present)	Rounded with interprofessional medical team on adult wards; precepted PUCOP students and Kenyan pharmacist interns. Duration: Two months	Patients: 40 patients/team/day Students/Interns precepted: >90
Maternal Health (2011-Present)	Rounded with antenatal, postnatal, and gynecology care teams; participated in an investigational GDM diagnosis clinic and development of postpartum family planning services. Duration: 1 month	Patients: ~50 patients/day Women screened in GDM clinic: >600
Pediatrics Inpatient Internal Medicine (2011-Present)	Rounded with interprofessional medical team on pediatric wards; precepted PUCOP students and Kenyan pharmacy interns; created a first-ever onsite compounding pharmacy for cardiac medications and other needs. Duration: 1 month	Patients: ~20 patients/team/day
Cardiac Care Unit (2013-Present)	Rounded with cardiac care team on critical adult and pediatric patients; represented pharmacy in cardiac care unit leadership meetings; created IV medication administration protocols, managed medication supply, conducted in-services. Duration: 1 month	Patients: ~10 patients/day
Ambulatory Care I (2011-Present)	Worked with the anticoagulation clinic; participated in supply chain management activities with Revolving Fund Pharmacy; worked with Kenyan government and rural community groups to develop new pharmacies; provided essential medicines in rural settings. Duration: 1 month	Anticoagulation patients: >1000 enrolled in the clinic Pharmacies created: 55
Ambulatory Care II (2011-Present)	Provided phone-based DM care through clinic based in Eldoret; provided care through microfinance group care program in rural settings; participated in screenings for DM and hypertension care. Duration: 1 or 2 months	Patients: 3500 enrolled >50 microfinance groups >2500 screened for DM or HTN
AMPATH Pharmacy (2011-Present)	Participated in pharmacy dispensing and counseling activities for HIV infected patients; implemented an assessment of pharmacy workflow issues and supply chain management; tested a new pharmacy database. Duration: 1 month	>5000 patients served
Drug Information/Medication Safety (2011-Present)	Answered drug information questions; participated in medication safety activities in inpatient and outpatient setting; created IV administration handbook for inpatient settings. Duration: 1 month	Medication safety center created and operational; IV handbook completed
Research	Worked on research project activities, clinical projects, grants and publications. Duration: 1 or 2 months	28 projects completed; 20 grants submitted; 12 published manuscripts
Longitudinal activities	Managed and mentored pharmacy staff in a rural dispensary clinic; participated in activities and fundraising for a street children's center; expanded and revised a medical wards handbook.	11 services developed; Tumaini Innovation center; Ward treatment handbook

PUCOP=Purdue University College of Pharmacy; GDM=gestational diabetes; IV=intravenous; DM=diabetes; HTN=hypertension; HIV=Human Immunodeficiency Virus

build a new care program while also meeting the needs of the patients in this practice environment. Each residency class worked with the PKP team to identify key patient needs to be addressed and these needs were used to create programs/services.

Few rotations were required to allow for more time spent working on building care services and participating

in high quality research. Fewer required rotations also allowed the residency program to be more flexible and allow residents to participate in projects or programs that may not have been possible at the beginning of the residency year, which was often the case in this ever-changing environment.

Residents participated in management activities during the core rotations, which showcase a different aspect

or style of management. Residents were expected to work with preceptors to learn and practice the management activities associated with programs/services related to that rotation. The intent behind this model was to provide graduates with a real-time perspective of how program logistics and management occur as many jobs require pharmacist participation in clinical and managerial positions simultaneously. Some management experiences included participating in supply chain procurement of medications, personnel management, and assessing the needs of the health care system and patients.

The residency program also aimed to train graduates with the ability to influence the next generation of health care leaders. By integrating residents as preceptors into the pharmacy student/intern rotations, they were engaged in hands-on training while being supervised by on-site faculty members. All residents participated in a variety of teaching opportunities throughout the year (Table 5).

Research projects related to program implementation and investigated the realities of care provision in a low and middle-income country (Table 6). Each residency

year, residents were involved in on-going projects in various stages of completion. The research component allowed residents to participate in every step of the research process (developing ideas, acquiring institutional review board (IRB) approval, collecting and analyzing data, and writing manuscripts and grants) with the aim of developing graduates who were experts in designing and implementing novel care solutions and competent in research strategies used to assess program implementation.

Finally, residents participated in additional activities throughout the year that broadened their experience with public health issues. Tumaini Innovation Center is a children's transition center dedicated to improving the lives of street children in Eldoret, Kenya by empowering them with hope, knowledge, opportunities, skills, and resources necessary for them to find a healthy alternative to street life.¹⁷ Residents assisted to varying degrees depending on the needs of the children and the center. Resident activities included grant writing, fundraising projects, development of service-learning activities, income generation

Table 5. Description of teaching activities in the Purdue University Global Health Residency

Teaching Activity	Description
Inpatient general medicine rotation	Each resident spent 2 months on this rotation and precepted PUCOP students and Kenyan pharmacist interns. The timing of this rotation for the residents aligned roughly with the start dates of the PUCOP student rotations, which were also 8 weeks. The purpose was to give residents a prolonged precepting experience under the supervision of the assigned PUCOP faculty member. While on this rotation, each resident directly coprecepted up to eight students and interns (16 student months). As part of this precepting, the residents rounded daily with an adult medicine team, led weekly topic discussions, assisted in biweekly chart reviews with students, participated in the mid-point and final evaluations, and aided students/interns in the development and editing of morning report and pharmacy inservice presentations.
Morning report	This was an interdisciplinary patient case discussion with medical and pharmacy residents and students. The residents and students participated actively in discussions twice weekly and provided 5-10 minute presentations related to the medication management of the disease states that were presented.
Fireside chats	These were interdisciplinary 2-hour weekly discussions that occurred in the evenings at AMPATH housing and were open to all AMPATH visitors. The talks discussed public health and cultural topics such as women's rights, death and dying, female circumcision, post-election violence, research ethics, and medical tourism.
Intern didactics	The residents developed a didactic education program for Kenyan pharmacist interns with topics that related to common disease states, especially expanding upon noncommunicable diseases, encountered in this practice environment. Each resident developed and presented two of these topic discussions for each intern class.
Pharmaceutical Care in Developing Countries Elective	Each resident developed and recorded a lecture, provided quiz questions, and constructed patient cases for discussion in the PUCOP elective course that was partnered with this APPE rotation. Each year, the residents revamped the content and built on what was previously done which has enhanced the elective course.
Student service-learning projects	Each residency class worked with the students and interns to create and deliver service-learning projects. As part of these projects, the residents mentored students on grant writing, project development, and project implementation.

Table 6. Select Residency Projects and Outcomes in the Purdue University Global Health Residency Program

Project	Project Progression	Publications/Funding
Patient Care		
Disease Care: developed a portable, microfinance linked healthcare delivery model for chronic diseases	Scale up of model throughout western Kenya; planned expansion to additional countries	NIH R01 funded grant
Maternal Health: developed a point of care screening strategy for gestational diabetes	Program continued after residency class implementation; possible use of this model at other clinics within western Kenya and other countries	Funding secured from the United Kingdom's Research Council; Publication
HIV Assessment: assessed recurrence of venous thrombosis among HIV positive patients	Continued assessment of patients and made modifications as necessary based on findings	American College of Chest Physicians Conference presentation; Publication
Pediatric Compounding: assessed feasibility of pediatric compounding	Sustainable compounding service now offered (previously unavailable)	ASHP Annual Meeting poster
Revolving Fund Pharmacy: developed a sustainable pharmacy model for essential medicines provision in rural western Kenya	Program expanded to stock medications at 55 pharmacies throughout western Kenya	Publications are in development; Secured expansion funding
Adherence Incentives: assessed the impact of incorporation of financial incentives for adherence	Incorporation of program within additional pharmacies throughout western Kenya	Publication
Cardiovascular Care Unit (CCU): developed pharmacy infrastructure	Built and maintaining pharmacy infrastructure in the CCU that are still used daily	Infusion protocols; Medication monitoring guidelines developed
Medication Safety		
Pharmacovigilance: evaluated adverse event monitoring in an HIV cohort	Expansion of peer-led care delivery model throughout western Kenya	WHO supported grant funding; Publications in progress
Counterfeit Detection Pilot: conducted preliminary testing of a novel paper-based counterfeit detection device	Expanded into a national surveillance program; expanded surveillance program to multiple countries	Grant funding support received; Lay press exposure; Publications in progress
Drug Information Center: developed first drug information center in western Kenya	Transitioned to a hospital-wide medication safety center	
Drug Interactions: assessed drug interactions between warfarin and tuberculosis medications	Continued assessment of patients and made modifications as necessary based on findings	Publication
IV Administration Chart: created a hospital wide IV administration chart	Hospital wide posting and reference to chart	
Medication Administration Record: revised medication administration record	Adopted for use hospital	
Informatics		
Pharmacy Database: planned and created an open source pharmacy information management system	Completed database used in pharmacies throughout western Kenya	Recipient of a Fulbright scholarship to obtain a PhD in medical informatics
Education		
Tumaini Center: participated in the development of a transition center for street youth in Eldoret, Kenya	Novel model for street youth education implemented	Submission of over \$USD 1 800 000 in grants by residents to support expansion

skill training, organizing activities with children and students, and acting as role models.

EVALUATION AND ASSESSMENT

To assess the outcomes associated with residents' involvement in the PKP, data were collected for each graduate from the last four residency cohorts from documents such as year-end reports, team meeting minutes that documented the presentations, grants, and papers of each team member, and job placement information. All program data used received IRB approval from Indiana University-Purdue University Indianapolis board and the Institutional Research and Ethics Committee approval at Moi University. Descriptive statistics were used when needed.

There were 14 residents in the global health residency, and three residents completed multiple years (Table 2). Eight of these pharmacists were from Kenya and six were from the United States. Seven of the eight (88%) Kenyan graduates were hired by PKP and are continuing the projects and patient care services they started as residents. One of the Kenyan pharmacists was awarded a Fulbright Science and Technology Fellowship to attend Columbia University in pursuit of a doctor of philosophy in informatics as a result of the research project he worked on as a resident.¹⁵ Out of the five United States residents, three (60%) elected to stay in the program an additional year to expand on projects they started in their first year. Of the other two United States graduates, one obtained a faculty position in the United States and the other became a fellow in the Human Resources for Health Program at Yale University and participated in global health activities and teaching in Rwanda. Of the three residents who elected to complete an additional year, at the time of writing, one was completing a fellowship with Afya Bora in global health leadership, one was completing a second year in the residency with a noncommunicable disease focus, and one received a Fulbright Scholar Program position to continue to enhance educational opportunities in clinical pharmacy at the PKP site.

The four graduated residency classes combined developed 11 sustainable pharmacy-led patient care services. With the limited infrastructure available in this practice site, each residency project either established or supported a previously unavailable service. Through grants received, these programs created new job opportunities for the residency graduates and other personnel, with more than 60 new positions ranging from community health workers to physicians. Developed services included an inpatient anticoagulation program (>1400 patients have received care), self-sustaining pharmacies for rural clinics (>154 000 patient encounters), rural outpatient diabetes

and hypertension programs (>3000 patients received services), a gestational diabetes screening and treatment service (>600 patients screened), peer-based patient education for patients with HIV (>1000 patients counseled for testing and >400 patients receiving outpatient follow up), counterfeit medication detection (>2000 medications sampled), World Health Organization (WHO) supported pharmacovigilance program (highest reporting facility in Kenya), a drug information and medication safety center, and oncology and cardiac intensive care unit (10-bed unit) services. Additionally, the residents have been instrumental in the development and updating of a pharmacy patient care database.

Each resident participated in 2-3 research projects during their tenure in the program, and approximately 28 research projects were completed with the help of residents (Table 6). This resulted in 40 national and international poster and platform presentations and the dissemination of 12 publications with residents as coauthors. Collectively, the residents wrote more than 20 grants with 60% being funded, acquiring \$US 1.5 million to date, and more than \$US 1.8 million worth of grant funding still pending review. Moreover, residents assisted with the acquisition and management of more than \$US 40 million in product donations. With the growth of the team, there has been a concerted effort to diversify and expand grantsmanship to tap into the many different funding sources available for international efforts including the Gates Foundation, USAID, pharmaceutical industry foundations, WHO, the Kenyan Ministry of Health, the National Institutes of Health, and the Medical Research Council of the United Kingdom.

Outside the care programs developed, residents were instrumental in the development and expansion of the Tumaini Innovation Center. Residents helped develop income-generating skills for participants and provided medical advice, screenings, and family planning services. Finally, residents were responsible for ideas and grants that allowed Tumaini to become a center for innovation, creating cutting edge educational programs for the children.

The residency classes collectively aided in the enhancement of the student/intern program as well. The PKP had up to eight students and interns on rotation at a time, and resident presence increased the ratio of preceptors, which allowed for more individual attention for each learner. They also worked over the years to provide new learning opportunities for students, including a weekly review with each student/intern of every patient's medical condition and treatment, which provided learning tailored to the student's needs. The residents also developed and led a weekly lecture series for Kenyan interns that discussed common disease states and included

diagnosis, relevant treatment guidelines, and patient monitoring. This weekly lecture series led to the development of a learning curriculum for the Kenyan pharmacist interns, which augmented the internship program. Finally, resident classes impacted the Pharmaceutical Care in Developing Countries course by updating and enriching its content, which helped students better prepare for working in Kenya.

DISCUSSION

The Purdue Global Health Residency is the first program where pharmacy residents from multiple countries engage 100% of their time in low and middle-income countries. Residents sustainably impacted the program through the development of 11 new programs and secured grant funding, which enhanced patient care and increased job opportunities at the practice site. They also provided a contribution to the training program and teaching activities offered by the PKP through the new teaching activities they created.¹⁸ Their efforts also affected the community in which they practiced through involvement in the creation of the Tumaini Innovation Center. With these accomplishments, each residency class demonstrated the PKP values of putting patients first, investing in future leaders, using bilateral collaboration, having a sustainable impact, and sharing best practices. Thus, the residency program achieved its aim of developing future global health clinical pharmacists capable of delivering sustainable health care to underserved populations.

Furthermore, it embraced the charge from the Institute of Medicine to develop training programs for health care providers to improve global development. Its strengths include a unique pharmacy practice setting created through the dedication of pharmacists who develop sustainable, innovative, award-winning care programs that affect change in the lives of patients in sub-Saharan Africa.¹⁹⁻²¹ Another strength was the support offered by the collective leadership from PUCOP, AMPATH and MTRH. Additionally, the residency structure offered a learning environment that allowed for real-time application of knowledge that could be used to develop care programs outside of this practice setting.

The program grew as a result of the foundation for experiential training created in the first years of the program. In the first year of the residency, it was challenging to recruit the one US and three Kenyan participants willing to make the yearlong commitment to live in Eldoret, Kenya and work with the PKP. In this year's selection process, there were more than 30 highly qualified candidates vying for the limited residency positions. Furthermore, the caliber of talent the program produced has expanded its reach, as graduates are now working in other

low and middle-income countries and for underserved patient populations around the world spreading PKP's models of care and training. Implementation of the residency program led to the development of innovative health care solutions and broadened the scope of practice at the PKP site. As the residency and diploma programs grow, they may expand access to interested parties from countries outside of Kenya and United States to reach more underserved populations across the world.

Despite the program's success, there are still challenges to overcome, such as securing appropriate recognition for the Kenyan pharmacists. At the time of writing, the residency was not a recognized training modality in Kenya, and graduates struggled to have their credentials recognized in the public sector. To address this challenge, the PKP worked with the Ministry of Health and the Kenyan Pharmacy and Poisons Board to provide greater flexibility to graduates to fill clinical pharmacy positions available through the Kenyan government. By working with partners at MTRH and Moi University, the first-ever postgraduate diploma in clinical pharmacy program in Kenya was created. These governing bodies were impressed with the clinical training offered and requested that the PKP expand the class size from 3 to 20. While this expansion was not feasible, it served as a testament to the positive reputation the PKP and the residency have attained since the start of the program. The PKP also worked with Moi University to develop a master's of pharmacy degree in clinical pharmacy that couples didactic course work and the experiential training offered in the residency. The MS program was approved and will begin enrolling students in fall 2016. As these programs continue to advance, assessment of clinical skills and knowledge base through problem-based learning, objective structured clinical examinations, and participation in courses that develop empathy will evolve as needed in accordance to standards of practice. The master's degree and diploma programs will allow future residents to obtain a certification so their training will be more formally recognized throughout Kenya. In addition to offering a degree to the Kenyan residents, the residency program will be strengthened by integrating it with a master's degree program offered by Purdue University, which would be open to enrollment for both Kenyan and US residents. A master's degree program will enhance the residents' knowledge by supplementing the experience with didactic teaching in public health topics, biostatistics, and research methodology.

In the past, the program explored the option of accreditation through ASHP. However, the program did not seek accreditation mainly because it could not ensure the hospital met ASHP standards. The only pharmacy

residency programs accredited by ASHP outside of the United States are located in high-income countries and United States territories.²² However, by not applying for accreditation, the program has been able to more easily adapt its curriculum to any changes in the public health needs of the population the PKP serves and maintain flexibility in accomplishing residency research projects and addressing the educational interests of residents.

SUMMARY

Each class of the Purdue University Global Health Residency left a legacy of accomplishment, with expanded funding and clinical programming, as well as curriculum development and job creation in a vulnerable population. These accomplishments demonstrated the PKP values of putting patients first, investing in future leaders, using bilateral collaboration, having a sustainable impact, and sharing best practices. Thus, the residency program achieved its aim of developing future global health clinical pharmacists capable of delivering sustainable health care to underserved populations.

ACKNOWLEDGMENTS

This program has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for International Development (USAID). The contents of this article are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. This program was made possible through the support of our key funding partners, Celgene, Lilly Fund, Abbott Nutrition, and Abbott Fund.

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