

Impact of Global Health Residency Training on Medical Knowledge of Immigrant Health

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Abstract. Lack of global health knowledge places immigrants at risk of iatrogenic morbidity. Although global health education programs have grown in popularity, measurable impact is lacking. We previously surveyed 363 physicians in training across 15 programs in four countries in 2004 regarding basic parasite knowledge and recognition of *Strongyloides* risk through a theoretical case scenario. In 2005, the University of Minnesota implemented a formal global health training program (GHP). In 2009, the identical survey was repeated. Strongyloidiasis recognition increased from 11.1% (19/171) in 2004 to 39.4% (50/127) in 2009 ($P < 0.001$). Trainees participating in formal didactic and interactive curriculum had superior recognition (77% versus 29%; $P < 0.001$). In a multivariate model of GHP training activities, participation in an American Society of Tropical Medicine and Hygiene-accredited global health certificate course increased recognition (odds ratio = 9.5, 95% confidence interval = 2.5–36, $P = 0.001$), whereas participation in international electives alone did not ($P = 0.9$). A formal GHP curriculum was associated with improved knowledge regarding common parasitic infections and the risk of iatrogenic morbidity and mortality due to strongyloidiasis.

INTRODUCTION

With more than 1 billion people crossing international boundaries and an estimated 12.5% of the US population being foreign-born, all US physicians need a basic understanding of common health conditions that affect mobile populations.^{1,2} Education of physicians is critical to decreasing disparities in medicine created by cultural, genetic, and geographic differences between the dominant population(s) and more vulnerable and disenfranchised populations, whether in the United States or abroad.

Although many graduate medical education (GME) residency programs offer opportunities for international rotations, there are a limited number with formal global health programs (GHPs), and fewer still have formal comprehensive curricula. A recent survey of 96 allopathic medical schools reported that 87% offered international clinical student electives; however, < 30% had any formal training before travel.³ Formal resident GHP tracks existed in 11 programs (10.7%), and elective international rotations were available in 61 (59%) programs. Although GHPs have increased in popularity, the translation of GHP implementation into improved clinical knowledge is unknown.

Medical school international electives have been reviewed in a number of studies,^{4–11} but there are fewer evaluations of GME programs, with the majority focusing on career choices and attitudes to international health.^{5–13} A retrospective study on the International Health Program at Yale University internal medicine residency program showed that residents who participated in GHPs were more likely to care for underserved populations and pursue a general medicine career.¹³ However, no study to date has evaluated clinical knowledge and the downstream effect on the quality of patient care from these burgeoning global health programs.

We previously surveyed physicians in training (i.e., resident physicians) at 15 different residency training programs across the United States, Brazil, Singapore, and Thailand regarding

their recognition of strongyloidiasis and very basic knowledge of parasites.¹⁴ We chose *Strongyloides stercoralis* to evaluate for disparities in knowledge, because ≥ 100 million people are infected worldwide.^{15,16} Additionally, strongyloidiasis is a common condition among US immigrants and refugees, with prevalence rates $\geq 40\%$ in many refugee populations.^{17–19} Unlike other intestinal helminths, strongyloidiasis is considered a life-long infection unless treated. In fact, one study found that 24% of Laotian refugees were still infected 12 years after resettlement.²⁰ *Strongyloides* is one of the few parasitic infections in which physicians can directly induce iatrogenic complications, including death,^{21,22} through the use of corticosteroids in chronically infected individuals. We have previously reported poor clinical outcomes, including deaths, in US patients with chronic strongyloidiasis who were cared for by US physicians without tropical or travel medicine training; there was an eightfold higher risk of iatrogenic errors.¹⁴ In our prior survey, US trainees showed poor recognition of *Strongyloides* risk, symptoms, and management as well as poor general knowledge of parasites.¹⁴ This finding was in marked contrast to foreign physicians in training in areas where *Strongyloides* and parasitic infections are considered endemic.⁴

In this study, we conducted a follow-up internet-based survey of physicians in training to evaluate the effect of a global health training program on recognition and management of strongyloidiasis. With the baseline data collected in 2004 before the implementation of our formal training program, we sought to determine if the formal global health training and which components of GHP training were associated with improved physician knowledge. This limited survey used *Strongyloides* and some questions of basic parasitic knowledge as indicators of knowledge and practices of trainees.

MATERIALS AND METHODS

In 2004, we conducted an internet-based survey of physicians in training to assess knowledge of risks posed by *Strongyloides* in migrant populations both in endemic as well as non-endemic settings.⁴ This initial survey was conducted at seven training institutions in Brazil, Singapore, Thailand, and the United States, including at our institution, the University of Minnesota (UMN). The initial survey was administered to

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520 GME resident trainees in internal medicine, pediatrics, and combined internal medicine and pediatrics (med-peds) residency programs, and there were 363 respondents. The same survey was repeated in 2009 with only UMN resident trainees, where the GHP training program was implemented. Results from the 171 UMN respondents from 2004 were compared with the 127 UMN respondents from 2009. The residents were presented with a case scenario with an open-ended query regarding their recommended diagnostic evaluation and initial management of the hypothetical patient. The case scenario was an 18-year-old Southeast Asian immigrant without prior asthma presenting with new onset wheezing, respiratory distress, and 9% eosinophilia (absolute 900 eosinophils/ μ L). This patient was at risk and presenting with common strongyloidiasis symptoms. The survey is available online.²³ We assessed the trainees' recognition of eosinophilia and basic knowledge of strongyloidiasis. Additionally, knowledge of other parasites that may cause pulmonary symptoms was assessed. The survey responses were compiled and reviewed independently by three of the authors, who qualitatively assessed respondents' open-ended responses to (1) eosinophilia, (2) potential parasitic infection (specifically *Strongyloides* infection), and/or (3) recommended additional diagnostics and/or treatment of parasitic infection as opposed to empiric use of corticosteroids for presumed asthma without concern for *Strongyloides*.

In 2005, after this initial survey, the UMN implemented a formal core competency-based GHP residency pathway that included 3–4 year curriculum as well as a formalized American Society of Tropical Medicine and Hygiene (ASTMH)-accredited Tropical and Travel Medicine Course (http://www.astmh.org/Certification_Program/3043.htm), referred to here as the UMN Global Health Course. In brief, this residency pathway consists of (1) mentorship from global health faculty, (2) formal comprehensive didactic and interactive training in global health, immigrant and refugee health, tropical medicine, and travel medicine through an ASTMH-accredited curriculum, (3) additional monthly evening seminars and noon lectures, (4) continuity clinic work serving immigrant and refugee populations, and (5) international and local electives. The ASTMH certificate course is held annually in August and encompasses 300 hours of education in a mixture of didactic lectures, case-based learning, and hands-on simulation, laboratory, and clinical skill experiences. This didactic portion of the curriculum is now available online for self-study and continuing medical education (CME) credit.²⁴ The GHP goals are to provide competent medical care for an evolving multicultural US society, particularly in serving immigrants, refugees, and travelers, to promote careers in underserved communities locally and globally, to prepare trainees for international rotations and careers in global health, and ultimately, to decrease disparities of care and to increase recognition of vulnerable populations and neglected diseases. Overall, approximately 30% of UMN trainees are formally enrolled in their residency program's GHP, although there is additional informal partial participation and hope for spillover of knowledge into the overall residency training program.

This follow-up survey was conducted to assess if there was a change in the baseline knowledge and practices after implementation of the formal GHP program, and if so, which resident trainees seemed to benefit (e.g. those trainees in the formal pathway vs. all resident trainees) and which experiences seemed to be most beneficial. Therefore, the follow-up analy-

sis was conducted only within the UMN residencies where the intervention had taken place. Analysis is primarily descriptive. Multivariate logistic regression presents adjusted odds ratio (OR) and 95% confidence intervals (95% CI) through SPSS 18.0.3 (SPSS, Chicago, IL). The UMN institutional review board approved the survey as exempt.

RESULTS

In 2004, the survey was conducted in 15 different residency programs in the United States, Singapore, Brazil, and Thailand, the latter three being *Strongyloides*-endemic areas. In 2004, there were 363 respondents globally, of whom 171 were UMN trainees involved in the medicine, med-peds, or pediatric residency training programs. In 2009, after the institution of the GHP, the survey was repeated with only the UMN trainees with 127 respondents. The overall response rate of the two surveys was 66% (490/744). Although all resident trainees are invited to participate in any of the GHP activities, to be considered a full GHP resident, they must formally enroll and complete all of the program activities. Of the 127 respondents in 2009, 62% self-identified as participating in any GHP training activity, and 27% (34/127) of these trainees were full GHP participants (15.5% medicine, 30% pediatrics, and 44% med-peds). There was no overlap in respondents between the two time periods, and therefore, no respondent completed the survey more than one time. The survey included all resident trainees from interns through third- and fourth-year seniors.

In 2004, when presented with a case scenario of a patient with symptoms consistent with and at risk for strongyloidiasis, only 11.1% (19/171) of UMN trainees recommended additional evaluation for parasites, despite the presence of an abnormally high eosinophil count. In 2009, after implementation of a GHP training program, the recognition of the need for intervention increased to 39.4% (50/127) overall ($P < 0.001$). There was superior recognition by residents participating as full GHP participants (59%) and even higher recognition in those residents who had completed the global health ASTMH certificate course (77%) compared with those residents who denied activity in any of the GHP training activities (29%; $P < 0.001$) (Table 1). In a multivariate model evaluating each training activity, participation in the formal ASTMH certificate course increased recognition (OR = 9.5; 95% CI = 2.5–36; $P = 0.001$), whereas international electives ($P = 0.9$) without the formal curriculum or pathway activities had no association with the recognition of the risk of strongyloidiasis.

Immunosuppressant therapy, especially corticosteroids, given to persons with chronic strongyloidiasis is a potentially fatal iatrogenic error. In assessing the open-ended question regarding management plans, recommendations for empiric corticosteroids without additional evaluation decreased from 23% in 2004 to 13% in 2009 (OR = 0.53; 95% CI = 0.29–0.95; $P = 0.03$) in all respondents. In 2009, none of the medicine or med-peds trainees who identified as full GHP participants, enrolled in the certificate course, or attended evening seminars recommended use of corticosteroids ($P < 0.001$). In 2009, all respondents who recognized *Strongyloides* as a potential risk did not recommend empiric use of corticosteroids.

General helminth knowledge among residents was quite limited in 2004, with only 59% able to identify any parasite

TABLE 1
Multivariate analysis of global health training activities and risk recognition

Global health training activity 2009	Number (N = 127)*	Recognition of <i>Strongyloides</i> risk n	Univariate P value	Multivariate P value
None	48 (38%)	14 (29%)†	0.09	0.33
Global health pathway participant	34 (27%)	20 (59%)	0.008	0.83
Global health certificate course	30 (24%)	23 (77%)	< 0.001	0.001
Immigrant-focused continuity clinic	25 (20%)	14 (56%)	0.058	0.61
International elective	19 (15%)	13 (68%)	0.009	0.92
Evening seminar series attendee	23 (18%)	16 (70%)	0.002	0.15
Intern (PGY-1)	35 (28%)	11 (31%)	0.31	0.46

* Individuals may be included in multiple categories, because they may participate in more than one activity.

† In 2004, 11.1% (N = 19) of 171 UMN residents recognized *Strongyloides* risk. In 2009, 39.4% (N = 50) of 127 UMN residents recognized *Strongyloides* risk.

causing chronic pulmonary symptoms when presented a list of 16 common parasites. Correct choices were *Strongyloides stercoralis* and *Paragonimus westermani*. The most commonly selected incorrect answer for a parasite causing pulmonary symptoms in 2004 was *Blastocystis hominis* (likely confused with the fungus *Blastomyces dermatitidis*). After instituting a formal GHP curriculum, 92% of trainees could name at least one parasite causing pulmonary symptoms ($P < 0.05$). Specifically in regards to *Strongyloides*, 87% of medicine and med-peds trainees recognized *Strongyloides* as causing chronic pulmonary symptoms, which increased from 46% recognition in 2004.

DISCUSSION

Interest in global health continues to rise among medical students and residents. In surveys from 1982 to 2007, residents had overwhelmingly positive responses to international electives, and global health exposures helped shape future career interests.²⁵ Global health, previously widely referred to as international health, is often viewed as health that occurs abroad—outside of the United States. However, with > 42 million of the US population being foreign-born, > 60 million Americans traveling internationally, and > 70 million foreign visitors to the United States annually,¹ we would argue that knowledge of global health is critical for physicians to provide competent care for patients in the United States—whether or not the physician is interested in international health. We chose to evaluate knowledge of *Strongyloides* and basic knowledge of parasites causing pulmonary symptoms because of the documented harm that lack of knowledge of infection with *Strongyloides* can cause,^{14,22} particularly in light of the long latency period and high prevalence rates in some populations in the United States and in Canada.^{17–20} Our results showed that trainees with formal global health instruction through participation in an ASTMH-accredited certificate course had greater recognition of the risk of strongyloidiasis and improved parasitic knowledge. Interestingly, there was improvement since 2004 in the recognition of strongyloidiasis risk as well as basic parasitic knowledge overall among all survey respondents. This finding may indicate that knowledge and practices may spill over into the residents with limited expressed interest through educational venues such as case conferences or morning reports.

The aspect of the training program that was most associated with increased knowledge measured seems to be a formal curriculum rather than simply the experience of working in resource-limited settings. Although there is no doubt that international electives or other work in resource-limited set-

tings have great benefits to physicians in training,^{3,26} these rotations are but one component of a comprehensive GHP. Formal didactic and interactive training is also a necessary component to improve knowledge. Unfortunately, educational activities aimed at reducing health disparities locally or globally, such as in-depth didactic programs and international electives, are not reimbursed as part of Medicare support for graduate medical education, despite well-documented health disparities both within the United States and between resource-rich and resource-poor settings. We believe that this study indicates that these non-reimbursable activities positively impact the knowledge and hopefully, the practices of future physicians within programs that offer formal global health training, and as such, they may help to decrease health disparities. With 12.5% of the US population being first-generation foreign-born, programs that address these issues are imperative in decreasing disparities in vulnerable populations and around neglected diseases even within the United States. We very much support international electives; however, we feel that an organized GHP is an essential, necessary component to impart knowledge to trainees.

Limitations. An internet-based survey or examination may not reflect actual clinical practice; however, the primary comparison was the change in responses using the exact same survey and methodology with a moderately good 66% response rate. The survey focused on strongyloidiasis and some very basic parasite knowledge, and thus, it may not be reflective of all tropical medicine and global health knowledge.

Conclusions. A formal GHP training program is associated with improved medical knowledge regarding both chronic parasitic infections and recognition of patients at risk of iatrogenic mortality in the United States because of *Strongyloides*. International electives based on experiences, without a formal global health educational curriculum, were not associated with increased physician knowledge in this survey. This study is the first evaluation of a comprehensive global health training program to our knowledge. However, it was limited in scope. More thorough evaluations of knowledge and actual practices of training programs are strongly encouraged.

Received December 29, 2010. Accepted for publication May 19, 2011.

Acknowledgments: The authors thank Debra Luedtke for institutional support of the Global Health Program.

Financial support: D.R.B. is supported by National Institutes of Health Grant K23AI073192-02. No specific financial support existed for the survey.

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