

An Electronic-Based Curriculum to Train Acute Care Providers in Rural Haiti and India

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ABSTRACT

Background Access to a trained, competent health care workforce remains a challenge globally, particularly in rural settings. To bridge this gap, the World Health Organization calls for innovations in electronic learning and task shifting. Yet, these approaches are underutilized due to cost, challenges associated with implementing technology, and a lack of suitably educated trainees.

Objective We explored the feasibility of the Acute Care Providers Project (ACPP) to remotely train community members to be health care providers in 2 sites: Haiti and India.

Methods The ACP program is an asynchronous curriculum that provides core health content and a structured approach to clinical care through an electronic curriculum. The curriculum is reinforced with case-based practice and hands-on workshops for procedural skills. ACPP was deployed in rural Haiti and India. Evaluation of the program included multiple-choice pretests and posttests, an objective structured clinical examination (OSCE), and direct observation of skills.

Results Four Haitian and 55 Indian trainees completed the course. In Haiti, mean scores were 34.8% (SD 12.4) on the pretest and 78.0% (SD 6.5) on the posttest ($P = .004$). Trainees scored 100% on the OSCE and passed the skills checklist. In India, mean scores were 16.5% (SD 3.9) on the pretest and 81.7% (SD 9.0) on the posttest ($P < .001$). Trainees scored a median of 91.8% (SD 3.95) on the OSCE and all passed the skills checklist.

Conclusions The ACPP offers a scalable, replicable asynchronous curriculum to train lay individuals to provide basic health care in rural communities.

Introduction

Access to trained health professionals remains a significant challenge in health care delivery worldwide, due to financial and time constraints, suitable trainees, and faculty shortages.¹ To bridge this gap, the World Health Organization (WHO) has called for innovations in electronic-based learning that include task shifting from physicians to less specialized health care workers.² Yet these approaches are vastly underutilized.³ Poor literacy and lack of formalized education make it challenging to broaden the scope of practice for laypersons.⁴ Many communities have populations of laypersons with limited opportunities for professional advancement. Training them to diagnose and treat patients not only meets community needs, but also offers career advancement opportunities. Traditionally, laypersons have been tasked with disease prevention, health promotion, treatment support, counseling, and linking patients to the health care system,⁵ while utilization of laypersons for diagnosis and treatment is narrow in scope (eg, the Integrated Management of Childhood Illness).⁶ Improving access to care in underserved settings requires

providers with basic diagnostic and clinical abilities to manage common problems for which community members seek care.

Electronic-based learning formats are well-suited for improving access to training for health care workers in resource-constrained settings.⁷ Obstacles to using electronic-based learning include poor connectivity, lack of staff and infrastructure to maintain devices, and lack of learner engagement when courses are not taught with live instruction.⁸ These challenges can impede the success of electronic-based learning platforms.

To meet the need of underserved communities, we designed the Acute Care Providers Project (ACPP) to remotely train previously untrained lay individuals with limited opportunities for advancement. The aim was to prepare them for the diagnosis, treatment, and triage of 30 acute care chief complaints specific to the needs of rural communities lacking access to care. The program utilizes an electronic-based, asynchronous curriculum to reduce faculty time and cost. We implemented ACPP in rural Haiti and India in 2 populations with differing educational backgrounds and spoken languages to explore whether this approach was feasible in different settings.

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TABLE 1
Trainee Characteristics

Characteristic	Haiti	India
Initial number of trainees	6	55
Sex		
Male	3	0
Female	3	55
Age group		
Mean age	24	39
< 30	6	0
30–45	0	52
> 45	0	3
Mean years of education	12	8
Marital status		
Single	6	0
Married	0	55
Widowed	0	0

Methods

Project Design and Evaluation

At the core of ACPP is a 3-step education program that encompasses (1) delivering health care content, (2) developing a clinical approach, and (3) learning procedural skills. The electronic, asynchronous curriculum uses animated video modules preloaded on tablets, eliminating the need for infrastructure, connectivity, and maintenance. Animation with minimal text allows synchronized translation of the narration to trainees' native language. Clinical care is simplified using a heuristic approach, basing decisions on a few relevant predictors that are easy for laypersons to identify and that can be pictorially represented to minimize the need for literacy and translation.^{9,10} Each module has criteria to transfer a patient to a hospital if they exhibit "red flag" signs portending clinical deterioration. Patterns are reinforced by case-based practice. Physician trainers lead a 2-week live skills workshop on basic airway maneuvers, suturing, traction, splinting, cervical spine protection, and transportation.

We separately assessed trainees at each step of the curriculum, requiring them to obtain a passing score before advancing to the next phase. We tested the efficacy of the core content module using 2 to 4 multiple-choice questions for each learning objective, divided equally into test A and test B. Four US emergency physicians reviewed and validated the questions, and piloted the tests for equivalency. Half of the trainees took test A prior to the project and half took test B, each receiving the opposite test for postevaluation. We *a priori* determined a passing grade of 75%.

What was known and gap

Many areas across the globe lack access to basic acute health care services.

What is new

An asynchronous, electronic education program prepares community members to provide basic health care services.

Limitations

Pilot lacks longer-term outcomes for program graduates and the communities they serve.

Bottom line

The program is affordable, scalable, and transferrable to other communities with lack of access to care, and offers local opportunities for professional advancement.

We evaluated trainees' clinical approach, diagnostic skill, and practice safety using an objective structured clinical examination (OSCE) of 15 standardized, simulated cases. Project faculty randomly administered 3 cases to each trainee. Critical actions were determined *a priori* as "could not miss" portions of the examination, including identifying an unprotected airway, abnormal vital signs, and "red flags" that mandate transfer to a higher level of care. We used a compensatory standard; trainees had to complete 3 cases with a score of 80% or higher. Missing even 1 critical action resulted in case failure. Workshop moderators evaluated procedural skills using direct observation and a performance checklist.

We calculated test score means, standard deviations, and *P* values using paired *t* tests and Microsoft Excel software (Microsoft Corp, Redmond, WA).

Study Setting 1: Haiti

After the project received approval from the Haitian Ministry of Health, we initiated training in a rural area of Fort Liberté with a population of approximately 34,000. This community had 1 general physician, 1 obstetrician and gynecologist, 1 general surgeon, and sporadic visits from health professionals of an American church group.

Recruitment of trainees used a public announcement, and our partner organization, the Baptist Church in Fort Liberté, chose 31 applicants. Prerequisites included an interest in health care, socioeconomic disadvantage, and lack of resources for advanced education. Because education quality varies among localities, we tested literacy and numeracy using a custom-created reading comprehension and mathematics examination. Three members of the research team chose 6 trainees from 31 applicants based on examination performance, and individual, group, and working interviews (TABLE 1).

Over 8 months, the Haitian trainees completed 39 modules as a self-study project (TABLE 2). They discussed modules weekly, and a member of the

TABLE 2
Haiti Acute Care Providers Project Module Topics

Introduction	Patient Care	Gastrointestinal (GI) System	Genitourinary (GU) System
Introduction to being a provider	General history	Critical signs and abdominal pain	GU and sexually transmitted infections
Basic cell physiology	Vital signs	Diarrhea	Women's GU
Circulatory system	General examination	Hernias	
Respiratory system	Chest and lung examination		
Nervous system	Abdominal examination		
GI system	The critical patient		
GU system	Medications		
Respiratory System	Infectious Disease	Trauma	Pediatric Diseases
Introduction to respiratory disease	Malaria	Being a first responder	Introduction to pediatrics
Asthma and COPD	Ameobiasis	Major trauma	Malaria
Pneumonia	Dengue	Minor trauma	Cough
	Cellulitis	Splinting	Respiratory infections
	Impetigo		Wheezing
	Scabies		Dengue
	Medications		Rashes
			Scabies

Abbreviation: COPD, chronic obstructive pulmonary disease.

research team conducted case-based practice with trainees weekly for 1 hour via video conference. The cost of training for each trainee was \$933, covering the tablets, translation of video narration and workbook, implementation, and travel.

Study Setting 2: India

Following approval by the Ethics Board of India, we initiated the program in rural villages in Uttar Pradesh and Bihar. Each village encompassed 500 to 1000 people and lacked a trained health care provider, with the nearest facility being a primary health center staffed during the day by a nurse located within 15 kilometers of the village.

Our partner organization, Healing Fields Foundation, chose 55 female trainees from 55 unique villages

in Uttar Pradesh and Bihar based on previous participation in a health educator program (TABLE 1). Using health educators ensured basic literacy and family permission to work outside the home, as the village patriarchy may not allow women to leave the house. We did not screen for numeracy because the pilot excluded pediatrics, the only module that required math.

Delivery of education in India used a modified pilot curriculum of 14 modules over 4 months (TABLE 3). Modules were selected based on common illnesses reported in the village. We removed pediatric modules to eliminate dose calculations. Four India-based facilitators with bachelor's degrees and technology literacy navigated the modules to view as a group. The cost of training each trainee was \$355, covering

TABLE 3
India Acute Care Providers Project Module Topics

Introduction	Patient Care	Gastrointestinal (GI) System	Genitourinary (GU) System
Introduction to being a provider	Approach to the patient	Minor trauma	GU and sexually transmitted infections
Basic cell physiology	Abdominal examination	Contusions, sprains, strains, and back pain	Women's GU
Circulatory system			
Respiratory system			
Nervous system			
GI and GU systems			

TABLE 4
Objective Structured Clinical Examination Results

Assessment	Haiti n = 12	India n = 165
Case specifics		
Recognized red flag	100%	98.7%
Acted on red flag	100%	98.2%
ABCD	100%	99.3%
Vital signs	100%	98.2%
Appropriate history of the present illness	100%	97.6%
Asked permission and privacy for examination	100%	99.3%
Appropriate physical examination	100%	96.3%
Appropriate diagnosis	100%	95.7%
Appropriate management	100%	87.9%

facilitator salaries, tablets, translation, implementation, and travel.

The overall study protocol was approved by the Institutional Review Board of Stanford University School of Medicine (IRB 43510).

Results

In Haiti, 4 students completed the ACPP. Of 6 students who started the curriculum, 1 dropped out prior and 1 failed the posttest. Data for the 5 trainees who completed the pretest and posttest were included in analysis. Pretest scores averaged 34.8% (SD 12.4) and posttest scores averaged 78% (SD 6.5), with this difference statistically significant ($P = .004$; FIGURE). The 4 students who completed the ACPP scored

100% on the OSCE and passed the procedural performance checklist.

In India, 55 students completed the pretest and posttest. The mean pretest score was 16.5% (SD 3.9) and the mean posttest score was 81.7% (SD 9.0, $P < .001$). Fifty of the original 55 trainees passed the OSCE on the first attempt with a median score of 91.8% and a SD of 3.95 (TABLE 4). Appropriate diagnosis and management were the areas where points were frequently lost. All trainees passed the procedural performance checklist. Graduates of the program are currently providing basic acute services in both nations.

Discussion

These results demonstrate the feasibility of an electronic-based, asynchronous educational intervention to train lay individuals as acute care providers capable of providing basic services with minimal involvement by formally trained health professionals. The success of our curriculum is due to its ability to address 3 challenges: providing training of adults with little formal education and poor literacy; using technology as a platform for learning; and making the curriculum applicable to 2 different cultural and geographic settings.

We overcame barriers to training adult learners with poor literacy through the use of heuristics. Many common acute complaints can be distilled to key objective findings, enabling heuristic approach. This is nearly equivalent to physicians using probabilistic inputs.^{9,11,12} We emphasized recognition of emergencies related to airway, breathing, circulation, and

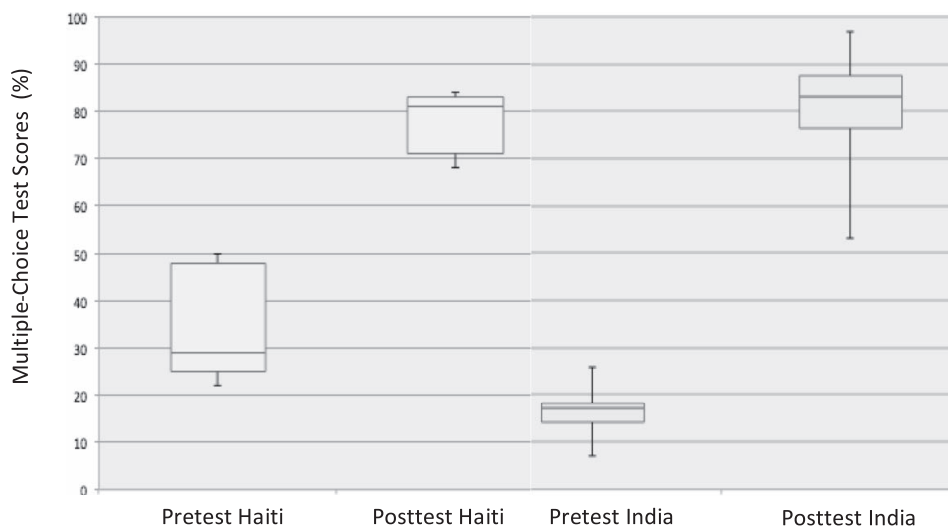


FIGURE
Written Examination Results

mental status, and diseases outside the scope of trainees' practice. To reduce availability bias as a source of diagnostic errors, we taught common complaints familiar to trainees prior to starting the course.^{13,14} Additionally, we compensated for the lower basic knowledge of the Indian trainees by increasing the time for each module from 3 days to 2 weeks, and devoting the extra time to group discussions and workshops illustrating basic scientific principles using familiar analogies (eg, a water pump was analogous to the heart and different-sized hoses explained blood pressure and flow).

Allowing sufficient time to solidify concepts and using a heuristic model, trainees made few diagnostic errors, and none that would have resulted in unsafe treatment. Trainees' management mistakes also did not result in unsafe situations; 15 involved simply forgetting to counsel on prevention and follow-up.

Our curriculum was designed to overcome challenges of using technology for electronic learning in developing nations. Tablets do not require the network or physical infrastructure often lacking in austere environments, and preloading course content eliminates reliance on connectivity, which may be poor in many settings. Separate video and audio tracks allow narration to be replaced with the local language. Tablets are less expensive than other devices and the cost of labor to translate and facilitate is low. Cost will vary by locale. Expenses associated with training in India were less than half compared to Haiti due to lower labor costs. In both nations, the cost to train a health worker using ACPP is significantly lower than the cost to train a nurse, physician, or other advanced health professional.

In addition to providing trained health care workers to communities that lack access to care, our project enables individuals with limited opportunities for advancement an avenue to education and employment. For this reason, we adapted the program to the cultural and educational needs of the local setting. To us, it was important to train village women in India, who are often disregarded citizens after childbearing, and overcome their lack of familiarity with technology that made it challenging to navigate the program as a self-study course. While having sessions facilitated by 4 local college-educated trainers added costs and reduced flexibility, we felt this adjustment was beneficial. An added benefit was that using local facilitators improved trainees' engagement by increasing face-to-face contact. Those wishing to implement this curriculum in new populations should begin with surveying local culture and needs, and leveraging the

adaptability of our modular, mixed-methods curriculum to suit their community.

Conclusion

ACPP utilizes a scalable, replicable, electronic-based curriculum to train laypersons as health care workers in areas with low provider-to-patient ratios. This curriculum can meet the educational requirements and language needs of local communities at a low cost, and can educate and increase professional advancement in resource-poor communities.

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