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Original Research

# International Infection Control Training Partnerships: Experiences from the Egypt-University of Louisville Collaboration

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## Abstract

**Background:** Healthcare-associated infection (HAI) is a global challenge that represent opportunities for international collaboration. Both the United States and Egypt prioritize HAI reduction as activities of public health importance. These shared priorities provide a foundation for interactive education and training.

**Objective:** In fall 2018, The United States Agency for International Development (USAID) sought a US training site where a delegation of physicians and nurses from Egypt could receive experiential training regarding HAI and prevention. The objectives of this review are to: 1) outline the training components used for the US-Egypt collaboration held at the University of Louisville in Kentucky; 2) describe the immersive and experiential approaches used to promote interprofessional education in infection control; and 3) identify some of the successes and challenges of this cultural and practice collaboration.

**Methods:** The course curriculum consisted of a 10-day agenda that provided classroom training, live simulation, role-playing, and healthcare facility visits all supporting immersive and experiential learning. Evaluation methods were based upon Kirkpatrick's Model and included individual self-assessments, daily course evaluations, a summative course evaluation, pre-and post-course testing, and action learning plans.

**Results:** The Egyptian cohort consisted of twenty-six physicians and nurses representing twenty-six different healthcare facilities across the country. Participants rated the course highly but had a strong desire for more interactive experiences at the hospitals. Comparing pre- and post-course knowledge, overall knowledge improved in both the physician and nurse groups.

**Conclusions:** Results from this collaboration demonstrate an ability to provide an organized infection prevention and control training course that reached the University of Louisville team goals and met the stated expectations of the course sponsors. Both the University of Louisville team and the Egyptian delegation indicated that a longer planning horizon would have been beneficial.

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## Background

Transmission of healthcare-associated infection is a global concern and is considered to be a threat to the safety of patients, healthcare personnel, and communities worldwide. Developing countries are especially challenged due to a lack of consistently available resources, including focused surveillance activities, as well as the needed for integrated national response efforts and international cooperative support [1]. Further, Allegranzi and colleagues reported that an incongruence between resource allocation and workforce density results in other emerging health problems and diseases becoming a priority. In response to this challenge, Egypt's Ministry of Health and Population (MHOP) collaborated with the World Health Organization, the United States Agency for International Development (USAID) and the United States Naval Medical Research Unit No. 3 to develop a national strategic plan aimed at reforming infection control [2]. The objectives of Egypt's national plan focused on improving the quality of care and reducing the transmission of hospital-acquired infections. To accomplish this objective, healthcare worker training and systems that monitor and evaluate processes and outcomes were emphasized. In addition, there was a desire on the part of the MHOP to identify international partners who share interests in addressing healthcare-associated infection issues, and engage them as a collaborator.

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Both the United States and Egypt experience infection prevention and control challenges as reflected by the rates of infection associated with healthcare [3, 4] and the presence of organisms resistant to antimicrobial agents [4, 5]. The USAID, in partnership with the Institute for International Education (IIE), sought a collaboration site in the United States where on-site training and immersive experiential learning could be delivered to a delegation of physicians and nurses involved in infection prevention and control resulting in shared learning. The infection prevention and control training program at the University of Louisville, Division of Infectious Diseases (ULDID), was selected by USAID and IIE as the site for this project.

The objectives of this paper are to: 1) outline the training components used for the US-Egypt collaboration; 2) describe the immersive and experiential approaches used to promote interprofessional education in infection control; and 3) identify some of the successes and challenges of this cultural and practice collaboration. As this is a review of the training program with no individually identified data, there was no review by the University's Institutional Review Board (IRB).

## Methods

In August 2018, USAID and IIE released a request for proposal outlining specific training requirements for a comprehensive infection prevention and control training program. In the description, there was emphasis on endemicity of Hepatitis C in Egypt and the need to address reduction efforts as a component of infection prevention and control knowledge and practice competence. The goal of the USAID/IIE project, entitled the Infection Control Short Course Study Tour, was to match a cohort of physicians and nurses from Egypt with colleagues in the United States with the purpose of gaining new knowledge and expertise in infection prevention and control. The ideal location in the US was a site with a recognized infection prevention and control program able to host a contingent of international physicians and nurses for a two-week immersive training experience.

The USAID/IIE goals for the participants included: 1) improving the infection prevention knowledge and practice of the participants; 2) exposing the participants to a variety of healthcare settings at risk for infection transmission and acquisition (e.g., operative settings, intensive care units, hemodialysis suites); 3) provision of interprofessional learning and teaching experiences that enable translation of prevention knowledge into actionable interventions; 4) helping participants conceptualize action learning plans that translate acquired knowledge into implementable plans that may address infection prevention challenges in their home facilities; and 4) providing cultural experiences that demonstrate existing societal models of interaction and healthcare in the Louisville community. In turn, the UL-ID team set of goals for its own portion of the program that included: 1) expanding the context of knowledge as to how infection prevention and control impacts healthcare delivery outside the United States; 2) developing a basis for long-term relationships with infection prevention leaders in Egypt; and 3) building a structure for an ongoing international infection prevention training and exchange program.

**Training Components**

The University of Louisville (UL) team consists of faculty with recognized expertise in infection prevention and control, healthcare epidemiology, hepatitis C diagnosis and treatment, leadership, biostatistics, human factors engineering, public health, and infectious diseases. The UL team responded to the request and submitted a comprehensive program that followed the Centers for Disease Control and Prevention (CDC) Core Practices for Infection Control framework [6]. This model incorporated interprofessional education and immersive experiences as the learning platform. The program outline for the University of Louisville Infection Control Training Course (UL-ICTC) is provided in **Table 1**.

**Immersive and Experiential Approaches**

The UL-ICTC consisted of a 10-day agenda that provided classroom training, simulation, role playing, and healthcare facility visits all supporting immersive and experiential learning. The UL-ICTC was organized into modules and the contents were housed on a learning management system made available to the participants the week prior to the course, throughout the course, and into the post-course collaborative phase (cerid.thinkific.com). The presentation files, tools, resources, videos, and simulation instructions were included and maintained in their native forms (e.g., in Word, Powerpoint) as a means of encouraging individualization and personalization for use in the participants' own settings. Videos and photos of some of the training activities are included as multimedia additions to this paper.

**Evaluation Metrics**

The UL-ICTC used evaluation metrics based upon Kirkpatrick's Model for Evaluation [7]. This process looks at four levels of evaluation: Reaction, Learning, Behavior, and Results.

Level 1: Reaction looks at how participants viewed the training in terms of its engagement and relevance to their jobs. Level 1 evaluation data were captured through self-assessments of learning needs and competencies completed by each participant prior to their arrival in Louisville. The self-assessment followed the infection prevention and control practice competencies identified as part of the 2015 practice analysis conducted by the Certification Board of Infection Control (CBIC)[8]. Each participant ranked their own level of knowledge and competence. In addition, each participant provided a list of experiential learning opportunities they sought as part of the program. These lists were used to craft specific visits to area hospitals/healthcare settings and were built into the course schedule. In addition, daily course evaluations sought subjective assessments and focused on the quality of the daily content, the methods used for content delivery (e.g., simulation), and the presenters' abilities to deliver the content. A 1-4 likert-type scale was used: 1=poor, 2=fair, 3=good, 4=excellent, and N/A where the question was not applicable. The final summative course evaluation sought subjective assessment regarding the planning process, housing, meals, and overall satisfaction with the content and content delivery methods. The same 1-4 likert-type scale was used.

Level 2: Learning looks at how well participants acquired the intended knowledge. This was captured using pre- and post-test assessments. The pre- and post- tests were constructed using eighteen (18) questions made available in the public domain from previous infection control certification examinations. Two questions addressed each of the nine core practice areas upon which the course was built. The situational aspects of the questions were adapted to the audience and to scenarios

**Table 1** Infection Prevention and Control Short Course Program Outline

| |
|---|
| **Module 1:** Basic elements of infection prevention and control practice; Infection prevention and control practice core competencies. This module will focus on core elements of infection prevention and control in care activities with an emphasis on putting knowledge into action (competence). The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 2:** Risk assessment as a foundation to effective infection prevention and control programs and practice focusing on prevention of healthcare-associated infection as well as bloodborne infections such as Hepatitis C; Hepatitis C: recognition, diagnosis, treatment, and outreach. The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 3:** Surveillance of infection and surveillance of practice and care processes focusing on how to evaluate existing performance in self and others and how to develop a framework for care process evaluation in self and others. This module will also include process, practice, and outcomes monitoring and how to demonstrate outcome results and engage participation and partnerships. The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 4:** Core Practices of Infection Prevention and Control including hand hygiene, aseptic technique, transmission-based precautions and personal protective equipment. The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 5:** Core Practices of Infection Prevention and Control including environmental cleaning and disinfection, reprocessing of reusable medical devices. The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. A majority of this module will be hands-on working with a variety of disinfection products, environmental cleaning practices, and issues regarding medical devices. A skeleton scope will be used to demonstrate the many challenges involved in cleaning and disinfection of endoscopes as well as challenges in addressing the cleaning and disinfection of devices used throughout facilities such as ultrasound probes. |
| **Module 6:** Core Practices of Infection Prevention and Control focusing on pathophysiology and prevention of catheter-associated urinary tract infection (CAUTI), central line-associated bloodstream infection (CLABSI), surgical site infection (SSI), and ventilator-associated events and outcomes. The module will consist of lecture outlining the principles of the module followed by case studies. Emphasis will be placed on surveillance for these high risk infections as well as how to apply CDC guidance for their prevention. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 7:** Core Practices of Infection Prevention and Control focusing on injection safety, medication administration, prevention of occupational exposure and the relationships between Core Practices and prevention of bloodborne pathogens including Hepatitis C. The module will consist of lecture outlining the principles of the module followed by case studies. Hands-on work will include simulations and return demonstration and discussion. |
| **Module 8:** The role of the physician and infection prevention and control in antimicrobial stewardship, preventing development and transmission of multidrug resistant organisms, and outbreak recognition and response. The module will consist of lecture outlining the principles of the module followed by case studies. Development of facility antibiotic usage guidelines and controlled access approaches for high consequence antibiotics will be included. Hands-on work will include role playing and interaction with other team members responsible for actions in prevention development of drug resistance. |
| **Module 9:** Infection prevention and control in special populations of interest to participants (e.g., pediatrics, maternal-child health, the immunocompromised). This module will focus on specific areas of practice of interest to the participants. Site visits will be used to enable participants to interact with other healthcare workers in those areas and discuss existing challenges that may be shared. These visits will be individualized for the participants. |
| **Module 10:** Basic statistics for healthcare epidemiology; the role the physician and the IP plays in leadership in preventing infection and leading practice change. This will be a closing module where there is emphasis on ensuring the participants are leaving with an ability to review the literature involving areas of interest to them in infection prevention and control. Some basic tools regarding basic statistical tests commonly used in epidemiology will be provided. |

reflective of global infection relevance. The same questions were used on both the pre- and post-tests as a measure of existing then acquired knowledge and application. Simulations were used for training and most of the participants engaged with the simulations. However, there was no measurement of return demonstration. Instead, simulations and role playing were used to demonstrate techniques and training approaches that could be used upon return to their home facilities.

Level 3: Behavior looks at how participants applied their knowledge once they returned to their jobs. Action learning plans were designed to assist with this level of evaluation. Each participant was expected to develop an individual action learning plan as part of their learning experiences. These plans were the basis of post-course conference calls.

Level 4: Results looks at targeted outcomes resulting from the training with emphasis on support and accountability. This level of evaluation was not part of the short course.

**Cultural Experiences**

The participants placed a high value on cultural activities including city tours, local community activities and shopping. Passes allowing free access to public bus transportation was provided for each participant. Suggestions for local sites such as museums and parks were provided. Lists of local restaurants and information about menu items were also made available. Shopping trips were planned each week and local community events including festivals on the downtown waterfront were arranged.

**Table 2** Self-Assessment Scores

| Area of Self-Assessment, n(%) | Proficient | No Knowledge | Not Applicable |
|---|---|---|---|
| **Identification of infectious diseases processes, surveillance, and epidemiologic investigations.** (Examples: information such as differentiating between colonization and infection; identifying reservoirs, incubation periods; interpreting laboratory test results; antimicrobial use; environmental culturing). | 9 (31%) | 1 (3%) | 0 (0%) |
| **Surveillance Systems.** (Examples: designing surveillance systems; developing surveillance plans; managing data; calculating rates). | 5 (17%) | 0 (0%) | 1 (3%) |
| **Collection of surveillance data.** (Examples: use of standardized definitions; systematic approaches to recording of surveillance data; determining numerators, denominators, and constants for calculating rates for process and outcome measurement). | 5 (17%) | 0 (0%) | 1 (3%) |
| **Interpretation of data.** (Examples: analysis of data; basic statistical techniques; proper application of epidemiologic study methods; presentation of surveillance data; development of action plans based upon findings). | 4 (14%) | 1 (3%) | 1 (3%) |
| **Outbreak investigation.** (Examples: steps in an outbreak investigation). | 4 (14%) | 3 (10%) | 1 (3%) |
| **Planning and controlling transmission.** (Examples: development and review of policies and procedures; collaboration with public health in community responses). | 5 (17%) | 1 (3%) | 1 (3%) |
| **Identifying and implementing strategies.** (Examples: hand hygiene; cleaning, disinfection, and sterilization; risks associated with diagnostic procedures; equipment and product recalls; isolation; construction). | 7 (24%) | 0 (0%) | 0 (0%) |
| **Employee/occupational health.** (Examples: screening and immunization programs; work restrictions; occupational exposures; risk assessment and reduction). | 6 (21%) | 2 (7%) | 1 (3%) |
| **Management and leadership planning.** (Examples: risk assessment; development mission, vision, goals and objectives; product evaluation; recommending practice change.) | 3 (10%) | 3 (10%) | 0 (0%) |
| **Communication and feedback.** (Examples: development of reports; sharing feedback; communicating with other departments and agencies). | 4 (14%) | 2 (7%) | 0 (0%) |
| **Quality and performance improvement.** (Examples: development of improvement plans; use of quality tools to design improvement projects). | 6 (21%) | 3 (10%) | 0 (0%) |
| **Education.** (Examples: development of teaching plans; principles of adult learning; preparing workshops and conferences; evaluating effectiveness of teaching and learning). | 8 (28%) | 1 (3%) | 1 (3%) |
| **Research.** (Examples: ability to critically read, assess, and apply research findings; incorporation of research findings into practice). | 3 (10%) | 2 (7%) | 0 (0%) |

## Results

The Egyptian cohort consisted of twenty-six physicians and nurses with representatives from twenty-six different healthcare facilities across the country.

The age range of the responding participants was 26-55 years with an average age of 36.5 years. There were 13 nurses (2 male and 11 female) and 13 physicians/microbiologists (7 male and 6 female) in attendance with all indicating they had a primary role in infection prevention in their respective healthcare facilities.

**Level 1: Reaction**

The self-assessment focused on how each participant viewed their existing knowledge within the context of infection prevention and control practice. Participants ranked their knowledge as follows: 0=no working knowledge; 1=minimal working knowledge; 2=working knowledge but need improvement in ability to apply this knowledge; 3=proficient in this area. If the question was not applicable to their job responsibility, there was the option to select N/A. The assessment results were used as a basis for the training module contents and the associated hospital experiences, simulations, and role playing activities. Results of the self-assessments, shown in **Table 2**, demonstrate areas where participants deemed themselves as proficient (3) or where they felt they had no working knowledge (0). Average scores varied between 2 and 3 for all competencies. Less than one-third of the respondents rated themselves as proficient in one or more of the practice areas, with the majority indicating they had working knowledge of the topics but needed to improve their abilities to apply that knowledge. Relatively few described their knowledge as minimal in any area.

**Level 2: Learning**
The pre-test was administered at the beginning of the first day of the course then repeated after the last session of the course on the last day. A paired t-test was performed to compare the pre and post-test scores of all participants. The overall test scores improved by 13% ($t(24)=5.44, p<0.001$). Test scores among physicians improved by 10% ($t(12)=2.93, p=0.012$) and test scores among nurses improved by 16% ($t(11)=5.07, p<0.001$). Daily and summative course evaluations indicated high levels of satisfaction with the course content. However, there were consistent comments regarding a desire to spend more time in the hospital.

**Level 3: Behavior**
Post-course communication with the Egypt delegation focused on aspects of their individual action learning plans. During those conversations, there continued to be enthusiasm among participants to lead major changes in their facilities. Examples of specific actions included development of new training approaches using experiences gained in Louisville, use of process evaluation as an addition to outcomes evaluations in assessing HAI, and discussion regarding development of future exchanges where members of the UL team receive training and experiential learning at facilities in Egypt.

## Conclusions

Results from this collaboration demonstrate an ability to provide an organized infection prevention and control training course that reached the University of Louisville team goals and met the stated expectations of the course sponsors (USAID/IIE). The training demonstrated impact in the core practice areas. The participants represented leaders from some of the major healthcare facilities across Egypt thereby providing opportunity for widespread change and practice influence.

There were a number of lessons learned. Due to the short planning interval there were only six weeks between notification of the intent to perform the training course and the arrival of the participants. The limited ability to establish precourse relationships with the participants and ensure mutual expectations for the training was clearly the greatest obstacle and ultimately impacted several aspects of the training program. A web-based conference room was established for virtual meetings, but only one meeting was attended by a small group of the participants. Ultimately, the limited pre-course, face-to-face preparation time resulted in difficulties meeting participants' initial expectations regarding the program content, housing,food, and additional extra-curricular and cultural events.

There were also several key challenges to the training process including variability in English fluency and limited experiences with interprofessional teaching and learning approaches among the participants. Team members from the UL-ID proficient in the Arabic language and Egyptian culture were in daily attendance throughout the course, with one acting as the project Chief of Staff. This assisted with cultural brokerage and helped ease, but not eliminate, the language fluency gap. Despite these steps, findings from this project may be limited in their generalizability. All course items were provided in English with periodic reviews of daily course contents done in a discussion format in Arabic. The pre- and post-tests were also in English and this may have impacted the scores. This lack of English proficiency may also have limited the ability of the participants to provide feedback on the daily and final course evaluations. Lastly, the course consisted solely of Egyptian physicians and nurses so it is unknown if the same program can be successfullyused with healthcare professionals from other countries.

Ultimately, the course received overwhelmingly positive responses from the participants, the course presenters, and the University of Louisville planning team. Verbal reports from the IIE site visit included recognition of the aforementioned challenges while also reinforcing the positive comments from the participants. Use of a learning management system to house the course contents has also facilitated ongoing communication with the Egypt participants and has provided ways to continue to share information and maintain it for endurance. This approach also paves the way for provision of similar courses to new national and international audiences who share the same focus on infection prevention and control.

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## Conflict of Interest

There are no conflicts of interest among the authors.

## Author Contributions

AA and RC were responsible for the design of the training program and for writing the manuscript. MS was responsible for data entry of the evaluations. SF was responsible for analysis of the evaluations. AA, MT, RC, MS, SF, DB, and LR were responsible for review of the manuscript.

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