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Infection prevention and control competencies for hospital-based health care personnel

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Background: Infection prevention and control education for hospital-based health care personnel has differed across organizations because of a lack of identified practice competencies. This gap also has resulted in variation of the educational curriculum in the academic setting and a lack of consistent preparation for emergency responses. The purpose of this study was to develop a list of competencies and measurable activities, or terminal objectives, for hospital-based health care personnel applicable for use during routine patient care activities as well as during natural and man-made disasters.

Methods: Competencies and terminal objectives related to infection prevention and control were developed using an evidence-based approach comprising the following steps: (a) review of the literature, (b) review of existing competencies and published curricula/training objectives, (c) synthesis of new competencies and terminal objectives, (d) expert panel review and competency refinement using the Delphi survey process, and (e) delineation of competencies by occupation. The 8 disciplines addressed were nurses (RNs and LPNs), nursing assistants, physicians, respiratory therapists, physical and occupational therapists, environmental services, laboratory professionals, and ancillary staff.

Results: An initial list of competency statements and terminal objectives were compiled and then vetted by a Delphi panel of experts in infection prevention and control until > 80% agreement was achieved on all competency statements and terminal objectives.

Conclusion: The final matrix of competencies and terminal objectives developed through this process may be used as a content framework for educational curricula and training materials for hospital-based health care personnel. The process also may be of use in determining the core competencies and terminal objectives regarding infection prevention and control for health care personnel in other settings. Validation of these results is an important next step. (Am J Infect Control 2008;36:691-701.)

BACKGROUND

The spread of infectious organisms within health care environments affects patients, health care personnel, and the community. Ongoing transmission

of multidrug-resistant organisms (MDROs), such as methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, and multidrug-resistant gram-negative organisms; documented episodes of influenza transmission between patients and health care personnel; and the historical record of severe acute respiratory syndrome (SARS) transmission all demonstrate the effects and risk of infection transmission during day-to-day patient care activities as well as during emergency responses. Klevens et al¹ stressed the impact of health care-associated infection (HAI) as a major public health challenge by noting that in 2002, HAI was the number-one reportable disease. Despite the broad impact of infection transmission, there remains no clearly articulated comprehensive plan of action for the education and training of health care personnel regarding infection prevention. Various guiding documents outline strategies for preventing various types of HAIs, but fundamental infection prevention core competencies that each health care worker must master as part of routine and emergent care situations have not yet been identified. As US hospitals continue to work toward pandemic

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preparedness, there is an increased sense of urgency in identifying ways to improve infection prevention and control practices in all health care environments. A fundamental change in the process is needed. To effect this change, infection prevention core competencies for hospital workers must be identified and used as the framework for training and education of health care personnel.

The issue of health care workers' competence has been raised in both the public and private health care sectors. Several research teams have worked to define competence in the area of emergency preparedness. Gebbie and Merrill² defined a competency as a combination of knowledge, attitude, and skills demonstrated by the health care worker. Hsu et al³ asserted that competency statements are broad and that activities associated with the statements are needed; as a result, they used the term "terminal objective" and defined it as the measurable performance after completion of a set of instructions. Gebbie and Merrill² emphasized the importance of competencies involving emergency response and public health workers. Hsu et al³ expanded on this area of research and described competencies for health care workers during disasters. The need for workforce competence has been addressed by the National Public Health Performance Standards Program, a collaborative effort among 7 national public health organizations. This group outlined essential functions for public health systems, with function 8 having a stated goal of ensuring a competent workforce.⁴ In the private health care industry, accreditation standards outlined by such organizations as the Joint Commission focus on the need for health care facilities to ensure workforce competence as a means of ensuring patient safety.⁵ In 2006, Henderson⁶ surveyed Canadian infection control professionals regarding their opinion of the necessary infection prevention competencies of Canadian health care workers. Her work is of particular importance in light of the impact of severe acute respiratory syndrome (SARS) on the Canadian health care workforce. The work of these research teams highlights the importance of identifying core competencies for US health care personnel and the existing gap regarding the definition of those core competencies related to infection prevention practices for routine care as well as during a naturally occurring or man-made emergency.

Establishing evidence-based practices along with practice outcome measures are essential foundation components for a health care system that prioritizes worker and patient safety. An organization must maintain a supportive learning system that incorporates clearly articulated infection prevention competencies and know how to apply the essence of those practices to the spectrum of health care worker disciplines.

Preventing the transmission of infection in health care facilities is a challenge that continues despite a plethora of recommendations, guidelines, and legislation. Quality improvement efforts have led to closer examination of how health care workers are trained. To be successful, health care workers must be able to transfer new knowledge and consistently apply it across the continuum of care and care settings. Identification of specific elements of practice that have the force of evidence behind them has not been delineated as the basis for comprehensive infection prevention training in either practice or academic settings. Health care facilities struggle to provide orientation and subsequent skill validation for new and experienced health care worker employees, often in an abbreviated format lacking standard elements, then lament that the new employees have not received sufficient training in their academic programs to allow them to practice infection prevention at the desired (albeit undefined) level.

The purpose of this study was to outline basic infection prevention and control (IPC) competencies for hospital-based health care workers, along with specific practice activities, as a means of developing a clear and organized framework as the basis for training and education programs and curricula. The aims of the project were to (1) identify a core group of experts from 8 hospital-based health care disciplines, (2) use those experts' knowledge and skill to outline IPC competency statements for hospital-based health care workers, (3) identify specific and measurable activities or terminal objectives associated with each competency statement, (4) develop a comprehensive matrix containing the competency statements and terminal objectives, and then (5) evaluate each competency statement and terminal objective in relation to the roles and responsibilities of the 8 hospital-based health care worker disciplines. These 8 disciplines included physicians, nurses (RNs and LPNs/LVNs), nursing assistants, respiratory therapists, physical and occupational therapists, environmental services workers, laboratory professionals, and ancillary staff. These disciplines were selected because they were deemed to best incorporate the range and complexity of tasks that can affect a patient's risk of infection.

The investigators hypothesized that IPC competencies would be consistent across health care worker disciplines, but that content for practical application and worker training would require refinement to address discipline-specific needs. It is important to note that this project did not address competencies that are part of the practice and job responsibilities of the IPC professional. The project was reviewed and approved by the Human Subjects Protection Offices of the University of Louisville, Saint Louis University, and the National Naval Medical Center.

METHODS

The evidence-based approach used to develop IPC competencies and terminal objectives for health care workers comprised the following steps: review of literature, review of existing competencies and published curricula/training objectives, synthesis of new competencies and terminal objectives, identification of an expert panel to review and refine the competencies and terminal objectives, use of a Delphi survey process to vet the competencies, terminal objectives and comments of the expert panel, and delineation of competencies by occupation. This process is similar to that used in other competency identification projects, including that used to outline the public health worker competencies for emergency response by Gebbie and Merrill.²

Literature review

A literature review was conducted in January 2007 using the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Health and Psychosocial Instruments, Healthstar, Psych Info, and Medline databases for the years 1966 through 2007. The following terms were used as keyword searches: infection control, competencies, training, health care workers, education, disaster, and mass casualties. A total of 843 references were identified and reviewed for relevance; most were eliminated based on the title or journal alone. Any journal that was not relevant or lacked peer review was excluded. A total of 224 references were screened by reading the abstract. Of those articles screened, 96 were deemed relevant and were analyzed in their entirety. A spreadsheet was created that delineated the worker group(s) addressed by the article and the competencies or terminal objectives identified by the authors. Competency and terminal objective categories were recorded verbatim on the spreadsheet.

Review of existing competencies and published training objectives

An Internet search was conducted in January 2007 using the same search terms as above to identify existing IPC competencies and terminal objectives (measurable actions or activities) outside the peer-reviewed literature. The investigators reviewed each report to determine its relevance. The only relevant reports found were specific to mass casualty or bioterrorism preparedness for various health care worker groups.^{7,8}

Synthesis of new competencies and terminal objectives

After the analysis of published literature and reports, the researchers condensed the competency and

terminal objective categories into themes. These themes were used as the basis for generating new competencies applicable to all hospital-based health care workers. Next, terminal objectives for each competency were developed, based on the analysis of published literature and the researchers' expertise in the field. At this point, specific worker groups were not mapped to the competencies or terminal objectives.

Expert panel review and competency refinement using the Delphi survey process

Once the initial listing of competencies and terminal objectives were developed, a core group of individuals was identified to serve as the Delphi panelists. Individuals with expertise in at least 1 of the 8 hospital-based health care practice disciplines as well as demonstrated knowledge and expertise relative to infection prevention were recruited. Three experts were identified for each of the 8 health care worker disciplines, for a total of 24 panelists. One additional nurse was included because of her significant experience in core competency and curriculum development. Her responses were included in the group of nurse responses, making a total of 4 Delphi panelists in that group. These experts were identified through their scholarly work, affiliation with professional organizations and societies, academic appointments, government agencies, and personal knowledge by the research team. The 8 groups included nurses (RNs and LPNs/LVNs), nursing assistants, respiratory therapists, physical and occupational therapists, environmental services workers, physicians, laboratory professionals, and ancillary staff. For the purpose of this project, ancillary staff was defined as hospital workers with limited patient care-related physical contact that is likely to result in disease transmission. Examples of ancillary staff include clergy, food service, and social workers.

The Delphi technique is a structured process that uses a series of data collection rounds to gather the opinions and judgments of a panel of experts on the topic of interest.⁹ At the end of each round, responses are analyzed and summarized, then reported back to the expert panel to begin the next round. These multiple iterations of data collection and review are used to achieve group consensus on the issue at hand. The Delphi technique was selected as the approach for this study because it provides an efficient means of capturing the expertise of multiple individuals who reside in various geographic regions, without the need for a formal meeting.¹⁰ Panelists can see how their views compare to those of other experts in the field and then adjust them, if desired, after considering the group's findings. It also gives participants an opportunity to express their opinions and knowledge in an anonymous

Table I. Infection prevention and control competencies for hospitalbased health care workers

Cluster area of competency	Competency statement	Terminal objective
Basic microbiology	1. Describe the role of microorganisms in disease.	<ul style="list-style-type: none"> a. Describe the different types of microorganisms (bacteria, viruses, fungi, etc.), and their role in health care-associated infections. b. Describe antimicrobial resistance and its importance in health care associated infections. c. Demonstrate proper techniques for collecting, handling and transporting of laboratory specimens.
Modes/mechanisms of infection/disease transmission	2. Describe how microorganisms are transmitted in health care settings.	<ul style="list-style-type: none"> a. Identify the links in the chain of infection. b. Differentiate between transmission routes of microorganisms in the health care setting (e.g., airborne, contact, droplet). c. Describe the role the environment plays in microorganism transmission in health care settings. d. Apply principles of asepsis (e.g., clean vs. dirty tasks, sterile vs. non-sterile procedures). e. Distinguish between clean, disinfected, and sterile patient care items. f. Describe the difference between a product that cleans and one that disinfects.
Standard and transmission-based precautions	3. Demonstrate standard and transmission-based precautions for all patient contact in health care settings.	<ul style="list-style-type: none"> a. Describe the principles of standard precautions. b. Demonstrate proper hand hygiene. c. Describe appropriate use of hand hygiene products (soap and water, antimicrobial soap, surgical scrub, waterless alcohol agent) and when to use each. d. Describe the categories of transmission-based precautions and when to initiate the preventive activities of each category. e. Demonstrate how to verify negative pressure function of a patient environment. f. Describe appropriate patient placement (e.g., room type, cohorting) relative to the category of transmission-based precautions. g. Describe appropriate interventions required during patient transport relative to the category of transmission-based precautions. h. List the appropriate personal protective equipment items for each category of transmission-based precautions. i. Demonstrate how to put on and take off personal protective equipment. j. Demonstrate fit check (user seal check) of NIOSH-approved respirator. k. Describe appropriate disposal of personal protective equipment. l. Describe the signs, symptoms and diagnoses that would alert a health care worker to initiate transmission-based precautions (e.g., fever with cough, fever with skin rash/lesion, fever with other respiratory symptoms, gastrointestinal symptoms).
Occupational health	4. Describe occupational health practices that protect the health care worker from acquiring infection.	<ul style="list-style-type: none"> a. Demonstrate safe handling and disposal of sharps. b. Demonstrate appropriate use of safety devices. c. Explain methods to safely handle blood and body fluids to prevent exposure. d. Describe the first aid for cut/puncture exposures, or fluid exposures to the eyes, nose or mouth. e. Articulate the process for reporting blood/body fluid exposure in the workplace. f. Describe appropriate disposal of items soaked/saturated with blood/body fluids or other potentially infectious materials. g. Describe regulated waste vs. general trash and the appropriate disposal of each.

Continued

Table I. Continued

Cluster area of competency	Competency statement	Terminal objective
Patient safety	5. Describe occupational health practices that prevent the health care worker from transmitting infection to a patient.	<ul style="list-style-type: none"> a. Describe work practices that reduce the risk of infection transmission (e.g., immunization, not coming to work sick, hand hygiene). b. Explain the importance of health care worker participation in immunization programs. c. Describe how a staff member with an infectious condition can pose a risk to other health care worker, patients, and visitors. d. Describe signs, symptoms and diagnoses that require absence from work or work restrictions (e.g., fever with cough, fever with skin rash/lesion, fever with other respiratory symptoms, gastrointestinal symptoms).
Critical thinking	6. Demonstrate ability to problem-solve and apply knowledge to recognize, contain, and prevent infection transmission.	<ul style="list-style-type: none"> a. Explain how to access infection control resources including policies and procedures. b. Discuss own role in infection prevention and control (e.g., recognizing unsafe activities, intervening when breaches in infection control are identified). c. Describe practice changes (e.g., altered standard of care) in the event of limited resources.
Emergency preparedness	7. Describe the importance of health care preparedness for natural or man-made infectious disease disasters.	<ul style="list-style-type: none"> a. Explain own role in the facility disaster plan. b. Demonstrate participation in facility drills and exercises. c. Describe practice changes (e.g., altered standard of care) in the event of limited resources.

fashion, thus avoiding undue influence of any one individual and putting all members on an equal footing.¹¹

Once the panel of experts was identified, the experts were invited to participate in an opening teleconference that outlined the project's concepts, goals, and objectives. The identities of the panelists were not shared among that group until permission had been received from each.

After the opening teleconference, Delphi panel members were e-mailed a link to an online survey in May 2007 and asked to assess the relevance of a first draft document containing the competency statements and the terminal objectives associated with that statement. The online survey was developed using Zoomerang (MarketTools, San Francisco, CA). Each competency and terminal objective was measured on a 4-point Likert scale (1 = agree/important; 2 = disagree/not important; 3 = neutral/no opinion; 4 = undecided). There was also space for panel members to edit wording and provide comments on the various statements; for example, a panelist could note that in his or her opinion, a specific terminal objective was best matched to another competency statement or note that multiple competency statements were redundant. The scores for each competency and terminal objective were averaged, and narrative comments were evaluated.

Agreement of $\geq 80\%$ was required to keep a competency or terminal objective; narrative comments were incorporated into the competency or terminal objective when applicable. New draft competencies and terminal objectives were developed based on findings from the Delphi process. In this step, a summary document containing all comments from the previous iteration and a revised version of the competency statements and terminal objectives were sent to each panelist. This provided them with the opportunity to see comments and assess changes in the new version in preparation for completing the next survey. A link to an updated survey was sent to each panelist the following week. This process was repeated in July and again in September 2007, for a total of 3 iterations. To support the questions or comments of any panelist, optional teleconferences were scheduled to facilitate discussion. The investigators remained in e-mail contact with all panelists as a means of capturing any comments that a panel member wished to relay in a confidential manner and to maintain cohesion.

Delineation of competencies by occupation

Once panel member agreement was confirmed and the existing competencies and terminal objectives

c. Describe appropriate use of hand hygiene products (soap and water, antimicrobial soap, surgical scrub, waterless alcohol agent) and when to use each.	●	●	●	●	●	●	●	●
d. Describe the categories of transmission-based precautions and when to initiate the preventive activities of each category.	●	●	●	●	●	●	X	●
e. Demonstrate how to verify negative pressure function of a patient environment.	●	●	X	●	●	●	X	●
f. Describe appropriate patient placement (e.g., room type, cohorting) relative to the category of transmission-based precautions.	●	●	X	●	●	●	X	●
g. Describe appropriate interventions required during patient transport relative to the category of transmission-based precautions.	●	●	●	●	●	●	X	●
h. List the appropriate personal protective equipment items for each category of transmission-based precautions.	●	●	●	●	●	●	●	●
i. Demonstrate how to put on and take off personal protective equipment.	●	●	●	●	●	●	●	●
j. Demonstrate fit check (user seal check) of NIOSH-approved respirator.	●	●	●	●	●	●	X	●
k. Describe appropriate disposal of personal protective equipment.	●	●	●	●	●	●	●	●
l. Describe the signs, symptoms and diagnoses that would alert a health care worker to initiate transmission-based precautions (e.g., fever with cough, fever with skin rash/lesion, fever with other respiratory symptoms, gastrointestinal symptoms).	●	●	●	●	●	●	X	●

Continued

	lesion, fever with other respiratory symptoms, gastrointestinal symptoms).								
Critical thinking	6. Demonstrate ability to problem-solve and apply knowledge to recognize, contain, and prevent infection transmission.	●	●	●	●	●	●	●	●
	a. Explain how to access infection control resources including policies and procedures.	●	●	●	●	●	●	●	●
	b. Discuss own role in infection prevention and control (e.g., recognizing unsafe activities, intervening when breaches in infection control are identified).	●	●	●	●	●	●	●	●
	c. Describe practice changes (e.g., altered standard of care) in the event of limited resources.	●	●	●	●	●	●	●	●
Emergency preparedness	7. Describe the importance of health care preparedness for natural or man-made infectious disease disasters.	●	●	●	●	●	●	●	●
	a. Explain own role in the facility disaster plan.	●	●	●	●	●	●	●	●
	b. Demonstrate participation in facility drills and exercises.	●	●	●	●	●	●	●	●
	c. Describe practice changes (e.g., altered standard of care) in the event of limited resources.	●	●	●	●	●	●	●	●

Note. X indicates statement not deemed as relevant to the specific health care worker discipline.

were finalized, a link to an online survey was e-mailed to each panel member to verify acceptance of the competency statements and terminal objectives as written (1 = I accept this statement; 2 = I do not accept this statement), then assess the applicability of each item to his or her specific occupation. Delphi panel members were asked to indicate the relevance of the competency statements and terminal objectives to the category of health care worker (1 = relevant; 2 = not relevant). Answers from the 3 panel members who represented each occupation were averaged.

RESULTS

After the third round of Delphi panel assessment in September 2007, there was a > 90% agreement on all statements and terminal objectives, and at least 2 of the 3 individuals representing each discipline, and at least 3 of the 4 nurses, were in agreement. This iteration provided the final version of the competencies and terminal objectives, as shown in Table 1.

After discipline-specific feedback was incorporated, a final matrix resulted that listed the competency statements and terminal objectives with notation from each discipline as to whether each statement and/or objective was pertinent to that discipline. This matrix is shown in Table 2. These results affirm the investigators' working hypothesis that the elements of an infection prevention and control competency training program likely would be consistent across health care worker disciplines. The content for practical application would require specific modifications to address discipline-specific needs, however.

DISCUSSION

Identifying the specific knowledge and skills that a hospital-based health care worker should possess is a first step in establishing the basic infection prevention and control foundation for educational settings, including academic programs, employer orientation processes, and other forms of health care worker continuing education. This project resulted in a set of IPC competencies that await testing in real-world settings and for hospital-based health care worker education. Overall, the competencies identified in this study are very similar to those identified for Canadian health care workers.⁶ Two advantages to the competencies identified through this study are the delineation of competencies by health care worker groups and the identification of terminal objectives that can be used to measure health care worker performance. Another unique finding in this study was the need for a competency that addresses health care preparedness for natural or man-

made infectious disease disasters. Bioterrorism and pandemic preparedness efforts tend to focus on facility or community readiness, but often fail to identify the individual health care worker's role in preparing for such an event. Given the impact of SARS, the 2001 anthrax bioterrorism incident, and extensive influenza pandemic planning in the United States, it is obvious that this competency must be incorporated into hospital-based health care worker training programs if we expect hospitals to be prepared for an infectious disease disaster.

Identifying IPC competencies is only the first step in standardizing infection prevention and control practices. Translation and dissemination of these competencies into educational programs across all settings and disciplines are also needed. Subsequent steps also should involve communicating these competencies to policy leaders and professional organizations in each of the hospital-based health care worker disciplines and developing discipline-specific curricula. Each discipline will require modified educational content specific to their job function as outlined by the study. A competency-based approach to health care worker training provides the framework on which this flexible training can be based. The terminal objectives identified in this project also could be used to assess health care worker performance and ensure that training has been successful and that proper infection prevention strategies are being implemented. A combination of individual and peer monitoring may be used to maximize the assessment of perceived and actual behavior. As the IPC competencies are translated and disseminated into educational programs and curricula, these training materials must be validated through a structured evaluation process that includes measurement of the behavioral change in the practice setting. In this way, educational content can be standardized to ensure maximum effectiveness.

One limitation of this study involves the small number of health care personnel (3) in each discipline. Another limitation involves use of the Web-based process as a primary means for vetting each iteration of the matrix. This method has the potential to limit open discussion that could be shared by all participants although discussion through more frequent group conference calls or interviews.

CONCLUSION

The methods used in this study were successful in developing the first IPC competency and terminal objective matrix for hospital-based health care personnel through a process of (1) drafting potential competency statements and measurable objectives using literature review, (2) verifying the information through an expansion of the competency statements and objectives using

a Delphi panel of experts crossing 8 different hospital disciplines, and (3) clarifying and confirming the competency statements and terminal objects according to health care discipline using the Delphi panel of experts.

This finalized set of core competencies and measurable terminal objectives were verified and confirmed by Delphi panelists who were all active in the health care field. The final matrix may be considered a first step toward the development of a framework for standardized infection prevention education and training materials for hospital-based health care workers. The next step should be a process that can determine how well the matrix can be used and applied to educational programs provided in the real-world setting as a means of determining the validity of training materials. To accomplish this necessary validation, future work should include developing curricula designed to address the necessary knowledge and skill elements, identifying metrics specific to the health care discipline, and evaluating the health care worker's ability to apply the knowledge in his or her specific field and environment. Ensuring that every hospital-based health care worker is competent to prevent infection transmission is an essential element for daily practice as well as during times of emergency. The competencies and terminal objectives can be used as a step toward ensuring the readiness of hospital-based health care workforce.

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