Practice analysis for infection control and epidemiology in the new millennium

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Background: The Certification Board of Infection Control and Epidemiology appointed an advisory committee to conduct a practice analysis (PA) of infection control professionals (ICPs) to identify current practices of ICPs. Results of the PA would assist in the development of a revised certification examination.

Methods: Five thousand seven hundred fifty-three questionnaires were distributed to ICPs in the United States and in Canada, as well as to a subsample of ICPs in other countries. Decision rules and criteria were applied to each identified task in the PA.

Results: A total of 1306 responses were available for analysis, for a 24% return rate. The majority of the respondents were certified in infection control, had a background as a registered nurse, and worked in a community hospital with 200 or fewer beds. Six major categories, with 135 tasks, were identified in the PA. The following 2 new categories were included: education and research and infection control aspects of employee health.

Conclusions: The PA reflects current changes in the practice of infection prevention/control and applied epidemiology in the United States and Canada. The test specifications accepted for adoption by the Certification Board of Infection Control and Epidemiology will be used to build all examination forms for a certification program for ICPs. (Am J Infect Control 2002;30: 437-48.)

The certification examination in infection control and epidemiology is periodically evaluated to ensure that test questions accurately reflect the knowledge and problem-solving skills used by the infection control professional (ICP) in diverse practice settings and ever-evolving professional activities. Each of these practice evaluations builds on previous research and is an important component of ensuring content validity of the examination results. This process of content validation also is known as *task analysis*, which involves systematic collection of information that describes behaviors and activities performed by occupants of the job in question.[1-3] Numerous changes in health care delivery and shifts within the scope and practice of infection control have occurred since the last task analysis in 1996.[4] In addition, the Association for Professionals in Infection Control and Epidemiology, Inc (APIC)/Canadian and Hospital Infection Control Association (CHICA)-Canada professional and practice standards for infection control were published in 1999.[5] Therefore, a more contem-

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porary analysis was needed to guide the content of the certification examination.

Members of the Certification Board of Infection Control and Epidemiology, Inc (CBIC) and other nationally recognized experts have conducted ICP-focused practice analyses since 1982.[5-12] The process involved, the methodology used, and the results obtained from the 2001 practice analysis are presented in this article. The resulting changes in the 2002 certification content outline will drive the composition of the certification examination.

The purpose of the practice analysis (PA) was 2-fold: (1) to determine and comprehensively describe the functions of the ICP and (2) to evaluate this description to define areas that should be assessed in a certification examination. The CBIC appointed a 13-member advisory committee (AC), which included members of the CBIC board of directors, the Test Committee, and other certified individuals. The AC conducted the activities necessary to identify ICP job responsibilities and to develop the test specifications on the basis of the analysis of these responsibilities. The education, work setting, and regional location of the AC membership were diverse and included demonstrated expertise in the duties and activities of the profession as well as certification in infection prevention/control and applied epidemiology.

The *APIC/CHICA-Canada Infection Control and Epidemiology: Professional and Practice Standards*[5] document has the following 2 sections: (1) professional standards that the ICP is expected to meet or exceed and (2) practice standards that the ICP is capable of meeting, regardless of applicability to the specific practice setting. The AC extensively reviewed these professional and practice standards and synthesized them into the 2001 PA survey to ensure that the resulting content outline was consistent with current standards of ICP practice.

The PA process involved 2 distinct phases. The first phase included developing a job analysis survey instrument, piloting that instrument, and distributing the instrument to a sample of ICPs throughout the United States and Canada. In the continuing process of serving the international infection control market, the survey instrument also was distributed to a small sample of international practitioners.

The second phase of the PA included analyzing survey responses, developing test specifications for the certification examination on the basis of the analysis of data, and finalizing the detailed content outline. The focus of the analyses was on the responses from participants from the United States and Canada to ensure that the resulting content outline could be used to support the validity of the certification examination results for candidates practicing in the United States and Canada. All phases of the project were accomplished with members of the AC working in concert with representatives from Applied Measurement Professionals, Inc (AMP) of Lenexa, Kansas, which was CBIC's contracted professional testing organization.

METHODS

The 2001 CBIC AC considered various resource materials to understand the current responsibilities of ICPs. With the assistance of the AMP project staff, the AC accomplished the following 6 tasks at its first meeting: (1) developed a sampling plan; (2) determined the relevant demographic variables; (3) identified tasks for the survey instrument; (4) identified major classifications of core tasks; (5) determined rating scales; and (6) integrated the demographics, rating scales, and tasks into a survey instrument.

Developing a sampling plan

The target population for the study consisted of ICPs in the United States and Canada who met the eligibility requirements for taking the certification examination. The *eligible ICP* was defined as an ICP with at least 2 years of direct experience working in a health care setting and responsible for the following: (1) collection, analysis, and interpretation of epidemiologic data relative to infections and (2) investigation and surveillance of suspected infection outbreaks. In addition, this professional performed activities in at least 3 of the following areas: (1) planning, implementing, and evaluating infection prevention and control measures; (2) providing education concerning infection risk, prevention, and control; (3) developing and revising infection control policies and procedures; (4) managing infection prevention and control activities; and/or (5) consulting on infection risk management, prevention, and control strategies.

The AC used the directories of the CBIC and CHICA to create a list of survey instrument recipients. Membership directories were compared to reduce the number of duplicated names. The use of the CBIC and CHICA directories ensured that ICPs throughout North America with varying levels of experience and

job responsibilities would be contacted. In addition, it was important to contact noncertified practitioners to verify that everyone, not just those who hold the CBIC's credential, performed the tasks represented in the survey. Names and addresses for the international sample were collected from personal contacts of the AC and others who had contacted the CBIC office to inquire about certification.

Determining the relevant demographic variables

Twelve demographic variables were determined to be relevant and important. Since this was a North American PA with international respondents, it was important to identify respondents' geographic region of employment. In addition, questions about educational background and work setting were asked to ensure that judgments of various subgroups would support the relevance of tasks for inclusion in the resulting test specifications. Other questions related to the number of years worked as an ICP, type of primary employment, bed capacity (if applicable), and certification status.

Identifying tasks for the survey instrument

AMP provided a draft task list, which had been developed from a review of various sources, at the AC's first meeting. The primary source was the 1997 Infection Control Professional task list.[4] In addition, job descriptions, performance appraisals, and course syllabi were reviewed.

The draft task list was thoroughly discussed, and tasks representing individual practice responsibilities were modified, added, or deleted. After the response to the pilot study was reviewed, the final list of 163 tasks was approved for inclusion in the survey questionnaire for mailing.

Identifying major classifications of core tasks.

The AC determined that each task in the survey instrument would be assigned to 1 of the following primary practice categories in which the task was usually performed:

- Identification of Infectious Diseases Processes
- Surveillance and Epidemiologic Investigation
- Preventing/Controlling the Transmission of Infectious Agents
- Employee Health/Occupational Health
- Management and Communication
- Education
- Research

Table 1. Distribution of sample by geographic location

Geographic location	N	%
New England (ME, NH, VT, RI, MA, CT)	88	6.7
Mid-Atlantic (NJ, NY, PA)	167	12.8
East North Central (OH, IN, IL, MI, WI)	162	12.4
West North Central (IA, KS, MN, MO, ND, SD, NE)	102	7.8
South Atlantic (DE, MD, VA, WV, NC, SC, GA, FL, DC)	174	13.3
East South Central (KY, TN, AL, MS)	59	4.5
West South Central (AR, LA, OK, TX)	89	6.8
Mountain (MT, ID, WY, CO, NM, AZ, UT, NV)	58	4.4
Pacific (WA, OR, CA, AK, HI)	105	8.0
Eastern Canada	27	2.1
Central Canada	107	8.2
Western Canada	80	6.1
Other*	28	2.1
Total	1246	95.4
No response	60	4.6
Total	1306	100

*Other responses included Australia, Caribbean, Central Europe, Eastern Europe, Western Europe, India, Japan, Saudi Arabia, South Africa, South America, Southeast Asia, South Korea, and Thailand.

Determining Rating Scales

The advantages and disadvantages of several different rating scales were discussed. It was important that the survey respondents could identify whether a task was included as a regular part of their practice as well as the perceived importance of that task to their role as an ICP. The following scale was adopted:

In your role as an ICP, considering both importance and frequency, how significant is this task to safe and effective performance?

0 = Not necessary for the job
1 = Minimally significant
2 = Somewhat significant
3 = Quite significant
4 = Extremely significant

Integrating demographics, rating scales, and tasks into a survey instrument

After the first meeting in February 2001, all components of the survey (demographics, rating scales, and tasks) were combined into a survey questionnaire. The questionnaires were distributed in April 2001 according to the sampling plan.

RESULTS

Of the 5753 questionnaires distributed to the survey sample, 315 were returned as undeliverable, and 8 were returned incomplete or too late for inclusion

Table 2. Distribution of sample by years of experience

Years of experience	n	%*
2-5	197	15.1
6-10	348	26.6
11-15	333	25.5
≥16	381	29.2
Total	1259	96.4
No response	47	3.6
Total	1306	100

*Percent on the basis of all respondents, including those who did not respond to the question: "How many years have you worked in infection control?"

Table 3. Distribution of sample by type of health care facility

Type of facility	n	%*
Community	563	43.1
University	118	9.0
Specialty	32	2.5
Federal	54	4.1
Regional or health care system	147	11.3
Long-term care	102	7.8
Mental health	25	1.9
Rehabilitation	13	1.0
Public health	52	4.0
Ambulatory care	11	0.8
Consultant	25	1.9
Correctional facility	7	0.5
Home care	8	0.6
Other	25	1.9
Total	1182	90.5
No response	124	9.5
Total	1306	100

*Percent on the basis of all respondents, including those who did not respond to the question: "Where are you primarily employed?"

Table 4. Distribution of sample by facility size

Bed capacity	n	%*
1-100	209	16.0
101-200	257	19.7
201-300	214	16.4
301-500	245	18.8
>500	210	16.1
Not applicable	121	9.3
Total	1256	96.2
No response	50	3.8
Total	1306	100

*Percent on the basis of all respondents, including those in the "not applicable" category and those who did not respond to the question: "What is the bed capacity of the facility where you are employed?"

Table 5. Distribution of sample by number of ICPs assigned to facility (FTEs)

FTE	n	%*
<1	309	23.7
1	454	34.8
>1 but <3	296	22.7
≥3	186	14.2
Total	1245	95.3
No response	61	4.7
Total	1306	100

FTE, Full-time equivalent.
*Percent on the basis of all respondents, including those who did not respond to the question: "How many infection control professionals (FTEs) are assigned to your facility?"

Table 6. Distribution of sample by number of hours/week spent in infection control activities

Hours/week spent in infection control activities	n	%*
8-20	297	22.7
21-39	322	24.7
≥40	634	48.5
Total	1253	95.9
No response	53	4.1
Total	1306	100

*Percent on the basis of all respondents, including those who did not respond to the question: "Over the past 2 years, approximately how many hours per week have you spent in infection control activities?"

Table 7. Distribution of sample by certification in infection control

Certification	n	%
Yes	1100	84.2
No	170	13.0
Total	1270	97.2
No response	36	2.8
Total	1306	100

in the data analysis. A total of 1306 responses were available for analysis, representing a corrected return rate of 24%. According to AMP,[13] the return rate was typical of studies of this type. Despite the low return rate, the distribution of the responses indicated that a wide range of ICPs was represented, but more specifically the criteria of including practitioners with varying years of experience, geographic location, and certification status were met. The AC confirmed that the demographics of the

Table 8. Distribution of sample by level of education

Educational level	n	%
High school	3	0.2
Associate degree	82	6.3
Diploma	216	16.5
Baccalaureate	577	44.2
Masters	340	26.0
Doctorate	33	2.5
Total	1251	95.8
No response	55	4.2
Total	1306	100

Table 9. Distribution of sample by professional background

Professional discipline	n	%
Registered nurse	1043	79.9
Medical technologist	119	9.1
Doctor of medicine/doctor of osteopathy	17	1.3
Licensed practical nurse/licensed vocational nurse/registered practical nurse	5	0.4
Other	51	3.9
Total	1235	94.6
No response	71	5.4
Total	1306	100

Table 10. Tasks and respondent rating reliability estimates for the importance scale*

Content area	No. of tasks	Reliability (consistency)		No. of respondents
		Between respondents (intraclass)	Between tasks (coefficient alpha)	
1. Identification of infectious disease processes	17	0.99	0.88	994
2. Surveillance and epidemiologic investigation	52	0.99	0.95	415
3. Preventing/controlling the transmission of infectious agents	18	0.99	0.92	778
4. Employee health/ occupational health	13	0.99	0.92	687
5. Management and communication	43	0.99	0.96	398
6. Education	13	0.99	0.92	820
7. Research	7	0.99	0.88	784
Total tasks	163	0.98	0.99	153

*Note: Respondent subsets of varying size are shown because complete data matrices were required to calculate reliability estimates and some respondents did not rate some tasks; therefore, they are excluded from all analyses.

respondent group mirrored those of the profession. In addition, the response rate of N = 1306 significantly exceeded the N = 1067 required by power analysis.

Demographic information

The "Background Information" section of the questionnaire provided descriptive information of the sample. As shown in Table 1, respondents were distributed across all 12 geographic regions (9 in the United States and 3 in Canada), with the largest number of respondents (n = 174) originating from the South Atlantic United States. An additional number of respondents surveyed were from outside the United States and Canada (n = 28).

Table 2 data indicate that the largest group of respondents (29%) had worked in infection control for 16 or more years. The remaining demographic characteristics of the sample are summarized in Tables 3 through 9. Seventy-three percent of the sample held a bachelor's or higher degree, and 80% had a background as a registered nurse. The majority (84%; n = 1100) of the survey sample was certified in infection control, with 94% of these planning to recertify. Of those who were not certified (n = 170), 53% planned to become certified. The typical respondent worked in a community hospital that was accredited by an organization that had infection control standards (85%), with the majority (52%) working in a facility with fewer than 300 beds. The typical respondent worked in a facility that employed 1 full-time equivalent ICP, with nearly half (49%) working 40 or more hours a week.

Adequacy of the instrument

Fifty-one percent (n = 623) of the respondents who answered the question: "How well do you feel this instrument covered the important tasks of your profession?" believed that the PA instrument adequately covered the important activities of an ICP. Another 48% (n = 586) believed that the instrument covered them completely.

Another aspect of the adequacy of the instrument relates to its reliability. In Table 10, the reliability esti-

Table 11. Decision rules and criteria for ineligibility of task for inclusion in examination

Decision rule	Criteria to remove tasks
Rule 1: The task should be judged necessary for the job	a. ≥20% "not necessary" rating (frequency) overall b. ≥30% "not necessary" rating from both Canadian and US respondents
Rule 2: The task should be judged as significant	Rating <2.50 (significance) overall
Rule 3: The task should be significant to ICPs in the United States and Canada	Rating <2.30 in 3 of the 12 geographic regions
Rule 4: The task should be significant to ICPs regardless of years experience	Rating <2.30 in any experience level
Rule 5: The task should be significant to ICPs regardless of infection control certification status	Rating <2.30 in either certification category

Table 12. Tasks removed from the examination on the basis of decision rules (n = 16)

Task	n	Mean	SD
Conduct surveillance for the detection of noninfectious adverse events	956	1.89	0.88
Design computerized data entry screens, input formats, and data entry codes for an occupational health program	833	2.15	1.00
Utilize predesigned surveillance software packages for occupational health programs	824	2.33	1.02
Assist in writing funding proposals	859	1.99	0.94
Provide consultation regarding worker's compensation relating to occupational infections and/or exposures	951	2.47	1.01
Contribute to the development of surveillance systems for noninfectious adverse events	1013	1.96	0.88
Use advanced statistical techniques to describe data (eg, z score, χ^2, odds ratio)	995	2.24	0.95
Provide surgeons with line listings of surgical-site infections for validation before formal analysis	971	2.47	1.00
Integrate cost accounting data into the analysis of nosocomial infection reports	1088	2.47	0.97
Communicate infection control information to the public and news media	1055	2.34	0.98
Design computerized data entry screens, input formats, and data entry codes for a surveillance program	1117	2.41	0.98
Contribute epidemiologic skills to quality/performance improvement process related to noninfectious adverse events (eg, falls, pressure ulcers, medication errors)	966	2.46	1.00
Conduct research in infection prevention and control either independently or collaboratively	1018	2.45	1.03
Participate in supervisory responsibilities for infection control personnel: interviewing and personnel selection	917	2.96*	0.98
Participate in supervisory responsibilities for infection control personnel: performance evaluation and counseling	916	2.96*	0.97
Evaluate compliance with regulatory agency requirements	1161	3.25*	0.93

*These tasks were eliminated on the basis of Rule 1. Although the overall mean was >2.50 for each of these tasks, fewer than 70% of Canadian ICPs rated them necessary.

mates of the 7 categories of tasks and the raters are shown. Task reliability estimates (coefficient alpha) show to what extent each scale "hangs together." Maximum reliability is represented by a coefficient of 1.00; therefore, an average task item reliability value of 0.92 indicates that the scale represents a consistent collection of tasks. Rater reliability estimates (shown as intraclass correlation coefficients in the table) are more important and indicate the degree to which raters agree on the significance of an item. The overall reliability coefficient of 0.98 indicates a high degree of inter-rater reliability.

Task ratings

A major objective of the PA was to determine which of the 163 tasks accurately reflected current practice in infection control and applied epidemiology. To accomplish this, the AC used several decision rules. Applying decision rules ensures that the resulting examination reflects only the responsibilities of ICPs for whom the examination is intended. These rules are outlined in Table 11.

Application of decision rules and criteria

Rule 1. ICPs should find the task necessary for practice. The first decision rule adopted by the AC had 2 components. The first was that at least 80% of the total respondent group should judge a task to be necessary for the task to be retained (Rule 1a). Stated another way, tasks for which 20% or more of the respondents rated as 0 (zero) would be removed. The second component of Rule 1 was that at least 70% of ICPs both from Canada and the United States (separately) should judge a task to be necessary for the task to be retained (Rule 1b). Application of Rule 1a indicated that 6 tasks should be removed from the certification examination. These eliminated tasks are listed in Table 12.

Applying Rule 1b resulted in 2 additional tasks being removed from the examination (see Table 12).

Rule 2. ICPs should judge the task as significant. On a rating scale from 0 (zero, not necessary for the job) to 4 (extremely significant), the most appropriate point separating a quite significant task from one that is only somewhat significant could be around 2.50, where values less than that may not be clearly significant enough for the examination. The AC determined that for a task to remain eligible for assessment, it should have received a mean rating of at least 2.50 from those individuals who provided a rating of significance for the task. Eight tasks that did not meet this criterion were removed (see Table 12).

Rule 3. The task should be significant to ICPs residing in the United States and Canada. For a task to remain eligible for assessment, it should have received a mean rating of at least 2.30 from respondents in 10 of the 12 regions in the United States and Canada. Including this decision rule ensures that the resulting examination will be appropriate for ICPs practicing throughout the United States and Canada. The slightly lower criterion for this and subsequent decision rules is a reflection of the fact that rating consistency can be expected to decrease with smaller respondent groups. No additional tasks were removed from the examination on the basis of this criterion.

Rule 4. The task should be significant to ICPs who have been practicing for various numbers of years. For a task to remain eligible for assessment, ICPs who have worked for various lengths of time (ie, respondents who have worked 2 to 5 years, 6 to 10 years, 11 to 15 years, and 16 years or more) must rate the task at least 2.30 on the significance scale. Application of this criterion resulted in no additional removal of tasks from the examination.

Rule 5. The task should be significant to ICPs regardless of their certification status. For a task to remain eligible for assessment, it should be judged as similar in significance by those who are certified in infection control and applied epidemiology and for those who are not. The criterion of the fifth rule was that regardless of certification status, ICPs should rate the task at least 2.30 on the significance scale. Applying Rule 5 criterion resulted in no additional removal of tasks from the examination.

Application of the decision rules and related criteria resulted in the removal of 16 tasks (see Table 12), leaving a reasonable distribution of topics for testing entry level ICPs throughout the United States and Canada. Removal of such a small number of tasks provided another indication of the appropriateness of the task list.

Development of final examination content outline and test specifications

Before finalizing the list of tasks for the examination, the AC reviewed the suggestions for additional tasks provided in response to an open-ended question at the end of the survey instrument. In general, the AC determined that most of the additional tasks suggested by the respondents were already addressed by an existing task. Other suggested tasks were judged by the AC to be either not possible or not significant enough to test.

The AC incorporated the identified tasks into a revised certification examination content outline. Because there were only 5 tasks added in the "research" category, they were combined with "education" and the content area was renamed "Education and Research."

Several new tasks related to employee health were identified in the 2001 PA survey; therefore, the rationale was that an added area to the examination content outline was necessary. The new content category was labeled "Infection Control Aspects of Employee Health." Tasks that were related to employee health in the previous (1997) content outline[4] were moved to this new category (Table 13).

The 2001 revised examination content outline contained 147 tasks that were organized into 6 major categories to ensure appropriate content coverage. A 135-item test was judged to be of a sufficient length to adequately cover the breadth of content at an appropriate level of reliability for the ICP examination. The 6 major categories were identified as:

Identification of Infectious Disease Processes
Surveillance and Epidemiologic Investigation
Preventing/Controlling the Transmission of Infectious Agents
Program Management and Communication
Education and Research
Infection Control Aspects of Employee Health

Once the number of items was determined, the next step involved defining the cognitive complexity of the content. A complexity scale was designed to determine at what cognitive level individual tasks were per-

Table 13. 2002 CBIC Certification Examination content outline

I. Identification of infectious disease processes
- A. Differentiate among colonization, infection, and contamination
- B. Identify occurrences, reservoirs, incubation periods, periods of communicability, and susceptibility
- C. Interpret results of diagnostic findings/testing (ie, laboratory, x-ray, and other tests)
- D. Interpret Gram's stains, microbiologic culture, and sensitivity reports
- E. Identify limitations and advantages of types of tests used to diagnose infectious processes
- F. Advise health care providers regarding appropriate laboratory testing to detect immunity to infectious diseases
- G. Interpret epidemiologic markers for bacteria in outbreak investigations
- H. Recognize sentinel events and epidemiologically significant organisms for immediate review and investigation
- I. Describe collection, handling, transport, and storage techniques of microbiologic specimens
- J. Differentiate among prophylactic, empiric, and therapeutic uses of antimicrobial agents
- K. Differentiate between appropriate and inappropriate environmental microbiologic monitoring
- L. Assess patient and employee status regarding the following:
  1. Signs and symptoms of infections
  2. Exposure to communicable disease
  3. Laboratory results
  4. Risk of transmission
  5. Host risk factors

II. Surveillance and epidemiologic investigation
- A. Design of surveillance systems
  1. Develop a plan on the basis of the population served, services provided, and available data
  2. Establish a mechanism for identifying baseline/threshold rates
  3. Establish a notification system for critical laboratory results
  4. Determine appropriate and feasible facility-specific denominator data for the following:
     a. Surgical procedures (eg, ASA score, wound classification, surgical time, surgeon-specific)
     b. Device-related infections (eg, central lines, ventilators, urinary catheters)
     c. Population at risk (eg, unit-specific, service-specific, procedure-specific)
  5. Review laboratory reports to identify potential infections due to reportable pathogens
  6. Develop surveillance and referral forms to collect appropriate data
  7. Utilize predesigned surveillance software packages for infection control programs
  8. Perform surveillance of patients with postdischarge infections
  9. Facilitate postdischarge follow-up for patient exposure to communicable diseases while in your facility
  10. Integrate surveillance activities within affiliated health care settings (eg, ambulatory, home health, long-term care, acute care)
  11. Perform surveillance studies with risk stratification
  12. Establish a mechanism for identifying those with communicable diseases who necessitate follow-up and isolation
  13. Participate in antimicrobial monitoring and evaluation
  14. Select indicators on the basis of the projected use of the data (ie, external benchmarking and/or internal trending)
  15. Evaluate periodically the effectiveness of the surveillance plan, and modify as necessary
- B. Collection of surveillance data
  1. Use a systematic approach to record surveillance data
  2. Use standardized definitions for the identification and classification of events, indicators, or outcomes
  3. Collect and compile data on the following:
     a. Surgical procedures (eg, ASA score, wound classification, surgical time, surgeon-specific)
     b. Device utilization (eg, central lines, ventilators, urinary catheters)
     c. Population at risk (eg, unit-specific, service-specific, procedure-specific)
  4. Use data from other departments or agencies (eg, admissions, pharmacy, operating room)
  5. Enter data into a computerized system
  6. Collect data correlating preoperative, intraoperative, and perioperative antibiotic use with surgical site infection rates
- C. Compiling surveillance data
  1. Determine the incidence of nosocomial infections (ie, number of new infections in a population at risk over a period of time)
  2. Calculate device-related infection rates with use of device days
  3. Use basic statistical techniques to describe data (eg, mean, standard deviation)
  4. Calculate rates or ratios
  5. Determine the prevalence of epidemiologically significant findings
  6. Monitor antibiotic resistance patterns
- D. Interpretation of surveillance data
  1. Generate, analyze, and validate surveillance data
  2. Prepare a periodic report of analyzed data
  3. Use computerized system to analyze data
  4. Identify variances from baseline surveillance data that require action
  5. Recognize statistical significance of surveillance data

Continued on next page

Table 13. Continued from previous page

6. Use tables, graphs, or charts to present reports of epidemiologic investigation or surveillance
7. Coordinate and/or conduct investigations of clusters of infection or other adverse events occurring above expected levels
8. Recognize the need for an epidemiologic study to investigate a problem (eg, case control, cohort studies)
9. Report findings of epidemiologic significance to appropriate customers
10. Compare results with published data or other benchmarks

E. Outbreak investigation
1. Collaborate with appropriate persons to establish the case definition, period of investigation, and case-finding methods
2. Define the problem with use of time, place, person, and risk factors
3. Verify existence of outbreak
4. Formulate hypothesis on source and mode of transmission
5. Institute and evaluate control measures
6. Prepare final written report

III. Preventing/controlling the transmission of infectious agents
A. Develop infection control policies and procedures
B. Identify infection control strategies:
1. For handwashing and antisepsis
2. Related to cleaning, disinfection, and sterilization
3. On the basis of variances identified through surveillance
4. For specific in-patient care settings (eg, nursing units, specialty units, respiratory therapy, operating room)
5. For nonpatient care departments (eg, environmental services, nutritional services)
6. To reduce infection risks associated with therapeutic and diagnostic procedures and devices (eg, intravascular devices, urinary drainage catheter, bronchoscopy, angiography)
7. For management of regulated medical waste disposal
8. For recall of potentially contaminated equipment and supplies
9. For outpatient health care settings (eg, ambulatory care center, free-standing surgery centers, dialysis center, day programs)

C. Initiate and discontinue isolation/barrier precautions when indicated
D. Advise on appropriate patient placement
E. Evaluate patient care environments for infection control practices and hazards through environmental inspections
F. Review infection control policies and procedures
G. Review the infection control implications of products and durable medical equipment (eg, wheelchair, walker, oxygen equipment)
H. Advise on patient transfer/discharge planning process
I. Collaborate on immunization programs for patients
J. Assist facility engineering in the development of infection control plans for air and water quality

IV. Program management and communication
A. Program planning and resource allocation
1. Develop, evaluate, and revise a written mission statement, goals, measurable objectives, and action plans for the Infection Control Program
2. Incorporate the facility profile (patient population, major services offered, customer needs and satisfaction, number of health care workers) in the infection control plan
3. Recommend specific equipment, personnel, and resources for the Infection Control Program
4. Evaluate hardware and software options for computer applications for the Infection Control Program
5. Facilitate meetings of the Infection Control Committee
6. Participate in special projects (eg, cost benefit, efficacy study, product evaluation)
7. Prepare Infection Control Program budget
8. Monitor Infection Control Program revenue and expenditures
9. Recommend changes in practice on the basis of clinical outcomes and financial implications
10. Document cost reduction in the organization through Infection Control Program activities

B. Communication and feedback
1. Identify health care workers' responsibilities to prevent and control infections
2. Distribute infection control findings and recommendations to appropriate individuals, committees, departments, and units
3. Disseminate pertinent policies and procedures, guidelines, consensus statements, position papers, and standards to applicable departments
4. Communicate resource needs to administration
5. Provide consultation to administration, committees, and department managers on issues relating to infection control
6. Prepare an annual summary of Infection Control Program activities
7. Consult with Risk Management in the investigation of patient claims
8. Serve as an infection control liaison with public health authorities
9. Serve as an infection control liaison among health care facilities, medical staff, and community
10. Market/promote the Infection Control Program within and outside the facility
11. Advise administrative staff on the infection control implications of architectural design and renovation
12. Advise site contractors on the infection control implications of architectural design and renovation
13. Communicate information electronically (ie, Internet, Intranet, e-mail)

Continued on next page

Table 13. Continued from previous page

- C. Human resources
  1. Develop, review, and revise job descriptions for infection control positions
  2. Participate in supervisory responsibilities by training infection control personnel
  3. Develop competencies to evaluate infection control personnel
  4. Provide goals for professional development of the infection control staff
- D. Regulatory standards
  1. Measure compliance with regulations and standards
  2. Assist in obtaining and maintaining accreditation/licensure
  3. Seek opportunities to influence policymaking bodies
  4. Communicate changes in regulations and standards
  5. Report cases of communicable diseases to appropriate health authorities
  6. Assess infection control implications of pending legislation
- E. Quality/performance improvement
  1. Coordinate quality/performance improvement activities related to infection control
  2. Demonstrate quality/performance improvement projects through the use of graphic tools (eg, "fishbone" diagram, Pareto charts, flow charts)
  3. Identify opportunities for improvement on the basis of indicators, process and outcome measures, other findings, or observations
  4. Participate in multidisciplinary quality/performance improvement strategies

V. Education and research
- A. Education
  1. Assess the educational needs of health care workers pertaining to infection control
  2. Develop goals, measurable objectives, and lesson plans for educational offerings
  3. Use principles of adult learning in developing educational strategies
  4. Assess size of audience, physical environment, and available resources to determine appropriate audiovisuals and handout materials
  5. Review prepared educational tools and audiovisuals for appropriate and current content
  6. Prepare, present, or coordinate educational workshops, lectures, discussion, or one-on-one instruction on a variety of infection control topics
  7. Instruct and advise staff on changes in policies, procedures, or working standards
  8. Evaluate the effectiveness of education and learner outcomes (eg, behavior modification, compliance rate)
  9. Participate in the facility's orientation program for health care workers
  10. Disseminate pertinent information and literature on infection control
  11. Assess the educational needs of patients/families pertaining to infection control
  12. Instruct patients/families in methods to prevent and control infections
  13. Serve as a public educator on infectious illness topics to individuals and groups in the community
- B. Research
  1. Conduct literature search relative to specific infection control problems/products/rates of infection
  2. Apply critical reading skills to evaluate research
  3. Incorporate research findings into practice
  4. Disseminate relevant published research findings through practice, education, or consultation
  5. Participate in research activities (eg, data collection, analysis)

VI. Infection control aspects of employee health
- A. Develop infection control strategies that address the risk of infection transmission between patients and health care workers, including the following:
  1. Recommend policies and procedures for pre-placement screening of health care workers
  2. Develop screening programs for health care workers for certain communicable diseases (eg, tuberculosis, rubella, measles)
  3. Investigate and follow-up health care workers exposed to communicable diseases
  4. Facilitate follow-up for emergency-response personnel exposed to communicable diseases
  5. Assist with analysis and trending of occupational exposure incidents
  6. Collaborate on immunization programs for health care workers
  7. Recommend level of work restriction for health care workers with communicable diseases
  8. Assess risk of occupational exposure to infectious diseases by job classification or department (eg, tuberculosis, bloodborne pathogens)
  9. Provide counseling to health care workers exposed to a communicable disease
- B. Implement a reporting system between the occupational/employee health service and the Infection Control Program

formed. The information provided a basis for matching test item complexity to task complexity. The AC determined a distribution for each major category on the basis of the cognitive levels of recall, application, and analysis (Table 14). For example, task groupings with mean complexity ratings of 1.00 to 1.44 will test candidates at the recall level; those with more than 1.45 will test candidates proportionately at the recall level, the application level, and the analysis level.

Table 15 lists an abbreviated example of test specifications. The test specifications approved by the AC were accepted for adoption by the CBIC as the specifications that will be used to build all examination

Table 14. Cognitive level descriptions

Recall	Requires only the identification, recall, or recognition of isolated information, such as specific facts, generalizations, concepts, principles, or procedures. The information generally does not vary relative to the situation.
Application	Requires comprehension, interpretation, or manipulation of limited concepts or data, in which the response or outcome is situationally dependent, but not overly complex (eg, application of knowledge that varies on the basis of patient characteristics and environment). Tasks that require candidates to recognize elements and relationships among data and to classify, explain, or differentiate are usually application level.
Analysis/evaluation	Requires the integration or synthesis of a variety of concepts or elements to solve a specific problem situation (eg, evaluating and rendering judgments on complex problems with many situational variables).

forms for a certification program for ICPs. The detailed content outline is listed in Table 13.

DISCUSSION/CONCLUSION

A response rate of 24% is typical for an unsolicited survey. However, because the intent was to subsequently use mean ratings as task selection criteria for the certification examination, the critical question to answer was how precisely task means from this sample represented the population. Fink[14] has instructed that as sample size increases, decreasing degrees of error are realized. Fig 1 shows that error in mean values derived from a sample of this size should be near the practical minimum. Therefore, mean task ratings on the basis of responses from this sample should closely approximate means for the population.

The figure isolates the portion of error found in sample means that can be attributed to the size of the sample. The curve represents the function SE = 1/SQRT(N-1) where N is sample size. The standard deviation (S) of task ratings also influences error in sample means. The more variable task ratings become, the more error one will observe. AMP calculated the task SE_{Mean} values in the PA by substituting S for 1 in the function described, such that SE_{Mean} = S/SQRT(N-1). Task SE_{Mean} values in the PA were less than 0.04.

Specifications for the new examination are similar to those on the basis of the 1996 task analysis.[4] Two

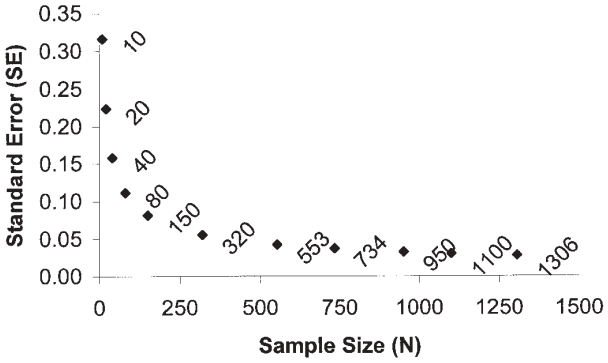

Fig 1. Relationship between sample size and standard error.

Table 15. CBIC abbreviated test specifications

	Cognitive level			
	RE	AP	AN	Total
I. Identification of infectious disease process	5	14	4	23
II. Surveillance and epidemiologic investigation	10	19	5	34
III. Preventing/controlling the transmission of infectious agents	7	20	7	34
IV. Program management and communication	6	12	2	20
V. Education and research	5	7	1	13
VI. Infection control aspects of employee health	4	5	2	11
Total	37	77	21	135

RE, Recall; *AP*, application; *AN*, analysis.

changes, which will be of importance to future candidates, were made. These include: (1) a new category, "Education and Research," which reflects the addition of content addressing research, and (2) the separation of infection control aspects of employee health as its own major category. Previously this content was included in the category addressing preventing and controlling the transmission of infectious agents.

The 2001 PA reflects current changes in the practice of infection prevention/control and applied epidemiology while identifying the comprehensive responsibilities of the ICP both in the United States and in Canada. The test specifications approved by the AC and accepted for adoption by the CBIC will be used to build all examination forms for a certification program for ICPs. Test specifications will be applied to

ensure the basis for appropriate examination development. The resulting examination scores will provide an accurate assessment of whether the candidates possess the mastery of knowledge necessary to practice as a certified ICP. When coupled with a criterion referenced passing point, the examination results will continue to provide the basis for a valid pass/fail decision that can be used to award the designation established by the CBIC.

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