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Major Article

Evaluation of Certification Board of Infection Control and Epidemiology, Inc Certification in Infection Control (CIC) examination rates

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Infection preventionist
CIC exam trends
training

Background: Infection prevention professionals develop through training and certification practices, with the Certified in Infection Control and Epidemiology (CIC) exam being the industry standard for infection prevention and control expertise.

Methods: This study conducted a secondary analysis of Certification Board of Infection Control and Epidemiology, Inc exam scores from 2013 to 2022. Reliability coefficients, Spearman-Brown coefficients, and Standard Error Measurement averages were calculated for the CIC exam's eight objective areas from 2016 to 2022.

Results: Over the past decade, pass rates varied from 57.30% to 85.40%, with a mean of 69.7%. The number of exam participants ranged from 574 to 1,392. Despite the variability, the highest reliability, Spearman-Brown, and Standard Error Measurement averages were consistently observed in areas such as identifying infectious disease processes, surveillance, epidemiological investigation, and controlling transmission of infectious agents.

Conclusions: As more facilities push for certification, the number of CIC exam takers has increased. However, the evolving nature of infection prevention and the lack of a standardized training track contribute to variations in reliability coefficients across the exam's objective areas.

BACKGROUND

The primary role of infection preventionists (IPs) is to develop and implement cost-effective infection prevention and control (IPC) programs to ensure a safe environment for patients and health care workers, reducing the transmission of health care-associated infections (HAIs).[1-3] IPs' primary role is to create a safe environment for patients and health care workers within a health care setting by developing policies and procedures, implementing best practices from the Centers for Medicare and Medicaid, Centers for Disease Control and Prevention (CDC), Occupational Safety and Health Administration, and other industry organizations.[1-3] IPs are responsible for observing practices to prevent infections, educating health care teams, advising hospital leaders on recommendations for best IPC practices, and compiling infection data. IPC programs crafted by IPs aim to ensure safe health care environments and prevent HAIs by coordinating with local and national public health agencies.[2,3]

IPs come from diverse professional disciplines, such as nursing, epidemiology, laboratory sciences, and public health.[2] The Certification Board of Infection Control and Epidemiology (CBIC) administers the Certified in Infection Control (CIC) exam.[4] The CIC credential is an industry-standardized metric designed to measure essential knowledge, skills, and abilities expected of an IP.[1-3]

The certification exam consists of 150 close-ended, multiple-choice questions, of which 135 are used to compute the examination score.[4-6] The exam tests the following 8 areas: (1) *identification of infection disease processes*, (2) *surveillance and epidemiology investigations*, (3) *preventing/*

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controlling the transmission of infectious agents, (4) *employee/occupational health*, (5) *management and communication*, (6) *education and research*, (7) *environment of care,* and (8) *cleaning, sterilization, disinfection,* and *asepsis*.[4-6] Each objective area is weighted, and an overall calculated passing or failing is compiled based on these 8 sections.[4-6] Eligible exam candidates must have direct responsibility for IPC activities in a health care setting, as reflected in their current job description, with a minimum of 1 year full-time, 2 years part-time, or 3,000 hours of compensated experience in infection prevention within the past 3 years. Credentials are valid for 5 years and can be renewed through re-examination or by completing at least 40 hours of continuing education in specified topics.[6,7] Because the exam is scored on a weighted scale and modifications to the exam over the years, the minimum pass number has fluctuated, with the current minimum scoring to pass being 700.[7] The current examination board provides ongoing content review, test development practice, and feedback mechanisms that help improve the reliability of the exam.[6] Previous evaluations of passing rate trends, exam reliability, and Spearman-Brown and Standard Errors of the Measurement (SEM) average trends have not been performed or published.

Overall, the trends in CIC exam pass rates and participation highlight the evolving nature of the IPC field.[3,4] High exam reliability is crucial for accurately assessing candidates' knowledge, maintaining certification credibility, and enhancing health care safety for workers and patients.[3-5] Reliability affects not only the fairness and validity of the certification process but also the credibility of the certification within the professional community and health care industry. Addressing examination challenges is paramount for advancing due to the CIC exam credentials demonstrating a proficiency level in IPC skills, and that highlights opportunities for improvement and commitment to patient and health care worker safety.[1-4] The industry aims to produce more certified individuals, enhancing health care quality and safety for health care workers and patients.[1,2,6,8] This discovery-oriented study aims to analyze candidate performance over the past decade, support the development of comprehensive exam preparation materials, and address the lack of hypothesis-generating research in this field.

METHODS

This study involved a secondary analysis of data collected by CBIC. Data were requested from CBIC for 2012 to 2022. The data included the number of individuals taking the CIC exam, annual pass rates, and statistics on the 8 objective exam areas. Basic descriptive statistics were applied to these variables. Due to a change in the CBIC exam vendors multiple times during the study period, data from 2012 were unavailable, and differences in data analysis occurred before and after 2016. Objective areas break data from 2016 through 2021 were available. Raw exam data and detailed demographic information were requested but not provided.

Descriptive statistics on examination pass rates for 2013 and 2022 were calculated, and pass rate trends were examined using Stata.[9] First-time test takers' pass rates were averaged from the pass rates from the test-taking cohorts during that year. Re-repeat attempts and CIC renewal test takers were excluded from the analysis. Reliability coefficients, Spearman-Brown coefficients, and SEM averages were calculated for the CIC exam 8 objective areas. The reliability coefficient averages represent the internal consistency reliability coefficient and SEM for the total test items and the objective area for the exam cohorts.[10,11] Internal consistency reliability estimates were computed using Cronbach's coefficient alpha.[10]

The reliability is impacted by the number of items that comprise the objective areas; the Spearman-Brown formula was also used to predict the anticipated reliability, assuming the Objective Area contains a more extended number of questions.[11] The SEM estimates the SD of the distribution of the observation scores around the actual score. This value can be interpreted as an index of expected variation occurring if the examinee was repeatedly tested on the objective areas on different forms of the exam.[10,11] A lower SEM indicates higher precision of the test objective, meaning the test consistently reflects an examinee's ability in a specific objective area.[10,11] This study was approved by the University of Texas Health Science Center at Houston Committee of the Protection of Human Subjects (CPHS) (HSC-SPH-23-0914). This research study did not receive any specific grant or internal or external funding from agencies in the public, commercial, or not-for-profit sectors. The authors report no potential conflict of interest.

RESULTS

Figure 1 shows the average pass rates and number of examinees for the CIC exam from 2013 to 2022. The mean pass rate was 69.7% (SD, 9.9; SE, 3.03), with a median of 69% and a range of 28% (min, 57.3% in 2020; max, 85.4% in 2018). The mean number of examinees was 1,069 (min, 574 in 2016; max, 1,313 in 2021). The mean number of participants was 1,069 (SE, 95.2; SD, 285.7), with a median of 1,172 and a range of 818 (min, 574; max, 1,392). The total number of participants over the study period was 9,623.

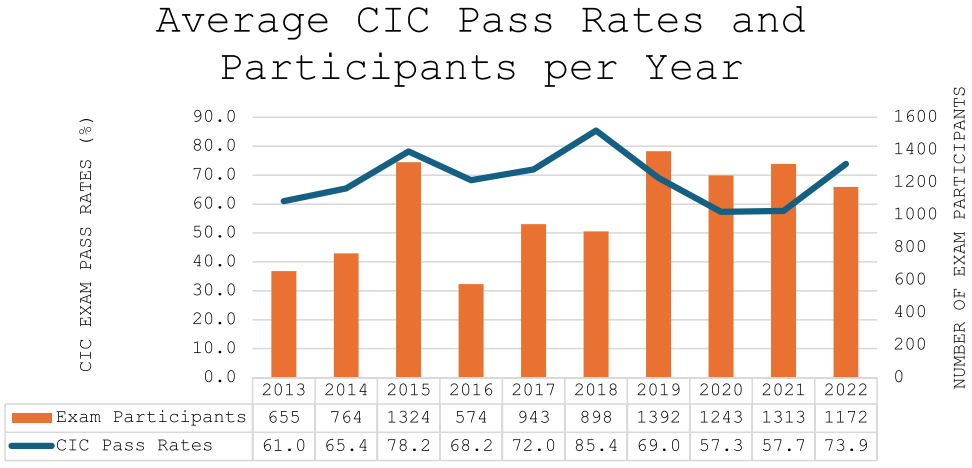

Fig. 1. CIC pass rates and participants' descriptive statistics. CIC, Certified in Infection Control.

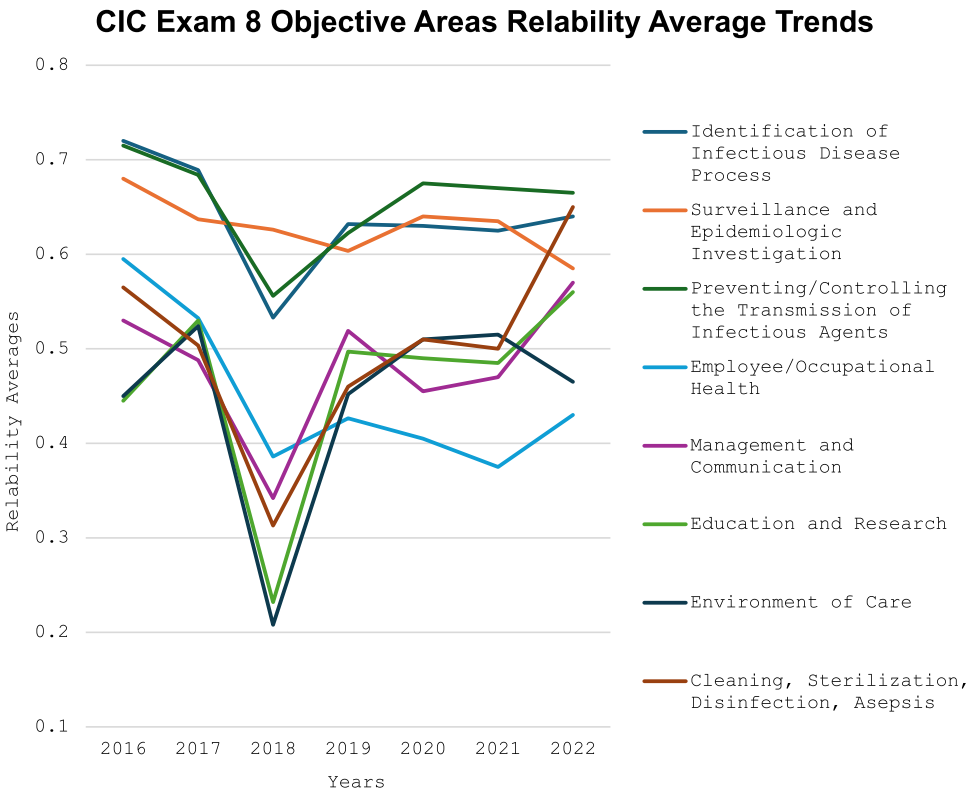

Fig. 2. CIC exam 8 objective areas reliability average trends. CIC, Certified in Infection Control.

Figure 2 illustrates the trends in CIC exam reliability averages across 8 objective areas from 2016 to 2023, highlighting the consistency with which the exam measures participant knowledge and skills. Reliability coefficients indicate the stability of results over time. Reliability coefficients in this context refer to the degree to which an assessment tool produces stable and consistent results over time. The graph indicates an overall downward trend in all objective areas from 2016 to 2018, with a sharp upward trend in 2019, leveling off from 2020 to 2022. The highest reliability was observed in *identifying infectious disease processes*, *surveillance and epidemiological investigation*, and *prevention/control of infectious agents*, with the highest coefficients in 2016. The lowest-performing areas were *education and research, environment of care, and employee/occupational health*. *Education and research* had significant fluctuations, particularly a drop to 0.23 in 2018. *Employee/occupational* health started with the lowest reliability in 2016 and declined.

Figure 3 presents the Spearman-Brown coefficient averages for CIC exam objective areas from 2016 to 2023. This statistical formula predicts test reliability if its length were altered, assessing the consistency with which the exam measures IPs' knowledge.

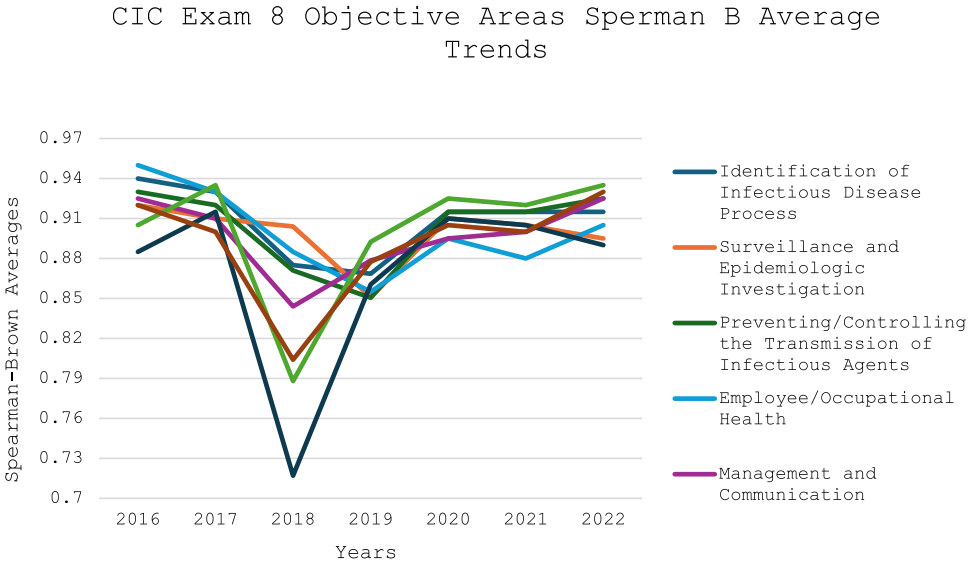

Fig. 3. CIC exam 8 objective areas Spearman-Brown coefficient average trends. CIC, Certified in Infection Control.

According to Spearman-Brown, these values fluctuated for these 3 areas similarly over the period studied, indicating higher reliability, consistency, and accuracy in these objective areas.

The highest reliability was seen in *identifying infectious disease processes, surveillance and epidemiological investigation, and prevention/control of infectious agents*, with these areas maintaining relatively stable scores over time, indicating strong reliability and accuracy. *Employee/occupational health, management, and communication* had mid-level reliability, with *employee/occupational health* starting at 0.95 in 2016 and decreasing to 0.85 in 2019. *Management and communication* also showed high reliability, though slightly lower, decreasing from 0.92 in 2016 to 0.84 in 2018.

The lowest-performing areas were *education and research*, the environment of care, *cleaning, sterilization, disinfection, and asepsis*. Education and research exhibited significant fluctuation, with a notable dip in 2018. The Spearman-Brown results suggest that the exam produced a stronger positive correlation with all objective areas with time, with results approaching 1. Overall, while the CIC exam remains a reliable measure of infection control knowledge, fluctuations point to potential areas for improvement in specific objective areas.

Figure 4 presents the SEM averages for CIC exam objective areas from 2016 to 2023. SEM values indicate the precision with which the exam measures candidates' abilities in specific areas.

The top-performing areas were the *identification of infectious disease processes*, *surveillance and epidemiological investigation*, and *prevention/control of infectious agents*. The highest scores were observed in *preventing/control of infectious agents* in 2020 to 2021, though there was a sharp decline in 2022. Variations in SEM values for infectious disease identification and surveillance suggest some fluctuations in exam precision over time. The *preventing/controlling the transmission of infectious agents* showed a high SEM, which could reflect increased variability in test questions or examinees, suggesting that exam questions in these years may vary more widely from the true ability levels of the candidates in this objective area due to challenges in preparedness during the COVID-19 pandemic.[12]

Employee/occupational health, management, and communication displayed consistent SEM values, indicating stable measures of examinee knowledge. However, the *education and research, environment of care,* and *cleaning, sterilization, disinfection, and asepsis* areas showed more variability, particularly a significant drop in the education and research SEM in 2018, reflecting more precise assessments that year. The *education and research* SEM significantly dropped in 2018, suggesting that the exam objectives reflected candidates' precise and accurate knowledge and skills in *education and research* related to infection prevention in that year.

In summary, the top-performing areas across all measures were the *identification of infectious disease processes*, *surveillance and epidemiological investigation*, and *prevention/control of infectious agents*, reflecting a strong knowledge base among IPs in these fields. *Employee/occupational health* and *management and communication* were mid-level, while *education and research*, and the *environment of care* consistently showed areas needing improvement. The performance in *cleaning, sterilization, disinfection, and asepsis* improved over the years, likely due to enhanced regulatory measures and CDC guidance.[13]

DISCUSSION

CBIC developed the CIC exam to certify IPs, ensuring their proficiency in infection control practices. This study evaluated the CIC exam trends over the last 10 years to gain more information on how IPs have performed. The pass rates range from 57.30% to 85.40%, and annual participants are between 574 and 1,392. These variations could be due to changes in exam difficulty, candidate preparedness, and shifts in health care practices and training resources.[14,15]

The number of certification seekers in the last 5 years (2018-2022) was higher than in the first 5 years (2013-2017), nearly doubling over the study period. From 2018 to 2022, more individuals sought certification than in 2013 to 2017, likely due to the growing demand for certified professionals, organizational requirements for certification in job descriptions, and increased recognition of infection prevention's importance.[13,16] Association for Professionals in Infection Control and Epidemiology (APIC) has estimated that 40% of IPs will retire in the next 5 years.[16] To fill this void, "The US Department of Labor issued the 'Infection Preventionist National Occupational Framework', a registered apprenticeship framework to help train new IPs and prepare them to work in the field. Under the Employment Training Administration, the Urban Institute, a nonprofit research organization, was awarded a grant to develop an infrastructure of occupational standards for registered

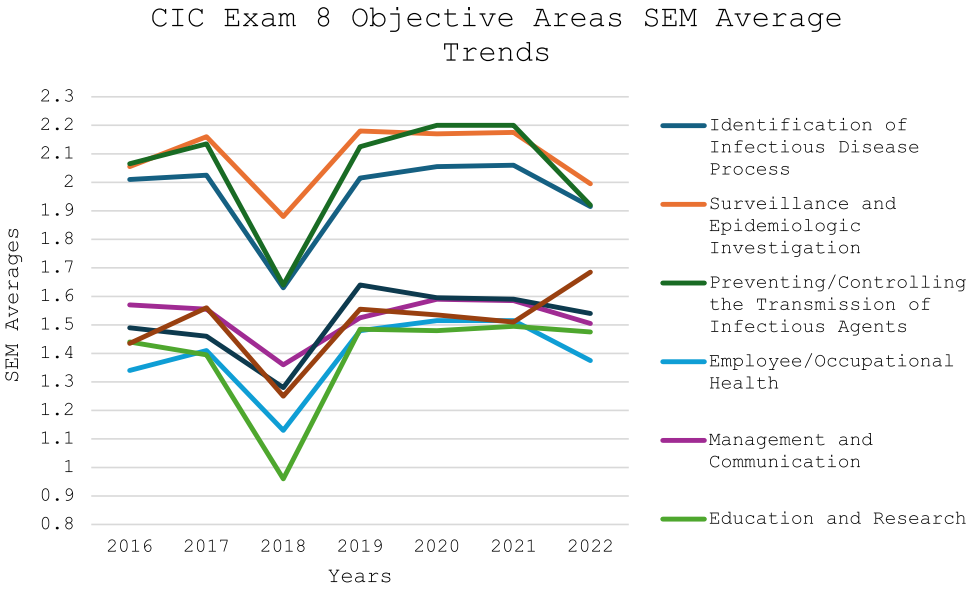

Fig. 4. CIC exam 8 objective areas SEM average trends. CIC, Certified in Infection Control; SEM, Standard Errors of the Measurement.

apprenticeship programs, helping to accelerate the expansion of such programs throughout the US."[17]

The 40% of individuals leaving the field could be due to the changing landscape of IPC practices that have occurred due to the COVID-19 pandemic constantly changing recommendations, increased working hours, and increased level of distrust in science, which has led to health care worker burnout.[12,18] The APIC surveyed the fall 2019 IPs exploring recruitment, hiring, and retention practices in IPs in the United States.[9,10] The authors calculated descriptive demographics, IP recruitment strategies, and hiring practices.[9] Five hundred and twenty-two APIC-eligible members (89.0% response rate) participated in the survey exploring IP staffing and hiring practices.[9] Twenty-five percent (n = 126) of participants reported vacant IP positions in their facilities, and 70.0% (n = 346) of recently hired IPs were nurses.[9]

High-reliability coefficients pertaining to *identifying infectious disease processes, preventing/controlling the transmission* of contagious agents, and *surveillance and epidemiological investigation* were anticipated. These objectives are the foundations of many IPC programs, and attention to these areas consumes a significant amount of time in the IP workday.[1-3] Most daily IP work tasks directly involve these objective areas and reflect the objective function of the IP's goal of providing a safe environment for patients and health care workers.[3]

The repeated lower reliability coefficient values observed in *employee/occupational health areas*, *management and communication*, and *education and research* indicate specific challenges in assessing these areas. These challenges could stem from various factors, including the complexity and broad complexity of the topic areas, the variability in professional backgrounds and experiences of exam candidates due to the absence of a standard education track for an IP to take, or potential misalignments between exam questions and current best practices in those fields. Some facilities have separate occupational health and infection prevention departments; therefore, not all IPs get exposed to occupational health and education practices.[2,3] The reliability coefficient results for the CIC exam's objective areas over the years indicated varying levels of consistency in how well the exam measured the knowledge and skills. This ensures that it remains aligned with current practices and knowledge within the IPC field, thereby maintaining the exam's integrity and ability to adequately reflect how well-prepared IP professionals who have obtained CIC credentials are.

The outlier data year was 2018. The CBIC changed the CIC exam in 2018, modifying the threshold candidates must meet to pass the exam.[19] The update was determined through a standard process involving subject matter experts who reviewed the questions to ensure they reflected the competencies expected from a minimally qualified IP.[19]

A limitation of this study is its reliance on secondary data, where details of data collection and cleaning are unknown. Changes in infection prevention practices, driven by regulatory shifts and events like the COVID-19 pandemic, likely impacted exam performance, with lower pass rates in 2020 to 2021 due to increased workloads and evolving best practices.[12] Another factor that could be responsible for the lower pass rate during this period was the constant change of best scientific practices to emergency management practices relating to managing resources and staff best when health care facilities were at capacity globally, combined with increasing COVID-19-related mortality rates. Due to health care workers' staffing shortages, hospital capacities were at an all-time high, and a lack of resources such as personal protective equipment, infection prevention, and control practices was modified to lower standards.[9,10,12] As the regions experienced different waves of COVID-19, information and best practices were implemented as the virus, and our understanding of the disease evolved. This led to other implementations of various practices across the globe, resulting in a need for more standardization, which is associated with varying levels of understanding of best practices and information being disseminated at different places and times.

CONCLUSIONS

This study showed that more infection prevention professionals are seeking CIC certification as a marker of expertise, benefiting individuals and health care organizations in the last 10 years.[18] Industry standards, along with APIC support, are advising individuals to obtain the CIC credential.[1,20,18] Certification correlates with improved care quality by knowing industry best practices in reducing HAIs and reinforcing its importance in creating safer health care environments and positive patient outcomes.[18,20] Research from CBIC shows that CIC-certified IPs demonstrate more robust competencies in infection prevention, leading to lower HAI rates and improved patient safety.[1,2,20] The data from this study may generate hypotheses for future research to identify and address gaps in low-performing objective areas.

IPs have diverse and expanding roles, highlighting the need for standardized training. While APIC offers preparation materials, the CIC exam, and the APIC online text, more comprehensive resources are needed to address variations in objective areas identified in this study.[2,4] Developing more comprehensive study guides and increasing the number of review courses and practice exams could help candidates better prepare for the CIC exam and increase the first-time CIC pass rate. Recommendations to improve the process include regular review and update of exam content, especially when IPC practices evolve due to global health concerns, and increased stakeholder engagement by widening the pool of professionals who develop the CIC examination and expanding the pilot test questions. An exam committee with diverse backgrounds, facility types, levels of experience, and recent frontline expertise will help ensure that exams reflect the latest IP recommendations, regulations, and relevant material. Finally, standardized training courses or degree pathways at the undergraduate and master's levels should be developed for IPs to reduce knowledge variation and promote a consistent professional skill set.

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