Postprint: Electronic Questionnaire-Based Analysis of Cognitive Differences Between Instructors and Trainees in Emergency Professional Skills Training in Standardized Residency Training in Hebei Province

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Abstract

Background: Standardized residency training is the key to cultivating a high-quality clinical physician workforce. The emergency medicine department is the frontline for treating critically ill patients and an important training ground for cultivating excellent clinical residents. Medical skills training is an important component of standardized residency training. Emergency core skills training covers numerous items, and differences in perception between teachers and trainees regarding specific training items can affect the efficiency and quality of skills training.

Objective: To investigate and analyze the differences in perception of training items between teachers and trainees in emergency professional skills training for standardized residency training in Hebei Province.

Methods: In October 2021, a total of 103 teachers and trainees from 15 emergency standardized training bases in Hebei Province, who were preparing to participate in the Hebei Province Standardized Residency Training Skills Competition, were selected as survey subjects, including 37 teachers and 66 trainees. Based on the "Clinical Skills Operation Detailed Process and Scoring Standards," an electronic questionnaire was developed for 13 emergency core skills training items according to the detailed operational steps of the process, to conduct a survey scoring "difficulty level" and "omission during operation."

Results: Regarding "difficulty level," there were differences in perception between teachers and trainees for 7 items (53.85%): electrocardiogram acquisition,

arterial puncture, abdominal paracentesis, single-person cardiopulmonary resuscitation, central venous puncture, endotracheal intubation, and Sengstaken-Blakemore tube placement, involving 25 steps (16.45%). Teachers' cognitive scores for "difficulty level" were lower than those of trainees ($P<0.05$). Regarding "omission during operation," there were differences in perception for 9 items (69.23%): electrocardiogram acquisition, abdominal paracentesis, single-person cardiopulmonary resuscitation, central venous puncture, endotracheal intubation, Sengstaken-Blakemore tube placement, lumbar puncture, non-invasive ventilation, and thoracentesis, involving 24 steps (15.79%). Teachers' cognitive scores for "omission during operation" were lower than those of trainees ($P<0.05$). For the remaining 3 training items: cricothyroid puncture, synchronized cardioversion, and bone marrow puncture, there were no statistically significant differences in perception between teachers and trainees regarding "difficulty level" or "omission during operation" for any operational steps ($P>0.05$).

Conclusion: Differences between teachers and trainees regarding "difficulty level" and "omission during operation" in emergency core skills training do exist. On one hand, this can promote improvement in clinical skills training curriculum design, enhance training efficiency, and provide a methodological foundation for cultivating high-level, high-caliber, and application-oriented medical talent. On the other hand, it suggests that in future similar studies on standardized residency training, when involving both teacher and trainee populations, potential differences between the two groups should be considered in order to more objectively reflect and explore issues related to residency training.

Full Text

General Practice Medical Education Research

Analysis of Cognitive Differences between Teachers and Residents in Emergency Professional Skills Training for Standardized Residency Training in Hebei Province: An Electronic Questionnaire Survey

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Abstract

Background: Standardized residency training is critical for cultivating a high-quality clinical physician workforce. The emergency department, as the frontline for treating critically ill patients, serves as an essential training ground for excellent resident physicians. Medical skills training constitutes a vital component

of residency education, and emergency core skills training encompasses numerous procedures. However, cognitive differences between teachers and residents regarding specific training modules can impact training efficacy and quality.

Objective: To investigate and analyze cognitive differences between teachers and residents concerning emergency professional skills training programs in Hebei Province's standardized residency training system.

Methods: In October 2021, 103 participants (37 teachers and 66 residents) from 15 emergency training bases in Hebei Province were selected as survey subjects, all preparing to participate in the provincial standardized residency training skills competition. Based on the *Clinical Skill Operation Refinement Process and Scoring Standards*, an electronic questionnaire was developed covering 13 emergency core skills training procedures, with items rated on "difficulty degree" and "omission during operation" according to detailed procedural steps.

Results: Regarding "difficulty degree," cognitive differences emerged in 7 procedures (53.85%)—electrocardiogram acquisition, arterial puncture, abdominal puncture, single-rescuer CPR, central venous puncture, tracheal intubation, and three-lumen two-balloon tube placement—encompassing 25 steps (16.45%), with teachers rating difficulty significantly lower than residents ($P<0.05$). Regarding "omission during operation," differences appeared in 9 procedures (69.23%)—electrocardiogram acquisition, abdominal puncture, single-rescuer CPR, central venous puncture, tracheal intubation, three-lumen two-balloon tube placement, lumbar puncture, non-invasive ventilation, and thoracentesis—covering 24 steps (15.79%), with teachers rating omission likelihood significantly lower than residents ($P<0.05$). No significant differences ($P>0.05$) were observed for the remaining three procedures: cricothyroid puncture, synchronized cardioversion, and bone marrow puncture.

Conclusion: This study confirms significant cognitive differences between teachers and residents in both "difficulty degree" and "omission during operation" for emergency core skills training. These findings can inform improvements in clinical skills training curriculum design, enhance training efficiency, and provide a methodological foundation for cultivating high-level, application-oriented medical talent. Furthermore, future research on standardized residency training involving both teacher and resident populations should account for potential inter-group differences to more objectively reflect and explore relevant issues.

Keywords: Education, professional, retraining; Resident standardized training; Emergency professional; Skill training; Surveys and questionnaires

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1. Subjects and Methods

1.1 Study Subjects

In October 2021, 103 participants (37 teachers and 66 residents) were selected from 15 emergency standardized residency training bases in Hebei Province who were preparing to participate in the Hebei Provincial Standardized Residency Training Skills Competition. The 66 residents were randomly selected by the Hebei Provincial Health Commission, the competition organizer, from resident pools at each emergency training base.

1.2 Research Methods

Based on the *Clinical Skill Operation Refinement Process and Scoring Standards* published by People's Medical Publishing House, and informed by expert consultation and literature review, we designed an electronic questionnaire survey. The online survey was administered on October 18, 2021, immediately following the competition. The questionnaire covered 13 emergency core skills training procedures: electrocardiogram acquisition, arterial puncture, cricothyroid puncture, abdominal puncture, lumbar puncture, non-invasive ventilation, synchronized cardioversion, bone marrow puncture, thoracentesis, single-rescuer CPR, central venous puncture, tracheal intubation, and three-lumen two-balloon tube placement. Each procedure was broken down into detailed operational steps and evaluated on two dimensions: "difficulty degree" and "omission during operation." Participants were briefed on the survey's purpose and completed the questionnaire online using their real names via the "Wenjuanxing" platform, with each WeChat account permitted only one submission.

1.3 Survey Content

The questionnaire collected: (1) basic demographic information; (2) participant role (teacher or resident); and (3) evaluations of emergency core skills training procedures. The "difficulty degree" was rated on a 5-point scale: 1=very difficult, 2=difficult, 3=moderate, 4=easy, 5=very easy. The "omission during operation" was rated on a 3-point scale: 1=prone to omission, 2=moderate, 3=not prone to omission.

1.4 Quality Control

During questionnaire development, experts were consulted and relevant literature reviewed to ensure scientific rigor. A pilot survey was conducted with 37 pre-test questionnaires, yielding 35 valid responses. The scale demonstrated good reliability (Cronbach's α coefficient=0.91) and validity (KMO=0.85). Invalid questionnaires were defined as those with: (1) incomplete real-name information; (2) incomplete item responses; or (3) identical responses across all items. Any questionnaire meeting one or more of these criteria was excluded.

1.5 Statistical Methods

Online questionnaire data were exported directly from the database and analyzed using SPSS 26.0. Normally distributed continuous variables were expressed as mean±standard deviation ($\bar{x}\pm s$) and compared between groups using t-tests. The significance level was set at α=0.05 (two-tailed).

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2. Results

2.1 Basic Situation

A total of 103 questionnaires were distributed (37 to teachers, 66 to residents), with 100 valid questionnaires returned. Three questionnaires were excluded due to incomplete information, yielding a response rate of 97.08% (97.30% for teachers, 96.97% for residents).

2.2 Cognitive Differences in "Difficulty Degree" and "Omission During Operation" for Each Procedure

(1) Electrocardiogram Acquisition: Teachers' difficulty ratings were significantly lower than residents' for Procedure 3 (correctly connecting limb leads), Procedure 4 (correctly connecting V1-V6, specifically V4 before V3), and Procedure 5 (correctly connecting right ventricular and posterior wall leads) ($P<0.05$). Teachers' omission ratings were significantly lower than residents' for Procedure 1 (calibration: 25 mm/s, 10 mm/mV) and Procedure 5 (correctly connecting right ventricular and posterior wall leads) ($P<0.05$) .

(2) Arterial Puncture: Teachers' difficulty ratings were significantly lower than residents' for the pre-procedure Allen test ($P<0.05$) .

(3) Abdominal Puncture: Teachers' difficulty ratings were significantly lower than residents' for: site selection (conventional puncture point at the intersection of the middle and outer third of the line between the umbilicus and left anterior superior iliac spine; splenomegaly puncture point 1.0 cm above the midpoint of the line between umbilicus and pubic symphysis, 1.5 cm lateral), Procedure 1 (checking puncture needle patency and seal), Procedure 2 (fixing skin with left hand, inserting puncture needle vertically through anesthetized path with right hand, advancing needle when draining large amounts of ascites), and Procedure 4 (instructing assistant to stabilize needle during aspiration, clamping proximal rubber tube after filling) ($P<0.05$). Teachers' omission ratings were significantly lower than residents' for Procedure 1 and Procedure 2 ($P<0.05$) .

(4) Single-Rescuer CPR: Teachers' difficulty ratings were significantly lower than residents' for: assessment (checking consciousness and carotid pulse technique), positioning (supine on hard surface, exposing chest, loosening belt), and Procedure 11 (observing chest rise during ventilation, releasing fingers pinching nose after chest elevation, observing exhalation) ($P<0.05$). Teachers' omis-

sion ratings were significantly lower than residents' for: assessment (checking consciousness and carotid pulse technique), Procedure 7 (head-tilt chin-lift maneuver), Procedure 8 (pinching nostrils with thumb and index finger of hand pressing forehead while other hand lifts chin), and Procedure 11 ($P<0.05$) .

(5) Central Venous Puncture: Teachers' difficulty ratings were significantly lower than residents' for: site selection (subclavian vein: ~1 cm below and 1 cm lateral to the midpoint of the clavicle; internal jugular vein: apex of triangular space formed by sternal and clavicular heads of sternocleidomastoid muscle and clavicle, located 0.5-1 cm lateral to strongest carotid pulse; femoral vein: 0.5 cm medial to femoral artery just below inguinal ligament), Procedure 5 (needle direction: internal jugular toward ipsilateral nipple with negative pressure; subclavian toward suprasternal notch with negative pressure; femoral toward umbilicus preferably with negative pressure), and Procedure 9 (advancing catheter over guidewire—ensuring catheter tip exposes part of guidewire before continuing; fixing guidewire with one hand while advancing catheter with the other) ($P<0.05$). Teachers' omission ratings were significantly lower than residents' for Procedure 9 ($P<0.05$) .

(6) Tracheal Intubation: Teachers' difficulty ratings were significantly lower than residents' for Procedure 14 (auscultating gastric area and both lungs to confirm tube position) ($P<0.05$). Teachers' omission ratings were significantly lower than residents' for: Procedure 6 (selecting appropriate tube size and checking cuff for leaks), Procedure 7 (inserting stylet, lubricating and shaping tube into J-form), Procedure 8 (holding laryngoscope in left hand, separating upper and lower teeth with right hand, entering vertically along right oral commissure, displacing tongue leftward to gradually expose uvula and epiglottis), and Procedure 14 ($P<0.05$) .

(7) Three-Lumen Two-Balloon Tube Placement: Teachers' difficulty ratings were significantly lower than residents' for: Procedure 2 (inflating balloons, immersing in saline to recheck for leaks, then measuring pressure: gastric balloon 200-300 mL (40-50 mmHg), esophageal balloon 100-150 mL (35-45 mmHg)), Procedure 5 (lubricating tube thoroughly with paraffin oil), Procedure 6 (measuring length from tube junction to xiphoid-to-hairline distance and marking (55 cm from junction, 65 cm from tip)), Procedure 8 (checking at 12-15 cm insertion with tongue depressor to ensure tube isn't coiled in mouth), Procedure 9 (instructing swallowing when reaching pharynx, avoiding airway insertion), Procedure 11 [confirming gastric placement: aspirating gastric contents (preferred), rapidly injecting 50 mL air and auscultating for gurgling, placing tube opening in water without bubble escape], Procedure 12 (injecting 250-300 mL air into gastric balloon, folding opening, clamping with hemostat), Procedure 13 (pulling tube outward until moderate resistance), and Procedure 17 (if bleeding uncontrolled, injecting 100-150 mL air into esophageal balloon, measuring pressure with sphygmomanometer (maintaining 35-45 mmHg), folding and clamping) ($P<0.05$). Teachers' omission ratings were significantly lower than residents' for: Procedure 1 (checking for cuff leaks, tube patency, and rubber

aging), Procedure 2, Procedure 8, Procedure 11, Procedure 12, Procedure 13, Procedure 17, and Procedure 18 (gastric balloon: deflate 15-30 min every 12-24 h; esophageal balloon: deflate 30-60 min every 8-12 h) ($P<0.05$) .

(8) Lumbar Puncture: Teachers' omission ratings were significantly lower than residents' for Procedure 1 (checking kit contents, verifying needle patency and dryness, connecting manometer) ($P<0.05$) .

(9) Non-Invasive Ventilation: Teachers' omission ratings were significantly lower than residents' for Procedure 2 (placing head strap under head, attaching two buckles to left and right straps) ($P<0.05$) .

(10) Thoracentesis: Teachers' omission ratings were significantly lower than residents' for Procedure 1 (checking puncture needle patency and seal) ($P<0.05$) .

(11) Remaining Three Procedures: No significant differences ($P>0.05$) were found between teachers and residents in either "difficulty degree" or "omission during operation" for cricothyroid puncture, synchronized cardioversion, or bone marrow puncture [TABLE:11-13].

2.3 Overall Cognitive Differences in "Difficulty Degree" for Each Project

Teachers' overall difficulty ratings were significantly lower than residents' for electrocardiogram acquisition and three-lumen two-balloon tube placement ($P<0.05$) [Figure 1: see original paper].

2.4 Overall Cognitive Differences in "Omission During Operation" for Each Project

Teachers' overall omission ratings were significantly lower than residents' for electrocardiogram acquisition, single-rescuer CPR, and three-lumen two-balloon tube placement ($P<0.05$) [Figure 2: see original paper].

2.5 Summary of Cognitive Differences

Comparing cognitive differences in "difficulty degree," significant differences were found in 7 procedures (53.85%) and 25 steps (16.45%) [FIGURE:3-4]. For "omission during operation," differences emerged in 9 procedures (69.23%) and 24 steps (15.79%) [FIGURE:5-6].

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3. Discussion

3.1 Addressing Differences in "Difficulty Degree"

Cognitive differences in "difficulty degree" existed across multiple procedures and steps. Teachers rated 7 procedures and 24 steps as less difficult than res-

idents did, warranting attention. Training should prioritize teachers' cognitive perspectives while strengthening communication between teachers and residents to optimize training and time allocation for these components. Innovative teaching methods could be explored, such as combining problem-based learning (PBL) with multimedia approaches, case-based learning (CBL), application-oriented teaching, and critical thinking pedagogy, alongside enhanced teacher training. This approach can ensure training quality while improving efficiency within limited timeframes.

3.2 Addressing Differences in "Omission During Operation"

Cognitive differences in "omission during operation" also existed across multiple steps. For steps teachers considered less prone to omission but residents considered prone, training should emphasize these components using memory aids like mnemonics, categorical memory techniques, and mind mapping to reduce omissions. For steps teachers considered prone to omission, training time could be appropriately reduced. Research indicates heavy clinical workloads often compress residents' training time, so strategic time reallocation can maintain quality while improving efficiency.

3.3 Overall "Difficulty Degree" Differences

Teachers rated electrocardiogram acquisition and three-lumen two-balloon tube placement as more difficult overall than residents did. This may be because previous cohorts found these procedures challenging, prompting teachers to invest substantial effort in improving teaching methods through repeated explanation, demonstration, and intensive practice, resulting in residents perceiving them as easier post-training. Teachers should summarize these experiences for broader application to other challenging skills.

3.4 Overall "Omission During Operation" Differences

Teachers rated electrocardiogram acquisition and three-lumen two-balloon tube placement as less prone to omission overall. This likely reflects teachers' intensive instructional efforts and methodological improvements based on previous cohorts' difficulties. For single-rescuer CPR, teachers rated it as less prone to omission, possibly because this core skill is repeatedly trained and assessed through scenario simulation throughout residency, making residents less likely to omit steps. Training time for this procedure could be moderately reduced.

Emergency physicians face intense time pressures, high professional demands, and heavy workloads, with shortages becoming more pronounced since the COVID-19 pandemic. Establishing excellent national standardized residency training bases in emergency medicine to cultivate competent emergency physicians is therefore crucial. This study demonstrates cognitive differences between teachers and residents across different procedures and specific steps, suggesting

that future skills training should acknowledge these objective differences in curriculum design, teaching model selection, and time allocation. Establishing comprehensive communication channels, conducting thorough investigations, and implementing feedback mechanisms will be essential. These findings provide a reference for improving training efficiency and quality in standardized residency programs.

This study confirms significant cognitive differences between teachers and residents regarding "difficulty degree" and "omission during operation" in emergency core skills training. These findings can improve clinical skills training curricula and provide methodological foundations for cultivating high-level medical talent. Moreover, future research on standardized residency training involving both groups should consider potential inter-group differences to more objectively reflect and explore relevant issues.

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