Title

Cardiovascular Point-of-Care Ultrasonography and Resident Learning

Keywords

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Author Statement

These authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

Conflicts of Interest

There are no disclosures.

# ABSTRACTINTRODUCTIONMETHODS

## Study population

This study is a single-institutional prospective cohort study designed to investigate the effect of POCUS curriculum on resident knowledge as well as decision making. The curriculum is designed as a two sessions of didactic and hands-on training during the PGY2 year. The cohorts were divided by class years, from PGY1, PGY2, PGY3, and recent graduates of the program. The population sampled was 225 residents (including recent grads). The data was acquired from 06/2018 to 08/2019. The study collected information on training level, prior experience, interest, and included a quiz that tested knowledge of cardiovascular ultrasonography and confidence in decision making. Participants all provided written informed consent, and the study was classified as exempt by the institutional review board.

## Quiz design

The quiz was broken down into several sections that targeted specific knowledge areas. The five domain were: 1) cardiovascular view identification, 2) cardiovascular structure identification, 3) cardiovascular function assessment (e.g. ejection fraction), 4) vascular structure identification (e.g. IVC, aorta), 5) vascular function assessment. The quiz was internally validated by experts in ultrasonography from the fields of emergency medicine and critical care medicine. Only questions that had unanimous agreement were selected. The quiz was 20 questions in length and had two components. The first component was a multiple choice assessment of an ultrasound image or video clip. The second component asked for a subjective level of confidence in the answer selected, given on a 3-level Likert scale (“Low”, “Medium”, “High”).

## Decision making

We chose to assess decision-making based on subjective confidence in decision-making on ultrasonography, which is a relatively novel skillset amongst internal medicine trainees. We compared answer choices to perceived confidence, creating a 2 x 2 contingency table as seen in **Table 1**, which had four possible combinations (*Knowledge Gap*, *Underconfidence*, *Overconfidence*, and *Understanding*). These are referred to as “confidence levels”.

## Statistical analysis of responses

The questions were analyzed for accuracy, and descriptive statistics were performed overall and stratified by the independent variables. Student’s t-test was performed to assess effect of curriculum on quiz accuracy, along with one-way ANOVA to assess overall differences by cohort training level. Overall confidence in quiz questions was assessed with descriptive statistics, and stratified by both training level and curriculum intervention. Ordinal logistic regression models, with the primary outcome being the four-item confidence levels, and the exposure being the curriculum and covariates. Repeat measures by participant were adjusted by using a mixed effects model. The interaction between curriculum and cohort was assessed in an additional model.

# RESULTS

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## Baseline characteristics

There were a total of 89 participants in the study, including PGY1 (n=19), PGY2 (n=19), PGY3 (n=16), and recent graduates (n=38). There was >80% self-reported interest in POCUS, with over >60% expressing interest in a procedural career, and <30% having prior experience in POCUS. Further breakdown by cohort is seen in **Table 2**.

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## Knowledge and confidence assessment

The mean percent score (SD) on the questionnaire was 65.2 (12.4). By cohort, the PGY1 class scored 56.1 (11.8), the PGY2 class scored 62.4 (11.5), the PGY3 class scored 73.0 (10.6), and the recent graduates scored 67.8 (11.1). The questions were further broken down by type, as seen in **Figure XXX**.

There was a difference in scores after completion of the curriculum (p = 0.002), as seen in **Figure XXX**.

Overall, participants reported being confident on 70.1% (4.6) questions. When compared with their individual answer choices, 15.2% demonstrated a *Knowledge Gap*, 14.8% demonstrated *Underconfidence*,16.2% demonstrated *Overconfidence*, and 53.8% demonstrated *Understanding*. This is further delineated in **Table 3**, including stratification by curriculum. Of note, although there was an increase in *Understanding* from 32.7% to 67.3 with the curriculum, there was also an increase in *Overconfidence* from 39.3% to 60. 7%. The distrubtion of confidence by question type is seen in **Figure XXX**.

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## Regression Analysis

Curriculum was found to be significant in affecting congruence between confidence and competence (p = 0). Completion of curriculum had an OR = 2.416 (95% confidence interval (CI) = 1.738, 3.359) of demonstrating *Understanding* over other categories (e.g. *Overconfidence*). In an additional model adjusted for cohort, there was a significant negative interaction between curriculum and cohort year (p = 0.018).

# DISCUSSION

## Major findings

We measured the impact of ultrasound curriculum on resident interpretation of POCUS findings to assess resident decision-making. We found that the ultrasound curriculum led to an increase in overall accuracy in the quiz, but also led to an increase in confidence in answer choices.

## Limitations

The current study has limitations, the most important of which is the cross-sectional study design. This limits our interpretation of the directionality of the association. Of the population sampled, there is likely also a self-selection bias for those that chose to participate.

# TABLES

## Table 1

|  |  |  |
| --- | --- | --- |
|  | Confident | Not Confident |
| Correct | Understanding | Underconfident |
| Incorrect | Overconfident | Knowledge Gap |

## Table 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | PGY1 | PGY2 | PGY3 | GRAD |
|  | N=18 | N=18 | N=15 | N=37 |
| Curriculum: |  |  |  |  |
| No | 17 (94.4%) | 17 (94.4%) | 1 (6.67%) | 3 (8.11%) |
| Yes | 1 (5.56%) | 1 (5.56%) | 14 (93.3%) | 34 (91.9%) |
| Experience: |  |  |  |  |
| No | 10 (55.6%) | 10 (55.6%) | 12 (80.0%) | 29 (78.4%) |
| Yes | 8 (44.4%) | 8 (44.4%) | 3 (20.0%) | 8 (21.6%) |
| Comfort (Dx): |  |  |  |  |
| High | 0 (0.00%) | 0 (0.00%) | 1 (6.67%) | 6 (16.2%) |
| Low | 15 (83.3%) | 15 (83.3%) | 4 (26.7%) | 5 (13.5%) |
| Medium | 3 (16.7%) | 3 (16.7%) | 10 (66.7%) | 26 (70.3%) |
| Comfort (Tx): |  |  |  |  |
| High | 0 (0.00%) | 2 (11.1%) | 2 (13.3%) | 17 (45.9%) |
| Low | 17 (94.4%) | 2 (11.1%) | 3 (20.0%) | 2 (5.41%) |
| Medium | 1 (5.56%) | 14 (77.8%) | 10 (66.7%) | 18 (48.6%) |
| Interest: |  |  |  |  |
| High | 15 (83.3%) | 15 (83.3%) | 13 (86.7%) | 26 (70.3%) |
| Low | 1 (5.56%) | 0 (0.00%) | 0 (0.00%) | 2 (5.41%) |
| Medium | 2 (11.1%) | 3 (16.7%) | 2 (13.3%) | 9 (24.3%) |
| Procedural Career: |  |  |  |  |
| No | 14 (77.8%) | 11 (61.1%) | 9 (60.0%) | 26 (70.3%) |
| Yes | 4 (22.2%) | 7 (38.9%) | 6 (40.0%) | 11 (29.7%) |

## Table 3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Knowledge Gap | Overconfidence | Underconfident | Understanding |
|  | N=239 | N=262 | N=237 | N=877 |
| Cohort: |  |  |  |  |
| PGY1 | 83 (34.7%) | 37 (14.1%) | 89 (37.6%) | 91 (10.4%) |
| PGY2 | 59 (24.7%) | 65 (24.8%) | 53 (22.4%) | 183 (20.9%) |
| PGY3 | 39 (16.3%) | 30 (11.5%) | 46 (19.4%) | 184 (21.0%) |
| GRAD | 58 (24.3%) | 130 (49.6%) | 49 (20.7%) | 419 (47.8%) |
| Curriculum: |  |  |  |  |
| No | 152 (63.6%) | 103 (39.3%) | 158 (66.7%) | 287 (32.7%) |
| Yes | 87 (36.4%) | 159 (60.7%) | 79 (33.3%) | 590 (67.3%) |

# FIGURES

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