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Original Contribution

Emergency medicine practice environment and impact on concert examination performance☆

Catherine A. Marco, M.D. [a,*], Robert P. Wahl, M.D. [b], James D. Thomas, M.D. [c], Ramon W. Johnson, M.D. [d], O. John Ma, M.D. [e], Anne L. Harvey, Ph.D. [f], Earl J. Reisdorff, MD [f]

[a] Department of Emergency Medicine, Wright State University, Dayton, OH, United States of America
[b] Department of Emergency Medicine, Wayne State University, Detroit, MI, United States of America
[c] Department of Emergency Medicine, Good Samaritan Hospital, Brockton, MA, United States of America
[d] Department of Emergency Medicine, Mission Hospital, Mission Viejo, CA, United States of America
[e] Department of Emergency Medicine, Oregon Health & Science University, Portland, OR, United States of America
[f] American Board of Emergency Medicine, East Lansing, MI, United States of America

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ABSTRACT

Objective: The ABEM ConCert Examination is a summative examination that ABEM-certified physicians are required to pass once in every 10-year cycle to maintain certification. This study was undertaken to identify practice settings of emergency physicians, and to determine if there was a difference in performance on the 2017 ConCert between physicians of differing practice types and settings.

Methods: This was a mixed methods cross sectional-study, using a post-examination survey and test performance data. All physicians taking the 2017 ConCert Examination who completed three survey questions pertaining to practice type, practice locations, and teaching were included. These three questions address different aspects of academia: self-identification, an academic setting, and whether the physician teaches.

Results: Among 2796 test administrations of the 2017 ConCert Examination, 2693 (96.3%) completed the three survey questions about practice environment. The majority (N = 2054; 76.3%) self-identified as primarily being a community physician, 528 (19.6%) as academic, and 111 (4.1%) as other. The average ConCert Examination score for community physicians was 83.5 (95% CI, 83.3–83.8); the academic group was 84.8 (95% CI, 84.3–85.3); and the other group was 82.3 (95% CI, 81.1–83.6). After controlling for initial ability as measured by the Qualifying Examination score, there was no significant difference in performance between academic and community physicians (p = .10).

Conclusions: Academic emergency physicians and community emergency physicians scored similarly on the ConCert. Working at a community teaching hospital was associated with higher examination performance. Teaching medical learners, especially non-emergency medicine residents, was also associated with better examination performance.

1. Introduction

At the dawn of the specialty, beginning in 1961 at a community hospital in Alexandria, Virginia, emergency medicine was community hospital-based; academic emergency medicine did not exist. Since then, numerous emergency medicine professional organizations have been created, academic departments have been established, residency training programs have been developed, and there are now over 220 emergency medicine residencies accredited by the Accreditation Council for Graduate Medical Education (ACGME). The American Board of Emergency Medicine (ABEM) developed a rigorous certification process after the American Board of Medical Specialties (ABMS) recognized emergency medicine as a specialty in 1979. To date, over 43,000 physicians have been certified by ABEM. Compared to other specialties, emergency medicine has the seventh largest number of practicing physicians and the fourth largest number of first-year residents pursuing specialty training.

The ConCert Examination (ConCert) emphasizes complex cognitive skills (e.g., diagnostic processing) as well as medical knowledge. ABEM seeks to assess the cognitive skills and medical knowledge required to practice in the specialty regardless of the practice setting.

☆ Conflicts and dualities of interest: Drs. Marco, Wahl, Thomas, Ma, and Johnson are Directors for the American Board of Emergency Medicine. Drs. Harvey and Reisdorff are employed by the American Board of Emergency Medicine.

* Corresponding author at: Wright State University, Department of Emergency Medicine, 3525 Southern Boulevard, Kettering, OH 45429, United States of America.
E-mail address: catherine.marco@wright.edu (C.A. Marco).

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The Model of the Clinical Practice of Emergency Medicine (The EM Model) describes the nature of clinical practice, and is updated every three years as a joint effort of several major emergency medicine organizations. The content of the specialty was further clarified when ABEM surveyed all 26,000 current ABEM diplomates in 2010 to find out the medical conditions considered to be important to the practice of emergency medicine and the frequency with which those conditions were seen [1]. The importance and frequency of emergency physician tasks were also included in the survey.

It is possible that certain practice patterns might contribute favorably to maintaining physician cognitive skills and to maintaining a more robust base of medical knowledge. For example, teaching and conducting research might help maintain cognitive skills and the retention of medical knowledge. A study of Internal Medicine and General Surgery physicians found that younger physicians, those with higher scores on the initial certification examination, and physicians in group, not solo, practice were significantly more likely to pass their respective recertification exam on the first attempt [2]. Passing the American Board of Anesthesiology Part 1 and Part 2 certification examinations on the first attempt is an independent positive predictor for the Maintenance of Certification – Anesthesiology (MOCA) examination score [3]. Surgeons with lower total CME and Category I CME hours, and those in solo practice were at greater risk for recertification examination failure [4]. Other factors positively affecting performance on board certification examinations include physicians who complete Maintenance of Certification (MOC) activities, U.S. medical graduates, and physicians who spend more time in patient care, teaching, or administration [5]. Factors negatively affecting performance on board certification examinations include postponing taking the exam and declining pass rates with greater frequency of attempts [6,7].

The objective of this study was to identify practice settings of emergency physicians, and to determine if there was a difference in performance on the 2017 ConCert between physicians of differing practice settings.

2. Methods

This was a prospective, mixed-model, cross sectional-study, using a post-examination survey and test performance data. This study was conducted by ABEM Directors and Staff. The 2017 ConCert was administered to 2690 physicians within a 6-day scheduled testing window between September 11 and September 16, 2017 at secure computer-based testing centers across over 200 sites in the United States. There were 106 additional test-takers who took the 2017 ConCert after these dates due to catastrophic weather, military duty, etc. This study was reviewed and determined to be exempt research by the Wright State University Institutional Review Board.

There was a posttest survey which the respondents were told was anonymous and de-identified. All physicians taking the 2017 ConCert who completed the three survey questions regarding their self-identified primary practice type ("Type"), practice locations ("Location"), and any teaching activities ("Teaching") were included (see Table 1). Since, to our knowledge, no common definition of an academic emergency physician exists, and considering that physicians can practice in multiple settings (both community and academic), the authors relied on physicians' self-definition for this study. The three aspects of practice were assessed to approximate various definitions.

Physicians who were eligible to take the 2017 ConCert included physicians who were current ABEM diplomates seeking continuance of their active certification, and previously certified physicians attempting to regain certification. The 2017 ConCert contained 205 items. Each item was a multiple-choice question with a correct answer and three or four incorrect answers. Most items on the 2017 ConCert used clinical case scenarios requiring complex cognitive skills (e.g., clinical synthesis) as well as other complex domains in Bloom's taxonomy to obtain the correct answer. The preponderance of items using higher level domains creates an assessment that focuses on cognitive skill, not fact recall. Exam scores are reported on a scale from 0 to 100, with a KR-20 (Kuder Richardson 20) reliability index of 0.83 to 0.84, and a standard error of measurement (SEM) of 2.4 to 2.5. Similar to a confidence interval, differences in scores equal to or less than the SEM are likely to be of little practical importance.

Table 1
Survey items.

Q1.	Do you see yourself as primarily an academic or a community physician?
a.	Academic
b.	Community
c.	Other
Q2.	How would you describe the setting in which you practice? (Check all that apply.)
a.	Medical school
b.	Academic medical center (university-based)
c.	Community-based teaching hospital
d.	Community hospital (non-academic)
e.	Non-hospital venue
Q3.	Do you supervise students or residents in any of your practice settings? (Check all that apply.)
a.	I teach EM residents in the ED
b.	I teach non-EM residents in the ED
c.	I teach medical students in the ED
d.	I do not teach medical students or residents in the ED

All ABEM item writers must be clinically active, board-certified emergency physicians and undergo extensive item development training. All items undergo several steps of editing and review by ABEM staff as well as final editorial review by test editors who are also clinically active emergency physicians. No item is scored on the ConCert until it has undergone field testing, psychometric performance analysis (e.g., difficulty and discrimination), and further editorial review, including review of diplomate feedback on individual items. All ConCert items are developed from content from the EM Model. The ConCert also follows a validated blueprint that guides the frequency of items about various conditions as well as the distribution of high and low acuity conditions [8]. For example, many more questions are asked about critical cardiovascular conditions than nonurgent dermatologic conditions. The passing score for ConCert is criterion-referenced, not based on a curve or pre-determined pass rate. The passing score is determined through a widely used psychometric process called a modified-Angoff study. Using this method, a panel of clinically-active physicians from the cohort of ABEM-certified physicians participates in a study to determine a recommended passing score, which is evaluated using a standard set of criteria [9,10]. If a physician meets the passing score, they pass. Using criterion-referencing, in theory, for any given examination, the pass rate could be 0% or 100%.

Immediately after completing the 2017 ConCert, examinees were invited to complete a voluntary post-examination survey. Respondents were assured that their answers would be anonymous and de-identified. If the physician agreed to participate, a 10-item survey and a free text comment section appeared. Since 2004, when ABEM began giving the ConCert using a computer-based format, there has been a posttest survey focusing on the testing experience and item relevancy. In 2017, ABEM added three questions about physician practice that form the basis of this study [Table 1]. The three survey items were developed by three experienced emergency physicians and reviewed by two ABEM psychometricians. Moreover, these items were similar to items included on the ABEM Longitudinal Study of Emergency Physicians (LSEP) and on some ABEM volunteer nomination forms.

One potential explanation for differences among the groups, that physicians with higher scores on relevant examinations are more likely to be in an academic setting, was also explored by controlling for scores on the initial certifying examination—the Qualifying Examination (QE). ABEM sought to determine the contributions of both practice and initial ability to ConCert performance. Specifically, could a difference in performance be solely determined by higher performing physicians self-

selecting as academic or community physicians? To assess for ability at the beginning of an emergency medicine career, physicians' ConCert scores were matched to their first QE score. Using the QE as a measure of initial ability allowed for the elimination of differences in the ability of those choosing between an academic-based or a community-based position, and the current relevance of the ConCert for those in each category. The QE is similar to the ConCert in content and format except that the QE is longer (305 items.)

The QE score was used as an indicator of ability at the beginning of an emergency medicine career because it was the most recent multiple-choice-question test the physician would have taken following residency. It is unlikely that the typical three to four months (the time between residency graduation and taking the QE for the first time) in a particular practice setting would have caused a difference in initial ability. Moreover, there is a close association between In-training Examination performance and performance on the QE, suggesting that any impact on practice setting and test performance would be minimal [11].

There were four primary outcome measures: 1) the self-identification of community- or academic-based practice status ("Type"); 2) whether the physician practiced in a community or academic center ("Location"); 3) whether the physician taught medical learners ("Teaching"); and 4) examination performance ("ConCert"). Performance on ConCert was measured as the equated, scaled scores.

3. Statistical methods

3.1. Integrity of the sample

To determine the impact on the results had all non-respondents answered the survey questions, chi-square analysis was completed on relevant demographic variables. Descriptive statistics, including 95% confidence intervals (CI) were provided for scaled scores. To assess whether scores were different for the sample, a test of location was completed for the ConCert and QE (a univariate *t*-test of the sample's difference from the mean score for the total group).

3.2. Impact of type, location, and teaching on ConCert scores

Whether there was an advantage for self-identified academic physicians (Type) when taking the ConCert was analyzed using an ANCOVA (general linear model). The first QE attempt was used as the covariate to eliminate differences in the initial ability among physicians self-identifying as academic or community physicians. The final scaled, equated ConCert score was used as the continuous dependent variable.

An ANCOVA is used to determine the unique contribution of each variable of interest to differences among scores. Significant differences in groups are determined using the F distribution. The R^2 statistic measures what percent of the differences in individual scores is accounted for by each variable.

Because Type has more than one group, follow-up analyses can determine which groups are different from each other. Too many analyses, however, can lead to an increasing number of false positives (Type 1 error.) The Tukey follow-up analyses used in this paper adjust for the Type 1 error.

More than one response could be chosen for the Location and Teaching questions. Therefore, linear multiple regression was used to determine the association of each Location or Teaching response with performance on ConCert. No a priori model was hypothesized. The QE was again used as an independent variable to account for initial ability at the beginning of the career. The R2 statistic measures what percent of the differences in individual scores is accounted for by the variables used in the regression.

Due to the cohort sizes, the pre-hoc significance was defined as $\alpha < 0.01$ (power analyses ≥0.90). Analyses were performed using SAS® (version 9.4, Cary, North Carolina).

4. Results

4.1. Integrity of the sample

There were 2796 administrations of the examination. Of the 2796 examinees, 2693 completed the post-exam survey for a response rate of 96.3%. Table 2 contains a comparison of the demographic variables (residency training and reason for taking the exam) for the total group of ConCert examinees and the survey sample. Gender and ethnicity were analyzed as well but resulted in too many missing observations for further analysis (17.4% and 22.7%, respectively). Physicians who were emergency medicine residency trained were more likely to complete the survey ($p < .01$). This did not result in a difference in ConCert pass/fail rates ($p = .20$); a test for location showed no significant difference in ConCert scores ($p = .54$) or QE scores ($p = .70$) between the total group and the survey sample.

4.2. Assumptions of the ANCOVA and linear multiple regression

For all three primary analyses, residuals (the difference between the predicted and actual values of ConCert) were found to have a normal, linear distribution. A lack of fit test was also conducted for each analysis and, with F values substantially smaller than the F value for the model, fit was verified. Given a Pearson correlation of 0.61 between ConCert and QE, the first 37% of the variance, as measured by the R^2, is accounted for by the QE.

4.3. Impact of type on ConCert scores

Of the 2693 respondents, 2054 (76.3%) self-identified as a community physician, 528 (19.6%) as academic, and 111 (4.1%) as 'other'. The average ConCert score for community physicians was 83.5 (95% CI, 83.3–83.8); the academic group was 84.8 (95% CI, 84.3–85.3); and the 'other' group was 82.3 (95% CI, 81.1–83.6) (Table 3). This indicates little practical significance in scores (a difference ≥ the SEM), even before controlling for initial ability, except when comparing academic and other physicians.

Table 2
Respondent and non-respondent comparisons.

Characteristic	All test takers	Survey respondents	Non-respondents	Comparison
Number	2796	2693	103	–
Emergency medicine residency trained (% of number)	2511 (89.8)	2428 (90.2)	83 (80.6)	X^2 (1, N = 2796) = 9.94, p < .01[a]
Not emergency medicine residency trained (% of number)	285 (10.2)	265 (9.8)	20 (19.4)	
Seeking recertification (% of number)	2652 (94.9)	2558 (95.0)	94 (91.3)	X^2 (1, N = 2796) = 2.82, p = .09[a]
Regaining certification (% of number)	144 (5.2)	135 (5.0)	9 (8.7)	
Pass/fail (pass rate)	2611/185 (93.4%)	2518/175 (93.5%)	93/10 (90.3%)	X^2 (1, N = 2796) = 1.65, p = .2[a]
ConCert scores [mean (SD)]	83.7 (6.0)	83.7 (6.0)	81.8 (6.4)	t (2,692, N = 2693) = 0.617, p = .54[b]
Qualifying scores [mean (SD)]	82.5 (6.4)	82.5 (6.4)	81.2 (7.0)	t (2,692, N = 2693) = 0.384, p = .7[b]

[a] Comparison between survey respondents and non-respondents.
[b] Comparison between all test takers and survey respondents.

Table 3
Examination performance by type of practice, location of practice, and teaching.

	Group size	ConCert score mean (95%CI)	Qualifying exam score mean (95% CI)
Type			
Community	2054	83.5 (83.3–83.8)	82.2 (82.0–82.5)
Academic	528	84.8 (84.3–85.3)	83.6 (83.1–84.2)
Other	111	82.3 (81.1–83.6)	82.1 (80.7–83.4)
Location			
Community hospital (non-academic)	1346	83.4 (83.0–83.7)	82.1 (81.8–82.5)
Community-based teaching hospital	871	84.5 (84.1–84.9)	82.6 (82.2–83.0)
Academic medical center	426	84.7 (84.2–85.3)	83.6 (83.0–84.2)
Non-hospital	260	81.9 (81.1–82.6)	82.0 (81.2–82.7)
Medical school	146	85.1 (84.3–86.0)	83.6 (82.5–84.7)
Teaching			
Does not teach[a]	1173	82.8 (82.4–83.1)	81.8 (81.4–82.2)
Teach non-EM residents	1007	84.8 (84.4–85.1)	83.1 (82.7–83.5)
Teach medical students	931	84.8 (84.4–85.2)	83.2 (82.8–83.6)
Teach EM residents	855	84.9 (84.6–85.3)	83.6 (83.2–84.0)

[a] Presumably, those answering, "does not teach", and one of the other categories are reflecting work at different institutions.

When controlling for QE score, there was a significant association between Type and ConCert scores ($R^2 = 0.38$, $p < .001$), most of which is accounted for by the QE. Tukey follow-up studies indicate that there was no significant difference in performance between academic and community physicians ($p = .10$), but rather that physicians choosing 'other' scored significantly lower than academic physicians ($p \leq 0.01$) [Table 4].

4.4. Impact of location on ConCert scores

Regarding the setting in which the respondents practiced, most (2391; 88.8%) identified a single type of practice venue (Location). The most common setting was a nonacademic community hospital (1346; 50.0%) followed by a community-based teaching hospital (871; 32.3%), academic medical center (426; 15.8%), and a non-hospital setting (260; 9.7%). Responses exceeded 100% because physicians may work in multiple locations.

Differences, before controlling for QE score, were only practically different from those reporting other practice locations for the non-hospital group.

Regression analysis for Location was significant ($R^2 = 0.39$, $p < .001$). Again, the QE score accounted for most of the variance in scores. The impact on the test score was most favorable for community teaching hospital (1.3 scaled score points) and least favorable for non-hospital settings (−1.1 scaled score points) [Table 5]. All other differences between locations were not of significance.

4.5. Impact of teaching on ConCert scores

Of the survey participants, there were 1173 (43.6%) who did not teach; 1007 (37.4%) physicians who taught non-emergency medicine residents; 931 (34.6%) who taught medical students; and 855 (31.7%); who taught emergency medicine residents. Responses exceeded 100% because physicians could report any combination of students and residents.

A follow-up analysis to determine the impact of teaching the various groups showed that, after inclusion of QE in the model, the impact for teaching emergency medicine residents and medical students was not statistically significant. Teaching non-emergency medicine residents had a small, but statistically significant favorable impact of 0.72 points ($R^2 = 0.38$, $\beta = 0.06$, $p < .01$) [Table 6].

5. Discussion

This is the first study to characterize how emergency physicians self-identify as community or academic and the degree to which ABEM-certified physicians are involved in teaching medical students and residents. We found that academic emergency physicians and community emergency physicians scored similarly on the ConCert. Working at a community teaching hospital was associated with higher examination performance. Teaching medical learners, especially non-emergency medicine residents, was also associated with better examination performance.

Emergency physicians practice in a variety of settings. These settings include hospital-based and free-standing emergency departments, urgent care clinics, observation medicine units, and pre-hospital care. Physicians practicing in a hospital-based emergency department work either in a community hospital or academic medical center. Moreover, many emergency physicians practice at more than one venue; and, these multiple settings can have widely differing characteristics. Only 20% of ABEM diplomates viewed themselves as academic emergency physicians, and 57% are teaching medical students and resident physicians. These findings challenge the convention that teaching defines one as an academician.

The primary focus of practicing emergency medicine in an academic medical center is to pursue scholarly activity, expand knowledge, and pass on that knowledge through resident education and supervision. While most emergency physicians practice in a community emergency department where their focus is primarily on direct patient care, the actual amount of patient care varies within individual departments.

Physicians who identified as being academic had average Concert equated, scaled scores that were higher by 1.3 points. This difference in scores was not statistically significant between academic and community physicians, and unless the physician scored right at the passing score, it does not represent a meaningful difference between the two groups.

In addition, the only significant difference based on practice location was for physicians who practice in non-hospital locations. In fact, the highest scores were obtained by those in community-based teaching hospitals—not those in primarily academic settings.

A stronger association was found between teaching medical learners and ConCert results. One might have intuitively assumed that teaching emergency medicine residents relative to other medical learners would be associated with a higher score, but this was not confirmed.

Table 4
ANCOVA results for type.*

Parameter	Estimate	Standard error	t value	Pr > |t|	95% confidence limits		LS mean (SE)	Effect comparisons (Pr > t)	
								Comm	Other
Intercept	35.569	1.26	28.26	<0.001	33.10	38.04			
Academic	1.582	0.50	3.19	<0.01	0.61	2.56	84.16 (0.21)	0.1	<0.01
Community	1.109	0.46	2.40	0.02	0.20	2.02	83.69 (0.10)	_	0.04
Other	0.0	.	.	.	.	.	82.58 (0.45)		
Qualifying exam score	0.570	0.01	39.78	<0.001	0.54	0.60			

* $F(3, 2689) = 540.96$; $p < .001$; $R^2 = 0.38$.

Table 5
Performance associated with location.

Location	β coefficient	Parameter estimate	p value*
Intercept	0	36.24	<.001**
Qualifying score	0.61	0.57	<.001**
Community hospital (teaching)	0.10	1.26	<.001**
Academic medical center	0.04	0.59	.09
Medical school	0.03	0.69	.12
Community hospital (non-teaching)	0.03	0.36	.24
Non-hospital setting	−0.05	−1.08	<.01**

* $F(6, 2686) = 283.02$, $p < .001$, $R^2 = 0.39$.
** Statistically significant.

Instead, teaching non-emergency-medicine residents had the highest positive impact on ConCert scores.

The investigators sought to control for initial ability. The reason for this was to try to determine whether the effect of practicing in a setting where the physician would self-identify as an academic physician might influence outcome. By considering past test performance, a better determination about the impact of practice environment versus initial ability could be made. There was a small, non-significant absolute difference in test performance for self-identified academic physicians, which seems to be entirely accounted for by initial ability. Still, these results do suggest that physicians who perform better on the QE are more likely to select an academic venue for practice. However, once the practice setting was selected, there appeared to be no additional benefit to ConCert performance.

One possible explanation for similar levels of performance between physicians who self-identify as academic and community physicians is that the clinical practice of emergency medicine is similar at both academic medical centers and community hospitals. An additional explanation might be that the ConCert tests material that would be known by both academicians and community physicians. These data confirm the clinical focus of the ConCert examination. These findings rebut a criticism that the ConCert Examination tests irrelevant, esoteric material that is taught in residency but is unimportant in clinical practice.

6. Limitations

This study has several limitations. The practice types were self-reported and not defined except by the content of the questions, as there is no standardized definition for academic physicians and community physicians. Some physicians may change practice locations during their career, and their current practice setting may not reflect their entire career path.

The authors did not attempt to confirm the veracity of responses. Nonetheless, the degree to which bias might affect a response is uncertain. It seems that little would be gained by reporting an inaccurate self-characterization (academic v. community), different practice setting, or teaching activity.

There was a difference in the group that did not respond to the survey and the group that did respond. Physicians who did not complete an emergency medicine residency were less likely to complete the survey. The impact of this group of 20 physicians (0.7% of all test takers) is small, especially given the overall response rate of 96.3%.

The "other" group (neither academic nor community) was not defined. This small group is presumed to be heterogeneous. The few who commented on their 'other' setting listed 50/50 academic and community, research positions, and urgent care. Many did not comment; therefore, any statement about the performance of this group should be limited. Either excluding this group from analysis or assigning the entire cohort to the academic or community group would not affect the results enough to alter the conclusions. Similar heterogeneity was presumed for nonhospital practice locations, leading to limited conclusions about this small group.

Finally, the generalizability of the results to other areas of physician performance such as patient care, must be avoided. Other competencies or areas of performance may not be measured by the outcome measures of this study.

Table 6
Performance associated with teaching.

Teaching group	β coefficient	Parameter estimate	P value*
Intercept	0.0	36.80	<.001**
Qualifying score	0.60	0.56	<.001**
Non-EM residents	0.06	0.72	<.01**
EM residents	0.04	0.47	.06
Medical students	0.03	0.39	.13
Does not teach	0.00	−0.05	.88

* $F(5, 2687) = 335.22$, $p < .001$, $R^2 = 0.38$.
** Statistically significant.

7. Conclusions

Academic emergency physicians and community emergency physicians scored similarly on the ConCert. Working at a community teaching hospital was associated with higher examination performance. Teaching medical learners, especially non-emergency medicine residents, was also associated with better examination performance.

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