



Visualizing Structure and Function in Real Time: How Osteopathic Students of Varied Confidence Learn Cardiac Physiology with Ultrasound

Ethan Weiss¹, Derek Dennard¹, Sydney Sudler¹, Spencer Vroegop¹, Halley McDonald¹, Chase Irwin^{1,2}, Charles Finch¹ and Layla Al-Nakkash^{1,3}

¹Arizona College of Osteopathic Medicine, Midwestern University, Glendale, 85308, AZ, USA, ²Office of Research and Sponsored Programs, Midwestern University, Glendale, 85308, AZ, USA. ³Department of Physiology, College of Graduate Studies, Midwestern University, Glendale, 85308, AZ, USA

Background & Introduction

- Existing literature argues for the integration of point-of-care ultrasound (POCUS) into undergraduate medical training.
- POCUS permits real-time demonstration of a primary tenet in osteopathic medicine - the interrelation of structure and function – through in-vivo visualization of tissues, organs, and their physiologic function.
- What's not clear is whether students derive greater or less benefit from ultrasound integration given their prior level of POCUS or cardiac physiology confidence.

Study Objectives

- To evaluate the usefulness of POCUS in physiology education and identify whether students with differences in prior ultrasound and cardiac physiology confidence derive more or less benefit from the aforementioned POCUS integration.

Materials & Methods

A total of 294 MWU AZCOM-2028 and AZPOD-2028 students during the 2024-2025 academic year participated in a 30-minute cardiac POCUS workshop. Of those, 291 provided survey responses, which were then centralized using REDCap for the collection of subjective data. Included in the pre-/post-survey:

- 5-Point Likert Scale
- Dichotomous Question: Yes or No

Objective data: cardiac POCUS images were graded & analyzed by a licensed clinician. Included in the image assessment: clarity, anatomical accuracy and measurement accuracy (each graded on a 3-point scale: 1=poor, 2=fair, 3=strong).

POCUS Workshop Content:

- Obtain a high-quality Parasternal Long Axis (PLAX) view of the heart to measure left ventricular outflow tract (LVOT) diameter and velocity time integral (VTI).
- Calculate cardiac output to obtain E-point Septal separation (EPSS) via POCUS.
- Utilize EPSS measurement to estimate left ventricular ejection fraction (LVEF).

Statistics:

- Wilcoxon Signed-Rank test utilized for comparison of pre- vs post-survey responses.
- Subgroup analyses: high vs low prior physiology confidence
high vs low prior POCUS confidence
- Two-sample independent t-tests utilized for comparison across prior confidence groups: mean, SD, and p-value.

Ultrasound Workshop

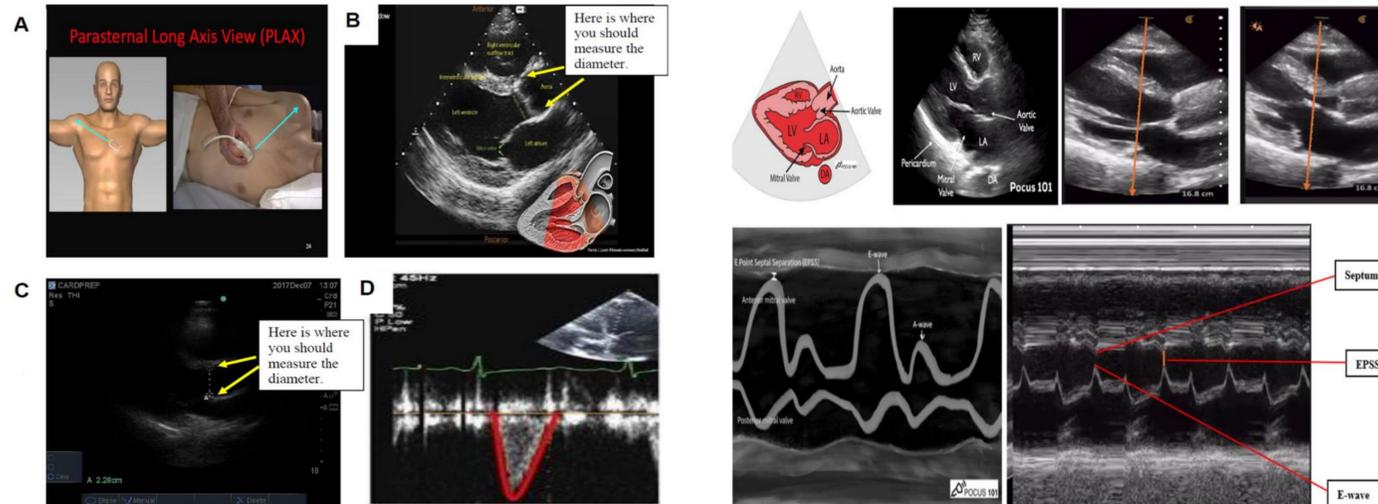


Figure 1: Use of POCUS PLAX view to measure aortic/LVOT diameter and LVOT VTI. A. PLAX view POCUS probe placement. B. PLAX view. C. PLAX view. D. Doppler and PLAX view to calculate LVOT VTI.

Figure 2: Use of POCUS PLAX view to measure E-point septal separation (EPSS).

Stratification Analysis

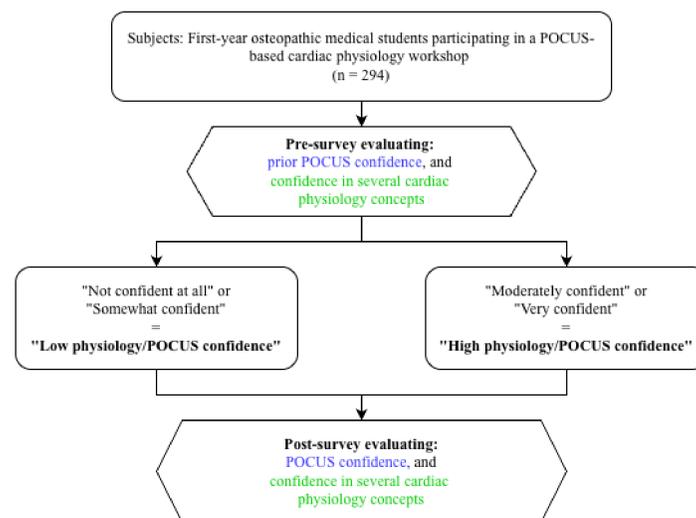
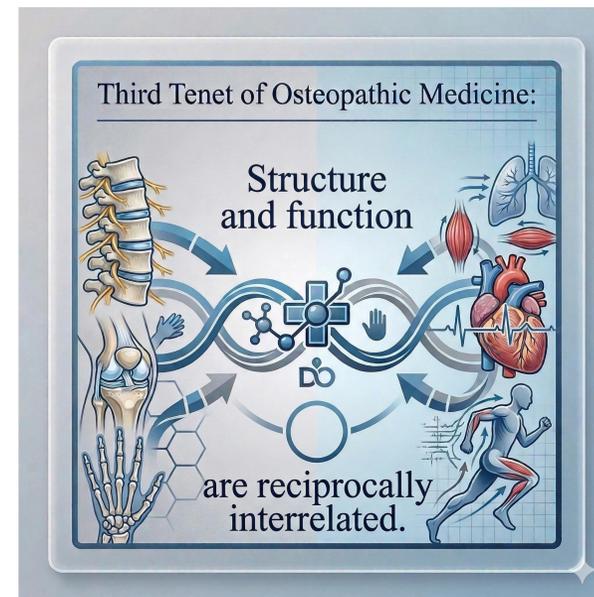


Figure 3. Post-hoc stratification schema for analyzing changes in confidence before and after cardiac POCUS workshop.

Survey Question	High Prior Physiology Confidence (n=94)	Low Prior Physiology Confidence (n=148)	p-value
	mean (SD)	mean (SD)	
"If you were tasked to perform the PLAX (parasternal long axis) scan alone, how would you rate your confidence level to obtain this view?" ^a (Growth pre-survey → post-survey)	1.07 (1.08)	1.51 (1.21)	0.05*
"Upon completion of this workshop, I am confident in my ability to use point-of-care ultrasound (POCUS) to estimate cardiac output." ^a	3.85 (0.95)	3.54 (0.83)	0.05*
"Upon completion of this workshop, I am confident in my ability to use point-of-care ultrasound (POCUS) to estimate Left Ventricular Ejection Fraction." ^a	3.79 (0.95)	3.52 (0.80)	0.09
"Rate your level of agreement with the following statement: This workshop enhanced my knowledge and understanding of cardiac physiology." ^a	4.22 (0.84)	4.07 (0.75)	0.55

Table 1. Post-survey responses stratified by high or low prior physiology confidence. The first row results represents growth from the identical pre-survey question. Highlighted results are statistically significant.



Survey Question	High Prior POCUS Confidence (n=83)	Low Prior POCUS Confidence (n=153)	p-value ^c
	mean (SD)	mean (SD)	
"If you were tasked to perform the PLAX (parasternal long axis) scan alone, how would you rate your confidence level to obtain this view?" ^b (Growth pre-survey → post-survey)	0.98 (1.08)	1.45 (1.16)	0.01*
"Upon completion of this workshop, I am confident in my ability to use point-of-care ultrasound (POCUS) to estimate cardiac output." ^a	4.04 (0.77)	3.56 (0.83)	<0.001*
"Upon completion of this workshop, I am confident in my ability to use point-of-care ultrasound (POCUS) to estimate Left Ventricular Ejection Fraction." ^a	3.94 (0.83)	3.52 (0.80)	<0.001*
"Rate your level of agreement with the following statement: This workshop enhanced my knowledge and understanding of cardiac physiology." ^a	4.37 (0.66)	4.02 (0.82)	0.003*

Table 2. Post-survey responses stratified by high or low prior POCUS confidence. The first row results represents growth from the identical pre-survey question. Highlighted results are statistically significant.

Discussion

- Students with lower prior confidence in POCUS or cardiac physiology saw significantly greater growth in perceived technical skill than students with more prior confidence.
- Higher prior confidence in POCUS correlated with higher cardiac physiology confidence after the workshop.
- Students with high prior confidence in POCUS or cardiac physiology may reach proficiency sooner, but relative improvement in low-confidence cohorts suggest that experiential learning with POCUS can effectively reduce knowledge gaps and boost technical self-efficacy.
- Results should allay faculty concerns that students with little prior POCUS confidence have an additional technical hurdle to learning cardiac physiology with this modality and will derive less benefit from experiential learning.
- Even students with low prior POCUS confidence derive significant learning benefits from a cardiac POCUS workshop, and in fact are primed to see more growth in subsequent workshops.

Limitations

Limitations of this study include:

- Measures of skill and physiology knowledge were self-reported.
- The high confidence subgroup was considerably smaller than the low confidence subgroup; the significance of its results is not as robust.

Conclusions & Next Steps

- Cardiac ultrasound workshops enhance undergraduate medical physiology coursework and promote confidence in both POCUS skill and physiology mastery.
- Designers of undergraduate medical physiology curricula should not shy away from POCUS just because students may have limited experience with the technology.
- Workshops have an additive effect; students with low confidence prior to a cardiac POCUS workshop report benefit that makes subsequent POCUS exposure even more effective as a learning modality.

Next steps:

- Consider longitudinal follow-up on knowledge retention.
- Incorporate objective pre-assessment quizzes or OSCE-style stations for more rigorous baseline measurements.

References

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