

**Hand-Carried Ultrasound
in the Hands of Hospitalists:
Does It Add to the Accuracy of the
Cardiac Physical Examination?**

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Disclosures

- None.

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Background: Cardiac Physical Examination (PE)

- Poorly performed and inherently limited
 - Residents identified only 20% of 12 important and commonly encountered cardiac events¹
 - Cardiologists diagnosed only 45% of left ventricular dysfunction and 50% of significant valvular lesions²

Background: HCU and PE

- Ultrasound is gold standard for demonstrating cardiac anatomy and function
- First year medical students using HCU were superior to cardiologists performing PE²
 - Identified 86% of left ventricular dysfunction and 89% of significant valvular lesions (vs. 45% and 50%, respectively)

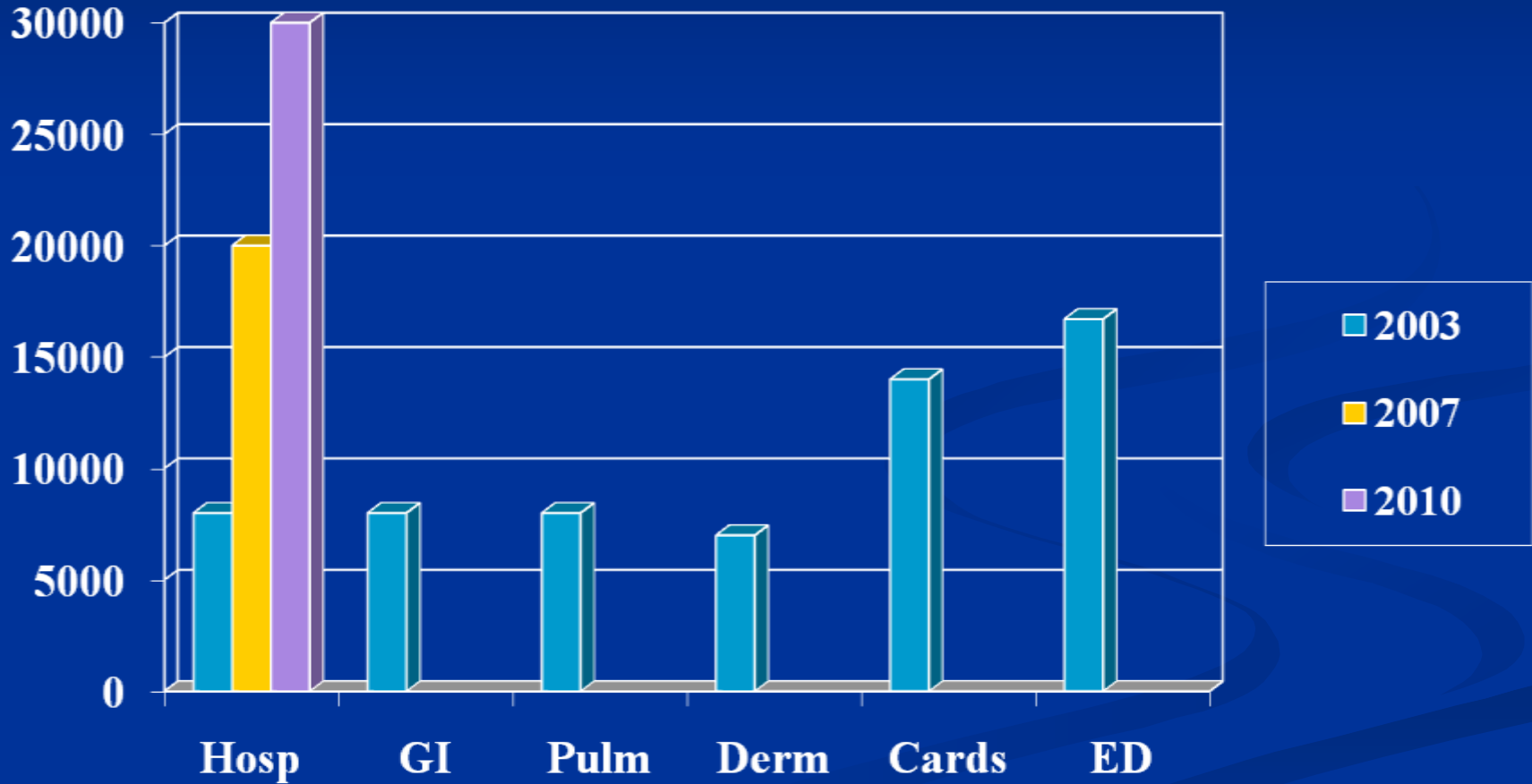
Background: HCU and PE

- HCU improves accuracy of cardiac PE
 - Medical students³
 - Medical residents^{4,5}
 - Cardiologists⁶ – rate of missing important cardiac abnormalities dropped from 43% to 21%
- No studies of general internists

Selecting Hospitalists for Training

- HCU has many inpatient applications
 - Cardiac exam
 - Assess volume status
 - Abdominal exam
 - Procedures
- Young field & accustomed to technology
 - Average age of Hospitalist: 35
- There are 30,000 of them!

Number of Docs by Specialty



Methods

- Subjects:
 - JHBMC hospitalists (n=10)
 - Patients on medical ward who had conventional echocardiogram as part of clinical care (n=354)
- 4-Step HCU training program
- Hospitalist training and patient recruitment by research echo tech

Methods

- Hospitalists performed cardiac PE prior to HCU on study patients
- By PE and then HCU, hospitalists evaluated
 - Heart (LV) size
 - LV function
 - pericardial effusion
 - aortic stenosis
 - aortic regurgitation
 - mitral regurgitation

Methods

- 4 point scale to grade cardiac findings
- Gold standard: expert cardiologist made same 6 assessments based on conventional echo
- Outcome measure: how frequently hospitalists' cardiac PE with or without HCU matched or came within one scale level of the gold standard
 - McNemar's test for paired proportions

Results

- 10 hospitalists
 - Average 2.9 years post-residency (range: 0-9)
 - 3 with limited prior echo experience
 - Completed 354 HCUs (mean=35.4, range 28-50)
 - Averaged 13 minutes to perform HCU
- 354 general medical inpatients
 - Mean age 63 yrs (SD 18.7); weight 75.5 kg (SD 14.0)
 - 53% were female

Results: PE + HCU vs. PE alone

Left Ventricular Function

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	59	<i>.005</i>	54	64	336	88	<i>.0001</i>	84	91	336
	PE	46		41	51	336	67		62	72	336
Normal	HCU	73	<i>.01</i>	67	79	219	89	<i>.005</i>	85	94	219
	PE	64		58	70	219	77		71	82	219
Abnormal	HCU	32	<i>.0001</i>	24	41	117	85	<i>.0001</i>	78	91	117
	PE	12		6	18	117	49		40	58	117

Comparison of Proportions for Positive and Negative Results

Left Ventricular Dysfunction (LVD)		Cardiologist Result was Positive						
		# Positive	% Positive (Sensitivity)		% False Negative		% Unable to Assess	
Any LVD	HCU	117	70.1	.0001	27.4	.001	2.6	.001
	PE	122	34.4		49.2		16.4	
Moderate or Severe LVD	HCU	71	62.0	.0001	36.6	.001	1.4	.001
	PE	73	12.3		68.5		19.2	
		Cardiologist Result was Negative						
		# Negative	% Negative (Specificity)		% False Positive		% Unable to Assess	
Any LVD	HCU	219	73.1	.05	24.7		2.3	.0001
	PE	232	62.9		20.3		16.8	
Moderate or Severe LVD	HCU	265	86.4	.05	10.9		2.6	.0001
	PE	281	78.3		5.7	.05	16.0	

Results: PE + HCU vs. PE alone

- HCU also significantly improved detection of cardiomegaly and pericardial effusion
- Did not improve valvular assessments

Results: Exit Survey

- Hospitalists expect to perform cardiac HCU on 44% of patients admitted to general medicine ward
- 90% say HCU adds important information to clinical evaluation at least half of the time
- 70% would give up the stethoscope for the HCU device

Conclusions

- HCU increases accuracy of hospitalists' PE to detect left ventricular dysfunction, cardiomegaly, and pericardial effusions
- Compared to PE alone, adding HCU increases detection of left ventricular dysfunction by up to 500%
- But HCU still misses 30% of left ventricular dysfunction (versus 65% missed by PE)

Conclusions

- HCU fails to improve accuracy of assessments of aortic stenosis, aortic regurgitation, and mitral regurgitation
- High rate of false positives for valvular regurgitation
 - Limited Doppler capability of device
 - Difficulty in obtaining relevant 2-D views

Study Limitations

- Assessed only one level of HCU training
- Did not address questions of clinical benefit and cost
- Did not measure impact on patient and physician satisfaction or on doctor-patient relationship

Summary

- HCU adds to the accuracy of hospitalists' cardiac PE in some areas but not others
- Because of relatively high error rates, hospitalist-performed HCU should not replace conventional echo
- Might best be used by hospitalists as a bedside adjunct to H&P, with follow-up testing or expert interpretation as appropriate

Implications

- Future studies of training hospitalists to perform HCU should focus on limited indications
 - Left ventricular dysfunction
 - Prevalent, and increases with age, often asymptomatic
 - Early diagnosis and treatment improves its associated morbidity and mortality
 - IVC assessment
 - Independent predictor of readmission for heart failure⁸

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Results: PE + HCU vs. PE alone

Cardiomegaly

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	90	<i>.005</i>	86	93	311	90	<i>.005</i>	86	93	311
	PE	59		53	64	311	59		53	64	311
Normal	HCU	93	<i>.0001</i>	90	96	271	93	<i>.0001</i>	90	96	271
	PE	59		54	65	271	59		54	65	271
Abnormal	HCU	70		56	84	40	70		56	84	40
	PE	53		37	68	40	53		37	68	40

Results: PE + HCU vs. PE alone

Pericardial Effusion

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	79	<i>.0001</i>	75	84	336	96	<i>.0001</i>	93	98	336
	PE	49		44	54	336	59		54	64	336
Normal	HCU	84	<i>.0001</i>	80	89	269	95	<i>.0001</i>	92	97	269
	PE	61		55	66	269	62		56	68	269
Abnormal	HCU	60	<i>.0001</i>	48	71	67	99	<i>.0001</i>	96	100	67
	PE	3		0	7	67	48		36	60	67

Results: PE + HCU vs. PE alone

Aortic Stenosis

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	73		68	77	336	83		79	87	336
	PE	74		69	79	336	90		87	93	336
Normal	HCU	79		75	84	286	85		81	89	286
	PE	84		79	88	286	94	<i>.005</i>	91	97	286
Abnormal	HCU	34		21	47	50	70		57	83	50
	PE	20		9	31	50	68		55	81	50

Results: PE + HCU vs. PE alone

Aortic Regurgitation

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	52		46	57	290	74		69	79	290
	PE	63		58	69	290	83		79	88	290
Normal	HCU	59		52	65	206	73		67	79	206
	PE	86	.0001	82	91	206	89	.0001	85	94	206
Abnormal	HCU	35	.0001	24	45	84	76		67	85	84
	PE	7		2	13	84	69		59	79	84

Results: PE + HCU vs. PE alone

Mitral Regurgitation

Cases		%	P	LCL	UCL	N	%	P	LCL	UCL	N
		<i>Exact Match</i>					<i>Close Match</i>				
All	HCU	42		36	48	290	77		72	82	290
	PE	40		34	46	290	77		72	82	290
Normal	HCU	54		44	63	114	80		72	87	114
	PE	79	.0001	71	86	114	89	.05	83	94	114
Abnormal	HCU	35	.0001	28	42	176	76		69	82	176
	PE	15		10	20	176	70		63	77	176