Development, Implementation, and Evaluation of a mobile point-of-care ultrasound tracking system and mobile research tool within an Internal Medicine residency David Tierney MD, FACP; Abbott Northwestern Hospital, Dept. of Graduate Medical Education; Minneapolis, Minnesota



BACKGROUND

Ultrasound competency and certification declarations both require timely, complete, and accurate collection of user exam data. The ability to record ultrasound exam data at the point of care with a mobile device may assist in these requirements.

METHODS

A mobile, smartphone-based application (Fig. 1) was developed to track point-of-care ultrasound (POCUS) exams performed across the Internal Medicine Bedside UltraSound (IMBUS) program at a quaternary care center's IM residency program. The application was built to gather immediate, complete, and robust data about the exam performed, physician/student interpretation of the exam, and any research data applicable to the performed exam. This mobile tracking system replaced the

previously in place paper-based system (Fig. 2).

The administrative back-end of the application was built to function as:

- 1. the QA interface for over-reading (Fig. 3)
- 2. a tracking interface for identifying struggling users
- 3. a graphic interface to track individual's progress towards competency and certification within the residency's IMBUS program (Fig. 4)
- 4. a flexible control center for an evolving certification and competency program (Fig. 5)
- 5. a data gathering and analysis center for research studies
- 6. a single central hub for interrogation and analysis of data across an entire system of POCUS at multiple sites (Fig. 6).

Analysis pre and post application implementation was completed to address completeness of data gathering and user experience.

FIGURE 1



FIGURE 2



FIGURE 3

		Hacko	S_ADDOLLINWIMBOS (LAA-05)	00
	106 / 5188 Found (Unsorted)		S. ≌ ♀.	Q*
Pro-Exams Detail	View As:	Show All New Record Delete F	Record Find Sort Share	BRO
Conto	- Free	Mina Durfa		
IBUS Contac	Deteil	List Approve Studies		
	Detail	List Approve Studies		0
Medical Record Number	1003318623			S
Study Date	8/15/14	Time 12:54:00		
Performing Physician	133	Thomas Miskavige	Location Other	
Staffing Physician	100	David Tierney	Outpatient	
	D	etail Study	Reports Dev	
Exams Possi	ble Count	15 Exams Completed Count	15 Completed Exam	
Physician	Component	ID Component	Exam Before Cert	10
Thomas Miskavige	24	Abdominal - Morrison's	×	
Thomas Miskavige	1	Cardiac - 3-4 Views	×	
Thomas Miskavige	91	Cardiac - Ao Root Dilation	×	
Thomas Miskavige	87	Cardiac - Aortic Regurg	X	
Thomas Miskavige	88 0E	Cardiac - Aortic Stenosis	×	
Thomas Miskavige	2	Cardiac - Diastolic Dysruncuon	×	
Thomas Miskavige	89	Cardiac - IVH	×	
Thomas Miskavige	83	Cardiac - Mitral Regurg	×	
Thomas Miskavige	90	Cardiac - Segmental WMA	×	
Thomas Miskavige	5	Cardiac - Severe Hypo LV	×	
Thomas Miskavige	50	Pulmonary - Blind	×	
Thomas Miskavige	19	Pulmonary - Interstitial Pattern	×	
Thomas Miskavige	18	Pulmonary - Pleural Effusion	×	
Thomas Miskavige	15	Pulmonary - Zones 1-4	×	
Thomas Miskavige				
				2 (** =)
				2 v4

FIGURE 4

ІМВ	JS	ts Exams M Detail List App	i SC prove	Prefs Studies	List	elp						
	Q, Find To	Certify		Bonus Repo	rt	Cert Info Report Open iPhone Entry						
Performing P	hysician	Exam Component	Active	<u>Tota</u> Completed	al <u>Total</u> d Required	<u>%</u> Complete				Certif	Certified Date	Bonus Due
1	Tim Cimbura	Abdominal - Morrison's	x	10	В	100%	-			D.		
1	Tim Cimbura	Abdominal - Liver Size	×	8	8	100%						
1	Tim Cimbura	Abdominal - Ascites	×	6	5	100%						
126	Chris Desautels	Pulmonary - Atelectasis	×	8	8	100%						
137	Solmaz Shayan-Kim	Cardiac - Normal Function	×	29	15	100%						
130	Brent Ekstrom	Cardiac - Hyperdynamic LV	×	8	8	100%						
109	Josh Becker	MSKL - Foot/Ankle	×	7	6	100%						
109	Josh Becker	MSKL - Bursitis	×	6	6	100%						
140	Josh Overgaard	HEENT - Sinus_NL	×	7	5	100%						
165	Patrick Odens	HEENT - Sinus_NL	×	8	5	100%						
161	Andrew Henn	Cardiac - Normal Function	×	16	15	100%						
161	Andrew Henn	Cardiac - Hyperdynamic LV	×	8	8	100%						
169	Sarah Prebil	Cardiac - IVC Volume	x	15	15	100%				×	9/16/14	\$74.00
163	Cara Moen	Soft Tissue - Cellulitis	x	4	4	100%				×	9/16/14	\$74.00
163	Cara Moen	Pulmonary - Pneumonia/Consol	×	20	20	100%				×	9/16/14	\$148.00
159	Abdul Ahmad	Cardiac - Severe Hypo LV	×	12	10	100%						
159	Abdul Ahmad	Cardiac - Normal Function	×	27	15	100%						
159	Abdul Ahmad	Cardiac - Left Pleural Effusion-	×	11	8	100%	1			×	9/16/14	\$148.00
159	Abdul Ahmad	Cardiac - 3-4 Views	×	52	50	100%						
172	Brian Post	Pulmonary - Interstitial Pattern	×	17	15	100%						
159	Abdul Ahmad	Cardiac - Mitral Regurg	×	15	15	100%						
159	Abdul Ahmad	Cardiac - LVH	×	9	8	100%	1			×	9/16/14	
140	Josh Overgaard	Abdominal - Splenomegaly	×	5	5	100%				×	9/16/14	
167	Bonnie Sohn	Abdominal - Kidney - CKD	×	5	5	100%				×	9/16/14	
167	Bonnie Sohn	Abdominal - Hepatomegaly	×	5	5	100%	-			×	9/16/14	
100	David Tierney	Cardiac - Segmental WMA	×	30	30	100%	1			×	9/16/14	
180	Karoline Lange	Pulmonary - Zones 1-4	×	16	15	100%				O		
180	Karoline Lange	Pulmonary - Pleural Effusion	×	14	10	100%				×	9/16/14	\$148.00
180	Karoline Lange	Pulmonary - Lung Sliding	×	12	10	100%				×	9/16/14	\$74.00
180	Karoline Lange	Pulmonary - Atelectasis	×	10	8	100%				×	9/16/14	\$74.00

FIGURE 5

MD		IVIISC	Piels	пер		
ID	05	Main Exam Area	as List	Exam Components		
Exa	m Area ID Exam Area	Descrip	tion			
1	Cardiac	Of, rela	ting to, situated i	near, or acting on the heart		
Ter	A Color Name					
liet	t Color Name					
Ligi	in corar					
		_	_			
٧	Vhite Black Icon	Other				
	RA RA					
		_			Active Components	1
Orde	r Exam Type	Abbrev	Descrip	otion	Required	Active
1	3-4 Views				50	×
2	IVC Volume				15	×
3	Normal Function				15	×
4	Hyperdynamic LV				8	×
5	Severe Hypo LV				10	×
6	Mild/Mod Hypo LV				18	×
7	Pericardial Effusion	PCE			8	×
8	Segmental WMA	WMA			30	×
9	Tamponade				8	×
10	Left Pleural Effusion-Heart				8	×
11	Right Pleural Effusion-Heart				б	×
12	Pleural and PCE				8	×
13	RV Overload	RVO			20	×
14	LVH	LVH			8	×
15	AAA Screen – Normal				25	×
16	AAA Screen - Abnormal				8	×
17	Mitral Regurg	MR			15	×
18	Mitral Valve SAM	SAM			10	×
19	Tricuspid Regurg	TR			15	×
20	Aortic Regurg	AI			15	×
21	Aortic Stenosis	AS			15	×
22	Ao Root Dilation				10	×
23	Diastolic Normal (E/A, e')				15	×
74	Diastolic Dysfunction				15	×



RESULTS

- 30 months (Fig. 6).
- based system was 68%.
- their pager amongst this group).
- competency/credentialing exam targets.
- customizable interface.

FIGURE 6: EXAM COUNTS BY QUARTER AND CLINICAL AREA



CONCLUSION

A robust point-of-care mobile tool resulted in more timely, complete, and accurate data for students, residents, and faculty performing point-of-care ultrasound. The ability for the administration and individual to track their progress and certification with the application was essential to the POCUS training environment. The administrative back-end added significant efficiency to a hybrid mastery learning approach to assess competency in point-of-care ultrasound. Integration of routine clinical POCUS exam data collection with research study data gathering may also make point-of-care ultrasound research more efficient. The conversion of the application to a fully customizable, web-based, and platform independent tool will allow use by other training programs in need of a comprehensive solution for gathering and analysis of POCUS user data.

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• Following implementation of the tracking application, 22,000 exams were performed over

• 99% of exams performed by residents and staff were recorded using the application at the point-of-care. The capture rate prior to the smartphone application while utlilizing a paper-

• Residents felt that the ability of the application to show them their progress towards certification in each area of IMBUS was helpful and motivational in guiding their practice exams.

• Users felt the application was a more efficient way to enter data with the primary reasons being the user-friendly interface and accessibility (as all physicians carry smartphones as

• The application successfully recorded data for POCUS research studies.

• The administrative back-end of the application allowed tracking and modification of our

• The original application was converted to a platform independent, web-based, and fully

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