

The Novel Concept of Patient Self-Imaging: Success in COVID-19 and Cardiopulmonary Disorders



Telemedicine lacks a traditional physical examination but can use video clues, as noted in the “Telehealth Ten” by Benziger et al.¹ Although ultrasound lung images are also transmittable via telehealth, patients at home would have to image themselves—a practice only described in case reports.² Notably, the anteroapical lung window is easily accessible for self-imaging and the presence of B-lines, which are ultrasound findings indicating edema or inflammation, at this site has clinical significance in congestive heart failure (CHF)³ and in coronavirus disease 2019 (COVID-19).⁴ We wish to report the feasibility of instructing patients on a simplified process of self-imaging and identify predictors of their proficiency.

With institutional review board approval at a 300-bed hospital, 80 patients were divided in 3 cohorts: 20

consecutive patients with mild-moderate COVID-19, 20 inpatients admitted with dyspnea, and 40 consecutive cardiology outpatients. Each were given a 4-MHz point-of-care ultrasound (POCUS) transducer (Vave Health) network-connected to its smartphone application to perform self-imaging of both anterior lung apices in the second intercostal space, midclavicular line. Patients placed the probe using an instruction sheet only and were not allowed to view images during acquisition. Each image was assigned a quality score (0-3) with a point given for the presence of any of 3 landmarks: the rib shadow, pleural line, and either A-lines or B-lines. Successful imaging was defined when either lung image scored ≥ 2 points. Accuracy for the presence of B-lines was assessed using physician-acquired images as the gold standard. Successful imaging and accuracy were tested for association with baseline characteristics using logistic regression.

Mean (\pm standard deviation [SD]) patient age was 65 ± 16 years. Successful imaging (108/160 images) had a

Table Selected Baseline Characteristic Data, Patient Cohort, Age Quartile, Cohort and Relationship with Successful Image Acquisition

Characteristic	Number of patients (%)	Proportion of patients with successful imaging*	OR [95% CI]	P value (univariable)
Gender (male)	45/80 (56.3%)	38/45 (84.4%)	1.88 [0.62-5.87]	.2639
Smartphone owner or home Wi-Fi	70/80 (87.5%)	60/70 (85.7%)	9.00 [2.20-41.04]	.0026
Internet daily	60/80 (75%)	55/60 (91.7%)	13.44 [3.97-52.13]	.0001
Telehealth use	51/80 (63.8%)	47/51 (92.2%)	8.29 [2.52-33.01]	.0010
Cohort				
Cardiology outpatient	40/80 (50%)	36/40 (90%)	Ref [Ref]	Ref
COVID inpatient	20/80 (25%)	16/20 (80%)	0.44 [0.09-2.09]	.2912
Dyspnea inpatient	20/80 (25%)	12/20 (60%)	0.17 [0.04-0.62]	.0102
Age quartiles				
Q1 (21-57 years)	20/80 (25%)	18/20 (90%)		
Q2 (58-67 years)	23/80 (29%)	20/23 (87%)		
Q3 (68-77 years)	19/80 (24%)	17/19 (89%)		
Q4 (78-94 years)	18/80 (22%)	9/18 (50%)		.004 [†]

CI = confidence interval; COVID-19 = coronavirus disease 2019; OR = odds ratio.

ORs, 95% CIs, and P values from univariable logistic regression are shown. Age quartiles, Q1-Q4, were compared (specifically, $P = .001$ for Q4 compared with Q1 + Q2 + Q3). ORs were calculated for the inpatients with COVID-19 and dyspnea using the outpatients from cardiology as the reference standard. ORs < 1 indicated worse performance.

*Proportion of successful imaging indicates: number of patients with a successful image divided by the number of patients with characteristic listed in column 1.

[†]P values comparing proportions of successful images between all quartiles by χ^2 test.

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sensitivity, specificity and accuracy of 67%, 94%, and 88%, respectively, and was associated with age (odds ratio [OR]: 0.94, [0.89,0.98], $P=0.011$). In a backward-selection reduced multivariable model, although age trended toward association (OR: 0.94, [0.87,1.00], $P=0.08$), the dyspnea cohort was associated with reduced odds of successful imaging (OR: 0.09, [0.01, 0.50], $P=0.009$), perhaps due to limitations from acute dyspnea. Daily Internet use was associated with successful imaging (OR: 6.37 [1.46, 31.55], $P=0.02$).

By using the readily accessible anteroapical location, we demonstrated that patients with stable cardiac disease or with mild-moderate COVID-19 infection, particularly those younger than 80 years old who use the Internet daily, can obtain diagnostic lung images with the most minimal of instruction. Our findings validate the imaging site and large potential pool of patients who could potentially self-image using lung ultrasound to improve telehealth examination (Table).

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