Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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https://doi.org/10.1016/j.echo.2021.10.001

Findings from Implementation of a Remote Collaboration Solution to Perform Echocardiograms during the COVID-19 Pandemic

The American Society of Echocardiography's recommendations for providing echocardiographic services during the COVID-19 pandemic emphasize performing limited problem-focused examinations with minimal possible scan time.[1] To help operationalize these recommendations, our laboratory employed a remote communication software (Philips Collaboration Live [CL] Feature on EPIQ Ultrasound Machines; Philips Healthcare, Bothell, WA) that allows the physician to connect to the ultrasound machine and provide real-time guidance. We hypothesized that using CL technology during the performance of limited echocardiograms would reduce examination time and image acquisition number without compromising diagnostic quality. To test this hypothesis, we engaged in a quality improvement project prospectively performing 101 limited echocardiograms (CPT 93308) with CL during the COVID-19 pandemic (January through March 2021). This group was compared with limited echocardiograms performed prior to the COVID-19 pandemic without the use of CL technology ($n = 101$, February 2019).

Results are shown in Table 1. All studies in both cohorts were of diagnostic quality. Image acquisition times and numbers analyzed using a two-sample t test and Wilcoxon rank-sum test showed a significant reduction in examination time ($P < .0001$) and image acquisition number ($P \leq .0001$) with CL. These differences remained statistically significant after adjusting for study indication.

Table 1 Clinical characteristics, image acquisition times, and image numbers for CL and noncollaboration live (No-CL) cohorts

	No-CL cohort ($n = 101$)	CL cohort ($n = 101$)	P value
Indication, *n* (%):			<.0001
Evaluate ejection fraction	59 (58.4)	68 (67.3)	
Evaluate for effusion	31 (30.7)	12 (11.9)	
Hypotension	10 (9.9)	5 (5.0)	
Other	1 (1.0)	16 (15.8)	
Body mass index, *n* (%)*:			.9988
≤25	27 (26.7)	26 (25.7)	
>25 to ≤30	28 (27.7)	27 (26.7)	
>30	44 (43.6)	43 (42.6)	
Unknown	2 (2.0)	5 (5.0)	
Duration, minutes:			<.0001
Mean (SD)	12.5 (±5.7)	7.1 (±4.4)	
Median (min-max)	11 (3-28)	6 (2-21)	
No. of images:			.0001
Mean (SD)	37.2 (±12.8)	30.1 (±12.7)	
Median (min-max)	37 (12-78)	27 (10-83)	

*Unknown category not included in testing for statistical difference between groups.

In the CL patient cohort, 43 (42.6%) individuals either had or were suspected of having COVID-19. The average examination time for these patients was 7.4 minutes. This value is important as SARS-CoV-2 transmission risk increases with increasing exposure time.[2]

While CL technology resulted in decreased image acquisition time and number, there were obstacles to the implementation of the technology. Performing examinations required coordination between the physician and sonographer and thus could not be performed on an unscheduled basis. While not formally assessed, it is possible that CL-guided echocardiograms were more physician time intensive than traditional limited echocardiograms since the physician watched the image acquisition in real time. Seventeen percent of the studies performed with CL experienced technological issues such as audio difficulties or lost connection; however, none of these issues limited the ability to complete the examination. Finally, because we used a prepandemic control group, we cannot exclude the possibility that examination time and image acquisition number were affected by pandemic-specific environmental factors, not just CL technology. This is partially refuted by the finding that in the CL cohort there were no statistically significant differences in image acquisition time or number between patients who had or were suspected of having COVID-19 and those who did not ($P = .5708$ and $P = .9244$, respectively).

Our study is the first to report on using a remote communication solution to decrease examination time and image acquisition number during the COVID-19 pandemic. The real-time physician guidance

enabled through remote communication solutions can remove sonographer uncertainty in determining when enough images have been acquired to answer the clinical question, thereby increasing efficiency. Such technological solutions, along with other strategies to limit sonographer exposure, may be valuable tools for adhering to the American Society of Echocardiography's recommendations for performing echocardiograms during the COVID-19 pandemic.[1,3,4]

ACKNOWLEDGMENTS

Philips Healthcare provided access to the Philips Collaboration Live Feature on EPIQ Ultrasound Machines.

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https://doi.org/10.1016/j.echo.2021.10.001

Reduced Cardiac Function by Echocardiography in a Minority of COVID-19 Patients 3 Months after Hospitalization

Studies have shown cardiac abnormalities in a majority of hospitalized patients with ongoing COVID-19 disease.[1] There are, however, conflicting results regarding ventricular function in patients recovered from COVID-19. One recent echocardiographic study showed abnormalities in ventricular function in nearly one-third of patients after 3 months.[2] Cardiovascular magnetic resonance studies have revealed a high frequency of cardiac involvement in patients recovered from COVID-19.[3]

All 92 patients were recruited prospectively at the time of hospitalization as a part of the NOR-Solidarity study evaluating the effect of repurposed antiviral drugs on hospitalized adult (≥18 years) COVID-19 patients.[4] Fourteen Norwegian hospitals did echocardiographic examinations of the patients 3 months after hospitalization. All measurements were performed at the core laboratory at Oslo University Hospital Rikshospitalet, according to current guidelines.[5] Intra- and interobserver reproducibility for left ventricular (LV) global longitudinal strain (GLS) in 10 random patients showed intraclass correlation coefficients of 0.90 ($P = .001$) and 0.94 ($P < .001$). Thirty-five healthy individuals matched for age and gender were used as controls.

The COVID-19 patients were 59 ± 13 years old (69% male). Twenty-five percent had hypertension, 16% had diabetes, and 16% had chronic heart disease prior to COVID-19.

Three months after hospitalization, all patients had normal LV ejection fraction (LVEF) ≥ 53%. In the COVID-19 patients as a whole, LV GLS was reduced compared with the control group (−18.6% ± 2.2% vs −20.1% ± 2.0%, $P = .001$), but only 14 patients experienced LV GLS > −17%. Of these, eight patients had LV hypertrophy, including four with known hypertension. In the six remaining patients, reduced LV GLS could not be attributed to hypertrophic or any other known premorbid cardiac diseases.

During hospitalization, 18 (20%) patients went through the intensive care unit, but only three needed mechanical ventilation. There was no difference in frequency of impaired LV GLS in intensive care unit patients compared with non–intensive care unit patients (3/18 vs 11/74, $P = .344$). We could not find any significant differences in LV GLS in the antiviral treatment groups (remdesivir −18.6% ± 2.3%, hydroxychloroquine −18.6% ± 2.3%) compared with controls (−18.5% ± 2.2%, $P = 1.00$).

Right ventricular (RV) function was normal in all COVID-19 patients and was similar to the control group when assessed by fractional area change and free wall longitudinal strain but was slightly lower when assessed by tricuspid annular plane systolic excursion. The results at 3 months are detailed in Table 1.

Table 1 Echocardiographic data in 92 patients 3 months after recovery from COVID-19 compared with healthy individuals

	Study patients (n = 92)	Healthy individuals (n = 35)	P value
LVEF, %	63 ± 6	61 ± 6	.241
LV GLS, %	−18.6 ± 2.2	−20.0 ± 2.2	.001
LVEDd, cm/m^2	2.4 ± 0.3	2.5 ± 0.3	.247
LVEDV, mL	120 ± 29	130 ± 25	.144
LVESV, mL	47 ± 15	50 ± 12	.496
LAVi, mL/m^2	27.9 ± 7.8	22.3 ± 6.4	.245
RV FAC, %	48 ± 7	47 ± 6	.519
RV fwLS, %	−28.4 ± 4.6	−28.3 ± 3.9	.974
TAPSE, cm	2.3 ± 0.3	2.4 ± 0.2	.022
E/é	8.4 ± 2.4	7.4 ± 2.2	.082
Estimated SPAP, mm Hg	29.0 ± 7.5	22.8 ± 5.5	.002

Data are presented as mean ± SD.
FAC, Fractional area change; *fwLS*, free wall longitudinal strain; *LAVi*, left atrial volume index; *LVEDd*, LV end-diastolic diameter (normalized by body surface area [cm/m^2]); *LVEDV*, LV end-diastolic volume; *LVESV*, LV end-systolic volume; *SPAP*, systolic pulmonary artery pressure; *TAPSE*, tricuspid annular plane systolic excursion.

This study received support from the National Clinical Therapy Research in the Specialist Health Services, Norway.

Conflicts of Interest: None.

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