

Oscillometry & Lung Mechanics: Respiratory Symptoms at 6-months post-COVID

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Post-Acute COVID-19 on Respiratory System

- More than 10-15% of the patients reported long-term symptoms.

Hanna E.D., et al., *Nature Rev Microbiol* 2023

- Reduced lung function and impaired exercise capacity that improved over 1 year.

Wu X., et al., *Lancet Respir Med* 2021

- Prevalence of symptoms is higher despite normal spirometry.

Zhang H., *Lancet Respir Med* 2023

McGroder CF, et al. *Thorax* 2024

- Persistent physiological impairment up to 78%.

Kjellberg S., et al. *Physiological Reports* 2024

Gap in the literature

Objective metrics of respiratory abnormalities in post-acute **mild** COVID is not well studied.

Most studies used standard PFTs.

Research question

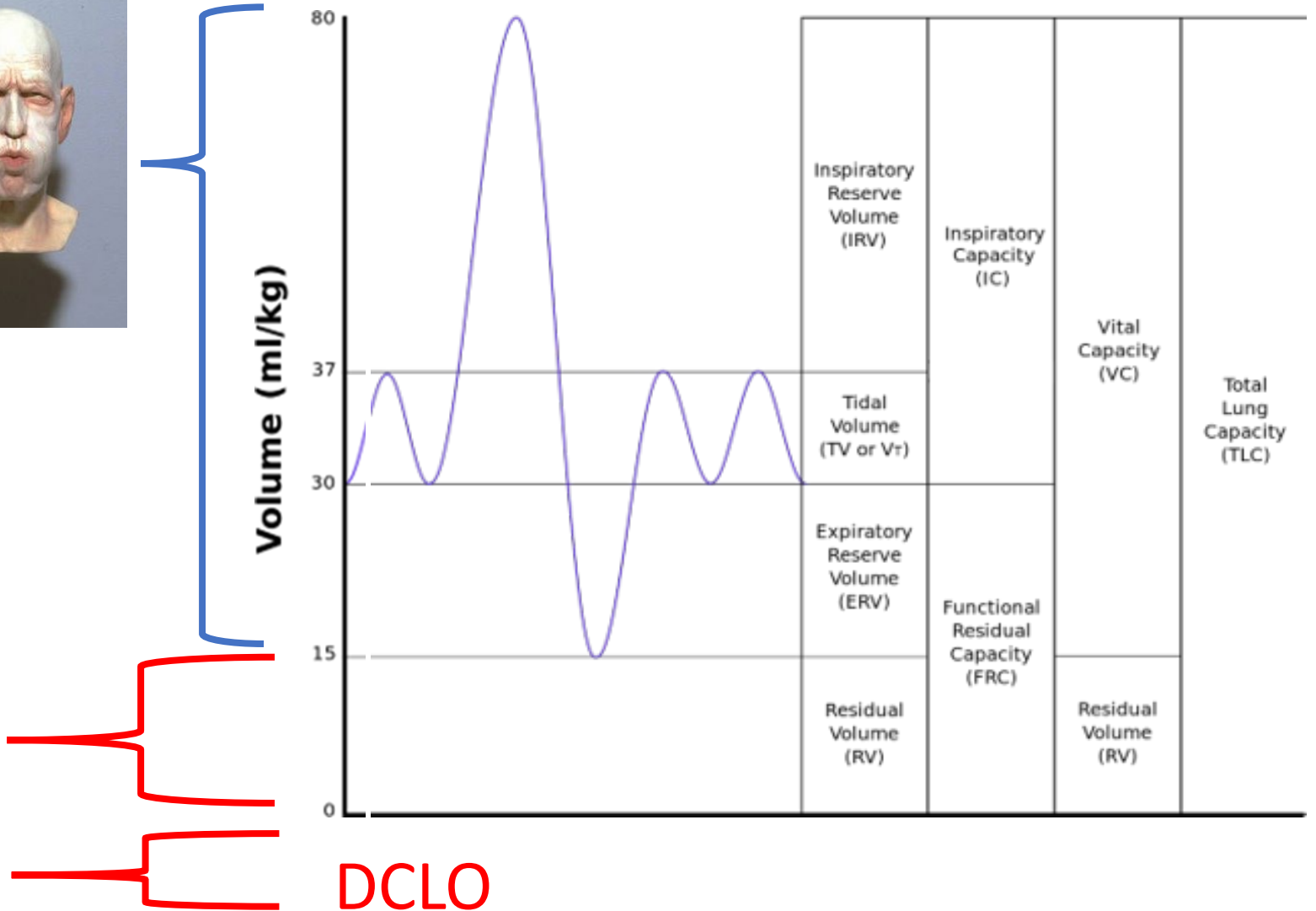
Can oscillometry identify the functional abnormalities in post-acute mild COVID-19?

Standard PFTs: 3 modalities

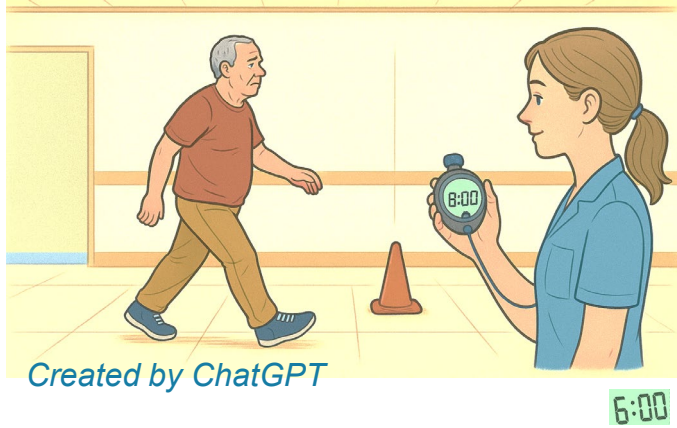
Spirometry Only!



Gold Standard PFT: Body box



6-Minute Walk Test (6MWT)



Walk at **usual pace** for 6 minutes.

1. 6MWD
2. SpO₂
3. Heart rate

Borg dyspnea and fatigue scale pre
and post 6MWT

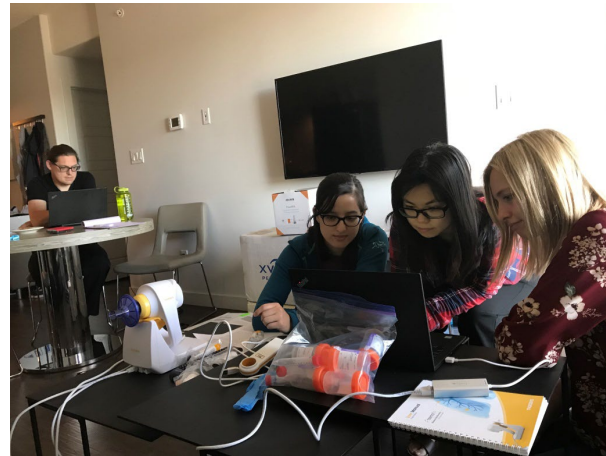
Modified Borg Scale

0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight (light)
3	Moderate
4	Somewhat severe
5	Severe (heavy)
6	
7	Very severe
8	
9	
10	Very, very severe(maximal)

Respiratory Oscillometry vs Standard PFT

Oscillometry

- portable
- normal breathing
- 20-30s/trial x 3
- reproducible



Fort McMurray-Fort McKay

Spirometry!

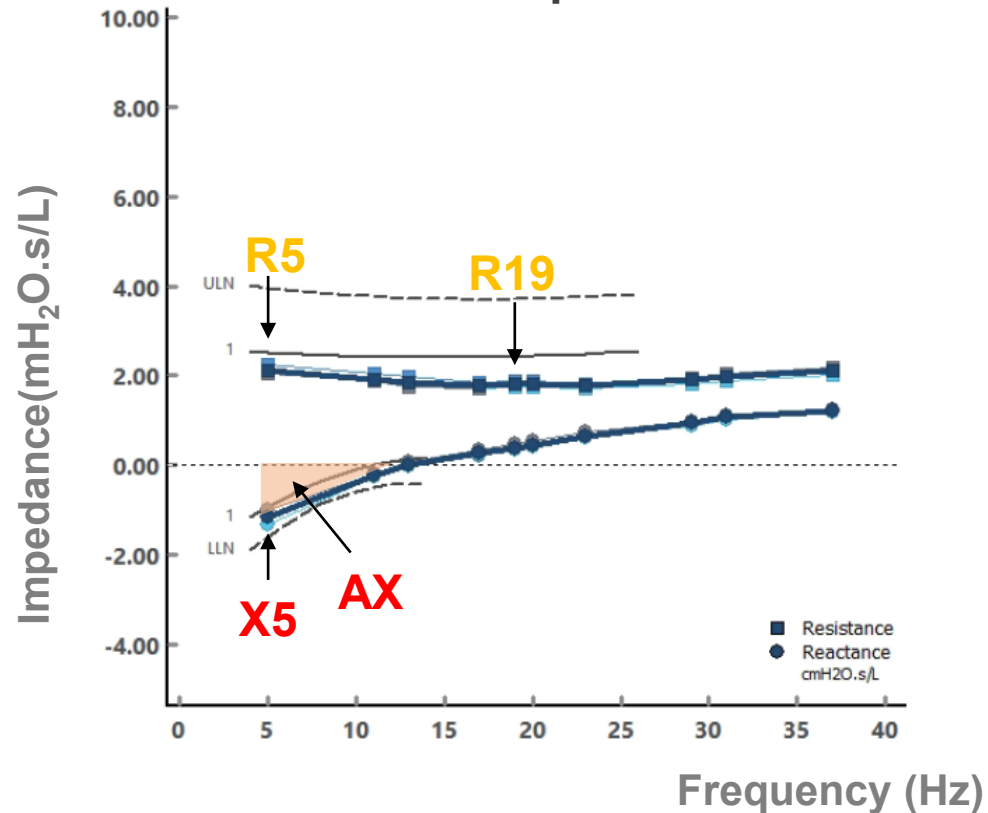


Gold Standard PFT: Body box

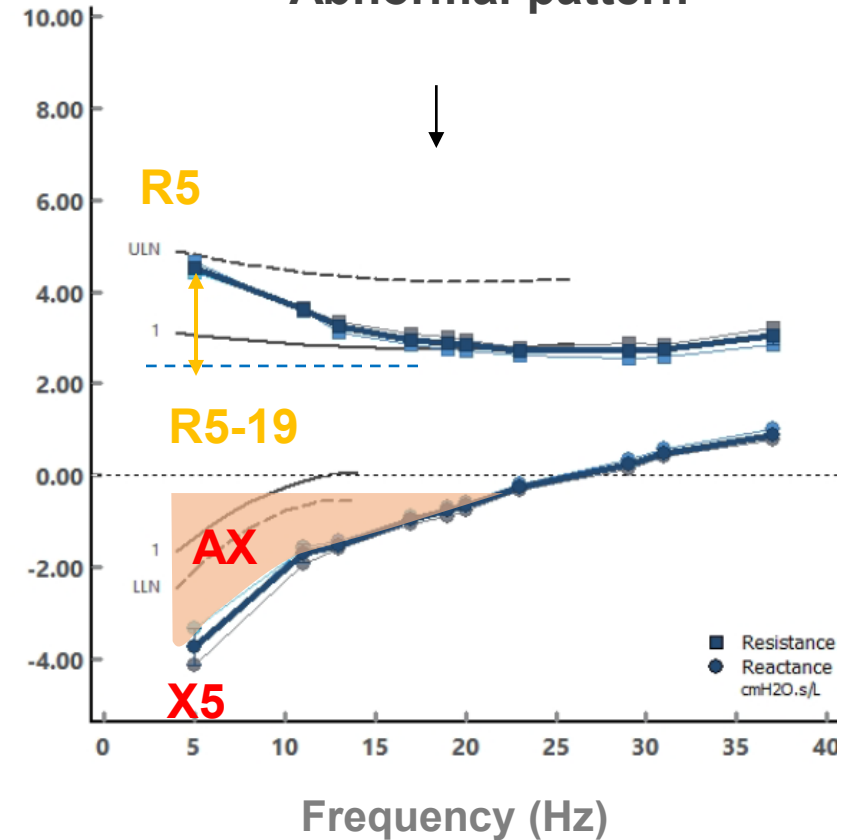


Normal and abnormal oscillometry

Normal pattern



Abnormal pattern



- Higher R5, R5-19, AX
- lower X5

Research Population and Methods

Cohort: Mild COVID patients in the CANCOV study.

Enrollment period: Aug 2020-Mar 2022.

Date of infection = date of symptom onset and/or positive test.

Mild COVID: patient did not require hospital admission, supplemental O₂ or ventilatory support.

During each clinic visit,

1. oscillometry followed by spirometry
2. 6MWT and Borg dyspnea scores

Clinical characteristics at 6 months

Mild COVID (n= 177)		Respiratory symptom		N (%)
Females, n(%)	114 (64.4%)	Presence of ≥ 1 symptom		90 (51.7%)
Age, years	43.7 (33.7, 53.1)	Shortness of breath		54 (31.0%)
Body mass index, kg/m ²	26.8 (23.6, 30.1)	Cough		19 (10.9%)
Never smokers, n(%)	128 (72.3%)	Chest heaviness/pain/tightness		33 (19.0%)
Cardiovascular diseases, n(%)	16 (9.0%)	Breathing harder/faster at rest		13 (7.5%)
Respiratory diseases, n(%)	32 (18.1%)	Breathing faster than normal		8 (4.6%)
6MWD < LLN, n(%)	35 (21.1%)	Fatigue		74 (42.5%)

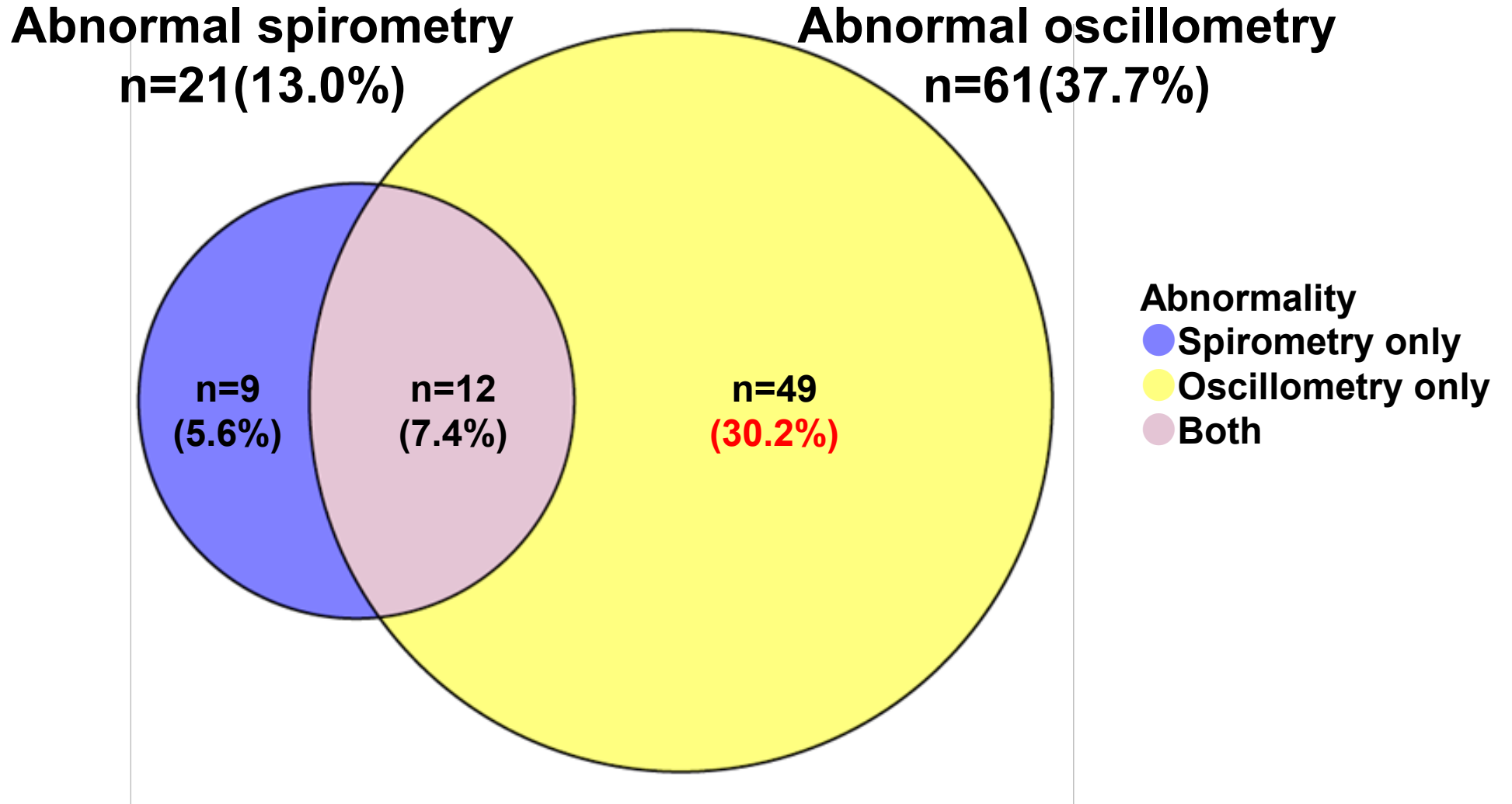
Data presented as median (IQR) or n (%). LLN, lower limit of normal based on the biometrics.

6 months: Normal Spirometry, Abnormal Oscillometry

Spirometry*	Abnormality	% pred	Z-score
FVC	10.0 (6.2%)	101.4(91.6, 109.7)	0.09 (-0.58, 0.67)
FEV1	13.0 (8.0%)	98.9 (89.4, 106.3)	-0.08 (-0.74, 0.46)
FEV₁/FVC	11.0 (6.8%)	98.4 (94.4, 101.1)	-0.22 (-0.76, 0.14)
Oscillometry	Abnormality	Absolute value	Z-score
R5^α	18.0 (10.2%)	3.38 (2.76, 4.22)	0.32 (-0.26, 0.78)
R5-19^α	45.0 (25.4%)	0.41 (0.12, 0.82)	N.A.
X5^α	29.0 (16.4%)	-1.37 (-1.78, -1.02)	-0.59 (-1.16, 0.18)
AX^β	46.0 (26.0%)	6.07 (3.71, 10.23)	1.16 (0.46, 1.67)

Data presented as median (IQR) . ^α cmH₂O·s/L; ^β cmH₂O/L. Abnormal FVC, FEV1 and FEV1/FVC, z-score < -1.645; abnormal R5 and AX, z-scores > 1.645; abnormal X5, z-score < -1.645; abnormal R5-19, R5-19 > 0.80. * Valid data available(n=162). N.A., not applicable.

Disconcordance of spirometry and oscillometry

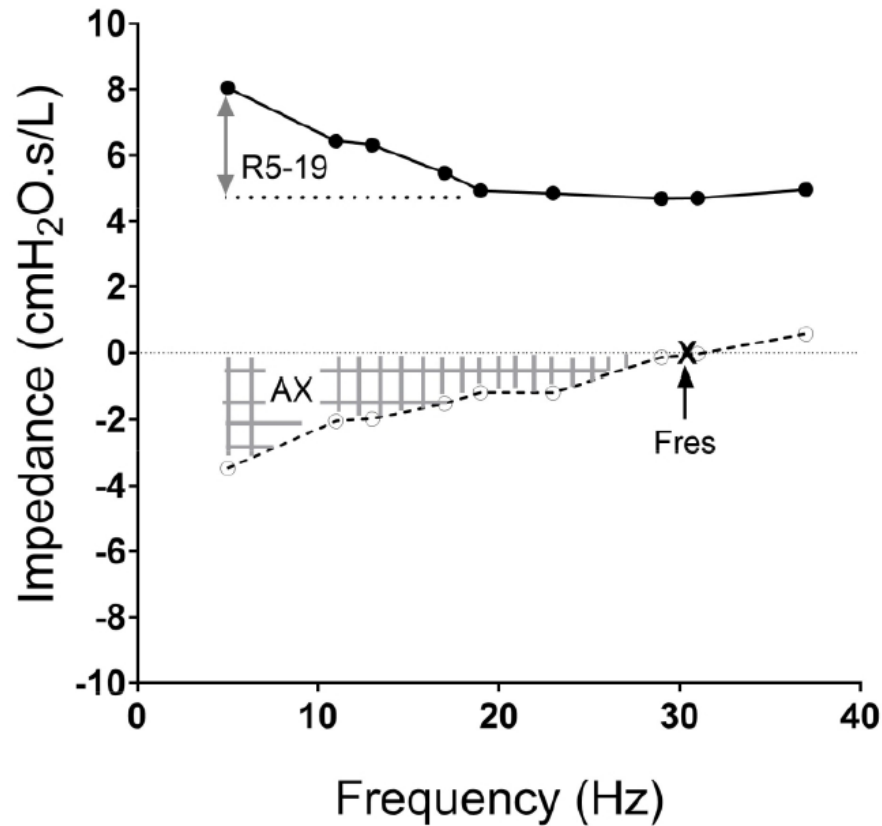


No association between spirometry and 6MWD

	Outcome	β	95%CI	P-value
FVC*	6MWD, m	0.60	-0.48, 1.68	0.279
	Post-dyspnea score	-0.02	-0.04, 0.00	0.089
FEV₁*	6MWD, m	0.46	-0.58, 1.5	0.385
	Post-dyspnea score	-0.01	-0.03, 0.01	0.190
FEV₁/FVC*	6MWD, m	-0.47	-2.81, 1.88	0.696
	Post-dyspnea score	0.01	-0.02, 0.03	0.654

The outcomes were assessed by linear regression. β , linear regression coefficient; CI, confidence interval.* %predicted values.

Oscillometry is associated with functional outcomes



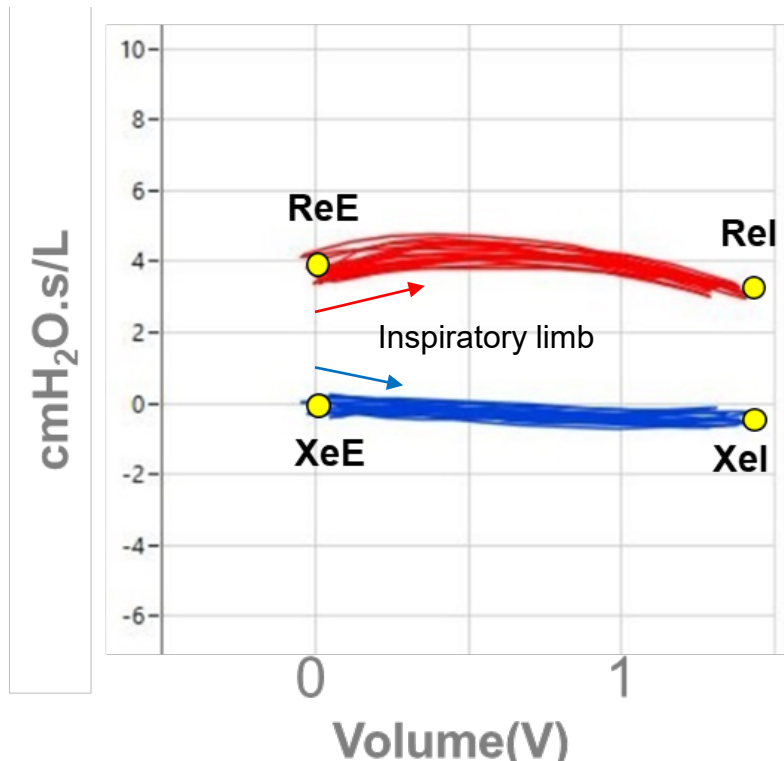
Outcome		β	95%CI	P-value
R5-19 6MWD, m		-34.33	-63.06, -5.6	0.020
Post-dyspnea score		0.55	0.00, 1.09	0.051
AX	6MWD, m	-20.38	-40.27, -0.48	0.046
Post-dyspnea score		0.44	0.07, 0.81	0.022

The outcomes were assessed by linear regression adjusted with age, sex, height. AX, log-normalized. β , linear regression coefficient; CI, confidence interval.

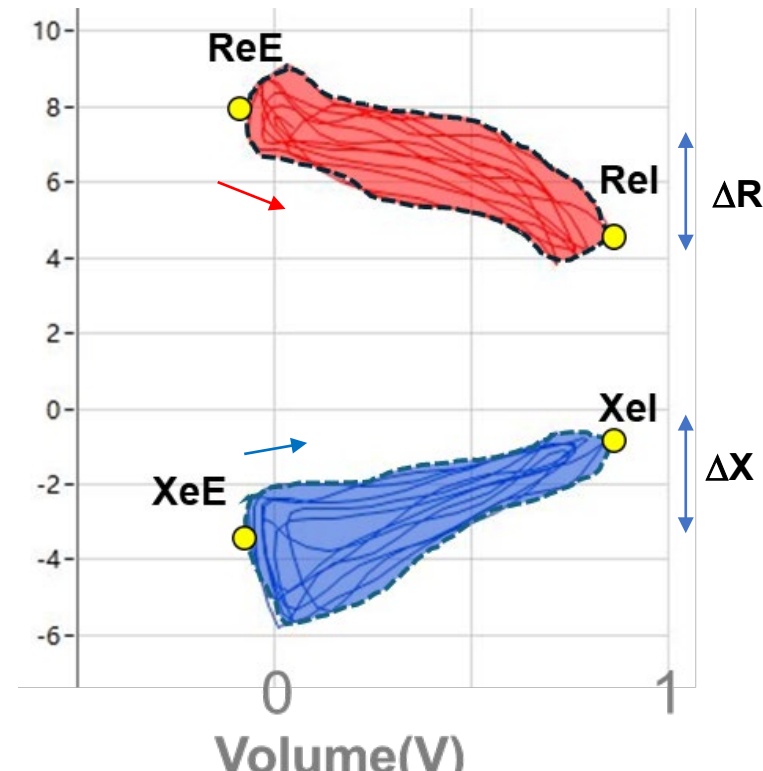
Intrabreath oscillometry tracks Rrs and Xrs during breathing cycle

- Measured at a single frequency(10Hz).

Normal

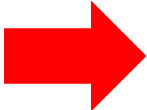


Abnormal



- Higher ReE and Rel and lower XeE and Xel = impaired lung mechanics
- No study investigated post-COVID patients with intrabreath oscillometry**

Intrabreath oscillometry is associated with 6MWD and Borg dyspnea score

	6 MWD			Post-6MWT dyspnea score		
	β	95% CI	p-value	β	95% CI	p-value
ReE$^{\alpha}$	-18.65	-33.66, -3.64	0.016	0.51	0.23, 0.78	<0.001
Rel$^{\alpha}$	-26.33	-49.34, -3.33	0.026	0.72	0.3, 1.14	<0.001
 $\Delta R/V_T^{\beta}$	-21.65	-42.09, -1.2	0.040	0.64	0.27, 1.02	0.001
XeE$^{\alpha}$	27.36	5.51, 49.21	0.015	-0.56	-0.97, -0.16	0.007
Xel$^{\alpha}$	60.30	11, 109.6	0.018	-1.15	-2.07, -0.24	0.015
 $\Delta X/V_T^{\beta}$	19.81	-1.23, 40.86	0.067	-0.47	-0.86, -0.08	0.019

The outcomes were assessed by linear regression models adjuted with age, sex, and height.

6MWD, 6 minutes walk distance; 6MWT, 6 minutes walk test; β , linear regression coefficient; CI, confidence interval.

Conclusion

1. Oscillometry is more sensitive than spirometry
2. Oscillometry detected abnormal lung mechanics
not discernible to spirometry & was associated
with functional limitation and symptoms
3. Oscillometry may help in prognosis for follow up
of functional limitation & symptoms post-COVID

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Questions?



CANADIAN RESPIRATORY HEALTH PROFESSIONALS



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University Health Network
Toronto General Hospital Toronto Western Hospital Princess Margaret Hospital