BENCH COMPARISON OF FOUR SPIROMETERS WHICH USE DISPOSABLE FLOW TRANSDUCERS

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Background: In recent years many new, low-cost spirometers have become available. Some of these spirometers, in order to control cost and provide infection control, utilize a disposable resistance element as a flow transducer. Manufacturing tolerance dictates that each of these elements will be slightly different, so a calibration number is input into the spirometer before use. This calibration number provides the spirometer with the required information to accurately estimate instantaneous flow from the pressure data it receives. We wondered whether this system provides consistent results. **Methods:** Four commercially available spirometers, Renaissance II (Mallinckrodt), Simplicity (Mallinckrodt), SpiroCard (QRS Diagnostic), and Sensaire (QRS Diagnostic) were challenged with a Flow – Volume Simulator (Hans Rudolph Inc.) that delivered a known FVC and FEV1. Three of the standard ATS waveforms (volume waveforms 2,12 and 17) were used. Five disposable flow elements were used for each device, selected from different manufacturing lots. The same selection of elements was used for the two Mallinckrodt devices. FVC and FEV1 values were recorded from each trial as reported by the device, and compared to the values reported by the simulator. **Results:** The spirometers reported different values than the simulator, as shown in the following table. The average and the range (maximum – minimum) for each set of flow elements is included. All data is expressed as % error.

% ERROR		Volume 2		Volume 12		Volume 17		
		FVC	FEV1	FVC	FEV1	FVC	FEV1	Average
Renaissance II	Error	1.5	2.1	1.7	3.5	1.7	2.5	2.1
	Range	2.1	1.8	1.0	1.5	0.9	1.0	1.4
Simplicity	Error	2.8	3.0	3.0	4.6	3.0	3.5	3.3
	Range	1.4	1.4	1.1	1.5	1.6	1.7	1.5
SpiroCard	Error	-2.7	-2.9	-2.4	-1.5	-2.0	-1.7	-2.2
	Range	1.6	1.6	1.6	1.8	1.2	1.0	1.5
Sensaire	Error	0.1	-0.2	-0.5	1.6	-0.9	-0.3	0.0
	Range	0.6	0.6	0.9	0.6	1.6	1.6	1.0

Discussion: The flow volume simulator delivers gas at ambient temperature and humidity. Spirometers on the other hand assume that the gas entering the flow element is at body temperature and humidity, and must assume some amount of cooling. This may create a systematic error in the measurements. **Conclusion:** The uncertainty introduced by the disposable flow elements is low, no greater than 1.5%. The difference between spirometer models, however can be as high as 5.5%, which should be considered, especially when testing the same patient on different devices.