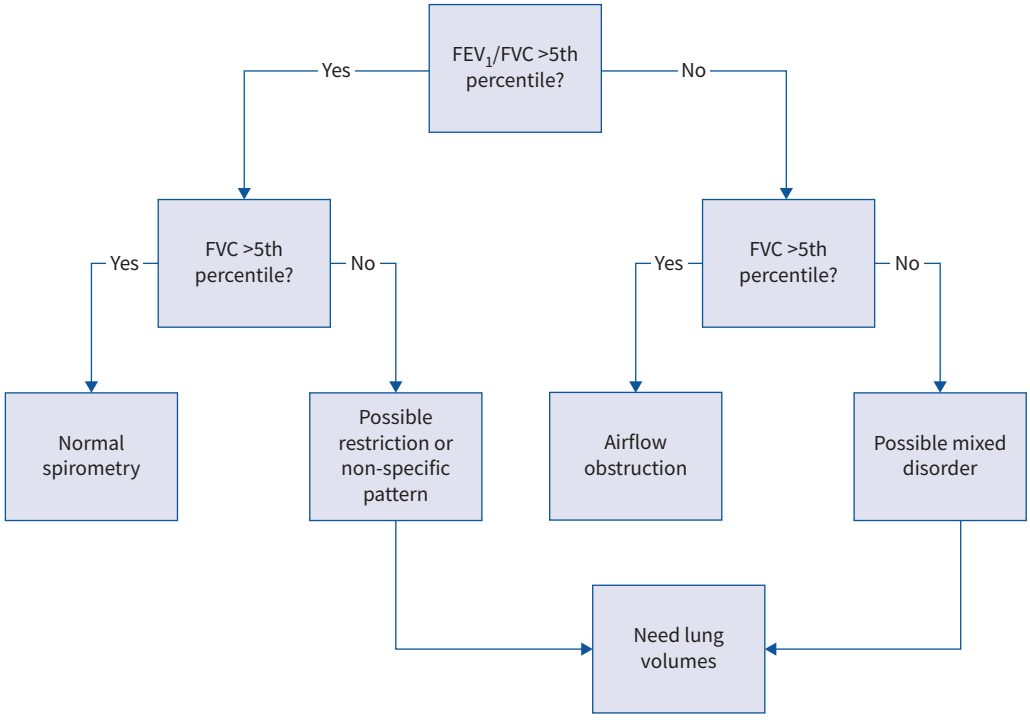

FIGURE 8 Approach to interpretation of spirometry. Beginning with the forced expiratory volume in 1 s (FEV_1)/forced vital capacity (FVC) ratio, determine whether obstruction is present based on whether the ratio is low (right side of figure). If obstruction is present, then assess the FVC to determine whether there is simply obstruction or whether there may be concomitant restriction ("mixed disorder"). Measurement of total lung capacity (TLC) will define restriction, so if TLC is normal, then there is only obstruction, but if TLC is low, then there is concomitant restriction. If FEV_1/FVC is normal, signifying no obstruction (left side of figure), then once again assess FVC. If FVC is normal, then spirometry is normal, but if FVC is low, then there may be possible restriction. This must be determined by measurement of TLC. If TLC is low, then spirometry is consistent with restriction. If restriction is ruled out by a normal TLC, then the pattern of impairment of low FVC with normal FEV_1/FVC has been termed the possible restriction or "non-specific" pattern, which may include diseases causing obstruction or restriction. Restriction presenting as the non-specific pattern is often caused by a chest wall or neuromuscular disorder.

concave shape is thought to reflect small airway dysfunction (figure 9b and c) compared to the normal flow–volume curve (figure 9a).

A number of attempts have been made to quantify these small airway impairments, especially when FEV_1 and FEV_1/FVC are normal ("isolated small airway dysfunction") [109]. A common approach is to measure the average flow between 25% and 75% of exhaled FVC ($FEF_{25–75\%}$); however, mid-range flow measurements during a forced exhalation are highly variable, poorly reproducible and not specific for small airway disease in individuals [110]. Furthermore, mid-range flow measurements usually do not add to clinical decision making beyond information contributed by FEV_1, FVC and FEV_1/FVC [111]. There is insufficient evidence to support the use of spirometry to identify small airway dysfunction [112]. There has been recent interest in FEV_3/FVC [113] or FEV_3/FEV_6 [114] providing more sensitive indication of airflow obstruction in adults when FEV_1/FVC is still in the normal range. Other tests such as oscillometry, multiple-breath washout and imaging may also provide evidence of airflow obstruction when FEV_1/FVC is normal [115].

Dysanapsis and other patterns of impairment in FEV_1, FVC and FEV_1/FVC

For healthy individuals, the meaning of a low FEV_1/FVC ratio accompanied by FEV_1 within the normal range is unclear. This pattern may be due to "dysanaptic" or unequal growth of the airways and lung parenchyma [116]. While this pattern has been thought to be a normal physiological variant [103], new data suggest that it may be associated with the propensity for obstructive lung disease [117, 118]. Factors