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REGARDING THE ARTICLES ON HOME SPIROMETRY

Running title:

Regarding the articles on home spirometry

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HIGHLIGHTS

- Home spirometry is increasing used but not many studies have evaluated its readings
- Two recent studies in the journal suggest that home FEV_1 readings lack precision
- Sheffield data also suggest that home FEV_1 readings may lack precision
- A research implication is studies using home FEV_1 may require larger sample sizes
- A clinical implication is home FEV_1 may miss important decline in lung health

Dear Editor,

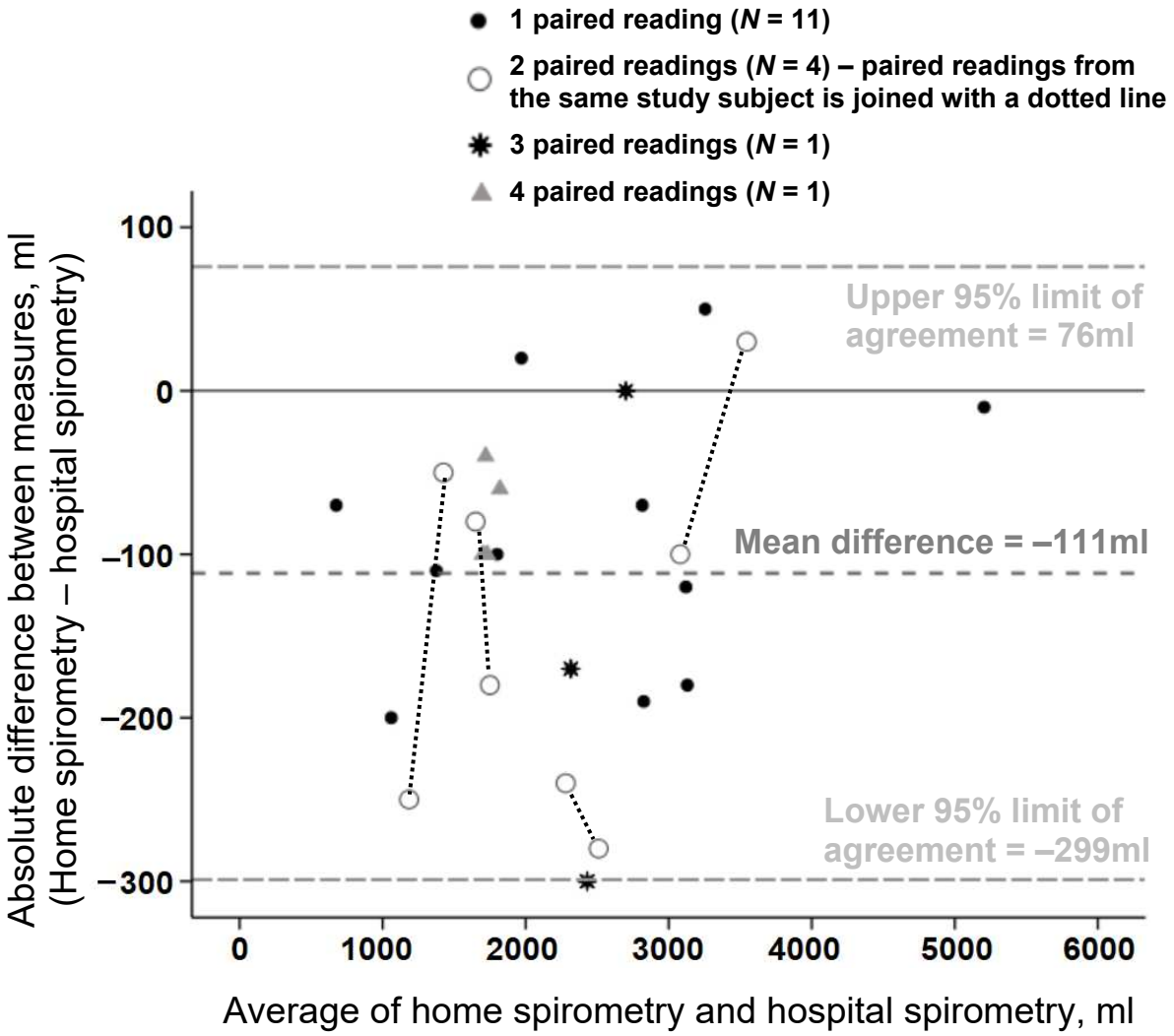
Home spirometry is increasingly used, in part due to the need for social distancing during the Covid-19 pandemic. We read with interest two recent JCF articles that evaluate home spirometry.

Paynter et al [1] performed a secondary analysis of a home monitoring trial (eICE) comparing home and clinic spirometry. The eICE trial has a 12-month follow-up and ran from October 2011 to July 2015. The secondary analysis included 133 adolescents and adults (mean age 27 years, SD 12; mean baseline clinic ppFEV_1 78.9, SD 22.0) randomised to the early intervention arm. Home spirometry was performed unsupervised with AM2+® Lung Function Monitor (ERT). Cross-sectional comparison of paired readings within 7 days showed home FEV_1 was 70ml lower (limits of agreement -972ml to 832ml). Mixed model with a cubic spline function for time was suggested as the most appropriate method for longitudinal analysis. Mean ppFEV_1 change was -2.0 (95% CI -4.3 to 0.2) with home spirometry versus -3.0 (95% CI -4.1 to -1.9) with clinic spirometry. The wider confidence interval indicates lower precision for home spirometry.

Bell et al [2] performed a single-centre prospective observational study comparing observed and unobserved home spirometry among 74 adults (mean age 37 years, SD 11; mean ppFEV_1 59) between February and December 2020. In contrast with Paynter et al, there was no 'gold standard' clinic spirometry, hence the study findings may be more difficult to interpret. Home spirometry was performed with Air-Next™ (NuvoAir) or Spirohome™ (Inofab). Unsupervised spirometry was performed within 24 hours prior to remote clinic consultation. During remote consultations, a respiratory scientist supervised the spirometry using video conferencing. Paired FEV_1 from 53 adults during their most recent clinic visit showed a mean difference of 0.7ml. However, the limits of agreement (-220ml to 220ml) for the same adult on separate occasions (observed versus unobserved) exceeds the ATS/ERS repeatability criteria for FEV_1 of 150ml [3].

These studies raise the concern that home spirometry, especially unsupervised, may lack precision for both cross-sectional and longitudinal analyses. Many centres will now be accumulating experience with home spirometry. Our single-centre prospective study is an example of smaller datasets that can emerge from clinical care in individual centres, and also identified that home spirometry may lack precision in comparison to clinic spirometry. Data were collected between June 2015 and July 2016 from 17 adults (26 paired readings; mean age 31 years, SD 7; mean clinic ppFEV_1 67.9, SD 21.3). Clinic spirometry was performed by lung physiologists using MicroLab ML3500 MK8 (Carefusion). Home spirometry was performed unsupervised within 3 days of clinic using Lung monitor USB model 4000 (Vitalograph). Cross-sectional FEV_1 comparison with random effects model fitted to account for multiple paired readings found an adjusted mean difference of 111ml in favour of clinic spirometry (limits of agreement -299ml to 76ml), see Figure 1.

Figure 1: Bland-Altman plot for home spirometry FEV_1 versus hospital spirometry FEV_1



In a research setting, lack of precision may mean that larger sample sizes are required in studies only using home spirometry to achieve similar statistical power as studies using clinic spirometry. Studies using both clinic and home spirometry may achieve optimal precision by analysing the readings separately, since current evidence suggest that the readings are not necessarily inter-changeable.

The lack of precision with home spirometry also presents challenges to clinical use. As CF prognosis improved, the rate of FEV_1 decline has gradually reduced. Highly efficacious CFTR modulators are now widely available and further attenuation of FEV_1 decline is now possible. The Canadian CF registry analysis found a mean annual $ppFEV_1$ change of only -0.3 (95% CI -0.9 to 0.3) following the initiation of Ivacaftor among those with gating mutations [4]. Such subtle FEV_1 decline is difficult to measure, even with clinic spirometry. More sensitive measures of lung health are required in the

post-modulator era, and imprecise home spirometry is unlikely to be the solution. Home spirometry may miss important decline in lung health, resulting in clinicians being falsely reassured and failing to institute treatments that are necessary for maintaining lung health.

The recent studies in JCF suggest that home spirometry readings may be lacking in precision compared to clinic spirometry. This applies to both cross-sectional and longitudinal analyses of FEV_1 data. Whilst it may be tempting to assume that home spirometry readings can replace clinic spirometry, further studies are required to understand and optimise the precision of home spirometry FEV_1 readings. The precision of spirometry readings is particularly pertinent in the post-modulator era, where precisely identifying annual $ppFEV_1$ change of -1.0 or less is critical to realising the full benefit of highly efficacious CFTR modulators and achieving a normal life-expectancy among people with CF.

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COMPETING INTERESTS

R Curley received funding from Profile Pharma Ltd for home spirometry. There is no other competing interests to disclose.

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