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LETTER TO THE EDITOR

Laboratory activity testing the lung function during 16 months of the Covid-19 pandemic



Dear Editor

Problems related to the clinical and organizational management of Covid-19 by pulmonologists have been vast.¹ Since March 2020, because of the SARS CoV2 correlated pandemic,² all lung function testing laboratories (LFTLs) have been reconfigured³ and examinations reduced or suspended. This reorganization has forced to changes in tasks, roles, protocols and scheduling of the LFTLs, starting from the initial proposed indications and suggestions.^{4,5}

This descriptive report aims to explore and measure, retrospectively, the impact of the relocation of an LFTL service, giving details on routine measures collected by an Integrated Health Care Record database.

We retrospectively (study approved by Ethics Committee CEC 2440; March 12th, 2020) undertook a revision of the number and quality of the examinations (Forced Expiratory Volume at first second-FEV₁, Residual Volume-RV, arterial blood gases, Lung carbon monoxide diffusion-DLCO) over 16 months (27th May 2020–11th October 2021, i.e. pandemic period) with respect to data from a corresponding (1st November 2018 - 29th February 2020) pre-pandemic period. Our hospital is a referral institution for pulmonary rehabilitation, performing in and outpatient diagnosis for post-acute, chronic subjects^{6,7} and post-Covid-19 population⁸ located in the Lombardy region, with high specialization and a multidisciplinary team. The particular mission of the hospital is linked to a) outpatient diagnosis for chronic respiratory diseases, preoperative needs and post-Covid-19 follow-up; b) care of patients with complex disabilities and needs, suffering from severe chronic and exacerbated respiratory failure including pneumonia post-Covid-19 sequelae.

Patients attended our outpatient LFTL service having been referred by their general practitioner or by an external pulmonologist for lung and disability assessment. Inpatients were transferred to our hospital directly or within 30 days following an acute illness, that had previously required either acute hospital care or home management by the general practitioner.

Our LFTL has undergone a profound transformation as imposed by the Italian Health Authorities and was

interrupted from March to May 2020 before re-opening; there was no reduction or increase in human resources (doctors and technicians). Specific instructions and suggestions were introduced during the pandemic, following Scientific Societies,^{4,5} for organization, waiting areas, re-organizing testing, tests procedure, increase of testing times, need for more consumables, use of UV sanitization, chemical sanitization of the plethysmography box between patients, use of antimicrobial filters during maneuvers, protection of health-care workers during lung function testing, training in use of medical masks such as FFP2,⁹ frequent hand hygiene, interpersonal distancing and re-indications for lung function tests. More space in waiting rooms, dedicated slots for exams, differentiation of spirometers, increased ventilation times to face the risk of contagion and requests for a negative swab for patients before accessing the LFTL have also been provided.

Table 1 shows LFTL volume activities. During the pandemic time, we performed 3663 LFTL tests. This is 2.5% more than pre-pandemic, resulting in a decrease in inpatient tests of 16.4% and an increase of outpatient tests by 23.8%. In pre-Covid time, DLCO was 7.5% of total examinations, rising during the pandemic time to 19.3% (17.2% of outpatient and 22.0% of inpatient tests). During the pandemic time 19.5% of total examinations referred to Covid-19 patients, DLCO being the most commonly requested test. The important decrease in inpatient requests was due to the reduction of availability of rehabilitative beds and came along with a significant increase in outpatient testing to determine and quantify long Covid-19.

During the pandemic period, 277 post Covid-19 patients, both inpatient and outpatients, attended our LFTL. One year after infection, these patients presented pathological values (<80% of predicted values) in 22%, 20%, and 63% of the cases for FEV₁, RV, and DLCO respectively.

To reduce the spread of the severe acute respiratory Coronavirus 2 syndrome, many LFTLs have been closed or significantly reduced their testing capacity,³ while respiratory physicians, researchers, and administrators have begun to consider how different options to conventional pulmonary function testing could be integrated into the patients' care.³ Since the pandemic beginning, scientific Societies have had a justified position of extreme caution in the execution of LFT.^{4,5} The same Societies have provided a set of information about the risks and recommendations for LFT, updating

<https://doi.org/10.1016/j.pulmoe.2022.01.013>

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Table 1 Lung function testing laboratory (LFTL) volume activities.

| | Pre-pandemic time | | | Pandemic time | | |
|--|-------------------|------------|-----------|-------------------|------------|-----------|
| | LFTL tests | | | LFTL tests | | |
| | Total | Outpatient | Inpatient | Total | Outpatient | Inpatient |
| FEV ₁ , n | 808 | 322 | 486 | 609 [#] | 346 | 263 |
| % of the total examination | 22.6 | | | 16.6 | | |
| RV, n | 1373 | 772 | 601 | 1370 [*] | 836 | 534 |
| % of the total examination | 38.4 | | | 37.4 | | |
| DLCO, n | 267 | 98 | 169 | 705 [@] | 359 | 346 |
| % of the total examination | 7.5 | | | 19.3 | | |
| PaO ₂ /FiO ₂ , n | 1124 | 495 | 629 | 979 ⁺ | 547 | 432 |
| % of the total examination | 31.5 | | | 26.7 | | |
| Total Examinations, n | 3572 | 1687 | 1885 | 3663 | 2088 | 1575 |

Legend: Data shown as number and (%). Abbreviations: LFTL: lung function testing laboratory; FEV₁ = forced expiratory volume at first second; RV = residual volume; DLCO = lung carbon monoxide diffusion; PaO₂ = arterial oxygen tension; FiO₂ = inspiratory fraction of oxygen;

[#] p = 0.0178
^{*} p = 0.0001
[@] p < 0.0001
⁺ p = 0.1376 for comparison between total values of each evaluation collected during pandemic and pre-pandemic.

them continuously during the pandemic time,^{4,5} and giving the possibility for a rapid reopening with maximum safety.⁵

To the best of our knowledge, this is the first Italian study showing what has changed in terms of quantity and quality since the reopening of a lung function testing laboratory after the deep Covid-19 crisis. Despite the strong perplexities, fear and resistance for a full resumption of activity, our service was able to restart its mission in maximal safety; the substantial restoration of the volumes of activity, even in a progressive way during the months of reopening, has allowed us to give significant answers especially to the strong demand for outpatient diagnostics. It is interesting to note how the requests received at our service have been deeply influenced by the post Covid-19 problems as demonstrated by the strong increase in testing for lung volume diffusion, one of the more significant and useful tests for post Covid-19 sequelae.¹⁰⁻¹² DLCO acquired in fact relevance due to its specific capacity to evaluate interstitial lung disease impairment and due to easy and non-invasive execution of the maneuver requested.¹⁰⁻¹²

Our data have demonstrated that the maximum pre-caution/safety and the essential need to measure the lung function may coexist, independently from the kind of respiratory disease. Furthermore, our data may be of interest for doctors and health organizers to develop a policy that provides strategies of re-opening and re-organisation of lung function laboratories; at the same time, it may be of interest to focus on which kind of performance (inpatient vs outpatient, types of respiratory function tests) is more requested during a pandemic time.

Our results have highlighted the impact of the SARS-CoV-2 pandemic on a lung function testing laboratory facility in a typical Italian rehabilitative hospital, showing a significant change in terms of quantity, modality and quality activities. Lung function testing laboratory should be considered a key component in the health follow up, planning a response to a respiratory pandemic crisis.

Author contributions

Conceptualization, writing original paper, review and supervision: Michele Vitacca; Data collection, revision of the paper: Michela Mineni, Gundi Steinhilber; Data curation, investigation, revision of the paper: Beatrice Salvi, Laura Comini; Investigation, Formal analysis, revision of the paper: Mara Paneroni. All Authors approved the current version of the manuscript.

Conflicts of interest

The authors have no conflicts of interest to declare.

Acknowledgment

The authors thank Adriana Olivares for technical assistance. This work was supported by the "Ricerca Corrente" funding scheme from the Italian Ministry

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Received 13 January 2022; Accepted 26 January 2022
Available online 7 February 2022