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Detecting COVID-19 and other respiratory infections in obstructive sleep apnoea patients through CPAP device telemonitoring

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Abstract

Objective: The earliest possible detection of individuals with COVID-19 has been essential to curb the spread of infection. Existing digital tools have been scaled up to address this issue. Every night telemonitoring data on continuous positive airway pressure (CPAP) device use, the first-line therapy for obstructive sleep apnoea (OSA), is collected worldwide. We asked whether the changes in CPAP adherence patterns of might constitute an alert for COVID-19.

Methods: We analysed preliminary results of telemonitoring data, recorded between February 1 and April 30, 2020, on OSA patients followed by our sleep clinics and diagnosed with COVID-19.

Results: CPAP telemonitoring data from the first 19 patients diagnosed with COVID-19 showed a clear decrease or halt in adherence in the 20 days immediately preceding COVID-19 diagnosis compared to an earlier period ($p < 0.01$).

Conclusion: Patterns of continuous positive airway pressure device use by obstructive sleep apnoea patients collected through telemonitoring can indicate the onset of COVID-19 symptoms. Existing telemonitoring platforms could be immediately used to screen for COVID-19, and for other respiratory infections, in this large at-risk population.

Keywords

Continuous positive airway pressure, telemonitoring, COVID, detection

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Introduction

To slow the spread of the current coronavirus (COVID-19) pandemic it has been crucial to prioritize early identification of infected subjects to quarantine patients and their entourage.

In the context of the pandemic various digital tools have been scaled-up to address this issue including population-wide surveys, online[1] or via social media,[2,3] and the exponential development of telemedicine with video consultations. The primary goal has been the early screening of already symptomatic patients to minimize pressure on healthcare facilities, and to protect health care personnel and other members of the community. We propose *that existing*

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telemonitoring platforms for the follow-up of sleep apnoea could be used as a resource to assist screening by overstretched health providers. In France, the national healthcare system actively promotes and reimburses telemonitoring of continuous positive airway pressure (CPAP) device use, the first-line therapy for obstructive sleep apnoea (OSA).[4,5] Every night CPAP devices transmit the residual apnoea-hypopnea index (AHI) and adherence making relevant information continuously available to clinicians and homecare providers for real-time patient follow-up (Figure 1). To date, over 1.2 million people throughout France and more than 10 million worldwide use CPAP telemonitoring.

It is particularly important to screen for signs of COVID-19 in the OSA population for two essential reasons: (i) CPAP treatment is considered as a high-risk aerosol-generating procedure potentially facilitating virus dispersion into the environment and transmission of infection to families;[6] (ii) OSA is a multi-morbid disease with up to 70% of patients being obese and having a high prevalence of cardiovascular and metabolic comorbidities. This context is known to greatly favour the occurrence of "cytokine storm" syndrome and severe inflammation processes that are the main mechanisms underlying fatal forms of COVID-19. Adults with OSA are thus more susceptible to severe COVID-19 outcomes owing to their clusters of co-morbidities.[7,8]

We hypothesized that symptoms associated with COVID-19, i.e. cough, fever, headache, diarrhoea, rhinorrhoea or nasal congestion, and nausea or vomiting would significantly alter CPAP usage leading to an abrupt reduction in adherence or discontinuation of treatment. In OSA patients with long-lasting good CPAP adherence, *the sudden appearance in telemonitoring data of such adherence patterns might constitute an alert for COVID-19*.

Methods

We analysed preliminary results of telemonitoring data, recorded between February 1 and April 30, 2020, on the first nineteen OSA patients followed by our sleep clinics and diagnosed with COVID-19 (eight hospitalizations, one death). As for all patients with CPAP telemonitoring, authorization and privacy issues had already been solved through signed patient consent and secured data access restricted to homecare providers and physicians.

Results

For the whole group there was a significant decrease in CPAP adherence when comparing the periods Day -40 to Day -21 versus Day -20 to Day 0 before COVID-19 diagnosis ($p < 0.01$). Figure 2 shows the evolution of adherence through individual day by day patterns of CPAP use (mean ± SE) in six OSA patients. We retrospectively phoned patients and they indicated that

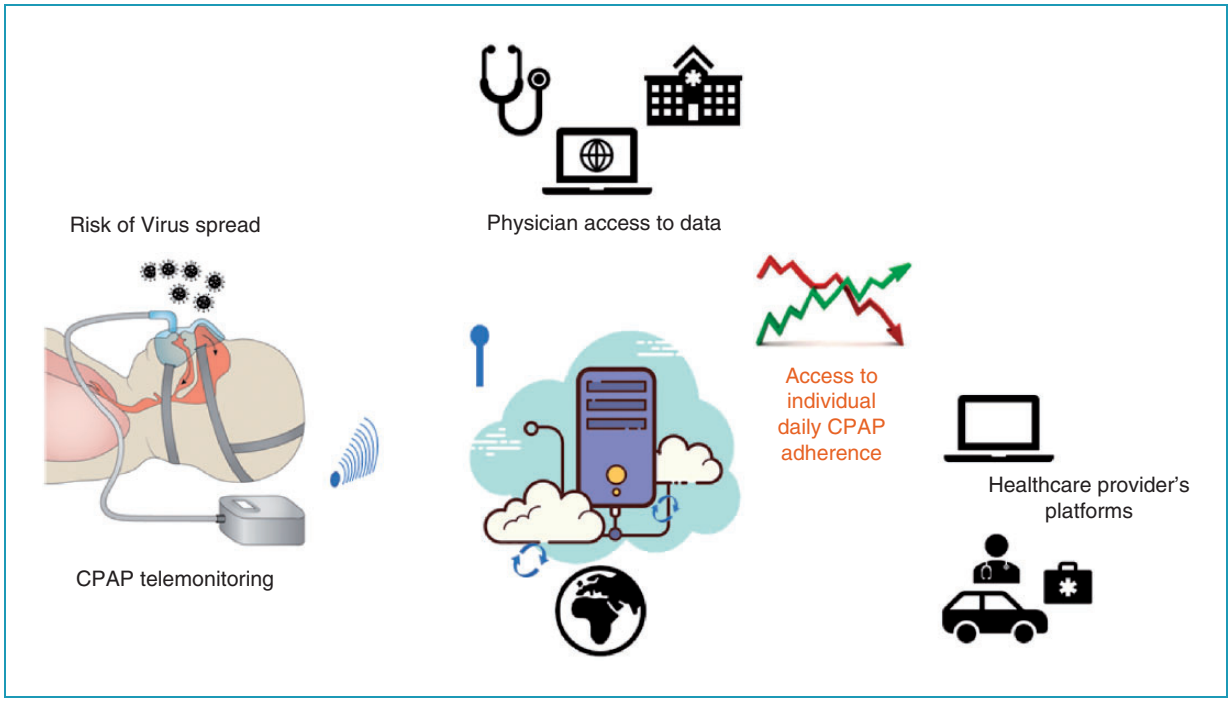

Figure 1. CPAP telemonitoring.

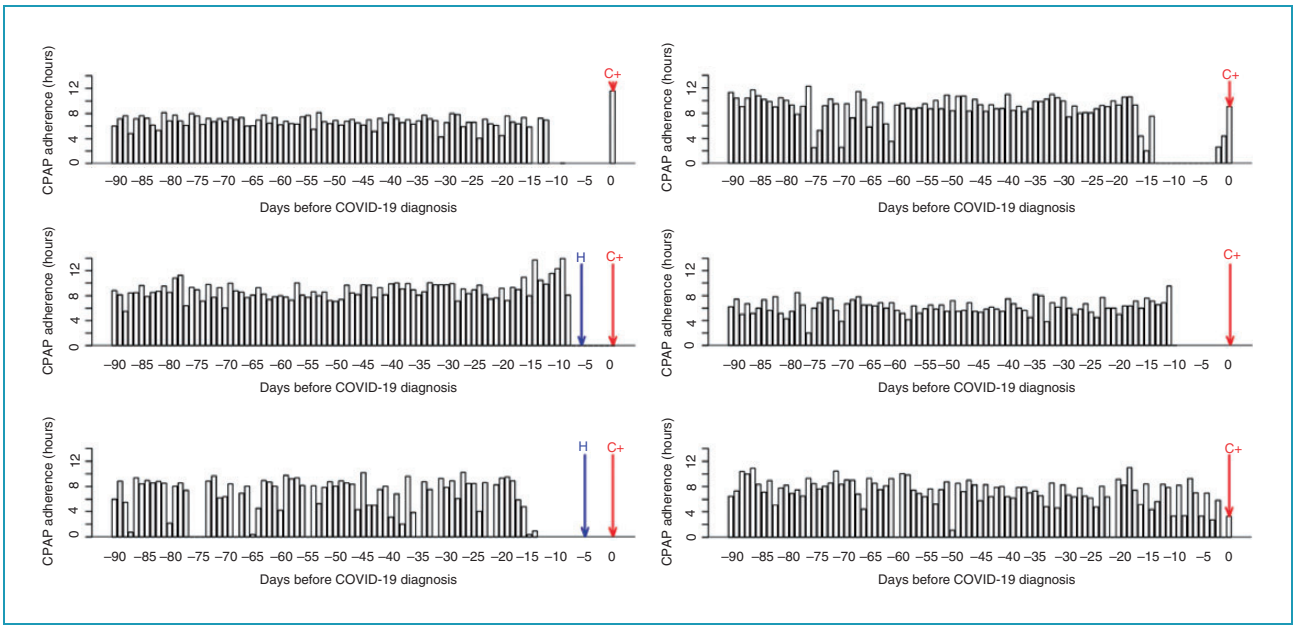

Figure 2. Patterns of CPAP use by six exemplary patients in the days preceding COVID-19 diagnosis C+: COVID-19 diagnosis, H: Hospitalization.

changes in CPAP usage were mainly driven by respiratory issues and/or the need for hospitalization.

Discussion

Our data clearly demonstrate that symptomatic COVID-19 is generally associated with an abrupt modification of CPAP adherence that is easy to identify in regular CPAP users. Our results are preliminary but have high potential for the wide-scale deployment of CPAP telemonitoring as a screening tool in the OSA population in many countries.

The pattern of reducing adherence or completely stopping CPAP treatment might be related to not only the burden of symptoms and severity of the disease but also to the concern by patients to reduce the risk of virus transmission to other household members through aerosolization. Early identification of the situation, in the absence of need for hospitalisation, could facilitate immediate self-isolation in another bedroom and implementation by homecare providers of non-vented masks with a virus filter, reducing the spread significantly during CPAP treatment.[9] A limitation of CPAP telemonitoring in the COVID-19 context, and shared with all screening procedures, is that cases of infection can go undetected because of lack of symptoms. The use of artificial intelligence with embedded alerts[10] could give rapid and accurate CPAP telemonitoring interpretations, triggering an investigation by the physician, improving workflow and limiting transmission. We acknowledge that the pattern of abrupt reduction in CPAP adherence is probably not COVID-19 specific and might be due to other respiratory infections. Likewise patients with erratic patterns of CPAP use might generate false alerts. For further research, a control group (without COVID-19 infection) should be included, allowing to determine sensitivity, specificity, and the optimal cut-off level for "reduction of average nightly CPAP-use" to detect COVID-19 infection.

The fact that OSA is one of the most prevalent chronic diseases affecting nearly one billion people worldwide[11] and that CPAP telemonitoring is currently used by millions of patients in many countries, makes the use of CPAP telemonitoring for screening for COVID-19 and for other respiratory infections, such as seasonal influenza, an attractive strategy in this large at-risk population. To develop the concept of screening for respiratory infections through telemonitoring, we urge other countries and a consortium of CPAP companies and homecare providers to share CPAP telemonitoring data and to build international collaborations for the development of methods, risk models and alert systems generated by artificial intelligence.

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