Home monitoring reduced short stay admissions in suspected COVID-19 patients: COVID-box project

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To the Editor:

Most coronavirus disease 2019 (COVID-19) cases can be managed in the outpatient setting; however, ∼10–15% deteriorate and require hospitalisation [1, 2]. Worldwide, including in the Netherlands, the COVID-19 pandemic is causing severe pressure on national healthcare systems and laboratory testing capacities [3]. Home monitoring has been suggested as potentially beneficial to monitor (suspected) COVID-19 patients while reducing hospital admissions and viral exposure of healthcare workers [4]. We performed a retrospective single-centre case–control study on the implementation of a home-monitoring programme of suspected COVID-19 patients presenting to the emergency department (ED) of the Leiden University Medical Center (LUMC; Leiden, the Netherlands). In this study, home monitoring referred to the clinical pathway (the COVID-box project) in which patients were given tools and devices (blood pressure monitor, pulse oximeter, thermometer and concomitant instructions) upon discharge from the ED to monitor their vital parameters at home three times a day, combined with daily teleconsultations (preferably video consultations) carried out by a healthcare professional, as reviewed extensively elsewhere [5]. The healthcare professional was a nurse practitioner or resident supervised by a medical specialist. When patients arrived home, e-health consultants contacted patients to ensure digital on-boarding of patients, giving instructions and guidance for adequate use of the devices. Thereafter, daily teleconsultations were conducted to assess patients' symptoms and vital parameters, based upon which an indication for reassessment at the ED was made. In addition, patients were given the possibility to actively contact our healthcare professionals in case of deviating measurements from personalised target values or progressive complaints. When reassessment was indicated, patients were seen at the ED of the LUMC. Home monitoring ended when patients recovered or were (re-)admitted to the hospital.

In this study, our source population consisted of all patients who visited the ED from 1 March to 15 June 2020 and who had suspected COVID-19, *i.e.* had flu-like symptoms and/or at least one diagnostic test for COVID-19 performed (*e.g.* nasopharyngeal swab and/or computed tomography (CT) scan). Physicians were given the possibility to allocate home monitoring to patients with suspected COVID-19. Allocation was based on physicians' clinical judgement for patients with moderate symptoms or underlying comorbidities posing patients at risk for worse prognosis [6]. To assess the effect of implementing a home-monitoring system, we matched each patient discharged with home monitoring to two control patients who were discharged without home monitoring. Propensity score matching analysis was performed to match cases to controls in a 1:2 ratio using R statistical software 4.0.3 [7]. We used nearest-neighbour propensity score matching without replacement with a propensity score estimated using logistic regression of the group on the covariates: nasopharyngeal swab, CT scan, age, sex, Charlson comorbidity index [8], COPD, diabetes mellitus, chronic kidney disease and immunocompromised state [6]. This study was approved by our local medical ethics committee (CoCo 2020-005) and did not allow access to electronic medical records of other hospitals.

55 patients with home monitoring were compared to 110 matched patients discharged without home monitoring (table 1). The number of total hospital admissions related to COVID-19 after visiting the ED within 28 days of follow-up was assessed as the primary outcome, and demonstrated 9% (five out of 55 patients) hospitalisations in the home-monitoring group compared to 27% (30 out of 110 patients) the control group. This equals to a risk ratio of 0.27 (95% CI 0.097–0.733; p=0.007) for hospitalisation. The

Shareable abstract (@ERSpublications)
Tele-monitoring during the COVID-19 pandemic is recognised as a safe strategy to monitor patients at home. This is the first controlled study that demonstrates the effectiveness of home monitoring to reduce hospital admissions during a 28-day follow-up. https://bit.ly/39vvngH

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TABLE 1 Characteristics of suspected coronavirus disease 2019 (COVID-19) patients at the emergency department (propensity score matched)

	Home monitoring	No home monitoring	p-value
Patients	55	110	
Age years	61 (45–69)	59 (46–70)	0.909
Female	27 (49)	53 (48)	0.912
Medical history			
Charlson comorbidity index	3 (1–6)	3 (1–5)	0.989
Hypertension	22 (40)	36 (33)	0.356
Diabetes mellitus	4 (7)	6 (5)	0.733
Coronary heart disease	0 (0)	13 (12)	0.005
COPD	8 (15)	13 (12)	0.620
Malignancy	17 (31)	40 (36)	0.487
Chronic kidney disease	6 (11)	12 (11)	1.000
Immunocompromised	23 (42)	44 (40)	0.823
COVID-19 diagnostics			
Nasopharyngeal swabs	44 (80)	85 (77)	0.689
CT scan	18 (33)	35 (32)	1.000
Underwent COVID-19 diagnostics	46 (84)	90 (82)	0.772
COVID-19 outcomes			
Nasopharyngeal swab positive	13 (24)	7 (6)	0.002
CO-RADS ⩾4	8 (15)	3 (3)	0.004
Confirmed COVID-19	16 (29)	9 (8)	<0.001
Primary outcomes			
Hospital admission (total)	5 (9)	30 (27)	0.007
Short stay admission	0 (0)	25 (23)	<0.001
Length of home monitoring days	4 (3–7)		
Secondary outcomes			
Stayed at home	47 (85)	76 (69)	0.023
Bed occupancy days per 100 patients	20	47	

Data are presented as n, median (interquartile range) or n (%), unless otherwise stated. CT: computed tomography; CO-RADS: COVID-19 Reporting and Data System.

median (interquartile range (IQR)) duration of home monitoring was 4 (3–7) days. It is noteworthy that 25 (83%) out of 30 admissions in the control group could be classified as "short-stay admissions", *i.e.* <24 h.

As secondary end-points, we observed that 47 (85%) home-monitored patients completed the follow-up duration of 28 days without ED reassessment compared to 76 (69%) patients in the control group (p=0.023). We calculated that the bed occupancy was 20 days per 100 patients discharged with home monitoring compared to 47 days per 100 patients discharged without home monitoring, equal to a 58% reduction.

The present study is the first controlled study demonstrating the effectiveness of home monitoring for suspected COVID-19 patients to reduce hospitalisations. In a systematic literature search, 16 relevant studies have reported on different concepts of home monitoring in patients with suspected/confirmed COVID-19 infection. Taken together, 92% (IQR 83–96%) of the patients could stay at home while surveyed with home monitoring and 5% (IQR 2–10%) required hospital admissions. Altogether, reported studies confirm the safety of home monitoring for suspected as well as established COVID-19 patients. The low frequency of hospital admissions further corroborated our observation that hospital admission can be reduced with home-monitoring strategies.

It is important to note that the positive results of our study were largely explained by a reduction in so-called short-stay admissions, *i.e.* <24 h. An in-depth analysis showed that nine (36%) out of 25 did not receive any treatment or received only oral antibiotics, both compatible with the assumptions that these patients could have been managed using home monitoring. In 12 (48%) out of 25 short-stay admissions, oxygen supplementation was given and tapered within 24 h, illustrating the heterogeneity of the indication to start oxygen therapy. It is plausible that the latter can potentially be replaced or influenced by the option of home monitoring. Not unimportantly, home monitoring indirectly reduces viral exposure for healthcare workers and other non-COVID patients, which is an invisible benefit during the current pandemic.

In our study, the number of confirmed COVID-19 cases was higher in the home-monitoring group, despite the equal frequency of COVID-19 diagnostics performed. The difference of confirmed COVID-19 cases between the groups is likely due to physicians' adequate risk assessment of patients with suspected symptoms. For our study, it re-affirms the effectiveness of home monitoring to reduce hospitalisation rate despite the over-representation of COVID-19 patients in the home-monitoring group. However, we need to be careful in drawing definitive conclusions on the efficacy of home monitoring for confirmed COVID-19 infection.

The low number of (re-)admissions and the high proportion of patients surveyed at home are encouraging results for healthcare providers to consider strategies of home monitoring. Our study provides evidence that home monitoring can indeed bring relief to the burden that the COVID-19 pandemic puts on hospitals. However, the implementation of home monitoring is not without cost and effort. Our local clinical practice of home monitoring of patients after myocardial infarction or kidney transplantation was the basis on which we extended home monitoring to suspected COVID-19 patients at a time when COVID-testing capacity was limited in the Netherlands [9, 10]. This lack, and the retrospective approach of the study, were limitations of the study. Therefore, our study addressed these issues by employing a propensity score matching case–control design based on the diagnostic tests conducted and the comorbidities that could have influenced the clinical outcome of patients. Importantly during this period of shortages, diagnostic testing with nasopharyngeal swabs and CT scans would indicate a strong suspicion of COVID-19 infection.

In conclusion, we demonstrated the potential of home monitoring to reduce hospital admissions by safely surveying clinical symptoms and vitals. These encouraging results should be further corroborated in larger patient groups, and notably in patients with a confirmed COVID-19 diagnosis.

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