



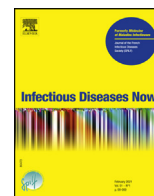
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Short communication

Asymptomatic SARS COV-2 carriers among nursing home staff: A source of contamination for residents?



Catherine Bayle^{a,b,1}, Delphine Cantin^c, Jean-Sebastien Vidal^{a,b}, Elise Sourdeau^c, Laurence Slama^{c,d}, Nicolas Dumesges^c, Sabine Trombert^e, Sonia Ayllon^f, Jean-Marie Nguyen^a, Dorsaf Slama^d, Mohamed Medaghecha^d, Olivier Hanon^{a,b}, Dominique Salmon^{c,d,g,1,*}, On behalf of the AP–HP COVID-19 research collaboration

^a Geriatrics Department, Broca Hospital, Assistance Publique-Hôpitaux de Paris, Hôpitaux Universitaires Paris Centre, Paris, France

^b EA 4468, Université Paris Descartes, Paris, France

^c COVID-19 screening center, Emergency Department, Hotel Dieu Hospital, Assistance Publique-Hôpitaux de Paris, 75004 Paris, France

^d Infectious Diseases and Immunology Unit, Hotel Dieu Hospital, 1, place du Parvis de Notre-Dame, 75004 Paris, France

^e Cerba Laboratory, Saint-Ouen L'Aumône, France

^f Emergency Department, Cochin Hospital, Assistance Publique-Hôpitaux de Paris, 75004 Paris, France

^g University of Paris, School of Medicine, 75005, Paris, France

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ABSTRACT

Objectives: To show that circulation of SARS-COV-2 in nursing homes in France can come from staff as well as residents' families, whether they are known or not to have had COVID-19.

Methods: This study reports a screening campaign of asymptomatic staff working in elderly nursing homes in Paris where the virus had been circulating actively in March and April 2020.

Results: Before the screening campaign, the rate of symptomatic COVID-19 was 23.3% among the residents and 12.1% among their home employees. Within a 72 h screening period, all employees not known to have the virus were screened by RT-PCR in nasopharyngeal swabs. Among the 241 screened employees, 32 (13.3%) tested positive for SARS-CoV-2 on RT-PCR. SARS-CoV-2 carriers and non-carriers did not differ in term of gender, age or type of staff. Staff carrying SARS-CoV-2 were strictly asymptomatic in 75% of cases while during the days following or before the test, 25% presented mild symptoms of COVID-19. Considering both symptomatic and asymptomatic cases, 66 out of 281 (23.5%) of the home employees had been carriers for COVID-19.

Conclusion: Screening for viral carriage of asymptomatic staff in nursing homes can avoid contact and transmission to frequently severely vulnerable residents.

Abbreviations

COVID-19 Coronavirus Disease 2019

CT Cycle Threshold

RT-PCR real time polymerase chain reaction

SARS-CoV-2 Severe Acute Respiratory Syndrome Coronavirus-2

1. Introduction

The COVID epidemic has highlighted the extreme vulnerability of the elderly to the SARS-CoV-2 virus. In France, senior residential care homes paid a particularly heavy toll to the COVID-19 epidemic:

more than half of COVID-19 deaths were those of elderly residents in nursing homes. Between March 1 and April 30, 2020, according to *Santé Publique France* (the French public health agency) there were 54,493 cases of COVID-19 among residents of nursing homes in France, and 6517 deaths [1]. Care home workers were also very strongly impacted by COVID-19; in the same survey, 18,936 COVID-19 cases were reported among their staffs [1].

These institutions were not prepared to deal with the epidemic. Containment, public health measures and social distancing were difficult to implement for residents often wandering and used to living together. Moreover, nursing homes for dependent elderly people were initially sorely lacking in suitable protective equipment.

In addition, COVID-19 diagnosis in the elderly is difficult insofar as they often develop atypical forms with digestive symptoms (vomiting, diarrhea) or confusion in the forefront and coughing in the background.

* Corresponding author.

E-mail address: dominique.salmon@aphp.fr (D. Salmon).

¹ First author and last author equally contributed to this manuscript.

Table 1
Description of elderly care home facilities.

Variables, % (N)	Whole sample	Nursing home 1	Nursing home 2	Nursing home 3	Nursing home 4	P
	N = 241	N = 84	N = 54	N = 52	N = 51	
Age (years), M (SD)	39.9 (11.0)	39.1 (10.7)	42.6 (11.7)	39.1 (10.1)	39.5 (11.6)	0.26 ^a
Women	83.8 (202)	84.5 (71)	83.3 (45)	82.7 (43)	84.3 (43)	0.99
Types of staff						0.01
Medical staff	2.5 (6)	2.4 (2)	1.9 (1)	0	5.9 (3)	
Nurses and nursing assistants	62.7 (151)	72.6 (61)	53.7 (29)	67.3 (35)	51.0 (26)	
Allied health professionals	6.2 (15)	3.6 (3)	7.4 (4)	9.6 (5)	5.9 (3)	
Clerical staff	8.3 (20)	8.3 (7)	5.6 (3)	11.5 (6)	7.8 (4)	
Environmental service staff	13.7 (33)	3.6 (3)	22.2 (12)	11.5 (6)	23.5 (12)	
Food service staff	5.0 (12)	8.3 (7)	3.7 (2)	0	5.9 (3)	
Volunteers	1.7 (4)	1.2 (1)	5.6 (3)	0	0	

% (N), percentage (count); M (SD), mean (standard deviation). *P-value from χ^2 comparing the 4 nursing home groups.

^a P-value from analysis of variance.

Despite the gradual arrival of personal protective equipment, the implementation of very strict public health and containment measures, and a ban on visits as of March 11, 2020, the SARS coronavirus 2 continued to spread in nursing homes in France.

Persistent circulation of the virus led the government to decide on large-scale screening in nursing homes. In an initial phase, all care home residents were to be screened for the virus, the objective being to isolate those who were carrying the virus.

During a second phase, all nursing home workers not known to have had COVID-19 were encouraged to get tested, the objective being to assess the risk of virus importation by non-virus-free staff.

This study reports the first screening phase of asymptomatic staff working in four elderly care nursing homes in Paris connected with the centrally located Paris hospitals (*Groupe Hospitalier Paris Centre*) in which the virus had been reported to be actively spreading in March and April.

2. Methods

All employees of the four nursing homes who had not previously been tested positive for SARS-CoV-2 RT-PCR and who had not raised strong clinical suspicion of COVID-19 were proposed for participating in an employee screening study.

COVID-19 cases were considered as confirmed in case of (1) virological confirmation of SARS-CoV-2 infection in nasopharyngeal swabs; and/or (2) CT-scan results typical for COVID-19 pneumonia; and/or (3) prior contact with a virologically confirmed case and at least two major symptoms of COVID-19 (fever $\geq 38^\circ\text{C}$, cough, pulmonary parenchymal disease, shortness of breath, anosmia/ageusia); and probable in case of strong clinical suspicion based on (1) at least three major symptoms or (2) two major and 2 minor symptoms (aches, sore throat, runny nose, headache, prolonged asthenia, chills, odynophagia, diarrhea, vomiting, cutaneous signs) or 1 major and three minor symptoms.

All employees gave oral consent to participate in this study. All participants, whatever their function, were screened at the COVID-19 screening center in the Hôtel-Dieu Hospital in Paris within a maximum 72-hour screening period. Search for RNA of the SARS-CoV2 virus was carried out by rhinopharyngeal swab and by RT-PCR (Elitech assay, ELITech Group, Puteaux, France). Viral load was expressed by Cycle Threshold (CT) values to provide a semi-quantitative assessment of SARS-CoV2 viral load. As recommended by the SFM [2], the amount of virus present at the nasopharyngeal level was considered moderate or low in case CT between 33 and 37 for at least 2 targets, significant in cases of $\text{CT} \leq 33$ for at least 2 targets, and negative in case of $\text{CT} \geq 37$.

Comparisons between characteristics of the different nursing-homes were made with χ^2 . Characteristics of positive and negative SARS-CoV-2 RT-PCR employees were compared with χ^2 for cate-

gorical variables and T-test for continuous variables. All analyses were two-sided and a P-value < 0.05 was considered statistically significant. Data analysis was performed using R software version 3.2.3.

3. Results

The four nursing homes (NH) participating in this study were located in Paris (NH of Péan (NH1), Amitié et Partage (NH2), Antoine Portail (NH3) and les Gobelins (NH4)). The general characteristics of the nursing homes are summarized in Table 1.

Before the screening campaign, all of the nursing homes had already confirmed cases of COVID-19 among their residents, with an infection rate of 23.3% (77/330) and an infected staff rate of 12.1% (40/263) (Table 2 and Fig. 1).

Between April 16, 2020 and April 29, 2020, testing was proposed for all asymptomatic or pauci-symptomatic NH employees at the Hôtel-Dieu screening center and 100% ($n = 241$) agreed to participate.

Among the 241 staff members, 32 (13.3%) persons tested positive for SARS-CoV-2 by RT-PCR. There was a non-significant difference in SARS-CoV-2 carriage prevalence between nursing homes, ranging from 9.3% to 17.9% (Table 2 and Fig. 1).

There was no significant difference between SARS-CoV-2 carriers and non-carriers in terms of gender, age and type of staff (Table 3).

In 75.0% of cases staff carrying SARS-CoV-2 had been strictly asymptomatic from the beginning of the pandemic until the screening survey, while 25.0% had presented, or presented in the days following the test, mild symptoms of COVID-19, such as headache, fatigue and runny nose (Table 3).

The amount of virus present at the nasopharyngeal level was moderate or low (CT between 33 and 37) in 14 (41.3%) cases, and significant ($\text{CT} \leq 33$) in 17 (58.6%). Mean SARS-CoV-2 load was 29.83 (SD = 7.2) and did not differ significantly across the four institutions. Subjects with significant SARS-CoV2 load experienced mild COVID-19 symptoms in 40% (2 out of 3), while subjects with mild or moderate SARS-CoV-2 load experienced mild COVID-19 symptoms in 22.2% (6 out of 27) ($P = 0.53$).

4. Discussion

Our results show 13.3% of asymptomatic or pauci-symptomatic carriage of SARS-CoV2 in nursing-home employees during the 1st wave of 2020 COVID-19 pandemic.

This asymptomatic carriage prevalence is of the same order as that found during the epidemic on the Diamond Princess cruise ship [17.9% (95% CI = 15.5–20.2%)] [3] but much lower than that found in

Table 2
Description of SARS-CoV2 RT-PCR results across the 4 nursing homes.

Variables	Whole sample	Nursing home 1	Nursing home 2	Nursing 3	Nursing home 4	<i>p</i> ¹
Status before the screening campaign						
Number of residents	330	94	73	70	93	
Confirmed or probable COVID-19	23.3% (77/330)	26.2% (25/94)	4.1% (3/73)	31.4% (22/70)	29.0% (27/93)	< 0.0001
Number of staff members	281	100	63	62	56	
Confirmed or probable COVID-19	12.1% (34/28154)	10% (10/100)	14.3% (9/63)	16.1% (10/62)	8.9% (5/56)	0.54
Screening campaign among staff members						
SARS-Cov2 tested staff members	241	84	54	52	51	
Positive RT-PCR	13.3% (32/241)	17.9% (15/84)	9.3% (5/54)	7.7% (5/52)	15.7% (8/51)	0.39
Mean CT ^a	29.83 (13.39–36.97)	27.70 (15.03–36.97)	35.04 (34.70–35.93)	35.42 (34.95–35.94)	26.28 (13.39–31.23)	
Totally asymptomatic	75.0% (24/32)	11	3	5	6	
Mild symptoms during or after the campaign	25.0% (8/32)	4	2	0	2	
Total staff members with SARS-CoV2 infection	23.5% (66/281)	25% (25/100)	22.2% (14/63)	24.2% (15/62)	23.2% (13/56)	0.98

P-values from χ^2 comparing the 4 nursing home groups.

^a Median cycle threshold in PCR positive samples.

Infection rate in residents and employees

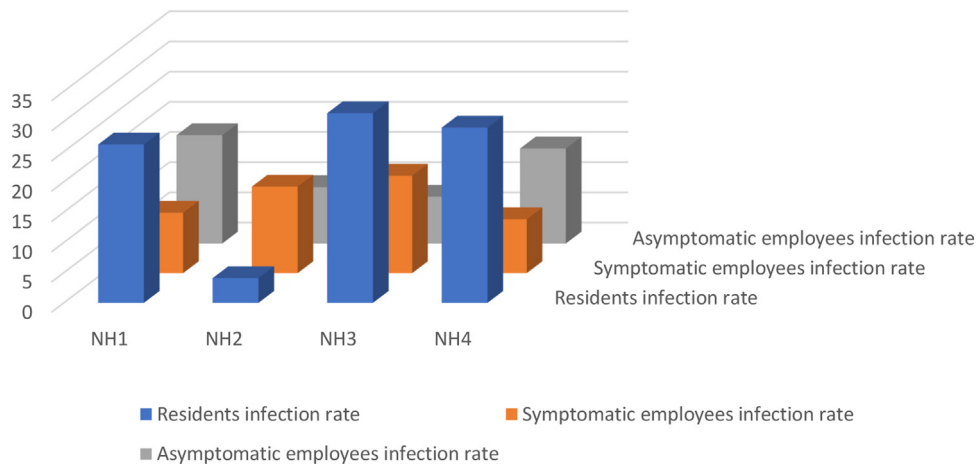


Fig. 1. SARS-COV-2 infection rate in residents and in employees in four nursing homes in Paris, France.

Table 3
Characteristics of the nursing-home employees participating in the screening campaign according to SARS-CoV2 RT-PCR results.

Variables, %(N) or M (SD)	Whole sample	SARS-CoV2 RT-PCR		<i>P</i>
		Negative	Positive	
	<i>N</i> = 241	<i>N</i> = 209	<i>N</i> = 32	
Age (years)	39.9 (11.0)	39.7 (11.1)	41.3 (11.0)	0.47
Women	83.8 (202)	83.7 (175)	84.4 (27)	0.99
Types of staff				
Medical staff	2.59 (6)	2.9 (6)	0	0.36
Nurses and nursing assistants	62.7 (151)	61.2 (128)	71.9 (23)	
Allied health professionals	6.2 (15)	6.2 (13)	6.3 (2)	
Clerical staff	8.3 (20)	9.6 (20)	0	
Environmental service staff	13.7 (33)	13.9 (29)	12.5 (4)	
Food service staff	5.0 (12)	4.3 (9)	9.4 (3)	
Volunteers	1.7 (4)	1.9 (4)	0	
Viral load, M (SD)				
Low			30.1 (7.2)	
Moderate			59.6 (19)	
High			25.0 (8)	
Totally asymptomatic			75.0 (24)	
Mild COVID-19 symptoms ^a			25.0 (8)	

P-value from χ^2 comparing negative vs. positive PCR groups

^a during the days after the campaign

other regions of France where the virus was not highly circulating [4].

Higher prevalence was found in China among people evacuated from Wuhan (China), Italy or during the epidemic in Oise (France) [5–7]. In our series, the lower prevalence found in the EHPADs compared to the previous series, may attest to the fact that the virus had already widely spread among staff members, or else be a consequence of the adoption of stricter and more effective barrier measures. It also bears mentioning that the survey was carried out at a time when the PCR test had just been rendered available in France and that employees had in median only one test performed during this period.

All types of nursing home employees, independently of their functions, were similarly affected by SARS-CoV-2. Interestingly enough, employees not in close contact with residents were no less affected than nurses and MDs.

Viral load at the nasopharyngeal level was considered as low in 41.3% of the cases and significant in 58.6% [2]. These high levels of viral load could present a risk of transmission to residents, their relatives and to other employees.

Of note, the NH2 nursing home, which had the lowest number of infected residents (4% vs. 23% on average) at the end of the 1st wave, had implemented stricter and earlier prevention rules (mask wearing from the 1st case on 14/03/2020, social distancing facilitated by the existence of two buildings with a dedicated team in each building, ample space for breaks, early awareness of caregivers of the need to be tested in case of symptoms). On the other hand, median viral load by institution was similar across the four facilities.

Screening for viral carriage of asymptomatic staff in nursing homes is therefore necessary in order in view of avoiding contact and transmission between these carriers and residents, who are often exceedingly vulnerable. Cases of asymptomatic SARS-CoV-2 virus carriage justify temporarily medical leave with isolation and precautions for at least 7 days after SARS-CoV-2 detection [8]. Evaluation of the duration of SARS-CoV-2 carriage in an asymptomatic person and their capacity to develop a protective immune response should also be considered.

If the virus keeps spreading in France over the months to come, the question will arise as to whether to repeat this screening at regular intervals.

Upcoming availability of serological tests will facilitate determination of persons already in contact with the virus, thereby allowing for combined approaches and limiting repeated screening of those who have not been in contact with the virus.

Our limitations are linked to the small study size and to the fact that when it took place, diagnosis of SARS-CoV-2 infection was based solely on virological RT-PCR on swabs, potentially leading to underestimation of the prevalence of SARS-CoV-2 infection. However, the participation of all employees, whatever their function, ensured precise assessment of asymptomatic carriage in nursing homes and showed that all staff members were liable to transmit the virus to the residents or to their coworkers.

In conclusion, the virus had been circulating in nursing homes in France for several weeks and this may well have been partially due to viral carriage by asymptomatic staff members lacking in adequate protective equipment. Our study demonstrates the usefulness of screening asymptomatic nursing home staff for viral carriage, the objective being to avoid contact and transmission of the virus to frequently severely vulnerable residents.

Human and animal rights

The authors declare that the work described has been carried out in accordance with the Declaration of Helsinki of the World Medical

Association revised in 2013 for experiments involving humans as well as in accordance with the EU Directive 2010/63/EU for animal experiments.

Informed consent and patient details

The authors declare that this report does not contain any personal information that could lead to the identification of the patient(s) and/or volunteers.

Disclosure of interest

The authors declare that they no competing interest.

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Data sharing statement

No additional data available.

Authors' contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

Conceptualization: DS, CB, RL and DC; Data management: DS, ES, DC Formal analysis: JSV, DS, CB, OH; Methodology: DS, OH EB Supervision: DS; Validation, DS, ES Writing—original draft: all

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