

## Implementation of an Algorithm of Cohort Classification to Prevent the Spread of COVID-19 in Nursing Homes



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### ABSTRACT

Older adults living in nursing homes are the most vulnerable group of the COVID-19 pandemic. There are many difficulties in isolating residents and limiting the spread in this setting. We have developed a simple algorithm with a traffic light format for resident classification and sectorization within nursing homes, based on basic diagnostic tests, surveillance of symptoms onset, and close contact monitoring. We have implemented the algorithm in several centers with good data on adherence. Suggestions for implementation and evaluation are discussed.

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**Keywords:** COVID-19, nursing home, algorithm, cohort classification, diagnostic tests

### Problem and Significance

Older adults are the most vulnerable group in the COVID-19 health crisis, because it is the highest mortality-rate age group. In our country of Spain, mortality from coronavirus in people older than 80 years is 21%, compared with a 7.8% overall rate.<sup>1</sup> Furthermore, 80% of all deaths occur in patients older than 70 years.<sup>1</sup> Nursing home residents are even more vulnerable than older adults in general because of their age, dependency, and comorbidities.<sup>2,3</sup> Moreover, disease transmission in this setting is much higher than that of adults living in the community, because of a greater difficulty to carry out isolation practices, because of the preexisting close contact to other residents and staff who look after them.<sup>4</sup> In general, nursing homes have structural problems that often make it difficult to correctly isolate infected residents; in Spain, about 80% of residents share a bedroom, and common areas are not usually designed to keep the recommended interpersonal distance of 1 to 2 m. For all these reasons, the COVID-19 pandemic is especially affecting nursing homes around the world.<sup>5</sup>

Public health recommendations for the sectorization of nursing home residents have been published in Spain.<sup>6,7</sup> However, they are not

easy to implement in real life because of the aforementioned difficulties. Our target was to make a practical guide to optimize existing resources to effectively isolate residents and prevent the spread of COVID-19 in nursing homes.

### Innovation

The pragmatic innovation consists of an algorithm that helps to classify residents in order to separate them into three different areas (Figure 1). This approach was designed in the surge of the COVID-19 outbreak when PCR tests could not be performed for all nursing-home residents. However, it would not be the recommended approach in a different clinical setting.

The first step in this algorithm is to perform a chromatographic immunoassay to detect IgG and IgM antibodies against SARS-CoV-2 in all residents in the nursing home using rapid point-of-care test (Guangzhou Wondfo Biotech Co, Guangzhou, Guangdong, China) (sensitivity 86.43%, specificity 99.57%), provided by the Spanish Government. Because of an occasional shortage in availability, a second testing kit, provided by our hospital, was performed; COVID-19 IgG and IgM rapid test cassette by Biozek medical (Apeldoorn, the Netherlands) (IgM: sensitivity 85%, specificity 96%; IgG: sensitivity 100%, specificity 98%). A positive result on the total antibody test indicates an active or past COVID-19 infection. Therefore, residents with a positive result would be placed in the “red zone,” assuming that the risk of transmission and reinfection between them is low or nil according to the available data to date.<sup>8</sup> In keeping with the current

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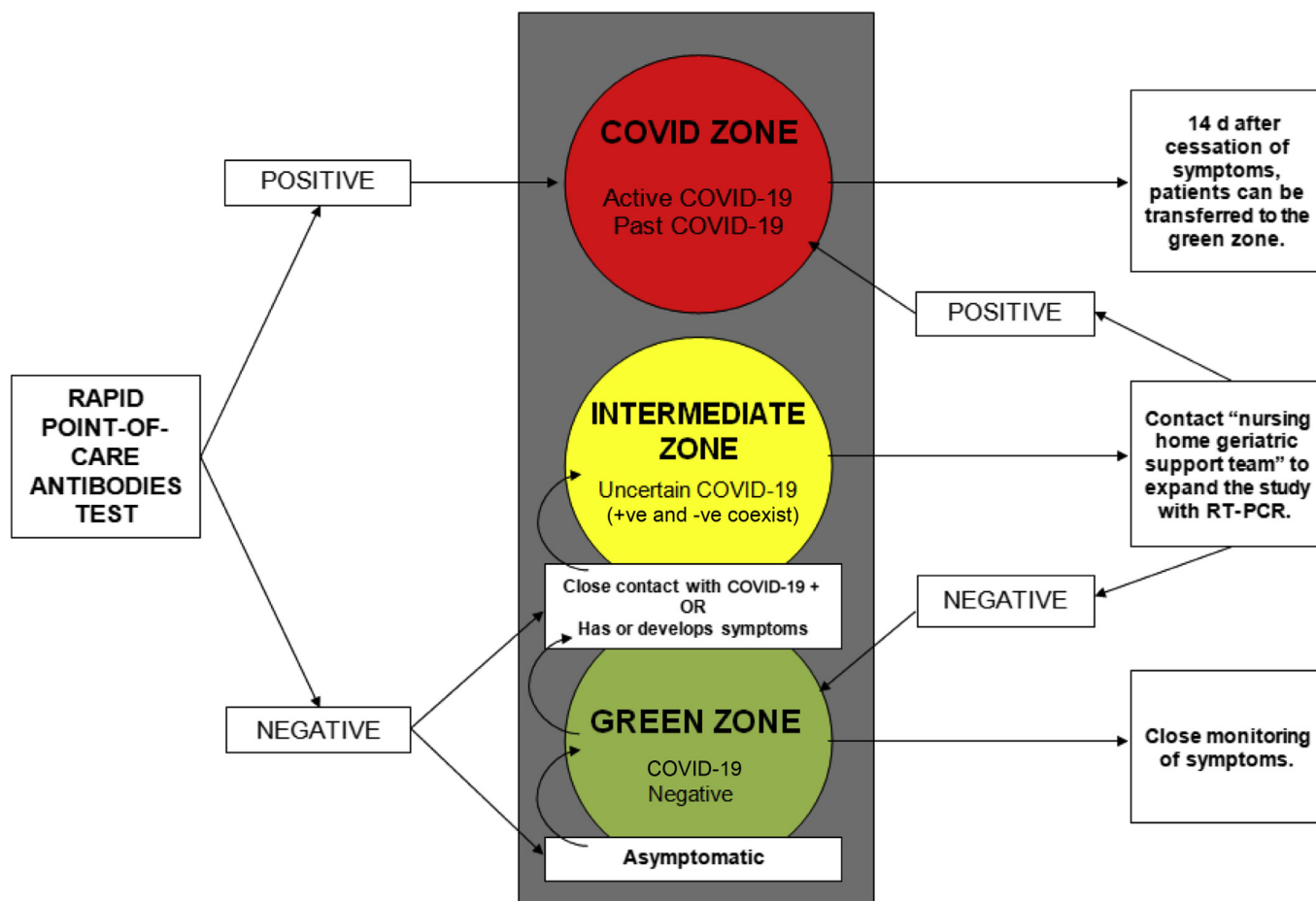


Fig. 1. Algorithm of sectorization to prevent the spread of COVID-19 in nursing homes. A downloadable PDF of this form is available at [www.sciencedirect.com](http://www.sciencedirect.com).

recommendations and scientific evidence available, residents would be considered disease-free or noncontagious after being asymptomatic for 14 days given the significant decrease in viral load in the nasopharynx after that time<sup>9–12</sup> and may be transferred to the “green zone.”

In case of a negative result of the rapid point-of-care test, the resident would initially be located in the “green zone.” Two negative antibody tests would be advisable as the false negative rates drop with testing twice. Early detection of cases of COVID-19 in this area must be performed either by identification of close contact to confirmed cases

**Table 1**  
Recommended Organizational Practices for Each of the Zones Detailed in the Algorithm

	Red Zone	Yellow Zone	Green Zone
Rooms	Double	Individual (mandatory)	Individual (recommended) Double if there are not enough individual rooms
Practices about meals	Dining room	Room	Room (recommended). If not possible, attend dining room keeping 2-m social distance
Use of common areas	Permitted	Prohibited	Avoidable. Patients can take turns walking, keeping mandatory social distance.
Personal protective equipment for health workers	Complete*. No need to change equipment between patients, except gloves, during the work shift as long as the worker remains within the zone.	Complete*. The equipment must be changed or disinfected between patients.	Mask, disposable gown and gloves.

The main strategy to avoid transmission is glove-changing and hand-washing using hydroalcoholic solution in between patients, regardless of the zone. Note: The following practices are aimed toward diminishing transmission risk between the following groups. In the red zone, the risk lies in patient to nursery home staff. In the yellow zone, both fellow residents or staff are at risk of contagion from patients. And in the green zone, the risk exists mainly in patient-to-patient transmission or staff-to-patient.

\*Complete personal protective equipment is composed of gloves, waterproof gowns, shoe covers, head covers, masks, eye protection, and face shields.

or through daily surveillance of symptoms (fever, cough, dyspnea, chest pain, odynophagia, myalgia, headache, confusional state, diarrhea, rash, or atypical symptoms<sup>13</sup>). In both situations, residents must be considered suspicious of being infected, and should be immediately transferred to the “yellow zone.” Further study must be undertaken once in this area, including COVID-19 detection using the reverse transcription–polymerase chain reaction (RT-PCR) technique (Genesig Real-Time PCR assay; specificity 98.2%). Depending on its result, the resident may be relocated to the red or green zone. The organizational practices of each zone are detailed in Table 1.

## Implementation

Our hospital is located in Madrid, Spain, and serves a population of 182,000 inhabitants, of which approximately 4000 are taken care of in 48 nursing homes. The liaison staff between residences and the hospital currently consists of a multidisciplinary team of 4 physicians and 3 nurses, together with primary care collaboration.

A briefing on the use of the algorithm was undertaken in a face-to-face interview with the attending physician and/or the manager of each nursing home, in order to answer questions about its implementation, taking into account each center's specific characteristics.

## Evaluation

The intervention was first implemented on April 24, 2020. At the time of this writing, the intervention has been held in 17 nursing homes, whose data on adherence to the algorithm is shown in Table 2. The mean number of residents per nursing home is 92, with a mean number of RT-PCR performed of 18 (19% of the residents of each center). Ten nursing homes (59%) had performed some rapid point-of-care test before the intervention, and 100% increased the tests performed afterwards. Seven nursing homes (41%) established some kind of sectorization before the intervention, and almost all (94%) made an improvement in that regard after the intervention.

**Table 2**  
Degree of Adherence to the Algorithm Recommendations

	Residents, n	Total Antibody Test Performed, n (%)		Creation of Differentiated Zones		Residents Reclassified*, n (%)
		Before Intervention	After Intervention	Before Intervention	After Intervention	
NH 1	170	170 (100)	170 (100)	Partial sectorization <sup>†</sup>	Fully implemented <sup>‡</sup>	23 (14)
NH 2	109	0	34 (31)	Partial sectorization	Fully implemented	18 (17)
NH 3	60	0	29 (48)	Partial sectorization	No improvement	6 (10)
NH 4	35	0	35 (100)	Partial sectorization	Improvement <sup>§</sup>	11 (31)
NH 5	19	0	19 (100)	No sectorization <sup>  </sup>	Fully implemented	19 (100)
NH 6	41	41 (100)	41 (100)	No sectorization	Fully implemented	41 (100)
NH 7	124	62 (50)	124 (100)	No sectorization	Fully implemented	3 (2)
NH 8	21	0	21 (100)	No sectorization	Partially implemented**	2 (9)
NH 9	270	140 (52)	270 (100)	No sectorization	Fully implemented	31 (18)
NH 10	13	13 (100)	13 (100)	No sectorization	Partially implemented	9 (69)
NH 11	72	0	72 (100)	No sectorization	Partially implemented	43 (60)
NH 12	55	0	55 (100)	Partial sectorization	Improvement	4 (7)
NH 13	203	160 (79)	203 (100)	Partial sectorization	Improvement	5 (2)
NH 14	248	248 (100)	248 (100)	Partial sectorization	Improvement	9 (4)
NH 15	46	46 (100)	46 (100)	No sectorization	Fully implemented	3 (7)
NH 16	55	0	55 (100)	No sectorization	Fully implemented	44 (80)
NH 17	28	0	28 (100)	No sectorization	Patients transferred to other facilities due to impossibility to apply necessary isolation measures	28 (100)
Overall	1569	880 (56)	1463 (93)			299 (19)

NH, nursing home.

\*Number of residents reclassified in the first week after the intervention due to RT-PCR testing.

<sup>†</sup>Partial sectorization: sectorization in 2 zones (usually red and green) was already made before the intervention.

<sup>‡</sup>Fully implemented: sectorization in 3 different zones according to the characteristics described in Figure 1 and Table 1 was implemented.

<sup>§</sup>Improvement: the sectorization was improved with respect to how it was previously done, but it did not meet all the characteristics recommended in this article, either because it did not create 3 different zones or because in some of them the recommended practices were not carried out as described in Table 1.

<sup>||</sup>No sectorization: isolation was carried out in a timely manner in some rooms, without sectoring by identifiable areas.

\*\*Partially implemented: if there was no previous sectorization, a sectorization was implemented but it did not meet all the recommended characteristics, either because it did not create 3 different zones or because in some of them the recommended practices were not carried out as described in Table 1.

A potential way to measure outcomes would be to compare the number of residents referred to the hospital, the mortality before and after the intervention, as well as how long it took to become a “COVID-19-free” center when compared to other nursing homes where the algorithm was not implemented. The number of diagnosed residents by itself would not be a good indicator because the goal of this intervention is early detection of infected residents to avoid COVID-19 spread.

## Comment

Data of our study shows, first of all, the heterogeneity in the number of rapid point-of-care tests performed and isolation measures taken by each nursing home before the intervention. Second, the degree of adherence to the recommendations was also variable, but most of the nursing homes adopted the recommended practices at least partially.

A simple algorithm for classifying residents in nursing homes may potentially improve health outcomes in the COVID-19 pandemic by reducing the number of infections. We are not aware of other similar algorithms published in the medical literature so far. Our experience with the proposed algorithm is that adherence by nursing homes to most of the recommendations has been satisfactory, and early detection of new cases by PCR has increased. This innovation arises from the need to simplify the numerous and evolving recommendations made by health authorities and scientific societies.<sup>14,15</sup>

The fact that this protocol is easy to understand, easy to carry out, and that it does not need many diagnostic tests is among its strengths.

The main limitation of this approach is that it should be used only in case of an outbreak of COVID-19 and lack of availability of PCR massive testing, because of the limitations in reliability of rapid point-of-care testing.<sup>16</sup> One way to improve the current algorithm would be to replace the rapid point-of-care test with RT-PCR instead, given the high number of asymptomatic residents and which was responsible for virus transmission in nursing homes.<sup>17</sup> The second fundamental

way to improve the algorithm is to complement it with a similar one in which RT-PCR is actively performed in health care personnel.

We still lack much data on the COVID-19 emerging infection. This study tries to shed light onto dramatic problem of dealing with COVID-19 in nursing homes, offering an affordable method to classify residents. However, further research is necessary to assess its capacity in preventing viral spread.

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### Supplementary Data

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.jamda.2020.10.023>.

### References

1. Informes COVID-19 [COVID-19 reports]. Available at: <https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Paginas/InformesCOVID-19.aspx>. Accessed May 1, 2020.
2. Una estimación de la población que vive en residencias de mayores – EnR? [An estimate of the population living in nursing homes]. Available at: <http://envejecimientoenred.es/una-estimacion-de-la-poblacion-que-vive-en-residencias-de-mayores/>. Accessed May 1, 2020.
3. Niu S, Tian S, Lou J, et al. Clinical characteristics of older patients infected with COVID-19: A descriptive study. *Arch Gerontol Geriatr* 2020;89:104058.
4. Van Houtven CH, DePasquale N, Coe NB. Essential long-term care workers commonly hold second jobs and double- or triple-duty caregiving roles. *J Am Geriatr Soc* 2020;68:1657–1660.
5. McMichael TM, Currie DW, Clark S, et al. Epidemiology of COVID-19 in a long-term care facility in King County, Washington. *N Engl J Med* 2020;382:2005–2011.
6. Protocolo para las pruebas diagnosticas en los centros sociosanitarios [Protocol for diagnostic tests in social health centers]. Available at: [https://www.comunidad.madrid/sites/default/files/doc/servicios-sociales/protocolo\\_para\\_las\\_pruebas\\_diagnosticas\\_en\\_los\\_centros\\_sociosanitarios.pdf](https://www.comunidad.madrid/sites/default/files/doc/servicios-sociales/protocolo_para_las_pruebas_diagnosticas_en_los_centros_sociosanitarios.pdf). Accessed May 1, 2020.
7. Boletín oficial del estado 2020-3951 [Government official newsletter]. Available at: <https://www.boe.es/boe/dias/2020/03/21/pdfs/BOE-A-2020-3951.pdf>. Accessed May 3, 2020.
8. Bao L, Deng W, Gao H, et al. Lack of reinfection in rhesus macaques infected with SARS-CoV-2. *BioRxiv* 2020.03.13.990226. <https://doi.org/10.1101/2020.03.13.990226>.
9. Pan Y, Zhang D, Yang P, et al. Viral load of SARS-CoV-2 in clinical samples. *Lancet Infect Dis* 2020;20:411–412.
10. To KK, Tsang OT, Leung WS, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: An observational cohort study. *Lancet Infect Dis* 2020;20:565–574.
11. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med* 2020;382:1177–1179.
12. Centers for Disease Control and Prevention (CDC). Communities, schools, workplaces, & events; 2020. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/community/strategy-discontinue-isolation.html>. Accessed May 6, 2020.
13. Norman RE, Stall NM, Sinha SK. Typically atypical: COVID-19 presenting as a fall in an older adult. *J Am Geriatr Soc* 2020;68:E36–E37.
14. Ouslander JG. Coronavirus disease 19 in geriatrics and long-term care: An update. *J Am Geriatr Soc* 2020;68:918–921.
15. D'Adamo H, Yoshikawa T, Ouslander JG. Coronavirus Disease 2019 in geriatrics and long-term care: The ABCDs of COVID-19. *J Am Geriatr Soc* 2020;68:912–917.
16. Lisboa Bastos M, Tavaziva G, Abidi SK, et al. Diagnostic accuracy of serological tests for covid-19: Systematic review and meta-analysis. *BMJ* 2020;370:m2516.
17. Gandhi M, Yokoe DS, Havlir DV. Asymptomatic transmission, the Achilles' heel of current strategies to control COVID-19. *N Engl J Med* 2020;382:2158–2160.

*The pragmatic innovation described in this article may need to be modified for use by others; in addition, strong evidence does not yet exist regarding efficacy or effectiveness. Therefore, successful implementation and outcomes cannot be assured. When necessary, administrative and legal review conducted with due diligence may be appropriate before implementing a pragmatic innovation.*