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Short Communication

Successful management of COVID-19 outbreak in a long-term care facility in Jeddah, Saudi Arabia: Epidemiology, challenges for prevention and adaptive management strategies

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ABSTRACT

The global transmission of SARS-COV-2 constitutes a highly challenging situation for long-term care facilities, especially with the lack of standardized and approved procedures. Residents in these facilities are at high risk for contamination due to proximity, and to morbidity and mortality given their advanced age and critical baseline health conditions. This paper exposes the experience and outcomes of a COVID-19 outbreak in a long-term facility in Jeddah, Saudi Arabia, which occurred after admission of a new resident despite high baseline level of alertness including systematic isolation and screening of all newly admitted residents. We highlight the challenges for case detection and application of protective measures, and describe the adaptive management strategies implemented to contain the outbreak.

Introduction

The year 2020 was marked by the global outbreak of a viral infection, COVID-19, due to a novel serotype of coronavirus, namely SARS-CoV-2, originating from Wuhan city, Hubei Province, China. This virus was highly contagious and responsible for deadly severe acute respiratory problems [1,2]. Lately, it was also associated with several other pathological conditions including hematological and coagulation [3–5], cardiovascular [6], neurological [7] disorders that are still poorly elucidated. The virus is transmitted by inhalation or contact with infected droplets and the incubation period ranges from 2 to 14 days [8].

A few weeks after the rapid spread of this virus globally, the World Health Organization stated that COVID-19 was a pandemic and a global emergency was declared [9]. In Saudi Arabia, the Ministry of Health declared the very first case on March 2, 2020 [10], and on April 10th, the total number of confirmed cases surpassed 3,600 [11]; while to date (June 30th), a total 186,436 confirmed cases are recorded, with 0.86 death rate [12].

Social distancing is a key measure to mitigate the transmission of COVID-19. Among several other countries, Saudi Arabia has started implementing social distancing protocols even before the first case was reported. Religious events including minor (Umrah) and major (Hajj) Pilgrimage, professional and cultural meetings, and entertainment and sporting activities, etc. were all suspended or canceled, and the educational institutions and mosques were temporarily closed [10]. However, these measures were not applicable to all institutions, notably health care and long-term care facilities.

A long-term care facility is an establishment designed to provide care and aid to people who need assistance to perform their daily activities during a period of time [13]. Residents in these facilities are facing high risk for SARS-COV-2 contamination due to advanced age and critical health conditions. In addition, the movement of caregivers from one patient to another can increase the risk of spreading the infection [14]. Therefore, it is quite challenging for long-term care facilities to deal with this pandemic, especially with the lack of standardized and approved procedures [15].

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We report the case of a successful management of a COVID-19 outbreak in a long-term care facility in Western Saudi Arabia. We highlight the challenges and describe the adaptive preventive and management strategies implemented to contain the outbreak.

Case report

Setting

The institution on study is a private long-term nursing center (LTNC) comprising a 100-bed nursing home and a 6-bed intensive care and cardiovascular unit (ICVU). The institution is disposed into three buildings, 1 for the ICVU and 2 for the LTNC. A 6 to 8-meter connection lies between building. It is located in South Jeddah, Western Province of Saudi Arabia.

Index patient admission and institution's preventive strategy

On April 9th, 2020, a new patient was admitted in the institution for long-term care. The patient AA, a 39-year old male, was transferred from the referring hospital as his bed was accommodated to receive acute COVID-19 cases. No suspect clinical signs were reported in the patient's hospitalization report from the referring center and no special recommendation was expressed.

On admission, the patient was screened for COVID-19 evocative signs. Screening included a physical examination and real-time polymerase chain reaction (rt-PCR) testing. Although, the patient had no clinical signs suggestive for COVID-19, he was placed in an isolation room with negative air pressure and managed as a suspect case, as per the institution's protocol for every new admission during the pandemic period.

Additionally, protective measures against airborne infections were implemented among all health care workers dealing with the newly admitted patient. These measures included being fit-tested for N95 masks, face shields and body protective suit. As per the institution's protocol, a team was delegated to deal with cases in isolation, comprising house-keeping staff, respiratory therapist, physiotherapist, nursing. A portable X-ray was dedicated for suspect cases, which was maintained regularly with a cleaning log.

Other clinical measures were systematically implemented among the newly admitted patients, including regular assessment for any evocative syndromic shift by monitoring of temperature and for any symptom such as cough, runny nose, sore throat, night sweat, weight loss, rash, vomiting, or diarrhea. Finally, education activities were systematically conducted to educate the patients regarding COVID-19 preventive measures. Family visits were prohibited and replaced with camera and videocalls to keep in touch with the family. All these measures were implemented among the patient AA pending the receipt of rt-PCR results.

On April 14th, results of rt-PCR came positive for SARS-COV2.

Methods

Positive results of the index patient led to the activation of the outbreak committee, which issued and implemented the following instructions and measures:

1 Close the building for admissions and transfers: no cases in or out of the building where the index patient was admitted;
2 Contact tracing of all staff who have been in contact with the case;
3 Screen all the patients in the same building for SARS-COV2 using nasopharyngeal swab;
4 Implement enforced social distancing and posted educational signs;
5 Enforce reporting to infection control team and clinical staff of respiratory tract symptoms or any deterioration of general health status among the patients and staff;
6 Reinforce environmental cleaning for nursing area and doctors' room, twice per shift (before and after the start of the shift);
7 Enforce the use of personal protective equipment;
8 Limit the use of the institution's bus by increasing the frequency of trips and decreasing the number of staff per trip;
9 Rigorously monitor housekeeping cleaning practices;
10 Reduce the risk of equipment cross-transmission by dedicating an elevator, an ECG, a care trolley, etc. for the infected case with cleaning log for each equipment after use.

a. Contact tracing and clinical screening

Contact tracing was carried out using a semi-structured interview divided into three sections:

1) Tracing of the index patient's movements and contacts within the facility since admission;
2) Monitoring of health status of all patients and health workers in the facility using a standard syndromic surveillance form with COVID-19 evocative symptoms (Fig. 1);
3) Contacts of health care workers including outside the facility such as relatives and friends, etc. with subject-reported assessment of their health status.

b. Personal protective equipment

Personal protective equipment included gown, surgical mask, non-sterile gloves, and face shield. Specifically, N95 mask was used by personal during aerosolized generating procedures (AGPs).

c. Screening

Screening primarily involved identified contacts of index cases, then was extended to all staff members and patients in the outbreak building. It was carried out by nasopharyngeal swab and tested by the MoH regional lab.

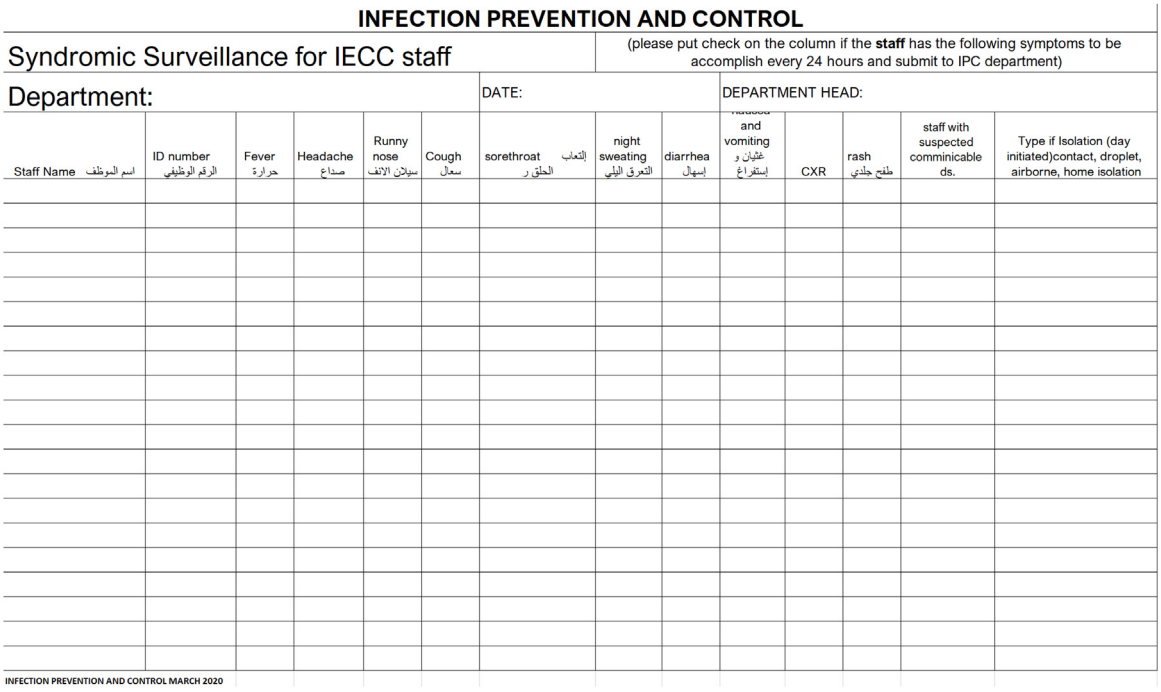
Results

Contact tracing identified 33 individuals among the staff who had direct contact with the patient. All 33 were swabbed for COVID-19 screening on the same day of the receipt of index patient results, i.e. on 14 April 2020. Screening results were issued on 17 April 2020, identifying 2 positive cases including a respiratory therapist (RT), *RT-S*, and a nurse, *Nurse-B* (Fig. 1). Further investigation showed that both positive health care workers have spent more than 20 min with the index patient, and the RT indicated having performed the tracheal sampling, for the patient, using mask-fitted N95 but not wearing his face shield.

Subsequent to these findings, a second-line process was implemented including two additional measures:

1 Secondary contact tracing and screening campaign involving all staff and patients who have had contact with the three cases, i.e. the index patient and the 2 healthcare workers. The screening campaign was carried out on 18th, 19th, 20th, and 22nd April.
2 Implementation of universal surgical masking for all staff while being in the center buildings, as well as in all critical and patient's area outside the buildings (courtyards, walking areas, etc.).

Secondary contact tracing among the staff identified 5 nurses, 4 from the same building where the index patient was and one from the long-term care building; in addition to one respiratory therapist. As to patients, all those hospitalized in the same building as the index case were considered as contacts. Screening of these



INFECTION PREVENTION AND CONTROL

Syndromic Surveillance for IECC staff

(please put check on the column if the **staff** has the following symptoms to be accomplish every 24 hours and submit to IPC department)

Department: DATE: DEPARTMENT HEAD:

Staff Name اسم الموظف	ID number الرقم الوظيفي	Fever حرارة	Headache صداع	Runny nose سيلان الانف	Cough سعال	sorethroat إلتهاب الحلق ر	night sweating التعرق الليلي	diarrhea إسهال	and vomiting غثيان و إستفراغ	CXR	rash طفح جلدي	staff with suspected comminicable ds.	Type if Isolation (day initiated)contact, droplet, airborne, home isolation

INFECTION PREVENTION AND CONTROL MARCH 2020

Fig. 1. Standard syndromic surveillance form for monitoring health status and COVID-19 evocative symptoms among patients and health workers in the facility.

Table 1
Results of patients and staff screening.

Category	No. screened	Positive (%)	Negative	Others
Health care workers	200	8 (4%)	191 (95.5%)	1 (0.5%) rejected
Drivers	4	0 (0%)	4 (100%)	–
Patients	107	1 (1%) false positive	106 (99.0%)	–

resulted into 3 additional positive cases among nurses, *Nurse-A*, *Nurse-S* and *Nurse-E*, all having been in contact with *Nurse-B* before the implementation of universal masking. However, no patient screened positive in the building.

Further investigation among the healthcare workers detected 36 potential secondary contacts among staff member from another building. These 36 staff members were tested on April 19th, and 2 of them were positive, namely *RT-J* and *Nurse-M*. However, given history of visiting a crowded supermarket, these two cases were assumed to be community-acquired infections.

A third-line contact tracing and screening was carried out revealing one additional positive case among nurses (*Nurse-G*), who sat together for 5 min with *Nurse-E* on April 19th. Additionally, one patient from the other building (*Patient-A*, 57 years old), who benefited from respiratory therapy by previously diagnosed *RT-J*, tested positive; however, a second PCR was negative for this patient concluding to a false positive result in the first PCR. The patient continued to be asymptomatic over 2-week monitoring. Contact tracing and screening strategy was continued for more than 2 weeks following the detection of the index case, and yet no additional case has been detected so far. The transmission diagram of SARS-COV2 in the facility is presented in Fig. 2.

Discussion

Highlights on the case

The present case showed the efficacy of rigorous contact tracing and screening strategy, combined with standard protective measures, in limiting the contagion of SARS-COV2 in a healthcare institution. This was evidenced by the low number of exposed and positively tested individuals and the absence of COVID-19 associated mortality to date. The strength of the strategy applied in our facility does not lie only in the control measures that were implemented following the detection of the index case, but also in the priorly implemented systematic isolation and screening strategy for every new admission, which enabled rapid detection of the first case. On the other hand, the circumstance of the outbreak initiation and the tertiary contact exposure deserve more attention, as they are probably associated to default in compliance with the protocol. Finally, asymptomatic presentation was consistently observed among all the cases, which constitutes another factor increasing the difficulty of case detection and supporting the need for systematic screening. All the aforementioned issues will be discussed in this section.

COVID-19 impact on long-term facilities

Although data measuring the impact of COVID-19 on long-term care facilities are imprecise, early evidence from international literature reported dramatically high morbidity and mortality among residents. In Europe, residents of these facilities accounted for nearly 50% of the overall COVID-19 related mortality during the first months of the pandemic, and SARS-COV2 outbreaks were reported in up to 90% of the facilities, depending on the country [16–20]. Such shocking impact is explained by several factors including high risk of virus dissemination due to promiscuity, advanced age and poor clinical status of residents, lack of systematic testing notably among the deceased residents, and lack of adequate training for protective and control measures among the staff. These factors are frequently associated with shortage in staff during the outbreak period, due to sickness and self-isolation [15,21].

Additionally, the psychological impact on health care staff, due to increased number of deaths among residents and concern for other residents' health as well as their own, should be added to the impact scale, as it may downplay the staff self-efficacy and per-

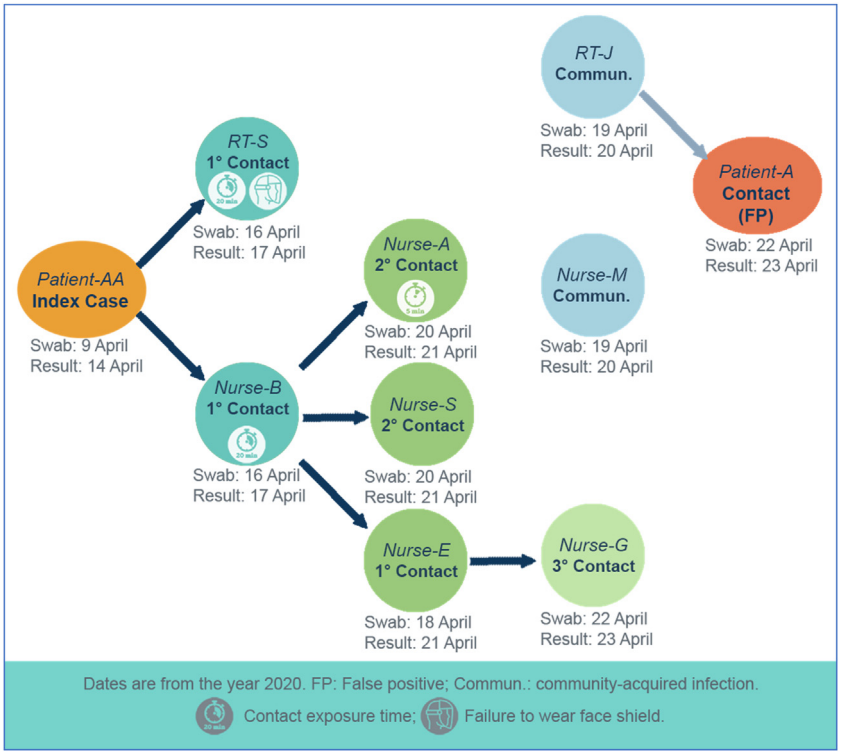


Fig. 2. Hypothetic transmission diagram of SARS-COV2 in the long-term care facility.
On April 26th, 200 staff members, 4 drivers, and 107 patients have been screened for SARS-COV2 (Table 1).

formance and lead to negative attitude towards the implemented protective measures [21–23].

In the United States, early studies comparable to the present case study suggest that healthcare staffs were outpaced by the outbreak, as index cases were tested relatively late and a number of staff members were contaminated in the meantime. This was the case in the study conducted by the Center for Disease Control (CDC) COVID-19 Investigation Team, in Washington, USA, back to 28 February 2020, where an index patient was tested and diagnosed only after an 8-day respiratory symptomatology progressing to intubation. On detection of this case, 2 other residents and one staff member were confirmed COVID-19 on the same day. Subsequently, despite massive contact tracing, isolation and quarantine, and screening campaign conducted by the CDC, combined with enhanced protective measures, 167 individuals were contaminated in the same facility including 101 residents, 50 staff members and 16 visitors, all being epidemiologically linked to the index case. Follow-up showed, 35 (33.7%) cases of mortality, majority (34) being among residents [14]. The delay of response to outbreak despite the clearly evocative symptoms of the index case, in the previous study, is explained by the level of alertness to COVID-19 as the pandemic was in its first days in the US. A complementary study on the case confirmed that symptom-based screening results in poor detection rates in COVID-19, as 27% of the positively screened residents were asymptomatic on the date of testing, and not all developed symptoms seven days after being tested. Authors concluded the necessity of screening and isolating all residents once a case is confirmed [24]. Another study reported the spread of COVID-19 in an assisted living community in Seattle, US, following the admission of two new residents with confirmed SARS-COV2 infection on March 5th. Sixty-five new persons tested positive 5 and or 12 days later, including 62 staff members [25].

Outbreaks in long-term facilities

Generally, long-term care facilities are at high risk for various respiratory and non-respiratory, viral or bacterial outbreaks. These were thoroughly studied and reviewed in literature to identify efficacious prevention and management strategies. Airborne infections are the most commonly reported outbreaks in long-term care facilities and are due to various viruses [26]. The most prevalent experience is that with influenza virus or seasonal flu, which provided valuables teachings for the preventive and control strategies against SARS-COV2, notably non-pharmacological measures. By comparison, the same principles are applied for the case of COVID-19, while leveling-up with SARS-COV2 infectivity and by considering the fact that no effective treatment or vaccine is available to date. A systematic review evaluated both pharmacological and non-pharmacological preventive and control measures of influenza outbreak in elderly long-term facilities. It evidenced that implementing personal protective equipment and social distancing measures combined with hand hygiene and droplet precautions were implemented in 32–38% cases of influenza outbreaks and was associated with nearly 25% reduction in influenza attack rate compared to no intervention. However, the use of antiviral drugs, notably 2 combined drugs, was associated with greater efficacy. Further, the study reported that only 23% of the participating facilities had a policy-defined epidemic threshold, and the definitions were discrepant across these facilities [27]. Although this discrepancy may not apply for COVID-19, given the globally declared state of emergency, such observation stress the necessity for standardized recommendation to enable rapid recognition and timely management of such infectious threats within the long-term care institutions.

Other more or less common viral infections causing respiratory tract infection or variable severity were reported in long-term facilities, such as adenovirus, rhinovirus and human metapneumovirus, which were responsible for up to 33% fatality rate among contaminated residents [28–30]. Such uncommon infections question the reliability of clinically-based diagnosis and stress the urgent need for rapid molecular testing methods for decision making, awaiting laboratory confirmation.

Besides respiratory infections, foodborne and waterborne infections, such as *salmonella* and norovirus infections, disseminate rapidly in long-term care facilities and may result in heavy morbidity and mortality among the hospitalized patients. Similar to airborne outbreaks, the management of foodborne outbreak involves restricting movements within the facility for patients, visitors and staff, and rigorous environmental cleaning and disinfection. Further to appropriate control of food preparation, prevention strategies emphasize the importance of staff training for the early detection of suspect cases [31]. Although uncommon, long-term care facilities are also exposed to bloodborne outbreaks. This was the case of a hepatitis B virus outbreak in a psychiatric long-term institution, where cross-contamination with podiatrist instruments was incriminated [32].

These observations highlight the vulnerability of long-term care facilities' residents to all infectious agents and emphasize the responsibility of the healthcare staffs to implement efficacious preventive and control strategies to protect the residents from such deadly risks.

Efficacy and limitations of personal protective equipment (PPE)

On 19 March 2020, WHO issued paper recommending rational use of PPE for COVID-19. According to the available evidence, the paper established SARS-COV2 transmission by close contact and droplets, but denied airborne dissemination. Further, the paper has highlighted disruption in supply chain of PPE due to global crisis, recommending rational use of the resource. Despite these factors, the wear of medical mask, notably N95 or FFP2 masks, and eye protection using goggles or face shield were recommended when caring for COVID-19 patients, as part of the protection equipment [33]. Further, there was controversy regarding the usefulness of medical mask use among non-contaminated people and its efficacy in preventing COVID-19 transmission compared to N95 or FFP2 respirators. However, a meta-analysis of 4 randomized controlled trials showed that medical mask was comparable to that of N95 respirator in term of prevention against the transmission of coronaviruses and number of other airborne viruses such as adenovirus, influenza A and B, human metapneumovirus, etc. [34]. Ever since, the use of standard medical masks was recognized efficacious and adapted among protective measures both in exposed professionals and the general population [35,36].

In the present case, the primary contact *RT-S* has defaulted on PPE, as he was not wearing his face shield while providing respiratory therapy session and taking tracheal samples from the index patient. On the other, the second respiratory therapist *RT-J*, who was assumed to be identified as community-acquired case (from supermarket), could potentially have been infected by his peer *RT-S* inside or outside the facility. Consequently, wearing the face shield would have prevented the transmission to 2 out of the 8 confirmed cases. Regarding the other cases, non-detection of further defaulting behaviors does not exclude their existence, as the responses of the staff to the investigation may be affected by social desirability bias. With regards to social distancing measures, no incompliance was detected in our institution; however, the staff movement between the buildings could have been restricted. Similar limitations were reported in the American case studies, where staff members were not familiar with PPE, which resulted in their low adherence to the protocol. Further, authors noted lack of PPE supply and alcohol-based sanitizer [21], a matter which was not present in our case. Besides, these easily detectable behaviors, incompliance associated with minor malpractice might constitute the actual weak link for the prevention and protection strategy; as this is more difficult to assess. An example is touching the face mask with the hand, rubbing the eyes, etc., which may be associated to inadequate familiarity with the equipment or lack of awareness. This highlights the importance and need for continuous awareness raising and training regarding best practice among the healthcare workers.

Efficacy and limitations of contact tracing

Regarding exposure and contact tracing, it is difficult to evaluate the efficacy of the strategy and the compliance with the protocol, since it relies on subjective interviews. One of the indicators of implementation could be the proportion of staff members and patients who were interviewed and tested. In the present case, all staff members and residents of the index case building were interviewed and tested, regardless of their exposure. However, results were not timely available in 5 out of 200 staff members and 29 out of 107 tested residents, which might potentially delay contact tracing and screening. Of the positive cases, notably those considered as secondary contacts, the established epidemiological links are presumptive and were based on the reliability of the contact tracing interviews. The other probability is the existence of other sources, either false negative, asymptomatic staff members or community-contaminated ones. Previous researchers acknowledged that adequate interviewing and testing of all staff members and residents may be challenging, thus limiting the efficacy of the strategy, notably in case of limited access to screening [21].

Efficacy and limitations of systematic testing

Early during the pandemic, WHO recommendations stressed the importance of combining social distancing and contact tracing measures with rapid diagnosis to immediately isolate other cases and expand tracing and precautionary self-isolation of close contacts. As such, the rt-PCR was acknowledged as the golden standard method enabling rapid results and was globally adopted. However, due to limitation in diagnostic performance of rt-PCR, yielding false negative results, virus dissemination by the undiagnosed cases represents a major threat, especially in close communities like long-term care facilities [37–41]. False negatives may be due to several factors that impact the performance of the assay including genetic diversity and rapid evolution of SARS-COV2, sample type and anatomic site (sputum, nasal/throat swab, bronchoalveolar fluid), technical issues such as inappropriate collection, transportation or handling, and viral load. Therefore, results should be interpreted in combination of the epidemiological and clinical data, and repeat tests are often necessary both to detect eventual seroCOnversion and to cover for false negativity [25,41,42].

Conclusion and recommendations

The present case study exposes the experience and outcomes of a COVID-19 outbreak in a long-term facility in Jeddah, Saudi Arabia, which occurred after admission of a new resident despite high baseline level of alertness represented by systematic isolation and screening of all newly admitted residents. The outcomes were favorable including low virus dissemination among both staff member and residents and absence of mortality, and none of the cases was symptomatic on the day of testing. Nevertheless, assessment and analysis of the efficacy and weak leaks of the strategy identified default on use of personal protective equipment among

one staff member, along with probably insufficient inter-building movement restriction measures leading to dissemination of the outbreak to another building. These factors are to be combined to the limitation of the testing assays that may increase silent virus dissemination, especially in close communities like long-term care facilities. Given these limitations, we emphasize the importance and urgent need for continuous awareness raising and training, among the healthcare workers, regarding best practices in self- and patients' protection. Psychological support should also be considered as it may hinder staff adherence to the safety and prevention guidelines and impact their self-efficacy.

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Competing interests

None declared.

Ethical approval

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