

National Weekly SARS-CoV-2 RT-PCR Screening of All Workers in Long-Term Care Facilities Associated with Decrease in Resident Mortality Rate

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Keywords

Long-term care facilities · SARS-CoV-2 reverse transcription polymerase chain reaction · Screening · Health care workers · Mortality

Abstract

Introduction: Outbreaks of COVID-19 in long-term care facilities (LTCFs) have resulted mainly from disease transmission by asymptomatic health care workers. This study examines whether routine screening tests carried out on health care workers can help in reducing COVID-19 outbreaks, morbidity, and mortality of LTCF residents. **Methods:** The study followed a weekly, nationwide, government-funded screening program of LTCF personnel for SARS-CoV-2, by using reverse transcription polymerase chain reaction as the main testing technology. It included all residents and employees in Israeli LTCFs who were screened weekly during the second wave of COVID-19, during the period of time between July 13, 2020, and November 21, 2020. **Results:** During the study period, 1,107 LTCFs were screened on a

weekly basis, including 62,159 HCWs and 100,046 residents. The program screened a median of 55,282 (range 16,249, min 45,910, max 62,159) employees per week, 0.05–1.5% of which were positive for SARS-CoV-2. LTCF mortality in the first wave accounted for 45.3% of all COVID-19 deaths recorded nationally (252 of 556), and in the second wave, this ratio was reduced to 30.3% (709 of 2,337) representing a reduction of 33.8% in expected mortality ($p < 0.001$). A significant reduction was detected also in hospitalization rate (13.59 vs. 11.41%, $p < 0.001$) and elder (≥ 75 years old) mortality rate (52.89 vs. 41.42%, $p < 0.001$). 214 outbreaks in the second wave were avoided by early identification of SARS-CoV-2 positive HCWs and successful prevention of subsequent infections in the facility. **Conclusion:** Routine weekly SARS-CoV-2 RT-PCR testing of LTCF employees was associated with reduced national LTCF residents' hospitalizations and mortality rate.

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Published by S. Karger AG, Basel

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Introduction

The global spread of coronavirus infectious disease (COVID-19) has taken its toll on the elderly, and especially on residents of long-term care facilities (LTCFs). COVID-19 outbreaks and mortality in LTCFs account for 30–80% of all COVID-19-related mortality in many western countries and these catastrophic events have driven up the total case-fatality rate worldwide [1–3]. LTCF residents are both elderly and have multiple comorbidities, including a high prevalence of cognitive impairment, making it challenging to appropriately apply measures to prevent infections. Moreover, most LTCFs are overcrowded and poorly prepared to implement infection control policies due to a shortage of staff and personal protective equipment (PPE), and a relatively low level of health care workers' (HCWs) training [4–7]. These factors make LTCFs extremely vulnerable to deadly COVID-19 outbreaks [8, 9].

During the first wave of the epidemic, Israel, which is, in effect, almost completely isolated from surrounding countries, reacted with a prompt and complete travel ban to and from all countries, together with a prolonged quarantine for returning citizens and an early lockdown. This quick response resulted in relatively low COVID-19 morbidity in the first wave, with a maximum weekly average incidence of 5.4/100,000 and a low mortality rate of 30.9/1,000,000 (compared to 95/100,000 and 110/1,000,000, respectively, in European Union [EU] countries). Nevertheless, LTCF mortality at the peak of the wave accounted for 52.4% of total national deaths [10]. Consequently, in mid-April 2020, public pressure and expert opinion led the government to establish a dedicated national task force to protect LTCF residents from COVID-19. This task force – “Senior Shield” (“Magen Avot Ve’Imahot”) – is a governmental agency tasked with the responsibility of managing the COVID-19 crisis in all LTCFs in Israel [11]. Unfortunately, a too-rapid return to normal life led to substantial spread of COVID-19 and a huge second wave of infection, starting in August 2020, reached a peak in September–October 2020 with a weekly average incidence of 800/100,000 new positive cases and 15% of SARS-CoV-2 RT-PCR tests being positive.

Israel was not the only country facing these high mortality rates in LTCFs. According to Ioannidis et al. [12], similar LTCF mortality rates were calculated for 11 other OECD countries, ranging between 28.4% in Australia and 85.1% in Canada. Up until November 2020, there were no clear international and/or professional guidelines on how to test and screen LTCFs residents and workers [13, 14].

Daly et al. [15] examined the policies of five European welfare states – Denmark, Germany, England, Italy, and Spain – and showed that although they were very diverse, all of them prioritized the hospitals during the first COVID wave, due to the uncertainty of the pandemic. The USA reported similar policies of “abandoning” the nursing homes [16]. In this situation of uncertainty and lack of information, Israel decided to launch the “Senior Shield” LTCF screening program in mid-July 2020 which included routine weekly RT-PCR testing for SARS-CoV-2 in all LTCF workers. This report presents the results of this nationwide program to reduce the burden of COVID-19 in LTCFs.

Materials and Methods

Study Design and Participants

This study included all residents and HCWs in Israeli LTCFs who were screened weekly during the second wave of COVID-19, which occurred between July 13, 2020, and November 21, 2020. We compared COVID-19 morbidity and mortality of LTCF residents before and after the implementation of a weekly, nationwide, government-funded screening of LTCF personnel for SARS-CoV-2, starting July 13, 2020, and using reverse transcription polymerase chain reaction (RT-PCR) as the main testing technology.

LTCFs across Israel encompass a broad range of types of institutions ranging from home-like facilities to those providing specialized medical care. These facilities include long-term care hospitals, skilled nursing facilities, nursing homes, residential homes, hostels for people with disabilities, palliative care centers, and rehabilitation centers. The wards are categorized based on the physical and cognitive function of their residents: independent, semi-independent, cognitively frail, frail, requiring simple nursing care, and requiring skilled nursing care. Independent residents are patients who are cognitively competent and do not need help with ADL. Semi-independent residents require some assistance due to disabilities. Frail patients are cognitively impaired and are either independent or need help with ADL. Patients requiring nursing care, skilled nursing care, and/or psychogeriatric care are patients who are cognitively impaired, need significant help with ADL, and need constant medical observation and monitoring.

Definitions

We defined an “outbreak event” as a situation where at least one resident in a LTCF was positive for SARS-CoV-2 in RT-PCR, and an “avoided outbreak event” as one where a single employee of a LTCF was discovered to be positive in the screening test but, in the subsequent 2 weeks of comprehensive LTCF testing, no resident was infected. “Decreased size outbreak event” was defined as an event where no more than 5 residents were infected in the 2 weeks following a SARS-CoV-2 positive result for a facility employee by the screening program.

Procedures

The Israeli Emergency Medical Services (“Magen David Adom”) screened each LTCF in Israel on a preset weekday. How-

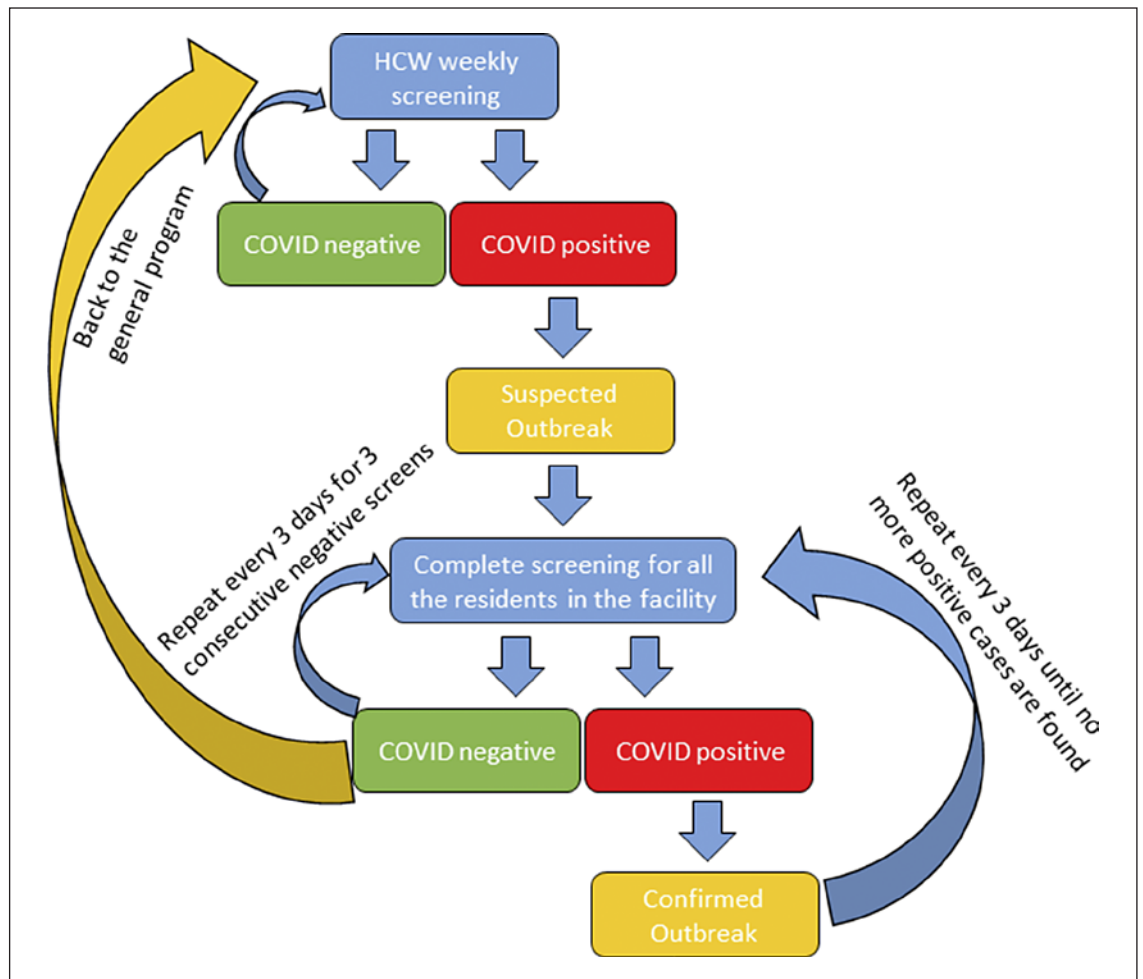


Fig. 1. Flowchart: Operational Testing Program. This chart demonstrates the general algorithm of the screening program. Further details on the program and the algorithm can be found in the online supplementary material. HCW, health care workers.

ever, the decision as to which workers would be included and screened weekly was given to the medical director and LTCF manager. Legally in Israel there is no way to enforce compliance with testing.

The specimens were transferred directly to a single RT-PCR laboratory (operated by a private company called “My Heritage”) that was dedicated to this project. The test results were reported directly to the LTCF medical directors and to “Senior Shield” headquarters within 24 h. When an employee was identified as positive for SARS-CoV-2, an outbreak response plan was activated immediately by the “Senior Shield” headquarters in collaboration with the National Infection Control Team, under the local supervision of the Ministry of Health public health and the Ministry district geriatrician. The employee was quarantined and all of his colleagues with whom he had been in contact, as well as exposed LTCF residents, were screened within 24 h and subsequently every 3 days in order to detect other asymptomatic carriers. This screening cycle was continued until all employees and residents were

negative for three consecutive tests (Fig. 1). Asymptomatic residents were quarantined in special COVID-19 wards within the LTCF or transferred to dedicated COVID-19 wards in other geriatric facilities. Symptomatic residents were admitted to a COVID-19 ward in general hospitals (see online suppl. File for detailed description of “Senior Shield” program; for all online suppl. material, see www.karger.com/doi/10.1159/000529029).

Statistics Database

We collected data on LTCF residents and HCWs who were diagnosed during the period of the first wave of COVID-19, between March 1, 2020, and July 13, 2020, and to the end of the second wave at November 21, 2020. The data were aggregated to a weekly sum of the number of SARS-CoV-2 RT-PCR tests, infected residents and HCWs, and resident mortality and hospitalization. The Israeli COVID-19 demographic statistics were taken from the Ministry of Health COVID-19 database during the periods mentioned.

Table 1. The subdivision of LTCFs in Israel

Type of residents:	Responsible ministry			Total	
	Ministry of Health	Ministry of Social Services and Social Affairs			
	requiring nursing care, skilled nursing care and/or psychogeriatric care	frail	independent	people with disabilities	
Facilities	315	111	293	388	1,107
Residents	33,424	5,200	41,696	19,726	100,046
Workers	30,363	4,658	11,540	15,598	62,159

LTCF, long-term care facility; ADL, activities of daily living.

Statistical Analysis

We compared the proportion of positive SARS-CoV-2 RT-PCR tests, hospitalizations, overall national mortality, and mortality in LTCF residents over age 75, before and during the implementation of the national program. Variables are described with numbers and percentages. In addition, comparisons between the two time periods are presented by *p* values. Percentages are rounded to one decimal place. Study variables were tested using Pearson's χ^2 test for contingency tables or Fisher Exact test, as appropriate. Statistical analysis was performed using R-studio (RStudio Team [2020]. Rstudio: Integrated Development for R. Rstudio, PBC, Boston, MA URL <http://www.rstudio.com/>) and python 3.9 (Python Software Foundation. Python Language Reference).

Ethics

The study was determined to be exempt by the Institutional Review Board of Soroka University Medical Center and thus informed consent was not required (0429-20-SOR).

Results

The screening program incorporated all 1,107 of the relevant licensed institutions in the country, involving 100,046 residents (1.1% of Israel's population), as well as 62,159 employees (Table 1). This table describes the facilities in Israel, according to their different functions, and the numbers of residents and workers in each type of facility (in total national numbers). One hundred percent of LTCFs joined the program and the weekly average compliance of HCWs was 88.5%. The program screened a median of 55,282 (range 16,249, min 45,910, max 62,159) employees per week. The employee screening tests were positive in 0.05–1.5% of cases and were similar to the incidence of COVID-19 in the general population during the second wave. During the 19 weeks of the screening program, 2,673 asymptomatic HCWs and 3,505 residents were found to be positive for the disease.

Mortality

COVID-19 mortality rate in LTCFs was calculated as a percentage of the national COVID-19 mortality in both the first and second waves of the epidemic (Fig. 2; Table 2). LTCF mortality in the first wave accounted for 45.3% (252 of 556) of all COVID-19 deaths recorded nationally, and in the second wave, this ratio was reduced to 30.3% (709 of 2,337) representing a reduction of 33.8% in expected mortality ($p < 0.001$). Analyzing only the peaks of the waves – LTCF deaths, as a proportion of total national deaths, reached 51.2% (60 of 117) at the crest of the first wave compared to 31.4% (233 of 742), at the crest of the second wave which signifies a reduction of 38.6% in expected mortality ($p < 0.001$). Additionally, Figure 2 demonstrates that this decrease started 2 weeks after the implementation of the screening program by the end of July 2020.

Outbreaks, Decreased Sized Outbreaks, and Avoided Outbreaks

During the screening period, 912 outbreak events were identified compared to only 235 outbreaks in the first wave. Out of these outbreaks, 20.4% in the first wave (48 of 235) were defined as decreased sized outbreaks, compared to 82.8% (755 of 912) in the second wave ($p < 0.001$). Furthermore, there were 214 cases of avoided outbreaks in which the early identification of SARS-CoV-2 positive HCWs prevented subsequent infections in the facility.

Discussion

This paper describes a national program of periodic universal LTCF staff screening for SARS-CoV-2. Our analysis indicates that implementation of such a weekly screening program for LTCF employees is associated with a substantial reduction in the mortality ratio of

Table 2. COVID-19 mortality and hospitalizations in LTCFs population

	Pre-national program implementation (March 1 – July 12; 19 weeks)	During national program implementation (July 13 – November 21; 19 weeks)	<i>p</i> value
Mortality:			<0.001
LTCF	252	709	
Total national (%)	556 (45.3)	2,337 (30.3)	
Hospitalizations in general hospitals:			<0.001
LTCF	2,010	4,224	
Total national (%)	14,790 (13.59)	36,991 (11.41)	
Elder mortality (≥75 years old):			<0.001
LTCF	201	616	
Total national (%)	380 (52.89)	1,487 (41.42)	
Outbreaks:			<0.001
Total	235	912	
Decreased sized outbreaks (%)	48 (20.4)	755 (82.8)	
Avoided outbreaks (%)	N/A	214 (23.5)	

LTCF, long-term care facility.

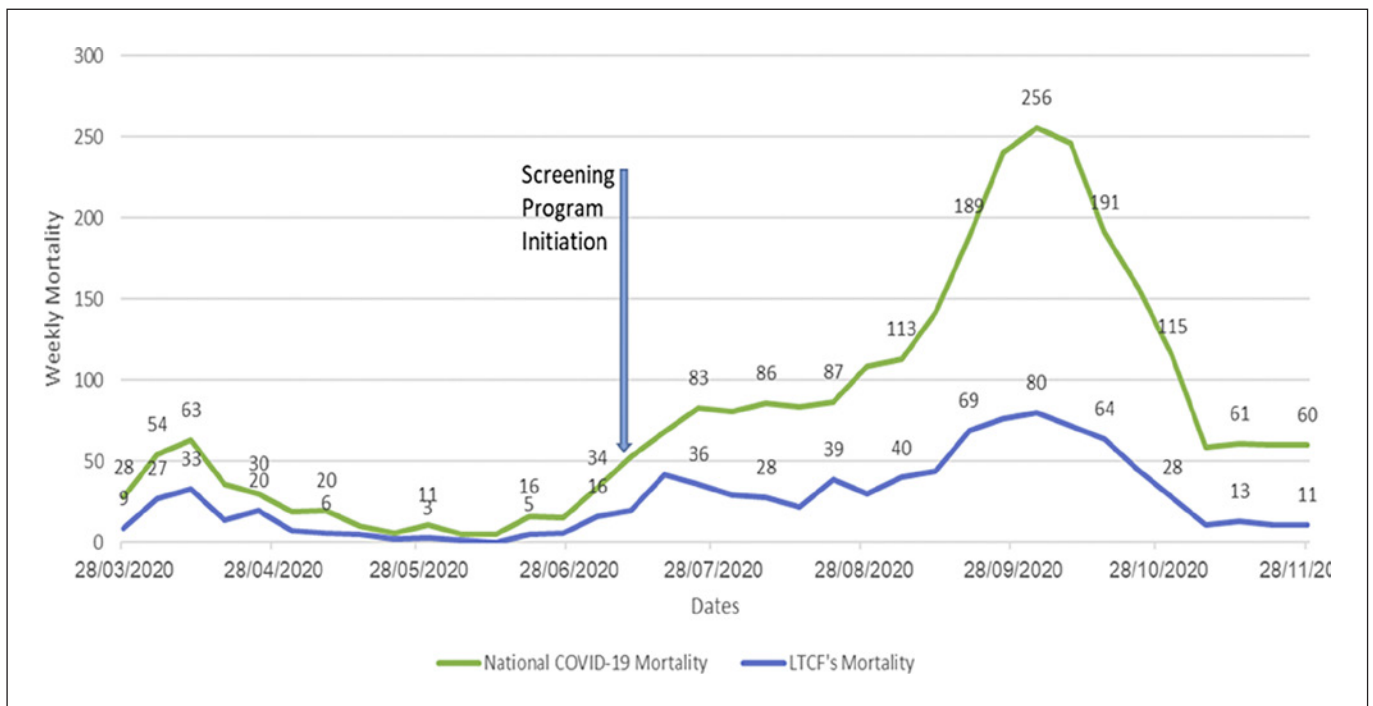


Fig. 2. National COVID mortality versus LTCF's COVID mortality. This graph demonstrates actual weekly COVID mortality during the study period. National COVID mortality is depicted by the green line, and LTCF COVID mortality is depicted by the blue line. LTCF, long-term care facility.

LTCF's population in the second wave compared to the first wave.

During the COVID-19 pandemic, LTCFs have been a major source of devastating outbreaks in many countries accompanied by high mortality and morbidity, causing a consequential load on national health systems [1, 2]. Root-cause analysis of LTCF outbreaks identified that COVID-19 prevalence in the community is the main factor that is directly associated with the likelihood of COVID-19 entering the facility [10, 17–21]. Accordingly, this program involves primary prevention of outbreak events by identifying asymptomatic HCWs and potentially preventing the outbreak entirely. Additionally, it includes a second line of defense in case of identifying an individual infected with SARS-CoV-2 – immediately activating the screening of all residents and employees, which enables the containment of the outbreak and the limitation of its spread. As mentioned, the RT-PCR test results were reported directly to the LTCF medical directors, within 24 h, and the response was immediately implemented out by the Senior Shield program headquarters, which stood by ready to take action at any time, 24 h a day, 7 days a week [22].

It should be noted that eight other countries demonstrated decreased LTCF mortality rate in the second wave – Belgium, Canada, Finland, France, Germany, Sweden, the UK, and the USA [12]. However, three of them (Belgium, Finland, and the UK) did not count in-hospital deaths of LTCF residents as nursing home deaths, and the rest (Canada, France, Sweden, and the USA) reported total counts of LTCF deaths that were not necessarily confirmed COVID-19 cases. When further examining these countries' policies for LTCFs: Belgium reports no specific policy and no significant change in mortality rate [23]; Canada and the UK implemented a similar screening program for LTCF workers that resulted in similar reductions in mortality rate and hospitalizations as the Israeli program [24, 25]; Finland and Germany did not have any screening programs, but had a strict lockdown and a comprehensive national prevention plan dedicated for LTCFs [26, 27]; France reported a lack of infection control and medical care management in some of the nursing homes in the first wave [28]; Sweden changed the defining documentation of LTCF deaths in the second wave and eventually reported excess mortality [29]; and in the USA, there was no specific federal policy for LTCFs. Although all western countries reported some changes in awareness, prevention strategies and availability of PPE in LTCFs in the second wave, other countries, such as Australia, Denmark, and Norway, showed an increase in their LTCF resident mortality rate [12].

Evaluation of international ability to defend the LTCF residents from COVID-19 mortality is a challenging task due to differences in the number of LTCF beds per population. Israel's population is significantly younger than other western countries (only 11.2% of Israel's population are older than 65 years old compared to the Organization for Economic Cooperation and Development [OECD] average of 18.3% and 16.5% in the USA) and the number of LTCF residents per million is lower than in most OECD countries [14, 30]. Nevertheless, an ECDC report showed that general mortality in the LTCF sector seems to be directly correlated with the prevalence of COVID-19 in the country [31]. However, according to this report, even though Israel had a high prevalence of COVID-19 cases, there was very low LTCF mortality per 1,000 beds. Given that access to health care in Israel is generally similar across the country, as well as the quality of medical services and treatments offered to COVID-19 patients, the decrease in LTCF residents mortality rate in the second wave, compared to the first wave, can be explained by the execution of the LTCF screening program.

During the COVID-19 pandemic, the Israeli Ministry of Health defined the national “red line capacity” level of Israel hospital system to be no more than 800 patients hospitalized with severe COVID-19. During the peak of the second wave, Israel crossed this red line and had 898 such patients. The activation of this program, with the reduction in LTCF outbreak events and the associated decrease in morbidity and acute hospitalizations, significantly contributed to preventing the national public hospital system from being overwhelmed during the second wave (Table 2). Our experience with this screening program indicated an ability to offer a sustained reduction in overall outbreaks up to a certain level of community spread of COVID-19. However, when the test positivity rate increased above 5%, and above a weekly incidence rate of 240 per million in the Israeli population, a bi-weekly screening was needed in order to better prevent outbreaks. However, the request to double the number of RT-PCR tests allocated to Senior Shield program was denied by the Ministry of health due to the shortage in national laboratories.

Before starting the program, there were three main concerns: first, HCWs with negative SARS-CoV-2 test results would weaken their compliance with the use of face-masks and would not follow mandatory hygiene procedures. Second, the ability to oblige LTCFs to join the program and the HCWs to undergo repeated weekly testing was weak. Interestingly, we noticed that the staff's accep-

tance of screening as an effective way of protecting the LTCF's residents resolved this issue rapidly. It was demonstrated by the 100% compliance of facilities in joining the program and the adherence of managers to screening more than 90% of their workers every week. Third, given Israel's strict medical confidentiality laws, there were legal obstacles to transferring the employee's medical information (SARS-CoV-2 test results) to their direct administrative manager. We were able to resolve this issue by permitting the results to be transferred to the LTCF's medical director.

This report has some limitations. Bear in mind that this was and continues to be a real-life pandemic situation with all of the confusion and uncertainty engendered by such crises. As such, it took 1 month from initiating the system to reaching full coverage of all LTCFs. Therefore, the results are not as precise as they should be in a well-designed study. Furthermore, there was a revolution between the first and second waves in regard to access to tests and PPE – which was scarce in the first wave and the supply was more generous in the second wave. This may have changed the clinical outcome between the waves. Nevertheless, it should be noted that lockdown restrictions were similar in both the first and second COVID waves, including the complete shutdown of all public spaces (e.g., schools, restaurants, synagogues, etc.), distance restrictions on travel and leaving private houses, mandatory mask wearing and almost no visits to LTCFs. The similarity in the restriction policies between the first and the second waves supports the conclusion that the reduction in mortality rate cannot be explained by looser restrictions on the general public compared to LTCF residents.

Another factor that may cause bias in the results between the waves was the access to specific medications. For example, during the second wave, the use of corticosteroids was more common due to accumulating evidence on their effectiveness. Clinical approaches, such as intubation time and strategies of hypoxemia rescue and mechanical ventilation, were adjusted as well. However, these modifications altered clinical outcome nationwide and not only in the LTCF sector. Thus, the dramatic differences in LTCF resident mortality and morbidity in the two waves, which started 2 weeks after the implementation of the screening program and continued throughout the second wave – strengthens our impression that such a national or local screening program is effective in reducing morbidity and mortality in this especially vulnerable group of older persons.

Conclusion

In this study, we found that by using weekly RT-PCR testing of all employees we were able to protect the LTCF system from outbreaks. Although immunization of LTCF residents and HCW is the ultimate goal in preventing further SARS-CoV-2 infection, our research suggests an effective method of protecting LTCF against future outbreaks caused by seasonal respiratory pathogens. This study also emphasizes the importance of centralized management of COVID-19 pandemic in LTCFs [32]. We conclude that adopting a program of routine employee screening may reduce LTCF resident mortality and morbidity and may help prevent national health systems from being overwhelmed.

Statement of Ethics

The study was approved by the Institutional Ethics Committee (Soroka Medical Center Ethics committee approval number 0429-20-SOR).

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions

Victor Novack, Nimrod Maimon: supervision; Nimrod Maimon: conceived the idea and directed the project; Michal Maimon: developed the framework and conceptual design; Lior Hassan and Victor Novack: contributed to the methods design and statistical analysis of results. Sivan Goldin, Limor Gortzak Uzan, and Itamar Grotto: contributed by collecting the data and describing the scope of Senior Shield project (as described in the online suppl. material). Yasmeen Abu-Fraiha and Shahar Geva Robinson drafted the manuscript, designed the figures, and revised and finalized the paper. All authors discussed the results and commented on the manuscript.

Data Availability Statement

Publicly available datasets were used in this study. These can be found in the Israeli Ministry of Health dashboard (Hebrew): https://datadashboard.health.gov.il/COVID-19/general?utm_source=go.gov.il&utm_medium=referral.

A preprint version of this article is available on Research Square: Maimon N, Maimon M, Hassan L, et al. The Effect of National Weekly COVID-19 Screening Testing of All Workers in Long-Term Care Facilities: a Decrease in Mortality. DOI 10.21203/

rs.3.rs-153758/v1. Research Square (preprint). Version 1, Feb 02, 2021. Further inquiries can be directed to the corresponding author.

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