Crises in care for older adults

Implementation and evaluation of intermediate care and SARS-CoV-2 infection prevention

van den Besselaar, J.H.

Publication date
2022

Document Version
Final published version

Crises in Care for Older Adults

Implementation and evaluation of intermediate care and SARS-CoV-2 infection prevention

Judith van den Besselaar

Crises in Care for Older Adults: implementation and evaluation of intermediate care and SARS-CoV-2 infection prevention

Judith Henriëtte van den Besselaar

Crises in Care for Older Adults

Implementation and evaluation of intermediate care and SARS-CoV-2 infection prevention

Colofon

Promotores:

prof. dr. B.M. Buurman-van Es, Universiteit van Amsterdam

prof. dr. C.M.P.M. Hertogh, Vrije Universiteit Amsterdam

Copromotor:

dr. J.L. MacNeil-Vroomen, Universiteit van Amsterdam

Overige leden:

prof. dr. M.C. de Bruijne, Vrije Universiteit Amsterdam

prof. dr. S.E. Geerlings, Universiteit van Amsterdam

prof. dr. D.J.A. Janssen, Universiteit Maastricht

prof. dr. M.D. de Jong, Universiteit van Amsterdam

prof. dr. H.L.G.R. Nies, Vrije Universiteit Amsterdam

dr. H.C. Willems, Universiteit van Amsterdam

Table of contents

1

General introduction

General Introduction

My grandparents moved to an apartment next to an assisted living facility (ALF) in 2002. My grandfather had fallen down the stairs in their previous house so they wanted to live in a safer place and be closer to care. The building of my grandparents' new apartment was connected to the ALF and they had pull cords in their home that they could use in case of emergency. My grandfather continued to fall multiple times; however, care came quickly to help them. They also could join social activities of the ALF and had the possibility to eat dinner in the common dining room. My grandfather happily lived there for two years before he died. My grandmother would occasionally sigh in relief remarking, "I am so happy we moved out of our big house with stairs to this nice place". However, the 2015 Dutch Long-term Care Reforms caused the ALF next door changed in a facility for persons with an intellectual disability. At the age of 91, my grandmother lost the facilities which made her feel safe. The emergency pull-cords were replaced by a button from a home care agency. If she pushed this button, a home care representative would call her, instead of a nurse who would have previously come by from the ALF. My family noticed that my grandmother in 2018 was quickly going downhill however she did not want to go to the hospital anymore and wanted to die in her own house with her family. The general practitioner did not know how to arrange palliative care in her own home and home care could only stop by a few times a day. The nurses that used to be next door who could have taken care of her in her last days were long gone… My mother, who was a nurse, took care of her. I was a doctor in training and between the two of us we tried our best and navigated through my grandmother's care crisis. She passed away in the summer of 2018.

According to the Oxford Dictionary, crisis is a time of great danger, difficulty or uncertainty when problems must be solved or important decisions must be made. From my personal and clinical experience and during my research projects of the last years it became clear to me the role crisis plays in care for our population, specifically for older adults. Crisis can occur at the individual level, but also at a societal level. For an older adult a crisis can be a broken hip, a delirium, but also progressing functional decline or the lack of a support system. At the moment, the healthcare system of Western countries is in crisis because of the increasing need for healthcare: the number of people aged 65 or over is projected to rise by 41% in the next 30 years in Europe.[1] With an increase in age, the prevalence of disability and the need for long term care increase. On the other hand, there has been a change of vision on care. The responsibility of an individual is emphasized and formal care is only addressed when informal care is not available or possible (any more). Intermediate care was created to address a care gap for older adults and to prevent a care crisis.

On top of the increasing demand for care for older adults, society has been dealing with the SARS-CoV-2 pandemic for the past several years. Our healthcare facilities and specifically nursing homes were in a state of crisis to prevent the spread of SARS-CoV-2 and to protect their residents, staff and society. To prevent spread of the virus in society, lockdown measures were taken with hypothesized risks for mental health.

This thesis is based on the implementation and evaluation of intermediate care in the Netherlands and implementation and evaluation of measures to prevent spread of SARS-CoV-2 in older adults.

Long term care reforms and rise intermediate care

Global ageing is one of the most controversial subjects facing the world. Is it a "Looming crisis or a booming opportunity?" This is how the discussion is currently framed for example at the World Economic Forum.[2] In Europe, ageing has been met with a trend to reform long-term care (LTC) for older adults from residential care to community care[3] in a way to address what is viewed by some as a financial care crisis.[2] Community care entails more home- and community-based care. Residential care facilities have been reduced over the past 25 years as result of policies aiming for deinstitutionalisation, which has increased the burden on community- and hospital-based care.[3] Because more older adults are living longer in the community, they are more at risk for a hospital admission in case of disease or crisis. In order to enable older adults to live independently, several countries implemented intermediate care for prevention- and rehabilitation strategies.[4-6] Intermediate care is defined by an international panel as a broad range of time-limited services, from crisis response to support for several weeks or months, that aim to ensure continuity and quality of care and promote recovery at the interface between hospital and home, care home, primary care and community services.[7] The goal of intermediate care is to enable recovery, restore independence and confidence, or prevent a decline in functional ability at times of change in health. Intermediate care can be provided at a facility, as ongoing outpatient therapy, or at home.

In 2015 the Dutch government reorganized the health care system because of rising health care expenses with a shift to non-residential settings.[8] Stricter criteria were set for admission to LTC in nursing homes. Nursing homes now only admit older adults who require care 24 hours per day. Residential care homes that looked after older adults for support in Activities of Daily Living (ADL) and instrumental Activities of Daily Living (iADL) were either closed or converted to nursing homes, leaving these patients to live independently.[9] Closure of the residential care homes meant often that the older adults continued to live in their apartments, while the care was no longer delivered by the residential care home, but by home care agencies. Residence was separated from care. Figure 1 shows the total number of older adults of 80 years and older living

in the Netherlands and the number of older adults of 80 years and older living in a nursing home or assisted living facility from 1998 until 2021. This figure shows that the proportion of older adults of 80 years and older living in the community increased: the total number of older adults over 80 increased, while the number of older adults living in a nursing home or assisted living facility decreased. Before the healthcare reforms, both nursing homes and residential care homes in the Netherlands offered short-term care. Under the new policy, these short-term admissions were extended.

Older adults aged 80 and over in the Netherlands
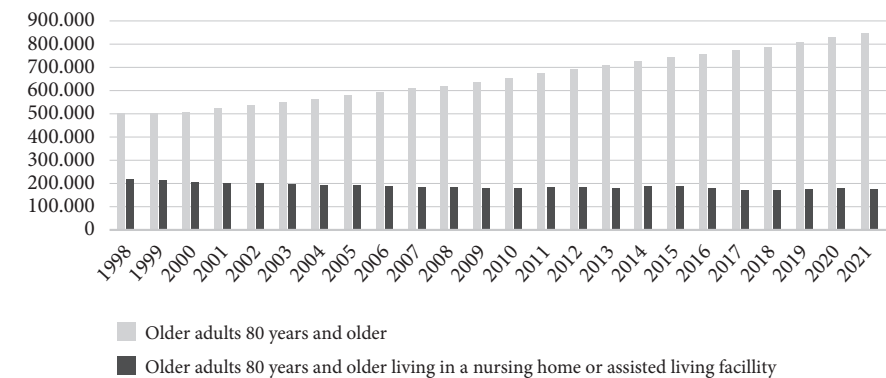
Figure 1: Older adults of 80 years and older in the Netherlands and older adult 80 years and over living in a nursing home or assisted living facility. Source: CBS kerncijfers bevolking, leeftijd, insititutioneel huishouden.

Implementation of Short-term Residential Care

There are two forms of intermediate care in the Netherlands: Geriatric Rehabilitation Care (GRC) and Short-term Residential Care (STRC). Geriatric Rehabilitation is a multidisciplinary set of evaluative, diagnostic and therapeutic interventions whose purpose is to restore functional ability or enhance residual functional capability in older people with disabling impairments.[10] It began in the 1980s with the concept of 'active treatment' in nursing homes: first for the whole nursing home, later as rehabilitation wards for older adults in nursing homes. Before, only rehabilitation centers offered rehabilitation care. Since then, GRC has developed from reablement of older adults to specialized rehabilitation.[11] The Elderly Care Physician is the responsible physician in GRC. Care pathways and guidelines are developed between the hospital and the intermediate care facility. Therapy is funded up to three hours per week for a maximum of six months. Examples of targeted groups are patients with a hip fracture or stroke.

With the reorganization of the health care system in 2015, short term admissions were no longer possible under the new Long Term Care Act (LTCA, in Dutch: Wet Langdurige Zorg, WLZ). The government wanted older adults to live as long as possible at home, with care close by. They expected that older adults would need more often short term admissions for medical problems, with the goal to return home.[12] To address this care gap, STRC (in Dutch 'Eerstelijnsverblijf') was implemented for older adults with general health problems that do not require admission to hospital for specialist care but that also cannot be treated at home. The goal was to enable older adults to return home and live independently in the community.[15] STRC can be step-up (prevent hospital or LTC admission) or step-down (the patient can be discharged from the hospital but cannot go home yet). It is also possible to admit patients for hospice care. STRC is bed-based care and often located in nursing homes. Patients can be admitted for up to three years, however the government expected that patients would be discharged within three months.[13] Unlike GRC, *no guidelines* and *no targeted patient groups* were provided for STRC.

What is clear are the payment structures. There are three different payment-structures for STRC: regular, high-complex and hospice care.[14] In STRC-regular the medical supervisor is the general practitioner (GP) and only help for activities of daily living (ADL) is provided by the nursing home. Paramedic treatment is according to the payment structure of the health insurer, as if the patient would be at home. STRC-regular is for patients who are not in need of specific paramedic treatment, but only need temporarily more care than homecare can provide. For STRC-high complex the specialist elderly care is the medical supervisor and up to 90 minutes per week of treatment is funded (physician, physical therapist, dietician, psychologist etc.). STRC-high complex is for patients who are not only in need of increased care, but also need (multidisciplinary) treatment or rehabilitation in a slower pace than in GRC. Third, STRC-hospice care is provided to patients in the last three months of their lives, the medical supervisor can be the nursing home physician or the GP. Three hours of (para)medic treatment per week is funded.

Necessary evaluation of Short-term Residential Care is required

However, the goal of STRC to support older adults in living longer independently at home is not met: in 2019, less than 50% of patients admitted to STRC returned home. Patients admitted to GRC are discharged home 80% of the time.

Limited information is available about the patients admitted to STRC facilities. Registrations show that patients are admitted from the emergency department, hospitals, or home and that the most common reasons for admission are trauma and infection. However, we do not know what happens to patients in the STRC facility or whether STRC care is adapted to the patient's needs. In-depth data about characteristics of patients admitted, how care is delivered and challenges in providing care in STRC are missing.

And then COVID hit

The first case of Corona Virus Disease 2019 (COVID-19) in the Netherlands was reported on February 28th 2020. COVID-19 is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). In the spring of 2020 there was a public health crisis with a lot of uncertainties about SARS-CoV-2: It was unclear how the virus spread, how the virus should be treated, and what the long term consequences would be. Further there were shortages of i.a. personal protective equipment, PCR-tests, and ventilation machines.

Older adults are at elevated risk for severe COVID-19 morbidity and mortality.[15, 16] Many nursing homes worldwide were hit by outbreaks of this new virus in the spring of 2020 with high case fatality rates.[17, 18] In the Netherlands over twenty thousand people died of COVID-19 in 2020: half of them were living in nursing homes.[19] To protect older adults in nursing homes and the community several infection prevention measures were implemented in the Netherlands: Nursing homes were closed for the public[20] and the government gave community-dwelling older adults additional recommendations next to the public health measures for the general population. They advised older adults against the use of public transport, not to do their own groceries and not to receive any visitors.[21]

Implementation of a new infection prevention guideline in nursing homes

Despite the closure of the nursing homes for the public, still many infections occurred. Nursing homes closed the 9th of March 2020 [20], but the peak of infections in nursing homes was at the end of April 2020.[22] In the first wave of the COVID-pandemic in 2020 the Dutch guideline for COVID-19 in nursing homes stated that only residents with possible symptoms of SARS-CoV-2 should be tested[23] and no policy for testing of asymptomatic residents or staff was facilitated in the Netherlands. However, already in April 2020 the first reports suggesting an important role for presymptomatic spread of SARS-CoV-2 among residents were published.[24-30] A presymptomatic individual does not express symptoms at the moment of testing, but will develop symptoms later. An asymptomatic individual also does not express symptoms at the moment of testing, but remains without symptoms after testing.[27]

Still, it remained unknown to which extent presymptomatic and asymptomatic cases of residents and staff contributed to the spread of SARS-CoV-2. Also, specifically in the nursing home setting, it remained unclear to what extent asymptomatic cases are truly

without symptoms. Sole reliance on symptoms for testing in nursing homes could be insufficient because self-reporting of complaints is often compromised in residents due to limited ability to communicate (e.g. in residents with dementia).[31]

The prevalence of asymptomatic staff and residents differed from single cases to up to half of the infected cases. Low cycle threshold (Ct) values were found in asymptomatic and presymptomatic cases, suggesting potential of viral shedding.[27, 30] A large registry of 857 Dutch residents with confirmed SARS-CoV-2 showed that 93% of cases expressed any of the symptoms of cough, shortness of breath, or fever. A large range of other symptoms were also reported such as fatigue, diminished intake, gastro-intestinal symptoms, malaise, or rhinorrhea.[32] However, the presentation of SARS-CoV-2 can be difficult to recognize in nursing home residents, causing delays in testing, isolation and treatment.[32, 33] In addition, during a community-wide outbreak it can be difficult to distinguish residential outbreaks from multiple introductions without sequencing of viruses from cases.[34]

Viral spread by presymptomatic or unrecognized symptomatic cases has important implications for Personal Protective Equipment (PPE) use, facility-wide testing and isolation measures in nursing homes for the prevention of outbreaks. In May 2020, the Centers for Disease Control and Prevention (CDC) recommended facility-wide testing of nursing home residents for SARS-CoV-2 if there was an outbreak in the facility. They also recommended testing residents 5–7 days after exposure to a SARS-CoV-2-positive individual even if the initial test was negative. A further recommendation was for asymptomatic healthcare personnel to be tested after exposure to a SARS-CoV-2-positive individual and to self-isolate for 14 days following the exposure.[35] Also, the European Centre for Disease Prevention and Control (ECDC) guideline recommended viral testing of all residents in nursing homes if a single new case of a SARS-CoV-2 infection is detected. Four nursing homes in the Netherlands implemented serial facility wide testing during an outbreak of SARS-CoV-2 regardless of symptoms in May 2020: this was in line with the international recommendations, instead of the current Dutch guidelines. This thesis reports on the outbreaks in these four nursing homes.

To analyze the contribution of presymptomatic spread of SARS-CoV-2 we performed serial weekly point prevalence surveys of symptoms in all staff and residents. Also, we performed sequencing of the samples to distinguish between residential outbreaks and multiple introductions from the community.

Evaluation of the new infection prevention guideline
After the first wave of the COVID-19 pandemic, presymptomatic transmission of SARS-CoV-2 had been well established[27, 30, 36, 37] and multiple nursing homes worldwide were able to keep outbreaks under control with serial testing of residents and staff.[38-44] On August 27th 2020, the national advisory board of the Dutch Government recommended unit-wide weekly testing of all individuals rather than just symptomatic individuals in nursing homes during a SARS-CoV-2 outbreak.[45] This choice for unit wide testing, instead of facility-wide testing was made, because facility wide testing very early in three outbreaks in the Netherlands identified limited new cases.[46] If multiple new cases would be detected in the unit-wide testing strategy, expanded testing of the whole facility was recommended. However, these guidelines were not implemented until November 2020 by the Elderly Care Physician Society (Verenso) and until December 2020 by the National Coordination Communicable Disease Control (Landelijk Coördinatiecentrum Infectieziekten). It is unknown whether serial testing was implemented in Dutch nursing homes and what the barriers and facilitators to testing were.

In other countries, reported barriers to facility-wide serial testing during the first wave of the pandemic include insufficient availability of tests, limited personnel, insufficient financial resources, limited public health resources such as laboratory capacity[47-50], and the discomfort of nasopharyngeal swabs.[51] In summer 2020, the availability of PCR tests and personal protective equipment (PEE) increased in the Netherlands, which eliminated some of these potential barriers.

Reported facilitators to facility-wide serial testing were collaborations with local hospitals, hospital laboratories, and local public health officials.[50, 52, 53] In a survey of nursing home staff in the US, 71.1% said regular testing was important[54], indicating that healthcare workers are willing to get tested. In addition, a systematic review reported that preparing for an outbreak can prevent or mitigate the outbreak when it happens.[55]

Evaluation of COVID measures for older adults in the community
Older adults in the community are not only at elevated risk for COVID-19 morbidity and mortality[15, 16], but also for adverse economic, social and psychological consequences related to the pandemic.[56, 57] For example, public health measures that conflict with personal freedom, contradictory messages from authorities, shortages of COVID-19 tests and personal protective equipment are hypothesized to cause emotional distress and increase risk for psychiatric illness.[58, 59] Older adults in the Netherlands were even more restricted in their personal freedom compared to younger adults by the additional recommendations of the government. Furthermore, the unexpectedness of the pandemic itself and the many consequences that seem uncontrollable by individuals,

such as cancellations of treatments and restrictions to social contacts may reduce feelings of personal control over life (mastery), which is an essential coping resource for maintaining good mental health.[60]

A meta-analysis showed that effects of lockdown on depression and anxiety were small on average but that study populations were heterogeneous.[61] Longitudinal studies which compared anxiety and depression before and during the COVID-19 pandemic showed younger age, female sex, and previous poor mental health as risk factors during the COVID-19 pandemic.[62, 63] The younger age as risk factor for negative psychological effects of the lockdown suggests older adults are possibly protected instead of at risk. At the same time, in older adults, fear for COVID-19-related morbidity and mortality could also result in increased feelings of depression and anxiety. Unfortunately, limited longitudinal data including pre-pandemic measurements of mental health focusing on older adults have been published. If we would identify older adults at risk for the development of depression, anxiety, and loss of mastery during the COVID-19 pandemic it could guide the development of preventive strategies for future restrictive measures during a pandemic. Furthermore, extending previous studies focusing on affective symptoms, we additionally examined mastery as a central indicator of control beliefs, which are strongly related to mental health and wellbeing[64], and may change as a result of the unexpected and unprecedented events occurring during the COVID-pandemic.

Aim and outline of the thesis

The overall aim of this thesis is to provide insights in the implementation and evaluation of policy for older adults in the Netherlands and relates to two types of crisis:
1. The older adult living at home with (a sudden) increase in care needs in our current health system.
2. The SARS-CoV-2 pandemic for which our health care system was poorly prepared.

Part 1 focuses on the implementation and evaluation of short-term residential care in the Netherlands. *Chapter 2* presents results from a qualitative study about 39 patient journeys of patients admitted to STRC and the experienced problems by health care professionals of 13 wards in nursing homes and hospitals providing STRC in Amsterdam. *Chapter 3* aims to triangulate the qualitative results with national survey data of 176 health care facilities providing STRC in the Netherlands and data of Statistics Netherlands (In Dutch 'Centraal Bureau voor de Statistiek').

Part 2 focuses on the implementation and evaluation of infection prevention policies for older adults during the SARS-CoV-2 pandemic. *Chapter 4*-6 describe implementation and evaluation studies in Dutch nursing homes. *Chapter 4* describes the results of testing all residents and staff during three small outbreaks of SARS-CoV-2 in three nursing homes and *Chapter 5* during one large outbreak in a fourth nursing home. *Chapter 6* evaluates the implementation of this policy on a national level with a survey of 117 nursing homes, 24 interviews and four focus groups about barriers and facilitators. *Chapter 7* evaluates the effect of lockdown measures on symptoms of depression, anxiety and feelings of mastery in older adults living in the community with the use of the Longitudinal Aging Study Amsterdam.

Chapter 8 is a general discussion of this thesis.

Reference List

1. 2021 Long-Term Care Report. Trends, challenges and opportunities in an ageing society. 1. European Commission; 2021.

2. Sethumadhavan, A, Saunders, M. Ageing: Looming crisis or booming opportunity?; 2021. https://www.weforum.org/agenda/2021/03/ageing-looming-crisis-or-booming-opportunity/. Accessed.

3. Spasova, S, Baeten, R, Coster, S, et al. Challenges in long-term care in Europe. Brussels: European Commision; 2018.

4. Young, J, Gladman, JR, Forsyth, DR, et al. The second national audit of intermediate care. Age Ageing 2015;44(2):182-184.

5. Abrahamsen, JF, Haugland, C, Nilsen, RM, et al. Three Different Outcomes in Older Community-dwelling Patients Receiving Intermediate Care in Nursing Home after Acute Hospitalization. The journal of nutrition, health & aging 2016;20(4):446-452.

6. Inzitari, M, Gual, N, Roig, T, et al. Geriatric Screening Tools to Select Older Adults Susceptible for Direct Transfer From the Emergency Department to Subacute Intermediate-Care Hospitalization. J Am Med Dir Assoc 2015;16(10):837-841.

7. Sezgin, D, O'Caoimh, R, O'Donovan, MR, et al. Defining the characteristics of intermediate care models including transitional care: an international Delphi study. Aging Clin Exp Res 2020;32(11):2399-2410.

8. Maarse, JA, Jeurissen, PP. The policy and politics of the 2015 long-term care reform in the Netherlands. Health policy (Amsterdam, Netherlands) 2016;120(3):241-245.

9. Onderzoek naar sluiting verzorgingshuizen; https://www.kcwz.nl/thema/extramuralisering/onderzoek-naar-sluiting-verzorgingshuizen. Accessed 1-12-2019 2019.

10. Boston Working Group on Improving Health Care Outcomes Through Geriatric Rehabilitation. Med Care 1997;35(6 Suppl):Js4-20.

11. Hertogh, CMPM. Functionele geriatrie: probleemgericht zorg voor chronisch zieke ouderen. Reed Business, 1999.

12. Schippers, EI. Kortdurend eerstelijns verblijf. In: Ministerie van Volksgezondheid, WeS, ed.; 2014.

13. van Rijn, MJ. Brief aan de Voorzitter van de Tweede Kamer: Eerstelijns verblijf. In: Ministerie van Volksgezondheid, WeS, ed. 647239-124137-CZ ed.; 2015.

14. Subsidieregeling eerstelijns verblijf 2016. 2016.

15. Blomaard, LC, van der Linden, CMJ, van der Bol, JM, et al. Frailty is associated with in-hospital mortality in older hospitalised COVID-19 patients in the Netherlands: the COVID-OLD study. Age Ageing 2021.

16. Kim, L, Garg, S, O'Halloran, A, et al. Risk Factors for Intensive Care Unit Admission and In-hospital Mortality Among Hospitalized Adults Identified through the US Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). Clin Infect Dis 2021;72(9):e206-e214.

17. Comas-Herrera, A, Zalakain, J, Litwin, C, et al. Mortality associated with COVID-19 outbreaks in care homes: early international evidence. International Long-Term Care Policy Network; 2020.

18. Yourish, L, Ivory, Smith. One-Third of all U.S. Coronavirus Deaths Are Nursing Home Residents or Workers. *New York Times.* 2020.

19. Ajrovic, S, Frijters, S. Ruim helft coronasterfte 2020 in verpleeghuizen, deze week minder besmettingen gemeld. *de Volkskrant.* 2021.

20. Rijksoverheid. Bezoek aan verpleeghuizen niet langer mogelijk vanwege coronavirus; 2020. https://www.rijksoverheid.nl/actueel/nieuws/2020/03/19/bezoek-aan-verpleeghuizen-niet-langer-mogelijk-vanwege-corona. Accessed.

21. Rijksoverheid. Aanvullende corona adviezen aan zelfstandig wonende ouderen; https://www.rijksoverheid.nl/documenten/rapporten/2020/10/14/aanvullende-corona-adviezen-aan-zelfstandig-wonende-ouderen. Accessed.

22. Rijksoverheid. Coronadashboard Verpleeghuiszorg Positief geteste bewoners; https://coronadashboard.rijksoverheid.nl/landelijk/verpleeghuiszorg. Accessed.

23. Behandeladvies COVID-19 Acute fase en nazorg; 2020. https://www.verenso.nl/_asset/_public/Thema-en-projecten/Infectieziekten/Covid-19/200825-15-00-COVID-19-behandel-advies-DEFINITIEF.pdf. Accessed 8-31-2020.

24. Roxby, AC, Greninger, AL, Hatfield, KM, et al. Outbreak Investigation of COVID-19 Among Residents and Staff of an Independent and Assisted Living Community for Older Adults in Seattle, Washington. JAMA Internal Medicine 2020.

25. Guery, R, Delaye, C, Brule, N, et al. Limited effectiveness of systematic screening by nasopharyngeal RT-PCR of medicalized nursing home staff after a first case of COVID-19 in a resident. Médecine et Maladies Infectieuses 2020.

26. Dora AV, WA, Jatt LP. Universal and Serial Laboratory Testing for SARS-CoV-2 at a Long-Term Care Skilled Nursing Facility for Veterans — Los Angeles, California, 2020. Morbidity and Mortality Weekly Report 2020;21(69):651-655.

27. Arons, MM, Hatfield, KM, Reddy, SC, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. New England Journal of Medicine 2020;382(22):2081-2090.

28. European Centre for Disease Prevention and Control. Surveillance of COVID-19 in long-term care facilities in the EU/EEA, 19 May 2020. Stockholm: ECDC; 2020.

29. Centers for Disease Control and Prevention (CDC). Testing Guidelines for Nursing Homes. Interim SARS-CoV-2 Testing Guidelines for Nursing Home Residents and Healthcare Personnel. Centre for Disease Control and Prevention 2020.

30. Kimball, A, Hatfield, KM, Arons, M. Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020. MMWR Morb Mortal Wkly Rep 2020;(69):377-381.

31. Huffman, JC, Kunik, ME. Assessment and Understanding of Pain in Patients With Dementia. The Gerontologist 2000;40(5):574-581.

32. Rutten, JJS, van Loon, SM, Joling, KJ, et al. Covid-19 in verpleeghuizen. Ned Tijdschr Geneesk 2020;164.

33. D'Adamo, H, Yoshikawa, T, Ouslander, JG. Coronavirus disease 2019 in geriatrics and long-term care: the ABCDs of COVID-19. Journal of the American Geriatrics Society 2020;68(5):912-917.

34. Voeten, HA, Sikkema, RS, Damen, M, et al. Unravelling the modes of transmission of SARS-CoV-2 during a nursing home outbreak: looking beyond the church super-spread event. PREPRINT available at Research Square 2020.

35. Interim Guidance on Testing Healthcare Personnel for SARS-CoV-2; https://www.cdc.gov/coronavirus/2019-ncov/hcp/testing-healthcare-personnel.html. Accessed 6-24-2021.

36. Goldberg, SA, Lennerz, J, Klompas, M, et al. Presymptomatic Transmission of Severe Acute Respiratory Syndrome Coronavirus 2 Among Residents and Staff at a Skilled Nursing Facility: Results of Real-time Polymerase Chain Reaction and Serologic Testing. Clin Infect Dis 2021;72(4):686-689.

37. van den Besselaar, JH, Sikkema, RS, Koene, F, et al. Are presymptomatic SARS-CoV-2 infections in nursing home residents unrecognized symptomatic infections? Sequence and metadata from weekly testing in an extensive nursing home outbreak. Age Ageing 2021.

38. Blain, H, Rolland, Y, Tuaillon, E, et al. Efficacy of a Test-Retest Strategy in Residents and Health Care Personnel of a Nursing Home Facing a COVID-19 Outbreak. J Am Med Dir Assoc 2020;21(7):933-936.

39. Escobar, DJ, Lanzi, M, Saberi, P, et al. Mitigation of a Coronavirus Disease 2019 Outbreak in a Nursing Home Through Serial Testing of Residents and Staff. Clin Infect Dis 2021;72(9):e394-e396.

40. Garibaldi, PMM, Ferreira, NN, Moraes, GR, et al. Efficacy of COVID-19 outbreak management in a skilled nursing facility based on serial testing for early detection and control. Braz J Infect Dis 2021;25(2):101570.

41. Karmarkar, EN, Blanco, I, Amornkul, PN, et al. Timely intervention and control of a novel coronavirus (COVID-19) outbreak at a large skilled nursing facility-San Francisco, California, 2020. Infect Control Hosp Epidemiol 2020:1-8.

42. Ehrlich, HY, Harizaj, A, Campbell, L, et al. SARS-CoV-2 in Nursing Homes after 3 Months of Serial, Facilitywide Point Prevalence Testing, Connecticut, USA. Emerg Infect Dis 2021;27(5):1288-1295.

43. Krone, M, Noffz, A, Richter, E, et al. Control of a COVID-19 outbreak in a nursing home by general screening and cohort isolation in Germany, March to May 2020. Euro Surveill 2021;26(1).

44. Psevdos, G, Papamanoli, A, Barrett, N, et al. Halting a SARS-CoV-2 outbreak in a US Veterans Affairs nursing home. Am J Infect Control 2021;49(1):115-119.

45. De Jonge, H. Advice of national advisory board of the Dutch Government of 27th of August. In: Ministy of Health, WaS, ed. https://www.rijksoverheid.nl/documenten/kamerstukken/2020/09/01/brief-inzake-omt-advies-27-augustus-2020; 2020.

46. van Buul, LW, van den Besselaar, JH, Koene, F, et al. Asymptomatic Cases and Limited Transmission of SARS-CoV-2 in Residents and Healthcare Workers in Three Dutch Nursing Homes. Gerontol Geriatr Med 2020;6:2333721420982800.

47. Blackman, C, Farber, S, Feifer, RA, et al. An Illustration of SARS-CoV-2 Dissemination Within a Skilled Nursing Facility Using Heat Maps. J Am Geriatr Soc 2020;68(10):2174-2178.

48. Abbasi, J. "Abandoned" Nursing Homes Continue to Face Critical Supply and Staff Shortages as COVID-19 Toll Has Mounted. JAMA 2020;324(2):123-125.

49. Grabowski, DC, Mor, V. Nursing Home Care in Crisis in the Wake of COVID-19. Jama 2020;324(1):23-24.

50. Jones, K, Mantey, J, Washer, L, et al. When planning meets reality: COVID-19 interpandemic survey of Michigan Nursing Homes. Am J Infect Control 2021.

51. Dumyati, G, Gaur, S, Nace, DA, et al. Does Universal Testing for COVID-19 Work for Everyone? J Am Med Dir Assoc 2020;21(11):1525-1532.

52. Morris, SC, Resnick, AT, England, SA, et al. Lessons learned from COVID-19 outbreak in a skilled nursing facility, Washington State. J Am Coll Emerg Physicians Open 2020;1(4):563-568.

53. Stall, NM, Farquharson, C, Fan-Lun, C, et al. A Hospital Partnership with a Nursing Home Experiencing a COVID-19 Outbreak: Description of a Multiphase Emergency Response in Toronto, Canada. J Am Geriatr Soc 2020;68(7):1376-1381.

54. Hofschulte-Beck, SL, Hickman, SE, Blackburn, JL, et al. Attitudes and Experiences of Frontline Nursing Home Staff Toward Coronavirus Testing. J Am Med Dir Assoc 2021;22(1):215-217.

55. Usher, K, Durkin, J, Gyamfi, N, et al. Preparedness for viral respiratory infection pandemic in residential aged care facilities: A review of the literature to inform post-COVID-19 response. J Clin Nurs 2021.

56. Armitage, R, Nellums, LB. COVID-19 and the consequences of isolating the elderly. The Lancet Public Health 2020;5(5):e256.

57. Tull, MT, Edmonds, KA, Scamaldo, KM, et al. Psychological Outcomes Associated with Stay-at-Home Orders and the Perceived Impact of COVID-19 on Daily Life. Psychiatry Research 2020;289:113098.

58. Pfefferbaum, B, North, CS. Mental Health and the Covid-19 Pandemic. New England Journal of Medicine 2020;383(6):510-512.

59. Stress in America(TM) 2020: A national menthal health crisis. 2020.

60. Taylor, SE, Stanton, AL. Coping resources, coping processes, and mental health. Annu Rev Clin Psychol 2007;3:377-401.

61. Prati, G, Mancini, AD. The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol Med 2021;51(2):201-211.

62. Banks, J, Xu, X. The mental health efects of the first two months of lockdown and social distancing during the Covid-19 pandemic in the UK. The Institute for Fiscal Studies; 2020.

63. Kwong, ASF, Pearson, RM, Adams, MJ, et al. Mental health before and during the COVID-19 pandemic in two longitudinal UK population cohorts. Br J Psychiatry 2020:1-10.

64. Hovenkamp-Hermelink, JHM, Jeronimus, BF, van der Veen, DC, et al. Differential associations of locus of control with anxiety, depression and life-events: A five-wave, nine-year study to test stability and change. J Affect Disord 2019;253:26-34.

Part I

Short-term-residential care

2

'Patients come with two garbage bags full of problems and we have to sort them.' A qualitative study of the experiences of healthcare professionals on patients admitted to short-term residential care in the Netherlands

Judith H. van den Besselaar,
Linda Hartel,
Joost D. Wammes,
Janet L. MacNeil-Vroomen,
Bianca M. Buurman-van Es

Abstract

Background
Short-term residential care (STRC) facilities were recently implemented in the Netherlands to provide temporary care to older adults with general health problems. The aim of STRC is to allow the individual to return home. However, 40% of patients are discharged to long-term care facilities. In-depth data about characteristics of patients admitted and challenges in providing STRC is missing.

Objective
To obtain perspectives of STRC professionals on the patient journey from admission to discharge.

Design
Qualitative study.

Setting
Eight nursing homes and three hospitals.

Subjects
28 healthcare professionals.

Methods
13 group interviews with in-depth reviews of 39 pseudonymised patient cases from admission to discharge. Interviews were analysed thematically.

Results
Many patients had complex problems that were underestimated at handover, making returning to home nearly impossible. The STRC eligibility criteria that patients have general health problems and can return home do not fit with current practice. This results in a mismatch between patient needs and the STRC that is provided. Therefore, planning care before and after discharge, such as advance care planning, social care, and home adaptations, is important.

Conclusions
STRC is used by patients with complex health problems and pre-existing functional decline. Evidence-based guidelines, appropriate staffing, and resources should be provided to STRC facilities. We need to consider the environmental context of the patient and healthcare system to enable older adults to live independently at home for longer.

Introduction

Global ageing has been met with a trend to reform long-term care (LTC) of older adults from residential care to community care.[1] Community care entails more home- and community-based care. This shift to community care has reduced the availability of residential care in several European countries over the past 25 years, which has increased the burden on community- and hospital-based care. To minimise hospital admissions and early LTC admissions, countries have implemented various forms of intermediate care.[2-4] Intermediate care can be provided at a facility, as ongoing outpatient therapy, or at home.

Because of rising expenses in LTC, the Dutch government reformed the healthcare system in 2015[5] with a shift to non-residential settings. First, stricter criteria were set for admission to LTC in nursing homes. Nursing homes now only admit patients who require care 24 hours per day. Care homes that looked after older adults with mild healthcare problems were either closed or converted to nursing homes, leaving these patients to live independently.[6]

The government also introduced intermediate care to reduce hospital and LTC admissions, including short-term residential care (STRC) facilities. Before the healthcare reforms, nursing homes and care homes in the Netherlands offered short-term care. Under the new policy, these short-term admissions were extended and long-term admissions were curtailed in intermediate care facilities. Table 1 compares the intermediate care in the Netherlands with that provided in the UK.

STRC is bed-based care for general health problems that do not require admission to hospital for specialist care but that also cannot be treated at home.[7] The goal of STRC is to enable older adults to return home and live independently in the community.[8] STRC can be step-up (prevent hospital admission) or step-down (patient can be discharged from hospital but cannot go home yet). It is also possible to admit patients for hospice care.

The goal of STRC is that patients should eventually be discharged home. However, in 2019, less than 50% of STRC patients returned home.[10] Limited information is available about the patients admitted to STRC facilities. Registrations show that patients are admitted from the emergency department, hospitals, or home.[10] and that the most common reasons for admission are trauma and infection.[9] However, we do not know what happens to patients in the STRC facility or whether STRC care is adapted to the patient's needs. In-depth data about characteristics of patients admitted and challenges in providing care in STRC are missing.

In this qualitative study, we described the experiences of STRC healthcare staff in Amsterdam. We asked about patients' care journeys from referral to discharge. The aim of this study was to explore how STRC is implemented and how it can be improved.

Table 1: Intermediate care in the Netherlands and the United Kingdom

---

Intermediate care in the Netherlands and United Kingdom

Short-term residential care (STRC)[7-10]
Definition: Bed-based care for general medical needs that do not require hospital admission for specialist care or rehabilitation, but that cannot be treated at home.
Goal: To enable older adults to return home and live independently in the community.
Treatment: Monodisciplinary or multidisciplinary. No specific patient groups were allocated to STRC, such as in geriatric rehabilitation care. Up to 1.5 hours of therapy is funded per week. Hospice care can be provided, with up to 3 hours of therapy per week for up to three years. The average length of stay in 2017 was 39 days.
Type of facilities: Nursing homes, care homes, hospitals, rehabilitation centres, or care hotels.
Healthcare professionals: Treatment is provided by a GP or elderly care physician supported by nurses, physical therapists, occupational therapists, psychologists, dieticians, social workers, and behavioural scientists.

Geriatric rehabilitation care [11-13]
Definition: Multidisciplinary care and therapeutic intervention to restore functional ability or enhance residual functional capacity in older adults with disabling impairments.
Goal: To slowly rehabilitate frail elderly individuals so they can return home and live independently in the community.
Treatment: Multidisciplinary team with special training in rehabilitation. Up to three hours per week of therapy is funded for up to six months. Targeted groups are patients with hip fractures or stroke. Care pathways are developed between the hospital and intermediate care facility.
Type of facilities: Nursing homes, hospitals, rehabilitation centres.
Healthcare professionals: Treatment is provided by an elderly care physician supported by nurses, physical therapists, occupational therapists, psychologists, dieticians, social workers, and behavioural scientists.

Intermediate care in the UK [14]
Definition: Intermediate care services are provided to patients, usually older people, after they leave hospital or when they are at risk of being sent to hospital. The services offer a link between the hospital and the patient's home, and between the healthcare system and the social care system. There are four types of intermediate care: crisis-response, bed-based, home-based, and reablement.
Goal: Prevent unnecessary hospital admissions, help people to be as independent as possible after discharge from hospital, and prevent unnecessary admission to a residential home.
Treatment: Up to 48 hours of crisis-response treatment is funded. For the other types of intermediate care, up to six weeks of therapy is funded.
Type of facilities: Bed-based care in residential homes or community hospitals. Crisis-response, home-based, and reablement care are provided in the home.
Healthcare professionals: A variety of different professionals can deliver this type of specialised care, from nurses and therapists to social workers. The care plan will depend on the individual's needs at that time. Home-based care involves a multidisciplinary team of predominantly health professionals and reablement also involves a multidisciplinary team of predominantly social care professionals.

Methods

Context

To structure the interview guide and analysis, we used the frameworks of Pearson and Jesus.[15, 16] We combined the programme theories with the quality concepts of both frameworks to create a new framework, which is described in Figure 1. We used the service user lifetime of Pearson to structure the patient journey. The patient journey starts before admission with a health crisis, followed by admission to STRC, and ends with discharge from STRC. After STRC, the patient's functioning, health, and well-being either improve, are maintained, or decline. To quantify STRC processes and post-STRC outcomes, we identified requirements for quality of post-acute care and rehabilitation according to Jesus. In the Netherlands, the only known end goal of intermediate care is the discharge destination – intermediate outcomes such as improvement in muscle-mass and prevention of malnutrition have not been investigated. It is also unknown how STRC processes and resources such as personnel, facilities, and equipment are organised in STRC facilities in the Netherlands. We expected the environmental context (i.e., availability of an informal caregiver) and system (i.e., funding by healthcare insurer) described by Jesus would influence the patient journey from admission to discharge.

Study design

Semi-structured group interviews with different intermediate care personnel provide the best insight into the concepts set out by Jesus and Pearson. The interview guide is described in Table 2. Questions were developed on the quality of post-acute rehabilitation according to Jesus[16] and on the stages of the patient journey according to Pearson.[15] Also, policy makers involved in developing STRC were consulted when developing the interview. The first part of the interview concerned the facility and provided insight into the working environment and working procedures of the participants and explored the structure and processes of STRC. In the second part of the interview, participants were asked to select at least three patients who were admitted to the STRC facility for at least 24 hours and were discharged within the last 6 months from their ward. Participants were free to choose any patient they wanted but were asked to represent different patient journeys if possible. Cases were discussed from referral until discharge from STRC. After the first two group interviews, the interview guide and transcripts were evaluated by two senior researchers with experience in qualitative research and intermediate care, to determine whether the questions sufficiently answered the research question and covered all concepts. No major adjustments were made.

Dutch health reforms 2015:
• Stricter criteria for access to long term care
• Assisted living facilities closed or transformed into nursing homes
• Implementation of short-term care services in facilities with the goal of discharge home

Pre-short term residential care   Short term residential care   Post-short term residential care

Health crisis or acute admissions

Older adults live longer independent in the community with multiple comorbidities.

Structure: personnel, facilities and equipment, organizational management

Macro-outcomes: health-care utalization quality of life, consumer experience, discharge destination, functional performance

Patient care process and inter-professional processes

patient

Home (48%)
Long-term care (25%)
Died (9%)
Other: (18%)

Immediate and intermediate outcomes

Outcomes not yet known

Environmental context (patient & system level)

Figure 1: Framework of concepts and outcomes based on Pearson (2015) and Jesus (2015). white boxes indicate concepts from Pearson and Jesus, while grey boxes indicate the Dutch circumstances.

Table 2: Topics and probing questions of the interview guide

Topic	Sample questions
General information	
Structure and processes of care	Who has the medical responsibility? How many nurses work during the day, evening, and night shifts? Do they work with goal-setting instruments or a geriatric assessment? How do they plan discharges or multidisciplinary consultations?
Patient file	
Patient characteristics (health crisis, environmental context)	Demographics Date of admission and discharge Why was the patient admitted? What was the medical history of the patient?
Patient journey (processes of care, environmental context)	What was the process of patient admission? What kind of treatment did the patient receive? Which professionals were involved and why? Was this treatment effective? (intermediate outcomes) What was the discharge destination and why? (macro-outcomes)
Reflection by staff	
Experience	What are features of good short-term residential care? What needs improvement? What competencies do staff need to deliver intermediate care to patients? (structure and interprofessional process)

Recruitment and participants

All five organisations offering short-term residential care in Amsterdam, the Netherlands were approached, from which 11 STRC wards agreed to participate in the study. Facilities and wards were stratified based on location and number of STRC beds (less than 10 beds, 10–20 beds, more than 25 beds) and location and type of care provided (such as geriatric rehabilitation care, psychogeriatric care, or hospice care). The manager of the ward approached potential participants who met the inclusion criteria: at least one participant had to be familiar with the procedure of referral and discharge and at least one participant had to be involved with patient care on the ward. Participants could be physicians, paramedics, administrative staff, or managers. Between one and four participants took part in each interview based on their knowledge of referral, discharge, and patient care. For example, an elderly care physician and nurse may provide knowledge of patient care and a manager may provide knowledge of referral and discharge.

Data collection

The interviews were conducted between January and August 2018 by an experienced interviewer (LH), at either the hospital or the nursing home. Written informed consent was obtained before the interviews began. Interviews were recorded on audiotape and transcribed verbatim by a second researcher (JB). Transcripts were not returned to the participants because this does not add value.[17] The interviewer summarised the participants' perspectives during the interview. An ethical waiver was obtained from the Medical Ethics committee of the Academic Medical Center. Patients were pseudonymised for discussions.

Data analysis

Thematic analysis was used to identify patterns in the data. Thematic analysis is an effective inductive and deductive way to acquire meaning from a dataset. Data on patient characteristics, admission, and treatment were synthesised. Data were analysed based on theoretical assumptions and with an open approach.[18] First, JB and LH read the transcripts and field notes to familiarise themselves with the data. An initial coding scheme was developed by JB and LH according to our framework (Figure 1). Coding was based on the phases of the patient journey: before, during, and after admission. We also coded experiences regarding outcomes, personnel, facilities, equipment, and organisational management. Second, the first two interviews were coded deductive and inductive by JB and LH. The coding scheme for these interviews was discussed with the research team. Third, the rest of the interviews were coded by JB and initial themes were created and examined against the coded data by the research team.

Multiple thematic maps were created by JB and LH during the analysis. The analysis was concluded by defining overarching themes that fitted the framework. MAXQDA 11 (VERBI Software 2018) was used for data analysis.

Results

In total, 28 participants were included: eight registered nurses, seven certified nursing assistants, seven physicians, and six administrative/management staff. Twenty-two participants were female and six were male. Their experience ranged from 1 to 45 years working in healthcare. A second interview was conducted in the same STRC facility three times to discuss more cases or to get a physician's perspective. Characteristics of the STRC wards and participants are described in Supplementary Table 1 and Supplementary Table 2.

After 11 group interviews, no new information was observed in the data. However, according to Guest et al., two more interviews were conducted to reach data saturation.[19] The interviews took between 45 minutes and 2 hours. In total, 13 group interviews were conducted in which 39 patient journeys were discussed. Details of patients' characteristics and journeys can be found in Table 3. Reasons for admission were collected during interviews. Participants reported additional problems during admission that were not recorded in the admission form and that prevented discharge in 25 patients.

Staff experiences

From the interviews, three main themes emerged over the different phases of the patient journey. The first theme was patients admitted to the STRC that had more complex needs than staff were anticipating. These patients did not meet the STRC admission criterion of being able to return home later. The second theme was staffing and funding were rarely sufficient after patients were admitted to the STRC facility. The third theme was the need for proactive healthcare planning and better transitions of care for frail patients. Figure 2 summarises the major themes found in relation to our proposed model.

Table 3: Characteristics of discussed patients and patient journeys

Characteristic	N total=39
Gender	
Male	14
Female	25
Age category in years	
Unknown	1
30–39	2
40–49	0
50–59	2
60–69	8
70–79	7
80–89	16
90–99	3
Unplanned/planned admission[†]	
Unplanned	19
Planned	20
Referring physician/institution	
General practitioner/home	16
Hospital	17
Emergency department	5
Geriatric rehabilitation care	1
Treating physician	
Nursing-home physician	31
General practitioner	8
Length of stay in days	
Median (interquartile range)	45 (21,90)
Minimum	2
Maximum	270
Reason for admission	
Musculoskeletal (fracture, contusion, infection)	12
Cognitive decline	2
Loss of informal caregiver	1
Wound care	2
Functional decline	4
Support during oncologic care	5
Hospice care (oncologic)	4
Heart failure	1
Infection	2
Electrolyte disorder	1
Dysregulated diabetes mellitus	1
Observation	1
Recovery after hospital admission	3

Table 3: Continued

Secondary problem (25 patients)	
No informal care	Total N=40
Overburden informal care	5
Patient does not accept LTC[*]	4
Neglect/rejection of home care	2
Cognitive problem	8
Unmotivated	4
Family demanded LTC admission	1
Psychiatric problem	1
Malignancy	4
Indication application at home for LTC not completed	1
Grief	2
Unsuitable living situation	2
Addiction	3
	3
Discharge destination	
Home	15
LTC facility	11
Died	4
Hospice	2
Hospital	2
Care home	2
Psychiatry	1
Other STRC facility	2
Reason for discharge to LTC facility	Total N=11
Mobility insufficiently improved	5
Cognitive disorder	3
Frequent falls	1
Need of unplanned care for comorbidities	1
Informal caregiver not willing to provide care	1

[*]Long-term care

[†]An unplanned admission is an admission during the weekend, evening, or night that was acutely needed.

A planned admission is an admission which was anticipated by the intermediate care facility. Those

admissions were usually a couple of days after application and mostly from the hospital.
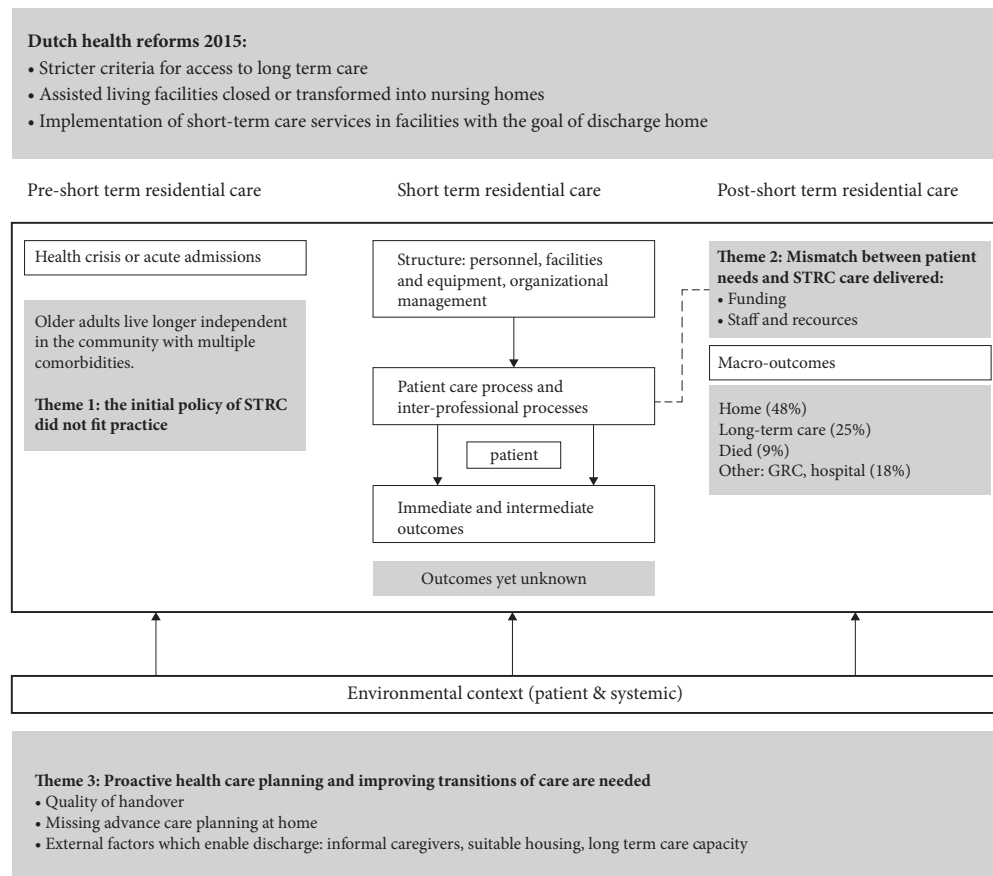
Dutch health reforms 2015:
• Stricter criteria for access to long term care
• Assisted living facilities closed or transformed into nursing homes
• Implementation of short-term care services in facilities with the goal of discharge home

Pre-short term residential care　　　　Short term residential care　　　　Post-short term residential care

Health crisis or acute admissions

Older adults live longer independent in the community with multiple comorbidities.

Theme 1: the initial policy of STRC did not fit practice

Structure: personnel, facilities and equipment, organizational management

Patient care process and inter-professional processes

patient

Immediate and intermediate outcomes

Outcomes yet unknown

Theme 2: Mismatch between patient needs and STRC care delivered:
• Funding
• Staff and recources

Macro-outcomes

Home (48%)
Long-term care (25%)
Died (9%)
Other: GRC, hospital (18%)

Environmental context (patient & systemic)

Theme 3: Proactive health care planning and improving transitions of care are needed
• Quality of handover
• Missing advance care planning at home
• External factors which enable discharge: informal caregivers, suitable housing, long term care capacity

Figure 2: Conceptual framework with emerging themes. White boxes indicate concepts from the frameworks of Pearson and Jesus, while grey boxes indicate the Dutch circumstances and themes emerging from interviews with STRC healthcare staff.

Theme 1. The initial policy of STRC did not fit practice

Staff reported that patient care needs were more complex than a few years ago. This could be a need for more complex medical care (oncology, enteral feeding, infections) or for more complex psychological, cognitive, and social care. This observation is in discrepancy with the original goal set by policy makers during the healthcare reform in 2015 that patients should be able to return home once STRC is complete.

> *"Short-term residential care is temporary care, patients come with two garbage bags full of problems and we have to sort these." (Elderly care physician, NH5)*

There are many possible reasons for this discrepancy between the defined patient population and the actual patient population. The triage process was developed for a patient population with uncomplicated needs, and these triage criteria did not meet the actual needs of patients. Also, referring hospitals and general practitioners may have unrealistic expectations of what STRC can offer with regard to duration of physiotherapy or frequency of laboratory tests, for example. This may result in patients being referred for STRC with more complex care needs than can be met. In addition, triage professionals may have been fully equipped to handle complex referrals. If so, they may have admitted patients who could clearly not return home because this was better for the well-being of the patient than a prolonged hospital admission would have been.

> *"We want to prevent STRC used as a disguised route for long-term care. […] An STRC facility is successful if it has a high discharge rate home. […] But patients must go somewhere. [When we reject the patient for admission] then the patient will go to the hospital, so what are the options […] You must focus on the bigger picture. If you can make sure this patient stays out of the hospital it is better [for them]." (Nurse, H1)*

Theme 2. Mismatch between patient needs and STRC care

The complex needs of the STRC patient population described in theme 1 could not be met by the care provided at the STRC facilities. This mismatch could not be resolved because of limited funding, staff, and resources.

Funding

The government allocated 1.5 hours of medical care and therapy per week for STRC, but the staff we interviewed reported a need for more than 1.5 hours, often because of secondary problems (Table 3) that were not mentioned at admission. Solving these problems and making a treatment plan takes time that was not covered by the available funding.

"I need three hours for a new admission and after that every week half an hour. I have to defend myself to colleagues and the board about the hours I need, while I think 'the workload is too much'." (Elderly care physician, NH5)

This also led to creativity in deployment of staff. Nurses did exercises with patients instead of a physical therapist or physicians sent patients to the hospital for cognitive screening because there were not enough treatment hours available at the STRC facility.

Availability of staff and resources
The mismatch between patient needs and STRC delivered was in part due to the conversion of care homes to nursing homes during the 2015 reforms. Care homes kept their staff and resources, but staff lacked the experience and training needed to meet the complex needs of this new patient population. It was also difficult for nursing homes to hire more registered nurses because of nursing workforce shortages. Some nursing homes had temporary workers to overcome staff shortages, which put pressure on the permanent staff who had to supervise these temporary workers. Furthermore, education on rehabilitation and the geriatric population appeared to be insufficient for nurses and certified nursing assistants.

"There are not enough qualified staff. At one point, a crash course on tube feeding was provided for the certified nursing assistants." (Physician, NH4)

Theme 3. Proactive healthcare planning and improving transitions of care are needed
Because patient needs are complex and STRC is limited, proactive healthcare planning and improved care transitions are essential. This can be achieved by advance care planning care at home, improving the quality of patient handover, and addressing external factors to improve discharge.

Missing advance care planning at home
Staff reported that patient care was not properly planned before the patient was admitted to the STRC facility. Often, functional decline had progressed over a long period without action by the GP or other healthcare professionals. Consequently, STRC was used as a crisis admission to long-term care. Recognising potential long-term care needs earlier, for example through advance care planning, may prevent crisis situations like this from occurring.

It is possible that patients did not acknowledge their need for long-term care or did not want to leave their home. Nevertheless, some participants felt the GP was complacent in providing necessary care and in anticipating the need for STRC while the patient was still at home. Proper ambulatory follow-up from the referring GP could have prevented admission.

"This could have been anticipated a long time ago. It was already clear for a long time that this patient could not live independently at home. I think if [crisis] prevention had taken place, then this admission to STRC would not have been needed. This patient could have been admitted directly to long-term care." (Manager, H3)

Quality of handover
According to participants, the quality of handovers varied for several reasons. First, GP rotations for weekend duty reduced contextual information in the handover. Second, staff hypothesised that time pressure compromised the handover, such as referrals from emergency departments and from hospital wards on a Friday afternoon. Third, cognitive impairment is not always evident in people living alone who followed their normal daily routines. This cognitive impairment can remain unrecognised until the patient's informal care changes, for example if their partner dies. Hence, this information is often not recorded by the GP in the handover.

"When patients with cognitive disorders, live at home on autopilot. [...] But when you take them out of this routine, then the dementia worsens and it's not possible to go back to the home situation. They [patients] cannot handle this [the change] and then you see we have to admit them to long-term care." (Nurse, NH6)

Fourth, participants felt that relevant clinical information was sometimes left out on purpose and some wondered if they could trust the information that was given. Information may have been left out to speed up the referral or to avoid the patient from being rejected because of social, cognitive and psychiatric problems, which prolonged stays and made discharge more difficult.

External factors that enable discharge from the STRC
Staff identified three important factors for a smooth discharge from the STRC : informal caregivers, a suitable living situation, and waiting lists for long-term care.

Informal caregivers were important in deciding where to discharge the patient. For example, one patient diagnosed with dementia after multiple urinary tract infections and delirium was able to go home because she had a good network of informal caregivers who had arranged private home care for her. Inappropriate living situations, such as houses with stairs or small bathrooms delayed discharge because time was needed to make necessary modifications. Sometimes, modification was not possible and alternative housing or long-term care residence was needed. Almost all the interviewees pointed out that long waiting lists for home care, psychiatric treatment, and long-term care delayed the discharge of patients from the intermediate care facility.

> *"What often happens at admissions; the patient has so many long-existing problems that it is not possible to go back home. We must put the patient on the waiting list for long-term care. This is a slow process because of the shortage of long-term care nursing homes." (Manager, NH8)*

Discussion

We interviewed staff working in STRC facilities to find out how STRC is implemented and how it can be improved. We found that healthcare professionals working in STRC facilities do not believe that the majority of admitted patients meet the objective of STRC, which is to return home. Patients were often admitted to the STRC in crisis situations or with higher care needs than could be offered at the facility. This resulted in a mismatch between the patient needs and care delivered, which meant fewer patients could be discharged home. In addition, environmental factors, such as availability of informal caregivers, advance care planning, appropriate housing, and waiting lists for long-term care, influenced the patient journey at several points.

A discrepancy between the target and actual patient population was also reported in a qualitative study discussing intermediate care in the UK, where staff felt pressured to accept as many referrals as possible, even if they suspected that some were not suitable.[20] A lack of awareness and understanding among GPs and hospital staff of what intermediate care is has also been recognised.[20, 21] The goals and admission criteria of STRC need to be thoroughly discussed to solve this problem. Patients who need LTC cannot realistically be discharged home from STRC; however, it would be better to refer these patients from their home directly to LTC facilities and not via an STRC facility.

STRC facilities cannot meet more complex patient needs because of funding, staff, and resource limitations. In the UK, a study in several regions confirmed these issues, where underfunding in intermediate care led to a shortage in therapists.[22] Recruitment and retention of qualified staff and volunteers was found to be the most significant challenge facing intermediate care.[22, 23] In agreement with others, we have shown that nurses require more education on geriatrics and rehabilitation.[20]

Last, we found that the complex patient population and the possibilities of STRC demand proactive healthcare planning and better care transitions. Lack of important information at handover (especially about cognitive functioning and social factors) has been reported previously and interventions to improve handover have been shown to reduce negative outcomes of hospital admissions.[24-26] Another study suggested that missing information at handover is caused by poor awareness and skills of personnel working in the referring hospitals.[27] Insufficient home care was linked to bed blocking in an earlier study. This agrees with our findings that patients stay longer in STRC facilities because of a shortage of LTC beds.[20] Hospital stays were shorter in regions with good social and community services. However, these hospitals (including those in Amsterdam) still had problems meeting the needs of patients with mental health problems.[23]

There are strengths to this study. We included multiple STRC facilities distributed evenly across Amsterdam and we obtained in-depth evaluations of the patient journey from different healthcare professionals, which allowed us to reach data saturation. An important limitation of the study is that patient files were selected by participants, which could have resulted in bias (i.e., participants may have selected the most 'problematic' cases). Further research should triangulate our results with rural areas, patients, informal caregivers, and referring professionals; this was beyond the scope of the current study.

Implications for policy

Our study shows that care delivery and organisation need to be improved in STRC facilities to meet patient needs. Staff frequently have to deal with crisis admissions to the STRC facility because no advance care planning was provided by the primary care practitioner or hospital. Gradual functional decline is rarely addressed by primary care professionals until acute events occur. Advance care planning and early anticipation of changing care needs is the shared responsibility of informal caregivers, GPs, municipalities, and home care organisations. If care needs of older adults living at home are known and anticipated, crisis admissions will be prevented and STRC facilities will be able to meet their patients care needs and discharge them home, since care is properly organised.

Our study included a heterogeneous patient population with complex care needs; therefore, we advocate developing clear and evidence-based treatment guidelines according to patient care needs. A more flexible funding system is needed for the intermediate care period.

Treatment and funding should be based on patient needs. This corresponds with earlier findings that patients receiving intermediate care have different care needs, and that there is no 'one size fits all' type of intermediate care.[28]

Quantitative research is needed to describe patient characteristics, treatment goals, STRC outcomes (such as length of stay and discharge destination), and patient outcomes (such as quality of life). This quantitative data can be used to develop guidelines that match patient needs with appropriate care and funding.

The staff competencies needed for good intermediate care need to be clearly described. Quality of STRC can only be improved by educating current STRC staff. This will equip STRC healthcare professionals with the skills they need to meet complex patient needs, such as tube feeding, fitting central venous lines, or knowledge of cognitive impairment and psychiatric disorders.

Finally, older adults living in the community need to be properly supported and provided with LTC in nursing homes when needed. Waiting lists for nursing homes and inappropriate housing for older adults cannot be solved by STRC. These problems need to be addressed before admission to enable older adults to live at home for longer.

Conclusions and implications

STRC in the Netherlands was designed for older adults with mild healthcare problems but is used by patients with complex health problems and functional decline. Evidence-based treatment guidelines and appropriate staffing and resources are necessary to meet these complex patient needs. STRC can only be improved by viewing problems in a larger context; prerequisites need to be addressed to enable older adults to live longer independently at home.

Reference List

1. Spasova S, Baeten R, Coster S, Ghailani D, Pena-Casa R, Vanhercke B. Challenges in long-term care in Europa: A study of national policies 2018. European Commission, European Social Policy Network (ESPN).

2. Young J, Gladman JR, Forsyth DR, Holditch C. The second national audit of intermediate care. Age and ageing. 2015 Mar;44(2):182-4.

3. Abrahamsen JF, Haugland C, Nilsen RM, Ranhoff AH. Three Different Outcomes in Older Community-dwelling Patients Receiving Intermediate Care in Nursing Home after Acute Hospitalization. The journal of nutrition, health & aging. 2016 Apr;20(4):446-52.

4. Inzitari M, Gual N, Roig T, Colprim D, Perez-Bocanegra C, San-Jose A, et al. Geriatric Screening Tools to Select Older Adults Susceptible for Direct Transfer From the Emergency Department to Subacute Intermediate-Care Hospitalization. Journal of the American Medical Directors Association. 2015 Oct 1;16(10):837-41.

5. Maarse JA, Jeurissen PP. The policy and politics of the 2015 long-term care reform in the Netherlands. Health policy (Amsterdam, Netherlands). 2016 Mar;120(3):241-5.

6. Onderzoek naar sluiting verzorgingshuizen. Aedes-Actiz Kenniscentrum wonenzorg; [cited 2019 1-12-2019]; Available from: https://www.kcwz.nl/thema/extramuralisering/onderzoek-naar-sluiting-verzorgingshuizen.

7. Mastenbroek CG, van der Meer FM. Het eerstelijnsverblijf binnen de Zorgverzekeringswet. Zorginstituut Nederland, 2016 29-03-2016. Report No.

8. van Rijn MJ. Brief aan de Voorzitter van de Tweede Kamer: Eerstelijns verblijf. In: Ministerie van Volksgezondheid WeS, editor. 647239-124137-CZ ed 2015.

9. Onderzoek Eerstelijns verblijf. Q-consult Zorg, 2018.

10. Actiz. Infographic ELV 2019. 2019 [cited 2019 1-12-2019]; Available from: https://www.actiz.nl/thema/zorg/eerstelijnsverblijf.

11. Boston Working Group on Improving Health Care Outcomes Through Geriatric Rehabilitation. Med Care. 1997 Jun;35(6 Suppl):Js4-20.

12. Geriatrische revalidatiezorg. Zorginstituut Nederland; [27-11-2020]; Available from: https://www.zorginstituutnederland.nl/Verzekerde+zorg/geriatrische-revalidatiezorg-zvw.

13. Verblijf Zorgverzekeringswet. Zorginstituut Nederland; [27-11-2020]; Available from: https://www.zorginstituutnederland.nl/Verzekerde+zorg/v/verblijf-zvw.

14. National Audit of Intermediate Care 2017 - summary report. NHS Benchmarking Network; 2017.

15. Pearson M, Hunt H, Cooper C, Shepperd S, Pawson R, Anderson R. Providing effective and preferred care closer to home: a realist review of intermediate care. Health & social care in the community. 2015 Nov;23(6):577-93.

16. Jesus TS, Hoenig H. Postacute rehabilitation quality of care: toward a shared conceptual framework. Archives of physical medicine and rehabilitation. 2015 May;96(5):960-9.

17. Hagens V, Dobrow MJ, Chafe R. Interviewee Transcript Review: assessing the impact on qualitative research. BMC Med Res Methodol. 2009;9:47-.

18. Braun V, Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology. 2006 2006/01/01;3(2):77-101.

19. Guest G, Bunce A, Johnson L. How Many Interviews Are Enough? Field Methods - FIELD METHOD. 2006 02/01;18:59-82.

20. Glasby J, Martin G, Regen E. Older people and the relationship between hospital services and intermediate care: results from a national evaluation. Journal of interprofessional care. 2008 Dec;22(6):639-49.

21. Millar AN, Hughes CM, Ryan C. "It's very complicated": a qualitative study of medicines management in intermediate care facilities in Northern Ireland. BMC health services research. 2015 Jun 2;15:216.

22. Regen E, Martin G, Glasby J, Hewitt G, Nancarrow S, Parker H. Challenges, benefits and weaknesses of intermediate care: results from five UK case study sites. Health & social care in the community. 2008 Dec;16(6):629-37.

23. Baumann M, Evans S, Perkins M, Curtis L, Netten A, Fernandez JL, et al. Organisation and features of hospital, intermediate care and social services in English sites with low rates of delayed discharge. Health & social care in the community. 2007 Jul;15(4):295-305.

24. Kripalani S, LeFevre F, Phillips CO, Williams MV, Basaviah P, Baker DW. Deficits in Communication and Information Transfer Between Hospital-Based and Primary Care PhysiciansImplications for Patient Safety and Continuity of Care. JAMA. 2007;297(8):831-41.

25. Hesselink G, Schoonhoven L, Barach P, Spijker A, Gademan P, Kalkman C, et al. Improving Patient Handovers From Hospital to Primary Care: A Systematic Review. Annals of Internal Medicine. 2012;157(6):417-28.

26. Cross DA, McCullough JS, Adler-Milstein J. Drivers of health information exchange use during postacute care transitions. The American journal of managed care. 2019 Jan 1;25(1):e7-e13.

27. Hesselink G, Vernooij-Dassen M, Pijnenborg L, Barach P, Gademan P, Dudzik-Urbaniak E, et al. Organizational culture: an important context for addressing and improving hospital to community patient discharge. Med Care. 2013 Jan;51(1):90-8.

28. Godfrey M, Townsend J. Older people in transition from illness to health: trajectories of recovery. Qualitative health research. 2008 Jul;18(7):939-51.

Appendix 1: Characteristics of participants of interviews

Participant		Location	Gender	Experience in health care
1	Manager	NH1	F	45 years
2	Health consultant*	NH1	F	Not discussed
3	Registered Nurse	NH2	F	9 years
4	Physician	NH2	F	20 years
5	Registered Nurse	NH3	F	Not discussed
6	Certified Health assistant	NH3	F	Not discussed
7	General practitioner	NH4	F	6 weeks in nursing home, total experience not discussed
8	Certified Health assistant	NH4	F	1 year
9	Certified Health assistant	NH4	M	6 years
10	Registered Nurse (Two interviews)	NH5	F	1,5 year
11	Physician (Two interviews)	NH5	F	29 years
12	Registered Nurse (interviews 1)	NH6	F	1,5 year
13	Certified Health assistant (interview 1)	NH6	F	15 years
14	Registered Nurse (interview 2)	NH6	F	20 years
15	Certified Health assistant (interview 2)	NH6	F	32 years
16	Manager	NH7	M	38 years
17	Physician	NH7	F	1 year
18	Certified Health consultant	NH7	F	5 years
19	Registered Nurse	NH7	F	3 months as a nurse, worked before as health assistant total experience not discussed
20	Manager	NH8	F	3 months, worked before as a nurse, experience not discussed
21	Physician	NH8	M	8 years
22	Registered Nurse	NH8	M	17 years
23	Physician	H1	F	Not discussed
24	Registered Nurse	H1	M	Not discussed

Participant		Location	Gender	Experience in health care
25	Physician	H2	F	2 year
26	Certified Health assistant	H2	F	2 year
27	Certified Health assistant	H2	F	8 year
28	Manager	H3	M	Not discussed

*A health consultant works as administrative staff of a nursing home or hospital. They judge the applications for admission to the nursing home for placement at a ward, organize discharge applications from the nursing home and have responsibilities in financing

Appendix 2: Characteristics of short-term residential care wards

Location	Characteristics
Nursing home 1	In transition from care home to nursing home. STRC: 2 beds
Nursing home 2	Nursing home with psychogeriatric, rehabilitation and somatic care. STRC and GRC* at same ward. STRC: 12 beds
Nursing home 3	Nursing home with psychogeriatric, rehabilitation, somatic and palliative unit Number of STRC beds not discussed
Nursing home 4	In transition from care home to nursing home. STRC beds are divided over the different wards of the nursing home. Number of STRC beds not discussed
Nursing home 5	Nursing home with somatic care, specialized ward for Huntington care. STRC: 7 beds STRC Hospice care: 7 beds
Nursing home 6	Part of the facility is in transition from care home to nursing home. Ward specialized in patients with a history of addiction. STRC: 7 beds
Nursing home 7	Nursing home for somatic care, provides also some care home beds, also for patients with history of psychiatric disease. STRC: 7 beds
Nursing home 8	Nursing home for somatic care, psychogeriatric care and provides some care home beds. STRC: 7beds
Hospital 1	Combined ward for GRC* and STRC. Ward has a goal for short-term transitional care and aims for a maximum length of stay of 21 days. Admissions are only from the hospital wards or directly from the ED† of the hospital. Admission from the ED is possible between 8.00 and 23.00. Number of beds: 28 (combined with GRC*, no strict division, depends on the needs of patients)
Hospital 2	STRC ward specialized in cognitive screening after delirium. STRC: 40 (20 beds dedicated to cognitive screening)
Hospital 3	Combined ward for GRC* and STRC. Ward has a goal for short-term transitional care and aims for a maximum length of stay of 14 days. STRC: 5 beds

*Geriatric Rehabilitation Care
† Emergency department

3

Short-term Residential Care in the Netherlands: patient characteristics from a national database and facility characteristics from a national survey

Judith H. van den Besselaar
Rebekka J. Arntzen
Janet L. MacNeil-Vroomen
Cees M.P.M. Hertogh
Bianca M. Buurman-van Es

Abstract

Background

*S*hort-term residential Care (STRC) is a recent, bed-based care concept for older adults aimed to avoid nursing home admission in the Netherlands.

Objective

To describe characteristics of patients admitted to STRC and the main organizational differences between facilities.

Methods

Patient characteristics were identified using a national STRC database (2018 and 2019). Organizational comparisons of STRC facilities were collected through an cross-sectional email survey sent to all facilities.

Results

Of the 68,682 older adults admitted to STRC, patients were mostly female (35%), living alone (64%) and with at least 10 medications prescribed (60%). Of the 36,660 patients admitted in 2018, 43.4% died within 24 months. Of the 176 STRC facilities that responded to the survey, 30.1% delivered care at an independent ward, 27.3% was within a geriatric rehabilitation care ward, and 33.5% at a ward in long-term care. The median number of beds was 8, with a range from 1 to 40. Most facilities admitted patients in evenings, nights, or weekends. Almost all wards employed registered nurses and paramedics.

Conclusions

Patients admitted to STRC have multiple medical problems, suggested by the high number of medication, and often have palliative care needs. Facilities providing STRC differ by the location of the ward, the number of beds, and frequency of medical rounds and multidisciplinary consultations. There is a pressing need to develop standards for STRC to effectively deliver care.

Introduction

Over the last decade, European countries have reformed long-term care (LTC) with a trend shifting from residential care towards home care and community care.[1] Residential care facilities have been reduced in number because of policies aiming for deinstitutionalisation. To enable older adults to live independently, several countries implemented preventive and rehabilitation strategies.[1-5]

In 2015 the Dutch government reorganized the health care system because of rising health care expenses[6]: Long-term care (LTC) in nursing homes is indicated only for patients who are in need of care 24 hours a day because of physical care needs and problems with self-management. The government wanted older adults to live as long as possible at home, with care close by. They expected that older adults would need more often short term admissions for medical problems, with the goal to return home.[7] To address this care gap, Short Term Residential Care (STRC, in Dutch 'Eerstelijnsverblijf') was implemented for older adults with general health problems that do not require admission to hospital for specialist care, but that also cannot be treated at home. The goal was to enable older adults to return home and live independently in the community.[8] However, no national guidelines were provided for STRC and it soon appeared that the goal of STRC to support older adults in living longer independently at home is not met: in 2019, less than 50% of patients admitted to STRC returned home.[9]

A previous qualitative study in three hospitals and eight nursing homes providing STRC in Amsterdam showed that older adults admitted to STRC had multiple complex problems in the medical, functional, psychological, and social domain.[10] Advance care planning in the home situation is often lacking and patients often have a longer existing functional decline. This results in discharge to a nursing home instead of home, or even hospice care. Because of the complex problems, staff experienced the tariff for STRC was inadequate to provide the right treatment and care. Furthermore, that study found that the participating STRC facilities showed multiple organisational differences[10], especially in availability of qualified staff (nurses, paramedics and physicians), admission possibilities during the evening, night and weekend, and in frequency of medical rounds and multidisciplinary consultations. As that study was only qualitative and focused on one city, it is unclear how STRC is provided on a national level and if other facilities have the same needs of a higher tariff, qualified personnel and advance care planning.

Therefore, we aim to describe how the patient population of STRC looks like on a national level and whether the organisational differences between facilities also apply. If we know the patient population using STRC and the different organisational characteristics of facilities providing STRC on a national level, it is possible to compare

outcomes such as discharge destination and length of stay between facilities in future research. This will enable the development of specific strategies to improve care. Using a national database of patients admitted to STRC and by distributing an exploratory national online survey, we addressed the following research questions:

1. What are the characteristics of patients admitted to STRC in the Netherlands?
2. What are the main organizational differences between individual facilities providing STRC in the Netherlands?

Methods

This was an observational, cross-sectional descriptive study. To describe the characteristics of patients admitted to STRC, we used a national database. To describe the main organizational differences between individual facilities providing STRC, we distributed an online survey. First we will describe the different tariffs of STRC, before elaborating on the study population, outcomes and statistical analysis of these two study methods.

Classification of Short-Term Residential Care (STRC)

STRC is bed-based care for general health problems with the goal to enable (older) adults to return home and live independently in the community. There are three different tariffs for STRC: regular, high-complex and hospice care. In STRC-regular the medical supervisor is the general practitioner (GP) and only Activities of Daily Living (ADL)-care is provided by the facility. Paramedic treatment is according to the payment structure of the health insurer, as if the patient would be at home. In the tariff for STRC-regular no treatment is included. STRC-regular is for patients who are not in need of specific paramedic treatment, but temporarily need more care than homecare can provide. For STRC-high complex the elderly care physician is the medical supervisor and up to 90 minutes per week of (para)medic treatment is funded. The elderly care physician is a medical practitioner who has specialized as a primary care expert in geriatric medicine[11] and has the goal to maintain or improve quality of life for older adults and chronically ill adults.[12] STRC-high complex is for patients who are not only in need of increased care, but also need (multidisciplinary) treatment or rehabilitation in a slower pace than in Geriatric Rehabilitation Care (GRC). Third, STRC-hospice care is provided to patients in the last three months of their lives, the medical supervisor can be the nursing home physician or the GP. In STRC hospice care, 180 minutes of (para)medic treatment per week is funded.

National database

For the description of characteristics of the patients using STRC, a cohort was constructed through data linkage of multiple databases of Statistics Netherlands (in Dutch: Centraal Bureau voor de Statistiek). We used a database of care expenses of all adults (18 years and older) in the Netherlands to select adults who used STRC in 2018 and 2019 to construct our study cohort.

The database of this study cohort was linked to databases with our main outcomes: age, gender, income, medication use, care utilization from 2017 to 2019, and cause of death. The number of medications is registered as the total number of different drugs used in a year, excluding drugs prescribed during a hospital, or nursing home admission. The database of care expenses contains the costs made in a whole year, but not the dates when these costs are made. This makes it possible to describe care utilisation, but not the order in which care is used or the duration of the used care. Drugs are described using the ATC-code. Cause of death is registered with the ICD-10 coding system.

We followed the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) Checklist for the reporting of this observational research (Supplementary Table 1).[13]

National email survey

We developed a survey based on the different characteristics of STRC-facilities in Amsterdam.[10] We followed the Checklist for Reporting of Survey Studies (CROSS, Supplementary Table 2).[14] The survey questions were composed with a physician elderly care with experience in STRC and geriatric rehabilitation and a nurse practitioner working in STRC. Further, the Dutch association of elderly care physicians (Verenso), the National Health Care Institute (Zorginstituut), the Dutch federation for long term care organizations (Actiz), and the Dutch Healthcare Authority (Nederlandse Zorgautoriteit) provided feedback on the survey. The survey, consisting of 30 questions, was built in Limesurvey, an online survey program. The questions were in Dutch and varied in closed and open form.

The survey addressed the following main areas through multiple questions: characteristics of the respondent; demographics of intermediate care facility; characteristics of the facility; specialization in specific patient groups; possibilities for patient admission; team organization and availability of paramedics; organization of care; use of guidelines in delivery of STRC (open question); discharge procedure; vision about target group and possible improvements for intermediate care (open question). The complete questionnaire is available in Supplementary Table 3.

Participant recruitment for online survey

The survey was distributed between December 2019 and February 2020 amongst healthcare professionals working in STRC in the Netherlands. No national list of STRC providers exist. To reach healthcare professionals working in STRC, the survey was shared online on social media and newsletters of associations of health care organizations from nursing home physicians, nurses and general practitioners. Secondly, email addresses of providers of STRC were collected from www.zorgkaartnederland.nl, designed by the Dutch Patient Federation.

Sample size calculation survey

In total, 390 health care organizations in the Netherlands provide STRC[15], but it is unknown at how many locations this type of care is provided. For a representative sample of all organizations, we would need a sample size of 196 respondents working in different STRC-facilities for the survey to be representative.[16]

Analysis

Data of characteristics of adults admitted to STRC are reported as mean with standard deviation (SD) and count with percentages as appropriate. Data was analyzed with R (Version R-4.0.5).

For survey data, any doubles would be manually excluded by checking the timing of the respondents or if an incomplete response was present. Also surveys with an unknown facility or surveys filled in for multiple facilities at one survey were manually excluded. Results were presented in counts with percentages. Data from the survey was analyzed in SPSS (IBM SPSS Statistics for Windows, Version 26.0 Armond, NY: IBM Corp).

Results

Characteristics of older adults in STRC

Table 1 shows the baseline characteristics of older adults admitted to STRC in 2018 and 2019. In total, 68,682 older adults were admitted to STRC in 2018 and 2019. Most patients admitted were female (64.7% in 2018, 65.0% in 2019), lived alone (64.1% in 2018, 64.2% in 2019) and about half of the patients had a low income (50.4% in 2018, 49.2% in 2019). Almost all patients use more than 5 different types of medication. In 2018 68.6% used 10 or more different drugs and in 2019 60.8% used 10 or more different drugs. Over a third of the patients admitted uses psychotropic drugs (2018: 38.6%, 2019: 36.5%).

Table 1: Adults admitted to short term residential care in 2018 and 2019

	2018 N=36,660	2019 N=36,613
Male, N(%)	12,994 (35.3)	12,813 (35.0)
Age, mean (SD)	79.4 (10.8)	79.1 (10.9)
Income of household (N,%)*		
Low income	18,508 (50.4)	18,014 (49.2)
Middle income	11,048 (30.1)	11,098 (30.3)
High income	6,891 (18.7)	7,221 (19.7)
Living in institution	218 (0.6)	215 (0.6)
Unknown	76 (0.2)	65 (0.2)
Living situation, N(%)		
Living alone	23,502 (64.1)	23,505 (64.2)
Living together†	12,864 (35.9)	12,828 (35.0)
Living in institution‖	218 (0.6)	215 (0.6)
Unknown	76 (0.2)	65 (0.2)
Number of drugs, N(%)**		
0	643 (1.7)	566 (1.4)
1-4	2,750 (7.5)	2,887 (7.9)
5-9	10,175 (27.8)	10,906 (29.8)
10-14	12,940 (35.3)	13,005 (35.5)
15-29	7,397 (20.1)	6,917 (18.9)
>20	2,755 (7.5)	2,332 (6.4)
Number of older adults using one or more psychotropic drugs, N(%)‡	14,119 (38.5)	13,361 (36.5)

SD = standard deviation

* Low income is up to 140% of social minimum income, middle income is 140% up to 200% of social minimum income and high income is more than 200% of social minimum income.

† 10,687 of 12,864 is living with spouse without children in 2018, 10,480 of 12,828 is living with spouse without children in 2019.

‖ One or more people who live together and are provided with daily necessities on a commercial basis. The housing also takes place on a commercial basis. These are for example nursing homes, assisted living facilities, facilities for intellectual disabled, jails, homeless shelter.

** Based on ATC-code system, does not include medication provided in hospitals or under the Long-Term Care Act in nursing homes.

‡ Based on Anatomic Therapeutic Chemical Code N05A(antipsychotics), N05B(anxiolytics), N05CD(benzodiazepine), N06A(antidepressants) and N06C (antidepressants in combination with psycholeptics).

Table 2 describes the longitudinal care utilisation and mortality of older adults admitted to STRC in 2018. The table describes their care expenses in the year prior to admission(2017), the year of admission(2018) and the year after admission(2019). Almost all older adults visit the hospital in the year before and after the admission to STRC. 33.2% of patients using STRC is admitted to a long-term care facility in the year of STRC and 29.7% dies in the same year. The year after admission, from the older adults that are still alive, 25.5% is living in a LTC facility, 11.3% receives LTC at home and another 19.4% dies. Of all patients admitted in 2018 to STRC, 15,887 (43.3%) died in the same or following year. The two major causes of death were cancer (38.8%) and diseases of the cardiovascular system (22.7%). Supplementary Table 4 describes all causes of death.

Table 2: Longitudinal care utilisation and mortality of older adults admitted to short-term residential care (STRC) in 2018.

	Care expenses in 2017 N=36,660	Care expenses in 2018 (year of admission) N=36,660	Care expenses in 2019 N=25,758
GP consultation, N(%)	34,242 (93.4)	34,305 (93.5)	19,818 (76.9)
Home care, N(%)	19,835 (54.1)	27,805 (75.8)	11,516 (44.7)
Hospital admission, N(%)*	34,564 (94.2)	35,331 (96.4)	22,631 (87.9)
Long term care at nursing home, N(%)	28 (0.8)	12,181 (33.2)	6,560 (25.5)
Long term care at home, N(%)	28 (0.8)	758 (2.1)	4,146 (11.3)
Death, N(%)	NA	10,902 (29.7)	4,985 (19.4)

GP= general practitioner, NA= not applicable

*Outpatient clinic, emergency department and admission.

National survey characteristics of organisation of STRC

We included 176 surveys for analysis. Supplementary Figure 1 shows the flowchart of inclusion. Participants of the survey were mainly elderly care physicians (33.5%), managers (22.2%), nurses (15.9%) and staff working in front office (11.4%). The front office is responsible for the planning of new admissions. 78.4% of the participants were directly involved in patient care at a STRC-ward. Full description on profession of respondents is described in Supplementary Table 5.

Table 3: Organizational structure and contractual arrangement of facilities providing short term residential care participating in survey

	N= 176
Facility, N(%)	
Nursing Home (NH)	100 (56.8)
Assisted Living Facility (ALF)	46 (26.1)
NH and ALF	7 (4.0)
Rehabilitation center	7 (4.0)
Hospital	10 (5.7)
Hospice*	2 (1.1)
Care hotel†	4 (2.3)
Number of residents or patients	
<51	37 (21)
51-100	55 (31.3)
>100	82 (46.6)
Don't know	2 (1.1)
Other types of care delivered at facility (multiple response)	
Geriatric rehabilitation care	79 (44.9)
LTC| psychogeriatric	118 (67.0)
LTC| psychiatric gerontology	34 (19.3)
LTC| somatic care	131 (74.4)
Respite care	35 (19.9)
Sheltered home	36 (20.5)
Homecare	50 (28.4)
Province:	
Noord-Holland	24 (13.6)
Zuid-Holland	37 (21.0)
Utrecht	9 (5.1)
Groningen	7 (4.0)
Friesland	10 (5.7)
Flevoland	5 (2.8)
Gelderland	23 (13.1)
Overijssel	15 (8.5)
Drenthe	5 (2.8)
Zeeland	6 (3.4)
Noord-Brabant	24 (13.6)
Limburg	11 (6.3)
Number of citizens in environment	
Big city (>100.000)	40 (22.7)
Medium-sized town (25– 100.000)	75 (42.6)
Small village (<25.000)	61 (34.7)
Type of intermediate care provided:	
High complex only	49 (27.8)
Low complex only	25 (14.2)
Hospice care only	4 (2.3)
High complex and low complex	19 (10.8)
High complex and hospice care	38 (21.6)
Low complex and hospice care	6 (3.4)
High complex, low complex and hospice care	35 (19.9)

	N= 176
Location of beds for STRC (multiple answers)	
Separate ward only for STRC	53 (30.1)
Shared ward with Geriatric Rehabilitation Care (GRC)	48 (27.3)
Shared ward with Long Term Care (LTC)	59 (33.5)
Shared ward with GRC and LTC	9 (5.1)
No separate ward, beds for STRC are divided over all wards of facility	34 (19.3)
Don't know	2 (1.1)
Are different types of STRC provided at same ward	
Only one type	68 (38.6)
Separate wards for every type	39 (22.2)
Different types share same ward	63 (35.8)
Don't know	6 (3.4)

* A hospice is a facility dedicated to palliative care where patients are admitted who have less than three months to live. Patients are transferred to these facilities because dying at home is unwanted or not possible for them.

† A care hotel is a facility for a temporary stay with the certainty of care 24 hours per day. They do not offer long term care. Patients have a private room and often pay for extra facilities or luxuries. Patients can be admitted for STRC, then the insurer pays (part of) the admission fee, while patients also can book a room for a holiday.

| Long Term Care

Table 3 describes the organizational structure and the contractual arrangement of the participating facilities. The participating facilities were distributed according to number of inhabitants over the 12 provinces of the Netherlands. 141 (80.1%) of participating wards provide STRC high complex, with a median number of beds of 8 (interquartile range 3-12, minimum 1, maximum 40). 85 facilities (48.3%) provide STRC regular care with a median number of beds of 3 (interquartile range 2-6, minimum 1, maximum 34). 83 (47.2%) facilities provide STRC hospice care, with a median number of beds of 3 (interquartile range 2-5, minimum 1, maximum 30). 153 (86.9%) of these facilities were nursing homes (NH), assisted living facilities (ALF), or both. In general, NH employ elderly care physicians who treat the residents, while in ALF the residents are treated by their general practitioner. In general, ALF do not employ their own physicians and in practice multiple general practitioners treat residents. 92 (52.3%) the facilities were smaller than 100 patients or residents. 79 (44.8%) also provided geriatric rehabilitation, 118 (67%) long term care for older adults with dementia and 131 (74%) long term care for older adults with a somatic disorder. The location of the STRC beds showed a large variation between organizations, but also within organizations: to the question where the beds were located organizations indicated multiple locations for 1 facility. Organizations have a combination of dedicated wards for STRC (30.1%), a shared ward with long term care (33.5%), geriatric rehabilitation (27.3%), or the beds of STRC are spread over the wards of the facility (19.3%).

In STRC high complex the elderly care physician was in 87.2% the responsible physician, while in STRC regular the general practitioner was in 90.6% the responsible physician. For STRC hospice care the elderly care physician is the responsible physician in 69.9% of the facilities, the general practitioner in 22.9%, and in 4.8% both were involved. Most STRC high complex (86.3%) and hospice care (89.2%) have the daily availability of a registered nurse. In STRC regular 59.0% of the facilities a nurse is daily available. ADL-care is mainly provided by registered nurse assistants in STRC high complex (43.4%) and regular (58.8%), while in STRC hospice care 26.5% is provided by nurses and 31.3% by health assistants and in 36.1% by both. 99.4% of STRC facilities have the availability of a physical therapist, 94.8% of an occupational therapist, 90.8% of a dietician, 82.1% of a speech therapist, 85.0% of a psychologist, and 53.8% of a social worker (Supplementary Table 6).

Table 4 shows the operating practices of the participating STRC facilities. On all items we saw a lot of variation: admission outside office hours, frequency of medical consultation and frequency of multidisciplinary team meetings.

Specialization was uncommon for STRC facilities. Only 12 facilities described a specialization, these were high complex or hospice facilities. They specialized in patients with cognitive impairment, cognitive impairment and alcohol abuse, psychiatric problems, patients with a tracheal canule or peripherally inserted central catheter, emergency admissions, or as an observation unit. tracheal cannula or peripherally inserted central catheters, or specialized in emergency admissions or as an observation unit.

STRC facilities used guidelines for the comprehensive geriatric assessment, multidisciplinary consultations geriatric rehabilitation, oncologic care and palliative care (Supplementary Table 7). Staff is missing guidance in the difference between GR and STRC: both admit frail older adults, but the tariff for GR is higher than for STRC. Some staff pointed out that STRC and GR should be combined or show a lot of similarities. Almost all staff pointed out that the tariff is not sufficient for reablement or observation and diagnostics in STRC. Also, a lot of the older adults are in need of LTC. Staff wanted guidelines for how to triage, for reablement, observation and for responsibilities and quality in STRC. Some staff pointed out they wanted their STRC beds to be clustered on a dedicated ward, instead of scattered over the facility (Supplementary Table 7).

Table 4: Operating practices of short term residential care

	High complex N=141	Low regular N=85	Hospice care N=83
Admission of patients outside office hours, N(%)			
Yes, evening	98 (69.5)	44 (48.2)	43 (51.8)
Yes, night	63 (44.7)	23 (27.1)	25 (30.1)
Yes, weekend	97 (68.8)	46 (54.1)	45 (54.2)
No admission outside office hours	28 (19.9)	26 (30.6)	26 (31.3)
Don't know	9 (6.4)	10 (11.8)	8 (9.6)
Frequency of physician's visit, N(%)			
Weekly	80 (58.0)	11 (13.4)	56 (69.1)
Every two weeks	15 (10.9)	8 (9.8)	2 (2.5)
Every three weeks	0	1 (1.2)	0
Every month	1 (0.7)	1 (1.2)	0
When needed, but regular moment	1 (0.7)	0	1 (1.2)
When needed, no regular moment	32 (23.2)	52 (63.4)	16 (19.8)
None	0	0	0
Other	3 (2.2)	0	0
Don't know	6 (4.3)	9 (11.0)	6 (7.4)
Frequency patient chart review, N(%)			
Weekly	98 (71.0)	14 (17.1)	49 (60.5)
Every two weeks	6 (4.3)	4 (4.9)	1 (1.2)
Every month	1 (0.7)	4 (4.9)	0
When needed, but regular moment	2 (1.4)	2 (2.4)	4 (4.9)
When needed, no regular moment	16 (11.6)	38 (46.3)	12 (14.8)
None	1 (0.7)	2 (2.4)	1 (1.2)
Don't know	14 (10.1)	18 (22.0)	14 (17.3)
Frequency of multidisciplinary team meetings, N(%)	50 (36.0)	14 (16.9)	33 (40.7)
Once per week	36 (25.9)	12 (14.5)	17 (21.0)
Once every 2 weeks	13 (9.4)	2 (2.4)	2 (2.5)
Once every 3 weeks	9 (6.5)	4 (4.8)	5 (6.2)
Once every month	7 (5.0)	7 (8.4)	7 (8.6)
Less than every month	8 (5.8)	1 (1.2)	1 (1.2)
When needed	0	32 (38.6)	0
None	5 (3.6)	11 (13.3)	5 (6.2)
Don't know	4 (2.8)	0	0
Other			
Goal setting with planned discharge date, N(%)			
Yes	120 (85.1)	60 (70.5)	NA
No	10 (8.2)	13 (15.3)	
Don't know	4 (2.8)	5 (5.9)	
Other	3 (2.2)	3 (3.5)	
Missing	4	4 (4.8)	

Discussion

We aimed to describe the patient population using short term residential care in the Netherlands and describe the organizational differences using a national database and an exploratory survey.

Short term residential care is mainly used by female and older adults who live alone. Over 60% of patients used more than 10 different drugs in the year of admission, suggesting multimorbidity, and a third used psychotropic drugs. Further, patients are very vulnerable, since 43% of the patients died in the same year of admission or in the year after the admission to STRC. STRC is mainly delivered in nursing homes and assisted living facilities. Facilities locate their STRC beds heterogeneous: there is almost an equal division of facilities who locate their STRC beds on a dedicated STRC ward, a ward with geriatric rehabilitation or a ward with long term care. A fifth of the participating organizations also indicated the beds for STRC are scattered over the different wards of the facility. Staffing is similar over the participating facilities with good availability of a registered nurse and paramedic care. The participating organizations differed in how often they provide medical and multidisciplinary consultations.

This study confirmed the results of our previous qualitative study of patient cases in Amsterdam. These also concerned mainly older adults living alone, with a lot of medical problems and often psychiatric disease. Patients admitted to STRC have a comparable age and gender to patients admitted to community hospitals in the UK[17] and patients admitted to post-acute care in skilled nursing facilities in the US.[18] Of the patients in post-acute care in the US two third has eleven or more chronic conditions, which reflects the high medication use of the Dutch populations. Death rates in STRC are comparable to the one-year-mortality rate in community hospitals, however the amount of patients dying of cancer in STRC is higher than of the community hospitals in the UK.[17] Death rates in intermediate care or community rehabilitation have been rising in the UK the last years. It has been advocated to integrate palliative care services for older people, as the complexity of cases being cared for in the community is increasing.[19]

The organization of STRC are heterogeneous, which makes it difficult to compare outcomes between facilities. This is also the case for intermediate care facilities in the UK.[20, 21] Two studies which tried to evaluate the effectivity of different programs of intermediate care in the UK failed, because they did not reach a sufficient sample size.[22, 23] Future research should focus on different care pathways of STRC and their outcomes.

Staff indicated a higher tariff is needed and the development of care pathways for STRC. Future guidelines should focus on two patient categories: reablement and observation for cognitive problems. Reablement could be, as suggested by staff, located near geriatric rehabilitation, while older adults admitted for cognitive observation could profit from being located near LTC. The higher tariff in the reablement care pathway could be used for more physical therapy, while in the observation care pathway this could be used for psychological observation and support of social work. The description of these pathways with quality indicators will make it easier to compare outcomes between facilities. Further, palliative care should have an important role in these care pathways, since the high mortality rate of older adults admitted to STRC.

Strengths and limitations

A strength of our study is the first national overview of the patients admitted and organization of care in short term residential care in the Netherlands. We objectified the differences and similarities of facilities providing STRC in the Netherlands, further we gave insight in the needs of staff in STRC. This study makes it possible to compare STRC to other types of intermediate care in the world.

A limitation is that the dataset of care costs does not provide admission dates: we were not able to calculate the exact one-year mortality or were able to determine the order in which care was used during the year. Because the costs did not describe if an older adult was using STRC regular, high complex or hospice care we could not analyse the mortality rate of patients of the separate types of STRC. However, we expect the total amount of STRC hospice care to be small according to our survey results. Most of the facilities provides STRC high complex and these wards are also larger than wards of STRC low complex and hospice care. The high mortality rate is in this way not only explained by the hospice care admissions. Also, it was not possible to determine different patient characteristics between STRC regular, high and hospice care.

Because it is unclear how many facilities provide STRC in the Netherlands we do not know if our sample size is representative. We made an estimation of approximately 400 different locations in the Netherlands, which would mean we needed a sample size of 196 locations. However, the distribution of the different locations is representative for the number of inhabitants of the different provinces of the Netherlands. Also we had a lot of incomplete surveys of general practitioners who also treat patients in STRC, which could reflect a selection bias of facilities.

Conclusion

This first national study on STRC confirmed a complex patient population and the large differences in operating practices such as medical and multidisciplinary consultations. An important insight is the high mortality rate of older adults in the year after admission to STRC. It important to develop care pathways and guidelines which make it possible to provide older adults with reablement, but also provide observation and diagnostics for long term care and palliative care. Future research should focus on the outcomes of these care pathways and which older adults benefit from them.

3

Reference List

1. Spasova, S, Baeten, R, Coster, S, et al. Challenges in long-term care in Europe. Brussels: European Commision; 2018.

2. Young, J, Gladman, JR, Forsyth, DR, et al. The second national audit of intermediate care. Age Ageing 2015;44(2):182-184.

3. Abrahamsen, JF, Haugland, C, Nilsen, RM, et al. Three Different Outcomes in Older Community-dwelling Patients Receiving Intermediate Care in Nursing Home after Acute Hospitalization. The journal of nutrition, health & aging 2016;20(4):446-452.

4. Inzitari, M, Gual, N, Roig, T, et al. Geriatric Screening Tools to Select Older Adults Susceptible for Direct Transfer From the Emergency Department to Subacute Intermediate-Care Hospitalization. J Am Med Dir Assoc 2015;16(10):837-841.

5. Sezgin, D, O'Caoimh, R, O'Donovan, MR, et al. Defining the characteristics of intermediate care models including transitional care: an international Delphi study. Aging Clin Exp Res 2020;32(11):2399-2410.

6. Maarse, JA, Jeurissen, PP. The policy and politics of the 2015 long-term care reform in the Netherlands. Health policy (Amsterdam, Netherlands) 2016;120(3):241-245.

7. Schippers, EI. Kortdurend eerstelijns verblijf. In: Ministerie van Volksgezondheid, WeS, ed.; 2014.

8. Subsidieregeling eerstelijns verblijf 2016. 2016.

9. Ligduur eerstelijnsverblijf loopt terug, uitstroom naar huis neemt toe; 2020. https://www.vektis.nl/intelligence/publicaties/ligduur-eerstelijnsverblijf-loopt-terug-uitstroom-naar-huis-neemt-toe. Accessed.

10. van den Besselaar, JH, Hartel, L, Wammes, JD, et al. 'Patients come with two garbage bags full of problems and we have to sort them.' A qualitative study of the experiences of healthcare professionals on patients admitted to short-term residential care in the Netherlands. Age and Ageing 2021;50(4):1361-1370.

11. Koopmans, RTCM, Lavrijsen, JCM, Hoek, JF, et al. DUTCH ELDERLY CARE PHYSICIAN: A NEW GENERATION OF NURSING HOME PHYSICIAN SPECIALISTS. Journal of the American Geriatrics Society 2010;58(9):1807-1809.

12. Specialist Ouderengeneeskunde; https://www.verenso.nl/de-specialist-ouderengeneeskunde/zoek-specialist/specialist-ouderengeneeskunde. Accessed.

13. Vandenbroucke, JP, von Elm, E, Altman, DG, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. PLoS Med 2007;4(10):e297.

14. Sharma, A, Minh Duc, NT, Luu Lam Thang, T, et al. A Consensus-Based Checklist for Reporting of Survey Studies (CROSS). J Gen Intern Med 2021;36(10):3179-3187.

15. Actiz. Infographic ELV 2019; 2019. https://www.actiz.nl/thema/zorg/eerstelijnsverblijf. Accessed 1-12-2019 2019.

16. Taherdoost, H. Determining Sample Size; How to Calculate Survey Sample Size. 2017.

17. Evans, CJ, Potts, L, Dalrymple, U, et al. Characteristics and mortality rates among patients requiring intermediate care: a national cohort study using linked databases. BMC Medicine 2021;19(1):48.

18. Wang, J, Mao, Y, McGarry, B, et al. Post-acute care transitions and outcomes among medicare beneficiaries in assisted living communities. J Am Geriatr Soc 2022.

19. Ariss, SM, Enderby, PM, Smith, T, et al. Health Services and Delivery Research. In: Secondary analysis and literature review of community rehabilitation and intermediate care: an information resource. Southampton (UK): NIHR Journals Library

    Copyright © Queen's Printer and Controller of HMSO 2015. This work was produced by Ariss et al. under the terms of a commissioning contract issued by the Secretary of State for Health. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK., 2015.

20. Martin, GP, Hewitt, GJ, Faulkner, TA, et al. The organisation, form and function of intermediate care services and systems in England: results from a national survey. Health Soc Care Community 2007;15(2):146-154.

21. Nancarrow, S, Moran, A, Freeman, J, et al. Looking inside the black box of community rehabilitation and intermediate care teams in the United Kingdom: an audit of service and staffing. Qual Prim Care 2009;17(5):323-333.

22. Young, J, Hulme, C, Smith, A, et al. Measuring and optimising the efficiency of community hospital inpatient care for odler people: the MoCHA mixed-methods study. Health Service and Delivery Research 2020;8(1).

23. Beresford, B, Mann, R, Parker, G, et al. Reablement services for people at risk of needing social care: the MoRe mixed-methods evaluation. Health Service and Delivery Research 2019;7(16).

Supplementary Table 1: STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Title describes the use of a national database of short-term residential care.
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses Research question at the end of the introduction.
Study design	4	Present key elements of study design early in the paper Before research questionas at the end of the introduction we state: "Using a national database of patients admitted to STRC and by distributing an exploratory national online survey, we addressed the following research questions"
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection We used a database of Statistics Netherlands of all patients admitted in 2018 and 2019.
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Adults of 18 years and older admitted to STRC in 2018 and 2019. We chose these years, because in 2020 a lot of STRC facilities were used to provide COVID-19 care.
		(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Since this was a descriptive observational study, we only describe characteristics (which are main outcomes). This is described in the paragraph of the national database.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group We used one datasource: the databases of Statistics Netherlands (in Dutch: Centraal Bureau voor de Statistiek) In the pararagraph of the national database we elaborate on the registration method of Statistics Netherlands.

continued

	Item No	Recommendation
Bias	9	Describe any efforts to address potential sources of bias Not applicable: we included all adults using STRC in 2018 and 2019.
Study size	10	Explain how the study size was arrived at Not applicable: we included all adults using STRC in 2018 and 2019.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why We only grouped on year of admission: 2018 and 2019.
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Paragraph analysis: we only used descriptive methods, with mean and counts.
		(b) Describe any methods used to examine subgroups and interactions NA
		(c) Explain how missing data were addressed NA
		(d) If applicable, explain how loss to follow-up was addressed NA
		(e) Describe any sensitivity analyses NA
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed NA: all admitted older adults in 2018 and 2019 were included.
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Table 1
		(b) Indicate number of participants with missing data for each variable of interest For living situation, and income of household we indicate the number of unknown. (Table 1)
		(c) Summarise follow-up time (eg, average and total amount)

3

continued

	Item No	Recommendation
Outcome data	15*	Report numbers of outcome events or summary measures over time Table 1 and Table 2, Suplementary table XXX
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Not applicable: descriptive study with characteristics of older adults using STRC in Table 1 and Table 2.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA
Discussion		
Key results	18	Summarise key results with reference to study objectives First paragraph of discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Paragraph strengths and limitations
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results This study is applicable for older adults in STRC in the Netherlands.
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based This research is funded by the Open Technology Program of the Dutch Research Council (NWO), project number 17710, DOLCE VITA (Data-driven Optimization for a Vital Elderly Care System in the Netherlands).

Supplementary Table 2: Checklist for Reporting Of Survey Studies (CROSS)

Section/topic	Item	Item description
Title and abstract		
Title and abstract	1a	State the word "survey" along with a commonly used term in title or abstract to introduce the study's design. Word stated in title and abstract
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions. Abstract
Introduction		
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed. Introduction
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study. Introduction: last paragraph, including research question.
Methods		
Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal). First sentence of the method
	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used). Paragraph on national email survey: 30 questions, closed and open.
Data collection methods	5b	Describe all questionnaire instruments that were used in the survey to measure particular concepts. Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any). Not applicable: no instruments were used.
	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population. The questionnaire was tested by 4 different health care workers with work experience in STRC: two physicians (male and female), a nurse(female) and a manager(female). The testing participants did not include all the professions of participants of the sample population.
	5d	Questionnaire if possible, should be fully provided (in the article, or as appendices or as an online supplement). Supplementary table 3

3

continued

Section/topic	Item	Item description
Sample characteristics	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria). All health care workers who work in a facility providing Short Term Residential Care and have enough knowledge of the ward to answer the questionnaire. This could be staff working in direct patient care on the ward (physician, nurse, health care assistant, occupational therapist etc) or staff which is involved with the care processes but not in direct patient care (managers, front office who handles the placement of older adults in STRC).
	6b	Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied. We used multistage sampling: the survey was distributed online on the website and newsletter of Actiz (trade association of multiple healthcare organizations in the Netherlands), in the newsletter of Verenso (the Dutch Association of Elderly Care Physicians) and amongst the Laego network (cooperation of general practitioners and elderly care physicians with a specialization in primary elderly care). Also the survey was shared on several social media channels by professionals involved in short term residential care to reach colleagues in their network. 4 weeks after distribution a reminder was send by Actiz and Verenso. Secondly, email addresses of providers of STRC were collected from www.zorgkaartnederland.nl, designed by the Dutch Patient Federation. Last, we checked which provinces had the least respondents and with purposeful sampling STRC facilities were extra reminded to participate in the survey.
	6c	Provide information on sample size, along with details of sample size calculation. Method section: sample size calculation.
	6d	Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys. We were able to survey all three tariffs of STRC in the Netherlands, distributed accordingly to patient population over the provinces of the Netherlands. We did not reach the sample size for enough power.

continued

Section/topic	Item	Item description
Survey administration	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient room or by use of online tools, such as SurveyMonkey). The survey was distributed in LimeSurvey. The survey had to be finished in the same session. The start screen provided information that the survey had to be finished in one session and would take 20-30 minutes to complete.
	7b	Provide information of survey's time frame, such as periods of recruitment, exposure, and follow-up days. The recruitment was in one period: December 2019-February 2020.
	7c	Provide information on the entry process: −>For non-web-based surveys, provide approaches to minimize human error in data entry. −>For web-based surveys, provide approaches to prevent "multiple participation" of participants. Participants had to state the organization and the name of the facility. If multiple health care workers would provide information for the same facility, we would know we had a double and we could exclude the doubles.
Study preparation	8	Describe any preparation process before conducting the survey (e.g., interviewers' training process, advertising the survey). The survey was tested by four health care workers working in short term residential care.
Ethical considerations	9a	Provide information on ethical approval for the survey if obtained, including informed consent, institutional review board [IRB] approval, Helsinki declaration, and good clinical practice [GCP] declaration (as appropriate). An ethical waiver was obtained by the Medical Ethics Committee of the Amsterdam University Medical Center.
	9b	Provide information about survey anonymity and confidentiality and describe what mechanisms were used to protect unauthorized access. To guarantee anonymity of the survey participants, we did not collect their email addresses, but distributed the survey with a web-page link. We only collected the profession of the participant, but no details on gender or age. Because the details of the survey were about the facility, we found it not necessary to collect these details of the participants.

3

continued

Section/topic	Item	Item description
Statistical analysis	10a	Describe statistical methods and analytical approach. Report the statistical software that was used for data analysis. Method section, analysis.
	10b	Report any modification of variables used in the analysis, along with reference (if available). We modified the answer 'other' of multiple variables to a new category for analysis.
	10c	Report details about how missing data was handled. Include rate of missing items, missing data mechanism (i.e., missing completely at random [MCAR], missing at random [MAR] or missing not at random [MNAR]) and methods used to deal with missing data (e.g., multiple imputation). We provided a flow-chart in supplementary Figure 1. 224 questionnaires were ended before question 14: we deemed this minimal information to include the survey for analysis. Of these 224 questionnaires, 185 were already stopped before the third page of the survey where the respondent had to answer questions about their profession and the facility they were working. We don't know why respondents stopped the survey so quickly, but we hypothesize possible respondents were curious how the survey looked like and went back later to answer the questionnaire. Since questionnaires had to be finished at once, they had to open a new questionnaire. The remaining 64 participants who quitted before question 14 were 10 physician elderly care, 7 GP, 2 residents, 1 physician assistant, 4 nurses, 20 managers, 1 occupation therapist, 1 physical therapist and 18 front office. These questionnaires were from facilities of all provinces, of which 53% provided high complex, 37,5% regular and 29,7% hospice care. Of the 176 included questionnaires, 167 were complete. The 9 questionnaires with missing data were from 2 physicians elderly care, 1 nurse, 4 front office, 1 manager and 1 physical therapist. 8 offered STRC regular and high complex and 4 offered hospice care. They were located in 5 provinces (Noord-Holland, Zuid-Holland, Gelderland, Limburg, Noord-Brabant). Since we had a low number of incomplete questionnaires we decided not to impute.
	10d	State how non-response error was addressed. Since we had a high rate of complete surveys (167/176 of included surveys), we think we have a low non-response error and did not alter analysis.
	10e	For longitudinal surveys, state how loss to follow-up was addressed. NA
	10f	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for non-representativeness of the sample. NA
	10g	Describe any sensitivity analysis conducted. NA

continued

Section/topic	Item	Item description
Results		
Respondent characteristics	11a	Report numbers of individuals at each stage of the study. Consider using a flow diagram, if possible. Flow chart in supplementary figure 1.
	11b	Provide reasons for non-participation at each stage, if possible. Flow chart in supplementary figure 1.
	11c	Report response rate, present the definition of response rate or the formula used to calculate response rate. Since we do not know how many Short Term Residential Care facilities exist in the Netherlands we could not calculate a response rate.
	11d	Provide information to define how unique visitors are determined. Report number of unique visitors along with relevant proportions (e.g., view proportion, participation proportion, completion proportion). We could only see how many times the web page with the questionnaire was started (496 times), but because we did not collect email-addresses or names of respondents we could not determine how many unique visitors we had. Because we collected information on a facility level we included one questionnaire per facility. We included the first most complete questionnaire for analysis. (Supplementary Figure 1) Of these 176 included questionnaires, 167 were answered completely.
Descriptive results	12	Provide characteristics of study participants, as well as information on potential confounders and assessed outcomes. We think our questionnaire had a low risk on bias, because we wanted to collect information on the facility level. However, it is possible that respondents who are proud of their facility or facilities with a higher staffing rate were more inclined to answer. These are hypotheses, so we were not able to correct for this possible biases.
Main findings	13a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates along with 95% confidence intervals and p-values. NA
	13b	For multivariable analysis, provide information on the model building process, model fit statistics, and model assumptions (as appropriate). NA
	13c	Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible). NA

3

continued

Section/topic	Item	Item description
Discussion		
Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders. Discussion section
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research. Discussion section
Generalizability	16	Discuss the external validity of the results. Discussion section
Other sections		
Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis. No funding for survey research.
Conflict of interest	18	Declare any potential conflict of interest. No conflict of interest
Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research. We thank Cynthia Bot for the help in drafting and building of the survey.

Supplementary Table 3: Survey questions

#	Question	Answer options	Additional information
	Start		
1	Does your facility offer intermediate care?	Yes/No	Survey ends when "No" is selected.
2	What is your current position?	1 = Elderly care physician 2 = General practioner 3 = Intellectual disability physician 4 = Resident 5 = Intern 6 = Specialized nurse or physician assistant 7 = Nurse 8 = Manager 9 = Other	
3	Are you directly involved with the intermediate care in your facility?	Yes/No	
	Demographics		
4	What is the name of your health care organization?	Free text entry	
5	What is the name of the specific location you are working?	Free text entry	
6	What type of location is this?	1 = Skilled nursing facility 2 = Residence for assisted living 3 = Revalidation center 4 = Hospital 5 = Other 6 = Don't know	
7	In which province is the facility located?	Answer options with all provinces	
8	Is the facility located big city, a small city or a small town?	1 = Big city (>100.000 residents) 2 = Small city (25.000 - 100.000 residents) 3 = Small town (<25.000 residents)	
9	What kind of intermediate care does your facility offer?	Multiple options can be selected: high complex, low complex and palliative	An extra question appears per type about how many beds are available.

#	Question	Answer options	Additional information
	Physical organization		
10	Which type of care is offered by your facility besides intermediate care?	Multiple options can be selected: 1 = GRZ[1] 2 = WLZ Psychogeriatric 3 = WLZ[2] Geropsychiatry 4 = WLZ Somatic care 5 = Respite care 6 = Protective living 7 = Service apartments 8 = Residential care 9 = Home care 10 = Other 11= Don't know	
11	How many beds are there in total?	1 = <20, 2 = 20-30, 3 = 31-50, 4 = 51-100, 5 = >100, 6 = Don't know	
12	Where are the intermediate care beds located?	1 = A special ward with only intermediate care beds 2 = A shared ward with GRZ beds 3 = A shared ward with WLZ beds, 4 = A shared ward with both GRZ and WLZ beds 5 = Beds are spread through the whole facility on different wards, 6 = Don't know 7 = Other	
13	Are different types of intermediate care located on the same ward?	1 = No, we offer only one type of intermediate care 2 = No, separate wards 3 = Yes 4 = Don't know	Appears if the answer on question 12 is 1-4.
	Collaboration and specialty		

#	Question	Answer options	Additional information
14	Does your facility has one or more of the following options:	Multiple options can be selected: 1= Collaborations with other facilities or hospitals 2= Specialization 3= Triage beds/white label beds[3] 4= Other 5= None of the above 6= Don't know	Further explanation is asked when 1-4 is selected. If a participant continued until this question, the survey was included for analysis.
	Admission		
15*	From where/who are applications for admission possible?	1 = General practitioner 2 = Elderly care physician (from another facility) 3 = Emergency department 4 = Hospital ward 5 = Other 6 = Don't know	
16*	Is admission possible in the evening, night or weekends?	Multiple options can be selected: 1= Evening 2= Night 3= Weekend 4= None of the above 5= Don't know	If 1-3 is selected, an extra question appears about how often this happens: daily, weekly, monthly, a couple times a year or never.
	Team organization		
17*	Who is the main physician?	1 = Elderly care physician 2 = General practitioner 3 = Intellectual disability physician , 4 = Other 5 = Don't know	
18*	Which health care professional has the daily control of the intermediate care patients?	Multiple options can be selected: 1 = Elderly care physician 2 = General practitioner 3 = Intellectual disability physician 4 = Resident 5 = Intern 6 = Specialized nurse or physician assistant 7 = Nurse 8 = Other 9 = Don't know	

3

continued

#	Question	Answer options	Additional information
19*	Give an indication of how often the following caretakers are involved with the daily care of intermediate care patients: specialized nurse, level 5 nurse, level 4 nurse, assistant elderly care and district nurse.	1 = Daily 2 = Weekly 3 = 1-2 times per month 4 = On demand 5 = Not involved 6 = Don't know	
20*	How is the daily care divided among the different caretakers?	1 = The daily care is equally divided 2 = The daily care is most done by level 5 nurses 3 = The daily care is most done by level 4 nurses 4 = The daily care is most done by level 3 health care assistants 5 = The daily care is mostly done by level 2 health care assistants 6 = Other 7 = Don't know	Explanation is asked if "Other" is filled in.

Other disciplines

#	Question	Answer options	Additional information
21	Which discipline(s) are available for patients in the intermediate care in your facility?	Multiple options can be selected: 1 = Physical therapist 2 = Occupational therapist 3 = Dietician 4 = Speech therapist 5 = Psychologist or behavioral therapist 6 = Social worker 7 = Elderly care physician (if not standard physician) 8 = Activities supporter 9 = Pharmacist 10 = Other 11 = Don't know	For each selected option, a new question appears about how fast this discipline is available.
22*	How often does a teammeeting take place?	1 = Once a week, 2 = Once every 2 weeks, 3 = Once every 3 weeks, 4 = Once every 4 weeks, 5 = Less than once every 4 weeks, 6 = There are no team meetings, 7 = Other, 8 = Don't know	

continued

#	Question	Answer options	Additional information
	Organization of care		
23*	How often is there a patient file round (discussing a patient without visitation) by a physician or a skilled nurse/physician assistant?	1 = Weekly, 2 = Once every 2 weeks, 3 = Once every 3 weeks, 4 = Once a month, 5 = Only when needed, 6 = Other, 7 = Don't know	
24*	How often is there a medical round (visitation of the patient) by a physician or a skilled nurse/physician assistant?	1 = Weekly, 2 = Once every 2 weeks, 3 = Once every 3 weeks, 4 = Once a month, 5 = Only when needed, 6 = Other, 7 = Don't know	
	Guidelines		
25	Does your facility use guidelines in the care of intermediate care patients? You can think of the guidelines from Verenso or NVKG[4], for example: Geriatric Rehabilitation care or Comprehensive Geriatric Assessment (CGA).	Yes/No/Don't know	If yes, the following question appears: which guidelines are used?
26	Which guidelines do you miss or would you want to be developed in the future?	Free text entry	Question is not mandatory.
	Discharge		
27*	Is there a conversation planned when a patient is discharged from the intermediate care?	1 = Always, 2 = Never, 3 = Sometimes, 4 = Only on family request, 5 = Only with complex patients, 6 = Don't know	If 1 or 3-5, who is doing the conversation?
28*	Does your facility work with a preliminary discharge date?	Yes/No/Don't know	
	Vision		
29	Which patient category is suitable for the use of intermediate care according to you?	Free text entry	Question is not mandatory.

3

#	Question	Answer options	Additional information
30	Do you have ideas of how the intermediate care can be improved?	Free tekst entry	Question is not mandatory.

*These questions appear individually for every type of intermediate care that a facility offers.

[1]GRZ = Geriatric Revalidation Care

[2]WLZ = Long-term care Act

[3]Triage or white label beds are beds where a patient can be admitted without an indication. The indication assessment will following during admission.
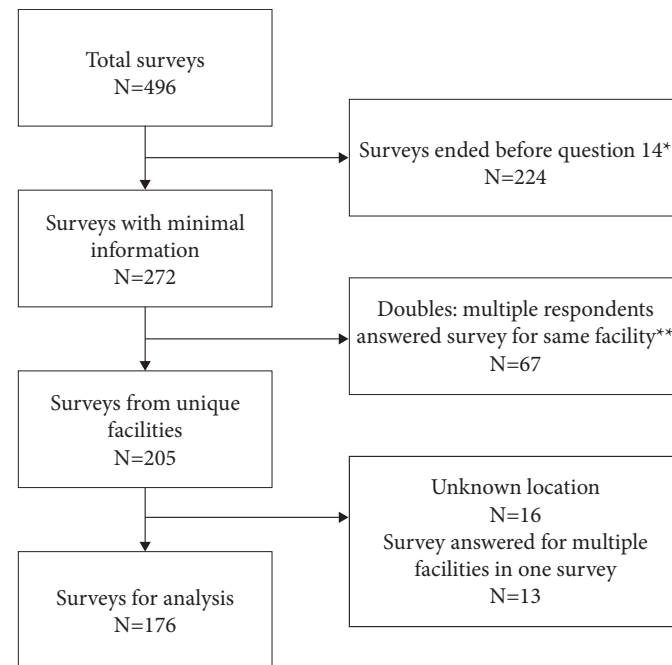
[4]NKVG = Dutch Association of Clinical Geriatricians

Supplementary Table 4: Causes of death

	2018 N= 10,902	2019 N= 4,985
Cause of death top 10 in 2018, N(%)**		
Lung cancer	1,165 (10.6)	218(4.5)
Heart failure	624 (5.7)	305 (6.1)
Breast cancer	322 (2.9)	100 (2.0)
Prostate cancer	310 (2.8)	103 (2.1)
Family history of stroke	299 (2.7)	138 (2.8)
Colon cancer	293 (2.7)	86 (1.7)
Dementia	287 (2.6)	355 (7.1)
Pneumonia	260 (2.4)	167 (3.4)
COPD	237 (2.2)	145 (2.9)
Fall	188 (1.7)	116 (2.3)
Top 5 cause of death 2018, major groups ICD		
Neoplasms	4,940 (45.3)	
Disease of circulatory system	2,335 (21.4)	
Disease of respiratory system	845 (7.8)	
Mental behavioural and neurodevelopmental disorders	366 (3.4)	
Diseases of the digestive system	321 (2.94)	
Top 5 cause of death 2019, major groups ICD	NA	
Neoplasms		1,239(24.9)
Diseases of circulatory system		1,279(25.7)
Diseases of the respiratory system		525(10.5)
Mental, behavioural and neurodevelopmental disorders		446(8.9)
Diseases of the nervous system		276(5.5)

	N=15,387*
Cause of death, major groups ICD, N(%)	
Certain infectious and parasistic diseases	208 (1.35)
Neoplasms	6,179 (40.2)
Diseases of the blood and blood-forming organs and certain disorders involving the immune system	338(2.2)
Endocrine nutritional and metabolic diseases	305(2.0)
Mental, behavioural and neurodevelopmental disorders	812 (5.3)
Diseases of the nervous system	565 (3.7)
Diseases of the circulatory system	3,614(23.5)
Diseases of the respiratory system	1,370(8.9)
Diseases of the digestive system	477(3.1)
Diseases of the musculoskeletal and connective tissue	163(1.1)
Diseases of the genitourinary system	487(3.2)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	389(2.5)
External causes of morbidity	441(2.9)

*Only causes of death with more than 100 persons were available from statistics Netherlands to ascertain the privacy. 500 missing.

Supplementary Figure 1

Supplementary Table 5: Profession of respondents

	N=176
Profession N (%)	
Elderly care physician	59 (33.5)
General practitioner	4 (2.3)
Resident elderly care	2 (1.1)
Physician assistant	5 (2.8)
Nurse	28 (15.9)
Health care assistant	4 (2.3)
Physical or occupational therapist	2 (1.1)
Social worker	1 (0.6)
Manager	39 (22.2)
Front-office*	20 (11.4)
Account manager	5 (2.8)
Board member health care organization	3 (1.7)
Team coach	3 (1.7)
Advisor quality and care	1 (0.6)
Involved in direct patient care at ward, N(%)	138 (78.4)

*Plans the admission of older adults in STRC

*We included surveys which were completed until the 14th question to make sure we had enough information of the facility. Questionnaires which were ended before the 14th question were excluded.

**If multiple respondents answered the questionnaire for the same facility we included the questionnaire which was answered most of the questions. If there were multiple questionnaires completed, we included the first completed questionnaire.

Supplementary Table 6: Staffing and skill mix in facilities providing short term residential care in the Netherlands

	High complex N=141	Regular N=85	Hospice care N=83
Responsible/supervising physician, N(%)			
Elderly care physician	123 (87.2)	8 (9.4)	58 (69.9)
General practitioner	15 (10.6)	77 (90.6)	19 (22.9)
Specialist elderly care or GP	1 (0.7)		
Specialist elderly care or physician assistant	2 (1.4)		4 (4.8)
Don't know			1 (1.2)
Other			1 (1.2)
In charge of daily care (multiple response), N(%)			
Elderly care physician	96 (68.1)	5 (5.9)	50 (60.2)
General practitioner	13 (9.2)	41 (48.2)	17 (20.5)
Resident	20 (14.2)	0	12 (14.5)
Intern	21 (14.9)	1 (1.2)	6 (7.2)
Physician assistant	41 (29.1)	8 (9.4)	17 (20.5)
Nurse	60 (42.6)	48 (56.5)	40 (48.2)
Health care assistant	55 (39.0)	56 (65.9)	34 (41.0)
Don't know	2 (1.4)	2 (2.4)	1 (1.2)
Other	1 (0.7)	2 (2.4)	1 (1.2)
Availability physician assistant , N(%)			
Daily	14 (9.9)	0	7 (8.4)
Weekly	40 (28.4)	7 (8.2)	20 (24.1)
Monthly	5 (3.5)	2 (2.4)	1 (1.2)
Consult	21 (14.9)	16 (18.8)	16 (19.3)
Never	54 (38.3)	51 (60.0)	32 (38.6)
Don't know	5 (3.5)	7 (8.2)	5 (6.0)
Missing	2 (1.4)	2 (2.2)	2 (2.4)
Availability skilled nurse level 5*, N(%)			
Daily	38 (27.0)	9 (10.6)	28 (33.7)
Weekly	31 (22.0)	21 (23.5)	16 (19.3)
Monthly	2 (1.4)	3 (3.5)	2 (2.4)
Consult	23 (16.3)	10 (11.8)	13 (15.7)
Never	37 (26.3)	33 (38.8)	20 (24.1)
Don't know	8 (5.7)	8 (9.4)	2 (2.4)
Missing	2 (1.4)	2 (2.4)	2 (2.4)
Availability skilled nurse level 4*, N(%)			
Daily	119 (84.4)	49 (57.6)	71 (85.5)
Weekly	15 (10.6)	16 (18.8)	7 (8.4)
Monthly	0	3 (3.5)	1 (1.2)
Consult	1 (0.7)	3 (3.5)	0
Never	1 (0.7)	3 (3.5)	0
Don't know	3 (2.1)	9 (10.6)	2 (2.4)
Missing	2 (1.4)	2 (2.4)	2 (2.4)

continued

	High complex N=141	Regular N=85	Hospice care N=83
Availability community nurse, N(%)	NA		NA
Daily		4 (4.7)	
Weekly		5 (5.9)	
Monthly		3 (3.5)	
Consult		16 (18.8)	
Never		45 (52.9)	
Don't know		10 (11.8)	
Missing		2 (2.4)	
Who is mainly providing ADL-care? , N(%)			
All levels	50 (35.5)	19 (22.4)	30 (36.1)
Skilled nurse level 5*	2 (1.4)	0	0
Skilled nurse level 4*	20 (14.2)	5 (5.9)	22 (26.5)
Registered level 3*	61 (43.4)	50 (58.8)	26 (31.3)
Health assistant level 2*	0	1 (1.2)	0
Other	2 (1.4)	2 (2.4)	2 (2.4)
Don't know	4 (2.8)	6 (7.1)	1 (1.2)
missing	2 (1.4)	2 (2.4)	2 (2.4)
Availability of paramedics	All level together, total N=173		
Physical therapist	172 (99.4)		
Occupational therapist	164 (94.8)		
Dietician	157 (90.8)		
Speech therapist	142 (82.1)		
Psychologist	147 (85.0)		
Social worker	93 (53.8)		
Pharmacist	92 (53.2)		
Activity support	89 (51.4)		

*In the Netherlands, skilled nurses and registered nurse assistants can be trained according to different levels with different responsibilities.

Supplementary Table 7: Open questions

Does your facility use guidelines in the care of intermediate care patients? You can think of the quidelines from Verenso or NVKG[4], for example: Geriatric Rehabilitation care or Comprehensive Geriatric Assessment (CGA).
Yes 83/172 (48.3%)
No 34/172 (19.8%)
Don't know 55/172 (32.0%)

Which guidelines do you use (108 answers)
Verenso guidelines*: multidisciplinary consultations, cerebrovascular accident, geriatric rehabilitation, dementia, delirium
NHG guidelines: urinary tract infections, airway infections
Pallialine guidelines
Oncoline guidelines
NVKG: Comprehensive Geriatric Assessment
Local carepaths/guidelines: short term residential care, fall prevention, decubitus, wound care
Triage guideline

Which guidelines do you miss or would you want to be developed in the future? (37 answers)
How to design wards and rooms for STRC
Difference between all forms of short term care/intermediate care
Care pathways for reablement or cognitive evaluation
How to determine the prognosis of patients in STRC
Because of the broad patient category, it is difficult to name a specific guideline

---

Which patient category is suitable for the use of intermediate care according to you? (121 answers)
- Patients with somatic problems (59): wound care, patients who cannot start with rehabilitation yet because they are not allowed to train yet, oncology, infection, reablement after hospital admission
- Temporary care: patients should be able to return home or need reablement
- Older adults
- Singular problem / no futher diagnostics needed
- Similarities with geriatric rehabilitation: should be before or after geriatric rehabilitaiton, in need of a rehabilitation climate
- No rehabilitation goal
- Observation or diagnostics
- Cognitive evaluation
- Care cannot be delivered at home
- Acute problem, crisis
- Multiple problems, multidiscilplinary care

Do you have ideas of how the intermediate care can be improved? (106 answers)
- Need for Long Term Care should be made clear: better triage, prevention, more crisis beds for Long Term Care, more admission possibilities to Long Term Care
- Higher tariff : observation, social work, psychologist
- Stop with different forms of short term care (STRC and geriatric rehabilitation) and provide a modular tariff
- It should be easier to change between forms of short term care
- Communication: handover, collaboration with referring physician, collaboration with paramedics, make it clear for family and the patient STRC is a temporary solution
- More time for observation and diagnostics
- Professionalization of STRC:
- Uniformity: quality criteria should be developed
- Competences of staff: training for nurses or physicians
- Design of the ward: Short term care should be on a dedicated ward or located near geriatric rehabilitation, observation and reablement should be different care pathways

---

NHG= Dutch Association of Primary Care Physicians (Nederlands Huisarts Genootschap)

NVKG= Dutch Association for Geriatricians (Nederlandse Verengiging voor Klinische Geriatrie)
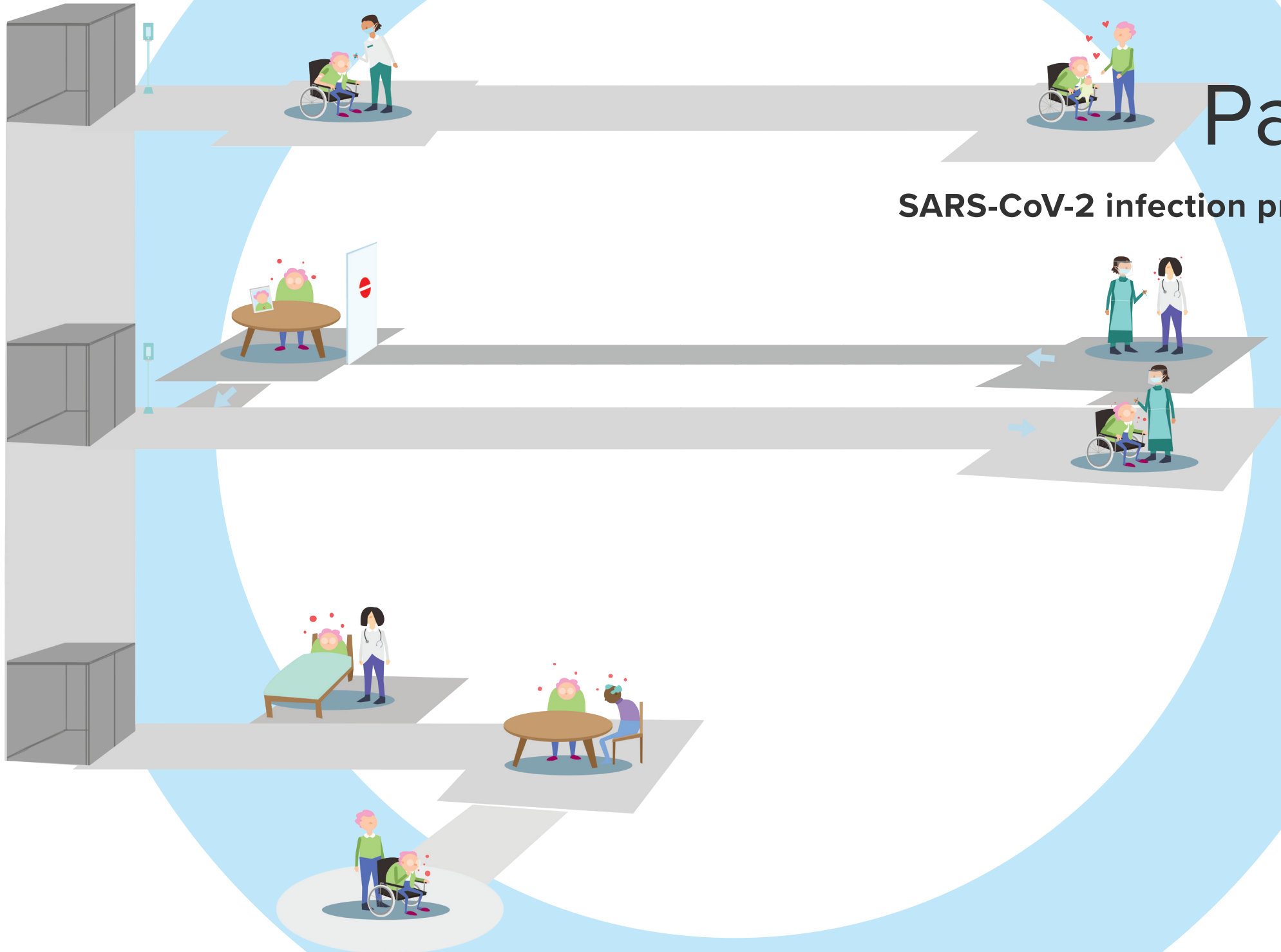
Oncoline= www.oncoline.nl is a Dutch website which comprises all the current guidelines for oncologic diseases

Pallialine= www.pallilaine.nl is a Dutch website which comprises all current guidelines for palliative care

Verenso= the Dutch association of elderly care physicians

Part II

SARS-CoV-2 infection prevention

4

Asymptomatic Cases and Limited Transmission of SARS-CoV-2 in Residents and Healthcare Workers of Three Dutch Nursing Homes

Laura W. van Buul*,
Judith H. van den Besselaar*,
Fleur M. H. P. H. Koene,
Bianca M. Buurman-van Es,
Cees M. P. M. Hertogh,
COVID-19 NH-Study Group
*contributed equally to this work

Abstract

We aimed to assess the contribution of a- and presymptomatic residents and healthcare workers in transmission of SARS-CoV-2 in nursing homes. We conducted two serial point-prevalence surveys, including standardized symptom assessment and nasopharyngeal and oropharyngeal testing for SARS-CoV-2, among 297 residents and 542 healthcare workers of three Dutch nursing homes (NHs) with recent SARS-CoV-2 introduction. At the first point-prevalence survey, 15 residents tested positive of which one was presymptomatic and three remained asymptomatic. At the second point-prevalence survey one resident and one healthcare worker tested SARS-CoV-2 positive and both remained asymptomatic. Although a limited number of SARS-CoV-2 positive cases were identified, this study confirms a- and presymptomatic occurrence of COVID-19. We additionally describe factors that may contribute to the prevention of transmission. Taken together, our study complements the discussion on effective SARS-CoV-2 screening in NHs.

Introduction

Since the introduction of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), many nursing homes (NHs) worldwide have been hit by outbreaks of this new virus. In the Netherlands, at the time of conduction of the current study it was advised to perform SARS-CoV-2 testing in case of symptoms consistent with possible coronavirus disease 2019 (Covid-19). However, transmission of SARS-CoV-2 by a- and presymptomatic NH residents has been reported, which may warrant alternative screening policy in NHs.[1,2] More evidence is needed to support adjustment of screening policy, thereby also including the role of healthcare workers in SARS-CoV-2 transmission. We therefore aimed to assess the contribution of a- and presymptomatic residents and healthcare workers in transmission of SARS-CoV-2 in three NHs in the Netherlands.

Methods

Setting and study population

The study was conducted in three NHs in the Netherlands with recent SARS-CoV-2 introduction (i.e. at least one SARS-CoV-2 positive resident): NH-A, NH-B, and NH-C, of which NH-B had a Covid-19 outbreak in the month preceding the study and recent newly identified cases. During the period of study conduction, the incidence of confirmed cases of COVID-19 varied from 0.6 to 2.1 cases per 100.000 inhabitants, and at the study onset there were 628 NH locations with COVID-19 cases across the country. (Dutch Ministry on Health, Welfare and Sport [VWS], 2020) It was national policy that all NHs were closed for visitors. Characteristics of participating NHs, including NH-specific Covid-19 policy at the time of study conduction, are presented in Table 1. All NHs implemented a policy of weekly testing of all residents and health care workers regardless of symptoms, while at the time of study conduction the national policy included testing in the occurrence of symptoms. All residents and health care workers were invited to participate.

In general, Dutch NHs accommodate frail older adults who require complex and continuing care. Types of wards on which they can be accommodated include; somatic wards (i.e. for persons with mainly physical issues), psychogeriatric wards (i.e. for persons with cognitive disorders, mainly dementia), rehabilitation wards, and palliative care wards. Medical care is generally provided by elderly care physicians – a separate medical discipline in the Netherlands – who are employed by, and have their principal site of practice in the NH.[3]

Table 1: Characteristics of the participating NHs.

	NH-A	NH-B	NH-C
Geographic characteristics	Located in suburb of large city in the province of South Holland	Located in a village in the province of North Brabant	Located in suburb of large city in the province of North Holland
Number of beds	140	120, and day service for people with dementia.	121
Number and type of wards	8 wards (on 10 floors); 5 where psychogeriatric care is provided, 3 where somatic care is provided.	15 residential groups with a separate front door each; 12 where psychogeriatric care is provided, 2 where somatic care is provided, 1 where both psychogeriatric and somatic care are provided.	14 wards (on 5 floors); 3 where psychogeriatric care is provided, 4 where somatic care is provided, 2 where psychiatric care is provided, 2 where geriatric rehabilitation is provided, 1 where long-term care for acquired brain injury is provided and 1 where intermediate care is provided.
Covid-19 policy at the time of study conduction*	Preventive use of surgical masks by healthcare workers on all wards; use of isolation gown, gloves over the wrists, goggles and a face mask in contact with Covid-19 suspected or confirmed residents. Covid-19 confirmed residents are transferred to a designated Covid-19 cohort ward; residents on the former ward of Covid-19 confirmed residents are placed in quarantine for 14 days.	Residential groups are divided in two cohorts because of previous Covid-19 cases; one cohort without and one cohort with Covid-19 (suspected) residents. Covid-19 suspected or confirmed residents are isolated in their rooms (or a complete residential group is isolated in case of multiple cases); use of isolation gown, gloves over the wrists, goggles and a face mask in contact with these residents.	Preventive use of face masks and gloves at the intermediate care ward. Covid-19 confirmed residents are isolated in their rooms (or a complete ward is isolated in case of multiple cases); use of isolation gown, gloves over the wrists, goggles and a face mask in contact with these residents. On one ward reversed isolation (negative residents isolated in their rooms) because of the inability to instruct a positive resident.

NH= nursing home, PPE= personal protective equipment, Covid-19= Coronavirus disease 2019.

*With regard to healthcare workers, policy of the National Institute for Public Health and the Environment is followed, implying that all individuals with Covid-19 consistent symptoms stay home until they receive their SARS-CoV-2 test results. In case of a negative result, healthcare workers with mild symptoms are allowed to work, taking into account general hygiene precautions. Health care workers with a positive test stay home until minimal 7 days after symptom onset, and until they have been free of fever for at least 48 hours and free of symptoms for at least 24 hours. In exceptional situations, positive and symptomatic healthcare workers can work using PPE. In addition to the abovementioned policy, policy of the participating NHs in case of positive but asymptomatic healthcare workers was that these individuals stay home for 72 hours; national policy as stated above was followed if symptoms developed in the meantime, if no symptoms developed healthcare workers were allowed to work using PPE.

Serial point prevalence survey

We conducted two serial point-prevalence surveys, including SARS-CoV-2 testing of all residents and healthcare workers, irrespective of whether they had been previously tested SARS-CoV-2 positive, and questionnaire completion. The first survey was performed in the week of May 4th 2020, and was repeated 7 days later when tests were negative. SARS-CoV-2 positive individuals without symptoms or with atypical symptoms in the 14 days before their positive test were followed 14 days for development of symptoms.

Nasopharyngeal and oropharyngeal swabs were collected by trained healthcare workers and specialized swab teams from the Public Health Service, in accordance with national guidelines.[4] Samples were transported to collaborating laboratories at the end of each test day, where they were tested for SARS-CoV-2 polymerase chain reaction (PCR) targets, see Supplementary Text 1.

Questionnaires were completed on the day of SARS-CoV-2 testing. Resident questionnaires were completed by healthcare workers, based on an interview with the resident and/or review of medical records; healthcare worker questionnaires were completed by the research team based on an interview with the healthcare worker, or online by healthcare workers themselves. The questionnaire included baseline characteristics (i.e. age and sex) and a standardized symptom-assessment form (for included signs and symptoms, see below). For residents, additionally documented were: ward name and type, comorbid conditions, previous Covid-19 disease, and recent admission or internal relocation. Healthcare workers were additionally asked for their type of profession (e.g. nurse assistant, nurse, physician), wards where they had worked the preceding 14 days, and personal protective equipment (PPE) use.

Analysis

A participant was classified symptomatic in case of at least one new/worsened typical or atypical symptom of Covid-19 in the 14 days before a positive SARS-CoV-2 test. Typical signs and symptoms included fever (measured according to local NH protocol), cough, and shortness of breath. Atypical symptoms included chills, malaise, fatigue, rhinorrhea, nasal congestion, sore throat, myalgia, headache, nausea or diarrhea, diminished food intake, and loss of smell or taste. For residents, (increased) confusion and decreased oxygen saturation (both measured according to local NH protocol) were also classified as atypical. A participant was classified presymptomatic if no symptoms were present the 14 days before a positive SARS-CoV-2 test, but typical or atypical symptoms developed

during follow-up; when no symptoms developed during follow-up the participant was classified asymptomatic. Data were analyzed descriptively using Excel and SPSS version 26 (IBM, Armonk, NY).

Ethics

Residents, or their representatives in case of legal incapacity, were given the opportunity to opt-out for using their data in the study. Health care workers provided informed consent for using their data prior to questionnaire administration. The Medical Ethics Committee of X reviewed the study protocol and confirmed that the study does not fall under the scope of the Medical Research Involving Human Subjects Act.

Results

A total of 297 NH residents were included in the study (overall response: 86%; NH-A: 86%, NH-B: 90%, NH-C: 80%). 542 healthcare workers were included (overall response: 91%; NH-A: 94%, NH-B: 93%, NH-C: 87%). Demographic characteristics are presented in *Tables 2 and 3*.

At the first point-prevalence survey, 15 residents (5%) tested SARS-CoV-2 positive (NH-A: 1, NH-B: 11, NH-C: 3), of which 9 (NH-B: 7, NH-C: 2) had a previous positive test result in the months preceding study onset. Of the 6 newly identified cases of SARS-CoV-2, 2 were symptomatic (both in NH-B; Cycle threshold (Ct) value 22 in both), 1 was presymptomatic (in NH-A; Ct value >35), and 3 remained asymptomatic during follow-up (2 in NH-B and one in NH-C; Ct values 23, 30, and 32). A total of 8 healthcare workers tested SARS-CoV-2 positive at the first point-prevalence survey (NH-B: 7, NH-C: 1). All had typical symptoms; 5 had not worked in the two weeks before the first point-prevalence survey. At the second point-prevalence survey, one resident and one healthcare worker in NH-A tested SARS-CoV-2 positive (Ct value >35 and 24, respectively). Both were asymptomatic on the day of testing.

Table 2: Demographic characteristics of residents of participating NHs.

RESIDENTS			
	NH-A (N=114)	**NH-B (N=104)**	**NH-C (N=79)**
Age, average (range)	86.2 (68 – 103)	84.9 (55 – 103)	79.5 (47 – 102)
Female, n (%)	84 (73.7)	84 (80.8)	51 (64.6)
Care type*:			
Geriatric rehabillitation / short term care, n (%)	N/A	N/A	20 (24.1)
Long-term somatic care, n (%)	37 (32.5)	18 (19.6)	(35.4)
Long-term psychogeriatric care, n (%)	77 (67.5)	74 (80.4)	(21.5)
Psychiatric care, n (%)	N/A	N/A	9 (11.4)
Intermediate care, n (%)	N/A	N/A	5 (6.3)
Previous or current Covid-19 (%)	0	13 (12.5)	3 (3.8)
Covid-19 based hospitalization, n (%)	0	0	0
Recent (<14 days) admission from other healthcare institution, n (%)	0	2 (1.9)	11 (13.9)
Recent (<14 days) internal relocation, n (%)	1 (0.9)	1 (1.0)	9 (11.4)
Comorbidity:			
Pulmonary disease, n(%)	19 (16.7)	12 (11.5)	10 (12.7)
Cardiovascular disease, n (%)	51 (44.7)	28 (26.9)	18 (22.8)
Cerebrovascular disease, n (%)	27 (23.7)	23 (22.1)	18 (22.8)
Diabetes, n (%)	28 (24.6)	17 (16.3)	27 (34.2)
Dementia / cognitive impairment, n (%)	85 (74.6)	83 (79.8)	24 (30.4)
Reduced kidney function, n (%)	15 (13.2)	4 (3.8)	11 (13.8)
Obesity, n (%)	11 (9.6)	4 (3.8)	12 (15.2)

*In NH-B, data on care type was missing for 12 residents.

Table 3: Demographic characteristics of healthcare workers of participating NHs.

HEALTH CARE WORKERS			
	NH-A (n=185)	NH-B (n=184)	NH-C (n=177)
Age, average (range)	46.7 (18 – 68)	43.0 (18 – 67)	47.5 (18 – 71)
Female, n (%)	175 (94.6)	167 (90.8)	153 (86.4)
Profession[*]:			
Nurse aid /nurse assistant, n (%)	90 (48.7)	94 (51.1)	63 (35.6)
Nurse, n (%)	17 (9.1)	24 (13.0)	33 (18.6)
Physical therapist, n (%)	2 (1.1)	3 (1.6)	6 (3.4)
Physician, n (%)	3 (1.6)	3 (1.6)	7 (4.0)
Other, n (%)	73 (39.5)	60 (32.6)	66 (37.3)
PPE use[**]:	(N=69)	(N=61)	(N=61)
Face mask, n (%)	68 (98.6)	53 (86.9)	49 (80.3)
Goggles, n (%)	33 (47.8)	51 (83.6)	41 (67.2)
Gloves, n (%)	67 (97.1)	53 (86.9)	54 (88.5)
Isolation gown, n (%)	59 (85.5)	50 (82.0)	51 (83.6)
None, n (%)	1 (1.4)	7 (11.5)	7 (11.5)

NH= nursing home, Covid-19= Coronavirus disease 2019, PPE= personal protective equipment.

[*]In NH-C, data on profession was missing for 2 healthcare workers.

[**]In nurse aids / nurse assistants and nurses who indicated to have worked on wards with Covid-19 suspected or confirmed residents.

Discussion

We aimed to study transmission of SARS-CoV-2 in three NHs with recent introduction of the virus, and to determine the role of a- and presymptomatic residents and healthcare workers herein. We identified 3 asymptomatic and 1 presymptomatic SARS-CoV-2 positive residents at the first point-prevalence survey. However, the number of cases identified in the follow-up survey was low (i.e. 2 in NH-A, none in NH-B and NH-C), which indicates very limited transmission and impeded the ability to answer the aforementioned research question. Nevertheless, we identified an asymptomatic resident and healthcare worker with Ct values below 25, suggesting that these cases have the potential to contribute to viral spread as previously suggested.[1, 2, 5]

Interestingly, the introduction of SARS-CoV-2 in two of the participating NHs (i.e. NH-A and NH-C) has not resulted in facility wide outbreaks during the study and the weeks thereafter. NH-B had an outbreak before the start of the study, and newly identified cases shortly before study onset. In response to the previous outbreak, this NH had taken measures such as increased hygiene precautions, the setup of cohorts of SARS-CoV-2 positive residents, and screening of healthcare workers for SARS-CoV-2, regardless of presence of symptoms (see also Table 1). The current study suggests that these measures were effective in this NH since no new transmission had occurred the weeks after the identification of new cases. This is supported by data where the implementation of repeated point prevalence surveys, including infection prevention consultations, resulted in mitigation of ongoing transmissions.[6]

Other factors that may have contributed to the prevention of spread in the participating NHs include the decreased prevalence of Covid-19 in the Netherlands from mid-April until after study conclusion (National Institute for Public Health and the Environment [RIVM], 2020), reducing chances of new introductions of the virus in NHs. A high number of cases per capita have been identified as a predicting factor for outbreaks in NHs in previous studies.[7, 8] In addition, whereas NHs were – due to scarcity of Covid-19 tests – previously advised to stop performing Covid-19 tests after two positive cases (and consider all symptomatic residents in that ward Covid-19 positive), the availability of Covid-19 tests had increased since April 10th. NHs had been able to perform low threshold testing ever since, facilitating early recognition of cases and, if appropriate measures are taken in response, decreasing chances of viral spread. Likewise, previously scarcely available PPE had become available on larger scale for NHs since April 13th. We indeed found high PPE use in the participating NHs (Table 3) and although we did not evaluate whether they were appropriately used, it is plausible that this contributed to the prevention of further spread. Finally, the constructional features of the NHs may have been beneficial in preventing transmission, e.g. by the ability to physically separate

wards, and an interior that facilitates quarantine and isolation measures. We did not collect data on the quality of the buildings' ventilation systems; it may be interesting to include this in future studies, given previous calls to include building engineering controls as part of the infection control strategy.[9]

Our study contributes to the discussion on appropriate screening for SARS-CoV-2 in NHs. Similar to our study, *Roxby et al.* reported limited detection and transmission of SARS-CoV-2 in a NH with recent Covid-19 cases, upon screening of all residents and healthcare workers.[10] There were asymptomatic residents among the identified cases, like in our study, which one may argue calls for policy beyond symptom-based screening. This is in line with recommendations of the European Center for Disease Prevention and Control (ECDC) to test all residents and healthcare workers once a confirmed case is detected (and in areas with ongoing community transmission, to test healthcare workers regularly even without any confirmed cases).[11] On the other hand, authors of a French study in which all healthcare workers of a NH were tested for SARS-CoV-2 after a first positive resident, argued that human and financial resources for systematic screening are disproportionate to its effectiveness (they identified only one asymptomatic individual).[12] The CDC advices initial testing of (asymptomatic) close contacts when testing capacity is limited: this could be a pragmatic alternative instead of facility wide testing at a first confirmed case.[13]

Our study has several strengths. First, we were able to collect data on all possible contributors to transmission, i.e. residents and healthcare workers, since visitors were not allowed in NHs at the time of study conduction. Second, response rates were high, which reduces chances of missing relevant numbers of Covid-19 cases in our study. A possible limitation is the limited amount of detail in the collected data (e.g. no registration of exact body temperature and oxygen saturation, no registration of previous Covid-19 in healthcare workers). We chose to keep the study questionnaire as short and simple as possible to reduce burden on healthcare workers, especially given their limited available time due to Covid-19 related understaffing. We anticipated that a lower questionnaire burden would contribute to the high responses required to study viral transmission.

Conclusions and implications

Based on our findings, we argue that the necessity of large-scale screening in NHs may be dependent of the local situation regarding prevalence of cases in the surrounding community, infection control opportunities and testing capacity. If availability of equipment and constructional features facilitate rapid application of appropriate measures after a first identified case, this may suffice in preventing further transmission of SARS-CoV-2.

In conclusion; although we were not able to answer our predefined research question on the contribution of a- and presymptomatic cases in transmission of SARS-CoV-2, our study confirms a- and presymptomatic occurrence of Covid-19 among residents and healthcare workers. We described factors that may contribute to the prevention of SARS-CoV-2 transmission in NHs. Finally, our findings add to the discussion of effective Covid-19 screening policy in NHs.

4

References

1. Arons, MM, Hatfield, KM, Reddy, SC, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. New England Journal of Medicine 2020;382(22):2081-2090.

2. Goldberg, SA, Pu, CT, Thompson, RW, et al. Asymptomatic Spread of COVID-19 in 97 Patients at a Skilled Nursing Facility. Journal of the American Medical Directors Association 2020.

3. Koopmans, RTCM, Pellegrom, M, van der Geer, ER. The Dutch Move Beyond the Concept of Nursing Home Physician Specialists. Journal of the American Medical Directors Association 2017;18(9):746-749.

4. Jacobi, A, Meijer, A, Molenaar, P, et al. Afnametechniek specifieke viral diagnostiek (2019-nCoV, influenza)>; https://lci.rivm.nl/sites/default/files/2020-02/Influenza%20%26%20COVID-19%20Afnametechniek%20specifieke%20virale%20diagnostiek.pdf. Accessed 17 June 2020.

5. Bullard, J, Dust, K, Funk, D, et al. Predicting infectious SARS-CoV-2 from diagnostic samples. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020.

6. Sanchez, GV, Biedron, C, Fink, LR, et al. Initial and Repeated Point Prevalence Surveys to Inform SARS-CoV-2 Infection Prevention in 26 Skilled Nursing Facilities - Detroit, Michigan, March-May 2020. MMWR Morb Mortal Wkly Rep 2020;69(27):882-886.

7. Gorges, RJ, Konetzka, RT. Staffing Levels and COVID-19 Cases and Outbreaks in US Nursing Homes. Journal of the American Geriatrics Society n/a(n/a).

8. Shi, SM, Bakaev, I, Chen, H, et al. Risk Factors, Presentation, and Course of Coronavirus Disease 2019 in a Large, Academic Long-Term Care Facility. Journal of the American Medical Directors Association 2020;21(10):1378-1383.e1371.

9. Morawska, L, Tang, JW, Bahnfleth, W, et al. How can airborne transmission of COVID-19 indoors be minimised? Environment international 2020;142:105832.

10. Roxby, AC, Greninger, AL, Hatfield, KM, et al. Outbreak Investigation of COVID-19 Among Residents and Staff of an Independent and Assisted Living Community for Older Adults in Seattle, Washington. JAMA Internal Medicine 2020.

11. Danis, K, Fonteneau, L, Georges, S, et al. High impact of COVID-19 in long-term care facilities, suggestion for monitoring in the EU/EEA, May 2020. Eurosurveillance 2020;25(22):2000956.

12. Guery, R, Delaye, C, Brule, N, et al. Limited effectiveness of systematic screening by nasopharyngeal RT-PCR of medicalized nursing home staff after a first case of COVID-19 in a resident. Médecine et Maladies Infectieuses 2020.

13. CDC. Testing Guidelines for Nursing Homes. Interim SARS-CoV-2 Testing Guidelines for Nursing Home Residents and Healthcare Personnel. Centre for Disease Control and Prevention 2020.

4

Supplementary text

Below we describe the SARS-CoV-2 testing procedures used by the different collaborating laboratories: A, B, C, D and E.

Laboratory A send the study test material to the collaborating laboratory B where SARS-CoV-2 reverse transcription polymerase chain reaction (RT-PCT) was performed according to the national reference method (*Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DKW, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill, 25 (2020), p. 2431*). Laboratory C used the same RT-PCR design and in some cases also used the CE-IVD kit GeneFinder™ COVID-19 Plus RealAmp Kit on the Sample to Result Platform ELITe InGenius® to confirm results when deemed necessary.

Laboratories D and E performed SARS-CoV-2 testing with the cobas® SARS-CoV-2 PCR on the cobas 6800 (Roche Diagnostics), according to the manufacturer's protocol. In addition to this protocol, the laboratory D performed an external lysis step prior to loading samples in the cobas 6800, in which the viral transport medium was 1:1 diluted in MagnaPure 96 External lysisbuffer (Roche Diagnostics). Laboratory E additionally used RT-PCR according to the national reference method (*see above*), when deemed necessary for confirmation.

4

5

Are presymptomatic SARS-CoV-2 infections in nursing home resident unrecognised symptomatic infections? Sequence and metadata from weekly testing in an extensive nursing home outbreak

Judith H. van den Besselaar,
Reina S. Sikkema,
Fleur M.H.P.A. Koene,
Laura W. van Buul,
Bas B. Oude Munnink,
Ine Frénay,
René te Witt,
Marion P.G. Koopmans,
Cees M.P.M. Hertogh,
Bianca M. Buurman-van Es

Abstract

Background
Sars-CoV-2 outbreaks resulted in a high case fatality rate in nursing homes (NH) worldwide. It is unknown to which extent presymptomatic residents and staff contribute to the spread of the virus.

Aims
To assess the contribution of asymptomatic and presymptomatic residents and staff in SARS-CoV-2 transmission during a large outbreak in a Dutch NH.

Methods
Observational study in a 185-bed NH with two consecutive testing strategies: testing of symptomatic cases only, followed by weekly facility-wide testing of staff and residents regardless of symptoms. Nasopharyngeal and oropharyngeal testing with RT-PCR for SARs-CoV-2, including sequencing of positive samples, was conducted with a standardized symptom assessment.

Results
185 residents and 244 staff participated. Sequencing identified one cluster. In the symptom-based test strategy period 3/39 residents were presymptomatic versus 38/74 residents in the period of weekly facility-wide testing (p-value<0.001). In total, 51/59 (91.1%) of SARS-CoV-2 positive staff was symptomatic, with no difference between both testing strategies (p-value 0.763). Loss of smell and taste, sore throat, headache or myalga was hardly reported in residents compared to staff (p-value <0.001). Median Ct-value of presymptomatic residents was 21.3, which did not differ from symptomatic (20.8) or asymptomatic (20.5) residents (p-value 0.624).

Conclusions
Symptoms in residents and staff are insufficiently recognized, reported or attributed to a possible SARS-CoV-2 infection. However, residents without (recognized) symptoms showed the same potential for viral shedding as residents with symptoms. Weekly testing was an effective strategy for early identification of SARS-Cov-2 cases, resulting in fast mitigation of the outbreak.

Introduction

Worldwide, nursing homes (NHs) are facing outbreaks of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) with high case fatality rates.[1, 2] The current ECDC-guideline recommends expanded viral testing of asymptomatic residents in NHs if a single new case of a SARS-CoV-2 infection is detected, based on data of previous NH outbreaks which suggest an important role for presymptomatic spread of SARS-COV-2 among residents.[3-9] However, it remains unknown to which extent asymptomatic and presymptomatic cases contribute to the spread of SARS-CoV-2. Also, specifically in the NH setting, it remains unclear to what extent asymptomatic cases are truly without symptoms. Sole reliance on symptoms for testing in NHs could be insufficient because self-reporting of complaints is often compromised in residents due to limited ability to communicate (e.g. in residents with dementia).[10] The Dutch guideline for COVID-19 in NHs states that only residents with possible symptoms of SARS-CoV-2 should be tested[11] and no policy for testing of asymptomatic residents or staff is facilitated in the Netherlands.

Multiple reports have been published about the prevalence of asymptomatic and presymptomatic residents and staff in NHs after the implementation of a facility-wide testing strategy during an outbreak.[4, 6, 9, 12, 13] The prevalence of asymptomatic staff and residents differed from single cases to up to half of the infected cases. Low cycle threshold (Ct) values were found in asymptomatic and presymptomatic cases, suggesting potential of viral shedding.[6, 9] A large registry of 857 Dutch residents with confirmed SARS-CoV-2 showed that 93% of cases expressed any of the symptoms cough, shortness of breath, or fever. A large range of other symptoms were also reported such as fatigue, diminished intake, gastro-intestinal symptoms, malaise or rhinorrhea.[14] However, the presentation of SARS-CoV-2 can be difficult to recognize in NH residents, which can cause delay in testing, isolation and treatment.[14, 15] In addition, during a community-wide outbreak it can be difficult to distinguish residential outbreaks from multiple introductions without sequencing of viruses from cases.[16]

Viral spread by presymptomatic or unrecognized symptomatic cases has important implications for Personal Protective Equipment (PPE) use, facility-wide testing and isolation measures in NHs for the prevention of outbreaks. The aim of this study is to analyze the contribution of presymptomatic spread of SARS-CoV-2 in all staff and residents of a NH in the Netherlands by serial weekly point prevalence surveys, PCR and sequencing.

5

Methods

Setting and study population

The study took place in a 185-bed NH in the province South Holland which provides long-term care and is specialized in dementia care. All residents and staff working during the outbreak were invited to participate in the study. Data was collected retrospectively before May 18th and prospectively from May 18th onwards. NH details are presented in Supplementary Figure 1.

SARS-CoV-2 testing and analysis

Two phases in the NH test strategy can be distinguished: First, until May 11th, a symptom-based testing strategy was followed, according to national guidelines: cases were tested when they experienced any symptoms. The only exception of this strategy was at May 6th at the ward where the outbreak started, all negative residents were tested regardless of symptoms. Second, from May 12th the NH implemented a policy of facility-wide weekly testing in addition to the symptom-based testing strategy, implying SARS-CoV-2 testing of all residents without a previous positive test and regardless of the presence of any symptoms. Staff was tested regardless of symptoms in the week of May 18th and June 1st.

Samples were transported to collaborating laboratories at the end of each test day, where they were tested for SARS-CoV-2 polymerase chain reaction (PCR) targets. Three different laboratories collaborated because of the large number of tests which were conducted: As a result, different PCR platforms were used, however the used targets were similar (RdRp- gene, E-gene, N- gene) see Supplementary text 1.

Sequencing, Phylogenetic analysis and cluster definition

PCR-positive samples with Ct-value below 32 were selected for sequencing using a SARS-CoV-2 specific amplicon based Nanopore sequencing approach, as previously described.[17] The consensus genome was generated only including positions with a coverage >30 as described previously.[18] Additional details on sequencing methods are provided in Supplementary Table 1.

Data collection

A standardized symptom-assessment form of sixteen symptoms was completed by the research team for each assenting resident, using electronic health record review. Staff was invited to complete a first questionnaire electronically (via email) in the week of May 18th. (Supplementary Text 2 and 3)

A participant was classified symptomatic if he had at least one new or worsened symptom in the fourteen days prior to a positive test result. A participant was classified asymptomatic if no new or worsened symptoms were present and no symptoms would develop in the fourteen days following the positive test. Participants were classified pre-symptomatic if they had no symptoms at moment of testing, but developed symptoms in the two weeks following a positive test.[19]

Analyses

Data are reported as mean/median with range and standard deviations (SD) and counts with percentages as appropriate. Differences between groups were assessed with student's T-test and Mann-Whitney U for continuous variables and Chi-Square test for categorical data. Differences were considered statistically significant at $P < 0.05$ (2-tailed). All analyses were done using SPSS, version 26 (IBM, Armonk, NY) and Excel.

Ethics

Written information about the study was sent out to residents and their legal representatives at May 18th, with the possibility to opt-out. Health care professionals were asked informed consent for participating in the study prior to digital questionnaire completion. The Medical Ethics Committee of the VU University Medical Centre in Amsterdam reviewed the study protocol and confirmed that the study does not fall under the scope of the Medical Research Involving Human Subjects Act.

Results

At April 29th, when the first resident tested positive for SARS-CoV-2, 185 residents lived and 384 staff worked in the NH. Four legal representatives of residents and 34 staff members declined participation. Baseline characteristics are described in Table 1. Residents who tested positive for SARS-CoV-2 were older and more likely to have cognitive impairment. Staff positive for SARS-CoV-2 consisted mostly of (registered) health care assistants and health-care aids. Supplementary Figure 2 shows the STROBE diagram of participating residents and staff.

Introduction of the virus and outbreak

The first positive resident (29 April) had been admitted from 17-23 April at the geriatric department of the local hospital with a urosepsis. She had a negative PCR for SARS-CoV-2 and her Chest X-Ray was classified as CORADS-1, suggesting a very low probability of COVID-19.[20] April 29th she developed a fever and was readmitted to the hospital, where retrospectively an outbreak had occurred, and tested positive for SARS-CoV-2. Previously, three NH staff members tested positive for SARS-CoV-2 in April,

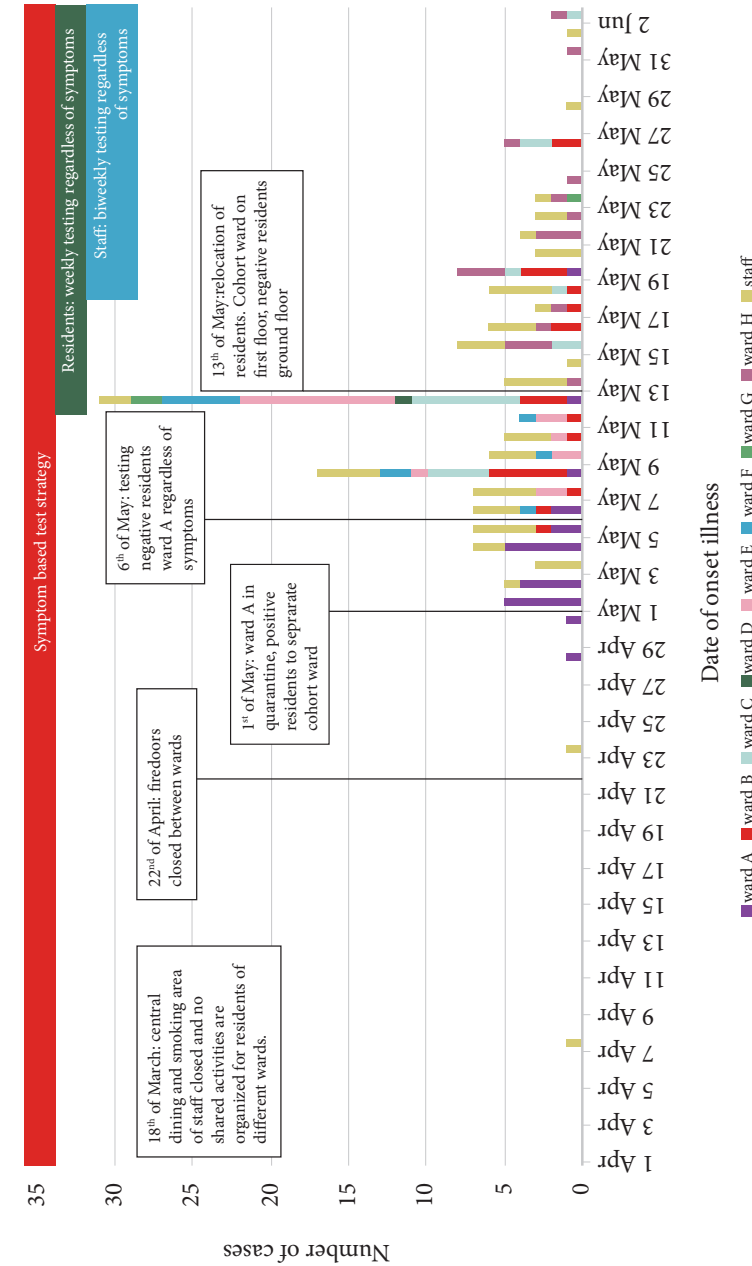but none of them worked in the period they were contagious. Figure 1 shows the date of onset of COVID-19 for participating residents of the different wards and participating staff from the 15th of April until the 2nd of June.

Table 1: *Baseline characteristics residents and staff*

	SARS-CoV-2 Test Results		p-value, (95% CI interval)
Residents	**Positive** N=113	**Negative** N=68	
Age (median/ range)	85.0 (44-99)	81.5 (48-100)	0.001 (-9.009 ; -2.237)
Female n (%)	82 (72.6)	50 (73.5)	0.888
Coexisting conditions			
Pulmonary disease n(%)	12 (10.6)	3 (4.4)	0.142
Cardiovascular disease n(%)	40 (35.4)	15 (22.1)	0.059
Cerebrovascular disease n(%)	23 (20.4)	9 (13.2)	0.224
Diabetes n(%)	18 (15.9)	18 (26.5)	0.085
Cognitive impairment n(%)	104 (92.0)	53 (77.9)	0.007
Reduced kidney function n(%)	7 (6.2)	2 (2.9)	0.329
Obesity n(%)	5 (4.4)	8 (11.8)	0.064
Staff*	**Positive** N=56	**Negative** N=188	
Age (median/ range)	43.0 (18-74)	46.5 (18-74)	0.853 (-5.764 – 3.942)
Female n (%)	47 (83.9)	175 (93.1)	0.036
Profession, n (%)			0.027
Health care assistants and aids	39 (69.6)	88 (46.8)	
Nurse	3 (5.4)	11 (5.9)	
Physical therapist	0	7 (3.7)	
Physician	0	6 (3.2)	
Other**	14 (24.6)	76 (40.4)	
Reporting contact with Covid-19 suspected or confirmed residents, n(%)			0.296
Yes	43 (76.8)	159 (84.6)	
No	5 (8.8)	8 (4.3)	
Unknown	8 (14.0)	21 (11.2)	

* 34 Staff members declined participation, 106 staff did not complete the questionnaire

** Staff working in kitchen, logistics, occupational therapists, psychologists, management

Figure 1: COVID-19 by date of onset and nursing home policy

COVID-19 by date of onset, Facility A the Netherlands, April-June 2020

Figure 1 shows the date of onset of COVID-19 for participating residents of the different wards and participating staff from the 15th of April until the 2nd of June. Key changes in NH policy for infection prevention and testing are indicated. On May 13th, facility management decided to move all positive tested residents to the first floor of the building, while residents who tested negative were moved to the ground floor of the building. PPE used on the first floor included isolation gown, gloves over the wrists, goggles and a surgical mask; on the ground floor surgical masks and gloves were used.
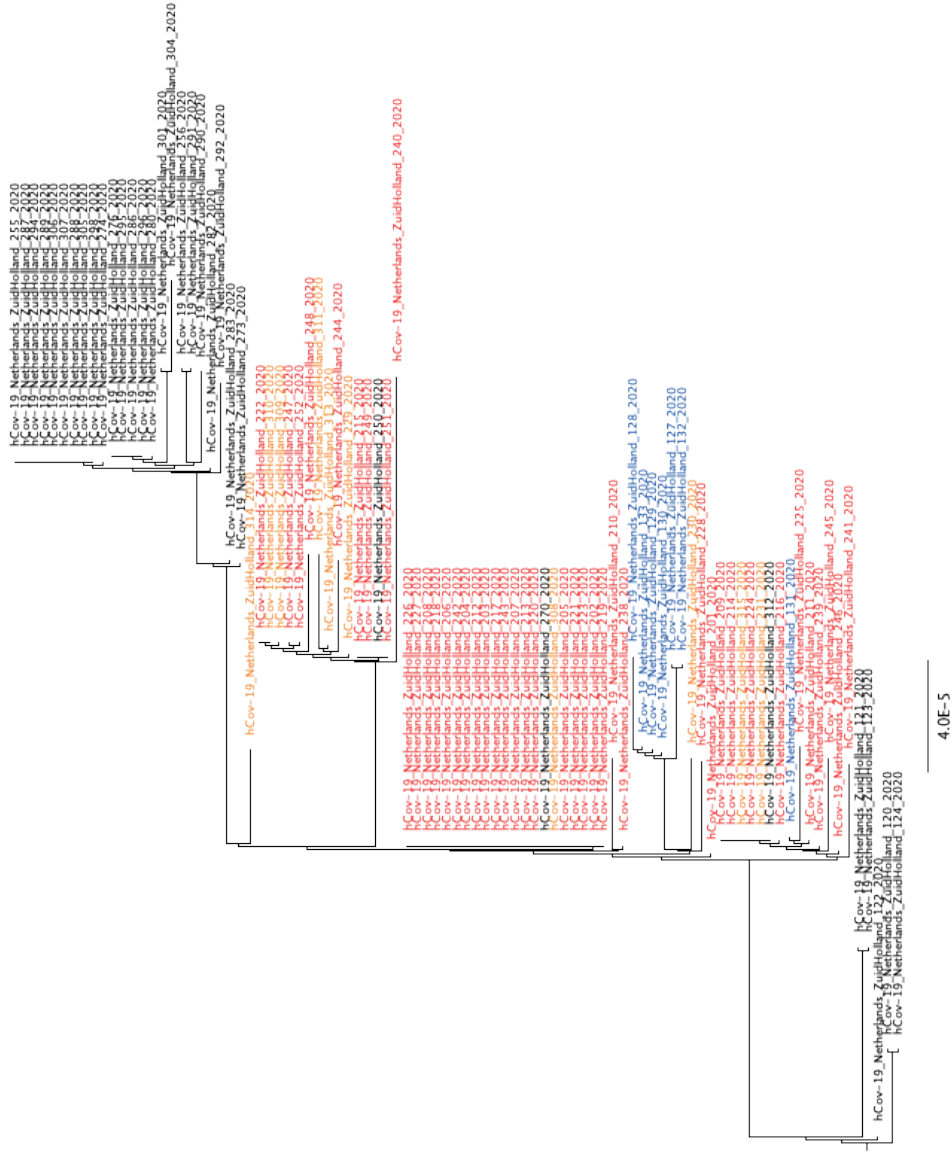
Figure 2: Zoom-in of Dutch phylogenetic tree, with sequences of nursing home A in red (clients) and orange (employees). Sequences in blue originate from the related hospital outbreak. Sequences in black originate from a Dutch national reference database.

4.0E-5

Table 2: Symptom assessment of residents and staff with a positive SARS-CoV-2 PCR-test

Symptom assessment n(%)	Residents N=113	Staff N=56	p-value
Symptomatic	65 (57.5)	51 (91.1)	<0.001
Presymptomatic	41 (36.3)	2 (3.6)	
Asymptomatic	7 (5.2)	3* (5.3)	
Cough	31 (27.4)	26 (46.4)	0.014
Dyspnea	13 (11.5)	20 (35.7)	<0.001
Fever	30 (26.5)	15 (26.8)	0.974
Saturation	27 (23.9)	NA	
Delirium	16 (14.2)	NA	
Chills	4 (3.5)	22 (39.3)	<0.001
Malaise	25 (22.1)	24 (42.9)	0.005
Fatigue	19 (16.8)	42 (75.0)	<0.001
Myalgia	2 (1.8)	26 (46.6)	<0.001
Headache	5 (4.4)	36 (64.3)	<0.001
Sore throat	2 (1.8)	21 (37.5)	<0.001
Nasal congestion	15 (13.3)	34 (60.7)	<0.001
Diarrhea	10 (8.8)	14 (25.0)	0.005
Nausea	9 (8.0)	7 (12.5)	0.343
Diminished intake	17 (15.0)	23 (41.1)	<0.001
Loss of smell or taste	0	27 (48.2)	<0.001

Testing strategy	Symptom based N=39	Weekly N=74	p-value	Symptom based N=26	Weekly N=30	p-value
Symptomatic, n (%)	36 (92.3)	29 (39.2)	<0.001	23 (94.6)	28 (93.3)	0.763
Presymptomatic, n (%)	3 (7.7)	38 (51.4)		1 (3.8)	1 (3.3)	
Asymptomatic, n (%)	0	7 (9.5)		2* (7.6)	1 (3.3)	

*Two staff members did not complete follow-up questionnaire

5

Sequencing

In total, 53 sequences of residents and NH staff were available. In addition, 7 sequences of the hospital outbreak were generated. All sequences cluster together, also sequences detected at the geriatric department of the hospital outbreak were near identical. Two subclusters appear to be present in sequences of residents and staff, without differences when considering wards where residents lived and staff worked (Figure 2).

Symptomatic, presymptomatic and asymptomatic cases during symptomatic and weekly testing strategy

Results of the standardized symptom-assessment are presented in Table 2. Except for the symptoms fever and nausea, residents and staff showed different prevalence for all symptoms. Because of retrospective and prospective data collection in staff, we performed sensitivity analyses which compared symptoms in prospective and retrospective questionnaires. Also we repeated comparisons between positive staff and residents only using prospective questionnaires of staff (Supplementary Table 2).

Staff was tested twice regardless of symptoms, while residents were tested four times regardless of symptoms: We performed a third sensitivity analysis where we compared residents/staff who were tested on the dates of the point prevalence surveys regardless of symptoms to residents/staff who were tested at all other dates in the study period. This did not alter results (Supplementary Table 3).

A significant difference in presymptomatic residents was found between the two testing strategies (p-value <0.001). Before the start of facility-wide weekly testing, 39 residents tested positive: 36 (92.3%) were symptomatic and 3 (7.7%) residents were presymptomatic. The three presymptomatic residents were tested at May 6th when all residents of the ward where the outbreak started were tested regardless of symptoms. In the period of weekly testing, 74 residents tested positive, of which 29 (39.2%) were symptomatic at the time of testing, 38 (51.4%) were presymptomatic and 7(9.5%) were asymptomatic.

A total of 56 staff tested positive and completed the questionnaire: 51 (91.1%) were symptomatic at the moment of testing, 2 (3.9%) were pre-symptomatic and 3 (5.9%) staff members were asymptomatic. No difference in symptomatic, presymptomatic and asymptomatic staff members was found between symptom based or additional weekly testing strategy (p-value 0.763).

Symptom onset and presentation with symptomatic and weekly testing strategy

Until May 11th, 39 residents tested positive and all developed symptoms. Symptoms developed between 6 days before testing and 3 days after testing, with a median of development of symptoms the day before the test (interquartile range 2 days to 1 day before test). (Figure 3A) After the addition of weekly testing regardless of symptoms, 74 residents tested positive of which 67 residents developed symptoms between 11 days before testing and 8 days after testing, with a median of development of symptoms the day of the test (interquartile range 2 days before the test to 3 days after the test) (Figure 3B). The time between onset of symptoms and test date differed significantly between the two testing strategies (p-value 0.000). With both test strategies symptomatic residents had symptoms for multiple days without testing.

Ct-values

Ct values were available for 97/113 positive residents; the median Ct-value was 21.3 (range 14.5-40). Symptomatic residents (N=59) had a median Ct-value of 20.8 (range 14.5-38.1), presymptomatic resident (N=33) had a median Ct-value of 21.3 (range 16.1 -40) and asymptomatic resident (N=5) had a median Ct-value of 20.5 (range 17.3-39.7). There was no difference in Ct-value between these groups(P=0.624).

Ct-values were available for 38/56 staff members; with a median of 24.6 (range 13.7-38.1). Of one asymptomatic staff Ct-value was 34.6. The two presymptomatic staff members Ct-values were 29.8 and 32.3. Symptomatic staff members (N=35) had a median Ct-value of 23.7 (range 13.7-38.1).

Discussion

We describe a large SARS-CoV-2-outbreak in a NH which most likely started by an infected resident discharged from a local hospital where SARS-CoV-2 prevailed. The addition of weekly facility-wide testing regardless of symptoms identified 38 (52.7%) presymptomatic residents and 7 (8.1%) asymptomatic residents. These cases were found up to eight days before symptoms occurred. In staff limited presymptomatic and asymptomatic cases were identified. The absence of subjective symptoms (such as loss of smell or taste) in residents compared to staff who are infected by the same SARS-CoV-2 strain suggests the under-reporting of symptoms in residents. As such, it is not possible to make a distinction between a/presymptomatic and unrecognized symptomatic residents in this study. However, a/presymptomatic residents have the same high viral load as symptomatic residents, which suggests the same potential for viral shedding. These results support the guidelines of the ECDC and CDC to test asymptomatic residents and staff to identify pre- and asymptomatic cases of SARS-CoV-2.

3A

Days until development of symptoms from positive PCR test Symptom based test strategy until the 11th of May (N=39)
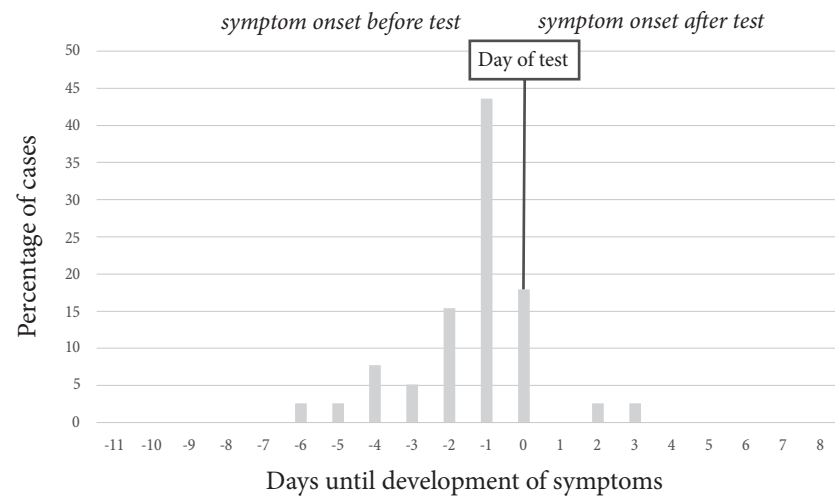
3B

Days until development of symptoms from positive PCR-test Weekly testing added to symptom based strategy from 12th of May (N=67)
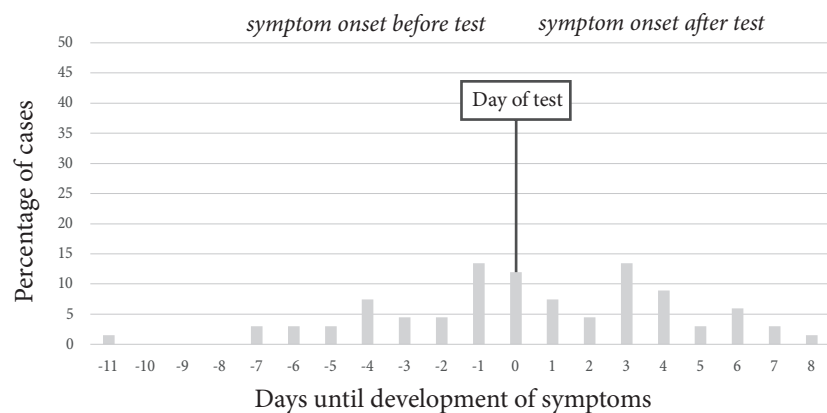

Figure 3: frequency plot of days until development of symptoms from positive PCR-test of residents. Negative values represent symptomatic residents, while positive values represent presymptomatic residents. The value 0 means that residents developed symptoms at the day of PCR-test: whether the symptoms developed before or after testing determines if they were presymptomatic or symptomatic. A) symptomatic testing strategy until the 11th of May. B) Addition of facility-wide weekly testing strategy regardless of symptoms from the 12th of May.

The high prevalence of presymptomatic cases in residents and the limited registration of subjective symptoms is comparable to other studies.[3, 5, 6, 9] Studies performing facility wide testing regardless of symptoms of staff in NHs with a confirmed COVID-19 case found the same limited number of asymptomatic staff as in our study.[3, 4, 13] To our knowledge, we are the first study reporting on symptoms from residents and staff in a large outbreak of the same virus strain. The large difference between presymptomatic staff and residents found in this study has three possible explanations: First, a large number of residents in this NH are cognitive impaired, which makes it difficult for them to express their symptoms. Second, staff reporting on residents' symptoms were not aware of all the symptoms related to COVID-19. During the outbreak symptoms of residents were sometimes documented for multiple days, but they were nevertheless not tested. Third, understaffing because of the outbreak could have led to suboptimal symptom registration: mild or subjective symptoms were missed, because staff had to take care of residents they were not familiar to work with, or because of limited time to register symptoms. Understaffing as a risk for under-recognition of new cases is supported by data of Gorges and Li which shows NHs with at least one case, higher nurse aide[21] and total nursing hours[21, 22] are associated with a lower probability of experiencing an outbreak and with fewer deaths.

Our study showed no difference between Ct-values of symptomatic, presymptomatic, or asymptomatic cases in residents, similar to previous studies.[6, 9] All these studies have the same risk of underreporting of (mild) symptoms of SARS-CoV-2 and incorrect classifying residents as pre- or asymptomatic. This suggest that these residents should be treated the same: as possibly infectious. Timely isolation of these residents and PPE could be important interventions to prevent further spread of the virus.

The new approach of mass repeated testing, irrespective of symptoms, in skilled nursing facilities has been advocated since May.[23] After this, studies have been published describing this approach, often resulting in reduced SARS-CoV-2 transmission after the implementation of this testing strategy.[24, 25] However, limited additional cases were found after a weekly testing strategy was implemented in three Dutch NHs after their first cases of SARS-CoV-2.[26] Possibly, the testing was early in the outbreak and led to rapid isolation, combined with the increased availability of PPE or because cases per capita in the community were very low.[26] Cases per capita in the community have been identified as an important predictor for outbreaks in NHs.[21, 27]

The testing of staff regardless of symptoms could be important because previous research showed that health care workers have difficulty in recognizing possible COVID-19 symptoms for themselves: 65% reported working while exhibiting symptoms.[28] This is reflected in our results, as we found that almost none of the staff was asymptomatic at

the moment of testing, even after the implementation of a testing strategy regardless of symptoms. The WHO advises that syndromic surveillance of health workers for COVID-19 symptoms should be performed before entering the workplace. If human resources and logistics permit it, active syndromic surveillance is recommended. Symptoms that should be monitored at minimum are fever, dry cough, myalgia, arthralgia, fatigue, headache, shortness of breath, anosmia and ageusia.[29]

Implementing sequencing, combined with epidemiological information, is important to understand the extent of intramural transmission versus introductions from the community. In addition, transmission clusters and risk factors for transmission can be identified, which can be used to implement infection prevention measures to prevent further spread. Previous research has shown that whole genome sequencing can generate evidence for transmission routes that would not have been identified with traditional epidemiological investigations.[16, 17]

Limitations

Not all staff members who tested positive participated in the study. In addition, some staff members had to answer the questionnaire retrospectively, which gives the risk of recall bias. Sensitivity analyses did not alter results.

Further, the difference between symptomatic staff and residents could perhaps be explained by the fact that staff was tested less frequent than residents. This may have contributed partly to the higher proportion of symptomatic staff. In our sensitivity analyses where we compared staff who were tested on the dates of the point prevalence surveys to staff who were tested on other dates during the study period because of symptoms (Supplementary Table 3) no difference in symptoms was observed , except for loss of smell and taste.

Also, the low rate of reported symptoms in residents could be explained by the high proportion of residents with cognitive impairment. The nursing home in this study was specialized in psychogeriatric care; in a representative sample of Dutch nursing home, 59% of residents were diagnosed with cognitive impairment.[30]

Last, not all SARS-CoV-2 positive samples were sequenced. However, a lot of time points could be analyzed and they show all the same cluster which makes it unlikely that multiple clusters were circulating in the NH.

Conclusion

Our study suggests that a proportion of the presymptomatic cases in NHs are possibly unrecognized symptomatic cases and supports the guideline of the CDC and ECDC that facility-wide testing of residents and staff needs to be undertaken after the first confirmed SARS-CoV-2 case in the facility.[7, 8] If there is limited viral testing capacity, initial testing of (asymptomatic) close contacts is advised.[8] This will identify possible asymptomatic, presymptomatic cases and unrecognized symptomatic cases and prevent further spread of the virus. Sequencing should be performed to discriminate ongoing intramural transmission and multiple introductions. *Box 1* summarizes the lessons learned during this study.

Lessons learned

1. Preparing for an outbreak

Educate staff about all the possible symptoms of COVID-19: Take routine temperature and saturation of residents for reference values. Also sufficient staffing and staff dedicated to a few patients is necessary for early recognition of symptoms. Nursing homes should make protocols with a local laboratory so when an outbreak occurs, rapid testing is possible.

2. Increasing cases per capita in the population

When cases per capita in the general population of the area are increasing, staff and visitors should wear at least surgical face mask to prevent introduction of the virus. In this outbreak, a resident transferring from another health care facility with a negative SARS-CoV-2 PCR was the index case and presymptomatic at the moment of transfer. Consider quarantine of residents who are admitted, regardless of a recent, negative PCR-test.

3. During an outbreak

Recognition of start of possible COVID-19 symptoms is very difficult, especially in residents with dementia. Weekly testing during an outbreak identifies presymptomatic or unrecognized symptomatic residents and makes timely isolation and use of PPE possible. We support international recommendations to consider routine testing of staff as soon a positive case of COVID-19 is identified in either staff or residents.[29]

Box 1: Lessons learned of SARS-CoV-2 outbreak

5

References

1. Comas-Herrera, A, Zalakain, J, Litwin, C, et al. Mortality associated with COVID-19 outbreaks in care homes: early international evidence. International Long-Term Care Policy Network; 2020.

2. Yourish, L, Ivory, Smith. One-Third of all U.S. Coronavirus Deaths Are Nursing Home Residents or Workers. New York Times. 2020.

3. Roxby, AC, Greninger, AL, Hatfield, KM, et al. Outbreak Investigation of COVID-19 Among Residents and Staff of an Independent and Assisted Living Community for Older Adults in Seattle, Washington. JAMA Internal Medicine 2020.

4. Guery, R, Delaye, C, Brule, N, et al. Limited effectiveness of systematic screening by nasopharyngeal RT-PCR of medicalized nursing home staff after a first case of COVID-19 in a resident. Médecine et Maladies Infectieuses 2020.

5. Dora AV, WA, Jatt LP. Universal and Serial Laboratory Testing for SARS-CoV-2 at a Long-Term Care Skilled Nursing Facility for Veterans — Los Angeles, California, 2020. Morbidity and Mortality Weekly Report 2020;21(69):651-655.

6. Arons, MM, Hatfield, KM, Reddy, SC, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. New England Journal of Medicine 2020;382(22):2081-2090.

7. European Centre for Disease Prevention and Control. Surveillance of COVID-19 in long-term care facilities in the EU/EEA, 19 May 2020. Stockholm: ECDC; 2020.

8. CDC. Testing Guidelines for Nursing Homes. Interim SARS-CoV-2 Testing Guidelines for Nursing Home Residents and Healthcare Personnel. Centre for Disease Control and Prevention 2020.

9. Kimball, A, Hatfield, KM, Arons, M. Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020. MMWR Morb Mortal Wkly Rep 2020;(69):377-381.

10. Huffman, JC, Kunik, ME. Assessment and Understanding of Pain in Patients With Dementia. The Gerontologist 2000;40(5):574-581.

11. Behandeladvies COVID-19 Acute fase en nazorg; 2020. https://www.verenso.nl/_asset/_public/Thema-en-projecten/Infectieziekten/Covid-19/200825-15-00-COVID-19-behandel-advies-DEFINITIEF.pdf. Accessed 8-31-2020.

12. Goldberg, SA, Pu, CT, Thompson, RW, et al. Asymptomatic Spread of COVID-19 in 97 Patients at a Skilled Nursing Facility. Journal of the American Medical Directors Association 2020.

13. Graham, NS, Junghans, C, Downes, R, et al. SARS-CoV-2 infection, clinical features and outcome of COVID-19 in United Kingdom nursing homes. medRxiv: the preprint server for health sciences 2020:2020.2005.2019.20105460.

14. Rutten, JJS, van Loon, SM, Joling, KJ, et al. Covid-19 in verpleeghuizen. Ned Tijdschr Geneesk 2020;164.

15. D'Adamo, H, Yoshikawa, T, Ouslander, JG. Coronavirus disease 2019 in geriatrics and long-term care: the ABCDs of COVID-19. Journal of the American Geriatrics Society 2020;68(5):912-917.

16. Voeten, HA, Sikkema, RS, Damen, M, et al. Unravelling the modes of transmission of SARS-CoV-2 during a nursing home outbreak: looking beyond the church super-spread event. PREPRINT available at Research Square 2020.

17. Oude Munnink, BB, Nieuwenhuijse, DF, Stein, M, et al. Rapid SARS-CoV-2 whole-genome sequencing and analysis for informed public health decision-making in the Netherlands. Nature Medicine 2020.

18. Au - Oude Munnink, BB, Au - Nieuwenhuijse, DF, Au - Sikkema, RS, et al. Validating Whole Genome Nanopore Sequencing, using Usutu Virus as an Example. JoVE 2020;(157):e60906.

19. Clinical management of COVID-19. World Health Organization.

20. Prokop, M, Everdingen, Wv, Vellinga, TvR, et al. CO-RADS: A Categorical CT Assessment Scheme for Patients Suspected of Having COVID-19—Definition and Evaluation. Radiology 2020;296(2):E97-E104.

21. Gorges, RJ, Konetzka, RT. Staffing Levels and COVID-19 Cases and Outbreaks in US Nursing Homes. Journal of the American Geriatrics Society n/a(n/a).

22. Li, Y, Temkin-Greener, H, Shan, G, et al. COVID-19 Infections and Deaths among Connecticut Nursing Home Residents: Facility Correlates. Journal of the American Geriatrics Society n/a(n/a).

23. Gandhi, M, Yokoe, DS, Havlir, DV. Asymptomatic Transmission, the Achilles' Heel of Current Strategies to Control Covid-19. New England Journal of Medicine 2020;382(22):2158-2160.

24. Sanchez, GV, Biedron, C, Fink, LR, et al. Initial and Repeated Point Prevalence Surveys to Inform SARS-CoV-2 Infection Prevention in 26 Skilled Nursing Facilities - Detroit, Michigan, March-May 2020. MMWR Morb Mortal Wkly Rep 2020;69(27):882-886.

25. Escobar, DJ, Lanzi, M, Saberi, P, et al. Mitigation of a COVID-19 Outbreak in a Nursing Home Through Serial Testing of Residents and Staff. Clinical Infectious Diseases 2020.

26. van Buul, LW, van den Besselaar, JH, Koene, F, et al. Asymptomatic Cases and Limited Transmission of SARS-CoV-2 in Residents and Healthcare Workers in Three Dutch Nursing Homes. Gerontol Geriatr Med 2020;6:2333721420982800.

27. Shi, SM, Bakaev, I, Chen, H, et al. Risk Factors, Presentation, and Course of Coronavirus Disease 2019 in a Large, Academic Long-Term Care Facility. Journal of the American Medical Directors Association 2020;21(10):1378-1383.e1371.

5

28. Chow, EJ, Schwartz, NG, Tobolowsky, FA, et al. Symptom Screening at Illness Onset of Health Care Personnel With SARS-CoV-2 Infection in King County, Washington. JAMA 2020;323(20):2087-2089.

29. Prevention, identification and management of health worker infection in the context of COVID-19. World Health Organization.

30. Rutten, JJS, van Loon, AM, van Kooten, J, et al. Clinical Suspicion of COVID-19 in Nursing Home Residents: Symptoms and Mortality Risk Factors. Journal of the American Medical Directors Association 2020;21(12):1791-1797.e1791.

Supplementary Figure 1: Details about the nursing home

The building has two floors and is divided in two parts: an old construction building and a new construction building. The wards of the old construction building are connected in a square and have an open connection which makes it possible for residents to walk around. The old and new building are separated by a staff only entry. The ground floor of the old building consists of four wards (A-D) and the first floor consists of three wards (E-G). The new construction building has a ground floor with one ward (H) and first floor with one ward (I). At each ward live 18 to 42 residents. Figure 1 shows the floor plan of the nursing home.
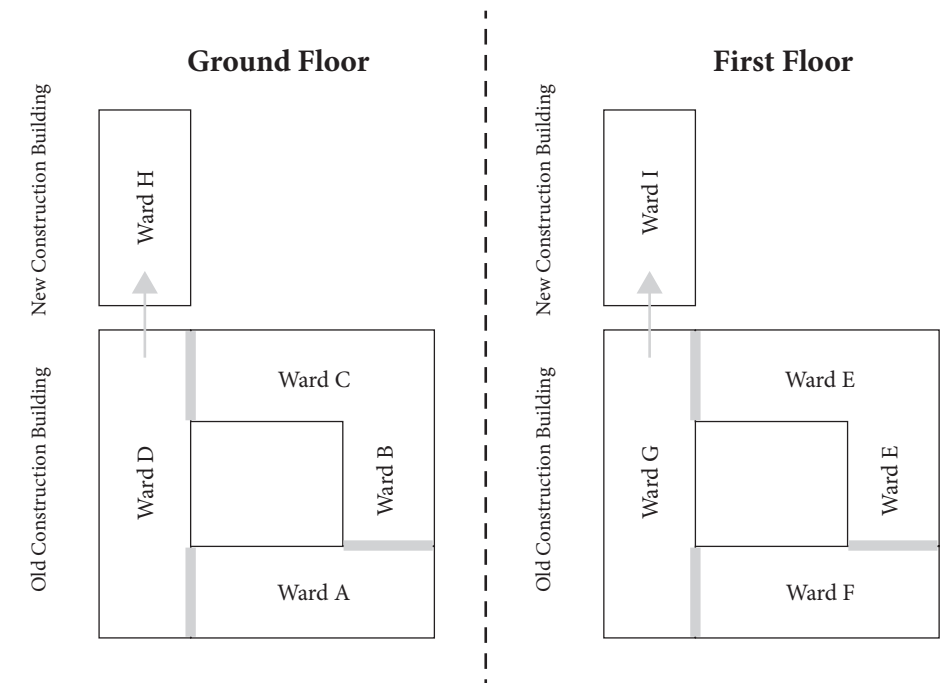

Figure 1: Grey lines represent the fire doors, which were closed from April 22nd, but they were not locked and residents strong enough could enter the other wards. The arrows represent the connection between the old and new building which could only be opened by a staff badge.

Supplementary Text 1: SARS-CoV-2 testing procedures by the different collaborating laboratories

DDL Diagnostic Laboratory Rijswijk used nasopharyngeal (NP) and throat samples obtained and placed directly into 3 ml of lysis buffer (LC Prep Lysis/Binding Buffer, Roche Diagnostics). Viral RNA extraction was performed by Cobas 4800 (Roche Diagnostics) using Chlamydia protocol; 200 µl sample was eluted in 100 µl elution buffer. Equine Arteritis Virus (EAV) was used as PCR internal control and added to each individual extraction. RT-PCR was performed using 5 µl of RNA sample in the E-gene plus EAV internal control PCR kit (TIBMOLBIOL, Germany) by using Light Cycler 480 (Roche Diagnostics)

The Regional Laboratory Medical Microbiology (RLM) performed SARS-CoV-2 reverse transcription polymerase chain reaction (RT-PCT) according to the national reference method (*Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DKW, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill, 25 (2020), p. 2431*) with sample eluted in 100 µl elution buffer (MP96, Roche Diagnostics).

Sanquin Diagnostic Services, Amsterdam performed SARS-CoV-2 testing with the cobas® SARS-CoV-2 PCR on the Cobas 8800 (Roche Diagnostics), according to the manufacturer's protocol.

Supplementary Table 1: Details on sequencing methods

Sequences with >10% "Ns" were excluded and compared to a reference database developed for the national COVID-19 response efforts.[1] The alignment was manually checked for discrepancies after which IQ-TREE[2] was used to perform a maximum likelihood phylogenetic analysis under the GTR+F+I+G4 model as best predicted model using the ultrafast bootstrap option with 1,000 replicates. The phylogenetic trees were visualized in Figtree.[3] For clarity reasons all bootstrap values below 80 were removed.

Sequences from national reference database

hCov-19/Netherlands/ZuidHolland_243/2020	EPI_ISL_523585
hCov-19/Netherlands/ZuidHolland_244/2020	EPI_ISL_523586
hCov-19/Netherlands/ZuidHolland_245/2020	EPI_ISL_523587
hCov-19/Netherlands/ZuidHolland_246/2020	EPI_ISL_523588
hCov-19/Netherlands/ZuidHolland_247/2020	EPI_ISL_523589
hCov-19/Netherlands/ZuidHolland_248/2020	EPI_ISL_523590
hCov-19/Netherlands/ZuidHolland_249/2020	EPI_ISL_523591
hCov-19/Netherlands/ZuidHolland_250/2020	EPI_ISL_523592
hCov-19/Netherlands/ZuidHolland_251/2020	EPI_ISL_523593
hCov-19/Netherlands/ZuidHolland_252/2020	EPI_ISL_523594
hCov-19/Netherlands/ZuidHolland_308/2020	EPI_ISL_523650
hCov-19/Netherlands/ZuidHolland_309/2020	EPI_ISL_523651
hCov-19/Netherlands/ZuidHolland_310/2020	EPI_ISL_523652
hCov-19/Netherlands/ZuidHolland_311/2020	EPI_ISL_523653
hCov-19/Netherlands/ZuidHolland_312/2020	EPI_ISL_523654
hCov-19/Netherlands/ZuidHolland_313/2020	EPI_ISL_523655
hCov-19/Netherlands/ZuidHolland_314/2020	EPI_ISL_523656
hCov-19/Netherlands/ZuidHolland_315/2020	EPI_ISL_523657

1. Elbe, S, Buckland-Merrett, G. Data, disease and diplomacy: GISAID's innovative contribution to global health. Global Challenges 2017;1(1):33-46.
2. Nguyen, LT, Schmidt, HA, von Haeseler, A, et al. IQ-TREE: a fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. Molecular biology and evolution 2015;32(1):268-274.
3. Figtree; http://tree.bio.ed.ac.uk/software/figtree/. Accessed.

5

Supplementary Text 2: Case record form and symptom assessment of residents

Gender: ☐ Male   ☐ Female

Birth year: …………

Ward :   ☐ A   ☐ E

            ☐ B   ☐ F

            ☐ C   ☐ G

            ☐ D   ☐ H

Is one of the next situations applicable to the resident:

(Multiple answers possible)

☐ The resident had COVID-19 in the past

☐ The resident has an active COVID-19

☐ The resident has been admitted to the hospital with COVID-19

☐ The resident has been admitted to the nursing home in the last 14 days from the hospital or another healthcare facility

☐ The resident has moved to another ward in the last 14 days within the nursing home

Did the resident express one of the following symptoms (new or worsened)?

Cough	☐ Yes	☐ No	☐ Unknown
Shortness of Breath	☐ Yes	☐ No	☐ Unknown
Fever (T>38)	☐ Yes	☐ No	☐ Unknown
Decreased oxygen saturation	☐ Yes	☐ No	☐ Unknown
Delirium/confusion	☐ Yes	☐ No	☐ Unknown
Cold chills	☐ Yes	☐ No	☐ Unknown
Malaise	☐ Yes	☐ No	☐ Unknown
Fatigue	☐ Yes	☐ No	☐ Unknown
Myalgi	☐ Yes	☐ No	☐ Unknown
Headache	☐ Yes	☐ No	☐ Unknown
Sore throat	☐ Yes	☐ No	☐ Unknown
Rhinorrhea/nasal congestion	☐ Yes	☐ No	☐ Unknown
Diarrhea	☐ Yes	☐ No	☐ Unknown
Nausea/vomiting	☐ Yes	☐ No	☐ Unknown
Diminished intake/loss of apetite	☐ Yes	☐ No	☐ Unknown
Loss of smell or taste	☐ Yes	☐ No	☐ Unknown

When did these symptoms start?

…… / …… / ……………… ☐ Not applicable

Which of the following co-existing conditions are applicable to the resident?

(Multiple answers possible)

☐ Pulmonary disease

☐ Cardiovascular Disease

☐ Cerebrovascular disease

☐ Diabetes

☐ Cognitive impairment

☐ Reduced kidney function

☐ Obesity

☐ None of the above

5

Supplementary Text 3: Case record form and symptom assessment of Staff

Gender: ☐ Male   ☐ Female
Birth year: …………
Profession: ☐ Healthcare aid
                    ☐ Healthcare assistant
                    ☐ Registered healthcare assistant
                    ☐ Nurse
                    ☐ Physical therapist
                    ☐ Physician
                    ☐ Other

QUESTIONS ABOUT WORK

At which wards did you work in the last 14 days?
(Multiple answers possible)
☐ A   ☐ E
☐ B   ☐ F
☐ C   ☐ G
☐ D   ☐ H

Did you have contact with a COVID-19 suspected or confirmed case at one of these wards?
☐ Yes
☐ No
☐ I don't know

Which Personal Protective Equiment did you use during your work in wards with (suspected) COVID-19 cases during the last 14 days?
(Multiple answers possible)
☐ Face mask
☐ Goggles
☐ Gloves
☐ Isolation gown
☐ None
☐ Not applicable: I did not work on a ward with a (suspected) COVID-19 case

Did you work somewhere else than in Nursing Home A?
☐ No
☐ Yes, in another facility of the healthcare organization of nursing home A

☐ Yes, in home care
☐ Yes, at a facility of another healthcare organization
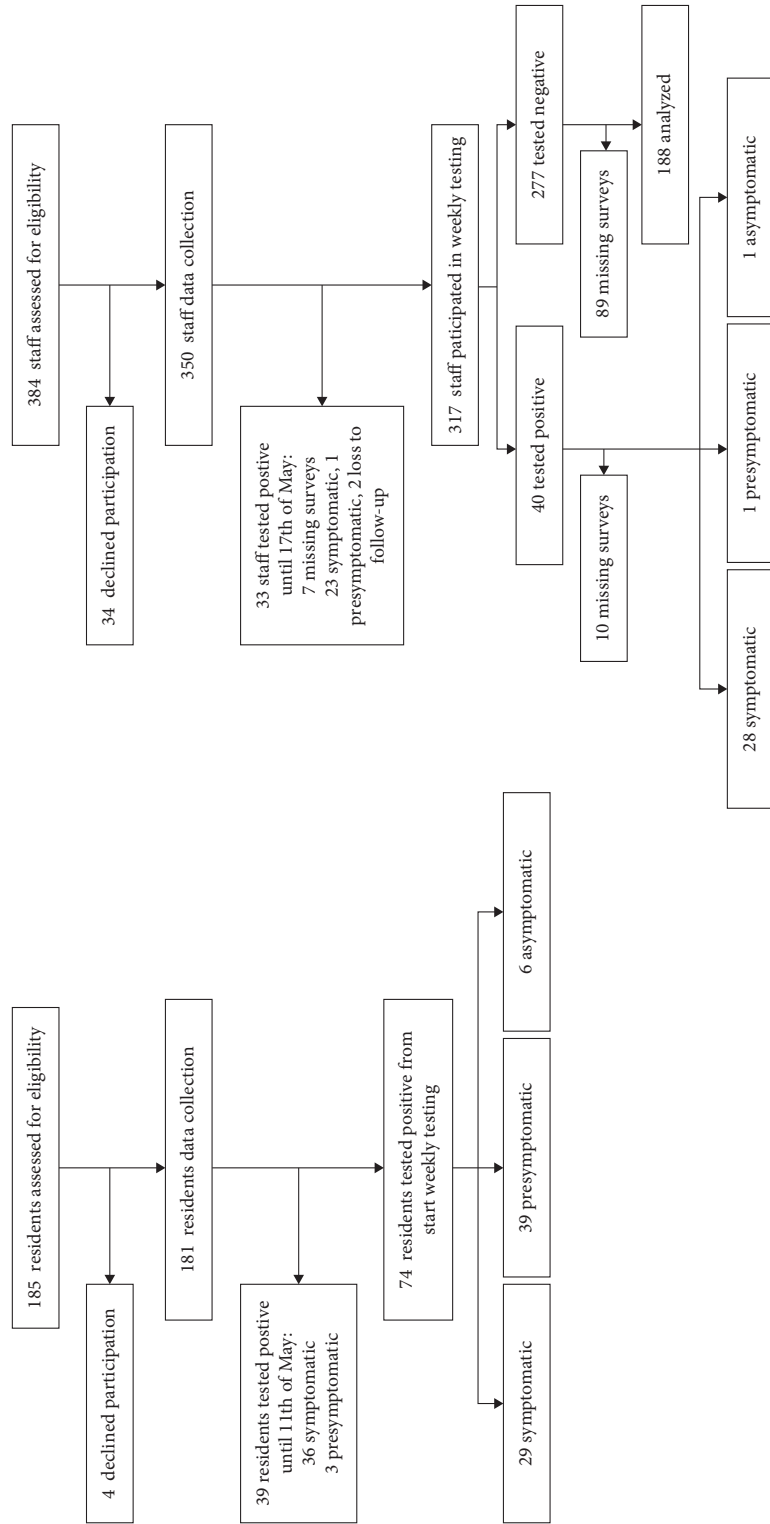☐ Yes, but not in healthcare

QUESTIONS ABOUT YOUR HEALTH

Did you experience any of the following symptoms (newly developed or worsened)?

Cough	☐ Yes	☐ No	☐ Unknown
Shortness of Breath	☐ Yes	☐ No	☐ Unknown
Fever (T>38)	☐ Yes	☐ No	☐ Unknown
Cold chills	☐ Yes	☐ No	☐ Unknown
Malaise	☐ Yes	☐ No	☐ Unknown
Fatigue	☐ Yes	☐ No	☐ Unknown
Myalgi	☐ Yes	☐ No	☐ Unknown
Headache	☐ Yes	☐ No	☐ Unknown
Sore throat	☐ Yes	☐ No	☐ Unknown
Rhinorrhea/nasal congestion	☐ Yes	☐ No	☐ Unknown
Diarrhea	☐ Yes	☐ No	☐ Unknown
Nausea/vomiting	☐ Yes	☐ No	☐ Unknown
Diminished intake/loss of apetite	☐ Yes	☐ No	☐ Unknown
Loss of smell or taste	☐ Yes	☐ No	☐ Unknown

When did the symptoms start?
… / … / ……   ☐ Not applicable

5

Supplementary Figure 2: STROBE diagram

Staff flow diagram:
- 384 staff assessed for eligibility
- 34 declined participation
- 350 staff data collection
- 33 staff tested positive until 17th of May: 7 missing surveys, 23 symptomatic, 1 presymptomatic, 2 loss to follow-up
- 317 staff participated in weekly testing
- 277 tested negative → 89 missing surveys → 188 analyzed
- 40 tested positive → 10 missing surveys
- 1 asymptomatic
- 1 presymptomatic
- 28 symptomatic

Residents flow diagram:
- 185 residents assessed for eligibility
- 4 declined participation
- 181 residents data collection
- 39 residents tested positive until 11th of May: 36 symptomatic, 3 presymptomatic
- 74 residents tested positive from start weekly testing
- 6 asymptomatic
- 39 presymptomatic
- 29 symptomatic

Supplementary Table 2: Sensitivity analysis

Symptom assessment of staff with and without positive SARS-CoV-2 PCR

Symptom assessment n(%)	SARS-CoV-2 test result prospective and retrospective		p-value
	Positive N=56	Negative N=188	
Cough	26 (46.4)	33 (17.6)	<0.001
Dyspnea	20 (35.7)	26 (13.8)	0.001
Fever	15 (26.8)	9 (4.8)	0.000
Chills	22 (39.3)	13 (6.9)	<0.001
Malaise	24 (42.9)	17 (9.0)	<0.001
Fatigue	42 (75.0)	82 (43.6)	<0.001
Myalgia	26 (46.4)	42 (22.3)	0.002
Headache	36 (64.3)	66 (35.1)	<0.001
Sore throat	21 (37.4)	40 (21.3)	0.044
Nasal congestion	34 (60.7)	48 (25.5)	<0.001
Diarrhea	14 (25.0)	26 (13.8)	0.023
Nausea	7 (12.5)	11 (5.9)	0.217
Diminished intake	23 (41.1)	16 (8.5)	<0.001
Loss of smell or taste	27 (48.2)	12 (6.4)	<0.001

Symptom assessment n(%)	SARS-CoV-2 test result prospective (from May 18th)		p-value
	Positive N=30	Negative N=188	
Cough	17 (56.7)	33 (17.6)	<0.001
Dyspnea	11 (36.7)	26 (13.8)	0.008
Fever	5 (16.7)	9 (4.8)	0.015
Chills	10 (33.3)	13 (6.9)	<0.001
Malaise	12 (40.0)	17 (9.0)	<0.001
Fatigue	21 (70.0)	82 (43.6)	0.012
Myalgia	14 (46.7)	42 (22.3)	0.017
Headache	18 (60.0)	66 (35.1)	0.033
Sore throat	11 (36.7)	40 (21.3)	0.171
Nasal congestion	18 (60.0)	48 (25.5)	0.001
Diarrhea	10 (33.3)	26 (13.8)	0.001
Nausea	3 (10.0)	11 (5.9)	0.641
Diminished intake	10 (33.3)	16 (8.5)	<0.001
Loss of smell or taste	10 (33.3)	12 (6.4)	<0.001

continued

	Staff tested positive for SARS-CoV-2		p-value
	Prospective N=30	Retrospective N=26	
Cough	17 (56.7)	9 (34.6)	0.099
Dyspnea	11 (36.7)	9 (34.6)	0.873
Fever	5 (16.7)	10 (38.5)	0.097
Chills	10 (33.3)	12 (46.2)	0.436
Malaise	12 (40.0)	12 (46.2)	0.231
Fatigue	21 (70.0)	21 (80.8)	0.493
Myalgia	14 (46.7)	12 (46.2)	0.969
Headache	18 (60.0)	18 (69.2)	0.472
Sore throat	11 (36.7)	10 (38.5)	0.890
Nasal congestion	18 (60.0)	16 (61.5)	0.906
Diarrhea	10 (33.3)	4 (15.4)	0.172
Nausea	3 (10.0)	4 (15.4)	0.543
Diminished intake	10 (33.3)	13 (50.0)	0.206
Loss of smell or taste	10 (33.3)	17 (65.4)	0.049

	Staff tested positive for SARS-CoV-2		p-value
	Symptom based N=39	Biweekly testing N=17*	
Cough	15 (38.5)	11 (64.7)	0.070
Dyspnea	14 (35.9)	6 (35.3)	0.965
Fever	13 (33.3)	2 (11.8)	0.094
Chills	17 (43.6)	5 (29.4)	0.318
Malaise	19 (48.7)	5 (29.4)	0.179
Fatigue	29 (74.4)	13 (76.5)	0.867
Myalgia	19 (48.5)	7 (41.2)	0.603
Headache	26 (66.7)	10 (58.8)	0.573
Sore throat	12 (30.8)	9 (52.9)	0.115
Nasal congestion	21 (53.8)	13 (76.5)	0.111
Diarrhea	8 (20.5)	6 (35.3)	0.240
Nausea	6 (15.4)	1 (5.9)	0.323
Diminished intake	17 (43.6)	6 (35.3)	0.562
Loss of smell or taste	23 (59.0)	4 (23.5)	0.015

*Staff tested in week of 18th and 22nd of May, 1st and 5th of June

Supplementary Table 3: Sensitivity Analysis

Symptom assessment of residents and staff with a positive SARS-CoV-2 PCR-test, prospective data collection from 18th of May

Symptom assessment n(%)	Residents N=113	Staff N=30	p-value
Symptomatic	65 (57.5)	28 (93.3)	0.001
Presymptomatic	41 (36.3)	1 (3.3)	
Asymptomatic	7 (5.2)	1 (3.3)	
Cough	31 (27.4)	17 (56.7)	0.003
Dyspnea	13 (11.5)	11 (36.7)	0.001
Fever	30 (26.5)	5 (16.7)	0.263
Saturation	27 (23.9)	NA	NA
Delirium	16 (14.2)	NA	NA
Chills	4 (3.5)	10 (33.3)	<0.001
Malaise	25 (22.1)	12 (40.0)	0.047
Fatigue	19 (16.8)	21 (70.0)	<0.001
Myalgia	2 (1.8)	14 (46.7)	<0.001
Headache	5 (4.4)	18 (60.0)	<0.001
Sore throat	2 (1.8)	11 (36.7)	<0.001
Nasal congestion	15 (13.3)	18 (60.0)	<0.001
Diarrhea	10 (8.8)	10 (33.3)	0.001
Nausea	9 (8.0)	3 (10.0)	0.721
Diminished intake	17 (15.0)	10 (33.3)	0.023
Loss of smell or taste	0	10 (33.3)	<0.001

Symptom assessment of residents and staff with a positive SARS-CoV-2 PCR-test who were tested regardless of symptoms

Symptom assessment n(%)	Residents* N=71	Staff** N=17	p-value
Symptomatic	25 (35.2)	15 (88.2)	<0.001
Presymptomatic	29 (54.9)	1 (5.9)	
Asymptomatic	7 (9.9)	1 (5.9)	
Cough	11 (15.5)	11 (64.7)	<0.001
Dyspnea	3 (4.2)	6 (35.3)	<0.001
Fever	1 (1.4)	2 (11.8)	0.035
Chills	1 (1.4)	5 (29.4)	<0.001
Malaise	6 (8.5)	5 (29.4)	0.019
Fatigue	7 (9.9)	13 (76.5)	<0.001
Myalgia	0	7 (41.2)	<0.001
Headache	2 (2.8)	10 (58.8)	<0.001
Sore throat	1 (1.4)	9 (52.9)	<0.001
Nasal congestion	4 (5.6)	13 (76.5)	<0.001
Diarrhea	7 (9.9)	6 (35.3)	0.008
Nausea	2 (2.8)	1 (5.9)	0.532
Diminished intake	5 (7.0)	6 (35.3)	0.002
Loss of smell or taste	0	4 (23.5)	<0.001

*tested at 6th, 12th, 19th, 26th of May and 2nd of June.

**tested at 18th and 22nd of May, 1st and 5th of June.

6

Implementation of a national testing policy in Dutch nursing homes during SARS-CoV-2 outbreaks

Judith H. van den Besselaar,
Marije Spaargaren,
Martin Smalbrugge,
Fleur M.H.P.A Koene
Loes Termeulen
Cees M.P.M. Hertogh
Bianca M. Buurman

Abstract

Background
To evaluate how a serial SARS-CoV-2 national testing policy was implemented in Dutch nursing homes regardless of symptoms during outbreaks in the second wave and to explore barriers and facilitators to serial testing.

Methods
We conducted a mixed-method study of nursing homes in the Netherlands with a SARS-CoV-2 outbreak after 15 September 2020. Direct care staff and management from 355 health care organizations were invited to participate in a digital survey. 74 out of 355 (20.9%) healthcare organizations participated and provided information about 117 nursing homes. We conducted 26 in-depth interviews on the outbreak and the testing strategy used. We also conducted four focus group meetings involving managers, physicians, nurses, and certified health assistants. Recordings were transcribed and data were thematically analyzed.

Results
104 nursing homes (89%) tested residents regardless of their symptoms during the outbreak, and 85 nursing homes (73%) tested the staff regardless of their symptoms. However, interviews showed testing was sometimes implemented during later stages of the outbreak and was not always followed up with serial testing. Barriers to serial testing regardless of symptoms were lack of knowledge of local leaders with decisional making authority, lack of a cohort ward or skilled staff, and insufficient collaboration with laboratories or local public health services. Important facilitators to serial testing were staff willingness to undergo testing and the availability of PCR tests.

Conclusions
Serial testing regardless of symptoms was only partially implemented. The response rate of 21% of nursing home organizations gives a risk of selection bias. Barriers to testing need to be addressed. A national implementation policy that promotes collaboration between public health services and nursing homes and educates management and care staff is necessary.

Introduction

In nursing homes (NH), presymptomatic transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease (COVID-19), has been well established.[1-4] Restricting SARS-CoV-2 testing to symptomatic individuals increases the risk of large-scale outbreaks in NHs. Before vaccines were available, NH residents with COVID-19 had a higher risk of morbidity and mortality[5] even if they were asymptomatic.[6] In May 2020, the Centers for Disease Control and Prevention (CDC) recommended testing all NH residents for SARS-CoV-2 if there was an outbreak in the facility.[7] They also recommended testing residents 5–7 days after exposure to a SARS-CoV-2-positive individual even if the initial test was negative. A further recommendation was for asymptomatic healthcare personnel to be tested after exposure to a SARS-CoV-2-positive individual and to self-isolate for 14 days following the exposure.[8] Multiple NHs were able to keep outbreaks under control with serial testing of residents and staff.[9-15]

On 27 August 2020, the national advisory board of the Dutch Government recommended unit-wide weekly testing of all individuals rather than just symptomatic individuals in NHs during a SARS-CoV-2 outbreak.[16] However, these guidelines were not implemented until November by the Elderly Care Physician Society and until December by the National Coordination Communicable Disease Control. It is unknown whether serial testing was implemented in Dutch NHs and what the barriers and facilitators to testing were.

In other countries, reported barriers to facility-wide serial testing during the first wave of the pandemic include insufficient availability of tests, limited personnel, insufficient financial resources, limited public health resources such as laboratory capacity[17-20], and the discomfort of nasopharyngeal swabs.[21] In summer 2020, the availability of PCR tests and personal protective equipment (PEE) increased in the Netherlands, which eliminated some of these potential barriers.

Reported facilitators to facility-wide serial testing were collaborations with local hospitals, hospital laboratories, and local public health officials.[20, 22, 23] In a survey of NH staff in the US, 71.1% said regular testing was important[24], indicating that healthcare workers are willing to get tested. In addition, a systematic review reported that preparing for an outbreak can prevent or mitigate the outbreak when it happens.[25]

6

In this mixed-method study of SARS-CoV-2 outbreaks during the second wave of the COVID-19 pandemic, we addressed two research questions:

1. How many NHs with a SARS-CoV-2 outbreak implemented unit-wide serial testing in all individuals, regardless of symptoms, during the outbreak?
2. What are the barriers and facilitators to unit-wide serial SARS-CoV-2 testing in all individuals, regardless of symptoms, during an outbreak in NHs?

Methods

This was a mixed-method study. We distributed a digital survey among Dutch NHs. To get an in-depth insight into how SARS-CoV-2 outbreaks were managed, we conducted semi-structured interviews and focus group meetings. This study was part of a larger project evaluating SARS-CoV-2 outbreaks and related infection prevention policies in Dutch NHs during the second wave of the pandemic. The aims of the current study were planned in the main study. The complete protocol is available in Dutch upon request. An ethical waiver was obtained by the Medical Ethics committee of the Academic Medical Center.

Recruitment and participants
Most NHs in the Netherlands are part of a larger organization. Email addresses were collected from www.zorgkaartnederland.nl, designed by the Dutch Patient Federation. In January 2021, we sent an email to 355 healthcare organizations representing over 2500 NHs, inviting them to participate in the study. Non-responders were reminded twice. We invited those NHs that reported a SARS-CoV-2 outbreak after 15 September, shortly after the new policy of weekly testing was advocated. At the peak of the second wave, 873 NHs reported an outbreak.[26]

Eligible participants for the questionnaire and interview were staff involved in managing a SARS-CoV-2 outbreak and eligible participants for the focus group meetings were managers, elderly care physicians[27], nurses, and certified nursing assistants. To ensure participants could exchange experiences on an equal footing, focus groups comprised participants of the same profession.

Survey design
Two pilot surveys were iteratively developed in June to August and November and December of 2020 together with managers and physicians of six NHs with a SARS-CoV-2 outbreak in the first wave of the pandemic. The survey was designed to evaluate the testing strategy and gain insight into the NH, the reported outbreak (number of tested and infected residents and staff), and the SARS-CoV-2 infection prevention policy and testing strategy (Supplementary Text 1).

Interview and focus group design
We followed the Consolidated Criteria for Reporting Qualitative Research (Supplementary Table 1).

To design the interview and focus groups, we used two frameworks. First, we organized probing questions based on the framework and results of Houghton.[28] Barriers and facilitators to following the infection prevention and control (IPC) guidelines for respiratory infectious diseases were organized in three levels: organizational, environmental, and individual. Second, we added probing questions based on the framework of Grol and Wensing.[29] On the organizational level, we focused on the social, political, and economic context; on the environmental level, we asked about innovation; and on the individual level, we asked about patient characteristics (Supplementary Table 2).

Only participants who completed the online survey were interviewed, so staff could reflect on the answers given in the survey. The Dutch public health service is organized into 25 districts and we were able to interview NH staff from 21 of these districts. We started the interview with general questions about the organization and continued with questions about the outbreak and how it was mitigated (Supplementary Text 2).

Staff focus group meetings included three open questions. The first was about outbreaks in the second wave: how did they happen and did increased testing and personal protective equipment (PPE) help to mitigate the outbreaks? The second was what the staff needed to control SARS-CoV-2 outbreaks in NHs. The third focused on serial testing and staff members' experiences with this policy (Supplementary Text 3).

Data collection
Data were collected between 12 January and 9 April 2021. The online survey was distributed using the online tool Castor[30] and we adhered to the guidelines of Good Clinical Practice. After obtaining informed consent, telephone interviews were conducted by JB, LT, and MSp. To ensure uniformity in interviewing, all interviews were by two researchers. Focus groups were conducted digitally with JB as moderator and LT and MSp as observers. Interviews and focus groups were recorded and transcribed.

6

Data analysis

Survey data were analyzed using SPSS (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). Data from interviews and focus group meetings were thematically analyzed according to Braun. Data were analyzed based on theoretical assumptions and with an open approach.[31] First, JB, LT and MSp read the transcripts to familiarize themselves with the data. After this, they coded three independent interviews inductively. After a team meeting about the initial coding, a coding scheme was developed. This coding scheme reflected the different levels of the framework: organizational, environmental, and individual. Experiences and policy choices were coded separately for the different IPC measures (preparation phase, testing, cohorting, and use of PPE). Next, JB, LT and MSp coded the rest of the interviews and focus group meetings. Recurring barriers and facilitators to testing were presented at weekly team meetings to reach consensus on results. Data saturation was reached after the 17th interview. We used MAXQDA 2020 (VERBI Software) to analyze data.

Results

Implementation of serial testing

74/355 (20.9%) healthcare organizations participated in the study: 72 in the online questionnaire, providing data from 117 NHs reporting an outbreak of which 24 also participated in focus groups and interviews. The remaining two healthcare organizations participated in the focus groups without completing a questionnaire (Supplementary Figure 1). Responding and non-responding nursing homes were compared in size and location: no differences were found (Supplementary Table 3). 53% of the NHs reported one outbreak, 23.9% reported two outbreaks, and 23.1% reported three outbreaks or more during the second wave. During the most recent outbreak, a median of eight residents (IQR 3;19) and 30 staff members (IQR 14;75) tested positive for SARS-CoV-2 (Table 1).

Figure 1 and Supplementary Table 4 illustrate the SARS-CoV-2 testing policies implemented by NHs. Respondents could check multiple boxes about their testing strategies. NHs performed unit- or facility-wide testing of all residents regardless of symptoms (104/117) more often than they did all staff (85/117) (Figure 1). Of NHs performing unit-wide testing of residents (84/117), 72.6% repeated this at least once a week. Of NHs performing unit-wide testing of staff (64/117), 62.5% repeated this at least once per week. Supplementary Table 4 shows that several testing strategies were implemented simultaneously, which was also reflected in the interviews. In some cases, serial testing was only implemented after multiple cases had been identified.

Barriers and facilitators to serial testing regardless of symptoms

We conducted 24 interviews about 26 outbreaks (one healthcare organizations was interviewed about 3 different outbreaks). We conducted four focus group meetings with 49 participants from 21/25 health service districts in the Netherlands (Table 3). We identified organizational, environmental, and individual barriers and facilitators to serial testing regardless of symptoms (Figure 2 and Table 3). These factors interacted with each other as described below.

Figure 1: Implementation of SARS-CoV-2 testing policy by nursing homes participating in surveys
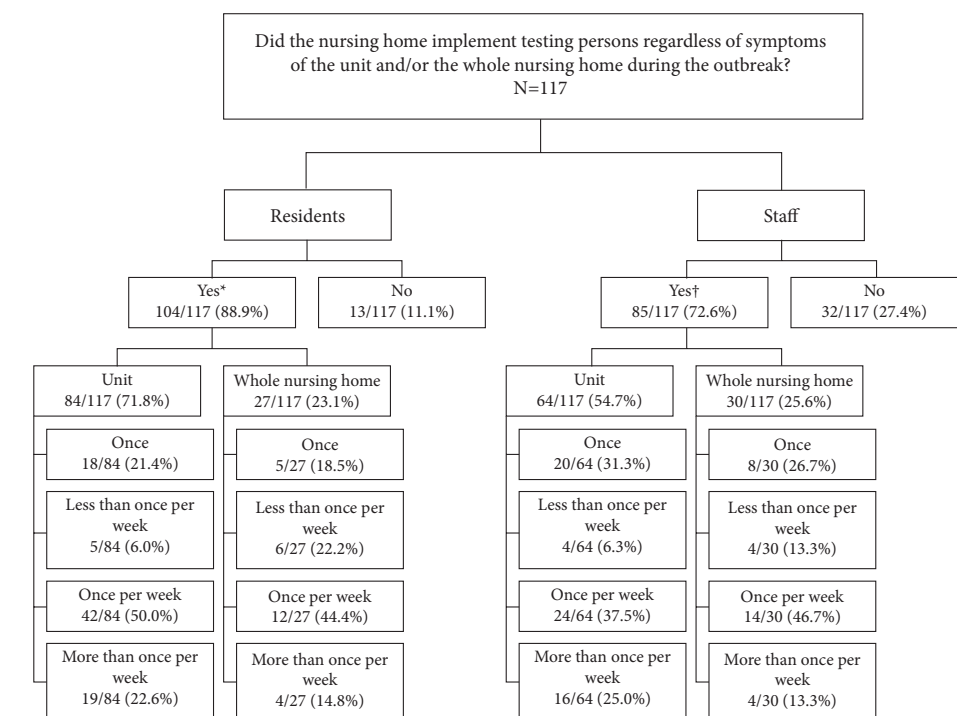
* Answered question "Which testing policy for residents was implemented at this outbreak?" with "we test residents of the whole unit regardless of symptoms" and/or "we test all residents of the nursing home regardless of symptoms". 7/104 nursing homes implemented both strategies.

† Answered question "Which testing policy for staff was implemented at this outbreak?" with "we test staff of the whole unit regardless of symptoms" and/or "we test all staff of the nursing home regardless of symptoms". 9/85 nursing homes implemented both strategies.

Table 1: Characteristics of participating staff and facilities

Characteristic	
Respondents participating in survey*, N	84
Female, N	59
Profession of survey respondent, %	15
Elderly care physician	30
Manager	14
Board member or secretary	16
Nurse	20
Administrator	5
Certified health assistant	
Facilities participating in survey, N	117
Urbanity, %	
Urban‖	12.8
Medium-sized cities †	53.0
Rural §	34.2
Number of residents, %	
≤60	33.3
61–120	40.2
≥121	26.5
Number of staff, %	
≤75	25.6
76–150	36.8
150–225	17.9
≥226	19.7
Shared bed/bathroom, %	
Bedroom	2.6
Bathroom	38.5
None	63.2
Number of outbreaks of SARS-CoV-2 after 15 September 2020, %	
1	53.0
2	23.9
≥3	23.1
Number of residents with a positive test** during the last outbreak, median (IQR‖)	8 (3,19)
Number of staff with a positive test** for SARS-CoV-2 during last outbreak, median (IQR‖)‡	30 (14,75)
Facilities experiencing an outbreak of SARS-CoV-2 in spring/summer 2020, %	38.5

* 8 surveys were answered by two respondents	**PCR or antigen test
‖>2500 addresses/km²	‖ Interquartile range (25%;75%)
† 1000–2500 addresses/km²	‡ 3 missing
§ <1000 addresses/km²	

Table 2: Characteristics of focus group interviews

Characteristic	
Participant's interview, N	31
Female, N	22
Profession*, N	
Elderly care physician	6
Manager	6
Board member	4
Nurse	6
Certified health assistant	4
Administrator	5
Years of work experience, mean	17
Participants focus groups, N	21
Female, N	19
Profession*, N	
Elderly care physician	5
Manager	8
Nurse	4
Certified health assistant	6
Years of work experience, mean	12

*One elderly care physician and two managers participated in an interview and a focus group.

Organizational level

A barrier to serial testing regardless of symptoms was the lack of collaboration with external parties. In the Netherlands, NHs are responsible for managing outbreaks of infectious diseases and the local public health service only assists on request or if the outbreak is large. Most NHs received guidance on hygiene and how to realize a cohort, but not on testing. Some NHs needed help managing their outbreak early on, but local public health services were often overloaded and unavailable. Furthermore, some NHs reported that local public health service staff were inexperienced and unable to advise on the latest testing guidelines.

> "At one moment, the public health service had a call center with 2000 employees and they weren't aware [of the latest guidelines]. […] We were very strict about implementing the guidelines, so we were struggling with the changing advice we were getting and the ambiguous explanations." (Board member, interview 23)

Another barrier to serial testing in some NHs was the lack of collaboration with a laboratory or hospital to provide quick PCR test results. Some NHs reported waiting up to 72 hours for a test result.

6

Table 3: Barriers and facilitators to weekly testing regardless of symptoms according to interview and focus group participants

	Barriers/Facilitators	Sample brief quotation
Organizational factors		
Barrier	Lack of collaboration with external parties	"At one moment, the public health service had a call center with 2000 employees and they weren't aware [of the latest guidelines]. […] We were very strict about implementing the guidelines, so we were struggling with the changing advice we were getting and the ambiguous explanations."
Environmental factors		
Barriers	Physical environment	*"Our dedicated ward for positive residents was not large enough, then you have a problem"*
	(Fear of) shortage of staff	*"We did not implement facility-wide testing of resident and staff because it's a pragmatic argument. I think, what if ten staff members are positive, where do I get the staff who have to do the work?"*
	Characteristics of residents	*"we waited to test [residents with dementia] until a resident had symptoms or altered behavior, because a lot of residents had a problem with the swab of their throat, that was not OK"*
	Number of positive tests in first testing round	*"if the outbreak is small with only one or two residents, then we could keep it small, but if we had 20 positive tests at once […] then it is very different"*
Facilitator	Availability of tests	*"The testing went smoothly and we had enough supplies"*
Individual factors		
Barrier	Lack of knowledge	*"In our experience, we had a lot of false negative tests. People felt safe with a negative test, but after a few days they developed symptoms, so the testing did not do us any good."*
	Beliefs	*"We did not transfer the resident from one ward to another: if a resident has dementia and you take this resident out of their own environment, that is difficult."*
Facilitator	Experience	*"You learned a lot [from an earlier outbreak] so you know immediately what to do."*
	Attitude	*"there was a high willingness of staff to get tested […] they were afraid of corona […] and they did not want to infect colleagues or residents."*

Figure 2: Barriers and facilitators for implementing serial facility-wide testing of residents and staff of nursing homes on the organizational, environmental and individual level.
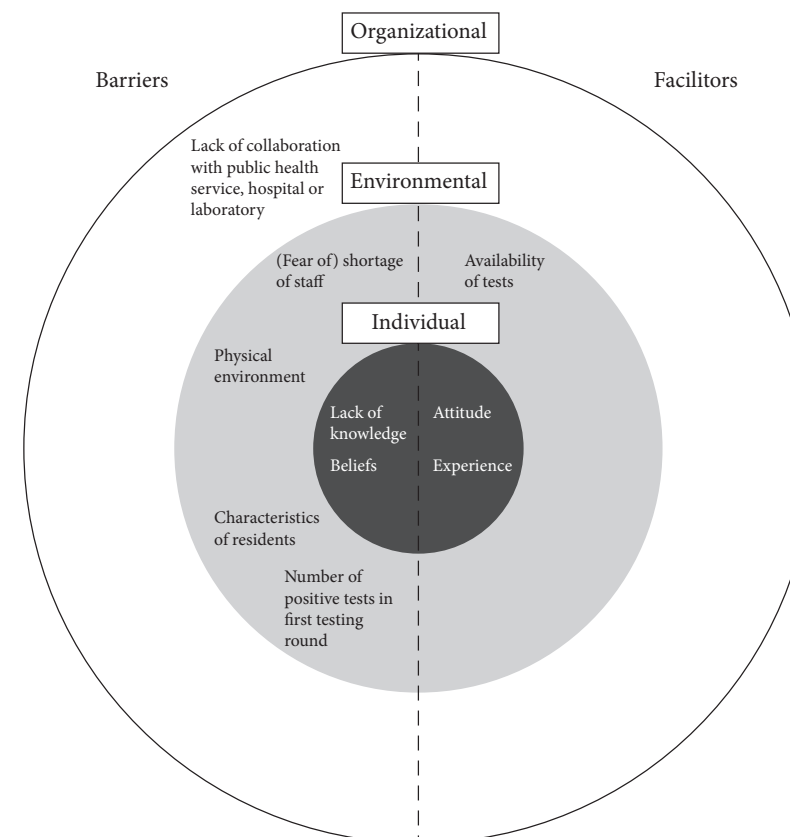
Environmental factors

A strong barrier to serial testing regardless of symptoms was the lack of a cohort ward in the NH. Multiple NHs couldn't create a separate ward because of limited staff or architectural constraints of the building. Some physicians and managers felt the test results had no consequences because residents would stay on the same ward anyway, so they did not test further. According to them, it was particularly difficult to isolate residents with dementia after a positive test result, so physicians did not see the advantages of repeated testing. In NHs with individual apartments, staff did not choose to test all residents regardless of symptoms – instead, they kept all residents in quarantine until 10 days after the last symptoms were detected. Characteristics of the outbreak and the residents were also considered when deciding to implement serial testing regardless of symptoms:

"Manager: if the outbreak is small with only one or two residents, then we could keep it small, but if we had 20 positive tests at once and residents walk around and are sick at the same time, then it is very different. I also think that if you [as an organization] choose to give residents with dementia the freedom to walk around the building you risk a lot of contagions.

Moderator: So, with the beliefs of the organization and the layout of the building, the serial testing had no benefit?

Manager: "Yes." (Manager 7, focus group managers)

Shortage of staff not only complicated the creation of a cohort ward but also prevented managers from testing staff regardless of symptoms.

"We did not implement facility-wide testing of resident and staff because it's a pragmatic argument. I think, what if ten staff members are positive, where do I get the staff who have to do the work?" (Manager, interview 10)

A facilitator to serial testing was the widespread availability of PCR tests – only one NH reported having to wait two days for enough tests. Also, no NH reported shortage of PPE.

Individual factors
Almost all participants felt they had to choose between the safety and quality of life of their residents. The outcome of this decision depended on the prior experience, knowledge, and beliefs of the participant. For example, if serial testing had been successful in managing a previous outbreak, then NHs were more likely to implement weekly testing regardless of symptoms in a future outbreak. However, if the managers and physicians had limited knowledge then misconceptions could be a barrier to serial testing. This influenced the decisions made on the organizational level. For example, some believed that if one resident tested positive, then all the other residents would test positive as well and it would be no use testing everyone more than once.

"Interviewer: But after the initial testing of the unit, did you continue with testing after a few days?"

Physician: No, because in all three common areas residents were positive, so we assumed that all residents in these units were positive." (Physician, interview 8)

Another misconception was that testing everyone would give more false negative test results. If new infections were detected after the initial testing, a number of managers and physicians felt that cases had been missed and that the testing was not reliable.

"Manager 2: In our experience, we had a lot of false negative tests. People felt safe with a negative test, but after a few days they developed symptoms, so the testing did not do us any good."

Moderator: Because you tested all residents and staff after a week?

Manager 2: We tested because somebody got symptoms, so we had a lot of false negatives…

Moderators: But the outbreak did not mitigate after the serial testing?

Manager: Well, we only tested because of symptoms and then we found new cases…" (Focus group managers)

Some managers and physicians believed that testing and transferring residents with dementia would reduce the quality of life too much and that it would be better to continue care as usual instead of testing all residents and isolating positive individuals to a cohort ward.

"We did not transfer the resident from one ward to another: if a resident has dementia and you take this resident out of their own environment, that is difficult." (Secretary of board, interview 12)

Participants reported that some residents would refuse to be tested but not if a familiar member of staff performed the test.

An important facilitator was the positive attitude of direct care staff towards testing during an outbreak. Staff wanted to know if they were positive and wanted to protect their family, friends, and residents.

6

Discussion

Serial testing all individuals in a NH regardless of symptoms had been implemented largely in Dutch NHs. Most participating NHs had performed unit- or facility-wide testing of residents (89%) and staff (73%) regardless of their symptoms during a SARS-CoV-2 outbreak. However, interviews showed that testing regardless of symptoms is often implemented later on in an outbreak instead of after the first positive PCR test result. Another finding was that testing was often not repeated. Important barriers to serial testing regardless of symptoms were the insufficient collaboration with laboratories or public health services, the lack of a cohort ward, not enough skilled staff, and insufficient knowledge leading to incorrect tradeoffs between safety and quality of life of residents among managers and physicians. Important facilitators were availability of PCR tests and willingness of direct care staff to undergo SARS-CoV-2 tests.

Implementing a testing strategy late in an outbreak is consistent with the findings of Lee[32] on how diseases are transmitted and controlled in NHs: outbreak mitigation was hampered by delayed notification of an outbreak, late implementation of IPC guidelines, and delayed recognition of outbreaks. Many NHs that successfully mitigated an outbreak with facility-wide testing were supported by the local hospital, laboratory, or public health services.[10, 13, 33, 34] Other studies have shown that a cohort ward or being able to isolate positive residents and having enough staff were key facilitators to mitigating an outbreak.[10, 13, 34, 35] This is in agreement with our findings. The last years, Dutch NHs have been built and renovated to resemble a home environment. However, infection prevention did not play a role and resulted in the experienced problems of not being able to cohort or isolate positive residents. Similar concerns have been addressed in the United States.[36]

A hypothesized barrier to serial testing is a fear of staff shortages if too many people test positive.[17] To our knowledge, we are the first study which showed managers avoided to test staff to prevent shortages. This may promote an outbreak among staff members resulting in more staff-shortages and more positive cases in the long run. To overcome this barrier, managers and physicians need to be educated on the rationale of serial testing regardless of symptoms and need to be supported by the local public health service. Also misconceptions and lack of knowledge among managers and physicians are important barriers to serial testing regardless of symptoms of residents. They believed that testing and cohorting would be too much of a burden for residents. However, respondents who did implement serial testing of residents did not report these negative effects. This lack of appropriate knowledge means managers and physicians are unconsciously incompetent and therefore cannot adequately weigh the risk of a large outbreak against the quality of life of residents. Managers and physicians need to make sure they have appropriate

knowledge of IPC guidelines for implementation in their NH. Ethical objections to visiting restrictions[37, 38] and moving positive residents[39] have been described before. However, implementing facility-wide testing and isolation or movement of positive residents during early stages of an outbreak could limit virus transmission, minimizing the need for future restrictions. This allows residents to maintain contact with their relatives and the NH to continue normal care, which is especially important for residents with dementia.

We observed almost no shortages in PCR tests and PPE in our participating NHs during the second wave of the pandemic. This contrasts with the shortages reported during SARS-CoV-2 outbreaks in NHs during the first wave of the pandemic.[18-20] The willingness of direct care staff to undergo SARS-CoV-2 testing is consistent with previous literature[24, 40, 41] and was explained by a desire not to infect family or residents.

A strength of our study is the sampling of healthcare organizations in the Netherlands with NH care distributed over rural and urban areas and from small and large organizations. The sample size of 117 assumes 95% confidence with an error of 10% of the survey results.[42] 21% of Dutch nursing homes organizations participated, which gives a major risk of selection bias: NHs with more staff and who were not dealing with a current outbreak were more likely to participate. Another limitation is that we did not validate our findings with the public health services, residents, and their informal caregivers.

The findings of our study are important because NH residents are vulnerable to infectious diseases.[43] The barriers to serial testing we describe suggest four ways to prevent infection in NHs. First, NHs need to collaborate with the public health service and the local hospital or laboratory. Second, NHs need to be designed so that infected residents can be isolated in case of an outbreak. Third, management and direct care staff need to be trained and educated on IPC guidelines to avoid misconceptions. Last, NHs need sufficient staff to implement infection prevention measures.

6

Reference List

1. Goldberg, SA, Lennerz, J, Klompas, M, et al. Presymptomatic Transmission of Severe Acute Respiratory Syndrome Coronavirus 2 Among Residents and Staff at a Skilled Nursing Facility: Results of Real-time Polymerase Chain Reaction and Serologic Testing. Clin Infect Dis 2021;72(4):686-689.

2. Arons, MM, Hatfield, KM, Reddy, SC, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. N Engl J Med 2020;382(22):2081-2090.

3. Kimball, A, Hatfield, KM, Arons, M, et al. Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020. MMWR Morb Mortal Wkly Rep 2020;69(13):377-381.

4. van den Besselaar, JH, Sikkema, RS, Koene, F, et al. Are presymptomatic SARS-CoV-2 infections in nursing home residents unrecognized symptomatic infections? Sequence and metadata from weekly testing in an extensive nursing home outbreak. Age Ageing 2021.

5. Rutten, JJS, van Loon, AM, van Kooten, J, et al. Clinical Suspicion of COVID-19 in Nursing Home Residents: Symptoms and Mortality Risk Factors. J Am Med Dir Assoc 2020;21(12):1791-1797.e1791.

6. Bigelow, BF, Tang, O, Toci, GR, et al. Transmission of SARS-CoV-2 Involving Residents Receiving Dialysis in a Nursing Home - Maryland, April 2020. MMWR Morb Mortal Wkly Rep 2020;69(32):1089-1094.

7. Testing Guidelines for Nursing Homes: interim SARS-CoV-2 Testing Guidelines for Nursing Home Residents and Healthcare Personnel; https://www.cdc.gov/coronavirus/2019-ncov/hcp/nursing-homes-testing.html. Accessed 6-24-2021.

8. Interim Guidance on Testing Healthcare Personnel for SARS-CoV-2; https://www.cdc.gov/coronavirus/2019-ncov/hcp/testing-healthcare-personnel.html. Accessed 6-24-2021.

9. Blain, H, Rolland, Y, Tuaillon, E, et al. Efficacy of a Test-Retest Strategy in Residents and Health Care Personnel of a Nursing Home Facing a COVID-19 Outbreak. J Am Med Dir Assoc 2020;21(7):933-936.

10. Escobar, DJ, Lanzi, M, Saberi, P, et al. Mitigation of a Coronavirus Disease 2019 Outbreak in a Nursing Home Through Serial Testing of Residents and Staff. Clin Infect Dis 2021;72(9):e394-e396.

11. Garibaldi, PMM, Ferreira, NN, Moraes, GR, et al. Efficacy of COVID-19 outbreak management in a skilled nursing facility based on serial testing for early detection and control. Braz J Infect Dis 2021;25(2):101570.

12. Karmarkar, EN, Blanco, I, Amornkul, PN, et al. Timely intervention and control of a novel coronavirus (COVID-19) outbreak at a large skilled nursing facility-San Francisco, California, 2020. Infect Control Hosp Epidemiol 2020:1-8.

13. Ehrlich, HY, Harizaj, A, Campbell, L, et al. SARS-CoV-2 in Nursing Homes after 3 Months of Serial, Facilitywide Point Prevalence Testing, Connecticut, USA. Emerg Infect Dis 2021;27(5):1288-1295.

14. Krone, M, Noffz, A, Richter, E, et al. Control of a COVID-19 outbreak in a nursing home by general screening and cohort isolation in Germany, March to May 2020. Euro Surveill 2021;26(1).

15. Psevdos, G, Papamanoli, A, Barrett, N, et al. Halting a SARS-CoV-2 outbreak in a US Veterans Affairs nursing home. Am J Infect Control 2021;49(1):115-119.

16. De Jonge, H. Advice of national advisory board of the Dutch Government of 27th of August. In: Ministy of Health, WaS, ed. https://www.rijksoverheid.nl/documenten/kamerstukken/2020/09/01/brief-inzake-omt-advies-27-augustus-2020; 2020.

17. Blackman, C, Farber, S, Feifer, RA, et al. An Illustration of SARS-CoV-2 Dissemination Within a Skilled Nursing Facility Using Heat Maps. J Am Geriatr Soc 2020;68(10):2174-2178.

18. Abbasi, J. "Abandoned" Nursing Homes Continue to Face Critical Supply and Staff Shortages as COVID-19 Toll Has Mounted. JAMA 2020;324(2):123-125.

19. Grabowski, DC, Mor, V. Nursing Home Care in Crisis in the Wake of COVID-19. Jama 2020;324(1):23-24.

20. Jones, K, Mantey, J, Washer, L, et al. When planning meets reality: COVID-19 interpandemic survey of Michigan Nursing Homes. Am J Infect Control 2021.

21. Dumyati, G, Gaur, S, Nace, DA, et al. Does Universal Testing for COVID-19 Work for Everyone? J Am Med Dir Assoc 2020;21(11):1525-1532.

22. Morris, SC, Resnick, AT, England, SA, et al. Lessons learned from COVID-19 outbreak in a skilled nursing facility, Washington State. J Am Coll Emerg Physicians Open 2020;1(4):563-568.

23. Stall, NM, Farquharson, C, Fan-Lun, C, et al. A Hospital Partnership with a Nursing Home Experiencing a COVID-19 Outbreak: Description of a Multiphase Emergency Response in Toronto, Canada. J Am Geriatr Soc 2020;68(7):1376-1381.

24. Hofschulte-Beck, SL, Hickman, SE, Blackburn, JL, et al. Attitudes and Experiences of Frontline Nursing Home Staff Toward Coronavirus Testing. J Am Med Dir Assoc 2021;22(1):215-217.

25. Usher, K, Durkin, J, Gyamfi, N, et al. Preparedness for viral respiratory infection pandemic in residential aged care facilities: A review of the literature to inform post-COVID-19 response. J Clin Nurs 2021.

26. Coronavirus Dashboard of the Dutch Government - Total number of infected locations over time; 2020. https://coronadashboard.government.nl/landelijk/verpleeghuiszorg. Accessed 7-29-2021.

6

27. Koopmans, RTCM, Lavrijsen, JCM, Hoek, JF, et al. DUTCH ELDERLY CARE PHYSICIAN: A NEW GENERATION OF NURSING HOME PHYSICIAN SPECIALISTS. Journal of the American Geriatrics Society 2010;58(9):1807-1809.

28. Houghton, C, Meskell, P, Delaney, H, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. Cochrane Database of Systematic Reviews 2020;(4).

29. Grol, R, Wensing, M. What drives change? Barriers to and incentives for achieving evidence-based practice. Med J Aust 2004;180(S6):S57-60.

30. Castor; https://www.castoredc.com/. Accessed 7-29-2021.

31. Braun, V, Clarke, V. Using thematic analysis in psychology. Qualitative Research in Psychology 2006;3:77-101.

32. Lee, MH, Lee, GA, Lee, SH, et al. A systematic review on the causes of the transmission and control measures of outbreaks in long-term care facilities: Back to basics of infection control. PLOS ONE 2020;15(3):e0229911.

33. Oldfield, BJ, DeCosta, S, Petterson, L, et al. A Blueprint for Community Health Center and Nursing Home Partnership: Testing for COVID-19 among Residents and Staff at Long-term Care Facilities. J Health Care Poor Underserved 2021;32(1):xi-xviii.

34. Montoya, A, Jenq, G, Mills, JP, et al. Partnering with Local Hospitals and Public Health to Manage COVID-19 Outbreaks in Nursing Homes. J Am Geriatr Soc 2021;69(1):30-36.

35. Seshadri, S, Concannon, C, Woods, JA, et al. "It's like fighting a war with rocks": Nursing home healthcare workers' experiences during the COVID-19 pandemic. Infect Control Hosp Epidemiol 2020:1-2.

36. Mody, L, Bradley, SF, Huang, SS. Keeping the "home" in nursing home: implications for infection prevention. JAMA internal medicine 2013;173(10):853-854.

37. Bolcato, M, Trabucco Aurilio, M, Di Mizio, G, et al. The Difficult Balance between Ensuring the Right of Nursing Home Residents to Communication and Their Safety. Int J Environ Res Public Health 2021;18(5).

38. Kusmaul, N. COVID-19 and Nursing Home Residents' Rights. J Am Med Dir Assoc 2020;21(10):1389-1390.

39. Gugliotta, C, Gentili, D, Marras, S, et al. SARS-CoV-2 Epidemics in Retirement and Nursing Homes in Italy: A New Preparedness Assessment Model after the First Epidemic Wave. Int J Environ Res Public Health 2021;18(11).

40. White, EM, Wetle, TF, Reddy, A, et al. Front-line Nursing Home Staff Experiences During the COVID-19 Pandemic. J Am Med Dir Assoc 2021;22(1):199-203.

41. Sarabia-Cobo, C, Pérez, V, de Lorena, P, et al. Experiences of geriatric nurses in nursing home settings across four countries in the face of the COVID-19 pandemic. J Adv Nurs 2021;77(2):869-878.

42. Dillman, DA, Smyth, JD, Christian, LM. Internet, Phone, Mail, and Mixed-Mode Surveys : The Tailored Design Method. New York, UNITED STATES: John Wiley & Sons, Incorporated, 2014.

43. Juthani-Mehta, M, Quagliarello, VJ. Infectious diseases in the nursing home setting: challenges and opportunities for clinical investigation. Clin Infect Dis 2010;51(8):931-936.

6

Supplementary

Supplementary Text 1: survey questions
This study was part of a larger project which evaluates COVID-19 outbreaks and all the aspects of the infection prevention policy of nursing homes in the Netherlands during the second wave of the pandemic.

Below we present the questions of the questionnaire which are related to the research questions of the current paper.

Questions about the outbreak
Q1: How many residents are living in your nursing home?

_____

Q2:How many units are at your nursing home?
A unit is a smaller section of the nursing home where residents live together. These residents can meet each other and have often their own team of staff. The units are separated with doors or because they are on a different floor.
Example: a nursing home has four floors. At each floor two wards with 8 residents are sharing the same staffing team and a common living area. This nursing home has 8 units.

_____

Q3: How many residents had a positive SARS-CoV-2 test since September 15th 2020?
These are residents who are infected in the nursing home. This are not residents/patients who are with a known SARS-CoV-2 infection.

_____

Q4: How many staff members are working at your nursing home?
☐ 75 or less
☐ 76-150
☐ 151-225
☐ 226 or over

Q5: How many staff members had a positive SARS-CoV-2 test since September 15th 2020?

_____

Q6: How many outbreaks of SARS-CoV-2 did your nursing home experience since September 15th 2020?
An outbreak are one or more residents with a positive SARS-CoV-2 test. They are infected in the nursing home. They are not admitted with a known SARS-CoV-2 infection.
Example: At the 20th of September a residents tests positive for SARS-CoV-2. After three weeks no new infections are identified any more. At the 15th of November another resident test positive for SARS-CoV-2. In this example two outbreaks occurred.

_____

Q7: Did your nursing home experience an outbreak of SARS-CoV-2 in the spring or summer of 2020?
☐ Yes
☐ No
☐ I don't know

Policy during the most recent outbreak
The next questions are about the most recent outbreak in your nursing home. An outbreak is one or more residents with a positive SARS-CoV-2 test. The resident was not admitted with a known SARS-CoV-2 infection.
Example: At the 20th of September a residents tests positive for SARS-CoV-2. After three weeks no new infections are identified any more. At the 15th of November another resident test positive for SARS-CoV-2. In this example the questions below should be answered about the outbreak which started at the 15th of November.

Q8: When was the first infection of the most recent outbreak?
_____ (day-month-year)

Q9: At what type of unit did the outbreak start?
☐ Psychogeriatric care
☐ Somatic care
☐ Psychiatric care
☐ Short term care/rehabilitation care/intermediate care
☐ Palliative care
☐ Other (free text space)

6

Q10: How many residents at this unit are approximately able to follow up instruction regarding infection prevention?
☐ Almost nobody (<10%)
☐ The minority (10-40%)
☐ Half (40-60%)
☐ The majority (60-90%)
☐ Almost everybody (>90%)

Q11.1: Which testing policy for residents was implemented at this outbreak? (multiple answers possible)
☐ We test residents with symptoms
☐ We test residents who had unprotected contact with a positive resident
☐ We test the whole unit regardless of symptoms
☐ We test all residents of the nursing home regardless of symptoms

If the whole unit or nursing home was tested regardless of symptoms:
Q11.2: With which frequency was the testing regardless of symptoms repeated?
☐ We tested residents once regardless of symptoms
☐ less than once per week
☐ once per week
☐ more than once per week

Q12: When was the last infection of the most recent outbreak?
_____ (day-month-year)

Q13: How many residents were tested during the most recent outbreak?
_____

Q14: How many residents had a positive SARS-CoV-2 test during the most recent outbreak?
_____

Q15: At how many units was the most recent outbreak?
_____

Q16: How many residents died of COVID-19 during the most recent outbreak?
_____

Q17: Who tested staff during the most recent outbreak? (multiple answers possible)
☐ Staff is tested by the nursing home

☐ Staff is tested by the local public health service
☐ Staff is tested by an external party other than the local public health service

Q18.1: Which testing policy for staff was implemented at this outbreak? (multiple answers possible)
☐ We test staff with symptoms
☐ We test staff who had unprotected contact with a positive case
☐ We test staff of the whole unit regardless of symptoms
☐ We test all staffof the nursing home regardless of symptoms

If the whole unit or nursing home was tested regardless of symptoms:
Q18.2: With which frequency was the testing regardless of symptoms repeated?
☐ We tested residents once regardless of symptoms
☐ less than once per week
☐ once per week
☐ more than once per week

Q19: How many staff members were tested during the most recent outbreak?
_____

Q20: How many staff members had a positive test during the most recent outbreak?
_____

Questions about the building
Q21: Do residents share a bedroom or bathroom? (multiple answers possible)
☐ bedroom
☐ bathroom
☐ all residents have their own bedroom and bathroom

Q22: Were common areas in use during the outbreak? (multiple answers possible)
☐ Restaurant
☐ Living room
☐ Fitness area
☐ Other
☐ None

Q23: Does your nursing home have a COVID-19 cohort ward?
☐ Yes

6

☐ Not at our nursing, but at another location of our health care organization
☐ No, and also no COVID-19 cohort ward available at another location

Barriers and facilitators to mitigate an outbreak
Which barriers did you experience in the mitigation of the outbreak?

_____

_____

_____

Which facilitators did you experience in the mitigation of the outbreak?

_____

_____

_____

Supplementary Table 1: COREQ (COnsolidated criteria for REporting Qualitative research) Checklist
The schedule below provides information on the performed study according to the COREQ Checklist. If information is also provided in the main text of the article, the location is provided.

Topic	Guide Questions/Description	Answer
Domain 1: Research team and reflexivity		
Personal Characteristics		
Interviewer/facilitator	Which author/s conducted the interview or focus group?	JB, LT, MSp *(Methods, Data collection)*
Credentials	What were the researchers's credentials?	JB, MD LT, BSc MSp, Bsc (*Title page*)
Occupation	What was their occupation at the time of study?	JB: PhD Student LT and MSp: research assistant
Gender	Was the researcher male or female?	JB, LT and MSp are females.
Experience and training	What experience or training did the researcher have?	JB was trained to perform qualitative research and interviews and conducted and published qualitative studies before. LT and MSp were trained by JB. The majority of the interviews and al the focus groups were conducted by JB.
Relationship with participants		
Relationship established	Was a relationship established prior to study commencement?	No.
Participant knowledge of interviewer	What did the participants know about the researcher?	The occupation of the researcher.
Interviewer characteristics	What characteristics were reported about the interviewer/facilitator?	JB is a PhD student and an experienced qualitative researcher. Before her PhD, she has worked as a medical doctor in the for five years (geriatrics, internal medicine, neurology). During medical school she worked for six years in a nursing home as a health care aid. MSp is a medical student and LT is a psychology student. Both completed their bachelor's degree and worked as a research assistant for the project. They were trained by JB.

6

Table 1 continued

Topic	Guide Questions/Description	Answer
Domain 2: Study design		
Theoretical framework		
Methodological orientation and Theory	What methodological orientation was stated to underpin the study?	We used thematic analysis according to Braun (*Methods, Data analysis*)
Participant selection		
Sampling	How were participants selected?	Purposive sampling.
Method of approach	How were participants approached?	Health care organizations providing nursing home care were approached by email. *(Methods, recruitment and participant)* The nursing home would distribute the invitation to their employees for participation in the interviews or focus groups.
Sample size	How many participants were in the study?	31 nursing home staff members participated in the interviews. 21 nursing home staff participated in the focus groups (*Results, Table 2*) 2 managers and one elderly care physician participated in the interviews as well as in the focus groups.
Non-participation	How many people refused to participate or dropped out? Reasons?	A flow chart about participant inclusion is provided in *supplementary 6*.
Setting		
Setting of data collection	Where was the data collected?	Data was collected with (video) calling.*(Method, Data collection)* Participants could be at home or at the workplace.
Presence of non-participants	Was anyone else present besides the participants and the researchers?	No.
Description of sample	What are the important characteristics of the sample?	Gender, profession and work experience is provided in *Table 2* in the *Results* section.
Data collection		

Table 1 continued

Topic	Guide Questions/Description	Answer
Interview guide	Where questions, prompts, guides provided by the authors? Was it pilot tested?	Provided briefly in the *Method* section *interview and focus group design*. Complete guides and questions are provided in *supplementary 4 and 5*. The interview guide was pilot tested in the summer of 2020 in a smaller study in the region of Amsterdam about outbreaks experienced in the first wave and was the basis for the study of outbreaks in the second wave. The focus group guide design was discussed and designed by the whole research team. After the first focus group the process was evaluated, but no adjustments to the guide were conducted.
Repeat interviews	Were repeat interviews carried out?	No. Sometimes participants provided additional information about details of their infection prevention protocols by mail after the interview. This was never about experienced barriers and facilitators.
Audio/visual recording	Did the research use audio or visual recording to collect data?	Interviews were recorded by audio, focus groups were recorded visually *(Methods, Data collection)*. Of two interviews the audio recording failed. Of these interviews field notes were analyzed.
Field notes	Were field notes made during and/or after the interview or focus groups?	During the interview brief field notes were made, also to structure the interview and to give the participant space to tell their story without interruptions. The field notes were used to ask additional questions and clarifications. Since the interviews and focus groups were almost all recorded, field notes were not analyzed.

6

Table 1 continued

Topic	Guide Questions/Description	Answer
Duration	What was the duration of the interviews and focus groups?	Interviews lasted between 30-60 minutes, focus groups lasted 2,5 hours.
Data saturation	Was data saturation discussed?	Data saturation was reached after the 17th interview. Other interviews were already planned according to the study protocol and completed.
Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No.
Domain 3: analysis and findings		
Data analysis		
Number of data coders	How many data coders coded the data?	Three: JB, LT, MSp.
Description of the coding tree	Did authors provide a description of the coding tree?	The coding scheme reflected the different levels of the framework: organizational, environmental and individual factors. Also, the experiences and policy choices were coded separately for the different infection prevention measures (preparation phase, testing, cohorting and use of personal protective equipment). (*Method, data analysis*)
Derivation of themes	Where themes identified in advance or derived from the data?	Both: theoretical frameworks and previous literature was used to identify the possible barriers and facilitators. However, questions were open ended and designed to explore also other barriers and facilitators. (*Method, interview and focus group design, data collection and data analysis*)
Software	What software if applicable, was used to manage the data?	MAXQDA 2020 (VERBI Software) (*Methods, data analysis*)
Participant checking	Did participants provide feedback on the findings?	No.
Reporting		

Table 1 continued

Topic	Guide Questions/Description	Answer
Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified?	Yes.
Data and findings consistent	Was there consistency between the data presented and the findings?	Yes.
Clarity of major themes	Were major themes clearly presented in the findings?	*Results Table 4:* Barriers and facilitators.
Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	In the main text (*Results, barriers and facilitators*) exceptions or diverse cases within the major themes are discussed.

Derived from Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International journal for quality in health care*, *19*(6), 349-357.

6

Supplementary Table 2: framework interview and focus groups barriers and facilitators for implementation of weekly testing for SARS-CoV-2 during a nursing home outbreak

Components of Houghton[1]	Components framework Grol&Wensink[2]
Organizational factors	Social context
Safety climate	Opinion of colleagues
Specific health and safety programs	Culture of the network
Availability of training programs	Collaboration
	Leadership
	Organizational context
	Organization of care processes
	Staff
	Capacities
	Resources
	Structures
	Economic and political context
	Financial arrangements
	Regulations
	Policies
Environmental factors	Innovation
Physical environment	Advantages in practice
Availability of personal protective equipment	Feasibility
	Credibility
	Accessibility
	attractiveness
Individual factors	Individual
Individual knowledge	Awareness
Individual attitudes	Knowledge
Individual beliefs	Attitude
Discomfort of testing	Motivation to change
	Behavioral routines
	Patient
	Knowledge
	Skills
	Attitude
	Compliance

Houghton, C, Meskell, P, Delaney, H, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. Cochrane Database of Systematic Reviews 2020;(4).

Grol, R, Wensing, M. What drives change? Barriers to and incentives for achieving evidence-based practice. Med J Aust 2004;180(S6):S57-60.

Supplementary Text 2: Interview guide following questionnaire

1. Could you tell us about your profession and your work experience?

2. How were you involved in the COVID-19 outbreak in your nursing home?

3. Could you tell us about the nursing home you are working?
   a. Which type of care is delivered?
   b. What does the building look like?
      i. How did the building influence the mitigation of the outbreak?

4. Could you describe the last outbreak of COVID-19 in your nursing home?
   Probing questions
   a. Where did it start?
   b. How did the outbreak spread over the nursing home?
   c. Check anwers of questionnaire: number of positive residents and staff and units involved.

5. Testing policy: check with answer online questionnaire. Why did the nursing home choose this strategy?
   Probing questions
   a. Feasibility of weekly testing?
   b. Availability of tests/resources?
   c. Did financial resources influence the testing policy?
   d. Compliance staff/residents?
   e. Collaboration with local public health service or other health organizations?
   f. Other barriers/facilitators?
   g. Would you choose the same strategy in a next oubreak? Why?

6. Check with questionnaire: availability of a cohort ward for COVID-19 in the nursing home? Why did the nursing home choose this strategy?
   a. Where was the location of the cohort ward? Outsourcing of cohort ward to other nursing home?
   b. Feasibility of creating a cohort ward?
   c. Did financial resources infuluence the creation of a cohort ward?
   d. Compliance staff/residents?
   e. Would you choose the same strategy in a next outbreak? Why?

6

7. Were visitors allowed during outbreak?
    a. If yes, how was this made possible? Experiences?
    b. If no, why not? Experiences?

Closing question: what do you need for the mitigation of a next outbreak of COVID-19?

Supplementary Text 3: Focus group design

Goal: to explore the barriers and facilitators for the implementation of a weekly testing policy during a COVID-19 outbreak in nursing homes.

Method: digital focusgroups with health care staff (managers, phycisians, nurses, health care assistants) of nursing homes. Participants will be from the same profession but from different nursing homes. Participants had to be involved in an outbreak of COVID-19 of their nursing home after September 15th 2020.

Moderator: JB
Observation: MSp, LT

Time schedule

Time stamp	Duration	Topic
00:00	15 min	Participants join online focus group Check technical resources: sound, vision
00:15	10 min	Start of focus group: introduction of focus group, researchers introduce themselves, check if everybody gave informed consent, introduction of program of focus group
00:25	10 min	Participants introduce themselves
00:35	25	Question 1: How do outbreaks of COVID-19 happen in nursing homes?
01:00	10	Break
01:10	25	Question 2: What do you need to control/mitigate outbreaks of COVID-19?
01:35	25	Question 3: What are your experiences with weekly testing of residents and staff regardless of symptoms?
02:00		Summary and closing of focus group

Introduction of focus group
-   Thank participants for their contribution
-   Introduce moderator and observants
-   Introduction of background and study aim
-   How to participate in a focus group, how to use digital tools (for example chat-function and raise hand)
-   Program of focus group
-   Check informed consent
-   start video recording of focus group

Participants introduce themselves

Research question 1: How do outbreaks of COVID-19 happen in nursing homes?

Probing questions:
- How is introduction of virus possible with the extended capacity of PPE?
- Role of management, testing, building, personnel, education, residents, family of residents?
- If you experienced an outbreak in first wave: what are the differences?

BREAK

Research question 2: What do you need to mitigate an outbreak of COVID-19?

Word cloud with menti.com. Start conversation about word cloud.

Possible probing questions:
Organizational: care processes, resources, staff
- Which care processes do you need?
  • Communication
  • Infection prevention
  • Training of staff
  • Testing
- What do you need of staff?
- Which resources do you need?
  • Cohort ward, testing, PPE, staffing
  • Where resources available? Why not?

Social context: Opinion of colleagues, culture of the network, collaboration, leadership
- How were you supported by the local health service and other health organizations?
- Did the safety climate/work environment influence the mitigation of the outbreak?

Innovation: Advantages in practice, feasibility, credibility, accessibility, aattractiveness
- How do current guidelines support you in mitigation of outbreak? Feasibility, advantages?

Individual: knowledge, attitude, believes, motivation to change, behavioural routines
- What training do you need?
- Did you feel prepared for an outbreak?
- Knowledge of colleagues about guidelines and infection prevention?

Patient: knowledge, attitude, believes, compliance

- What do you need from residents during an outbreak?
- How did residents react to the outbreak policy?
- How was the compliance of residents for outbreak policy?

Economic and political context: Financial arrangements, regulations, policies
- Did you experience financial barriers?

Research question 3: What are your experiences with weekly testing of residents and staff regardless of symptoms?

Probing questions:
- Was the policy of weekly testing of residents and staff regardless of symptoms implemented in your nursing home? Why?
- What were your personal feelings about the policy?
- How did other staff experience this policy?
- How did residents experience this policy?
- How did family of residents experience this policy?
- Feasibility of the policy?
- Enough resources?
- How did you experience the leadership from management and/or physicians?
- Advantages/disadvantages of weekly testing?

6

Supplementary Figure 1: Flow chart of inclusion
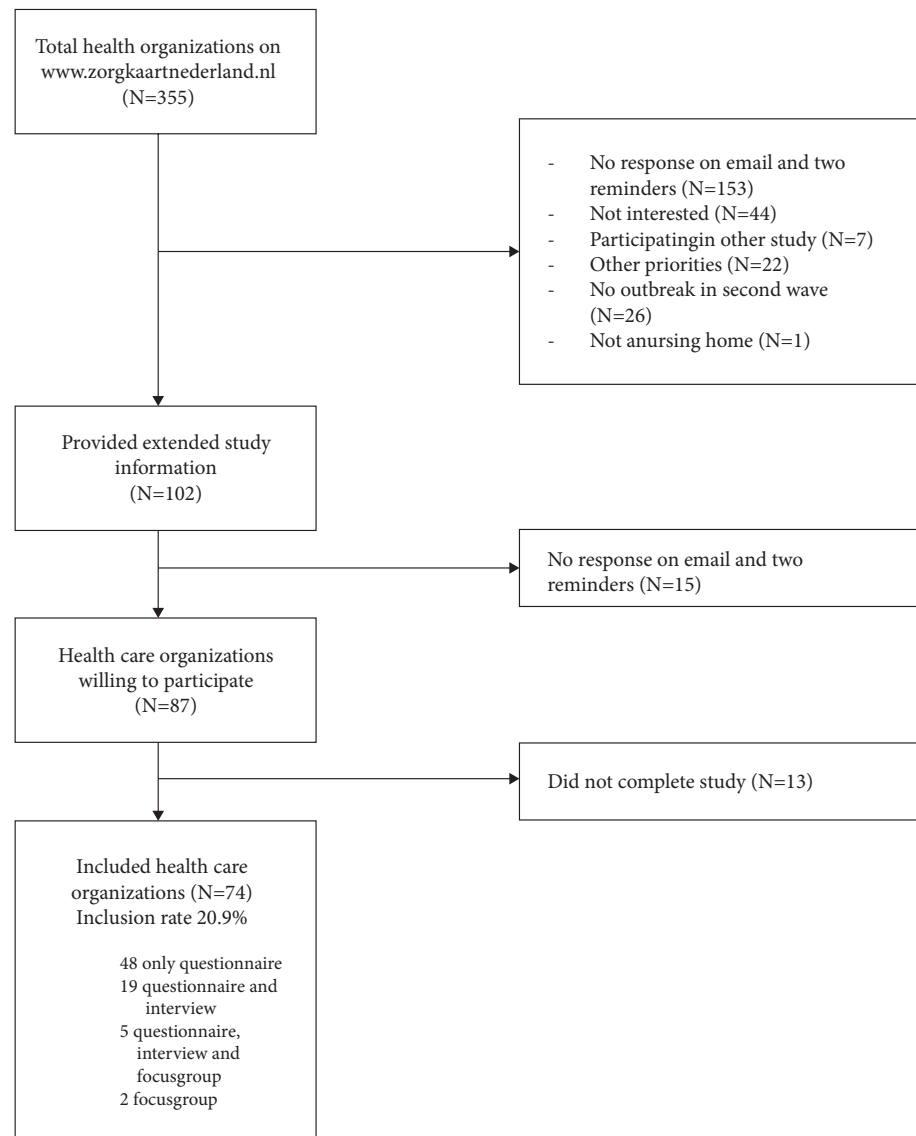
Supplementary Table 3: Rtesponder-nonresponder analysis

	Total	Responder	Non-responder	p-value
Healthcare organizations, N	355	74	281	NA
Number of nursing homes in organization, median (IQR*)	3 (1-9)	5 (2-9)	3 (1-9)	0.095†
Provinces, N(%)				0.727‡
Zuid-Holland	63 (17.7)	15 (20.3)	48 (17.1)	
Limburg	20 (5.6)	5 (6.8)	15 (5.3)	
Overijssel	29 (8.2)	8 (10.8)	21 (7.5)	
Zeeland	10 (2.8)	2 (2.7)	8 (2.8)	
Noord-Holland	41 (11.5)	11 (14.9)	30 (10.7)	
Noord-Brabant	51 (14.4)	11 (14.9)	40 (14.2)	
Drenthe	13 (3.7)	3 (4.1)	10 (3.6)	
Flevoland	4 (1.1)	1 (1.4)	3 (1.1)	
Friesland	14 (3.9)	1 (1.4)	13 (4.6)	
Gelderland	62 (17.5)	7 (9.5)	55 (19.6)	
Utrecht	29 (8.2)	7 (9.5)	22 (7.8)	
Groningen	19 (5.4)	3 (4.1)	16 (5.7)	

*Interquartile range
† Mann-Whitney U test
‡ Chi-square test

Supplementary Table 4: Implementation of SARS-CoV-2 testing policy by nursing homes participating in surveys (N=117)

Testing policy (multiple answers possible), N (%)	For residents	For staff
Only symptomatic persons	38 (32.5)	48 (41.0)
In case of unprotected contact	33 (28.2)	24 (20.5)
Whole unit regardless of symptoms	84 (71.8)	64 (54.7)
Whole nursing home regardless of symptoms	18 (21.4)	20 (31.3)

6

7

Symptoms of depression, anxiety, and perceived mastery in older adults before and during the COVID-19 pandemic: Results from the Longitudinal Aging Study Amsterdam

Judith H. van den Besselaar,
Janet L. MacNeil-Vroomen,
Bianca M. Buurman,
Cees M.P.M. Hertogh,
Martijn Huisman,
Almar A.L. Kok,
& Emiel O. Hoogendijk

Abstract

Objective

Governmental measures to protect older adults from COVID-19 are hypothesized to cause anxiety and depression. Previous studies are heterogeneous and showed small effects. This study aims to assess depressive and anxiety symptoms and perceived mastery just after the first wave of the COVID-19 pandemic compared to previous years in community-dwelling older adults and to identify potential risk groups according to the comprehensive geriatric assessment framework.

Methods

Data were used from 1,068 Dutch older adults (aged 55-93 at baseline in 2011-2013) participating in the Longitudinal Aging Study Amsterdam, including 4 follow-ups spanning 9 years. Depressive symptoms, anxiety symptoms and feelings of mastery were assessed with the short Center for Epidemiologic Studies Depression scale (CES-D-10), the Hospital Anxiety Depression Scale- Anxiety subscale (HADS-A) and the Pearlin Mastery Scale. Linear mixed regression was used to compare outcomes in June-August 2020 to previous years and to examine predictors to identify risk groups.

Results

Slight increases in CES-D-10 (1.37, 95% Confidence interval [CI] 1.12;1.62), HADS-A (0.74, 95% CI 0.56;0.94) and mastery (1.10, 95% CI 0.88;1.31) occurred during the COVID year compared to previous years. Older adults with functional limitations or with frailty showed a smaller increase in feelings of mastery in the COVID-year.

Conclusion

Our results suggest limited mental health effects on older adults from the first COVID-19 wave. Older adults have perhaps better coping strategies than younger adults, or preventive measures did not have extensive consequences for the daily life of older adults. Further monitoring of depression, anxiety and perceived mastery is recommended.

Introduction

Older adults are at elevated risk for severe Corona Virus Disease 2019 (COVID-19) morbidity and mortality[1, 2] and for adverse economic, social and psychological consequences related to the pandemic.[3, 4] For example, public health measures that conflict with personal freedom, contradictory messages from authorities, shortages of COVID-19 tests and personal protective equipment are hypothesized to cause emotional distress and increase risk for psychiatric illness.[5, 6] Furthermore, the unexpectedness of the pandemic itself and the many consequences that seem uncontrollable by individuals, such as cancellations of treatments and restrictions to social contacts may reduce feelings of personal control over life (mastery), which is an essential coping resource for maintaining good mental health.[7] In the Netherlands, the government gave community-dwelling older adults additional recommendations next to the public health measures for the general population at the peaks of the pandemic from March-May 2020 and October 2020 until April 2021. The government advised older adults against the use of public transport, not to do their own groceries and not to receive any visitors (https://www.rijksoverheid.nl/documenten/rapporten/2020/10/14/aanvullende-corona-adviezen-aan-zelfstandig-wonende-ouderen). Therefore, older adults were even more restricted in their personal freedom compared to younger adults with possible risks for their mental health.

A meta-analysis showed that effects of lockdown on depression and anxiety were small on average but that study populations were heterogeneousn.[8] Longitudinal studies which compared anxiety and depression before and during the COVID-19 pandemic showed younger age, female sex, and previous poor mental health as risk factors during the COVID-19 pandemic.[9, 10] The younger age as risk factor for negative psychological effects of the lockdown suggests older adults are possibly protected instead of at risk. At the same time, in older adults, fear for COVID-19-related morbidity and mortality could also result in increased feelings of depression and anxiety. Unfortunately, limited longitudinal data including pre-pandemic measurements of mental health focusing on older adults has been published. If we would identify older adults at risk for the development of depression, anxiety, and loss of mastery during the COVID-19 pandemic it could guide the development of preventive strategies for future restrictive measures during a pandemic. Furthermore, extending previous studies focusing on affective symptoms, we additionally examined mastery as a central indicator of control beliefs, which are strongly related to mental health and wellbeing[11], and may change as a result of the unexpected and unprecedented events occurring during the COVID-pandemic.

7

Trajectories of mental health in older adults before and during the COVID-19 pandemic and risk factors for depressive and anxiety symptoms have been assessed in a few studies. Depressive and anxiety symptoms increased in older adults during the pandemic in Chile, however only one measurement was performed before the pandemic, therefore data on the trajectories of depressive and anxiety symptoms for multiple years is limited.[12] In a population aged 50-years and over, higher loneliness, reductions in physical activity, female gender and being retired were risk factors for increased depressive and anxiety symptoms during the COVID-year.[13] In older adults in Japan, internet use for communication had a protective influence on the probability of developing depression.[14]

These studies suggest that determinants for depression, anxiety and mastery are heterogeneous. Therefore, a comprehensive assessment approach and systematic categorization of determinants may help to identify risk groups. To assess older adults at risk, we used the framework of the Comprehensive Geriatric Assessment (CGA). The CGA is a multidimensional, multidisciplinary diagnostic and therapeutic process focused on determining an older person's medical, functional, mental, and social capabilities and limitations with the goal of ensuring that problems are identified, quantified, and managed appropriately.[15] In a meta-analysis of risk factors for depressive symptoms in older adults, bereavement, sleep disturbance, disability, prior depression, and female gender were significant risk factors.[16] Based on the CGA-framework, we hypothesize that having multiple comorbidities (medical domain), cognitive impairment (mental domain), functional limitations (functional domain) or living alone (social domain) are possible risk factors in older adults living in the community for negative psychological impact during the lockdown measures. We also hypothesize that a higher frailty score, which summarizes limitations on the medical, mental, and functional domain, is a risk factor for an increase in affective symptoms and decrease in perceived control.

In this longitudinal observational study, we addressed the following two research questions: 1) Is there a change in depressive or anxiety symptoms or in perceived mastery in community dwelling older adults in the Netherlands during the COVID-19 pandemic compared to previous years? And 2) Are older adults with multiple chronic diseases, cognitive impairment, functional limitations, who are living alone or with frailty at risk for a change in depressive or anxiety symptoms or perceived mastery?

Materials and methods

Study sample and design
The Longitudinal Aging Study Amsterdam (LASA) is an ongoing prospective cohort study initiated in 1992 based on a representative sample of older adults aged 55–84 years in the Netherlands.[17] The primary objective of LASA was to study determinants, trajectories, and consequences of (changes in) functioning in four domains: physical, cognitive, emotional, and social. Participants are interviewed approximately every three years and in 2002 and 2012 refresher cohorts aged 55-64 were added to the study. Interviews include a main face-to-face interview and a subsequent medical interview with additional questionnaires and clinical tests. The LASA study was approved by the medical ethics committee of the VU University Medical Center. Written informed consent was obtained from all participants.

As the COVID-19 pandemic is an exceptional situation, an extra assessment after the measurement wave of 2018-2019 was added.[18] This was a questionnaire that was sent to LASA participants in June 2020, just after the first wave of the pandemic, in a period that most social distancing measures were eased (most governmental measures in the Netherlands were eased as of mid-May 2020). Of the 1,701 respondents of the last measurement wave (Wave J, 2018-2019) 1,485 were selected to participate. Respondents who were not selected had already died (n=61) or were purposefully not selected (n=155) because the questionnaire was expected to be too much of a burden.[18] These 155 people were older and more vulnerable than selected participants, for example, 98 of them had short or proxy interviews at the last measurement wave before the pandemic (2018-2019) because of cognitive impairment or poor health. The questionnaire was sent on June 8, 2020, by postal mail: participants could choose to return it by mail or fill it out online. Participants aged 80 years and older who initially did not respond were offered to answer the questionnaire in a telephone interview. Data collection ended on October 8, 2020, however 99% of all data were received before the end of August 2020. Of the 1,485 LASA participants approached, 1,128 (76%) returned the questionnaire. On average, responders had more years of education and a higher MMSE-score compared to non-responders. No differences in age, sex, chronic diseases, and functional limitations were found.[18] We restricted our sample to individuals with complete outcome measures for the COVID wave in 2020 (n=1,068; Figure 1) and longitudinally followed the same individuals over 4 waves: T1: 2011-2013 (n=1,049), T2: 2015-2016 (n=1,026), T3: 2018-2019 (n=984), T4: 2020 (n=1,068). The N of previous waves was slightly lower because of missing data (some participants of the COVID wave in 2020 did not complete all measurements at previous waves).

7

We applied STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines for reporting observational studies in epidemiology (Supplementary Table 1).

Figure 1. Flow diagram on analysis of depressive symptoms, anxiety symptoms and mastery in an older cohort (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).
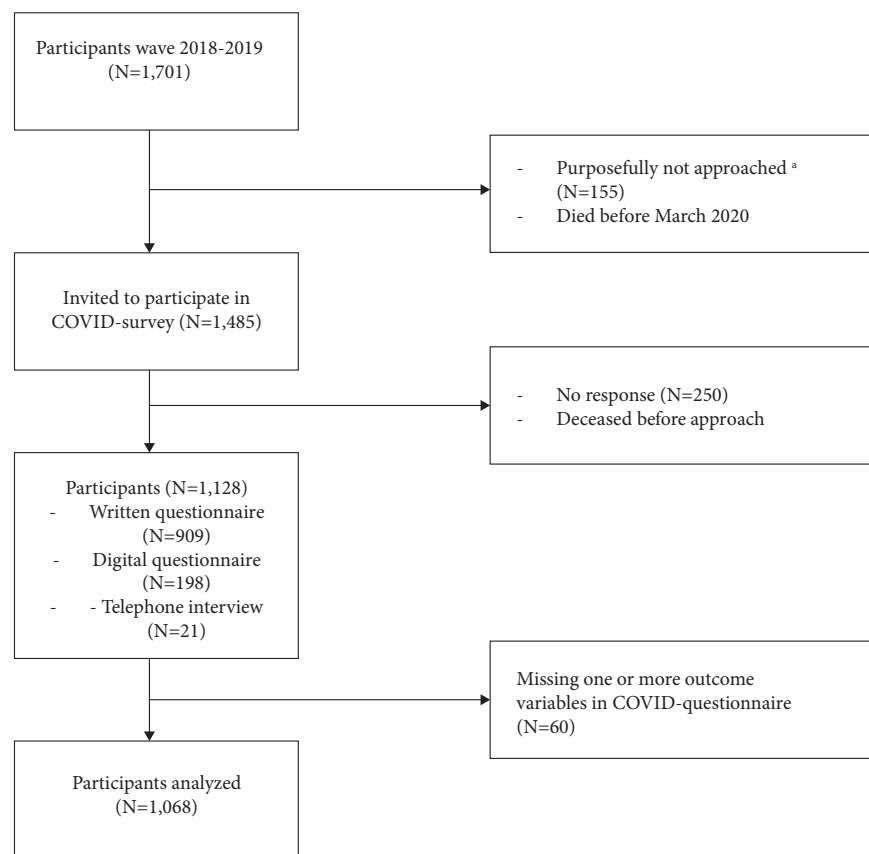
ªParticipants for whom the questionnaire was expected to be too much of a burden, such as respondents who did only a short telephone interview or had a proxy interview at the last measurement cycle T3 (2018-2019).

Mental health outcomes

To assess depressive symptoms we used the Center for Epidemiologic Studies Depression scale (CES-D) short version (10-item scale).[19] The CES-D-10 is a self-report questionnaire designed to measure depressive symptoms in the general population and has good psychometric properties and validity in elderly samples.[20] For the 10-item list a cut-off score of ≥10 is used to determine a probable depression.[21]

To assess anxiety symptoms we used the Hospital Anxiety Depression Scale- Anxiety subscale (HADS-A).[22] The HADS-A subscale consists of seven items for measuring symptoms of anxiety. A Likert-scale is used to compute a score with a range from 0-21. A clinically relevant cut-off for longitudinal analysis is based on two criteria: a score ≥8 and an increase of 0.5 times the standard deviation (SD) of the baseline score.[23]

To assess mastery, we used the 5-item Pearlin Mastery Scale.[24] The Pearlin Mastery Scale items need to be answered with a Likert-scale. The scale score ranges from 0-25, where a higher score indicating internal locus of control (the perception that events in one's life relate to one's actions) and a low score indicating an external locus of control (the perception that events in one's life relate to external sources like chance, other persons/ the government, or unpredictable circumstances).

Risk factors from CGA domains

Using the CGA framework, risk factors were chosen from four domains. For the medical domain, we assessed multiple chronic conditions by seven groups which were explicitly asked about: Chronic non-specific lung disease, cardiac disease, peripheral artery disease, stroke, diabetes mellitus, arthritis, and malignancies. This count variable could therefore range from 0 to 7.

For the mental domain, we assessed cognition by the Mini-Mental State Examination (MMSE).[25] The MMSE is a brief primary screening test for cognitive functioning, which is strongly influenced by age and education. The MMSE consists of 23 items and the score ranges from 0-30, higher scores indicating better cognitive functioning.

For the functional domain, we described functional limitations in seven common daily activities: Can you walk up and down a staircase of 15 steps without resting? Can you dress and undress yourself? Can you sit down and stand up from a chair? Can you cut your own toenails? Can you walk outside during five minutes without stopping? Can you use your own public transportation? Can you take a shower or bath? A score of 0-7 was calculated counting the number of items answered with 'some difficulty' or worse. A higher score indicates more limitations.

We assessed the social domain with the living situation of the participant if the participant lived alone or with someone.

Last, we assessed frailty as reflecting an individual-level combination of the four domains, measured by the LASA frailty index (LASA-FI).[26] This index is based on the idea that a great number of deficits indicates higher frailty.[27] The LASA-FI is a 32-item frailty index, where 32 deficits were scored by absence (0) or presence (1). These deficits are items taken, among others, from the chronic diseases, functional limitations, MMSE and CES-D questionnaires. The score for each participant is calculated by dividing the sum of the health deficit score by the total number of health deficits measured, resulting in a score between 0 and 1. A cut-off of 0.25 is used to indicate frailty.[28, 29]

The risk factors and FI were measured at T3 (2018-2019), because the COVID-questionnaire did not include all necessary items.

Covariates
We adjusted for baseline age (years, continuous), gender (male/female) and educational level (years, continuous). These were selected as potential confounders because they do not lie on the causal pathway between risk factors and the outcomes.

Statistical analyses
Baseline characteristics were described with mean values for continuous variables and with percentages for categorical variables. Prevalence estimates (with interquartile ranges) for each outcome were calculated in repeated cross-sectional analysis using all responses of the COVID and previous waves. A sensitivity analysis for baseline characteristics between participants who had complete and incomplete outcome variables was performed.

We conducted a linear mixed model to assess change in outcomes over time, using time in days as predictor; additionally, we added a dummy for the year 2020 to test differences between the COVID-wave and pre-COVID waves and adjusted model for age (continuous), gender (dichotomous) and educational level (continuous in years of education). Predicted residuals were plotted to evaluate model assumptions.

Additional analyses to assess if the change was associated with the selected predictors chronic diseases (continuous per 1 increment), MMSE (continuous per 1 increment), functional limitations (continuous per 1 increment), living with someone (dichotomous, living alone or with someone) or frailty (dichotomous yes/no, with cut-off at 0.25) were done by fitting interaction terms between the dummy variable for the year 2020 and

the predictors. Predictors were time-fixed variables from T3 (2018-2019). Analysis was conducted with Stata version 15 (StataCorp. 2017. *Stata Statistical Software: Release 15.* College Station, TX: StataCorp LLC).

Results

The 1,068 participants had a mean age of 73.8 years and 47.2% were male. Regarding the potential risk factors, 14.2% of the participants had three or more chronic conditions, 18.9% had three or more functional limitations, 71.8% of participants were living together with someone and 20.0% of participants had a LASA-FI of 0.25 or above and were considered frail (Table 1). Last, the median MMSE score of participants was 29 (interquartile range [IQR] 28;30). Regarding COVID-19 infections, 2.6% of participants reported a COVID-infection in themselves and 3.5% reported a COVID infection in a close relative (partner, parent, child). Sensitivity analysis in which participants of the LASA COVID study with complete (n=1,068) and incomplete (n=60) data on outcome measures were compared showed that the participants with complete outcomes were younger, had a higher MMSE score and less functional limitations (Supplementary Table 2).

The mean follow-up time was 7.8 years with a standard deviation of 0.54 years. Mean and median scores of outcome variables for all waves are described in Figure 2 and in the appendix (Supplementary Table 3). Median CES-D-10 score showed a gradual increase over time (Figure 2A). Median HADS-A score was stable for the three pre-COVID time points and increased during the pandemic (Figure 2B). Mean values of CES-D-10 and HADS-A did not reach cut off values at any time point. Also, median scores of the mastery outcome were stable for the three pre-COVID time points and increased during the pandemic (Figure 2C).

Mixed linear regression showed that CES-D (β=1.37, 95% Confidence interval [CI] 1.12;1.62), HADS-A (β=0.74, 95%CI 0.56;0.94) and mastery (β=1.10, 95%CI 0.88;1.31) increased in the COVID year compared to pre-COVID waves (Table 2).

Each additional functional limitation was associated with a 0.11 smaller increase in mastery in the COVID year compared to previous years (95%CI -0.20; -0.02). Being frail was associated with a 0.43 smaller increase in mastery score in the COVID year compared to previous years (95%CI -0.84; -0.02, Table 2). Having more chronic conditions, a higher MMSE-score or living with someone were not associated with change in CES-D, HADS-A or mastery during the COVID-year. Having more functional limitations was not associated with a change in CES-D or HADS-A in the COVID year.

Table 1. Characteristics of the cohort members (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).

	Total
N[a]	1,068
Age[b], mean ± SD	73.8 (7.5)
Male[b], (%)	47.2
Educational level[c], (%)	
Primary/lower vocation	29.1
Junior/senior high school	40.5
Higher vocational/university	30.4
Medical domain: Number of chronic diseases from 7 majors[c], (%)	
0	23.2
1	37.4
2	25.2
3 or more	14.2
Mental domain: MMSE (0-30)[c], median (IQR)	29 (28;30)
Functional domain: Functional limitations (of 7 items)[c], (%)	
0	44.9
1	24.2
2	11.9
3 or more	18.9
Social domain: household[c], (%)	
Living alone	28.3
Living with someone	71.6
LASA frailty index 32 items[c], (%)	
Not frail	80.0
Frail (cut off 0.25)	20.0

Note: MMSE= Mini-Mental State Examination Score

[a] Number of participants with complete information on symptoms of depressions, symptoms of anxiety and mastery at the COVID-questionnaire, [b]measured atT4(2020), [c]measured at T3(2018-2019), excluding missing data

Table 2. Adjusted mixed linear models for depressive symptoms, anxiety symptoms and mastery and possible risk factors according to Comprehensive Geriatric Assessment framework in an older cohort (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).

	CES-D-10	HADS-A	Mastery
	Coeff (95% CI)	Coeff (95% CI)	Coeff (95% CI)
Base model:			
Year 2020[b]	1.37 (1.12;1.62)*	0.74 (0.56;0.94)*	1.10 (0.88;1.31)*
Model 1: Medical domain[a]			
Year 2020[b]	1.45 (1.10;1.81)*	0.94 (0.68;1.21)*	1.11 (0.82;1.41)*
Chronic conditions (0-7) [c]	0.31 (0.18;0.43)*	0.18 (0.08;0.27)*	-0.18 (-0.28;-0.08)*
Chronic conditions*year2020	-0.05 (-0.23;0.13)	-0.14 (-0.27;0.0004)	-0.03 (-0.17;0.12)
Model 2: Mental domain			
Year 2020[b]	0.54 (-2.69;3.77)	0.21 (-2.27;2.68)	0.23 (-2.49;2.94)
MMSE (0-30) [c]	-0.11 (-0.19;-0.03)*	-0.48 (-0.11;0.01)	0.09 (0.03;0.15)*
MMSE*year2020	0.03 (-0.08;0.14)	0.02 (-0.07;0.11)	0.03 (-0.07;0.13)
Model 3: Functional domain			
Year 2020[b]	1.42 (1.23-1.71)*	0.73 (0.54;0.91)*	1.23 (0.99;1.48)*
Functional limitations (0-7) [c]	0.40 (0.32;0.48)*	0.19 (0.13;0.24)*	-0.15 (-0.21;-0.09)*
Functional limitations*year2020	-0.02 (-0.12;0.09)	-0.04 (-0.12;0.04)	-0.11 (-0.20;-0.02)*
Model 4: Social domain			
Year 2020[b]	1.28 (0.86;1.68)*	0.58 (0.27;0.88)*	1.09 (0.75;1.43)*
Living with someone[d]	-0.55 (-0.86;-0.24)*	-0.09 (-0.32;0.13)	-0.03 (-0.27;0.22)
Living with someone*year2020	0.17 (-0.26;0.60)	0.26 (-0.07;0.59)	-0.01 (-0.36;0.36)
Model 5: Frailty			
Year 2020[b]	1.41 (1.14;1.68)*	0.83 (0.62;1.03)*	1.16 (0.94;1.39)*
Frailty[e]	1.92 (1.59;2.27)*	0.95 (0.69;1.20)*	-0.80 (-1.07;-0.53)*
Frailty*year2020	-0.06 (-0.55;0.43)	-0.34 (-2.91;0.04)	-0.43 (-0.84;-0.02)*

Notes: models are all adjusted for time, age, sex, educational level and baseline measurement of outcome variable (wave 2011-2013); 95% CI= confidence interval; CES-D-10 = Center for Epidemiologic Studies Depression scale 10 item list; HADS-A= Hospital Anxiety Depression Scale-Anxiety subscale

[a] the CGA consists of four domains: medical, mental, functional, and social. For each domain, a potential group at risk for negative outcome is chosen. [b]questionnaire was before 2020 is reference group; [c] continuous per 1pt increment; [d] living alone is reference group; [e] frailty according to LASA Frailty Index (LASA-FI): frail if LASA-FI score is ≥0.25, not being frail is reference group. *significant p<0.05

Figure 2A-C. Depressive symptoms, anxiety symptoms and mastery before and during COVID in an older cohort (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).

2A: Depressive symptoms over waves

2B: Anxiety symptoms over waves

2C: Perceived mastery over waves
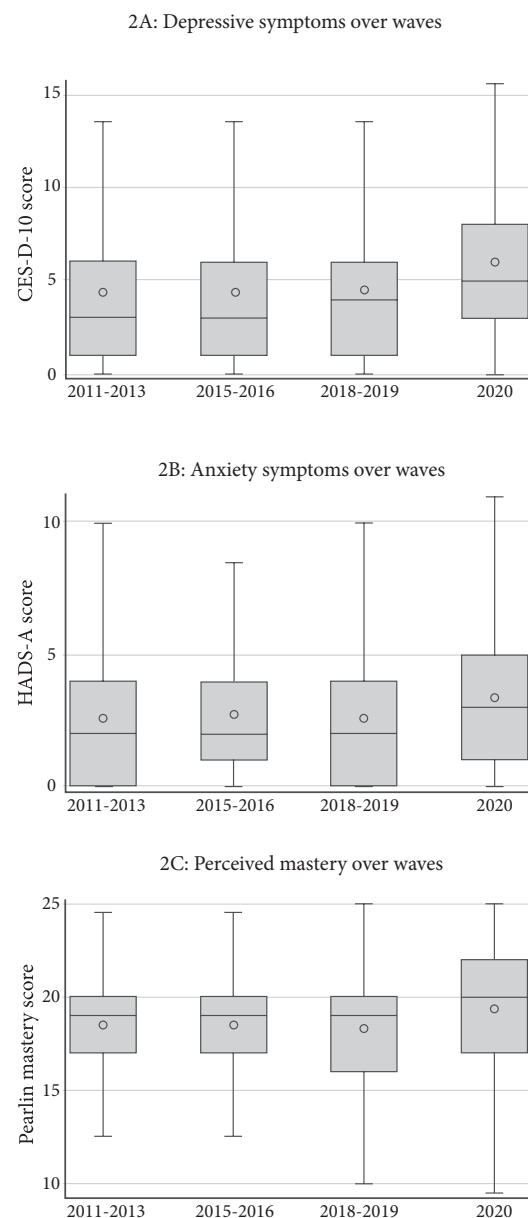
Note: CES-D-10 = Center for Epidemiologic Studies Depression scale 10 item list; HADS-A= Hospital Anxiety Depression Scale- Anxiety subscale. Boxes represent the median and the interquartile range (IQR), whiskers represent minimum and maximum of the observed values, excluding outliers (+/- 3 IQR). The dot represents the mean.

Discussion

This longitudinal observational study showed that depressive and anxiety symptoms slightly increased in community dwelling older adults in the Netherlands during the COVID-19 pandemic compared to previous years. However, perceived mastery also increased. Having more functional limitations or being frail was associated with a smaller increase in mastery during the COVID-pandemic. No other risk factors for a change in CES-D-10, HADS-A or mastery could be identified. Since absolute changes of depressive and anxiety symptoms were small and mean values did not reach cut-off scores, our study suggests that the possible negative effect of the pandemic on mental health – at least in the first months – is limited. Also, the modest increase in mastery scores suggests a positive effect from the lockdown measures on mental health in older adults occurred.

Our findings of a limited effect of the pandemic on depressive and anxiety symptoms is consistent with previous research. In cross-sectional cohorts of older adults in the Netherlands and Germany mental health did not change during the pandemic.[30, 31] Also, a 5-year longitudinal cohort study among the general population in the UK showed that mild symptoms of anxiety and depression increased in the COVID-year while moderate to severe scores remained the same.[13] Further, anxiety and depression symptoms increased in longitudinal population-based cohorts in the US, but especially in young adults aged 18-39.[32, 33] The LASA cohort consists only of older adults, which could explain the minor increase of depressive and anxiety symptoms in our study. A possible explanation could be that older adults have better coping strategies than younger adults. A narrative review highlights psychosocial strengths of older people such as reflection, adaptive use of personal memory and a focus on generativity.[34] Lind et al.[34] hypothesizes that life expertise may protect older adults from negative psychological effects. A second explanation for the mild increase of depressive and anxiety symptoms could be the period of sampling: In a population based cohort in the US the increase of anxiety was at the beginning of the pandemic in April 2020, but decreased in May and remained 3% above the level of 2019 in December.[33] Questionnaires of LASA were completed in summer 2020, when most of the lockdown measures were stopped in the Netherlands and cover a later stage of the first wave of the pandemic, when levels of depression and anxiety were almost back to pre-pandemic levels like observed in the US, so the mild increase in anxiety symptoms could be explained by the period of the sampling.[32, 33]

The current study showed an unexpected increase of perceived mastery during the COVID pandemic. A longitudinal study of adults of 60 years and older in Chile showed comparable results of increased resilience measured by the Brief Resilient Coping

Scale (BRCS), next to an increase in symptoms of anxiety and depression.[12] A possible explanation is that the public health measures resulted in a more quiet and clear everyday life for older adults which could have led to an increase of perceived mastery. To our best knowledge, no other data on mastery during the COVID-pandemic has been published so far. Unpublished data from the LASA COVID-questionnaire showed that the participants had more attention for the things they enjoyed doing and reflected more on the things that were valuable in their lives. This would also fit in the theory of psychological strength of older adults of Lind.[34]

In our study no risk factors for increased symptoms of depression or anxiety in older adults could be identified. Other longitudinal studies identified the following risk factors; however these studies were not restricted to an older adult population. For the medical domain, lung problems were associated with high anxiety and depressive symptom scores before and during COVID-pandemic.[35] Having heart problems was a risk factor during but not before COVID-pandemic.[35] Also, low self-rated physical health was associated with higher risk of increased anxiety (GAD-7 score).[36] The authors of the latter study used different self-reported outcomes which may have caused the discrepancy with our study.

To our knowledge, we are the first to report on longitudinal data which explores the relation between MMSE and symptoms of depression, anxiety, or perceived mastery during the COVID-19 pandemic. A cross-sectional study evaluating older adults with mild cognitive impairment (MCI) and subjective cognitive decline (SCD) during lockdown measures reported that 27.2% of 125 respondents felt sad or depressed. Depression was significantly associated with living alone or being in a poor relationship with cohabitants, low sleep quality and not owning a pet.[37] However, no control group was described.

For the social domain, we did not find an association between living alone and an increase in the feelings of depression or anxiety in the COVID-year. This is inconsistent with a population-based study in the UK describing living alone was associated with increased depressive symptoms scores.[10] A possible explanation could be that the questionnaire took place after most lock-down measures were elevated. Also as described earlier, other studies showed that older adults were more in touch with family and friends through internet and smartphone use [12] and could relate this to depressive symptoms[14]: the amount of communication possibilities would probably better explain negative psychological effects of the lockdown than the household composition.

We were able to study trajectories of feelings of depression, anxiety, and perceived mastery in a large cohort of community dwelling older adults over a 10-year period. An important limitation of our study is possible survivorship bias: previous analysis of non-responders of the LASA COVID study showed that the participants were younger and had a higher MMSE score.[18] Furthermore, as shown in sensitivity analyses of the current paper, participants with complete outcomes were younger, had a higher MMSE score and less functional limitations compared to participants without complete outcomes. Also, our cohort has an overrepresentation of participants of the last refresher wave of 2012, which consisted of older adults aged 55-64 and could explain the high MMSE score in general and the limited comorbidities and functional limitations. This could have resulted in bias of a cohort of older adults with limited health and social problems, but with the protective effect of life experience and so limited negative psychological effects.

In conclusion, negative psychological effects of the pandemic are limited in community dwelling older adults of the LASA cohort in the Netherlands. The observed increase in perceived mastery during the pandemic adds to the theory of the resilience of older adults for negative effects of lockdown measures. No risk factors for feelings of depression or anxiety could be identified, however functional limitations and being frail tempered the increased perceived mastery older adults experienced. To evaluate if the changes are persistent, follow-up data are needed to evaluate further trajectories.

7

Reference List

1. Blomaard, LC, van der Linden, CMJ, van der Bol, JM, et al. Frailty is associated with in-hospital mortality in older hospitalised COVID-19 patients in the Netherlands: the COVID-OLD study. Age Ageing 2021.

2. Kim, L, Garg, S, O'Halloran, A, et al. Risk Factors for Intensive Care Unit Admission and In-hospital Mortality Among Hospitalized Adults Identified through the US Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). Clin Infect Dis 2021;72(9):e206-e214.

3. Armitage, R, Nellums, LB. COVID-19 and the consequences of isolating the elderly. The Lancet Public Health 2020;5(5):e256.

4. Tull, MT, Edmonds, KA, Scamaldo, KM, et al. Psychological Outcomes Associated with Stay-at-Home Orders and the Perceived Impact of COVID-19 on Daily Life. Psychiatry Research 2020;289:113098.

5. Pfefferbaum, B, North, CS. Mental Health and the Covid-19 Pandemic. New England Journal of Medicine 2020;383(6):510-512.

6. Stress in America(TM) 2020: A national menthal health crisis. 2020.

7. Taylor, SE, Stanton, AL. Coping resources, coping processes, and mental health. Annu Rev Clin Psychol 2007;3:377-401.

8. Prati, G, Mancini, AD. The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol Med 2021;51(2):201-211.

9. Banks, J, Xu, X. The mental health efects of the first two months of lockdown and social distancing during the Covid-19 pandemic in the UK. The Institute for Fiscal Studies; 2020.

10. Kwong, ASF, Pearson, RM, Adams, MJ, et al. Mental health before and during the COVID-19 pandemic in two longitudinal UK population cohorts. Br J Psychiatry 2020:1-10.

11. Hovenkamp-Hermelink, JHM, Jeronimus, BF, van der Veen, DC, et al. Differential associations of locus of control with anxiety, depression and life-events: A five-wave, nine-year study to test stability and change. J Affect Disord 2019;253:26-34.

12. Herrera, MS, Elgueta, R, Fernández, MB, et al. A longitudinal study monitoring the quality of life in a national cohort of older adults in Chile before and during the COVID-19 outbreak. BMC Geriatr 2021;21(1):143.

13. Creese, B, Khan, Z, Henley, W, et al. Loneliness, physical activity, and mental health during COVID-19: a longitudinal analysis of depression and anxiety in adults over the age of 50 between 2015 and 2020. Int Psychogeriatr 2020:1-10.

14. Nakagomi, A, Shiba, K, Kondo, K, et al. Can Online Communication Prevent Depression Among Older People? A Longitudinal Analysis. J Appl Gerontol 2020:733464820982147.

15. Ellis, G, Gardner, M, Tsiachristas, A, et al. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev 2017;9(9):Cd006211.

16. Cole, MG, Dendukuri, N. Risk factors for depression among elderly community subjects: a systematic review and meta-analysis. American journal of psychiatry 2003;160(6):1147-1156.

17. Hoogendijk, EO, Deeg, DJH, de Breij, S, et al. The Longitudinal Aging Study Amsterdam: cohort update 2019 and additional data collections. European Journal of Epidemiology 2020;35(1):61-74.

18. Hoogendijk, EO, van der Horst, MHL, Poppelaars, J, et al. Multiple domains of functioning in older adults during the pandemic: design and basic characteristics of the Longitudinal Aging Study Amsterdam COVID-19 questionnaire. Aging Clinical and Experimental Research 2021.

19. Radloff, LS. The CES-D Scale:A Self-Report Depression Scale for Research in the General Population. Applied Psychological Measurement 1977;1(3):385-401.

20. Beekman, ATF, Deeg, DJH, Van Limbeek, J, et al. BRIEF COMMUNICATION.: Criterion validity of the Center for Epidemiologic Studies Depression scale (CES-D): results from a community-based sample of older subjects in the Netherlands. Psychological Medicine 1997;27(1):231-235.

21. Andresen, EM, Malmgren, JA, Carter, WB, et al. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). Am J Prev Med 1994;10(2):77-84.

22. Zigmond, AS, Snaith, RP. The hospital anxiety and depression scale. Acta psychiatrica scandinavica 1983;67(6):361-370.

23. Snaith, RP. The hospital anxiety and depression scale. Health and quality of life outcomes 2003;1(1):1-4.

24. Pearlin, LI, Schooler, C. The structure of coping. Journal of health and social behavior 1978:2-21.

25. Folstein, MF, Folstein, SE, McHugh, PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. Journal of psychiatric research 1975;12(3):189-198.

26. Hoogendijk, EO, Theou, O, Rockwood, K, et al. Development and validation of a frailty index in the Longitudinal Aging Study Amsterdam. Aging Clinical and Experimental Research 2017;29(5):927-933.

27. Rockwood, K, Mitnitski, A. Frailty in relation to the accumulation of deficits. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences 2007;62(7):722-727.

28. Rockwood, K, Andrew, M, Mitnitski, A. A Comparison of Two Approaches to Measuring Frailty in Elderly People. The Journals of Gerontology: Series A 2007;62(7):738-743.

7

29. Song, X, Mitnitski, A, Rockwood, K. Prevalence and 10-Year Outcomes of Frailty in Older Adults in Relation to Deficit Accumulation. Journal of the American Geriatrics Society 2010;58(4):681-687.

30. van Tilburg, TG, Steinmetz, S, Stolte, E, et al. Loneliness and Mental Health During the COVID-19 Pandemic: A Study Among Dutch Older Adults. The Journals of Gerontology: Series B 2020.

31. Röhr, S, Reininghaus, U, Riedel-Heller, SG. Mental wellbeing in the German old age population largely unaltered during COVID-19 lockdown: results of a representative survey. BMC Geriatrics 2020;20(1):489.

32. Daly, M, Sutin, AR, Robinson, E. Depression reported by US adults in 2017-2018 and March and April 2020. J Affect Disord 2021;278:131-135.

33. Daly, M, Robinson, E. Anxiety reported by US adults in 2019 and during the 2020 COVID-19 pandemic: Population-based evidence from two nationally representative samples. J Affect Disord 2021;286:296-300.

34. Lind, M, Bluck, S, McAdams, DP. More Vulnerable? The Life Story Approach Highlights Older People's Potential for Strength During the Pandemic. The Journals of Gerontology: Series B 2020;76(2):e45-e48.

35. van der Velden, PG, Contino, C, Das, M, et al. Anxiety and depression symptoms, and lack of emotional support among the general population before and during the COVID-19 pandemic. A prospective national study on prevalence and risk factors. J Affect Disord 2020;277:540-548.

36. Ramiz, L, Contrand, B, Rojas Castro, MY, et al. A longitudinal study of mental health before and during COVID-19 lockdown in the French population. Global Health 2021;17(1):29.

37. Di Santo, SG, Franchini, F, Filiputti, B, et al. The Effects of COVID-19 and Quarantine Measures on the Lifestyles and Mental Health of People Over 60 at Increased Risk of Dementia. Front Psychiatry 2020;11:578628.

Supplementary Table 1: STROBE checklist

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Prospective cohort study in abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Abstract is written
Introduction		
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses Hypotheses and objective in last two paragraphs of introduction
Methods		
Study design	4	Present key elements of study design early in the paper First paragraph of method
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Older adults aged 55-84 in the Netherlands, dates of data-collection, follow-up time and data collection described. Exposure not applicable.
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up All respondents of last wave, excluding participants who had already died or where last wave was too burdensome. Follow up with postal letter and digital questionnaire.
		(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Method section
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Method section
Bias	9	Describe any efforts to address potential sources of bias Method section

	Item No	Recommendation
Study size	10	Explain how the study size was arrived at 30-year study with repeated measures over 1000 participants. We had sufficient power for analysis. Huisman, M., Poppelaars, J.L., Van der Horst, M.H.L., Beekman, A.T.F., Brug, J., Van Tilburg, T.G., Deeg, D.J.H. (2011). **Cohort Profile: The Longitudinal Aging Study Amsterdam**. International Journal of Epidemiology, 40, 868-876
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Method section
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Method
		(b) Describe any methods used to examine subgroups and interactions Method
		(c) Explain how missing data were addressed Handled by mixed model
		(d) If applicable, explain how loss to follow-up was addressed
		(e) Describe any sensitivity analyses Described in method, results, discussion and supplementary file
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Figure 1, methods, results
		(b) Give reasons for non-participation at each stage Figure 1
		(c) Consider use of a flow diagram Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Results, table 1
		(b) Indicate number of participants with missing data for each variable of interest Supplementary table
		(c) Summarise follow-up time (eg, average and total amount) Results

	Item No	Recommendation
Outcome data	15*	Report numbers of outcome events or summary measures over time Results, supplementary file
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Table 3 and results describe estimates and for which confounder was adjusted
		(b) Report category boundaries when continuous variables were categorized Table 3
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Methods, results
Discussion		
Key results	18	Summarise key results with reference to study objectives Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results Discussion
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Described

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Supplementary Table 2: Comparison between respondents with complete and incomplete outcome variables for characteristics of the Cohort Members (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).

	Outcome complete	Outcome incomplete	p-value
N[a]	1068	60	
Age, mean ± SD	73.8 (7.5)	76.1(7.6)	0.020
Male, (%)	47.2	46.6	0.006
Educational level, (%)			
Primary/lower vocation	29.1	36.67	0.321
Junior/senior high	40.5	31.67	
Higher vocational/university	30.4	31.67	
Region, (%)			
West	43.6	51.7	0.448
East	33.1	30.0	
South	23.3	18.3	
Medical domain: Number of chronic diseases from 7 majors[b], (%)			
0	23.2	19.6	0.749
1	37.4	33.3	
2	25.2	29.4	
3 or more	14.2	17.7	
Mental domain: MMSE (0-30)[b], median (IQR)	29 (28;30)	28 (27;30)	0.033
Functional domain: Functional limitations (of 7 items), (%)			
0	44.9	28.6	0.031
1	24.2	38.8	
2	11.9	18.4	
3 or more	18.9	14.3	
Social domain: household[b], (%)			
Living alone	28.3	35.3	0.285
Living with someone	71.6	64.7	
LASA frailty index 32 items (with max of 6 missings)[b], (%)			
Not frail	80.0	74.5	0.344
Frail (cut off 0.25)	20.0	25.5	

Note: MMSE= Mini-Mental State Examination Score

[a] Number of participants with complete information on symptoms of depressions, symptoms of anxiety and mastery at the COVID-questionnaire, [b] measured at T3(2018-2019), excluding missing data

Supplementary Table 3: mean and median of CES-D-10, HADS-A and Pearlin mastery score of the Cohort Members (aged 63-102 years) of the Longitudinal Aging Study Amsterdam (2011-2020).

Outcome variables	Mean (sd)	Median (IQR)
CES-D-10		
T1: 2011-2013 (N=1049)	4.29 (4.05)	3 (1,6)
T2: 2015-2016 (N=1026)	4.26 (3.86)	3 (1,6)
T3: 2018-2019 (N=984)	4.49 (4.05)	4 (1,6)
T4: 2020 (N=1068)	5.92 (4.11)	5 (3,8)
HADS -A		
T1: 2011-2013 (N=1049)	2.73 (2.99)	2 (0,4)
T2: 2015-2016 (N=1025)	2.74 (2.83)	2 (1,4)
T3: 2018-2019 (N=984)	2.58 (2.70)	2 (0,4)
T4: 2020 (N=1068)	3.35 (2.99)	3 (1,5)
Mastery		
T1: 2011-2013 (N=1038)	18.59 (3.13)	19 (17,20)
T2: 2015-2016 (N=1003)	18.52 (3.27)	19 (17,20)
T3: 2018-2019 (N=957)	18.32 (3.20)	19 (16,20)
T4: 2020 (N=1068)	19.32 (3.92)	20 (17,22)

8
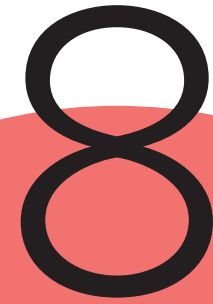
General discussion

Discussion

The topic of crisis arises at the individual, family, health care professional, and societal level throughout my thesis. From my work with short term residential care (STRC), we cannot help but be alarmed for each of these levels. In the introduction, I described my personal experience with crisis and the last months of my grandmothers' life, but her story does not stand alone. In recent years, as a granddaughter, as a medical doctor and as a researcher, I wondered: What happens to older adults out there that do not have dedicated and loving care professionals in their family? How do informal caregivers manage organizing care when each municipality appears to arrange care differently?[1] What if there is no informal caregiver close by or no informal caregiver at all? My thesis shows the cycle that happens to older adults admitted to STRC through the emergency department (ED) or hospital simply because we do not know where to put these people. We have a system gap here and STRC tries to be flexible to catch older adults. My thesis also delves into the early stages of COVID-19 in nursing homes. When I think back to this time, we have learned so much about SARS-CoV-2 contamination and prevention. In an ironic twist STRC changed its care to help COVID-19 patients recover. This is another example of STRC striving to be a catch all for care.

The following section comprises the main results, limitations, clinical and policy implications, areas for future research, a future perspective and a conclusion of this thesis.

Part 1: Short term residential care

Main results
The qualitative article (Chapter 2) on STRC in Amsterdam found that most patients admitted to STRC did not meet the objective to return home. Health care professionals reported that patients were often admitted in crisis situations with higher care needs than what could be supported at the STRC facility. This resulted in a mismatch between patient needs and care delivered. In addition, environmental factors, such as availability of informal caregivers, advance care planning, appropriate housing and waiting lists for long-term care, influenced the ability of STRC to deliver appropriate care and to discharge older adults' home. In Chapter 3 we used data of Statistics Netherlands to validate the described patient population in Chapter 2 on a national level. STRC is mainly used by female, older adults with a low income and older adults who live alone. Over 60% of the older adults used more than 10 different drugs in the year of their admission and a third used psychotropic drugs. 43% of the older adults admitted in 2018, died before the end of 2019. This confirmed the experience of the health care workers in Chapter 2, of a very frail population admitted to STRC.

A remarkable finding of Chapter 2 was that STRC was organized very differently between the facilities in Amsterdam. Some were in a hospital and admitted patients from the ED with the goal to discharge them within two weeks and had availability of nurses specialized in geriatric rehabilitation. Other would provide STRC on wards with long term care (LTC) admissions or would specialize in providing care to patients with a malignancy receiving radiotherapy or recovering from a delirium. In Chapter 3, we triangulated these results with a national survey: we found the same heterogeneity in the location of the ward and the number of beds of the ward. For example, some nursing homes had a dedicated ward of 20 beds for STRC, sometimes in combination with geriatric rehabilitation (GR), while other nursing homes had only 1 bed on a ward for long term care. STRC was mainly offered by nursing homes and ALF, but sometimes by hospitals or commercial organizations that were reimbursed to provide STRC. Also, organization of care on the ward differed: some nursing homes had weekly medical rounds and multidisciplinary consultations, while others only offered medical consultation at request. Less than 10% of the nursing homes specialized, in contrast to the nursing homes in Amsterdam.

Strengths and limitations
We provided the first comprehensive overview of STRC in the Netherlands. Our study provided important insights in the patient population, the variation of how care is delivered in STRC and the needs of health care workers and older adults in STRC. The in-depth data of the qualitative study provided a framework to validate the findings on a national level. These results make it possible to develop guidelines and care pathways for STRC. However, because the health care professionals in Chapter 2 selected the patient files which were discussed, this could have resulted in selection bias. Participants could have selected the most problematic cases. On the other hand, nursing homes with sufficient work force are possibly more likely to participate in the survey, which also could have resulted in selection bias.

The dataset of care costs of Chapter 3 does not provide admission dates: we were not able to calculate the exact one year mortality or were able to determine the order in which care was used during the year. Because the costs did not describe if an older adults was using STRC regular, high complex or hospice care we could not analyse the mortality rate of patients of the separate types of STRC. Also, because of the very broad definition of STRC it was not possible to evaluate all forms: general practitioners providing low complex care in STRC were underrepresented in our studies. In our studies we presented results of STRC provided in nursing homes, while STRC is also delivered in care hotels, hospitals, and rehabilitation centres. Future research should also focus on these areas.

8

Clinical and policy implications

Definition of STRC and alternative models
Chapter 2 and 3 showed that STRC has a wide ranging patient population and is also organized very differently across the country. Evaluation of outcome of STRC is difficult because of this heterogeneity. The specialization of some STRC-wards in Amsterdam was not confirmed in the rest of the Netherlands: wards of STRC deliver general care for a broad spectrum of health care problems. Our qualitative study showed that older adults are not only admitted for reablement, but most of the time as a response to crisis. Often, not only reablement but also observation of the older adults is necessary because it is not clear what care is needed for the older adults. This indicates that STRC could be classified according to the needs of the older adult and that care pathways for crisis, reablement or observation should be created.

In the UK, intermediate care was introduced in 2000 and was defined as services provided to patients, usually older people, after leaving the hospital or when they are at risk of being sent to hospital.[2] The services offer al ink between hospitals and where people normally live and between different areas of the health and social care system.[3] Intermediate care in the UK is provided in different categories: reablement, crisis response, home based and bed based.[3] Only bed based intermediate care is provided in a facility, the other forms are provided in the home situation of the older adult. Bed based intermediate care is comparable to STRC in the Netherlands, but the UK model also provides other services which could be a blueprint for the Netherlands. If a crisis occurs in the Netherlands, we do not have the options to provide care in the home situation and older adults are sent to the hospital or to the nursing home. As experienced by health care professionals in Chapter 3, especially for older adults with cognitive impairment, the translocation of the older adult gives a worsening of the cognitive impairment which suggests that an intervention is better provided in the home situation. Another difference with the Netherlands is that intermediate care in the UK is also provided by social care professionals. This is consistent with our results that for many older adults there are not only issues on medical conditions, but often also on social isolation, loneliness, and the lack of informal caregivers.

Crisis response and advance care planning in the home situation in the Netherlands
Homecare organizations in Roosendaal and Heerlen in the Netherlands experiment with crisis response care.[4, 5] The community nurse visits older adults with unplanned care needs and is able to organize extra home care if needed. These care organizations collaborate with emergency departments and general practitioners. In Heerlen, the community nurse was able in 75% of the cases to solve the care crisis at home and no

further referral to the emergency department or general practitioner was needed.[4] Home care organizations need to be flexible and a 24/7 mentality to make crisis response care possible. This kind of care will create more dynamic models , instead of the choice between home without (insufficient) care or admission to a hospital or nursing home. This will make it possible to upscale homecare quickly to the (temporary) needs of an older adult.

STRC was developed to provide in a gap of care after the healthcare reforms. However, STRC often comes too late for older adults. The government tells them to maximize time at home, but in practice this means that older adults stay home until a crisis happens. If homecare or general practitioners are not equipped to support older adults at home and if the housing of older adults is not suitable the goal of staying home as long as possible will not be met. CBS data showed 43% of older adults die the same year or the year after admission to STRC (Chapter 3). This implicates that advance care planning should have an important role in the development of guidelines for STRC.

A new development to support frail older adults in the home situation is the possibility of a consultation or the co-treatment of an elderly care physician at home. The elderly care physician is a medical practitioner who has specialized as a primary care expert in geriatric medicine.[6] Until recently, elderly care physicians worked mainly in nursing homes, but a new initiative is the home consultation and treatment. Going to the hospital for a consultation of the geriatrician can be a burden for older adults. Also, to discuss delicate matters like end-of-life care and admission to a nursing home, it could be better to provide a home consultation. It is easier to work together with the general practitioner, community nurse and physical therapist to help older adults to remain self-reliant in their own home. This will make it possible to detect early needs for an admission to i.e., STRC and to have a plan how to return home. However, Chapter 2 showed that this advance care planning is often missing. As a response to the healthcare reforms in 2015, the VU medical center started the University Practice of Elderly Care.[7] The goal is to provide older adults the expertise of an elderly care physician in the home situation and to collaborate with the general practitioner. The quality of life and life goals of the older adult are central. 190 patient files were analysed: 91 older adults were referred for a geriatric assessment, and 55% of older adults had pre-existing cognitive impairment. This is in line with the experience with STRC that often older adults are referred where observation and diagnostics are needed (Chapter 2). However, in this case the GP prevents a crisis with an early referral to the elderly care physician in the home situation. Interviews with patients, informal caregivers, staff of the University practice and GPs showed a lot of positive experiences: the expertise of the elderly care physician was accessible, quickly available and made proactive care possible. Patients and informal caregivers found the reason for referral to the elderly care physician not

always clear but were in the end very content with the delivered care. They felt they were taken seriously and that they were seen. Similar results were seen in interviews with informal caregivers who had an experience with the elderly care physician in other parts of the Netherlands.[8] Focus groups with elderly care physicians providing care for older adults in the home situation showed in agreement with the experiences in STRC that older adults live longer in the home situation with more comorbidities: they describe that older adults who would beforehand live in a nursing home, now were living at home.[8] These physicians and informal caregivers describe that it is not possible for GPs to deliver the appropriate care and that the expertise of the elderly care physician is needed to manage polypharmacy, to support older adults with cognitive impairment or for a comprehensive geriatric assessment for functional decline. Informal caregivers and elderly care physicians described that they were able to discuss the prognosis of the functional or cognitive decline of older adults, to focus on life goals of the older adult and help with advance care planning.[7, 8]

The estimated costs of the University Practice of Elderly Care were 776 euro per patient. GPs indicated they would have referred the patient to medical care in the hospital otherwise, which was estimated on 1750 euro per patients. This model shows that providing care in the home situation could be cost effective in the prevention of crisis admissions.

National audit STRC and monitoring effectivity
Another important difference with the UK is the national audit that is held for intermediate care including bench marking. In the Netherlands we do not have any numbers on patient related outcomes. We only know the number of days an older adult was admitted and the discharge destination. If there is no structure for auditing, benchmarking or a platform to share good practice of STRC in the Netherlands, STRC will remain a black box. A first step will be a registration study by Dutch Healthcare Authority (NZa).[9] Because of the problems with the funding, 150 healthcare organizations are registering the care they are delivering, starting in July 2022. The goal is to update the tariff for STRC. Participants will receive a report for internal use with a benchmark compared to other participants. However, this is only one aspect of STRC and is not focussing on creating guidelines and the restructuring of STRC to fit older adults needs.

We describe two examples of how intermediate care could be audited, which were performed in the UK. First, the NHS has a benchmarking network for intermediate care and second, the national institute for health research performed case studies to measure the efficiency of community hospitals and reablement services.

The NHS benchmarking network performs the National Audit of Intermediate Care (NAIC).[3] The audit evaluates intermediate care service user demographics and processes, the effectiveness of intermediate care, service user experience, interaction, investment and capacity, access, workforce and mental health provision. These domains make it possible to provide a comprehensive overview of how STRC facilities perform and where they can improve.

Further, the National Institute for Health Research (NIHR) of the NHS, performed two studies to compare outcomes of community hospitals[10] and reablement services.[11] However, both surveys did not reach sample size and were not able to draw conclusions on characteristics of patient care that optimise performance. This shows that also other countries have difficulty with the evaluation of what makes intermediate care effective and asks for new research strategies.

Recommendations for funding of STRC
STRC is funded based on the occupancy rate: only if a bed is used by an older adult the nursing home receives funding from the insurer. This contrasts with hospital or ED funding: they have a fixed funding level; regardless how many beds are occupied. Possibly a consequence of the funding based on occupancy is that nursing homes want to have their beds occupied as much as possible and it is not possible to leave a few beds empty to enable new admissions from hospitals or home situations. This creates waiting lists for STRC: older adults must wait in the hospital or must be admitted from the emergency department to the hospital because there is no place in STRC. To prevent hospital admissions, it should be possible for STRC facilities to fund empty beds to make emergency admissions possible.

In addition, funding should be divided in the two groups for STRC: reablement and observation. These groups have different needs: in the reablement group more occupational and physical therapy could be provided, while in the observation group the availability of a psychologist is often important. This asks for different approaches of the staff and different funding. Also, staff experienced that most costs are made in the beginning of the admission: if an admission is short, the funding is not appropriate. However, if the funding for the first two weeks would be higher to make it possible to do all the necessary analysis, a lower tariff for the alter weeks if an older adult needs more time could be available. This will remove the incentive to admit an older adult for a longer time to cover all costs of the admission.

A last problem in funding which creates crisis situations is the 'fall in care support' (in Dutch: zorgval). Even if nursing home physicians can support the GP and the community nurse in advance care planning another important problem arises when an older adult

8

is provided with an indication for the nursing home and is placed on a waiting list, the older adult transfers from the Health Insurers Act to the Long-term Care Act. This means in practice that not everything that is financed through the Health Insurer Act is also financed through the Long term Care Act and the older adults will have to pay much more for services that were beforehand available to him, i.e. for day care or case management.[12] Because of this fall in care support, older adults wait as long as possible to subscribe to a waiting list of a nursing home or wait until a crisis situation occurs and they are directly admitted to the nursing home.

Research recommendations
Future research in STRC should focus on how to improve quality of STRC and how to use the limited capacity of STRC facilities and personnel. Since internationally the comparison of the effectiveness of different models of intermediate care did not yet succeed, this should be an important starting point. To answer questions about the organization of STRC in the future, new methods are necessary. The Dolce Vita project is a collaboration between the faculty of medicine of Amsterdam UMC, the centre for mathematics and computer sciences (CWI) and health care organizations in Amsterdam. In the Dolce Vita project a model will be developed that addresses 'what if' questions about the effects of long term policy decisions in the healthcare system. The model can be used to support complex decision-making process regarding the healthcare system. This model could calculate in example the effect of a shortening of admission time on the necessary capacity of STRC or what the effect is of funding of empty beds in STRC on hospital admissions. This makes it possible beforehand to substantiate policy decisions.

Second, pilot and case studies should focus on the development of two care paths and guidelines for STRC: one for reablement and one for observation. We hypothesize that when[11] treatment and diagnostics are concentrated at the beginning of the admission in STRC this could result in a more effective treatment. Experiments for different treatment schedules could provide the evidence for appropriate funding for STRC and describe the necessary skills and knowledge for staff in STRC. Examples of pilots for these treatment schedules could be observation wards for cognitive impairment, reablement wards combined with geriatric rehabilitation or wards focused on observation and to determined what could be a suitable long term care facility. With the development of these pilot and case studies it is important to collaborate with insurance companies to enable funding for this new treatment schedules from the beginning. Further, end points should not only be admission time and discharge destination, but also if the goals of older adults in STRC are reached.

With the development of the separate care pathways it is important to implement advance care planning. Our research showed that the population in STRC is very vulnerable and a large part is in their last year of life. We do not know how advance care planning is provided at the moment in STRC. However, we do know that STRC is provided largely in nursing homes and the elderly care physician is already involved in care in STRC high complex. The physician elderly care is specialized in providing care in the last phase of life of older adults and focuses on quality of life and life goals of older adults. We expect that advance care planning is already provided in STRC high complex. Future research should focus on place of death of older adults who received STRC and the role STRC played in the last year of life of the older adult. Research questions would be if older adults are dying in their preferred place of death and if they are dying at home. In this way, STRC would have succeeded in the goal of enabling older adults to remain in their own environment.

In the development of care pathways and the implementation of advance care planning in STRC not only quantitative research should be performed. Qualitative research about the experiences of older adults in STRC is scarce.[7, 8] Qualitative research should focus on the question if STRC supports older adults in aging-in-place. This includes the needs of the older adults of STRC, their goals and preferences according aging-in-place and end of life care. This qualitative research should be performed parallel in the development of the care pathways and guidelines.

Implication COVID-19 had on STRC care delivery and nursing home care
During the COVID-19 pandemic, STRC beds were used to admit older adults with COVID-19. This to support hospitals in discharging patients quickly, or by admitting patients who did not need hospital care for COVID-19, but also could not stay home.[13] Insurers payed a higher tariff for patients admitted because of COVID-19.[14] This showed how fluent the definition of STRC is: according to the needs of society the type of patients using the beds is changed. This shows how important it is that staff in STRC has the proper knowledge to deliver care to patients.

Waiting times for LTC decreased during COVID: at the peak of the first wave 5,500 beds were not used in nursing homes in the Netherlands. A lot of residents died and older adults waiting to be admitted, postponed this admission. They did not want to be admitted if family could not visit and because of the large outbreaks.[15] However, with the greying of society it is to be expected that more beds in LTC are needed. At the moment three peaks of excess mortality have occurred in the nursing homes since the start of the pandemic, all followed with smaller lows of under mortality.[16]

8

Part 2: SARS-CoV-2 infection prevention

Main results

The COVID-19 pandemic created a state of crisis worldwide. All healthcare resources were focused on delivering COVID-care. COVID-19 caused high mortality for older adults, and in the spring of 2020, it was unknown how the virus spread. Four nursing homes in the Netherlands implemented a new testing strategy which was more progressive than the current guideline: all staff and residents were tested regardless of symptoms, and the testing was repeated every week until the outbreak mitigated. The first three outbreaks were small. We identified asymptomatic and presymptomatic SARS-CoV-2 positive residents but could not determine the contribution of pre- and asymptomatic cases (Chapter 4). In a fourth, large outbreak, the addition of weekly facility wide testing regardless of symptoms identified 51.4% of residents were presymptomatic and 9.5% of residents were asymptomatic (Chapter 5). A remarkable finding was that almost all staff (93.3%) reported symptoms in the point prevalence surveys. With sequencing we discovered that residents and staff were infected by a single strain. The absence of subjective symptoms (such as loss of smell or taste) in residents compared to staff who were infected by the same SARS-CoV-2 strain suggested the underreporting of symptoms in residents. We concluded underreporting was probably due to cognitive impairment that occurred in many (104/113) of the nursing home residents. Due to the cohortation of positive residents, staff was taking care of residents they were not familiar with, which made it difficult for them to recognize symptoms and alterations of behaviour of residents. Other explanations could be lack of knowledge by staff about all symptoms of COVID-19 or understaffing. The expected underreportation of symptoms made it not possible to distinguish between residents with and without symptoms. However, residents with and without symptoms had the same high viral loads which suggested the same potential for viral shedding.

These two studies contributed to the literature on presymptomatic spread in nursing homes. To our knowledge, we were the first authors globally to describe symptoms in residents and staff infected by the same SARS-CoV-2 strain. Our study results were reported to the Dutch government and national Outbreak Management Team with a summary of international studies and guidelines, which resulted in the adaptation of the Dutch guideline for outbreak management in nursing homes.

Chapter 6 evaluates the implementation of the new Dutch guidelines that required weekly PCR testing of health care professional and nursing home residents of the same unit regardless of symptoms during an outbreak. We found that this new guideline was partly implemented in Dutch nursing homes: 89% tested residents and 73% tested staff of a unit of the whole facility regardless of symptoms. However, interviews showed that testing regardless of symptoms was implemented later in an outbreak or testing was not repeated. A noticeable finding was the feeling of staff they had to choose between safety and quality of life of the residents. Local leaders with limited knowledge on how SARS-CoV-2 spread and the rationale of the guideline, valued the burden of weekly testing of residents (especially with cognitive impairment) as too high compared to the protection of residents. However, a lot of nursing homes were able to test residents by familiar nurses and with a calm approach and were successful in mitigating outbreaks, just as we have shown in Chapter 4 and 5.

Other barriers for full implementation of the guideline were lack of a cohort ward or the fear of managers for loss of staff due to asymptomatic positive testing, understaffing and insufficient collaboration with local public health services. Facilitators for guideline implementation were the availability of PCR tests, the willingness of staff to get tested and earlier experiences with an outbreak.

Chapter 7 shows in a longitudinal observational study of community-dwelling older adults in the Netherlands limited mental health effects of the lockdown measures. There was a slight increase of symptoms of depression and anxiety but also an increase of perceived mastery. Having more functional limitations or being frail was associated with a smaller increase in mastery during the COVID-pandemic. Our study suggests that the possible negative effect of the pandemic on mental health – at least in the first months – was limited. Also, the modest increase in mastery scores suggests a positive effect from the lockdown measures on mental health in older adults occurred. This was in line with a longitudinal study of older adults in Chile. This study described an increase in symptoms of anxiety and depression, but also increased resilience.[17] A possible explanation is that the public health measures resulted in a more quiet and clear everyday life for older adults which could have led to an increase of perceived mastery. To our best knowledge, no other data on mastery during the COVID-pandemic has been published so far.

Strengths and limitations

We were able to study nursing homes at the forefront of infection prevention for COVID-19. We were able to include residents and staff in our studies to the spread of the virus (Chapter 4 and Chapter 5) with high response rates. Also the collaboration between multiple health care organizations, the Dutch National Institute for Public Health and Environment (RIVM) and the ministry of Health, Welfare and Sports made it possible to influence guidelines and policy quickly. In our evaluation study (Chapter 6) we were able to include nursing homes evenly distributed over the Netherlands and

8

we reached data saturation in the qualitative part. The LASA Cohort made it possible to study trajectories of feelings of depression, anxiety and perceived mastery in a large cohort of community dwelling older adults over a 10-year period (Chapter 7).

In the fourth nursing home (Chapter 5), not all staff members who tested positive during the outbreak participated (17/73 questionnaires were missing). Questionnaire for staff were partly retrospective, which gives risk of recall bias, which resulted in a low percentage of staff experiencing symptom. Another limitation was only 36% of samples were available for sequencing. Last, we could not consider the contribution of ventilation in the outbreaks of Chapter 4 and 5.

In the national evaluation of the implementation testing regardless of symptoms (Chapter 6) a limitation is the risk of selection bias: nursing homes with sufficient staffing, or who experienced a small outbreak, are to be expected to be more willing to participate in the study. Another limitation is we could not validate our findings with the public health services, residents and their informal caregivers.

A major limitation of the LASA COVID study was the possible survivorship bias. Non responders of the questionnaire were older and had lower MMSE scores. Also, the participants with complete outcomes of our study were younger, had a higher MMSE score and less functional limitations. Last, the cohort has an overrepresentation of participants of the refresher wave of 2012, consisting of older adults aged 55-64. This could explain the high MMSE score in general and the limited comorbidities and functional limitations. Our results are possibly only applicable to community dwelling older adults with limited health and social problems, who have the protective effect of life experience and so limited negative psychological effects.

Clinical and policy implications for infection prevention in nursing homes

During the writing of this discussion, two years have passed since the start of COVID-19 pandemic and there is an abundance of face masks, you can receive a booster shot of your vaccine without an appointment at the local public health service and oral medication is introduced. While the COVID-19 pandemic is not over yet, important lessons can be learned for infectious disease prevention and control in general in nursing homes.

Training of staff and board members
A systematic review of 1332 outbreaks of infectious diseases between 2008 and 2018 in nursing homes[18] stated that the most frequently observed problem was suboptimal hand hygiene, followed by personal protective equipment and cleaning and disinfection. This is also described by the Health and Youth care Inspectorate in the Netherlands about nursing homes they visited in November and December 2020[19], when the pandemic was already for nine months in our country. Almost all organizations showed multiple shortcomings in infection prevention. Especially the use of PPE needed attention. The elderly care physicians of the organizations met the standard of their tasks in infection prevention and the prescription of antibiotics. However, they could play a larger role in the training of the staff in Infection Prevention and Control (IPC) guidelines. This is also shown in additional results of our evaluation study of infection prevention for COVID-19 in the second wave[20]: the training of health care staff is mainly done by nurses. Nurses stated that in the case of an outbreak it is necessary that they provided bed side teaching at the ward of an outbreak to coach the staff in the application of the appropriate guidelines. Staff of the nursing homes were not appropriately trained beforehand in the IPC guidelines. These nurses made the connection to the other staff and are qualified professionals for the training in IPC, however this should be a shared responsibility and priority of nurses and physicians in nursing homes.

Another finding of the Healthcare and Youth Inspectorate was that most of the board members of the nursing homes did not facilitate the execution of appropriate IPC guidelines enough.[19] They offer only online training for their staff, a board member who focusses on IPC is often missing and the board is missing the knowledge about their role in the organization of appropriate IPC. This lack of knowledge is also shown in our evaluation study. Part of the local leaders were unconsciously incompetent in infection prevention and were not able to balance advantages and disadvantages of the implementation of the new guideline for testing residents and staff for SARS-CoV-2. One of the nurses who was training staff in IPC stated that the focus of the nursing home has been mostly at providing a home like environment: infection prevention had not been a priority in the last years.[19] This could be an explanation for the lack of knowledge of the board members. However, when large outbreaks of infectious diseases happen in nursing homes, this also leads to a loss of quality of life for residents. Preventing transmission and outbreaks minimizes the needs for more rigorous restrictions and allows residents to maintain contact with their relatives and the NH to continue normal care, which is especially important for residents with dementia.

The compliance to IPC guidelines, facilitating staff in the compliance to these guidelines and maintaining the safety of residents is a primary responsibility of the board of the nursing home. A change in culture is needed in nursing homes: safety of residents and quality of life should be seen as two sides of the same coin. Nursing homes in the Netherlands have the responsibility for their own infection prevention management and outbreak management, the public health services only assist in case of large or problematic outbreaks. The lack of knowledge of the board members and managers shows a more proactive attitude of the local public health services and the physicians elderly care in the IPC management of nursing homes is needed.

8

Collaboration of nursing homes, public health services, hospitals and laboratories.

Public health services do not only play an important role in the education of board members of nursing homes. From our evaluation studies, public health services were often not available to support nursing homes during an outbreak, or only were involved when an outbreak was large. Not only nursing homes but also the former assisted living facilities have large risks for infectious disease outbreaks. After 2015 reforms, part of the assisted living facilities became independent apartments where care is provided by home care organizations and all older adults are treated by their own general practitioner. However, general practitioners do not manage outbreaks. These vulnerable older adults still live close to each other and share the same home care organizations. Public health services should coordinate outbreak management in these facilities and prevent further spread of an infectious disease from the beginning.

Many nursing homes that successfully mitigated an outbreak with facility-wide testing were supported by the local hospital, laboratory, or public health services.[21-24] This shows the importance of collaboration between different health care providers. In the Netherlands, such collaboration exists for the prevention of antibiotic resistance (In Dutch: ABR-zorgnetwerken). They are organized in 10 networks, where nursing homes work together with general practitioners, hospitals, home care, organizations for intellectual disabled and microbiologists.[25] These networks could also play an important role in cyclic auditing for infection prevention of nursing homes, which was recommended by the inspection for youth and healthcare.[19] They could provide in the exchange of knowledge of IPC and support pandemic preparedness.

The pandemic had a major impact on older adults in society and in nursing homes. An important lesson from this pandemic is that we need to be better prepared for pandemics. A review of the preparedness for a viral respiratory pandemic in residential aged care facilities showed limited pre-pandemic disaster planning.[26] The same was shown in the evaluation of infection prevention in nursing homes in the Netherlands and in a report of the inspection for youth and healthcare.[19, 20] After the first wave, nursing homes invested limited measures and time in the preparation for next outbreaks. A possible explanation is the need of rest after the very high workload of the first wave. However, this created the same problems in the second and third wave of limited preparation of how to respond to an outbreak. Auditing, collaboration and knowledge exchange between different health services could support in pre-pandemic disaster planning.

The physical environment of nursing homes

Another important implication from Chapter 4 to 6 is the role of the design of the physical environment of the nursing home in the spread of COVID-19 and the risk in the spread of other infectious diseases. In Chapter 4 the nursing homes with relatively small outbreaks all had the opportunity to close wards from each other, in contrast to the nursing home in Chapter 5 where a large outbreak occurred. In Chapter 6 an important barrier for the implementation of facility wide testing was the lack of isolation opportunities or the lack of a cohort ward.

Zhu et al. studied the relationship between the size of the outbreak in nursing homes in and characteristics of the design of the nursing home in a large cross-sectional study of 7,785 nursing homes in the US.[27] An increased percentage of private rooms and larger living areas per bed were associated with reductions in COVID-19 cases, deaths, and transmissibility among residents. This has important implications for the design of future nursing homes. Instead of focusing on looking as much as home like as possible and trying not to resemble a hospital like environment[28], infection prevention should be one of the requirements in the design of nursing homes.

Research recommendations

During the COVID-pandemic, research focused on effective strategies on mitigating outbreaks. However, as shown by our research in Chapter 6, implementing new strategies and guidelines are difficult. Implementation science focuses on what helps and what hinders the uptake, effective implementation, and sustainability of evidence-based programs in clinical practice.[29] A review of implementation strategies regarding nursing guidelines concluded a wide variety of implementation strategies is used.[30] However, not one single strategy or combination of strategies can be linked directly to successful implementation. Two-third of the reviewed studies reported a positive significant effect of the implementation of guidelines on patient-related nursing outcomes or guideline adherence. Future research should focus on which components of an implementation strategy are effective for change. The ABR-networks could also facilitate as research networks, which could not only find out what works in implementing IPC guidelines, but also how it works and in what settings.[31] In example, details about the staffing resources necessary to consistently implement interventions are currently missing and should be the focus of future research.[32] In these implementation studies older adults and their informal caregivers should also be given an important role: one of the main barriers for the implementation of the infection prevention guidelines was the presumed loss of quality of life of residents and their informal caregivers. Informal caregivers experienced irreparable harm from separation from their relative in nursing homes.[33] If informal caregivers and residents are involved in the implementation of IPC guidelines and if they understand why certain measures are taken, they can also be involved in how to make

8

periods of quarantine or isolation possible in a bearable way. These implementation studies are not only relevant for COVID-19 but for infectious disease prevention in nursing homes in general.

The barrier assessment of Chapter 6 showed that in the Netherlands, boards and managers should be involved in the implementation of infection prevention and control. Visible leadership, timely and efficient information sharing and a coaching manager are identified as facilitators for effective management practices in infection prevention.[34] Future research should contain an implementation study of these management practices for boards and managers of nursing homes.

During our implementation study, most of the residents and staff were not yet vaccinated. In the Netherlands, the first health care worker was vaccinated on January 6th 2021.[35] However, globally multiple outbreaks in nursing homes where staff and residents are vaccinated occurred.[36-39] The vaccines showed good prevention for severe disease and death, however infection prevention protocols are still necessary. A study of COVD-19 cases and deaths among residents and staff in the US, showed that in the presence of high community prevalence of COVID-19, nursing homes with low staff vaccination coverage had higher numbers of cases and deaths than those with high staff vaccination coverage.[40] This shows that vaccination of staff is key in prevention of outbreaks and death in nursing homes. In the Netherlands, vaccination coverage for all adults with a booster was 64.2% in May 2022. It is unknown how much health care workers in nursing homes are vaccinated. National data on vaccine coverage among health care personnel are necessary and determine the need for studies how to motivate staff to get vaccinated. Before the COVID-19 pandemic, only 10-15% of staff in nursing homes was vaccinated yearly for influenza.[41] It is unknown if staff in nursing homes will be motivated for repeated vaccination of COVID-19. Also, future research should focus on the place of serial asymptomatic testing in nursing homes with high vaccination coverage of residents and staff.

In the outcome of future trials of mitigating outbreaks in nursing homes, also cases of COVID-19 among informal caregivers and family members of staff should be involved. Informal caregivers are often also vulnerable and can have negative effects of an outbreak, and family members of staff could be at risk of quarantine and cannot go to school or work. This is an important impact of an outbreak of COVID-19 in a nursing home which has been missing in previous studies.

Future perspective and conclusion

Having a sufficient workforce in health care
Both intermediate care and the COVID-19 pandemic showed that having a sufficient workforce of healthcare professionals is needed. For intermediate care, shortage of staff in homecare is a risk for creating crisis in the home situation and causing an hospital, intermediate care and long-term care admissions. In the COVID-19 pandemic shortage of nurses in the ICU were the reason to close the country with a lockdown. In the nursing homes, shortage of staff caused, among other reasons, limited testing and not being able to isolate residents or having a cohort ward. This resulted in the limited implementation of measures (Chapter 6).

The association between staffing and number of cases and deaths during outbreak of SARS-CoV-2 has been studied in a large cross-sectional study in the US, which showed that every 20 minutes (per resident day) increase in registered nurse staffing was associated with a 22% reduction in confirmed cases.[42] The same was described in Spain, in a small study: for every additional staff per place a reduction of 0.44 percentual point was predicted in fatalities.[43] Also for other infectious diseases the understaffing has been reported as a threat in management: A systematic review of 1,062 outbreaks of gastroenteritis in France described in 10% of the outbreaks problems of the management in the outbreak due to understaffing.[44]

Problems in workforce are also described for intermediate care. A qualitative study of five case study sites in the UK showed that lack of mainstream home care meant that patients who would otherwise receive intermediate care in their own homes could not be left safely overnight or receive assistance with daily activities. Potential service-users were sometimes admitted to hospital as a result. Also the shortage in care workers and rehabilitation assistants meant led to an inability to cater for potential service users, even when all criteria were met and therapist input was available.[45]

A recent report by Strategies in Regulated Markets in the Netherlands calculated how to enlarge the Dutch healthcare workforce in number of hours and how to lower the workload.[46] Obviously, no quick fix could be identified, but the lowering of the administrative work (increase of 20% in number of hours of healthcare staff) and the use of technology (increase of 7% in number of hours of healthcare staff) were identified as promising measures. Another promising option is to considering staff with enough or relevant skills or work experience qualified to work in health care. The expertise of the person would be leading, instead of the official certification. In this way, the number of hours of healthcare staff could also be increased with 7%. Nursing homes need to

8

register the portfolios of their staff with their skills and provide in learning on the job. At the moment, this is not possible by law. Also, external parties have to trust the nursing homes in their judgement of the expertise of their staff.

How to prevent crisis for older adults living in the community
The shift from residential care to care in the community has shown multiple difficulties. The stories of older adults in crisis using STRC, but also my personal experience with the care for my grandmother shows we need a care system that enables older adults to live in a safe independent environment yet receive timely care. The care of my grandmother in the last week of her life was a very valuable and beautiful experience, however this was only possible because of the background of my mother and myself. Older adults and their families need to be properly supported to live independent in the community with good quality of life. Luckily, there have been multiple initiatives which could make this possible such as crisis response by homecare or the elderly care physician performing home consultations and co-treatment. Further the Dutch Healthcare Authority is taking a first step in creating an appropriate tariff for STRC, however other gaps in funding such as the funding based on occupancy and the 'fall in care support' need to be fixed.

How to prevent crisis for older adults living in nursing homes
Nursing homes have shown an immense flexibility and resilience during the pandemic. However, the last two years also showed that a lot of nursing homes should invest in infection prevention and pandemic preparedness. Boards of nursing homes need to take their responsibility to attain the appropriate knowledge of infection prevention for their organization. On the other hand, they need to be supported by a network to exchange knowledge (similar to the ABR-networks) and by the public health services. Infection prevention should also be taken into account in the design of nursing homes. Further, knowledge about effective implementation strategies for IPC guidelines is needed. Last, a sufficient workforce in healthcare needs to be one of the priorities of our government to ensure the safety and preparedness for crisis of our older adults.

Reference List

1. Alders, P, Schut, FT. Strategic cost-shifting in long-term care. Evidence from the Netherlands. Health policy (Amsterdam, Netherlands) 2022;126(1):43-48.

2. Roe, B, Daly, S, Shenton, G, et al. Development and evaluation of intermediate care. J Clin Nurs 2003;12(3):341-350.

3. National Audit of Intermediate Care - Summary Report England. 2017.

4. Wijkteam Acute Zorg ontlast spoedeisende hulp; https://www.dejuistezorgopdejuisteplek.nl/praktijkvoorbeelden/wijkteam-acute-zorg-ontlast-spoedeisende-hulp/ Accessed 1-3-2022.

5. Factsheet Acuut Team TWB; https://www.twb.nl/wp-content/uploads/2021/03/factsheet-Acuut-Team.pdf. Accessed 1-3-2022.

6. Koopmans, RTCM, Lavrijsen, JCM, Hoek, JF, et al. DUTCH ELDERLY CARE PHYSICIAN: A NEW GENERATION OF NURSING HOME PHYSICIAN SPECIALISTS. Journal of the American Geriatrics Society 2010;58(9):1807-1809.

7. Ronde, B, Broulikova, H, Bosmans, J, et al. [Five years University Practice of Elderly Care: users, care provided, costs and experiences]. Tijdschr Gerontol Geriatr 2021;52(2).

8. van den Besselaar, JH, Buurman, BM, Hartel, L, et al. Varen op ervaringen van zorgvragers, mantelzorgers en zorgverleners in geriatrische revalidatie (GRZ), eerstelijnsverblijf (ELV) en geneeskundige zorg voor specifieke patientgroepen (GZSP). 2021.

9. NZA. Op weg naar nieuwe prestaties en tarieven eerstelijnsverblijf en WLZ crisiszorg vv; https://www.nza.nl/zorgsectoren/kortdurende-zorg/op-weg-naar-nieuwe-prestaties-elv-en-wlz-crisiszorg-vv/op-weg-naar-nieuwe-prestaties-elv-en-wlz-crisiszorg-vv. Accessed.

10. Young, J, Hulme, C, Smith, A, et al. Measuring and optimising the efficiency of community hospital inpatient care for odler people: the MoCHA mixed-methods study. Health Service and Delivery Research 2020;8(1).

11. Beresford, B, Mann, R, Parker, G, et al. Reablement services for people at risk of needing social care: the MoRe mixed-methods evaluation. Health Service and Delivery Research 2019;7(16).

12. De zorgval, wat is dat eigenlijk?; 2017. https://www.alzheimer-nederland.nl/nieuws/zorgval. Accessed.

13. Regio Drenthe biedt opvang voor patiënten coronavirus; 2020. https://www.waardigheidentrots.nl/actueel/regio-drenthe-biedt-opvang-voor-patienten-coronavirus/. Accessed 15-2-2022.

14. van den Berg, D. Brief zorgverzekeraars Nederland: Corona-regeling 2021 voor wijkverpleging, GRZ en ELV. 2021.

8

15. Bezetting verpleeghuizen stijgt, wachtlijsten nemen iets af; https://www.nza.nl/actueel/nieuws/2020/09/04/bezetting-verpleeghuizen-stijgt-wachtlijsten-nemen-iets-af. Accessed 4-9-2020.

16. sterfte in februari onder verwacht niveau; https://www.cbs.nl/nl-nl/nieuws/2022/09/sterfte-in-februari-onder-verwacht-niveau. Accessed.

17. Herrera, MS, Elgueta, R, Fernández, MB, et al. A longitudinal study monitoring the quality of life in a national cohort of older adults in Chile before and during the COVID-19 outbreak. BMC Geriatr 2021;21(1):143.

18. Lee, MH, Lee, GA, Lee, SH, et al. A systematic review on the causes of the transmission and control measures of outbreaks in long-term care facilities: Back to basics of infection control. PLoS One 2020;15(3):e0229911.

19. Verdiepende analyse na infectiepreventiebezoeken aan verpleeghuizen. Inspectie Gezondheidszorg en Jeugd 2021.

20. Buurman, BM, Hertogh, CMPM, van den Besselaar, JH, et al. Onderzoeksverslag Evluatie en implementatie COVID-19 testbeleid in verpleeghuizen. 2021.

21. Escobar, DJ, Lanzi, M, Saberi, P, et al. Mitigation of a Coronavirus Disease 2019 Outbreak in a Nursing Home Through Serial Testing of Residents and Staff. Clin Infect Dis 2021;72(9):e394-e396.

22. Ehrlich, HY, Harizaj, A, Campbell, L, et al. SARS-CoV-2 in Nursing Homes after 3 Months of Serial, Facilitywide Point Prevalence Testing, Connecticut, USA. Emerg Infect Dis 2021;27(5):1288-1295.

23. Oldfield, BJ, DeCosta, S, Petterson, L, et al. A Blueprint for Community Health Center and Nursing Home Partnership: Testing for COVID-19 among Residents and Staff at Long-term Care Facilities. J Health Care Poor Underserved 2021;32(1):xi-xviii.

24. Montoya, A, Jenq, G, Mills, JP, et al. Partnering with Local Hospitals and Public Health to Manage COVID-19 Outbreaks in Nursing Homes. J Am Geriatr Soc 2021;69(1):30-36.

25. Antibioticaresistentie: regionale aanpak; https://www.rivm.nl/antibioticaresistentie/nationale-aanpak-antibioticaresistentie/zorgnetwerken. Accessed.

26. Usher, K, Durkin, J, Gyamfi, N, et al. Preparedness for viral respiratory infection pandemic in residential aged care facilities: A review of the literature to inform post-COVID-19 response. J Clin Nurs 2021.

27. Zhu, X, Lee, H, Sang, H, et al. Nursing Home Design and COVID-19: Implications for Guidelines and Regulation. J Am Med Dir Assoc 2022;23(2):272-279.e271.

28. Mody, L, Bradley, SF, Huang, SS. Keeping the "Home" in Nursing Home: Implications for Infection Prevention. JAMA Internal Medicine 2013;173(10):853-854.

29. Gilmartin, HM, Hessels, AJ. Dissemination and implementation science for infection prevention: A primer. Am J Infect Control 2019;47(6):688-692.

30. Spoon, D, Rietbergen, T, Huis, A, et al. Implementation strategies used to implement nursing guidelines in daily practice: A systematic review. Int J Nurs Stud 2020;111:103748.

31. Saint, S, Howell, JD, Krein, SL. Implementation science: how to jump-start infection prevention. Infect Control Hosp Epidemiol 2010;31 Suppl 1(Suppl 1):S14-17.

32. Simmons, SF, Schnelle, JF, Sathe, NA, et al. Defining Safety in the Nursing Home Setting: Implications for Future Research. J Am Med Dir Assoc 2016;17(6):473-481.

33. Kusmaul, N, Miller, VJ, Cheon, JH. "They Just Took Him Out of My Life": Nursing Home Care Partner Experiences During the COVID-19 Pandemic. J Gerontol Nurs 2022;48(2):7-11.

34. McAlearney, AS, Gaughan, AA, DePuccio, MJ, et al. Management practices for leaders to promote infection prevention: Lessons from a qualitative study. Am J Infect Control 2021;49(5):536-541.

35. Huisman, C. Eerste vaccinatie in Nederland is een historisch moment: de spuiten gaan naar het museum. de Volkskrant. 2021.

36. Ripabelli, G, Sammarco, ML, Rezza, G, et al. A SARS-CoV-2 Outbreak Among Nursing Home Residents Vaccinated with a Booster Dose of mRNA COVID-19 Vaccine. J Community Health 2022:1-6.

37. Lafuente-Lafuente, C, Rainone, A, Guérin, O, et al. COVID-19 Outbreaks in Nursing Homes Despite Full Vaccination with BNT162b2 of a Majority of Residents. Gerontology 2022:1-9.

38. Pierobon, A, Zotto, AD, Antico, A, et al. Outbreak of SARS-CoV-2 B.1.617.2 (delta) variant in a nursing home 28 weeks after two doses of mRNA anti-COVID-19 vaccines: evidence of a waning immunity. Clin Microbiol Infect 2022;28(4):614.e615-614.e617.

39. Bart, SM, Harizaj, A, Pearson, CL, et al. SARS-CoV-2 Delta outbreak among fully vaccinated nursing home residents likely initiated by a fully vaccinated staff member - Connecticut, July-August 2021. Clin Infect Dis 2021.

40. McGarry, BE, Barnett, ML, Grabowski, DC, et al. Nursing Home Staff Vaccination and Covid-19 Outcomes. N Engl J Med 2022;386(4):397-398.

41. De jaarlijkse griepvaccinatie; 2021. https://www.rivm.nl/griep-griepprik/professionals/vaccinaties/elkjaar. Accessed 30-5-2022.

42. Li, Y, Temkin-Greener, H, Shan, G, et al. COVID-19 Infections and Deaths among Connecticut Nursing Home Residents: Facility Correlates. J Am Geriatr Soc 2020;68(9):1899-1906.

43. Costa-Font, J, Jiménez Martin, S, Viola, A. Fatal Underfunding? Explaining COVID-19 Mortality in Spanish Nursing Homes. J Aging Health 2021;33(7-8):607-617.

8

44. Barret, AS, Jourdan-daSilva, N, Ambert-Balay, K, et al. Surveillance for outbreaks of gastroenteritis in elderly long-term care facilities in France, November 2010 to May 2012. Euro Surveill 2014;19(29).

45. Regen, E, Martin, G, Glasby, J, et al. Challenges, benefits and weaknesses of intermediate care: results from five UK case study sites. Health Soc Care Community 2008;16(6):629-637.

46. Brocken, E, Heida, J, Ponds, R. Opties onder de loep: onderzoek beleidsopties arbeidsmarkt ouderenzorg. Strategies in Regulated Markets; 2022.

8

A

Summary

Crises in Carse for Older Adults: implementation and evaluation of intermediate care and SARS-CoV-2 prevention

Chapter 1 provided the background related to crises in care for older adults, specifically in intermediate care and Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection prevention.

Most counties in Europe have reformed their long-term care (LTC), because of the growing number of older adults and increasing costs of LTC. One main trend is to move LTC from residential to community care. This has been lauded by governments to manage costs and to appease older adults and society in general as the consensus is older adults want to stay at home for as long as possible.

To support older adults to maximize time at home, intermediate care was implemented for prevention- and rehabilitation strategies. In the Netherlands, the government reformed the healthcare system in 2015 and implemented short-term residential care (STRC) as a new form of intermediate care. STRC is bed-based care for simple medical problems with the aim to discharge older adults to home. No guidelines and no targeted patient groups were provided. In 2018 and 2019 less than half of the patients were discharged home. In-depth data of characteristics of older adults admitted to STRC and how STRC is organized were missing.

On top of the increasing demand for care for older adults a second crisis occurred in the spring of 2020: The SARS-CoV-2 pandemic. This was a public health crisis with a lot of uncertainties about SARS-CoV-2. It was unclear how the virus spread, how the virus should be treated, and what the long-term consequences would be. Further there were shortages of medical equipment for example: personal protective equipment, PCR tests, and ventilation machines. The Dutch government-imposed measures to protect older adults in nursing homes and the community from a high mortality risk.

This thesis is based on the implementation and evaluation of short-term residential care in the Netherlands (**Chapter 2 and 3**) and implementation and evaluation of measures to prevent spread of SARS-CoV-2 in older adults (**Chapter 4 to 7**).

The first part of this thesis focuses on short-term residential care. In **Chapter 2** we explored the implementation of STRC and the patients using STRC in Amsterdam with a qualitative study. In 13 group interviews, we discussed 39 patient cases who were recently admitted to STRC with 28 healthcare professionals. Most of these patients

*

had complex problems that were underestimated at handover, making returning to home nearly impossible. The STRC eligibility criteria that patients have general health problems and can return home did not fit with current practice. This resulted in a mismatch between patient needs and the care that is provided: the staffing did not have the appropriate education and the treatment time needed. Because of the complex problems, planning care before and after discharge, such as advance care planning, social care, and home adaptations, was important. Another important finding was that the 13 facilities organized care in STRC in different ways: the size of the ward differed and if facilities for geriatric rehabilitation were available. Some wards specialized in cognitive screening after delirium.

In **Chapter 3** we aimed to validate the findings of our qualitative study with a national survey about organizational characteristics of STRC and data of statistics Netherlands of characteristics of older adults admitted to STRC. STRC is mainly used by female and older adults who live alone. Patients use a high number of different drugs, suggesting multimorbidity. Over 60% used more than 10 different drugs in the year of their admission and a third used psychotropic drugs. Further, patients are very vulnerable according to the high mortality rate. Forty percent of the patients died in the same year of admission or in the year after the admission to STRC. 176 facilities participated in the survey, mainly consisting of nursing homes (NH) and assisted living facilities. 30.1% of facilities delivered STRC at an independent ward, 27.3% at a ward shared with geriatric rehabilitation care, and 33.5% at a ward shared with long-term care. The number of beds varied from 1 to 40. Frequency of medical rounds and multidisciplinary consultations varied from never, monthly, biweekly to weekly. Only 12 facilities reported to specialize on a specific patient group.

We objectified the differences and similarities which can be used to evaluate outcomes of STRC and to compose a guideline.

The second part of this thesis focuses on SARS-CoV-2 infection prevention. **Chapter 4** aimed to assess the contribution of a- and presymptomatic residents and healthcare workers in transmission of SARS-CoV-2 in nursing homes. We conducted serial point-prevalence surveys regardless of symptoms among 297 residents and 542 healthcare workers of three nursing homes with recent introduction of SARS-CoV-2, including standardized symptom assessment and nasopharyngeal and oropharyngeal testing for SARS-CoV-2 and whole genome sequencing of the PCR samples. In the first point-prevalence survey 15 residents tested positive (5%) of which nine had a positive test result in the months preceding study onset. Of the six new cases, one was presymptomatic and three remained asymptomatic. Eight health care workers (1.5%) tested positive at the first point-prevalence survey, all had typical symptoms. At the second point-prevalence

survey one resident and one health care worker tested positive, both asymptomatic at the day of testing. Because of the limited number of cases, it was not possible to assess the contribution of a- and presymptomatic cases. However, we confirmed a- and presymptomatic occurrence and hypothesized on factors that contributed on the prevention of transmission.

Chapter 5 describes a large outbreak in a fourth nursing home. At the beginning of this large outbreak, residents and staff were tested based on symptoms or close contact with a positive resident. Halfway the outbreak the nursing home changed the testing strategy. All residents and staff were tested regardless of symptoms and this testing was repeated every week in addition to the testing strategy based on symptoms. Standardized symptom-assessment and sequencing of positive PCR samples was performed. 113/181 residents and 56/244 health care workers tested positive. Before weekly testing regardless of symptoms 92.3% of residents were symptomatic, compared to 39.2% after implementation of the new testing strategy (P-value < 0.001). There was no difference in staff who expressed symptoms at the moment of testing between the two testing strategies (94.6% and 93.3%). Sequencing showed that infections were caused by the same virus strain. A notable finding was loss of smell and taste, a sore throat, headache or myalga was hardly reported in residents compared to staff. This suggested that residents were not able to express their symptoms or symptoms in residents were poorly recognized or documented by staff. However, no difference in median Ct-value between symptomatic (20.8), asymptomatic (20.5) and presymptomatic (21.3) residents was found (P=0.624). This suggested that residents without symptoms have the same potential for viral shedding as residents with symptoms. Weekly testing was an effective strategy for early identification of SARS-Cov-2 cases, resulting in mitigation of the outbreak. The studies of chapter 4 and 5 added to international literature and strengthened the evidence for serial testing regardless of symptoms during a SARS-CoV-2 outbreak. Based on international literature and the studies of chapter 4 and 5, the Dutch guidelines were updated.

In **chapter 6,** we describe how the updated guideline was implemented during outbreaks in the second wave of the pandemic in the winter of 2020/2021. We reported on the barriers and facilitators of the implementation. First, we distributed an online survey of nursing homes who experienced an outbreak in the study period and collected data on the testing strategy. We collected data of 117 outbreaks. Second, we conducted interviews about 26 of the 117 outbreaks to gain in depth data about the choices which were made in the mitigation of the outbreak and the implementation of a testing strategy. Last, we performed four focus groups with managers, physicians, nurses, and certified health assistants of their experiences with the testing strategy and barriers and facilitators of the testing strategy. Unit- or facility-wide testing of residents regardless of symptoms was

*

implemented during 104/117 outbreaks, while staff was tested regardless of symptoms during 85/117 of the outbreaks. Of NHs performing unit-wide testing of residents (84/117), 72.6% repeated this at least once a week. Of NHs performing unit-wide testing of staff (64/117), 62.5% repeated this at least once per week. The survey showed that weekly testing residents and staff regardless of symptoms was largely implemented for residents and staff, however the interviews showed testing was often implemented during later stages of the outbreak and was not always followed up with serial testing. Barriers to serial testing regardless of symptoms were lack of knowledge of local leaders with decisional making authority, lack of a cohort ward or skilled staff, and insufficient collaboration with laboratories or local public health services. Important facilitators to serial testing were staff willingness to undergo testing and the availability of PCR tests. This study has important implications for infection prevention in general in nursing homes and how to address the implementation of guidelines for infection prevention.

Next to measures in the nursing homes the government also wanted to protect older adults in the community. In addition to the lockdown measures which applied for the total population, the government advised more measures for older adults to minimize contacts. All these measures were hypothesized to cause anxiety and depression. Previous studies on the effect of lockdown measures on anxiety and depression were heterogeneous and showed small effects.

In **Chapter 7** we used the Longitudinal Aging Study Amsterdam (LASA) to assess depressive and anxiety symptoms and perceived mastery just after the first wave of the COVID-19 pandemic compared to previous years in community-dwelling older adults. We used the comprehensive geriatric assessment framework to identify potential risk groups. Depressive symptoms, anxiety symptoms and feelings of mastery were assessed with the short Center for Epidemiologic Studies Depression scale (CES-D-10), the Hospital Anxiety Depression Scale- Anxiety subscale (HADS-A) and the Pearlin Mastery scale. Symptoms were assessed over a period of 12 years to compare outcomes of questionnaires in June-August 2020 and to examine predictors to identify risk groups. Slight increases in CES-D-10 (1.37, 95%CI 1.12;1.62) and HADS-A (0.74, 95% CI 0.56;0.94) occurred during 2020 compared to previous years. A remarkable finding was the increase of feelings of mastery (1.10, 95%CI 0.88;1.31) which suggested even a positive effect of the lockdown. Older adults with functional limitations and with frailty showed a smaller increase in feelings of mastery. Our results suggested limited mental health effects on older adults from the first COVID-19 wave. Older adults have perhaps better coping strategies than younger adults, or preventive measures did not have extensive consequences for the daily life of older adults.

In the **General Discussion**, we discuss the clinical and policy implications of this thesis and the future perspective.

STRC has a wide-ranging patient population and is also organized differently across the country. Older adults are not only admitted for reablement, but most of the time as a response to crisis. These findings indicate that STRC should be organized differently, and guidelines for reablement and observation should be developed. We propose that STRC should be organized and evaluated accordingly to the model of intermediate care in the UK: next to bed-based care, crisis response and reablement in the home situation should be available. The focus should not only be on medical interventions, but also on social aspects of disease. Also, we discuss alternative funding for STRC to prevent the accumulation of waiting lists and better treatment possibilities. Last, advance care planning is important to prevent crisis admissions to STRC. Consultation of the physician elderly care in the home situation and early home care interventions should be available to older adults in the community.

The COVID-19 pandemic learned important lessons for for infectious disease prevention and control (IPC) in general in nursing homes. Board members of nursing homes should facilitate the execution of appropriate IPC guidelines. Nursing homes focused on creating a home-like environment and infection prevention had not been a priority in the last years. A change of culture is needed where safety of residents and quality of life is seen as two sides of the same coin. Public health services should support board-members in the correct implementation of IPC guidelines and have a more proactive role. This change of culture is also needed in the design of new nursing homes, where IPC should be one of the requirements.

Last, having a sufficient workforce in healthcare is important in preventing crisis in older adults in the home situation, providing STRC and implementation of IPC guidelines.

*

Nederlandse samenvatting

Ouderenzorg: implementatie en evaluatie van het eerstelijnsverblijf en SARS-CoV-2 infectiepreventie

Hoofdstuk 1 beschrijft de context van dit proefschrift met betrekking tot crises in de zorg voor ouderen, met name in het eerstelijnsverblijf (ELV) en Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infectiepreventie.

De meeste Europese landen hebben hun langdurige zorg voor ouderen hervormd, vanwege het groeiende aantal ouderen en de toegenomen zorgkosten. Een belangrijke trend is om de langdurige zorg te verplaatsen van intramuraal naar thuis. Dit is door regeringen bepaald om de kosten te beheersen en om ouderen en de samenleving in het algemeen tevreden te stellen, aangezien de consensus is dat ouderen zo lang mogelijk thuis willen blijven.

Om ouderen te ondersteunen om zo lang mogelijk thuis te wonen, werd kortdurende zorg in het verpleeghuis geïmplementeerd voor preventie- en revalidatiestrategieën. In Nederland heeft de overheid in 2015 het zorgstelsel hervormd en het ELV ingevoerd als nieuwe vorm van kortdurende zorg. ELV is verblijf voor zorg zoals de huisarts die pleegt te bieden, met als doel ouderen naar huis te ontslaan. Er werden geen richtlijnen en geen gerichte patiëntengroepen geformuleerd. In 2018 en 2019 werd minder dan de helft van de patiënten naar huis ontslagen. Gedetailleerde gegevens over welke ouderen het ELV gebruiken en hoe zorg in het ELV is georganiseerd, ontbraken.

Naast de toenemende vraag naar zorg voor ouderen deed zich in het voorjaar van 2020 een tweede crisis voor: de SARS-CoV-2-pandemie. Dit was een volksgezondheidscrisis met veel onzekerheden. Het was onduidelijk hoe het virus zich verspreidde, hoe het virus behandeld moest worden en wat de gevolgen op lange termijn zouden zijn. Verder waren er tekorten aan medische hulpmiddelen zoals persoonlijke beschermingsmiddelen, PCR-testen en beademingsmachines. De Nederlandse overheid voerde maatregelen in om ouderen in verpleeghuizen en thuis te beschermen tegen een hoog sterfterisico.

Dit proefschrift is gebaseerd op de implementatie en evaluatie van het ELV in Nederland **(hoofdstuk 2 en 3)** en implementatie en evaluatie van maatregelen om verspreiding van SARS-CoV-2 bij ouderen te voorkomen **(hoofdstuk 4 tot 7).**

Het eerste deel van dit proefschrift richt zich op het ELV. In **hoofdstuk 2** hebben we de implementatie van het ELV en de ouderen die van het ELV gebruik maken in Amsterdam onderzocht middels een kwalitatieve studie. In 13 groepsinterviews met 28 zorgprofessionals bespraken we 39 casussen van recent in het ELV opgenomen patiënten.

De meeste daarvan hadden complexe problemen die bij de overdracht werden onderschat, waardoor terugkeer naar huis vaak niet mogelijk was. De praktijk week dus sterk af van het indicatiegebied voor ELV: patiënten met algemene gezondheidsproblemen die na herstel naar huis kunnen terugkeren. Hierdoor ontstond er een discrepantie tussen de zorgbehoefte van de patiënt en de zorg die geboden wordt: de medewerkers hadden niet de benodigde behandeltijd of waren onvoldoende geschoold. Vanwege de langdurig bestaande gezondheidsproblemen was de zorg voor en na ontslag, zoals advance care planning, maatschappelijk werk en huisaanpassingen, belangrijk. Een andere belangrijke bevinding was dat de 13 ELV afdelingen de zorg op verschillende manieren organiseerden: er was bijvoorbeeld verschil in de grootte van de afdeling en of er ook geriatrische revalidatie werd aangeboden. Ook waren er afdelingen die zich gespecialiseerd hadden, bijvoorbeeld in cognitieve screening na delier.

In **hoofdstuk 3** hebben we de bevindingen van onze kwalitatieve studie gevalideerd met een landelijke vragenlijst naar organisatiekenmerken van het ELV en patiëntkenmerken op basis van data van het Centraal Bureau voor de Statistiek (CBS). In totaal werden 68.682 ouderen opgenomen in het ELV in 2018 en 2019. Het ELV wordt voornamelijk gebruikt door vrouwen en ouderen die alleen wonen. Patiënten gebruiken veel verschillende medicijnen, wat multimorbiditeit suggereert. 60% van de ouderen in het ELV gebruikte meer dan 10 verschillende medicijnen in het jaar van hun opname en meer dan een derde gebruikte psychotropica. Verder waren patiënten kwetsbaar blijkens het hoge sterftecijfer. Veertig procent van de patiënten overleed in het jaar van opname of het jaar na de opname in het ELV. Er namen 176 zorginstellingen deel aan de vragenlijst, voornamelijk bestaande uit verpleeghuizen en woonzorgcentra. 30,1% van de faciliteiten leverde ELV op een daartoe aangewezenafdeling, 27,3% op een afdeling die wordt gedeeld met geriatrische revalidatiezorg en 33,5% op een afdeling die wordt gedeeld met langdurige zorg. Het aantal bedden varieerde van 1 tot 40. De frequentie van medische visites en multidisciplinaire overleg varieerde van nooit, maandelijks, tweewekelijks tot wekelijks. Slechts 12 instellingen meldden zich te specialiseren in een specifieke patiëntengroep.

We hebben de verschillen en overeenkomsten geobjectiveerd die kunnen worden gebruikt om de uitkomsten van ELV te evalueren en een richtlijn op te stellen.

Het tweede deel van dit proefschrift richt zich op infectiepreventie SARS-CoV-2. **Hoofdstuk 4** had als doel de bijdrage van a- en presymptomatische bewoners en medewerkers in de verspreiding van SARS-CoV-2 te analyseren. 297 bewoners en 542 medewerkers van drie verpleeghuizen met een recente introductie van SARS-CoV-2 werden wekelijks getest op SARS-CoV-2 ongeacht symptomen. Daarnaast werd er een gestandaardiseerde symptoomvragenlijst afgenomen en werden positieve

PCR-testen geanalyseerd middels whole genome sequencing. In het eerste punt-prevalentieonderzoek testten 15 bewoners positief (5%) van wie er negen een positieve testuitslag hadden in de maanden voorafgaand aan het begin van het onderzoek. Van de zes nieuwe gevallen was er één presymptomatisch en drie bleven asymptomatisch. Acht gezondheidswerkers (1,5%) testten positief bij het eerste punt-prevalentieonderzoek, ze hadden allemaal typische symptomen. Bij het tweede punt-prevalentieonderzoek testten één bewoner en één gezondheidswerker positief, beide asymptomatisch op de dag van de test. Vanwege het beperkte aantal gevallen was het niet mogelijk om de bijdrage van a- en presymptomatische gevallen te beoordelen. We bevestigden wel het voorkomen van a- en presymptomatische bewoners en medewerkers. Daarnaast beschreven we factoren die mogelijk bijdroegen aan de beperkte verspreiding van het virus.

Hoofdstuk 5 beschrijft een grote uitbraak in een vierde verpleeghuis. Aan het begin van deze grote uitbraak werden bewoners en personeel alleen getest wanneer zij symptomen hadden of nauw contact hadden gehad met een positief geteste bewoner. Halverwege de uitbraak veranderde het verpleeghuis de teststrategie. Alle bewoners en personeel werden getest ongeacht symptomen en PCR-testen werden elke week herhaald naast het al bestaande testbeleid op basis van klachten. Daarnaast werd er een gestandaardiseerde symptoomvragenlijst afgenomen en werden positieve PCR-testen geanalyseerd middels whole genome sequencing. 113 van de 181 bewoners en 56 van de 244 gezondheidswerkers testten positief op SARS-CoV-2. Voor invoering van de wekelijkse teststrategie had 92,3% van de bewoners symptomen, vergeleken met 39,2% na implementatie van de nieuwe teststrategie (P-waarde < 0,001). Er was geen verschil in het aantal personeelsleden met symptomen op het moment van testen tussen de twee teststrategieën (respectievelijk 94,6% en 93,3%). Sequencing toonde aan dat infecties werden veroorzaakt door dezelfde virusstam. Een opvallende bevinding was dat reuk- en smaakverlies, keelpijn, hoofdpijn of spierpijn nauwelijks werden gerapporteerd bij bewoners in vergelijking met personeel. Dit suggereerde dat bewoners hun symptomen niet konden uiten of dat symptomen slecht werden herkend of gedocumenteerd door medewerkers. Er werd echter geen verschil in mediane Ct-waarde gevonden tussen symptomatische (20,8), asymptomatische (20,5) en presymptomatische (21,3) bewoners (P=0,624). Dit suggereerde dat bewoners zonder symptomen dezelfde potentie hebben om het virus te verspreiden als bewoners met symptomen. Wekelijks testen bleek een effectieve strategie voor vroege identificatie van bewoners en medewerkers met SARS-Cov-2, wat resulteerde in het indammen van de uitbraak. De studies van hoofdstuk 4 en 5 versterkten het bewijs voor wekelijks testen ongeacht symptomen tijdens een SARS-CoV-2-uitbraak en bevestigde eerdere resultaten gerapporteerd in de internationale literatuur. Op basis van internationale literatuur en de studies van hoofdstuk 4 en 5 zijn de Nederlandse richtlijnen (Verenso en LCI) geactualiseerd.

In **hoofdstuk 6** beschrijven we hoe de vernieuwde richtlijn is geïmplementeerd tijdens uitbraken in de tweede golf van de pandemie in de winter van 2020/2021 en de ondersteunende en belemmerende factoren voor implementatie van de nieuwe richtlijn. Ten eerste verspreidden we een digitale vragenlijst onder verpleeghuizen die in de onderzoeksperiode een uitbraak hadden meegemaakt. We verzamelden gegevens van 117 uitbraken. Ten tweede hebben we interviews afgenomen met zorgpersoneel over 26 van de 117 uitbraken om gedetailleerde gegevens te verkrijgen over de keuzes die zijn gemaakt bij het beheersen van de uitbraak en de implementatie van een teststrategie. Als laatste hielden we vier focusgroepen met managers, artsen, verpleegkundigen en verzorgenden over hun ervaringen met de teststrategie en ondersteunende en belemmerende factoren voor de implementatie van de teststrategie. Tijdens 104/117 uitbraken werden bewoners van de kleinst afsluitbare eenheid of van het gehele verpleeghuis getest ongeacht de aanwezigheid van symptomen, terwijl het personeel tijdens 85/117 van de uitbraken onafhankelijk van symptomen werd getest. Van de verpleeghuizen die bewoners van de kleinst afsluitbare eenheid testten (84/117), herhaalde 72,6% dit minstens één keer per week. Van de verpleeghuizen die medewerkers van de kleinst afsluitbare eenheid testten (64/117), herhaalde 62,5% dit minstens één keer per week. Uit het de vragenlijsten bleek dat het wekelijks testen van bewoners en personeel, ongeacht de symptomen, grotendeels was geïmplementeerd. Echter, uit de interviews bleek dat testen vaak werd uitgevoerd tijdens latere stadia van de uitbraak en niet altijd werd opgevolgd met wekelijks hertesten. Belemmerende factoren voor wekelijks testen ongeacht symptomen waren gebrek aan kennis van bestuurders, managers en artsen, gebrek aan een cohortafdeling of geschoold personeel en onvoldoende samenwerking met laboratoria of de GGD. Belangrijke ondersteunende factoren voor wekelijks testen waren de bereidheid van het personeel om zich te laten testen en de grote beschikbaarheid van PCR-tests. Deze studie heeft belangrijke implicaties voor infectiepreventie in het algemeen in verpleeghuizen en voor de wijze waarop richtlijnen voor infectiepreventie kunnen worden geïmplementeerd

Niet alleen in verpleeghuizen waren maatregelen aangewezen, ook wilde de overheid thuiswonende ouderen beschermen. Naast de lockdown die voor de gehele bevolking gold, waren er aanvullende adviezen voor ouderen om het aantal contacten te beperken. Er werd verondersteld dat de lockdown-maatregelen angst en depressie zouden veroorzaken. Eerdere studies waren heterogeen en lieten kleine effecten van de lockdown op stemming en angst zien.

In **hoofdstuk 7** hebben we de Longitudinal Aging Study Amsterdam (LASA) gebruikt om depressieve en angstsymptomen en gevoel van controle te beschrijven vlak na de eerste golf van de COVID-19-pandemie in vergelijking met voorgaande jaren bij thuiswonende ouderen. Voor het beschrijven van potentiële risicogroepen hebben we gebruik gemaakt van de onderdelen van het comprehensive geriatric assesment (CGA). Depressieve

symptomen, angstsymptomen en gevoel van controle werden beoordeeld met de korte Centre for Epidemiological Studies Depressieschaal (CES-D-10), de Hospital Anxiety Depression Scale-subschaal Angst (HADS-A) en de Pearlin Mastery-schaal. Symptomen werden beoordeeld over een periode van 12 jaar om de uitkomsten van vragenlijsten in juni-augustus 2020 te vergelijken en om voorspellers voor risicogroepen te identificeren. Lichte stijgingen in CES-D-10 (1,37, 95% CI 1,12; 1,62) en HADS-A (0,74, 95% CI 0,56; 0,94) traden in 2020 op in vergelijking met voorgaande jaren. Een opmerkelijke bevinding was de toename van het gevoel van controle (1,10, 95% BI 0,88; 1,31), wat een positief effect van de lockdown suggereerde. Ouderen met functionele beperkingen en met kwetsbaarheid lieten een kleinere toename van gevoel van controle zien. Onze resultaten suggereerden beperkte effecten op de mentale gezondheid van thuiswonende ouderen vlak na de eerste COVID-19-golf. Mogelijk hebben ouderen betere copingstrategieën dan volwassenen onder de 65, of de beschermende maatregelen hadden geen grote gevolgen voor het dagelijks leven van ouderen.

In de **Algemene Discussie** bespreken we de klinische en beleidsimplicaties van dit proefschrift en het toekomstperspectief.

Het ELV heeft een brede patiëntenpopulatie en is ook landelijk heterogeen georganiseerd. Ouderen worden niet alleen opgenomen voor herstel, maar veel vaker als reactie op een crisis. Deze bevindingen geven aan dat het ELV anders moet worden georganiseerd en dat er richtlijnen voor behandeling en observatie moeten worden ontwikkeld. We stellen voor om het ELV te organiseren en te evalueren overeenkomstig het model van intermediate care in het Verenigd Koninkrijk: naast intramurale zorg, zou er crisiszorg en herstelzorg in de thuissituatie kunnen moeten worden aangeboden. De focus moet niet alleen liggen op medische interventies, maar ook op sociale aspecten van ziekte. Ook bespreken we alternatieve financiering voor het ELV om wachtlijsten te voorkomen en betere behandelmogelijkheden te bieden. Ten slotte is vroegtijdige zorgplanning belangrijk om crisisopnames in het ELV te voorkomen. Consulten van de specialist ouderengeneeskunde in de thuissituatie en vroegtijdige inzet van thuiszorg moeten beschikbaar zijn voor thuiswonende ouderen.

De COVID-19-pandemie heeft belangrijke lessen opgeleverd voor de preventie en bestrijding van infectieziekten in het algemeen in verpleeghuizen. Bestuur en management van verpleeghuizen dienen de uitvoering van passende IPC-richtlijnen te faciliteren. Verpleeghuizen hebben zich de afgelopen jaren vooral gericht op het creëren van een huiselijke omgeving, waarbij infectiepreventie minder prioriteit had. Er is een cultuuromslag nodig waarbij veiligheid van bewoners en kwaliteit van leven als twee kanten van dezelfde medaille moeten worden gezien. De GGD zou een meer proactieve rol moeten gaan spelen bij infectiepreventie en verpleeghuizen meer

moeten ondersteunen bij de implementatie van passende infectiepreventierichtlijnen. Deze cultuuromslag is ook nodig bij de inrichting van nieuwe verpleeghuizen, waar infectiepreventie een van de vereisten zou moeten zijn bij het ontwerp. Ten slotte is het hebben van voldoende (geschoold) personeel in de zorg belangrijk bij het voorkomen van crises bij ouderen in de thuissituatie, het verlenen van kortdurende ELV-zorg en het implementeren van infectiepreventiemaatregelen.

*

Portfolio & Publications

Name PhD student: J.H. van den Besselaar

PhD period: April 2019-June 2022

Names of PhD supervisor(s) & co-supervisor(s): B.M. Buurman, C.M.P.M. Hertogh, J. Macneil-Vroomen (co-supervisor)

1. PhD training

	Year	ECTS
General courses		
World of Science	2019	0.7
eBROK	2019	1.5
Datamanagement	2019	0.5
Project management	2020	0.6
Scientific Writing in English	2020	1.5
Specific courses		
Practical Biostatistics	2019	1.4
Clinical Epidemiology – Observational Research	2019	1.5
Basic concepts of qualitative research in health care	2019	5
Epidemiology – Mixed Methods	2020	4
Advanced Biostatistics	2021	2.1
Presentations		
Studiedag kortdurende ouderenzorg: "Onderzoek eerstelijnsverblijf. Ervaringen uit de praktijk."	2020	0.5
Webinar ABR-Netwerk Zuidwest Nederland: "Wetenschappelijk onderzoek naar COVID-19 in verpleeghuizen. Stand van zaken."	2020	0.5
Actiz webinar voor zorgbestuurders: "COVID-19 verpleeghuisstudie. Onderzoek naar besmettingsgraad, transmissie en clustering in verpleeghuizen."	2020	0.5
Verenso najaarscongres: "COVID-19 in het verpleeghuis: Onderzoek, beleid en innovatie."	2020	0.5
Amsterdam UMC & COVID-19, Unorthodox Teams, Accelerating Science	2020	0.5
Alumnidag Amsterdam UMC: "COVID-19 verpleeghuisstudie".	2020	0.5
Summerschool Stichting Trainingen Infectie Preventie: "Uitbraakbeleid verpleeghuizen SARS-CoV-2 gedurende de tweede golf van de pandemie"	2022	0.5
(Inter)national conferences		
EUGMS 2020 (2 posters)	2020	1
IAGG 2022 (poster)	2022	0.5
Other		
Podcast Besmettelijk!: COVID-19 & Ouderenzorg. I was invited as a guest speaker on infection prevention and COVID-19 in nursing homes.	2020	0.5

2. Teaching

	Year	ECTS
Supervising		
Cynthia Bot, master thesis: "Organization of intermediate care at facility level in the Netherlands"		1
Jonneke Stijger, master thesis: "The influence of residential community care on the health outcomes of older adults who experienced an acute medical condition and/or health crisis'		1,5
Aloe-Lin Stieber, master thesis: "Characteristics of nursing homes in Amsterdam with large and small outbreaks of SARS-CoV-2"		1
Jenny Wan, master thesis: "Modifiable factors associated with the course of health-related quality of life up to three months postdischarge in acutely hospitalised older adults"		1

3. Parameters of Esteem

	Year
Grants	
ZonMW, programma BeterThuis: 'Algemene inventarisatie van ervaringen (organisatie en inhoud) onder zorgvragers, mantelzorgers en zorgverleners binnen de GRZ, het ELV en de GZSP'	2020
Awards and Prizes	
Amsterdam UMC Societal Impact Award voor onderzoeksgroep COVID-19 verpleeghuisstudie	2020

4. Publications	
	Year

Peer reviewed

van den Besselaar JH, Spaargaren M, Smalbrugge M, Koene FMHPA, Termeulen L, Hertogh CMPM, Buurman BM. Implementation of a national testing policy in Dutch nursing homes during SARS-CoV-2 outbreaks. J Am Geriatr Soc. 2022 Jan 26. doi: 10.1111/jgs.17687. Epub ahead of print. PMID: 35080774.	2022
van den Besselaar JH, MacNeil Vroomen JL, Buurman BM, Hertogh CMPM, Kok AAL, Hoogendijk EO. Symptoms of depression, anxiety, and perceived mastery in older adults before and during the COVID-19 pandemic: Results from the Longitudinal Aging Study Amsterdam. J Psychosom Res. 2021 Dec;151:110656. doi: 10.1016/j.jpsychores.2021.110656. Epub 2021 Oct 30. PMID: 34741872; PMCID: PMC8556729.	2021
van den Besselaar JH, Sikkema RS, Koene FMHPA, van Buul LW, Oude Munnink BB, Frénay I, Witt RT, Koopmans MPG, Hertogh CMPM, Buurman BM. Are presymptomatic SARS-CoV-2 infections in nursing home residents unrecognised symptomatic infections? Sequence and metadata from weekly testing in an extensive nursing home outbreak. Age Ageing. 2021 Sep 11;50(5):1454-1463. doi: 10.1093/ageing/afab081. PMID: 33963830; PMCID: PMC8136016.	2021
van den Besselaar JH, Hartel L, Wammes JD, MacNeil-Vroomen JL, Buurman BM. 'Patients come with two garbage bags full of problems and we have to sort them.' A qualitative study of the experiences of healthcare professionals on patients admitted to short-term residential care in the Netherlands. Age Ageing. 2021 Jun 28;50(4):1361-1370. doi: 10.1093/ageing/afab011. PMID: 33629713.	2021
van Buul LW, **van den Besselaar** JH, Koene FMHPH, Buurman BM, Hertogh CMPM; COVID-19 NH-Study Group**; COVID-19 NH-Study Group. Asymptomatic Cases and Limited Transmission of SARS-CoV-2 in Residents and Healthcare Workers in Three Dutch Nursing Homes. Gerontol Geriatr Med. 2020 Dec 21;6:2333721420982800. doi: 10.1177/2333721420982800. PMID: 33426178; PMCID: PMC7756037.	2020
Wammes JD, Kolk MSc D, **van den Besselaar** Md JH, MacNeil-Vroomen PhD JL, Buurman-van Es Rn BM, van Rijn PhD M. Evaluating Perspectives of Relatives of Nursing Home Residents on the Nursing Home Visiting Restrictions During the COVID-19 Crisis: A Dutch Cross-Sectional Survey Study. J Am Med Dir Assoc. 2020 Dec;21(12):1746-1750.e3. doi: 10.1016/j.jamda.2020.09.031. Epub 2020 Sep 30. PMID: 33148480; PMCID: PMC7524682.	2020
van den Besselaar JH, Chua JS, van der Pol R, Delfos NM, Stalenhoef JE. Endogene endoftalmitis door Staphylococcus aureus [Endogenous endophtalmitis in a patient withStaphylococcus aureusbacteraemia]. Ned Tijdschr Geneeskd. 2020 May 28;164:D4251. Dutch. PMID: 32608921.	2020

Other

Medisch contact: 'Eerstelijnsverblijf: niet meer bedden, maar meer kwaliteit'	2022
Magazine 'Leven en zorgen in de grote stad': 'De specialist ouderengeneeskunde in de eerste lijn'	2022
Onderzoeksverslag voor Ministerie Volksgezondheid, Welzijn en Sport en Outbreak Management Team: 'Evaluatie implementatie COVID-19 testbeleid in verpleeghuizen'	2021
Rapport voor ZonMW programma BeterThuis: 'Varen op ervaringen van zorgvragers, mantelzorgers en zorgverleners in geriatrische revalidatie, eerstelijnsverblijf en geneeskundige zorg voor specifieke patientgroepen'	2021
Onderzoeksverslag voor Ministerie Volksgezondheid, Welzijn en Sport en Outbreak Management Team: 'COVID-19 studie in verpleeghuizen'	2020
Nurse Academy: Eerstelijnsverblijf	2020

Author contributions

Chapter 1
General introduction

Concept and design	Judith H. van den Besselaar
Data Collection	Not applicable
Statistical analysis	Not applicable
Interpretation of data	Not applicable
Drafting the manuscript	Judith H. van den Besselaar
Critical revision of the manuscript	Janet L. MacNeil-Vroomen, Cees M.P.M. Hertogh, Bianca M. Buurman

Chapter 2
'Patients come with two garbage bags full of problems and we have to sort them.' *A qualitative study of the experiences of healthcare professionals on patients admitted to short-term residential care in the Netherlands. Age and Ageing, Volume 50, Issue 4, July 2021, Pages 1361–1370, https://doi.org/10.1093/ageing/afab011*

Concept and design	Linda Hartel, Bianca M. Buurman
Data Collection	Linda Hartel
Qualitative analysis	Judith H. van den Besselaar, Linda Hartel
Interpretation of data	Judith H. van den Besselaar, Linda Hartel, Janet L. MacNeil-Vroomen, Bianca M. Buurman
Drafting the manuscript	Judith H. van den Besselaar, Linda Hartel
Critical revision of the manuscript	Joost D. Wammes, Janet L. MacNeil-Vroomen, Bianca M. Buurman

Chapter 3
Short Term Residential Care in the Netherlands: patient characteristics from a national database and facility characteristics from a national survey. *Submitted*

Concept and design	Judith H. van den Besselaar, Janet L. MacNeil-Vroomen, Bianca M. Buurman
Data Collection	Judith H. van den Besselaar
Statistical analysis	Rebekka Arntzen, Judith H. van den Besselaar
Interpretation of data	Judith H. van den Besselaar
Drafting the manuscript	Judith H. van den Besselaar
Critical revision of the manuscript	Rebekka Arntzen, Janet L. MacNeil-Vroomen, Bianca M. Buurman, Cees M.P.M. Hertogh

Chapter 4
Asymptomatic Cases and Limited Transmission of SARS-CoV-2 in Residents and Healthcare Workers in Residents and Healthcare Workers of Three Dutch Nursing Homes. *Gerontology and Geriatric Medicine.* January 2020. doi:10.1177/2333721420982800

Concept and design	Laura W. van Buul, Fleur M.H.P.H. Koene, Bianca M. Buurman, Cees M.P.M. Hertogh
Data Collection	Laura W. van Buul, Judith H. van den Besselaar
Statistical analysis	Laura W. van Buul, Judith H. van den Besselaar
Interpretation of data	Laura W. van Buul, Judith H. van den Besselaar, Fleur M.H.P.H. Koene, Bianca M. Buurman, Cees M.P.M. Hertogh
Drafting the manuscript	Laura W. van Buul, Judith H. van den Besselaar
Critical revision of the manuscript	Fleur M.H.P.H. Koene, Bianca M. Buurman, Cees M.P.M. Hertogh

Chapter 5
Are presymptomatic SARS-CoV-2 infections in nursing home resident unrecognised symptomatic infections? Sequence and metadata from weekly testing in an extensive nursing home outbreak. *Age and Ageing*, Volume 50, Issue 5, September 2021, Pages 1454-1463, https://doi.org/10.1093/ageing/afab081

Concept and design	Laura W. van Buul, Fleur M.H.P.H. Koene, Bianca M. Buurman, Cees M.P.M. Hertogh
Data Collection	Judith H. van den Besselaar, Reina S. Sikkema, Bas B. Oude Munnink, Ine Frénay, René te Witt
Statistical analysis	Judith H. van den Besselaar
Interpretation of data	Judith H. van den Besselaar, Reina S. Sikkema, Fleur M.H.P.H. Koene, Cees M.P.M. Hertogh, Bianca M. Buurman
Drafting the manuscript	Judith H. van den Besselaar, Reina S. Sikkema
Critical revision of the manuscript	Fleur M.H.P.H. Koene, Laura W. van Buul, Bas B. Oude Munnink, Ine Frénay, René te Witt, Marion P.G. Koopmans, Cees M.P.M. Hertogh, Bianca M. Buurman

*

Chapter 6

Implementation of a national testing policy in Dutch nursing homes during SARS-CoV-2 outbreaks. *J Am Geriatr Soc.* 2022; 70(4): 940- 949. doi:10.1111/jgs.17687

Concept and design	Judith H. van den Besselaar, Martin Smalbrugge, Cees M.P.M. Hertogh, Bianca M. Buurman
Data Collection	Judith H. van den Besselaar, Marije Spaargaren, Loes Termeulen
Statistical and qualitative analysis	Judith H. van den Besselaar, Marije Spaargaren, Loes Termeulen
Interpretation of data	Judith H. van den Besselaar, Martin Smalbrugge, Cees M.P.M. Hertogh
Drafting the manuscript	Judith H. van den Besselaar
Critical revision of the manuscript	Marije Spaargaren, Martin Smalbrugge, Fleur M.H.P.H. Koene, Loes Termeulen, Cees M.P.M. Hertogh, Bianca M. Buurman

Chapter 7

Symptoms of depression, anxiety, and perceived mastery in older adults before and during the COVID-19 pandemic: Results from the Longitudinal Aging Study Amsterdam. J Psychosom Res. 2021 Dec;151:110656. doi: 10.1016/j.jpsychores.2021.110656.

Concept and design	Judith H. van den Besselaar, Janet L. MacNeil Vroomen, Bianca M. Buurman, Cees M.P.M. Hertogh, Martijn Huisman, Almar A.L. Kok, Emiel O. Hoogendijk
Data Collection	Not applicable
Statistical analysis	Judith H. van den Besselaar, Janet L. MacNeil-Vroomen
Interpretation of data	Judith H. van den Besselaar, Janet L. MacNeil-Vroomen, Almar A.L. Kok, Emiel O. Hoogendijk
Drafting the manuscript	Judith H. van den Besselaar, Janet L. MacNeil-Vroomen
Critical revision of the manuscript	Bianca M. Buurman, Cees M.P.M. Hertogh, Martijn Huisman, Almar A.L. Kok, Emiel O. Hoogendijk

Chapter 8

General Discussion

Concept and design	Judith H. van den Besselaar
Data Collection	Not applicable
Statistical analysis	Not applicable
Interpretation of data	Not applicable
Drafting the manuscript	Judith H. van den Besselaar
Critical revision of the manuscript	Janet L. MacNeil-Vroomen, Cees M.P.M. Hertogh, Bianca M. Buurman

*

Dankwoord

Een promotietraject doe je nooit alleen, daarom wil ik graag de gelegenheid nemen om iedereen die mij heeft gesteund, geholpen en belangstelling heeft getoond te bedanken. Ook wil ik iedereen die een bijdrage heeft geleverd aan dit proefschrift bedanken. Het is onmogelijk om iedereen persoonlijk te noemen, een aantal personen wil ik in het bijzonder bedanken:

Mijn promotor prof. dr. B.M. Buurman- van Es, beste Bianca, het begon met een promotietraject naar het ELV, wat opeens een andere wending kreeg door de corona-pandemie. Dank voor het vertrouwen en de kans voor alle projecten die ik heb kunnen en mogen doen. Er waren wat frustraties over uitblijvende subsidie-oproepen en over verdwenen corona samples, maar behalve dat had ik geen voorspoediger promotietraject kunnen wensen.

Mijn promotor prof. dr. C.M.P.M. Hertogh, beste Cees, een samenwerking bleef in eerste instantie uit, maar door de corona-pandemie kwam er een nieuwe kans. Je passie voor infectieziektebestrijding in het verpleeghuis is zeer aanstekelijk. Dank voor alle mogelijkheden die ik heb gekregen.

My co-supervisor, J.L. Macneil-Vroomen, dear Janet, thank you for your guidance and planning assistance to keep me on track. I could not have wished for a better co-supervisor. You never rushed our weekly meetings, gave advice on work and personal related issues and were always available for feedback on the first shitty drafts. I enjoyed our collaboration when we worked together on mixed models and to learn from your extensive statistical knowledge. You encouraged me and made me a better scientist. You are a wonderful person and I hope we can work together again in the future.

Prof. dr. de Bruijn, Prof. dr. Geerlings, Prof. dr. Jansen, Prof. dr. de Jong, Prof. dr. Nies en dr. Willems, geachte leescommissie, dank voor de tijd die jullie hebben genomen om mijn werk te beoordelen.

Ik wil alle ouderen en zorgmedewerkers die hebben deelgenomen aan de verschillende studies in dit proefschrift van harte bedanken. Zonder jullie was dit proefschrift nooit mogelijk geweest. Ik hoop dat de resultaten iets voor jullie kunnen betekenen in de toekomst.

Beste Paul, op een maandagavond in mei 2020 sprak ik jou samen met Bianca over de telefoon. Er was een grote uitbraak in jouw verpleeghuis en je wilde weten of we iets voor jullie konden betekenen. Ik mocht de volgende dag direct komen en iedereen in de organisatie was ontzettend behulpzaam en gemotiveerd om bij te dragen aan ons onderzoek. Of wij op dat moment echt iets voor jullie betekend hebben weet ik niet, maar jullie organisatie heeft wel ontzettend veel betekend voor de infectiepreventie in (Nederlandse) verpleeghuizen. Jullie progressieve beleid en jullie openheid voor wetenschap heeft dat mogelijk gemaakt. Ik wil de bewoners en al je personeel en je organisatie hiervoor hartelijk bedanken!

Beste Laura, in de eerste coronapandemie hebben we een zeer intensieve samenwerking gehad voor de transmissiestudies. Het was een unieke periode om onderzoek te doen en ik heb veel van je kunnen leren. Dank daarvoor.

Beste Fleur en Martin, dank voor jullie feedback en kritische blik gedurende de verschillende COVID-19 onderzoeken. Ik denk met plezier terug aan de wekelijkse besprekingen op woensdagochtend.

Beste Reina, dank voor het sequencen van de verschillende corona-stammen bij dit onderzoek. Ik heb veel van je geleerd en kon mijn eigen werkdruk weer relativeren als ik zag welke bergen jij kon verzetten.

Beste Almar, Emiel en Michiel, bedankt voor de fijne samenwerking, jullie hulp met statistiek en de kans om gebruik te mogen maken van de LASA dataset.

Lieve Linda, dank dat je me wegwijs hebt gemaakt in de wereld van het ELV en van het kwalitatief onderzoek doen. Door jouw gedegen interviews is het mogelijk geweest om de problemen, successen en kansen van het ELV inzichtelijk te maken.

Lieve Rebekka, dank voor de fijne samenwerking, de mooie tabellen van de CBS-data en voor alle inzichten die de econometrie kunnen brengen voor de ouderenzorg. Ik hoop dat we in de toekomst blijven samenwerken en dat we onze krachten als wiskundige en medicus kunnen blijven bundelen!

Beste Ingeborg, dank voor de ruimte om mijn opleiding te kunnen onderbreken voor dit promotietraject en ook voor de ruimte om na drie jaar weer mijn draai in de kliniek te kunnen vinden.

Graag wil ik ook alle studenten bedanken die hebben geholpen met de dataverzameling voor dit proefschrift.

Lieve Ilse, alweer 13 jaar geleden brachten we samen, zeer jong en naïef, een zomer door in Ghana. Sindsdien hebben we een bijzondere vriendschap. We hebben al wandelend, fietsend, zeilend en reizend perikelen in de liefde en op werk gedeeld. Tijdens onze wekelijkse wandelingen in de corona-jaren had je altijd een luisterend oor voor de voortgang van mijn onderzoek en was je mijn motivator om te schrijven. Ik ben dankbaar dat je vandaag als paranimf naast mij wil staan.

Lieve Mojca, het begon met de organisatie van een studentencongres, maar er bleef een mooie vriendschap. Ik kijk met veel plezier terug op onze gezamenlijke fietstochten naar het LUMC of treinreizen naar Den Haag voor onze vele gezamenlijke coschappen. Ook konden we tegelijk onze ervaringen delen van onze eerste baan als ANIOS, solliciteren voor de opleiding, promotieonderzoek en later het moederschap. Ik vind het geweldig dat je vandaag mijn paranimf wilt zijn.

Lieve schoonfamilie, dank voor alle belangstelling en steun de afgelopen jaren.

Lieve Paula, dank voor de prachtige illustraties die je bij mijn proefschrift hebt gemaakt.

Lieve Michiel en Melanie, dank voor jullie steun en betrokkenheid. Bij jullie kan ik altijd thuiskomen.

Lieve pap en mam, in dit promotietraject komt jullie beider kracht samen. Mama, jouw passie voor de oudere patiënt heb ik altijd bewonderd. Ook kreeg ik van jou mijn eerste lessen over infectiepreventie aan de keukentafel (of deelde je frustraties over zorgpersoneel dat ringen en armbanden droeg) . Papa, jij gaf al feedback op mijn eerste wetenschappelijke teksten - tijdens de studie, maar ook ook tijdens mijn ANIOS-tijd. Tevens ben je mijn trouwe groupie op pubmed - soms wist je al eerder dat een paper online stond dan ikzelf. Dank voor alle steun en liefde.

Lieve Jeroen, achter elke succesvolle vrouw staat een man die fantastische excel-sheets kan maken. Je bent mijn rustpunt en klankbord. Dank voor al je steun en dat je nooit zeurt als ik weer eens laat thuis kom of in het weekend achter mijn computer duik voor werk of opleiding. Ik hou van je.

Curriculum Vitae

Judith Henriëtte van den Besselaar was born on the 22nd of April 1990 in Leiden, the Netherlands. During her secondary education on the Stedelijk Gymnasium in Leiden, she started with Pre-University College of the University of Leiden in 2006. In 2008, she graduated from high school and Pre-University College. She studied medicine at the University of Leiden and graduated in 2014. For her master thesis she went to the department of geriatrics of the University of Illinois in Springfield. She studied mutant mice with delayed aging and the role of growth hormone, under supervision of prof. Andrzej Bartke. From 2015 to 2017 she worked as a resident in geriatrics and neurology, before she started her medical training to become a geriatrician. The first two years of her training she worked as a resident in internal medicine at the Alrijne Ziekenhuis in Leiderdorp. In 2019 she paused her residency for a full-time PhD trajectory at the Amsterdam University Medical Center. She continued her training in 2022 to become a geriatrician in the Onze Lieve Vrouwe Gasthuis (OLVG) in Amsterdam. Judith lives in Leiden with Jeroen and their son Pepijn.