

Efficient measures to control an outbreak of SARS-CoV2 in an elderly care home and to prevent a spill over into the general population

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Abstract

Background: The vaccination campaign against SARS-CoV2 in Germany started at the peak of the second wave. An outbreak in an elderly care home occurred in our county at the time of the second vaccination.

Aims: To describe a package of measures to control the outbreak and to prevent a spill over into the general population.

Methods: After outbreak confirmation a package of measures such as quarantine of the elderly care home, staff and visitors, and their households was implemented. By sequential testing quarantine measures were lifted. Surveillance of staff and residents by rapid antigen test and symptom monitoring was used in parallel.

Results: The outbreak was on-going for around 17 days until it was noticed by a symptomatic external staff member as index case. A total of 23 out of 96 (24.0%) residents and 9 out of 114 (7.9%) staff were infected. Three residents died. Effective first dose vaccine coverage was 85.4% in residents, 27.4% in internal and 10.5% in external staff. Given the long latency period the use of household quarantine prevented a spill over into the public. Already 16 days after notification of the index case the outbreak could be declared over.

Conclusions: Interferences between vaccination coverage and outbreak characteristics in regard to an extended latency period were observed. Household quarantine of case as well as contact households is of increased importance in the era of vaccination to prevent further spread into the general population until population based control measures and lockdowns can be lifted.

Introduction

The turn of the year 2020 to 2021 was at the peak of the second wave of the current pandemic in our region [1]. At the time community transmission and extensive outbreaks in the regional hospitals were on-going. The UK variant (B 1.1.7) was spreading and spill overs into the broader community with enhanced transmission were imminent. After implementing vaccination centres to be ready for service as of 15 December 2020, vaccination started in our region (Schleswig-Holstein) on 27 December 2020. Many outbreaks in elderly care homes (ECHs) were notified before, during and immediately after the immunisation visits by teams of the Federation of Managed Care Physicians, the Kassenärztliche Vereinigung (KV).

Outbreak detection

On Tuesday 16 February 2021 our department, the County Health Department Ploen (CHD Ploen), was notified by a neighbouring CHD in regard to a PCR-positive tested external staff member of an elderly care home (ECH) in our county. This index case had respiratory symptoms since 11 February 2021 and was on

duty until then. An antigen rapid test was negative, but a consecutive PCR in the top regional laboratory was positive with a ct-value of 20 (ct above 30 was considered non contagious). The exploratory interview revealed no suspicious contacts outside the job. We were reassured that a FFP2 mask was carried during work and the contacts to the residents were below 15 minutes each.

With this work we want to illustrate the containment tactics of our response and of measures taken. The emphasis is on the configuration of measures taken, from which others can profit as we hope. The ultimate goal was to limit the outbreak in the ECH as well as to prevent a spill over into the general population as fast and as effective as possible.

Methods

Study design

The classical principles of an outbreak investigation were used [2]. After confirmation of the outbreak the immediate next steps and measures are described. After a comprehensive regimen of quarantine measures a de-escalating and fine tuning tactic by stratification of measures according to laboratory results and households was used.

Case definition

A case was either a resident or an internal or external staff member of the ECH initially as off 4 February and later corrected to the set point 30 January 2021 with PCR-confirmation of an SARS-CoV2 infection. An epidemiological curve is not shown, since the incidence of cases depended from the timing of the swabbing actions.

Laboratory analysis

The ECH used the rapid antigen test of Siemens (Clinitest®). All samples of the mass swabbing actions were investigated in our preferred laboratory using a N-gene and E-gene based real-time RT-PCR. All positive samples were screened for the N501Y mutation and the delH69/V70 deletion by a specific S-gene based PCR. Solitary samples taken by the managed health care were tested also in other laboratories.

Statistical analyses

Only absolute numbers, percentages and proportions are used stratified by resident and staff (internal and external) and according to residential zone and vaccination status.

Ethical statement

Since our CHD was the primary public health institution responsible for this particular ECH, there are no constrains for the actions taken besides the general principles of the applying German laws, especially the Infectious Diseases Control Act of the year 2001, latest modification 2020.

Results

The ECH consisted of three residential zones and the option for short term care with a total of 96 residents, mean age 84 years, 95% CI [81.8; 85.7], range (54-101), and 114 staff, mean age 46 years, 95% CI [43.3; 47.8], range (19-67), on 30 January 2021: 95 internal, 6 external care staff and 13 external therapists (**Table 1**). The staff is not described according to zones, since many staff members were active across zones. A first vaccination visit took place on 8 January and a second on 6 February, i.e. after/at possible exposure to the wild virus after introduction into the ECH.

Outbreak confirmation and staging

The morning of Wednesday 17 February, the day after notification, all residents and the present staff were tested with the rapid antigen test (Clinitest®, Siemens) under control of the management of the ECH. Twelve residents and one staff member were tested positive. In the afternoon a team of our CHD took swabs of all antigen-test positive persons and two residents with onset of symptoms in the meantime. Further exploration and interviews with the management, staff members and residents were carried out at the same time.

On Thursday 18 February morning, 10 of the 12 residents with positive antigen-tests, the one staff member and the two symptomatic residents were confirmed SARS-CoV2 positive by PCR. All antigen test positive persons had ct values below 26. This was proof that an outbreak was on-going and a comprehensive testing of all the 95 internal and the remaining 4 external (total 6) staff members whether on duty or not, was intended for the next day. The staff members not on duty during the entire period were excluded. External “staff members” such as therapeutic specialists were ordered to get a PCR test at their closest facility, if eligible due to exposure. Swabs of the residents for PCR testing were postponed for one day, since they were confined to the institution.

On Friday 19 February swabs from 87 available personnel were taken by our team. Additional 6 staff members were PCR-confirmed adding up to 8 total so far (**Table 2**).

On Saturday 20 February all not yet PCR-tested residents plus 7 further staff members not available at the previous day were PCR tested by the KV team. Ten additional residents particularly those with higher ct values were found positive, adding up to 22 (22.9%) positive residents and 8 (7.0%) staff. In zone 2 three residents had the highest ct values (31, 33 and 35, respectively) and therefore the most advanced infection. In all positive cases no variants of concern were diagnosed. Additional interviews based on these findings led to the primary case, a lady with a ct value of 31 who was in the local university hospital the entire day of 27 January, in the middle of an on-going outbreak there and most likely acquired the infection there. No better alternative source could be elucidated. She had no vaccination so far, showed no symptoms and had contact to her peers in the same zone, zone 2, the hot zone (Table 2). Given this new information, the set point for the case definition was reset to 30 January, the day of earliest transmission from the supposed primary case within the ECH. From zone 2 the infection was spread

supposedly by junior staff and external staff to the other zones. An introduction of the infection by the external vaccination team on 6 February could be excluded by the testing and vaccination history.

Outbreak control measures

Immediately on Thursday 18 February, the morning when the outbreak was confirmed by the incoming PCR results, comprehensive measures were taken. The entire ECH was put under quarantine and visitors only allowed for moribund residents or a single visitor across the coming fortnight for psychological impaired residents. Visitors after 30 January and their families were put into quarantine, the so-called quarantine of contacts' households (HhQ2°). For all but one family, quarantine could be lifted already on 21 February, the day of the PCR-results of the residents.

All PCR-test-negative staff was put under quarantine, but was allowed to work to keep the ECH functional under the premises that an antigen test is performed daily before starting duty on top of personal protective equipment (PPE). In the local jargon we call this "tunnel-quarantine". Staff members could come to work by private transport or by the ECH shuttle, but were prohibited to use public transport. Their family members were put under quarantine, too (HhQ2°). When the swabs were taken on Friday 19 February by our own team, staff members could state on a questionnaire, whether they could separate themselves from their families at home from now onwards until the end of the quarantine period in case the PCR result was negative. If so, the quarantine of their family members was lifted. A junior staff member turned out positive and his entire family, who was under quarantine already by this measure since 18 February, turned out PCR-positive. So did one other co-worker and a family member. A spill over in the population was prevented to the best of our knowledge. The time interval from 18 February to 20 February protected by HhQ2° was of key relevance to prevent further spread from already incubating or shedding family members into the community given the long exposure history as off 30 January, i.e. three serial intervals.

On-going surveillance and maximum attack rate

In agreement with the management of the ECH the following measures were put in place for surveillance: daily antigen-testing of the three shifts before work and notification to the CHD Ploen, notification of symptom onset in residents and staff members, and notification of hospitalisations and deaths. One staff member was confirmed positive 3 days after the last swabbing by his own physician, and one resident showed symptoms and was confirmed positive, adding up to a total attack rate of 23 out of 96 residents (24.0%) and 9 out of 114 staff (7.9%). One of those vaccinated was admitted to hospital. Three residents died; two after two doses of vaccination and one, who refused vaccination in his final stage of cancer.

On 3 March another comprehensive PCR-test action was performed for residents and staff, again by the team of the KV and all PCRs were negative except one of a resident with an original ct value of 12, who now had a ct value of 27 and her isolation was extended for one further week.

Vaccination status and vaccine efficacy

With 84.4% in residents and 25.3 to 10.5 for permanent and external staff, respectively, vaccination coverage was very heterogeneous. This is also reflected in the attack rate per vaccination status (Table 2). It is important to note that all staff members but one with one vaccination only obtained their shot on 6 February and had no time to build up their immune response and can be considered unvaccinated. The two doses in residents and staff in fact only warrant a one dose situation since the second dose was unlikely effective at the time of exposure. A second dose given at the second visit could not yet guarantee full protection by a two dose regimen at the time of exposure in spite of a faster booster reaction by a second dose.

Discussion

Ploen County on the Baltic Sea shore is the county with the lowest cumulative incidence of SARS-CoV2 across the entire pandemic in Germany so far [3]. Therefore a strong effort was made to prevent a spill over into the general population. Since exposure of the index case (an external staff member) was most likely within the ECH, exploratory and low threshold testing of all residents and available staff by rapid antigen test was performed and turned out a positive signal. This signal could be confirmed by a fast first swabbing action by our own team with confirmation of an outbreak within the ECH by PCR. Just 10 days before the index case occurred, the ECH had its second vaccination visit.

With confirmation of the outbreak a comprehensive pattern of quarantine measures was launched according to the principle – “hit it hard and early”. From there a de-escalating tactic was followed according to the diagnostic work-up and staging of the outbreak. To put an entire ECH under quarantine and not allowing visitors into the facility is a standard principle. Also the option of a “tunnel-quarantine” for staff members is widely practiced given the shortage of elderly care workers and the necessity for care by staff, which is familiar to fragile elderly people with a considerable fraction with dementia. To order immediate household quarantine to contact persons’ households (HhQ2°), however, is less commonly practiced, but a highly efficient tool [4]. The burden for most households whether the households of employees or visitors, could be lifted quickly (here 3 to 4 days) in case a reliable separation within the household could be adhered to and the contact person could be proven PCR-test negative at the time of separation or the potential source person was proven PCR negative. Given the long ago set point of 30 January with around three cycles of viral spread having taken place according to the generation time of around 6 days [5] and the problem of transmission by asymptomatic persons, the threat of a spill over into the general population via household members, in this case the households predominantly of the staff members, was real.

The number of cycles of viral spread explains the considerable size of the outbreak with 32 persons in total, 24.0% (n=23) of the residents and 7.9% (n= 9) of the staff; according to a recent statistics by the Robert Koch-Institute an at least upper mid size outbreak [6]. One very important reason why it took so long to notice the outbreak is that it took an unvaccinated staff member working under PPE becoming

infected and revealing symptoms. The reason why no resident so far showed up with symptoms might well have been a considerable fraction of residents with a sufficient degree of immunity by the first vaccination visit of 8 January. The vaccination status of an ECH can well increase the latency period until an outbreak is noticed. However, the observation of spreading by asymptomatic residents and staff in ECHs was also already made early in this pandemic, long before the vaccination era [7].

At this moment a high incidence of outbreaks in ECHs settings occurred in our region. At many occasions, suspicion was raised that there might be a connection to the vaccine (mainly Comirnaty®) or the vaccination teams. The earlier can be excluded, since it is an mRNA vaccine and not a life-attenuated vaccine and the latter could be excluded, since vaccination teams are closely monitored by PCR-testing as was the case here. The explanation for the phenomenon of many outbreaks at the time of vaccination is that the local vaccination campaign for the ECHs started at the peak of the second wave and therefore was a co-incidence. The death toll of 3.1% of the residents (n=3, of whom 2 were vaccinated) is plausible and at the lower margin reported [6] given the proven vaccine efficacy of at least 52% early after the first dose [8]. Given the exposure time and the time of the second vaccination visit, a booster response by the vaccine was unlikely for many residents. A booster was, however, rendered by the wild type infection, at least in those in whom an infection could be documented. In the long run this even could be an advantage given the broader immune response by a wild type infection [9]. Whether the death toll would have been bigger without vaccination can be assumed but not be proven. The attack rate was higher in not vaccinated residents (5 out of 14 unvaccinated and 6 February first vaccinated) than in at least once vaccinated (17 out 81 twice and one once vaccinated) and shows that the virus will find the unvaccinated even in a setting with an high vaccine coverage. Vaccine coverage was higher in the internal staff members than in external ones and demonstrated that all present staff whether external or internal, whether care personnel or technical staff, has to be vaccinated to lower the vulnerability for the function of the ECH and the personal risk. Not all staff members were ready for vaccination at the first visit, but many decided to participate in the second visit. This means they had their priming vaccination at 6 February and given the necessary time window to build up a proper immune response [8], they can be assumed naïve at the time of exposure. None of the 24 staff who was vaccinated already at 8 January was tested positive for SARS-CoV2, which is remarkable given that they can be counted as only vaccinated once. It was also remarkable for us that at the follow-up testing on 3 March already all but one formerly PCR-positive persons had turned negative, which hints to a faster viral clearance in vaccinated and primed persons, although elderly. On the other hand the sequence of events proofs that SARS-CoV2 mRNA vaccines are non-sterilising, i.e. vaccinated persons can transmit the virus. However, the caveat of a not yet matured booster response due to the timeline has to be mentioned here.

The so-called “tunnel-quarantine” in our local experience is a valid tool to maintain the function of the ECH; augmented by surveillance by daily rapid-antigen testing and symptom monitoring after a baseline PCR-negative test, increased the certainty that no further infections were imported into the facility. It is important to notice that this was done before the new testing strategy in Germany with routine antigen testing in the general population and workforce became effective. One staff member on sick leave was tested positive outside and one further resident got symptoms and was tested PCR-positive.

The outbreak could be declared as ended already as of 4 March, which was surprisingly fast and we were sufficiently sure that no spill over into the population did occur.

The Role of the laboratory

The ct values from a competent laboratory are of great value as could be shown here. The high ct values in three zone 2 residents led the suspicion to one of the three ladies with the high ct values. To this end the ct values were essential to identify the source, the primary case. It is awkward that to this date laboratories in Germany cannot be obliged to communicate the ct values or the viral load to the CHDs routinely. We consider all excuses made as not valid. On the contrary, they are more suited to cover up insufficiencies in the laboratories than shortcomings of the value itself. All diagnostic results in medicine have to be appraised critically by the user. Ct values and the reiterative interview in the setting were essential for success to disclose the sequence of events in the outbreak reported here.

The rapid antigen test fulfilled its mission, since by this tool the outbreak signal was identified. At the same time it cannot be used to stage the outbreak precisely, since its sensitivity and specificity are not sufficient for this purpose. Once a person is tested negative by PCR at baseline, antigen tests again can help in the on-going surveillance within staff and residents, since any new case would need to pass through the time window, when ct values would be low enough so that the antigen test would turn positive.

The concept of the incubation period

There is a repeated need to remind hospitals and care facilities about the nature of the incubation period when admitting and re-admitting patients and residents, respectively. Many times the error is made that a person is assumed not infected, if a PCR test after possible exposure is negative in analogy to the MRSA screening. Even with hospital doctors this is an issue. The right skewed distribution of the incubation period comes on top [10,11].

Lessons learned

Vaccination efforts have to be maintained after the formal two visits by the KV team. Very often external and technical staff is not in focus for vaccination. The window of increased willingness to accept vaccination after an outbreak should be leveraged better. Vaccination should be offered as easily accessible as possible. In the near future hopefully this issue is resolved by primary care or workforce physicians involved in care within the ECHs.

Efficacy of isolation is guaranteed by swabbing activities and on-going monitoring. Efficacy of tracking is enhanced by household quarantine for case households as well as contact households [4,12]. "Tunnel-quarantine" is an effective and safe way to maintain the function of the institution. In the outbreak here visitors did not play a pronounced role. However, a minimum of visits should be allowed even in an outbreak, e.g. for moribund or psychiatric residents.

Communication within an outbreak situation is known to be a delicate task and we only want to mention at this occasion that there remained a discrepancy of view between our team and local politics in regard when to disclose the name of the ECH to the media.

Conclusions

After notification of the index case fast action for outbreak confirmation and the necessary measures by the ECH management and the CHD were essential for success. Then detailed testing for fine tuning and de-escalation of measures according to the test findings followed.

With increasing vaccination coverage outbreaks can be masked for a longer time period and the virus can spread more extensively than before in spite of a shorter and less intense shedding of the virus by vaccinees. By this the virus will still find the SARS-CoV2-naïve, e.g. the unvaccinated subjects. Household quarantine in case households as well as contact households is essential also in outbreaks to prevent a spill over into the public given the longer latency period in institutions with considerable vaccination coverage.

Declarations

Acknowledgements

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Conflict of interest: none

Authors' contributions:

JW was responsible for the outbreak investigation, the concept and the measures, and wrote the manuscript; TW created the database; MW coordinated the contact tracing and measures; HH led the key exploratory interviews, coordinated the contact tracing and the test actions by our CHD.

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Tables

Table 1. Overview

<i>Subjects on 30 January 2021</i>	<i>Residents N=96 (100%)</i>	<i>Staff total N=114 (100%)</i>	<i>Staff internal N= 95 (100%)</i>	<i>Staff external N = 19 (100%)</i>
Location				
zone 1	31 (32.3)			
zone 2	31 (32.3)			
zone 3	29 (30.2)			
short term care	2 (2.1)			
Vaccination status (shots)				
none	9 (9.4)	68 (59.6)	51 (53.7)	17 (89.5)
one	6 (6.3)	20 (17.5)	20 (21.1)*	0
two	81 (84.4)	26 (22.8)	24 (25.3)	2 (10.5)

*immunisation not yet effective since 18 out of 20 vaccinated on 6 February (second vaccination visit)

Table 2. Attack rates stratified by residents and staff

<i>Subjects on 30 January 2021</i>	<i>Residents N=96 (100%)</i>	<i>Staff total N=114 (100%)</i>	<i>Staff internal N= 95</i>	<i>Staff external N = 19</i>
<i>subgroup</i>				
symptom positive initially	3 (3.1)	3 (2.6)	2	1
symptom positive totally	5 (5.2)	4 (3.5)	3	1
hospital admissions	1 (1.0)	0	0	0
deaths	3 (3.1)	0	0	0
<hr/>				
PCR-positive initially**	22 (22.9)	8 (7.0)	6	2
PCR-positive later	1 (1.0)	1 (0.9)	0	1
PCR-positive totally	23 (24.0)	9 (7.9)	6	3
PCR-positive at end***	1 (1.0)	0	0	0
<hr/>				
PCR-positive total and vaccination status				
none	5	7	4	3
one	1	2*	2*	0
two	17	0	0	0
<hr/>				
PCR-positive total and residential zone				
zone 1 (N=31)	3 (ct 18-21)	n/a	n/a	n/a
zone 2 (N=31)	10 (ct 14-35)	n/a	n/a	n/a
zone 3 (N=29)	9 (ct 18-28)	n/a	n/a	n/a
short term care (N = 2)	1 (ct 22)	n/a	n/a	n/a

* immunisation not yet effective since 18 out of 20 vaccinated on 6 February 2021 (second vaccination visit)

**at initial outbreak staging (17 to 21 February 2021)

*** at end of outbreak (3 March 2021)

n/a not applicable