Epidemiological analysis of 3,219 COVID-19 outbreaks in the state of Baden-Wuerttemberg, Germany.

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Research Article

Keywords: SARS-CoV-2, COVID-19, outbreak, Baden-Wuerttemberg

Posted Date: January 4th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-137431/v1>

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Abstract

Background: The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has emerged as an unprecedented global crisis challenging health systems. The dynamic nature of the pandemic warrants ongoing characterisation and assessment of outbreak settings to identify groups at greatest risk, to establish early measures to curb transmission. The current analysis aims to assess and characterise SARS-CoV-2 outbreaks in the state of Baden-Wuerttemberg.

Methods: We analysed all mandatory notified (i.e. laboratory-confirmed) coronavirus disease (COVID-19) outbreaks from the state of Baden-Wuerttemberg in calendar weeks 18 to 49 (from April 27 to December 06, 2020). We used the following classification for settings: asylum and refugee accommodation, care homes, care facilities, day care child centers, hobby related, hospitality, hospitals, households, other, residence halls, schools, supported housing, training schools, transportation, treatment facilities, and workplace (occupational). We used R program version 3.6.3 for analysis.

Results: In the current analysis, 3,219 outbreaks with 22,238 individuals were included. Around 48% of all outbreaks in this period were in household settings and hobby related activities. We observed an exponential increase in the number of notified outbreaks starting around the 41th week with N = 291 outbreaks reported in week 49. We observed an increase in hospitalisations, and mortality associated with COVID-19 outbreaks in care homes after the 40th week. Overall, 70% (500/715) of all deceased persons in outbreaks in the study period were in care homes compared to 4.2% in household settings (30/715).

Conclusions: The increase in the number of outbreaks and in the number of cases per outbreak in high-risk settings, specifically in care homes after the 40th week highlights the imperative of controlling transmission in vulnerable populations.

Background

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic is an unprecedented global crisis challenging health systems. Like in most countries in the European Union, the German regional and national response shifted from an initial containment strategy, to a control strategy which aims to strike a balance between imminent public health considerations and economic considerations and allow as much social, economic, educational and cultural life as possible to take place. To contain the rapid spread of the SARS-CoV-2 pandemic in Germany, the Federal State Governments declared two lockdowns. Currently, in the state of Baden-Wuerttemberg (BW), a second hard lockdown is underway, which came into effect on the 16th of December, 2020.

The dynamic nature of the pandemic warrants ongoing characterisation and assessment of outbreak settings to identify groups at greatest risk and settings where transmissions are occurring, to establish early measures to curb transmission. The current analysis aims to assess and characterise SARS-CoV-2 outbreaks in the state of Baden-Wuerttemberg. Our analysis provides a reference for decision makers to formulate and adjust control measures.

Methods

We analysed all mandatory notified (i.e., laboratory-confirmed) coronavirus disease (COVID-19) outbreaks from Baden-Wuerttemberg in calendar weeks 18 to 49 (27th of April to the 6th December 2020). COVID-19 cases are notified to the local public health department in the respective districts, in accordance with the German Protection against Infection act (IfSG). The data are then transferred to the respective federal state health authority. Laboratory confirmation requires detection of SARS-CoV-2 nucleic acid by polymerase chain reaction (PCR) testing. In the following analysis, the term “COVID-19” covers SARS-CoV-2 infections as well as cases of COVID-19. An outbreak was defined as at least two cases reported by a local public health authority that occurred within an epidemiological context.¹ The classification for settings was not pre-defined. New settings (categories) emerged over the course of the pandemic. We used the following classification for settings: asylum and refugee accommodation, care homes, care facilities, day care child centers, hobby related, hospitality, hospitals, households, other, residence halls, schools, supported housing, training schools, transportation, treatment facilities, and workplace (occupational). Epidemiological characteristics of outbreaks were descriptively analysed. We used R program version 3.6.3 for analysis.

Results

We included 3,219 outbreaks with 22,238 individuals over a 32-week period (calendar weeks 18 to 49) (Table 1, Figure 1A). Around 48% of all outbreaks occurred in household and hobby related settings (Table 1 and Figure 1). We recorded 9.5% of all outbreaks in care homes, which accounted for more than 20% of all cases in outbreaks in the current analysis. We did not have information on the setting in 12.1% (N = 391) of outbreaks. We observed a shift in the frequency of outbreaks and their settings over time. After an initial decrease in outbreaks from calendar week 18 (N = 95) until the 26th week (N = 10), an increase in the number of outbreaks was observed from the 30th week (N = 32) until the 35th week (N = 94). We observed an exponential increase in the number of notified outbreaks starting around the 41th week (N = 138) with N = 291 outbreaks reported in week 49.

Over the 32 week period, we observed an altering age distribution in outbreaks (Figure 2). More outbreaks occurred in care homes initially, followed by a shift in outbreaks to household settings and hobby related settings which steadily increased around the 30th week (Figure 1B). The number of outbreaks in care homes stabilised at a low level of outbreaks between weeks 24 and 40, but increased thereafter. Figures 3A and B illustrate the age and sex distribution per setting. The number of cases, hospitalisations and deaths also increased over time after the 40th week, particularly in care home settings (Figures 1, 2B & 4). The median number of cases in outbreaks in care homes and care facilities after the 40th week was 16 (interquartile range (IQR) 7-30) and 12.5 (5.8-24.8), respectively, compared to 4 (3-5) in households.

Table 1: COVID-19 outbreaks in the state of Baden-Wuerttemberg in calendar weeks 18 to 49.

Setting	Outbreaks (N, %)	Total Cases (N, %)	Age (y, median, IQR)	Hospitalised (N, %)	Deceased (N, %)
Asylum accommodation	53 (1.6)	603 (2.7)	26 (17-34)	13 (0.9)	1 (0.1)
Care facilities	59 (1.8)	826 (3.7)	59 (40-83)	71 (4.7)	45 (6.3)
Care homes	307 (9.5)	4,801 (21.6)	81 (56-88)	466 (30.8)	500 (70)
Day care centers	61 (1.9)	343 (1.5)	29 (5-45)	2 (0.1)	0 (0)
Hobby related	165 (5.1)	1,484 (6.7)	28 (19-44)	45 (3)	3 (0.4)
Hospitality	48 (1.5)	251 (1.1)	30 (29.5)	9 (0.6)	0 (0)
Hospitals	87 (2.7)	875 (3.9)	51 (20-49.5)	300 (19.9)	47 (6.6)
Households	1,367 (42.5)	5,830 (26.2)	34 (18-50)	268 (17.7)	30 (4.2)
Other	566 (17.6)	3,290 (14.8)	37 (21-55)	143 (9.5)	48 (6.7)
Residence halls	12 (0.4)	118 (0.5)	21 (16-31.8)	0 (0)	0 (0)
Schools	91 (2.8)	511 (2.3)	16 (11-32)	3 (0.2)	0 (0)
Supported housing	104 (3.2)	656 (3)	45 (26-68)	35 (2.3)	23 (3.2)
Training schools	12 (0.4)	94 (0.4)	16 (11.2-31)	2 (0.1)	0 (0)
Transportation	8 (0.2)	37 (0.2)	36 (20-60)	3 (0.2)	0 (0)
Treatment facilities	47 (1.5)	335 (1.5)	58 (39.5-74)	73 (4.8)	10 (1.4)
Workplace	232 (7.2)	2,184 (9.8)	40 (28-53)	78 (5.2)	8 (1.1)
Total	3,219 (100)	22,238	43 (24-63)	1,511 (100) 1. (100)	

Accommodation for asylum seekers including refugees; care facilities (for the disabled or other individuals in need of care); care homes include day care centers for senior citizens and long-term care homes for the aged; hobby related settings include, camping and forest, and club membership; hospitality settings include, hotels, restaurants, diners, inns, and hostels; other (includes outbreaks for which information on the setting was unavailable); supported housing (includes lodging in a dwelling, as well as housing with support, supervision or care for older people, people with disabilities, mental health issues etc.); workplace i.e., occupational settings (excluding hospitals, day care centers, and schools), residence halls (for students, this category also includes children's homes and juvenile homes); training schools (educational institute or training centers); treatment facilities include rehabilitation centers and medical practices.

Discussion

We observed, a somewhat stepwise pattern of increase in outbreaks, with temporary stabilization in certain periods. We observed a substantial increase in the number of outbreaks around the 41st week. To contain the rapid spread of SARS-CoV-2, two countrywide lockdowns were imposed in Germany. The first lockdown in Baden-Wuerttemberg came into effect on the 17th of March, 2020 (12th calendar week). A stepwise reopening followed around the 20th of April, 2020 (17th calendar week). A second, partial lockdown in Baden-Wuerttemberg went into effect on the 2nd of November, 2020 (45th week in our analysis), which resulted in the closure of bars and restaurants, but left all shops open. In lieu of rising infections, further restrictions were imposed and a hard lockdown came into effect on the 16th of December, 2020 (51st week).

The pattern of outbreaks altered over time. The primary site of SARS-CoV-2 outbreaks from around the 30th calendar week was in private settings i.e., household and hobby related settings. In such settings, suboptimal or no adherence to preventative measures constitutes a major risk factor, possibly, due to a low risk perception.² The median number of cases per outbreak across settings has increased in care homes and facilities as compared to households after the 40th week. This suggests that although outbreaks continue to occur in household settings at a high frequency, they are low amplitude outbreaks i.e., with few people.

Larger outbreaks are occurring in specific “high-risk” settings such as care homes. Residents of long-term care facilities (LTCFs i.e., care homes and care facilities) are a medically and socially vulnerable group with an elevated risk of severe disease and death due to COVID-19.³ For COVID-19, there are strong indications of age dependence in severity and mortality.^{4,5} Community transmission of SARS-CoV-2 in Baden-Wuerttemberg is at a high level. The 7-day incidence as of 20.12.2020 (12:00 AM) was 204 per 100,000.⁶ This has serious implications for vulnerable populations exposed to care givers/personnel that might be “silent shedders” who might spread the disease unawares in care homes and hospitals. Given the lack of effective therapeutics and a licensed vaccine, non-pharmacological public health measures are the best interventions that exist at this point in time against the pandemic. Even after vaccinations begin, it is likely that there will be a considerable period of time where non-pharmacological public health interventions will remain the mainstay of prevention.

Our data underscores the need to focus on “protection” of vulnerable population groups in high-risk settings. We recorded numerous outbreaks in various settings over the 32 week period, which highlights the continued need for the entire population to be committed to infection prevention and control. Currently, data on adherence to COVID-19 related personal safety guidelines such as social distancing, and mask wearing, in Baden-Wuerttemberg is not available. We found relatively few outbreaks in day care centers and schools in the 32 week period. Furthermore, outbreaks in these settings had few cases. A higher proportion of outbreaks and cases in schools was observed among older age groups (≥ 15 years of age), including staff members or other adults linked to the outbreak. A previous analysis on surveillance data from Germany also made similar observations on infections in schools.⁷

The limitations of the current analysis must be considered when interpreting the results. First, surveillance data gives an indication of the trends of infection in the population, based on primarily symptomatic subjects and their contacts. However, an estimated 40-45% of SARs-CoV-2 infections in adults are asymptomatic.⁸ It is possible that some outbreaks in certain settings such as day care centers and schools, may not have been detected because of asymptomatic infections, however, children may also have a lower susceptibility to infection, in addition to a lower propensity to show clinical symptoms.⁹ A recent German study found a high seroprevalence in children compared to health-authority reported cases.¹⁰ However, one cannot exclude the presence of false positives due to beta coronavirus cross-reactivity in this study.¹⁰ Second, there may be a time lag in outbreak notifications due to information gathering processes at the level of the notifying local health offices. Third, the quality of reporting in the

national surveillance system varies in terms of completeness of data. Furthermore, there may be inconsistencies and delays in recording individual cases belonging to a specific outbreak. Fourth, despite the multitude of choices of settings available in the surveillance software in use, it is not always possible to reliably determine the setting where the actual infection transmission occurred. Outbreaks may be under-recorded in certain settings such as public transportation, particularly, because infections could not be identified and potential contacts might be difficult to trace.

Conclusions

Our analysis demonstrates a substantial increase in outbreaks, particularly in care homes from weeks 41 to 49 and highlights the imperative of controlling transmission in vulnerable populations.

Abbreviations

BW: State of Baden-Wuerttemberg

COVID-19: Coronavirus disease

IfSG: German Protection against Infection act

LTCFs: Long-term care facilities

PCR: Polymerase chain reaction

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

Declarations

Ethics declarations

Ethics approval and consent to participate

All data were collected as part of mandatory notified outbreaks in accordance with the German Protection against Infection act (IfSG). This analysis was conducted as part of public health usual practice, and was not conducted for research. Hence, ethics approval was not needed.

Consent for publication

Not applicable.

Availability of data and materials

The dataset used and analysed in the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors' contributions

AD and SOB conceived the analysis. AD performed the statistical analysis and wrote the manuscript. IF contributed to the analysis of surveillance data. AD, ME and SOB, interpreted the data. All authors critically reviewed the manuscript and approved its final version.

Acknowledgements

We thank all local health offices in Baden Wuerttemberg involved in COVID-19 outbreak detection, investigation and control. This analysis would not have been possible without their diligence and hard work.

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Figures

Figure 1

COVID-19 outbreaks in BW in calendar weeks 18-49, 2020 (A) by setting and reporting week of outbreaks; (B) number of cases in outbreaks by reporting week, (3,219 outbreaks; 22,238 cases)

Figure 2

(A) Proportion of COVID-19 cases in outbreaks (3,219 outbreaks; 22,238 cases) in BW, in calendar weeks 18-49, 2020 by age group; (B) Number of hospitalisations by reporting week in all reported settings.

Figure 3

(A) Age & (B) Sex distribution across settings with COVID-19 outbreaks (3,219 outbreaks; 22,238 cases) in BW, in calendar weeks 18-49, 2020.

Figure 4

(A) Number of hospitalisations (B) Number of deaths due to or with COVID-19 in outbreaks in selected settings by reporting week in BW, in calendar weeks 18-49, 2020 (see Table 1 for further details).