

Germany physical distancing policies and epidemiology from January 2020 - August 2022:

A case report

Policy Frameworks and Epidemiology of COVID-19

Working Group

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Policy Frameworks and Epidemiology of COVID-19 – Germany case report

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Conflicts of Interest

No conflicts of interest were reported.

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Links to supplementary materials

[Study proposal](#)

[Informed consent](#)

[Interview guide](#)

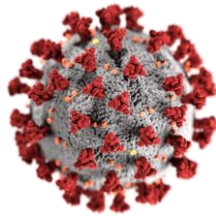
COVID-19 [Country characteristics database](#)



I. Introduction and project description

A new disease that spread around the world

On December 31, 2019, the World Health Organization (WHO) was notified of a cluster of individuals with pneumonia of unknown cause in Wuhan, China. (1) On January 12, 2020, China shared the genetic sequence of the novel coronavirus with other countries to help develop diagnostic tests. (1) Thailand reported the first known case of the novel coronavirus outside of China on January 13, 2020. WHO declared the novel coronavirus (2019-nCoV) outbreak a Public Health Emergency of International Concern on January 30, 2020 with 7,711 confirmed cases, 12,167 suspected cases, and 170 deaths in China and 83 cases in 18 countries outside of China. (1,2) The disease was later named COVID-19 for coronavirus disease 2019 and the virus referred to as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). (1) WHO declared COVID-19 a pandemic on March 11, 2020. (1)



Physical distancing policies and knowledge gaps

As an emerging infectious disease, there were originally no effective vaccines or preventive treatments for SARS-CoV-2. Therefore, governments have had to rely on the use of public policies to combat the spread of the virus. (1–4) Creating policies has been difficult due to the large amount of information and ongoing uncertainty around the characteristics of the virus and who it affects. (4) One of the most commonly used policies to mitigate (slow) the spread of the virus that causes COVID-19 centres on physical or social distancing, which relies on separating people to reduce the transmission of the virus. (5) However, it is still unclear when is the best time to institute such policies and what happens when distancing policies are eased in which contexts. There are many aspects of distancing, such as recommendations for maintaining a physical distance in public, banning group gatherings, or complete lockdowns, that complicate their assessment. (5) There are also many factors that have been attributed to people acquiring or having a worse outcome from COVID-19. (6–11) However, there was no harmonized database available with all the policies, epidemiology and contextual information that were needed to perform comparative analyses useful to informing policy making.



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About this project

The Policy Frameworks and Epidemiology of COVID-19 Working Group was developed after a “CONVERGE Virtual Forum: COVID-19 Working Groups for Public Health and Social Sciences Research.” A group of international researchers convened to explore what physical distancing policies countries implemented and their effects on the epidemiology of COVID-19. The Working Group was further supported through an award from CONVERGE and the Social Science Extreme Events Research (SSEER) Network. CONVERGE is a [National Science Foundation](#)-funded initiative headquartered at the [Natural Hazards Center](#) at the [University of Colorado Boulder](#).

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II. Methods

Research design

A qualitative embedded multiple case study research design was used to compare countries (or subnational jurisdictions, such as provinces, states or territories). The suite of public policies and resulting changes in the epidemiology of COVID-19 are examined within their specific country setting. Our cases start in January 2020. (Please see full [study proposal](#)). Research ethics approval was obtained by the Hamilton Integrated Research Ethics Board (HIREB) (Project # 11243).

Data Collection

For each country, the setting, such as health systems, political systems and demographics were described to help with interpretation of findings and potential transferability, or the degree to which findings are applicable to other sites or future research.

Publicly available data were first collected on the jurisdiction following a standardized data collection form. Epidemiological data were drawn from publicly available data. WHO, World Bank, Central Intelligence Agency and other publicly available sources were used for timelines and country characteristics, where possible. Other sources of information included governmental and non-governmental websites, news articles, government reports, and peer-reviewed journals.

Next, key informant interviews were conducted to fill in gaps, verify information found through the documentary searches, and identify further participants and documentary sources of relevant information. (See [informed consent](#) and [interview guide](#)) Key informant interviews were conducted with policymakers, health workers, researchers and other stakeholders as appropriate to fill in knowledge gaps.

Data Analysis and Presentation

Our [COVID-19 policies](#) and epidemiology databases harmonize data on setting characteristics, policies, demographic characteristics and epidemiological risk factors and outcome metrics. These will further be described in single country or jurisdiction case reports. Comparisons will be selected based on both literal and theoretical replication. Countries that have similarities in either policies or epidemiological trends can be considered literal comparisons, whereas countries that differ will be used as theoretical comparisons. These comparisons will be submitted to peer-reviewed journals for publication.



III. Findings

A. Setting characteristics

Geographic, environmental, social, and economic contextual factors

Germany is a country in the WHO European Region. (12) In 2019, Germany had a population of 83,132,799, a land area of 349,360 km², and a population density of 237.31 people per km² (2018). (13–15) It is the most populous country in Europe, with a fairly even population distribution throughout most of the country. The urban areas contain larger and denser populations, particularly in the far western part of the industrial state of North Rhine-Westphalia. (16) As of 2019, 77.38% of Germany's population lived in urban areas. (17)

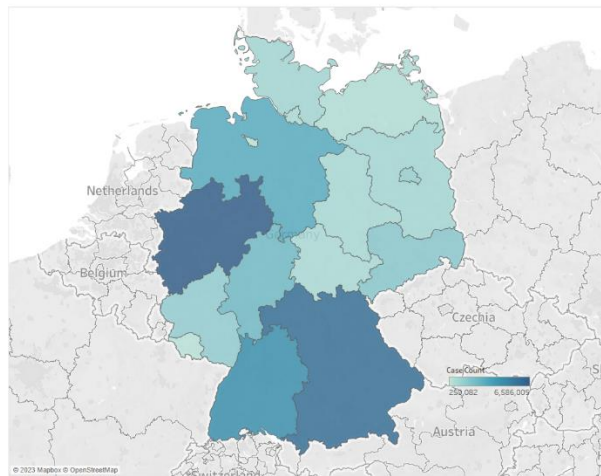


Figure 1. Heat map of COVID-19 cases in the various federal states of Germany as of August 31, 2022 (18)

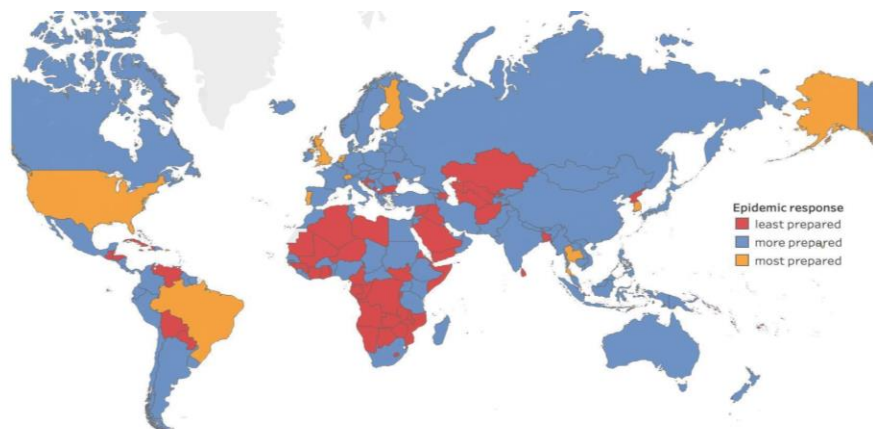


Figure 2. Global Health Security Index Epidemic Preparedness Rank Category (19)



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Table 1. COVID-19 relevant contextual factors for Germany

Global Health Security Index, 2019 (Overall Index Score out of 100 and category) (19)	66—More Prepared
Global Health Security Index, 2019 (Epidemic Preparedness Index Score out of 100 and category) (19)	54.8—More Prepared
Particulate matter (PM2.5) air pollution, mean annual exposure, 2017 (micrograms per cubic meter) (20)	12.03
PM2.5 air pollution, population exposed to levels exceeding WHO guideline value, 2017 (% of total) (21)	89.17
International migrant stock, 2015 (% of population) (22)	14.88
Trust in national government, 2018 (% of population) (23)	53.57
Mobile cellular subscriptions, 2019 (per 100 people) (24)	128.36
Individuals using the internet, 2019 (% of population) (25)	88.13
Index of economic freedom, 2020 (Score and category) (26)	73.5—Mostly free
World Bank classification, 2020 (27)	High
Gini Index, 2016 (28)	31.9
GDP per capita, PPP, 2020 (Current international \$) (29)	54,844.50
GNI per capita, PPP, 2020 (Current international \$) (30)	56,370
Current health expenditure, 2020 (%) (31)	12.82
Vulnerable employment, total, 2020 (% of total employment) (32)	5.58
Vulnerable employment, female, 2020 (% of female employment) (32)	4.92
Vulnerable employment, male, 2020 (% of male employment) (32)	6.16
Homelessness, 2018 (%) (33)	0.41
Adult literacy rate, 2018 (%) (34)	--
Literacy rate, adult female, 2018 (% of females 15 and above) (35)	--
Literacy rate, adult male, 2018 (% of males 15 and above) (36)	--
Primary school enrolment, 2017 (% net) (37)	90.14

GDP - gross domestic product; **GNI** - gross national income; **PPP** - purchasing power parity



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Population health characteristics

Life expectancy at birth in Germany was reported to be 80.89 years in 2018. (38) For males, life expectancy at birth was 78.60 years, and for females it was 83.30 years in 2018. (39,40) Non-communicable diseases are believed to play a role in who develops severe symptoms of COVID-19. In Germany, the proportional mortality from cardiovascular diseases was 37%, cancers 26%, chronic respiratory diseases 6%, and diabetes 3%. (41) (Figure 3.) The probability of dying between ages 30-70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease was 12.1% for all adults, and 15.2% and 8.9% for males and females, respectively. (42)

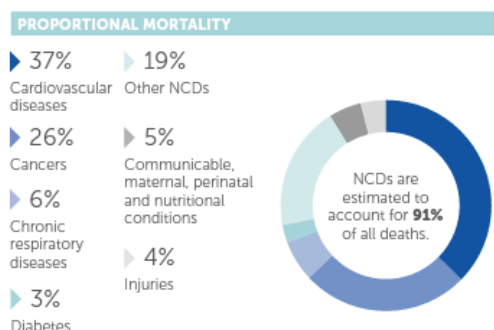


Figure 3. Proportional mortality from non-communicable diseases (NCDs)-Germany, 2016 (41)

Table 2. Age and health characteristics for Germany

	Male	Female	Total
Population ages 0-14, total, 2019 (% of total population) (43-46)	5,918,374 (7.12)	5,553,586 (6.68)	11,471,901 (13.80)
Population ages 15-64, total, 2019 (% of total population) (47-50)	27,285,496 (32.82)	26,449,654 (31.82)	53,734,979 (64.64)
Population ages 65 and above, total, 2019 (% of total population) (51-54)	7,855,465 (9.45)	10,070,225 (12.11)	17,925,919 (21.56)
Current tobacco use prevalence, total, 2018 (%) (55)	29.9	26	28
Raised blood pressure (Systolic blood pressure ≥ 140 or Diastolic Blood Pressure ≥ 90), ages 18+, 2015 (%) (56)	30.7	24.8	27.7
Raised fasting blood glucose (>7.0 mmol/L or on medication), ages 18+, 2014 (%) (57)	8.4	6.4	7.4
Prevalence of obesity among adults (Body Mass Index ≥ 30), 2016 (%) (58)	26.6	24.9	25.7
Prevalence of Human Immunodeficiency Virus (HIV), 2020 (% of population ages 15-49) (59)			--
Bacillus Calmette-Guérin (BCG) Immunization coverage estimates, 2020 (%) (60)			--
Prevalence of undernourishment, 2018 (% of population) (61)			2.5



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Governance and health systems (RKI)

Germany is a democratic federal parliamentary republic, with the Federal President acting as the Head of State and the Federal Chancellor acting as the Head of the Government. (62–64) While the Federal President is the country's highest-ranking official, the role is largely ceremonial, and the Federal Chancellor holds the most political power. (63,64) Federal authority is divided into legislative, executive, and judicial branches. (63) The legislative branch consists of the federal Bundestag and State parliaments of the 16 states. Members of the Bundestag (MBs) are elected by German citizens in each legislative period. (62) The Federal Chancellor is elected via general elections every four years with no term limits, while the Federal President is elected by the Federal Convention, consisting of all MBs and delegates from State Parliaments, and subject to only one term renewal. (64–66)

Germany has a multi-party system, in which the party in power often operates as a coalition government with a number of other smaller partnering parties. (67,68) The Social Democratic Party of Germany (SPD), a centre-left party led by Chancellor Olaf Scholz, has been in power since December 7, 2021. (69,70) SPD operates a coalition with the Greens and the Free Democratic Party (FDP). (68) Previously, the Christian Democratic Union of Germany (CDU), a centre-right political party led by Chancellor Angela Merkel, was in power from 2005 to 2021. (69,71)

Germany has a federalist system, in which health policies fall within the responsibilities of each federal state. (72) Health systems in Germany are highly decentralized, with each administrative level being responsible for the task it can best perform. (73) Germany relies on a mixed financing model for healthcare. (74) Health insurance is mandatory, and ~ 86% of the population is enrolled in non-profit statutory health insurance (SHI), which is administered by a non-governmental insurer called the Sickness Funds. This public insurance is funded by a mix of general wage contributions and supplementary contributions by workers and employers. The Sickness Funds cover preventive services (e.g., vaccinations, cancer screenings), inpatient and outpatient hospital care, physician and mental health services, dental care, optometry, physical therapy, most prescription drugs, and many other services. They offer a range of deductibles and co-payments for various services, but they do not apply to recommended preventive services. In addition to the Sickness Funds, private health insurance is available to individuals earning more than € 60,750 per year, with no government subsidies. Currently, ~ 10.6% of the population have private insurance plans that cover benefits outside of the Sickness Funds. Physicians who contract with the Sickness Funds must not charge above the fee schedule for services within the SHI benefit catalogue, but they may request out-of-pocket fees for health services not covered under public insurance.

Health policy authority in Germany is spread out across multiple agencies. The Federal Ministry of Health is the highest health authority and is responsible for the drafting of legislation and regulations, disease prevention, and rehabilitation and disability. (75) The Ministry also



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supervises the Federal Institute for Drugs and Medical Devices (BfArM) and the Federal Centre for Health Education. (76,77) The Conference of Health Ministers of the Federal States is the second-highest health authority in Germany, and it provides technical and policy advice for health policies and coordinates tasks between the federal states, such as health promotion and disease prevention. (78) The Robert Koch Institute (RKI) is Germany's central scientific institution and is responsible for the identification, surveillance, and prevention of infectious diseases, pandemic preparedness, informing and advising politicians and the general public, and providing a scientific basis for health policy decision-making. (79) Public Health consists of state and local public health departments, with only five out of the 16 German states having state-level public health authorities. (78) The core of public health services is the local health authority or public health department of various municipalities. In total, there are ~ 400 offices across Germany. Public health services are mainly funded by public budgets from the States and municipalities, and to a lesser extent, by out-of-pocket fees required by some services.

Table 3. Political and health system indicators for Germany

Fragile States Index score, 2020 (maximum 120, higher value is worse) (80)	23.20
Fragile States Index rank, 2020 (out of 178 countries, higher value is better) (80)	166
Global Freedom score and status, 2020 (81)	94—Free
Internet Freedom score and status, 2020 (82)	80—Free
World press freedom index, 2020, global score (0-100, lower value is better) and rank (out of 180 countries, lower value is better) (83)	10.34—11
Physician density, 2017 (physician/1,000 pop) (84)	4.25
Hospital bed density, 2013 (beds/1,000 pop) (85)	8.3



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Pandemic experience and preparedness

Germany's experience with infectious diseases in the past 25 years were centred around HIV/AIDS and respiratory diseases, such as the H1N1 flu pandemic. Germany detected its first case of HIV/AIDS in 1982 and the transmission and prognosis of HIV/AIDS has continued to affect Germans. (86) In 2015, there were 3,200 new HIV infections, with 85,000 acquired cases in total. (87) However, HIV treatment has been available in Germany for over 20 years and less than 500 deaths occur each year. The most significant respiratory disease outbreak in Germany prior to COVID-19 was H1N1, also known as the Swine Flu. Germany reported its first case of H1N1 in April 2009 and as of May 2010, there were 226,158 cases of H1N1 and around 253 deaths. (88–90) Subsequently, the RKI modified its Influenza Pandemic Preparedness Plan by integrating the lessons learned from the H1N1 pandemic. (91) Aside from HIV/AIDS and H1N1, Germany also had minimal experience working with the SARS and MERS outbreaks, with less than 20 cases of either disease in the country. (92,93) Germany also deployed resources to Africa to aid with the 2014 Ebola outbreak and received Ebola patients for treatment. (94,95)

Laboratories in Germany operate in a decentralized system, with labs located in a variety of settings, such as hospitals, private practices, public health authorities, and emergency responders. (96,97) Each lab has the freedom to select a commercially available diagnostic test with relevant approvals or conduct their own testing to assess the validity of a test. Certified labs in Germany operate under the trade group association of ALM (Akkreditierte Labore in der Medizin). (98) As of October 2020, ALM had 109 labs across Germany, which formed a network that worked cooperatively and coordinated with local public health authorities for contact tracing. (96) Contact tracing proceeded without specific directions from the federal government. Despite operating privately and independently, the ALM labs used the tiered guidelines developed by the RKI to determine the priority of testing for individuals. (96) From February to May 2020, ~300 labs in Germany were commissioned to produce COVID-19 tests, and large private employers, such as Deutsche Post and Volkswagen, also opened their own labs in their medical facilities. (96)

While Germany has no national strategic stockpile of personal protective equipment (PPE), Germany is one of the few countries in the European Union (EU) that manufactures PPE domestically. (99) In March 2020, Germany banned the export of PPE, and the EU began to organize a pandemic PPE stockpile to assist member states. (100) Germany also began to centralize PPE procurement and sought to promote domestic PPE production due to COVID-19. (101,102)



B. Policies and epidemiology

Cases, vaccinations, and social distancing policies

Germany's first case of COVID-19 was recorded on January 27, 2020. (103) A national state of emergency was declared on March 28, 2020, and lasted until November 25, 2021. (104) As of August 31, 2022, there were a total of 32,145,157 cases and 147,404 deaths recorded in Germany. (105) COVID-19 vaccines first became available in Germany on December 27, 2020, and by August 31, 2022, 76.1 % of the country's population had been fully vaccinated. (105,106) Figure 4 shows the number of new daily cases and deaths in Germany, cumulative vaccination rates, and dates for selected public health policies implemented from January 2020 to August 31, 2022.



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Germany COVID-19 cases, deaths, vaccinations and physical distancing policies

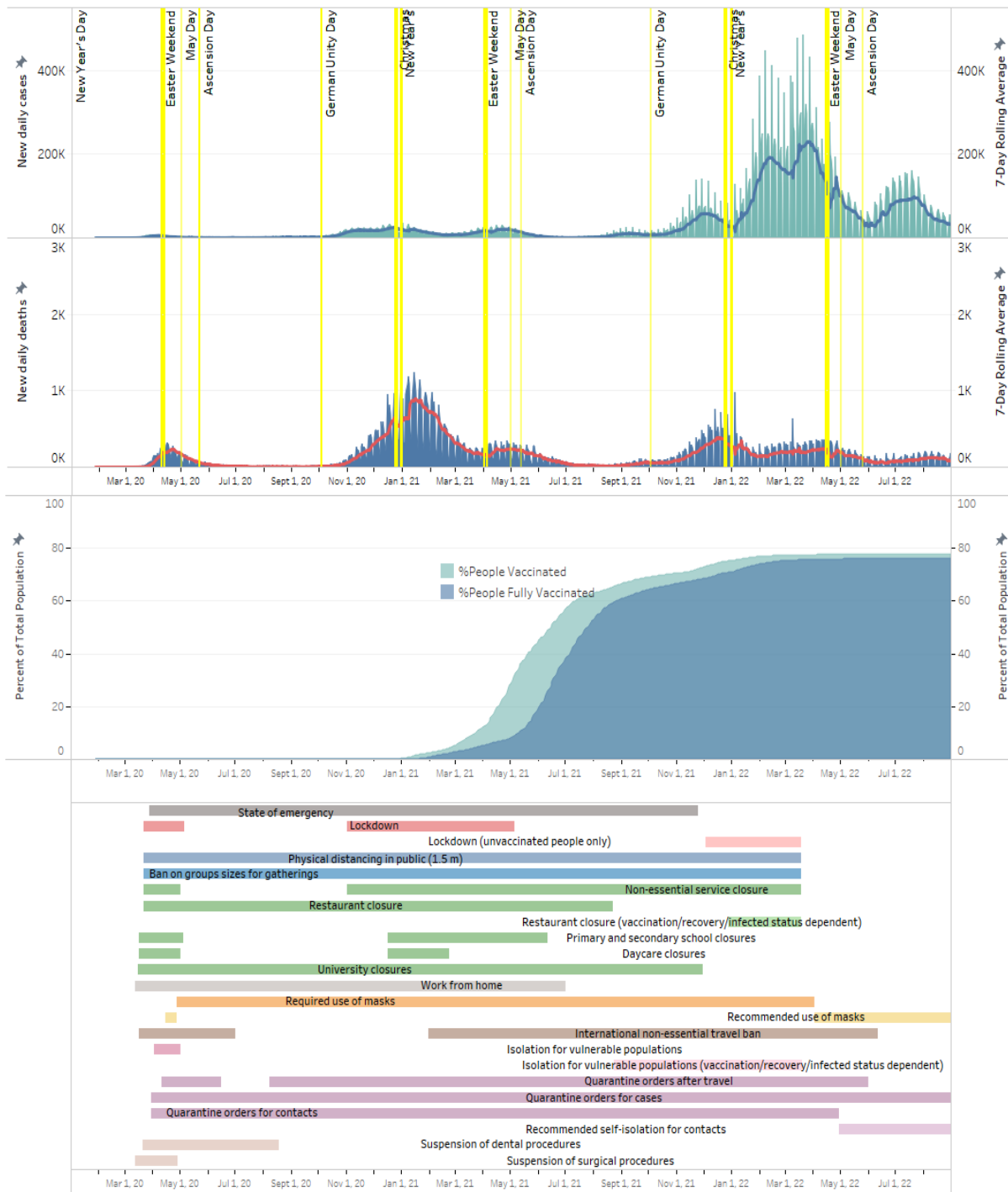


Figure 4. Number of daily reported COVID-19 cases and deaths in Germany with cumulative vaccination rates and select policies from January 2020 to August 31, 2022



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Description of events in Germany

Germany had no clearly designated primary spokesperson for COVID-19 policies at the federal level. However, the federal health minister often communicated public health policies and recommendations to the press and the public. (107,108) This role was filled by Jens Spahn from March 2018 to December 2021, and by Karl Lauterbach since December 2021. The Federal Chancellor also played an important role in public health communication. Most notably, as the first wave of distancing policies was introduced, Chancellor Angela Merkel held a televised speech to the nation on March 18, 2020, in which she urged the people to take public health measures seriously. (109) After the election on December 7, 2021, Olaf Scholz took over the role of Federal Chancellor and has also communicated to the press regarding various COVID-19 policies. (69,110) In addition to public officials, Christian Drosten, the head of the Institute of Virology at the Charité Hospital became a notable expert for the government and has communicated health information to the press through interviews. (111)

Shortly after detecting its first case, COVID-19 became a notifiable disease in Germany. (112) This status mandated physicians and laboratories to report suspected and positive cases to local public health authorities, who then began to break the chain of infection via contact tracing. The first outbreak in Germany began in the state of Bavaria, and it was initially controlled with a combination of testing, contact tracing, and quarantine. (112) Initially, Germany employed a containment approach that aimed to keep infections at a minimum using active testing, contact tracing, and quarantine. (113) While this approach was not officially declared, government rhetoric centred towards containing disease spread. (114) Notably, Health Minister Jens Spahn stated that “So far, in Europe and the European Union, detection and containment is working” during a meeting of European health ministers in Brussels on February 13, 2020. (114) However, cases continued to rise in Germany, and by March 10, 2020, COVID-19 had reached all 16 German states. (103) Starting at that point, the rhetoric shifted to focusing on minimizing hospitalization and deaths by keeping infections within the capacity of the healthcare system. (109) From that point on, Germany’s COVID-19 approach can be considered as one focused on mitigation. (113)

Wave 1

In March 2020, daily new cases in Germany sharply increased, reaching 1043 new cases on March 15, 2020. (105) In response to rising case counts, Germany began to restrict regular life to control disease spread in March 2020. Starting on March 12, 2020, many businesses encouraged workers to work from home if possible. (115) This encouragement was later echoed by some state governments, such as Bavaria. (116) Bavaria was also the first German state to enter lockdown on March 20, 2020 – two days before the federal lockdown. (117) Educational institutions were similarly affected. All universities in Germany transitioned to an online format on March 15, 2020, and primary and secondary schools in all 16 states were closed by March 19, 2020. (118–120) Likewise, children stopped attending early childhood



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education and care (ECEC) centers, such as daycares, by the same date. (120) However, exceptions were made for the children of essential workers and child welfare reasons. (121)

On March 18, 2020, Federal Chancellor Angela Merkel addressed the nation to communicate the seriousness of COVID-19 and the need for strict lockdowns and other distancing policies soon to be implemented. (109) On March 22, 2020, Germany entered its first lockdown, which included many restrictions and public distancing policies. (122) Large events (e.g., sports, concerts) and public gatherings with more than two people were banned. A minimum public distance of 1.5 m was mandated. Non-essential businesses where a 2 m distance between individuals is not possible were also required to close. All restaurants and other businesses serving food were closed for dining, with only delivery and pick-up services allowed. Essential businesses, such as medical services, were allowed to open. All the above restrictions were enforceable by law enforcement agencies. Notably, these policies were officially referred to as “guidelines” by Merkel and individual states had authority over implementation. While all states implemented many of the federal policies, there were differences between jurisdictions. For example, in Saxony, one could only leave home for essential reasons, such as shopping, work, medical visits, etc. (123) Outdoor exercise was only allowed alone or with four other members of the same household. Meanwhile, the state of Bavaria refused to implement the two-person ban due to having implemented its own lockdown, involving its own policies, prior to the federal lockdown. (122) Given that Germany has the second oldest population in the EU, and other EU countries had seen high death rates in nursing homes, many German states enacted restrictions around nursing home visits. (124) The state governments aimed to separate nursing homes from the outside world as much as possible, with many nursing homes being completely closed for outside contact starting April 2, 2020.

In addition to distancing policies, Germany also relied heavily on testing, contact tracing, and quarantine. Various drive-in testing sites were set up in March 2020, with patients staying in their vehicles while tests were conducted. (125–127) A physician referral was needed to register for the test and results would be given to the referring physician and the local health department. (126) Once a positive case was detected, the local public health office was notified, and contact tracers were assigned to call the infected individual and produce a list of contacts since becoming symptomatic. Starting in March 2020, all positive cases and close contacts, defined as a contact within 2 m of an infected person for more than 15 minutes, were put under a 14-day mandatory home quarantine period. (128,129) Breaking this quarantine could have resulted in fines of up to € 25,000 or even five years in prison. (128) Close contacts under quarantine were called daily by contact tracers and underwent COVID-19 testing if necessary. (129) The contact tracing and quarantine cycle was repeated once a contact had tested positive.

To ensure the contact tracing system could be effective, Federal Chancellor Merkel aimed to have one tracer per 4,000 people, and mass recruitments were done to achieve this goal. (129) New contact tracers came from all walks of life, such as soldiers, students, and regular civilians.



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The local public health office provided grocery pickup services for individuals under quarantine who needed it. This service ensured that individuals under quarantine did not need to leave to receive essential supplies.

On March 16, 2020, Germany began to enact international travel restrictions. On that day, land borders with France, Austria, Luxembourg, Denmark, and Switzerland were closed for non-commercial traffic. (130,131) Traffic crossings were restricted to goods and work commutes, and while German citizens and residents in those countries could still return home, non-essential travel was discouraged. (131) At the same time, the EU also closed its borders to all non-EU countries. (132) Interestingly, no official airport screenings were implemented until July 27, 2020, when the daily case counts were much lower. (105,133) Between March and July 2020, screening decisions were up to individual airlines, with passengers from certain countries, such as China, South Korea, Japan, Iran, and Italy, being subjected to additional scrutiny via health forms. (134) On April 10, 2020, Germany enacted a mandatory 14-day quarantine for all German citizens, residents, and EU nationals entering the country. (135)

Like many other countries, Germany also suffered a personal protective equipment (PPE) shortage. To address the shortage, on March 4, 2020, Germany banned all exports of PPE and centralized the procurement process. (136) This ban was upheld despite attempted persuasion from the EU. (137) PPE supply problems persisted throughout March 2020, with many procurement directors in German hospitals and clinics attempting to sterilize and re-use masks and other PPE, as well as encountering much higher prices. (101) Despite these challenges, on March 31, 2020, Jena became the first German city to issue a mask mandate, requiring face coverings (e.g., towels, masks, scarfs) during shopping or on public transit. (138)

To mitigate disease spread and reserve healthcare capacity, elective surgeries and dental procedures were suspended in March 2020. (139,140) On March 12, 2020, Health Minister Spahn requested clinics to postpone planned operations and provided bonuses for each ICU bed that was created and maintained. In March 2020, the National Association of Statutory Health Insurance Dentists (KZBV) advised all patients with acute respiratory symptoms not to proceed with non-urgent dental procedures. (141) Routine in-person dental care was suspended, and patients were directed to specific urgent dental care centres. (142,143) By March 31, 2020, 50% of clinic beds had been cleared and were available for COVID-19 patients. (139) On April 28, 2020, planned medical operations resumed, and on August 18, 2020, the KZBV and BZAC (German Dental Association) declared routine dental visits safe to proceed. (139,144) After those dates, nationwide suspension of surgical and dental procedures never occurred again. The number of surgeries increased in 2021 as they worked to clear the backlog of procedures. (145) However, patients who tested positive for COVID-19 still needed to have their procedure evaluated on a case-by-case basis. (146)

As these policies were implemented, daily new case counts continued to rise throughout March and April 2020, reaching a peak of 6174 new cases recorded on April 3, 2020. (105) Deaths



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followed a similar trajectory, with the highest number of daily deaths recorded at 315 deaths on April 16, 2020. Beginning in mid-April 2020, new daily cases and deaths began to stabilize and gradually decline.

Given the decline in new daily cases, Chancellor Merkel announced the easing of pandemic restrictions on April 15, 2020. (147) Schools could reopen gradually starting May 4, 2020, with dates differing slightly state-to-state. New safety measures were implemented for school buses and the reopening prioritized students with exams, such as final-year primary and secondary school students. (147,148) Universities could resume in-person labs and exams with proper protective and hygiene measures, with lectures remaining online. (119) Social distancing rules were ordered to remain in place until at least May 3, 2020, and large public gatherings, including religious services, remained banned until at least August 31, 2020. (147) On April 30, 2020, museums, monuments, gardens, and zoos reopened under strict conditions. (149) Beginning in May 2020, certain non-essential businesses were also allowed to reopen. All shops below an area of 800 m² could reopen, and other large businesses, such as bookstores, bike stores, and car dealerships, were also allowed to reopen. (147,150) Restaurants, bars, and hotels could reopen but were limited to two households and mandatory social distancing of 1.5 m. (150) All of the above businesses were also required to follow hygiene standards. It is important to note that the reopening process varied state by state, with some states taking the lead on easing restrictions. (148)

To complement the ease of restrictions, Chancellor Merkel's announcement also included a public face mask recommendation. (147) The hope was that voluntary mask-wearing could help curb infections despite the reopening of businesses. However, this recommendation was short-lived, with all states mandating face masks by April 27, 2020. (151) Masks were defined as "mouth-nose-protection", which was a purposefully broad definition that included everyday objects, such as scarfs, towels, or homemade masks. (152) In some cases, non-medical masks were preferred, as Minister-President Winfried Kretschmann of Baden-Württemberg stated that medical masks should be reserved for healthcare workers. (151) Each state also varied in their implementation of a mask mandate. While all states required masks on public transit, Berlin was the only state that did not mandate masks when shopping. In Rhineland-Palatinate, students were given reusable masks upon returning to school. In Bavaria, masks were mandatory for everyone above the age of seven, and in Saxony-Anhalt, the minimum age was two years old. (151,152) Penalties for violating the mask mandate also varied wildly from state to state, with Bavaria issuing € 150 fines for first-time offenders, Mecklenburg-Western Pomerania issuing only a € 25 fine, and some states only issuing warnings. (152)

On May 6, 2020, the first lockdown in Germany largely ended. Chancellor Merkel stated that Germany's goal of slowing COVID-19 spread had been achieved, so all shops could reopen, albeit with some restrictions still in place. (153) All 16 federal states reached an agreement with the federal government, which gave state governments the power to control the timing of the reopening and agree to operate an "emergency brake" in reopening if a new surge of infections



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occurred. (153) General physical distancing policies were to continue for an additional month, and two households were allowed to meet and dine together. Nursing facilities were also open to limited visitors. Notably, local health authorities had the power to reimpose restrictions if new infection rates rose above 50 people/100,000 in a district over a seven-day period. (153)

In addition to loosened domestic restrictions, border restrictions also began to ease in May 2020. On May 15, 2020, border restrictions with Luxembourg were lifted, and on May 20, the mandated two-week quarantine no longer applied for travelers from any country with an infection rate below 50 people/100,000. (154) On June 15, 2020, all entry restrictions were lifted for EU nationals, and for people from the UK, Iceland, Norway, Switzerland, and Liechtenstein. (155) On July 1, 2020, Germany began to publish a biweekly list of low-risk countries who were excluded from any travel restrictions. (156) Travelers from countries absent from the list were permitted entry for essential reasons, such as urgent family visits and skilled workers in a crucial sector. At the same time, travelers from high-risk countries had to undergo mandatory free COVID-19 testing. However, starting in August 2020, rules surrounding international travel became stricter once again. This decision was in response to data showing that 40% of new cases were contracted overseas. (157) On August 8, 2020, the German Ministry of Health began to require travelers departing from a high-risk area to take a mandatory free COVID-19 test upon arrival. (158) A negative test within 48 hours was also acceptable if the test result was in German or English and had been approved by the RKI. On August 24, 2020, while COVID-19 testing was not required nor free upon arrival, travelers from high-risk areas were subjected to a 14-day quarantine. (157) The quarantine period was terminated on the fifth day if negative COVID-19 test results were produced.

Germany continued to employ testing and contact tracing to mitigate COVID-19 spread even after loosening restrictions. On April 20, 2020, federal and state governments announced that they would ensure a five-member contact tracing team per 20,000 people. (159) On May 8, 2020, Germany loosened its testing eligibility, with open public testing for all individuals. (160) On June 16, 2020, Germany launched its first contact tracing app, named “Corona-Warn-App”. (161) People were encouraged to download the app, and a threshold of 60% of the population were required to use the app for it to be useful. The app exchanged anonymous codes with other smartphones that came within 2 meters for 15 minutes or longer. (162) Once someone notified the app that they had tested positive, a notification would be sent to their close contacts. However, the rollout of this app faced challenges. A poll found that only 42% of Germans would have downloaded the app at the time of rollout, with many others concerned about their privacy. (161) In July 2020, it was reported that the app was not working for five weeks due to technical issues with Apple and Android operating systems. (162) Additionally, by mid-July, the app only had 16 million downloads, far from the 60% threshold required to maintain efficacy.



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As Germany entered the summer of 2020, daily new cases remained fairly low, with most days having less than 1000 new infections. Deaths were similarly low, with less than 20 new deaths per day. This positive pandemic outlook allowed some German states to loosen physical distancing policies. Starting June 13, 2020, Thuringia lifted all physical distancing and gathering restrictions, while recommending people limit their contacts to one other household or a maximum of 10 people. (163) Thuringia's Health Minister Heike Werner nonetheless emphasized the need for personal responsibility. Federally, the government remained more cautious. On August 27, 2020, in a meeting between Chancellor Merkel and the 16 state leaders, a nationwide ban on major public events was extended. (164) A minimum fine of € 50 would also apply to the whole country for individuals caught violating mask mandates. However, there was no consensus on limiting the number of private event participants. Instead, the government leaders asked individual citizens to evaluate the necessity and justifiability of private celebrations. (164) From this point until November 2020, only the following restrictions remained: mask mandates, physical distancing requirements, group gathering limits in most states, university closures, limits around restaurant dining, and quarantine policies for cases, close contacts, and some travelers.

Wave 2

Beginning October 2020, cases began to rise again, with daily new cases being consistently over 10,000 starting October 22, 2020. (105) By October 28, 2020, contact tracing was overwhelmed in hotspot areas, with Berlin and some other communities giving up contact tracing altogether. (165) Instead, cases were instructed to inform their contacts themselves. Public health contact tracing would only continue for high-risk groups, such as hospital patients, nursing home residents, and homeless individuals. As of November 6, 2020, around 75% of new cases could not be fully contact traced. (166) Hence, media reports indicated that Germany's previously highly touted "test-contact trace-isolate" strategy started to fail. (165)

To combat this new wave of COVID-19, a new lockdown was introduced. On November 2, 2020, Chancellor Merkel declared a new partial lockdown, lasting one month. (167) Businesses that served food were closed for indoor dining, and only pick-up and take-out was allowed. All large events, entertainment, and public recreation facilities were closed. Sporting events could only proceed with no crowds. Unnecessary travel was strongly discouraged and overnight stays in hotels were banned for tourism. Employees were required to work from home if possible and employers needed to facilitate such transition. Public gatherings were restricted to two households or a maximum of ten people, with exceptions made for church and protests. Non-essential businesses were restricted to 1 customer/10m². Since different German states were at different levels of reopening before this wave, these measures by the federal government were designed to unify COVID-19 rules across all states. This nationwide lockdown also most likely meant that physical distancing of 1.5m in public spaces was re-established across all states. Interestingly, less than a week after this new partial lockdown was announced, mandatory quarantine for travelers from high-risk areas was reduced from 14 days to 10 days, with a five-



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day minimum even if one tests negative. (168) It was unclear why this policy was loosened after a new round of restrictions and high case counts.

Despite the partial lockdown, the pandemic situation continued to worsen. By December 2020, new infections often surpassed 20,000 every day, with hundreds of new daily deaths. (105) In response, Chancellor Merkel transformed the partial lockdown into a full lockdown. (169) This lockdown would eventually receive extensions and only be lifted in May 2021. (170,171) On December 16, 2020, all non-essential businesses were ordered to close. (169) Private gathering limits were tightened to a maximum of five people. (172,173) However, exceptions were made between December 24-26 due to Christmas celebrations, during which a maximum of four close family members were allowed to gather in each household. Children aged up to 14 were exempted from the gathering restrictions throughout this lockdown. (173) Schools were also closed, and while children could theoretically attend ECEC centers, all states strongly urged parents to take their children home. (172,174) All higher education institutions were ordered to minimize the number of students and staff on campus. (119) Only essential administrative work was allowed on-site. Libraries were completely closed for purposes, including borrowing. In-person teaching and exams were required to take place virtually.

On December 27, 2020, the Pfizer-BioNTech COVID-19 vaccine began to be rolled out in German nursing homes following approval by the European Medicine Agency (EMA). (106) This news marked the beginning of a new stage of the COVID-19 pandemic in Germany, as vaccines started to become an available tool for reducing infections and deaths. Throughout 2021, different COVID-19 vaccines became available to different groups in Germany at varying times, and vaccination status became an integral part of Germany's COVID-19 policies. For details on Germany's COVID-19 vaccine policies, see the *Vaccination Policies* section of this case report.

By January 2021, the new wave of COVID-19 continued to surge in Germany, and further restrictions were imposed. To halt the spread of new variants that were more transmissible, Germany banned all flights from the UK on December 20, 2020, and by January 30, 2021, the bans were extended to Ireland, Portugal, Brazil, and South Africa. (175,176) Exceptions were only made for German citizens and residents, and those transiting through Germany to non-Schengen countries. On January 13, 2021, while previous quarantine rules were not tightened, negative COVID-19 results within 48 hours of arrival were made mandatory for all travelers. (177) On January 5, 2021, private gathering limits were tightened to a maximum of just one person outside of a household, and in districts with more than 200 infections/100,000, individuals were limited to a travel distance of 15 km. (178) On January 20, 2021, Germany also mandated medical grade masks, such as single-use FFP or FFP-2 masks, in shops, workplaces, and on public transit. (179) Other forms of face coverings, like cloth masks or scarves, were no longer permitted.

Starting mid-February 2021 and into March 2021, daily infections and deaths declined and became roughly half of the peak in January 2021. (105) However, the numbers were still much



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higher than they were in the summer of 2020. With this positive trend, Germany began to lift some restrictions. On February 22, 2021, ECEC centers and elementary schools began to open in 12 of the 16 states, with other states following suit not long after. (180,181) Starting in March 2021, all primary and secondary schools begin to open across Germany, with exact dates varying from state to state. (170) Hairdressers also became the first non-essential businesses to reopen in March 2021, given hygiene conditions were met. (170) Germany continued to be vigilant about international transmission. On February 14, 2021, Germany enacted a partial border closure with Czechia and the Tyrol region of Austria for three days due to a surge in mutated variants. (182) Physical checkpoints were set up by the police and only German citizens and residents who tested negative could enter, with exceptions for essential workers and urgent humanitarian reasons. On March 26, 2021, Germany issued travel warnings for France, Austria, Denmark, and Czechia due to rising infection rates in those countries. (183) Travelers who entered Germany from those countries must present a negative COVID-19 test taken within 48 hours and follow the pre-existing traveler quarantine policy after arrival. On March 30, all travellers needed to present a negative COVID-19 test conducted 48 hours before arrival, and only those who presented a test could board flights into Germany. (184) The tests were paid out of pocket by travelers, and both PCR and approved rapid tests were valid. Exemptions were given to airline crews and children under six years of age.

From April to June 2021, COVID-19 data continued to improve, with daily new infections dropping below 10,000 starting late May and daily deaths being consistently under 500 during that period. (105) The vaccine roll-out was also ramped up during this time, with around 20% of the German population being fully vaccinated by June 2021. (105) These positive trends led to the continued loosening of restrictions. On May 6, 2021, private gathering limits were completely lifted for fully vaccinated and previously infected individuals. (171) The next day, post-secondary institutions were allowed to increase the number of in-person education and research events. (119) This change was primarily done for practical and experimental training, such as labs, artistic exercises, and exams. The exact implementation of this shift was up to individual universities, and they needed to abide by the requirements of the amended Federal Infection Protection Act. By June 11, 2021, all primary and secondary schools had returned to complete in-person instruction. (185) To mitigate further disease spread, N95 or KN95 masks became mandatory on public transit and the more centralized contact tracing app, named “Luca” was launched. (186,187) On April 23, 2021, the German labor law was amended with the new Section 28b, which required employers to allow work from home if possible. (188) This legislation was meant to ease future transitions to remote work if needed. Travel restrictions were also loosened at this time. On April 15, 2020, border entry was permitted for EU and Schengen countries, and EU-approved low-infection countries. (189) However, entry from other countries was only permitted for urgent reasons. On May 13, 2021, fully vaccinated or recovered travelers could skip the mandatory quarantine and testing process. (190) However, negative test results (within 48 hours for antigen test and 72 hours for PCR test) were still required for unvaccinated passengers and those from countries designated as “virus-variant



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areas”. (191) On June 25, 2020, Germany was open for non-essential travel for fully vaccinated individuals from non-EU countries, with a continued ban for travelers from virus-variant areas. (192)

By July 2021, the new wave of COVID-19 that began in December 2020 had largely ended. While there were still significant numbers of new daily infections, daily deaths were below 100 for most days from July to October 2021. (105) In terms of the number of deaths, this second wave was the most devastating for Germany. Between December 1, 2020, and July 1, 2021, more than 74,000 people died from COVID-19. (105) At this time, fully vaccinated individuals also comprised around 40% of Germany’s population, which led to the 3G, 2G, and 2G+ rules. (193) These rules were an integral part of Germany’s reopening after wave 2 and its more targeted restrictions in wave 3. 3G was short for “Geimpfte, Genesene, und Getestete”, referring to individuals who were fully vaccinated, fully recovered, or had tested negative for COVID-19. (193) 2G was short for “Geimpfte und Genesene”, referring to those who were fully vaccinated or fully recovered. 2G+, the strictest of the three, referred to 2G populations who also must carry an additional negative COVID-19 test result. Businesses, facilities, and services that implemented the above rules would only allow entry or service to people that met the definition of their G rule requirements.

In the summer of 2021, Germany continued to relax restrictions. On July 1, 2021, the work-from-home requirement was lifted, and beginning in August 2021, small in-person classes could be conducted at universities with proper distancing and ventilation. (119,194) Hybrid teaching formats continued to be offered. (119) On August 23, 2021, indoor dining at restaurants and all indoor events and venues were allowed to resume under the 3G rule. (195–197) However, some states limited these privileges to the 2G rule. Starting in October 2021, mask mandates in some areas, such as schools and nightclubs, were lifted in the following states: North Rhine-Westphalia, Bavaria, and Saarland. (198,199) Bavaria and Saarland reopened sex work facilities and other entertainment venues to 3G populations, and public festival restrictions were lifted. (199) Unvaccinated employees in businesses involving public contact were required to undergo two PCR tests per week. Both states also lifted most other restrictions, including mandatory minimum distancing requirements, which transitioned into recommendations. (199) North Rhine-Westphalia also restored full seating capacity at concerts and sports events.

Despite a new round of reopening, some restrictions continued. From July to December 2021, some schools experiencing outbreaks faced restrictions or closures. (200) However, no nationwide school closures were ordered for the remainder of the pandemic. On August 1, 2021, all unvaccinated travelers needed to undergo mandatory COVID-19 testing, regardless of their means of transportation. (201) On August 24, 2021, nursing home visits were put under the 2G rule. (195) Notably, nursing home closures were never officially ordered during wave 2, and many remained open. (202) Although many of them remained open, the number of visitors declined in the winter of 2021. On September 6, 2021, Lufthansa banned cloth masks and required medical-grade masks on their flights. (203)



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During wave 2, testing and contact tracing took a back seat compared to wave 1. Nonetheless, there were new developments in their policies during this period. In March 2021, at-home rapid COVID-19 tests became available, and all German residents could receive one free test each week. (204) On October 11, 2021, all free testing ended to encourage vaccination, with exemptions for minors and those with medical conditions. (195) Tests were still available for those willing to pay. As of July 29, 2020, contact tracing policies varied by state. For example, in Hamburg, guests needed to register with the Luca tracing app before entering businesses. (205) Whereas in Hessen, restaurants used Luca or asked guests to complete physical contact forms, with no stores conducting contact tracing. By late August 2021, the Luca contact tracing app became commonplace for businesses across Germany. (195)

Wave 3

Starting in November 2021, Germany marked the beginning of its largest wave of COVID-19 in terms of the number of infections. (105) In early November 2021, new daily cases often surpassed 15,000 per day, and on November 22, 2021, daily new cases surpassed 100,000 for the first time in Germany. The situation continued to worsen into December 2021 and the early months of 2022. This wave was heavily driven by the new and far more infectious Omicron (B.1.1.529) variant, which was first detected in Germany on November 24, 2021. (206,207) In response to soaring cases, Germany enacted a new round of restrictions. However, this round of restriction was more targeted towards unvaccinated individuals per the 3G, 2G, or 2G+ rules.

A major political event in Germany around this time also heavily influenced the country's pandemic response. Germany held a federal election on September 26, 2021, which resulted in the victory of the centre-left Social Democratic Party of Germany (SPD), ending the 16-year reign of the centre-right Christian Democratic Union (CDU) under the leadership of Angela Merkel. (104,208) In late October 2021, SPD entered negotiations with the Green Party and the business-centric Free Democratic Party (FDP), eventually forming a coalition government with them. (68,209) Under the influence of the incoming SPD coalition, Germany ended the COVID-19 state of emergency on November 25, 2021, despite recognizing rising infection. (104) All three parties in the coalition appeared to be antagonistic to additional restrictions, with the vice-chairman of the SPD parliamentary group Dirk Wiese stating, "School closures, lockdowns, and curfews will no longer happen with us." (104) Wiese also stated that COVID-19 no longer posed a serious threat and favored low-intervention measures. Similarly, leaders of the Green Party and the FDP also urged a quick return to normalcy and an end to all restrictions by March 2022. (104) The SPD coalition officially came into power on December 8, 2021, with Olaf Scholz replacing Angela Merkel as the Federal Chancellor of Germany. (69)

In November 2021, less than a month after ending the free COVID-19 test policy, Germany re-introduced free tests to the public due to high case counts. (210) Despite readily available testing, contact tracing was essentially non-existent. On December 24, 2021, Berlin, Baden-Wuerttemberg, and Hamburg officially suspended all contact tracing operations due to the



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overwhelming workload. (211) In other areas of Germany, remaining contact tracing focused on simply recording the number of cases, rather than tracking down and isolating contacts to break the chain of infection. Around Mid-November 2021, both Bavaria and Saxony mandated all restaurants to close by 10 pm and 8 pm, respectively, and restaurants in both states needed to operate under the 2G rule. (212) In addition, Bavaria introduced the 2G rule for all non-essential businesses in the state, and sports and cultural events were limited to 25% capacity and subjected to the stricter 2G+ rule. In Saxony, all entertainment and public venues were closed, and all retail stores operated under the 2G rule and needed to close by 8 pm. (212) For health districts that had an incidence rate greater than 1,000 cases/100,000, a curfew was enacted between 10 pm-6 am. (212) However, these restrictions were localized to the two states and were not done nationwide.

Several nationwide policies were enacted around the same time. On November 19, 2021, a new set of guidelines were implemented across Germany, using the local hospitalization rate as the threshold. (212,213) If the rate was above 3/100,000, then the 2G rule would be in place for all venues and services, such as non-essential businesses and nursing homes. If the rate surpassed 6/100,000, then the 2G+ rule would apply. On November 24, 2021, in-person workplaces were open only to the 3G population, with a remote work option offered to workers if possible. (214,215) Unvaccinated employees needed to take a daily COVID-19 test and present a negative result. On December 3, 2021, Germany placed all unvaccinated people on lockdown, banning them from entering non-essential businesses and banning gatherings of more than two people between households. (216) Bars and nightclubs were also ordered to close in areas with incident rates greater than 350 cases/100,000 people. (216) On December 28, 2021, restaurants were placed under the 2G rule federally, and all private gatherings were limited to a maximum of ten vaccinated people. (217,218) All large events across Germany were closed to the public. (217) During this time, there were no school or daycare closures, and German universities even opened in-person courses to 2G students, with alternatives provided for non-2G students. (119)

In addition to restrictions at home, international travel also became more restricted. Between November 26 and December 19, 2021, more countries were added to the flight ban list due to the Omicron variant, which was in accordance with the virus variant area policy of June 2021. (219–221) Starting December 19, 2021, all travelers from the UK must quarantine for 14 days, as opposed to ten days, and produce a negative test. (222) However, this requirement for UK travelers was soon dropped on January 4, 2022. (223) A few days later, it was announced all airport entries would only be open to 2G+ individuals, with exceptions made for travelers under 6 years old. (224)

Daily COVID-19 cases peaked in Germany between January and March 2022, with most days recording daily six-digit infections. (105) This situation did not improve until May 2022. However, during this period, daily new deaths were significantly lower than in the peak of wave 2. (105) The reduced death rate may be attributable to a variety of factors, including the high



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full vaccination rate (74% by February 2, 2022) and Omicron's intrinsic reduced lethality. (105,225) Starting in January 2022, Germany began to loosen restrictions despite high case counts. Starting January 7, 2022, close contacts of a positive case were no longer required to quarantine if they were a part of the 3G population. (226) All non-3G populations were permitted to reduce the quarantine period from 14 days to 10 days, which could be cut short with the presentation of a negative test result. On January 22, 2022, it was announced that PCR tests were restricted to medical staff and vulnerable populations due to limited laboratory capacity. (227) Prior to this announcement, all positive rapid antigen tests needed to be confirmed by a PCR test. The German government then announced a three-stage reopening plan for all populations, starting February 16, 2022. (228,229) As a part of Stage 1 reopening, members of the 2G population could meet with no limitations, even if one person in the group was not a 2G individual. Gathering limits would remain for non-2G groups. (228) Proof of vaccination was no longer required at grocery stores and unvaccinated individuals could shop with no restrictions. (229) Stage 2, which began on March 4, 2022, opened restaurants and hotels to 3G populations. (230) Entertainment venues, such as clubs and discos, also reopened, but only for 2G+ populations. Stadiums could reach 75% full capacity or a maximum of 25,000 people. Indoor venues were reopened for 60% capacity or a maximum of 6,000 people, with a 2G rule required. Finally, on March 19, 2022, Stage 3 reopening began, which lifted all COVID-19 physical distancing policies across the country, with life returning to pre-pandemic normalcy in most cases. (231) The new German Health Minister, Karl Lauterbach stated, "We can't continue to shield the whole country to protect a small group of those unwilling to be vaccinated". (231) However, state governments and German businesses retained their right to impose their own restrictions should the pandemic worsen. While a 1.5 m distance was no longer required in the public, it was still recommended by many government websites. (232) At the same time, German employers needed to implement the AHA+L (Abstand, Hygiene, Alltagsmaske + Luft) hygiene measures. (233) These measures include a 1.5 m distance, hand hygiene and proper cough etiquette, indoor medical masking if multiple people were in the same area and when a 1.5 m distance was not possible, and proper ventilation.

Similarly, international travel rules were loosened. Starting March 3, 2022, Germany stopped using the high-risk country list, and all entry rules were lifted for travelers belonging to the 3G population, regardless of the country of origin. (234,235) However, non-3G travelers from non-EU countries could only enter Germany for essential reasons. (235) On June 1, 2022, the 3G requirement was lifted and no travelers faced quarantine requirements. (236) Ten days later, all entry restrictions were lifted, and proof of vaccination, recovery, or testing was no longer required. (237) From that point on, Germany's international travel policies essentially returned to what it was like pre-COVID.

From April 2022 onwards, Germany continued to loosen non-distancing COVID-19 policies. Mask mandates were officially lifted on April 2, 2022, in most settings. (238) The few locations the mandates remained were on public transit (including long-distance trains and flights), in hospitals, and in nursing homes. (231) The types of masks required in those settings varied by



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state, and businesses could still mandate masks on their properties. (239) However, Health Minister Lauterbach continued to recommend indoor masking. (238,240) Starting April 30, 2022, quarantine for infected individuals was reduced to five days, after which they were recommended to conduct a rapid test and continue to quarantine until testing negative. (241,242) For people working in healthcare and rehabilitation facilities and nursing homes, a negative test and a 48-hour prior symptom-free period was needed to return to work. Close contacts of a positive case were no longer required to quarantine but were only strongly recommended to undergo five days of isolation. (241,242) For people working in the previously mentioned settings, daily COVID-19 tests were mandatory before returning to work during the five-day isolation. All COVID-19 restrictions in universities were lifted on May 31, 2022, but many classes already returned to in-person lectures for the Summer 2022 semester. (243) Some universities even require professors to justify the continued use of online lectures. (244) In July 2022, Chancellor Olaf Scholz publicly stated that Germany will not close schools or non-essential businesses again even if the COVID-19 infection rate rose later in 2022. (245) He stated, “There should not be school closures again, and I also don’t think that we will need the kind of lockdowns we had several times in the last couple of years”.

Despite a series of reopenings, COVID-19 infections eventually declined in May 2022. (105) Regardless, daily infections remained higher than in the previous two waves. On August 31, 2022, there were 49,303 new cases and 181 new deaths in Germany. This daily case count was higher than the peak during the winter of 2021, but with a much lower death rate. By the end of data collection, Germany had a total of 32,145,157 reported COVID-19 cases and 147,404 reported deaths. Only a few public health policies remained by that date, including mask mandates in certain settings, a five-day quarantine for positive cases, a five-day recommended isolation for close contacts, and indoor masking recommendations.

Vaccination policies

COVID-19 vaccines first became available in Germany on December 27, 2020. (106) The majority of vaccines used in Germany required two doses to be considered fully vaccinated, with the exception being the vaccine by Johnson & Johnson (J&J), which initially only required one dose for full vaccination. (246) The low initial vaccine supply led Germany to adopt a gradual vaccine roll-out, prioritizing the most vulnerable populations, such as the elderly, and prioritizing giving the first dose to as many vulnerable individuals as possible before rolling out additional doses. (247) In November 2020, Germany and its various states prepared a 15-page document on a vaccine distribution strategy that sought to avoid logistical challenges. (248) The document allowed states to set up vaccination centers early on and established tasks and workflows. However, despite this preparation, Germany’s initial roll-out was nonetheless hampered by low supply and logistical challenges. The first two vaccines approved by the European Medicine Agency (EMA) were the mRNA vaccines by Pfizer-BioNTech (Pfizer) and Moderna, both of which had more stringent storage temperature requirements. (249) Stringent privacy laws in some states also delayed the process, with some workers attempting to guess a



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person's age by their name, with individuals with stereotypically "older" names being invited for a vaccine regardless of their actual age. (250)

Soon after the Pfizer vaccine, the Moderna COVID-19 vaccine also became available. (251) Both vaccines use mRNA technology. Around the same time, the AstraZeneca COVID-19 vaccine, a viral vector vaccine, was also available. (252) However, on January 28, 2021, Germany's Standing Committee on Vaccinations (STIKO) restricted its use to only people under the age of 65 as it lacked efficacy data for older populations. (252) The vaccine also encountered supply issues within the EU. AstraZeneca's lack of efficacy data also led to public mistrust, and by the end of February 2021, more than a million doses of AstraZeneca vaccines were in storage and saw limited uptake. (253) On March 31, 2021, Germany halted the use of AstraZeneca for everyone under 60 due to the occurrence of blood clots in younger individuals. (254) Those under 60 who had already received a first dose of the AstraZeneca vaccine were given a different vaccine for their second doses. (255) However, this ban did not last long, with Germany re-allowing the use of AstraZeneca for all adults on May 6, 2021. (256) Four days later, the J&J vaccine, another viral vector vaccine, became available for all German adults despite having similar blood clot incidents as AstraZeneca. (257) On July 2, 2021, Germany officially recommended mixing vaccines, such as an individual receiving both non-mRNA and mRNA vaccines to complete a two-dose series. (258) Starting November 10, 2021, Germany recommended only the Pfizer vaccine for individuals under 30 years old due to higher myocarditis risks associated with the Moderna vaccine for that population. (259) On February 22, 2022, the Novavax COVID-19 vaccine became the most recent vaccine available in Germany. (260) It is a protein subunit vaccine that was meant for individuals unable or unwilling to receive mRNA vaccines.

In early 2021, Germany had three vaccination priority groups. (247) Group 1 (highest priority) included individuals over the age of 80, and people working in intensive care units (ICUs), emergency rooms (ERs), and senior care homes. Group 2 included people between the ages of 70-80, and group 3 included people between 60-70. Ineligible individuals who received early vaccinations were liable for criminal prosecution. (261) These priority groups ended on June 7, 2021, with everyone above the age of 16 now eligible for vaccination. (262) Around the same time, Germany also took steps to stretch the limited vaccine supply. On January 4, 2021, Germany began to consider delaying the second vaccine dose beyond the 42-day maximum determined by the EMA. (263) On March 4, 2021, Germany implemented a maximum 42-day interval for the second dose of mRNA vaccines and a maximum interval of 12 weeks for the second dose of the AstraZeneca vaccine. (264) Also, Germany decided to only administer one vaccine dose to people who recovered from a COVID-19 infection in the previous six months. (265) As of April 3, 2021, 10 million Germans had received at least one dose and 4.3 million had received two doses. (266)

Starting in the summer of 2021, Germany expanded vaccine eligibility and began the roll-out of second and booster doses. Starting August 2, 2021, all individuals aged 12-17 could be



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vaccinated, and in September 2021, Germany began to offer mRNA boosters to seniors, medical workers, workers in care homes, immunocompromised individuals, and all individuals fully vaccinated with non-mRNA vaccines. (267–269) Pregnant women were also recommended to be vaccinated in the same month. (270) On October 11, 2021, Germany recommended boosters for everyone above the age of 70, and this recommendation was expanded to all 18+ individuals in November, with a recommended minimum gap of six months. (271,272) On December 13, 2021, STIKO recommended children at risk or those who have relatives at risk of COVID-19 receive vaccinations, with healthy children also able to do so following a doctor consultation. (273,274) On December 21, 2021, STIKO shortened the minimum booster interval to 3 months, and in January 2022, boosters were recommended for youths aged 12-17, albeit only for the Pfizer vaccine. (275,276)

Germany's vaccination policies continued to evolve in 2022. By this point, more than 70% of Germany's population had been vaccinated. (105) On January 19, 2022, Germany disqualified individuals who received one dose of the J&J vaccine from the fully vaccinated status, requiring them to receive an additional mRNA or J&J vaccine dose. (277) This change was due to efficacy issues with the J&J vaccine. From February to July 2022, Germany began to recommend a 4th-dose to its population, starting with people aged 70 years and older, then gradually expanded it to all adults. (278–280) On May 24, 2022, STIKO recommended healthy children receive only one dose since many of them were previously infected. (281) As of June 2022, children aged 5-11 received a low-dose version of the Pfizer vaccine (3 micrograms per dose, 3 doses). (282,283) This version was then approved for children between the ages of six months and four years old by the EMA in October 2022 and was recommended for at-risk children in that age group in Germany the next month. (283,284)

Vaccine hesitancy was another issue for the German authorities to tackle. Vaccine hesitancy manifested as both individual actions and group initiatives. After Germany began to issue an EU-wide vaccination pass that allowed for travel in June 2021, fraudsters began to sell fake passes to individuals who refused to be vaccinated. (285,286) In August 2021, there was also a media report of thousands of people receiving a saline injection due to intentional sabotage by a vaccine-hesitant nurse. (287) There were many individuals who did not show up for their vaccine appointments as they were satisfied with one dose and did not want a second dose to be fully vaccinated. (288) On January 24, 2022, anti-vaccine protests also occurred in Germany. (289) These protests involved tens of thousands of participants and even turned violent in some occasions.

To address vaccine hesitancy, Germany's strategy was more focused on punitive measures. Starting November 1, remuneration for workers under quarantine due to a positive COVID-19 test result was discontinued for unvaccinated individuals. (290) On December 9, 2021, Germany enacted a lockdown for unvaccinated individuals. (216) Later, in 2022, Germany considered a vaccine mandate for the elderly, but this motion was rejected by the parliament. (291) However, on May 19, 2022, the German Constitutional Court approved a vaccine mandate for



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healthcare workers. (292) In addition to these measures, Germany also tried to encourage vaccination by increasing accessibility, such as the “vaccine action week” in September 2021, during which vaccines were offered near supermarkets, stadiums, and on trains. (293)

Relief programs and other supporting policies

On March 27, 2020, the German parliament passed a COVID-19 stimulus package to support individuals and businesses during the lockdown. (294,295) This package included many economic relief policies. (294) Self-employed individuals could apply for direct loans of up to € 9,000 over a three-month period. Eligibility for long-term unemployment benefits (Hartz IV) and child support was temporarily expanded. Recipients were now only required to present proof of a short-term income decrease as opposed to the six-month period proof that was required before the pandemic. Funds were provided for parents who stopped working or worked less due to school closures. The German government also covered 60% or more of the salaries of short-term employees. In terms of housing, evictions were banned for individuals who missed rent payments due to COVID-19 income loss. The authorities were instructed to presume a connection between reduced income and the pandemic as they judged these cases. This policy was especially crucial as most Germans are renters. (296)

For businesses, companies needed to prove that 10% of their workforce was affected by COVID-19 measures to qualify for employee salary coverage. (294) Businesses were eligible for direct loans of € 9,000 – 15,000 over a three-month period, depending on their number of employees. For large businesses, a national fund was set up to take on their liabilities and this fund could guarantee up to € 400 billion in liabilities. The Kreditanstalt für Wiederaufbau (KfW) state development bank also enabled emergency loans to companies that faced cash flow issues. Another fund of € 100 billion was established to protect large German companies from hostile takeovers, with the government willing to purchase stakes in major employers, with the promise of later re-privatization. Companies were also allowed to calculate owed taxes later in the year and insolvency regulations were loosened.

On May 23, 2020, Germany enacted additional policies to support senior care homes. (297) Employees were eligible for a one-time benefit of up to € 1,000, with full-time staff in direct contact roles receiving the maximum amount. State governments and individual care homes could add an additional € 500 to the maximum amount. This benefit was exempt from tax and social security deductions. Monetary bonuses were also provided for trainees, volunteers, and temporary workers. From May 23 to September 30, 2020, some long-term care providers could receive reimbursements of € 125/month for reduced income and extraordinary expenses. Workers under quarantine orders could also receive reimbursements for lost earnings.

On June 4, 2020, Germany unveiled another € 130 billion COVID-19 recovery package. (298) From July 1 to December 31, 2020, Germany’s sales tax was cut from 19% to 16%. A one-time € 300 payment for every child in Germany became available, and a € 25 billion loan program



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was established for small businesses whose sales dropped more than 60% from June to August 2020. This package also included a € 6,000 government subsidy to encourage electric vehicle (EV) purchases. In November and December 2020, the German government designated funds to compensate businesses for up to 75% of their monthly sales. (299) On December 8, 2020, Germany sped up the distribution process, increasing the initial payout from € 10,000 to € 50,000. After 2020, there were no further reports found regarding any new economic relief policies by the German federal government.

In addition to economic relief policies, Germany also took limited steps towards telehealth, so the German people could access healthcare more easily during lockdowns. Just before the pandemic, in November 2019, Germany passed the Digital Healthcare Act (Digitale-Versorgung-Gesetz). The bill allowed doctors to prescribe medical mobile apps to their patients and the apps could be reimbursed by the public health insurance plan, similar to a medical device. (300) This legislation paved the legal path for expanded telemedicine during COVID-19. By March 2020, many medical documents (e.g., prescriptions, doctor letters) were legally allowed in digital channels and many telehealth tools have been recognized by the Federal Ministry of Health. (301,302) The Ministry published those tools with comprehensive specifications (e.g., costs, reimbursement policies) that helped doctors integrate those tools into their practices. (301) A month later, low-risk medical apps could receive fast-tracked approval from BfArm within three months. (302) On September 22, 2020, then-Health Minister Jens Spahn announced € 3 billion for digitizing German hospitals, with funding available starting in 2021. (303) Telehealth continued to grow in 2021, with electronic medical record (EMR) access mandated for all providers under public health insurance and many German hospitals using virtual networks to consult specialists. (302,304) However, unlike rapid advances in telehealth, the use of electronic prescriptions (e-prescriptions) progressed slowly in comparison. There were numerous local pilot projects for e-prescriptions in Germany from May 2020 to July 2021, and full implementation of the technology was only planned for September 2022 in the states of Schleswig-Holstein and North Rhine-Westphalia. (297,305–307)

Disproportionately affected populations

Foreign workers in the meat industry in Germany were disproportionately affected by COVID-19. In May and June 2020, several large outbreaks occurred at meat factories, among workers primarily from Bulgaria, Poland, and Romania. (308) Many foreign workers lived in crowded dorms with unclean living conditions, making at-home quarantine nearly impossible. These outbreaks led to local lockdowns around the factory, with the German military being called in to conduct testing for workers and their families in some areas. (309) In response to these outbreaks, the then-German Labour Minister proposed to increase worker protection regulations in the meat industry. (308) However, this move received pushback from representatives from the meat industry. They argued outbreaks would have happened regardless of living conditions due to the meat industry's status as a critical industry that needed to remain open.



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In addition, the elderly in Germany's care homes were especially vulnerable. Even after seniors were vaccinated, outbreaks occurred at some nursing homes and led to deaths. (310,311) It was found that in some cases, many employees were not vaccinated, leading some states, like Brandenburg, to introduce stricter testing requirements for nursing home employees. (311) Before vaccinations, Germany relied on isolating seniors to protect them from COVID-19. However, this approach was traumatic for many residents and families, who lost the ability to see their loved ones, especially those who were already dying. (124) Many family members were also concerned about the quality of care the seniors received during isolation. Hence, not only was COVID-19 more deadly for the seniors, but it also worsened their mental and emotional health.

Successes and Challenges in Germany's Pandemic Response

This study identified and contacted seven key informants in Germany to gather additional information about Germany's COVID-19 response. However, none responded to an interview request. Nonetheless, media reports identified several successes and challenges in Germany's response.

Germany was initially at the forefront of COVID-19 testing and contact tracing. Germany's Charité hospital developed one of the first tests specific to SARS-CoV-2, which enabled Germany to quickly expand its testing capacity. (312) Germany successfully incentivized private laboratories to expand their capacity by mandating insurance coverage for COVID-19 tests. Bavaria – the German state with the first COVID-19 outbreak, also successfully broke the chain of transmission among its first cluster of cases. (312) This success gave Germany time to learn more about SARS-Cov-2, such as its method of transmission and incubation period. Even as cases grew rapidly in the first half of 2020, local and national health authorities focused heavily on contact tracing every infected case, using a combination of increased staffing, citizen science projects, and digital contact tracing tools. (312) Additionally, despite being a federalist country with a highly decentralized healthcare system, Germany had a united initial approach. All levels of government were clear in their communication with the public. (313) The city of Jena issued the first mask mandate in Germany, with its success credited to the flexibility to experiment in a federalist system and transparent communication of masks' benefits and drawbacks. (313) Soon after the epidemiological benefits of masks became apparent in Jena, all 16 German states adopted the policy. According to Dr. Clemens Wendtner of the Ludwig-Maximilian University in Germany, "There was a very close interaction between scientists, physicians, and politicians". (313)

As the pandemic progressed, Germany's detailed contact tracing system was challenged by surging workloads. In the second half of 2020, Merkel's spokesman publicly admitted, "In many communities it is no longer possible to do proper contact-tracing. The infection numbers are just too high". (165) Similar sentiments were echoed by local health authorities, such as in Frankfurt, whose leader stated, "Contact-tracing to the full extent is no longer possible". (165)



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This challenge continued despite recruiting additional personnel, and since then, Germany's contact tracing system could no longer break chains of transmission. Furthermore, Germany's nationwide response became more fragmented as time went on. Germany's early success contributed to a sense of complacency and lower adherence to public health policies. (313) Some state leaders, such as the School Minister of North Rhine-Westphalia stated that masks in schools were "no longer necessary". (313) This rhetoric fueled the anti-lockdown movement in Germany, leading to a less united public. It was particularly challenging for the heads of the states to agree on common measures and the federal government took a much longer time to persuade them to commit to a stricter lockdown.



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Comparison with other country responses

There are many concerns in trying to compare countries' responses to COVID-19. Those concerns are shaped by the limitations of the data itself and differences in contextual factors. A separate paper by this working group describes the limitations of COVID-19 data. (314) Table 4 presents a list of countries included in this project and their use of different physical distancing policies.

Table 4. Comparative national-level responses to COVID-19 by country as of August 2020 (filled in means policy was implemented)

Category	Policy	AUS	BGD	BRA	CAN	CHN	CRI	CUB	DNK	DJI	EGY	ENG	FRA	GER	GHA	IND	IRN	IRE	ISR	ITA	KAZ	LBR	NDL	NZL	NIR	PAK	RUS	SCL	SLE	SGP	ZAF	KOR	SRI	SWE	UGA	UAE	VM	WLS	
Government	State of Emergency																																						
	Case Management																																						
Closure	Non-essential service closure																																						
	Restaurant closure																																						
	Suspended elective medical/dental procedures																																						
Detection	Surveillance systems																																						
	Contact tracing																																						
	Assessment centres																																						
	Drive through testing centres																																						
Economics	Mass fever screening in public transportation																																						
	Economic relief policies for individuals/families																																						
	Economic relief policies for businesses																																						
Education	Housing economic relief																																						
	Anti-hoarding																																						
	Anti-price gouging																																						
	School closure- daycare																																						
	School closure- elementary school																																						
Health Workforce	School closure- high school																																						
	University closure																																						
Healthcare Resources	Health workers allowed to only work at one site																																						
	LTC Health workers allowed to only work at one site																																						
Physical Distancing	Audio/video telehealth																																						
	Telehealth access to prescription medication																																						
	Physical distancing recommendation																																						
	Ban on group size																																						
	Quarantine orders after travel																																						
	Quarantine orders for cases																																						
	Quarantine orders for contacts																																						
	Isolation for vulnerable populations																																						
	Work from home/remote work																																						
	Recommended use of masks/PPE for public																																						
Public Decontamination	Required use of masks/PPE for public																																						
	Quarantine for "at risk" or priority neighbourhoods																																						
	Lockdown																																						
Travel bans	Public decontamination transit																																						
	Public decontamination streets																																						
	International bans for non-essential travel																																						
	Screening at airports/borders																																						
	Closing public transportation																																						

AUS–Australia, **BGD**–Bangladesh, **BRA**–Brazil, **CAN**–Canada, **CHN**- China, **CRI**- Costa Rica, **CUB**-Cuba, **DNK**–Denmark, **DJI**–Djibouti, **EGY**-Egypt, **ENG**-England, **FRA**-France, **GER**- Germany, **GHA**-Ghana, **IND**-India, **IRN**-Iran, **IRE**-Ireland, **ISR**- Israel, **ITA**- Italy, **KAZ**-Kazakhstan, **LBR**- Liberia, **NDL**-Netherlands, **NZL**- New Zealand, **NIR**-Northern Ireland, **PAK**-Pakistan, **RUS**-Russia, **SCL**-Scotland, **SLE**-Sierra Leone, **SGP**-Singapore, **ZAF**-South Africa, **KOR**-South Korea, **SRI**-Sri Lanka, **SWE**- Sweden, **UGA**- Uganda, **UAE**-United Arab Emirates, **VM**-Vietnam, **WLS**-Wales



IV. Discussion of main findings, limitations, and next steps

Germany has an estimated population of 83,369,840 with 32,145,157 cases and 147,404 deaths from COVID-19 as of August 31, 2022. (105) Germany initially tried to contain the pandemic by testing and quarantining travellers, especially those from countries first affected by COVID-19. Once community transmission took hold, Germany employed a mitigation strategy that focused on keeping infections within the capacity of the healthcare system.

Germany employed a variety of policies, such as the closure of non-essential businesses, public mask mandates, restrictions on public and private gatherings, physical distancing, and border restrictions. Germany began implementing mitigation measures for COVID-19 in March 2020, with the announcement of their first nationwide lockdown. Germany experienced three main waves of COVID-19: wave 1 between March and June 2020, wave 2 between November 2020 and July 2021, and wave 3 between November 2021 and May 2022. Mitigation measures were imposed and lifted cyclically, with the lifting of policies coinciding with stabilized infection and death counts or high vaccination rates.

In 2021 and 2022, Germany focused on vaccinating their population. Despite facing initial challenges with vaccine roll-out due to supply shortages and logistical challenges, Germany successfully vaccinated over 70% of their population in 2021. Germany prioritized vaccinating the elderly and medical workers, then gradually recommending vaccines to younger populations, and offering further doses.

This case study allowed for an in-depth understanding of Germany's COVID-19 policies for a span of more than two years. Limitations to this report may exist because findings relied on accurate, up-to-date reporting of policy responses by the media and government sources. Some sources were only found in German, creating a language barrier. Translation software was used to minimize the language barrier as much as possible. Seven relevant key informants in Germany were also contacted, with none responding to an interview request.

Conclusions

Germany has used a variety of policies in their COVID-19 response. Germany experienced varying success with using testing, contact tracing, and lockdowns to reduce COVID-19 cases and deaths. Germany's successful COVID-19 vaccine roll-out enabled the country to open their economy without significant increases in deaths. In the future, it will be important for Germany to reassess whether their disease contact tracing capacity can be relied upon in future epidemics.



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