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Together we can do it: Each individual contribution protects health, society, and the economy

A statement by the presidents of the non-university research organizations on the COVID-19 epidemic based on mathematical analyses of the data situation

Introduction

Even though we have been living with the COVID-19 pandemic for more than half a year, there are still many unanswered questions and major uncertainties regarding further infection. How will the epidemic develop in Germany – especially during the upcoming flu season and the cold autumn and winter months? Which strategies are particularly effective in containing the rising number of infections in Germany and worldwide? What has proved successful in recent months? What properties of SARS-CoV-2 are now understood? And what measures can be imposed for the population and the economy without restricting social life too much?

But one thing is sure: The COVID 19 pandemic is dynamic. Containment measures must therefore be continuously monitored and adapted. In order to help overcome the epidemic and close gaps in knowledge, modelling experts from the non-university research organizations – the Fraunhofer-Gesellschaft, the Helmholtz Association, the Leibniz Association, and the Max-Planck-Gesellschaft – have joined forces and drawn up a joint statement. Based on the data available and with a complementary spectrum of methods, we have developed model scenarios for the further course of the COVID-19 epidemic in Germany. These are designed to help policy makers and individuals continually review and (if necessary) adjust mitigation measures.

We summarize the key findings from our models based on the information currently available. Our calculations show that against the background of increasing numbers of infections, it is all the more important that each individual helps contain the infection rate. Only together can we effectively protect health, society, and the economy.

Results of the models

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The recent development of the COVID-19 epidemic in Germany requires an analysis of the current situation. The increased number of newly infected individuals in Germany, the lower death rate, and the increasing reluctance of the population to comply with measures make it necessary to reassess the situation and reconsider previous measures. Compared with countries like Spain and France, the situation in Germany is still relatively well under control. We should therefore not put ourselves at risk, especially with regard to our social and economic life. The upcoming colder season in particular requires a solid plan. We need to create the best conditions to help us to get through the winter while maintaining social and economic activity as well as stable infection rates.

Current risks

The number of current new infections is several times higher than in June. Even if it is assumed that the reproduction rate will stabilize at around 1, the number of new infections is currently so widespread and so high that the health authorities are working at their capacity limits and are no longer able to completely

identify and isolate infection chains through testing and tracing. **Especially against the background of seasonal effects from autumn onwards, we must once again reduce the number of new infections.**

Increased mobility through travel abroad has contributed to the incidence of infection. In order to understand the infection pattern, it is important to distinguish whether the recent increase in new infections was caused by cases registered from abroad or by increasing domestic contacts. Our simulations show that a substantial part can be explained by new cases from outside Germany. However, the effective reproduction rate has also risen *without* the inclusion of returnees. There is thus little room for further easing or a seasonally dependent increased incidence of infection. In particular, each entry from outside Germany acts like a germ that can spread quickly within the country. Simulations of the current situation show that even minor *additional* contact restrictions can contain a new flare-up of infection if those returning from abroad consistently adhere to the quarantine and the DHM formula (distance, hygiene, masks) continues to be observed by all.

There are two major tipping points that threaten the containment of SARS-CoV-2 For one thing, it is now common knowledge that we start to see exponential growth as soon as the effective reproduction number R rises above 1. We have identified a second, at least equally important tipping point, which depends on the number of new infections. If so many people are infected that the chains of infection can no longer be quickly traced by the health authorities, the spread of the virus will become much more difficult to contain. This will result in self-reinforcing growth that is difficult to contain. By contrast, a low number of new infections facilitates containment.

Seasonal effects influence the spread of the virus. The evidence of infection via aerosols has now been scientifically substantiated. This means that the risk of infection is significantly increased in enclosed spaces. A significant seasonal factor in the upcoming months will be the increased amount of time spent indoors. This can be counteracted by consistently wearing masks.

However, we are still not able to achieve herd immunity. There is growing evidence that a significant proportion of carriers of the SARS CoV-2 virus do not contract the disease or they prevent the virus from quickly spreading in their bodies. In principle, this should accelerate the development of a herd immunity. Nevertheless, according to current estimates, even taking into account the number of unreported cases, we cannot achieve the state of herd immunity in the medium term without placing a heavy burden on the health system. Recent evidence also suggests that exposure to SARS-CoV-2 results only in relatively short-lived immunity through antibodies. People could therefore fall ill with the virus again. Also from this aspect, herd immunity is not a sensible objective. In addition, in countries that relied on herd immunity or were late in controlling the virus, the number of reported deaths is 5–10 times higher than in countries that sought and achieved early control. Italy, the UK, Sweden, and Spain have reported around 470–600 COVID-19-related deaths per million while Germany, Austria and Norway have reported only 50–100 COVID-19-related deaths.

The decrease in mortality can be largely explained by the age distribution. Although the number of new daily infections in Germany has been rising considerably since mid-June, the death figures do not follow this trend. In addition to improved treatments, simulations show the changed age distribution of the virus carriers as a main cause. The percentage of infections among people over 60 has fallen. Among other things, this can be explained by the constant reduction in critical contacts with the older generation. However, because of the higher rate of infection among the younger population, there is a risk of re-spreading the infection among the elderly with an associated increase in mortality (something that can be observed especially in other European countries). It is difficult to calculate mortality; because of the number of unreported cases so the number of carriers of the virus can only be estimated. The current tendency for the number of undetected cases to decrease as a result of consistent testing (e.g. of people returning to their home countries) can be mistakenly interpreted as a decrease in mortality.

The consistent protection of the vulnerable population with high general prevalence of SARS-CoV-2 is not feasible. One approach discussed as an alternative to herd immunity is accepting the uncontrolled spread in the general population while protecting those at risk by isolating them. This approach can be regarded as critical from various points of view. On the one hand, serious, long-lasting side effects cannot be ruled out even in non-risk individuals after illness with COVID-19. This makes an uncontrolled spread of the virus seem unacceptable. On the other hand, protection of people at risk with a high prevalence of SARS-CoV-2 is not feasible in practice for several reasons. (1) Infections can also come from pre- or asymptomatic individuals. Carriers may therefore infect people at risk without them knowing it. (2) People at risk in particular need interaction with and support from other people. This poses a major risk of transmission. (3) Very frequent, precautionary testing to protect persons at risk is currently not possible in Germany because only a limited number of PCR tests are available.

Effects of the measures

Hygiene measures work. We know from the first wave of COVID-19 that the virus can be contained by hygiene measures. In April, as the number of new cases decreased to around 2000 per day, a complete lockdown was no longer necessary. The establishment of a Test Trace and Isolate System (TTI), the consistent wearing of masks, adherence to hygiene and distance rules, the cancellation of major events, travel restrictions, and voluntary contact restrictions were sufficient to reduce the number of new cases to less than 300 per day in June. In this phase, infection was no longer widespread but rather limited to local events. Over 100 districts did not register any new infections for at least one week. This has enabled a largely normalized life and extensive economic activity.

Test, trace, and isolate (TTI) strategies can contain the infection only together with DHM measures. Our model calculations show that TTI strategies are an effective tool for containing SARS-CoV-2 when the number of new infections is low. To illustrate with specific figures: Behaviour patterns like those before the epidemic lead to an average of 3 to 4 people being infected with SARS-CoV-2. To achieve stabilization, the infection rate must therefore be reduced by a factor of 3 or 4. Our studies show that the currently used TTI strategies are highly effective but only reduce this factor by 50%. The other contribution to the reduction results from seasonal effects and DHM measures. These DHM measures are necessary because a perfect implementation of the TTI strategies is not possible (e.g. because infections are asymptomatic or contacts remain undetected).

The testing capacity is limited. In Germany, only around 1.4 million PCR tests per week are currently available. This means that every person in Germany can be tested less than once a year on average. We must therefore reckon with limited test capacity at present. As a result, weekly precautionary tests (e.g. to protect persons at risk) cannot be implemented. It is therefore important to make targeted use of the available tests. This can be remedied by establishing efficient pooling strategies or by building up large capacities of PCR tests or other rapid tests.

In order for the TTI strategies to work as efficiently as possible, the contact persons must be isolated quickly. Ideally, they should be isolated before they become infectious. The decentralized Corona warning app can make an important contribution to quickly informing contact persons. Infected people who isolate themselves before they infect other people contribute to slowing down the infection process. The Corona warning app does help – even if it is used only by a small part of the population.

Preventive quarantine is an effective means of containing infections. Once an infection is confirmed, the contact clusters of the infected individual are identified. In simulations, the precautionary isolation of the entire cluster has proven to be highly effective at containing the spread of infections. If individuals isolate only after positive tests have been found in the cluster, valuable time is lost, and there is a risk of further

infections. A negative test result after the incubation period of 5–7 days may allow an early termination of the quarantine. However, if testing is carried out too early (i.e. during the incubation period), there is a risk of a false negative result. The tested person is given a false sense of security, which can lead to increased spread.

Avoiding super-spreading events can make a significant contribution to containing the epidemic. It can be assumed that the virus has a high dispersion. Potential super-spreading events are therefore of great importance. If these were avoided completely or reduced in scope, the number of reproductions could be significantly reduced. It is therefore advantageous to hold events and meetings on a much smaller scale than they had been before the outbreak of the pandemic.



Conclusion

Each individual contribution protects health, society, and the economy. The COVID 19 epidemic has also led to deaths in Germany and will unfortunately cause further deaths. Some patients who are considered to be recovering will still suffer from long-term health problems. At the same time, many economic livelihoods have been threatened or destroyed as a result of the COVID 19 epidemic. Many people have suffered from financial insecurity and limitations. Rising case numbers – whether with or without lockdown – would again result in considerable health, social, psychological, and economic costs. This can be prevented. If we manage to keep the number of new infections low, the chains of infection can be broken or at least contained. By following these prescribed measures, we help to protect lives and livelihoods and to normalize our social life. SARS-CoV-2 can be kept under control if everyone contributes according to their ability.

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