



January 22, 2022

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Risk assessment for the development of the covid-19 epidemic

The Statens Serum Institut (SSI) has been asked to prepare a status of the current infection situation, including expectations for the development in infection and hospitalizations in the coming months.

Status of the epidemic as of January 21, 2022

The epidemic continues to grow. A very high number of new daily cases of infection driven by the spread of infection with the SARS-CoV-2 omicron variant are observed, which is estimated to be more than 99 per cent. of all confirmed cases in week 3. Especially in recent days, historically high infection rates have been seen, where the number of new cases on 21 January 2022 rounded 46,000. An increasing test activity is also seen a record high positive percentage of 20.4 per cent. on January 21, 2021. The total 7-day incidence has increased to 3,792 cases per 100,000 per January 21, 2022, which is a noticeable increase compared to 2,137 cases per 100,000, as described in the risk assessment on 9 January.

The infection continues to vary between different parts of the country. The Capital Region of Denmark is still hardest hit with a 7-day incidence of 4,339 cases per 100,000 and a positive percentage of 23 per cent. per 21 January, where the Region of Southern Denmark has a 7-day incidence of 3,086 cases per 100,000 and a positive percentage of 18. Vaccination coverage continues to increase, and in the total population is up to 81 per cent, of which the proportion who have received revaccination is 59 pct. as of January 21st.

The growth in infection rates has recently been assessed to be driven by a large increase in infection among children of pre- and school age corresponding to the age groups 3-5 years, 6-11 years and 12-15 years. This pattern is a change compared to the period right up to and over Christmas and New Year, when the infection rates were highest among the younger adults. The change in the age distribution is assessed, among other things, to reflect the start of school after the Christmas holidays. On the other hand, the growth in the infection seems to have stabilized for the age groups from 19-29 years, who have experienced a more subdued infection development since week 1. For the parental generation of 30-49 year olds, there is also an increase in the infection, while there is a stable development among the older age groups over 50 years, which is also reflected among the nursing home residents, where the number of infections has developed stably since week 1.

The total number of inpatients with a positive test result for SARS-CoV-2 has increased compared to the assessment on 9 January to 781 inpatients (as of 22 January), and has periodically exceeded 800 in the period since 9 January. The number of inpatients in intensive care is 45 patients per. 22 January, and has thus fallen since the risk assessment on 9 January. Over the past 2 weeks, the number of admissions has averaged 184 new admissions per day, with signs of stabilization since the beginning of January. Among the admissions, the proportion of patients who are assessed as being admitted by others increased



causes than covid-19, from 27 per cent. in week 51 to 31 per cent. in week 52. The statement for week 52 is the latest available figure due to post-registration. It is especially among the younger patients between 0-59 years, that the proportion assessed to be hospitalized with a covid-19 diagnoses has decreased. In week 52, the proportion was 58 per cent. compared with 60 per cent. in week 51. For the elderly over 60 years, it is estimated to remain close to 80 per cent. who are admitted due to covid-19 also in week 521 .

It should be noted that the incidence of new admissions has stabilized in the age groups 40-64, 65-79 and +80 years from (week 51 to week 52), where in the same period there has been an increasing incidence of new admissions in the younger age groups.) .

Figure 1 below describes the development in the number of new admissions in relation to the number of new daily cases of infection 10 days earlier. Data are calculated in the period from 1 November to 10 January 2022. Where the admission rate at the beginning of November was around 3 per cent, it is at the end of the period around 1.5 per cent. The graph shows a tendency for further stabilization in the hospitalization rate compared with the rate described in the risk assessments from resp. 3 January and 9 January 2022. The declining growth from 1 November to mid-December is estimated to reflect a declining risk of hospitalization due to the roll-out of vaccinations, a declining risk of hospitalization related to the delta variant, and that omikron continues to be associated with a reduced risk of hospitalizations compared to the delta variant. This has not changed, although from the end of December 2021 very high daily infection rates related to omikron have been seen.

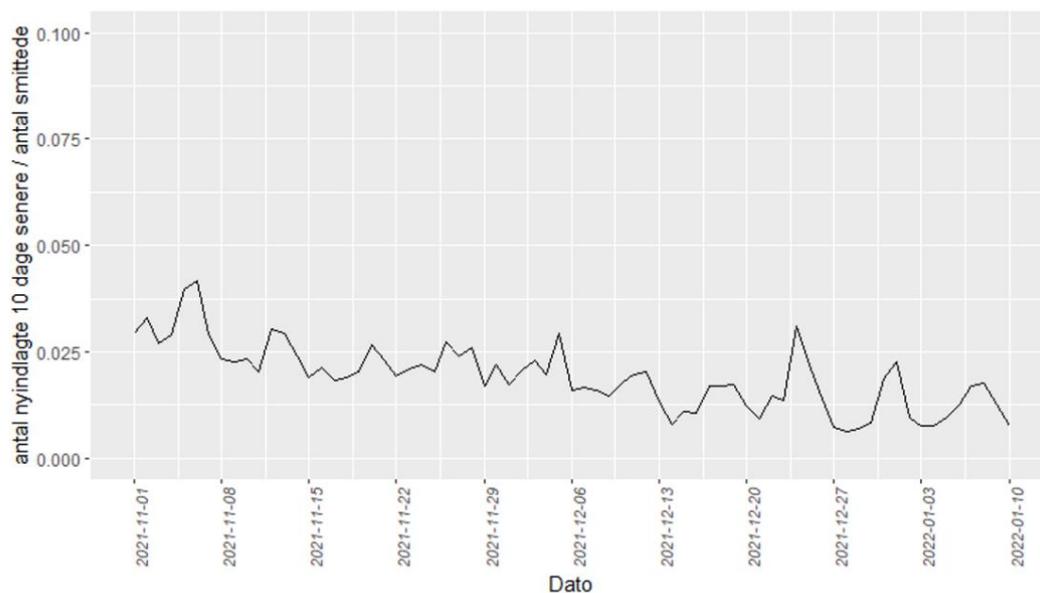


Figure 1. Number of new admissions per number infected 10 days earlier in the period 1 November 2021-10. January 2022.

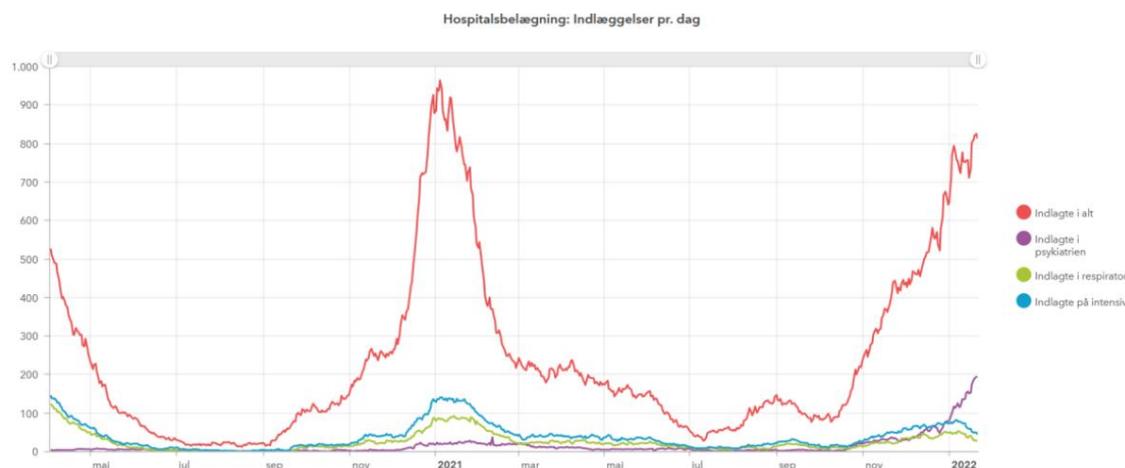


Figure 2 shows the development in the covid-19 related hospital occupancy per day divided into total, psychiatry, intensive care and hospitalized in respirator.

Figure 2 shows that an increasing proportion of the inpatients are patients admitted to a psychiatric ward. Furthermore, the figure also shows a significant decrease in the number of inpatients in intensive care units.

The decrease in the number of admissions to intensive care units is happening despite the high infection rates. The latest report from the Danish Intensive COVID database is described, in line with the general development in all admissions, a higher proportion of patients admitted for reasons other than covid-19. This development seems to coincide with the fact that omicron has become the dominant variant among inpatients in intensive care units.

The number of daily covid 19-related deaths has been rising slightly in recent weeks. So far, there are an average of 13 covid 19-related deaths daily in January 2022 compared to an average of 10 covid 19-related deaths in December 2021 and an average of 6.5 covid 19-related deaths daily in November 2021.

As with the admissions, it is estimated that a greater proportion of covid-19-related deaths will be due to causes other than covid-19 when the incidence is as high as it currently is in society.

The number of deaths where a positive SARS-CoV-2 test has been found within 30 days in advance must also be expected to be affected by the high infection rates in society in general, and the number of covid-19 related deaths may be overrated. Data from the monitoring program EuroMOMO at SSI show that a significant excess mortality has been seen in Denmark from week 49 in 2021 to week 1, especially among the 75+ year olds. Similarly, in many European countries a marked excess mortality is seen, not only in the older age groups, but also among people aged 45-64 years.

There are no immediate causes for this excess mortality to point to other than the widespread infection with the covid-19 delta variant. As mentioned, the development in excess mortality up to the end of December 2021 is assessed primarily to reflect the delta variant, but due to post-registrations, data for the

² Danish Intensive COVID-19 report, 20 January 2022. <https://www.rkkp.dk/siteassets/de-clinical-quality-databases/databases/intensive-database/>



recent weeks are uncertain, so whether the development continues, now that the infection is primarily driven by omicron, can not yet be assessed.

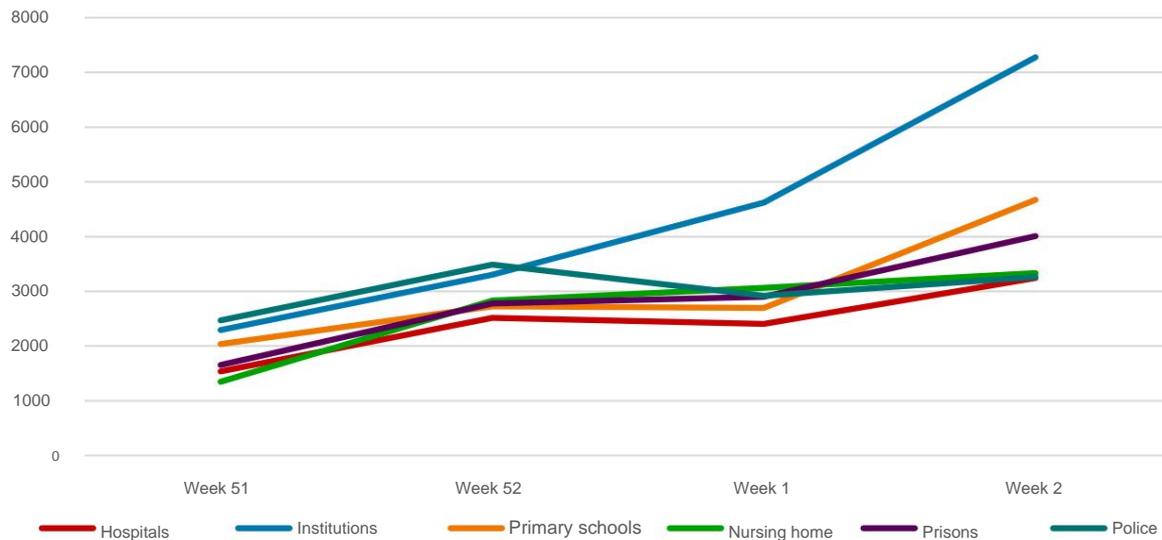


Figure 3. Development in incidence in the period week 51 2021-week 2 2022 divided into selected staff groups.

SSI and the Danish Health and Medicines Authority have continuously monitored the incidence of infection in selected staff groups, and Figure 3 above describes the development in the incidence within some of the staff groups that are assessed to be employed in critical societal functions. In general, the incidence for the specific staff groups is above the national incidence throughout the period. The highest level of infection is currently seen among the staff in day care institutions, which in week 2 reached an incidence of 7,277 cases per 100,000 staff. Overall, the graph includes staff groups that have close contact with citizens, including vulnerable groups, and who fill functions that are considered socially critical. It should be borne in mind that the high number of cases of infection will give rise to a high level of secondary sickness absence, which already in the current situation entails a great deal of pressure within several of the specific occupations.

Status BA.2

In a short time, omikron has become the dominant variant in Denmark due to its increased growth potential. Worldwide, BA.1 is the most frequent sub-variant, according to GISAID 98%, while BA.2 is approx. 1.6%. BA.1 has been the most frequent sub-variant in Denmark until the beginning of January, but within the last few weeks BA.2 has developed rapidly, and it is estimated that the variant became dominant in Denmark during week 2. BA.2 spreads thus rapidly, and accounts for an ever-increasing proportion of Omikron cases. Preliminary calculations indicate that BA.2 is effectively more than one and a half times more contagious than BA.1. The same pattern with increase in BA.2 - is not seen as markedly in other countries. In the UK, Sweden and Norway, there is also an increase in BA.2 cases, but there are relatively not nearly as many BA.2 cases as in Denmark. The reason for this difference is known



not yet, but it may be important that there are differences in vaccination coverage or in contact patterns on the basis of restrictions, population density, etc.

BA.2 differs from BA.1 by several mutations in the spike protein, including in the receptor binding domain (the part of the virus that binds to the airways). It is not yet known what significance these mutations have in relation to infectivity and evasion of immunity after previous infection or vaccination, or severity.

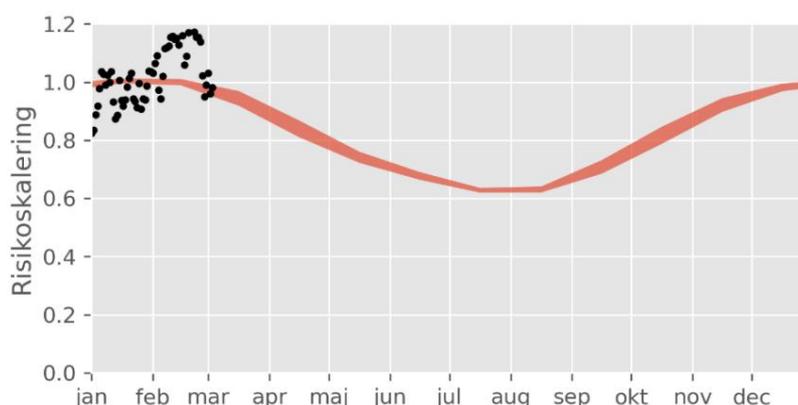
BA.2 was first detected in the Capital Region, but the geographical distribution in recent weeks is similar to the distribution of BA.1 with geographical spread to the whole country, and there are no immediate clear signs of discrepancies between BA.1 and BA.2 in relation for distribution by sex or age. Preliminary analyzes do not suggest that BA.2 is associated with an increased risk of hospitalization. More detailed analyzes of BA.2's infectivity and ability to dodge antibodies following previous vaccination and infection are ongoing.

Considerations about whether one can be infected with BA.1, and then BA.2, are still of a theoretical nature and unclear at present, but SSI follows this in Denmark and internationally.

Seasonal effect

The figure below graphically shows the expected seasonal effect from the Expert Group for Mathematical Modeling of the covid-19 season model. The model is based on analyzes of the relationship between temperature, population density and infection rate in 2020³, and is assessed against long-term forecasts for the temperature from DMI (black dots). If data for the climate norm in Denmark are used in the model, it is estimated that the seasonal effect gradually reduces the spread of infection, and the reduction can be up to 35 per cent. in spread of infection in July and August compared to mid-January (red graph in Figure 4).

Here it is seen that due to expected colder temperatures in DMI's long-term forecasts for February 2022 than the climate normal, a reduction in the infection, due to the seasonal effect, will only occur in the middle of March.



³ https://covid19.ssi.dk/-/media/arkiv/subsites/covid19/modelberegninger/teknisk-baggrundsrapport_26032021.pdf?la=from



Figure 4: Model for the seasonal effect. The figure shows the expected scaling of the risk of infection over the year. The red range is based on the climate normal in Denmark, while the black dots indicate actual temperatures and long-term forecasts from DMI. The seasonal effect is thus expected to have the greatest positive effect around July-August and the greatest negative effect in January-February.

The WHO announced on 11 January that up to 50% of all Europeans should expect to be infected in the following 6-8 weeks⁴. As shown in Figure 4, no decrease in infection is expected due to the seasonal effect during that period.

On 22 December 2021⁵, the expert group has projected infection rates and new admissions until March, and the infection is expected to peak at the end of January in a range from 25,000 to 55,000 daily cases. Relief restrictions have subsequently been introduced in the field of culture and in the business sector, which have not been included and which may result in higher infection rates than projected. Thus, a slowdown in infection is not only due to the expected seasonal effect, but will be a result of the built-up immunity in the population after the omicron infection has been combined with the high vaccination rate.

in continuation of the recent roll-out of the 3rd plug, and thus cross-immunity from the past infection with previous variants which together will contribute to reducing the SARS-CoV-2 infection in Denmark.

It is not expected that the seasonal effect will change significantly before March, when it is expected to decrease the infection over the summer.

Expectation of development in infection and hospitalizations in the coming months

On 6 January 2022, the expert group for mathematical modeling published a supplementary memorandum in which the daily infection rate and number of new admissions are simulated until the end of February. The simulation was made on 22 December. The model calculations showed that the daily infection rate was expected to peak at the end of January, after which the curve was expected to fall. From the beginning of January, the observed infection rates have been within or close to the range for the total number of infected, see Figure 5. A clear weekly effect is seen, where infection rates jump upwards at the beginning of the week, but fall slightly during the week. At the end of week 2, however, an increase in infection rates was seen, indicating that the epidemic is still growing. At the beginning of week 3, very high infection rates were seen. In continuations of easing of restrictions in mid-January, and any further easing during January and February, there is a risk that the infection rates will increase, and the expected decrease in infection rates will therefore only happen a little later in February. Thereafter, increasing immunity in the population and the seasonal effect during March will contribute to the decrease in infection. However, there is a fundamental uncertainty in the projections in relation to the so-called "dark figure", which until now has been estimated to be in the order of 2 undiagnosed cases per detected case.

However, this rate must be expected to change if further changes are made to the overall testing strategy. At the same time, i.a. heterogeneity and limited PCR test capacity additional uncertainty about how high infection rates can be expected.

⁴ <https://www.euro.who.int/en/media-centre/sections/statements/2022/statement-update-on-covid-19-omicron-wave-threatening-to-overcome-health-workforce>

⁵ <https://covid19.ssi.dk/-/media/cdn/files/tillqsnotat-af-den-6-januar-2022-til-ekspert rapport-af-den-17-december-2021endelig.pdf? la = da>



The model is adapted to the sub-variant of the omicron variant, BA.1, which became dominant in mid-December. The development in the sub-variant BA.2 therefore entails some uncertainties if BA.2 is more contagious than BA.1. An increased infectivity for BA.2 can be expected to increase the peak of infection spread, just as it may delay the time when the expected decrease in infection sets in.

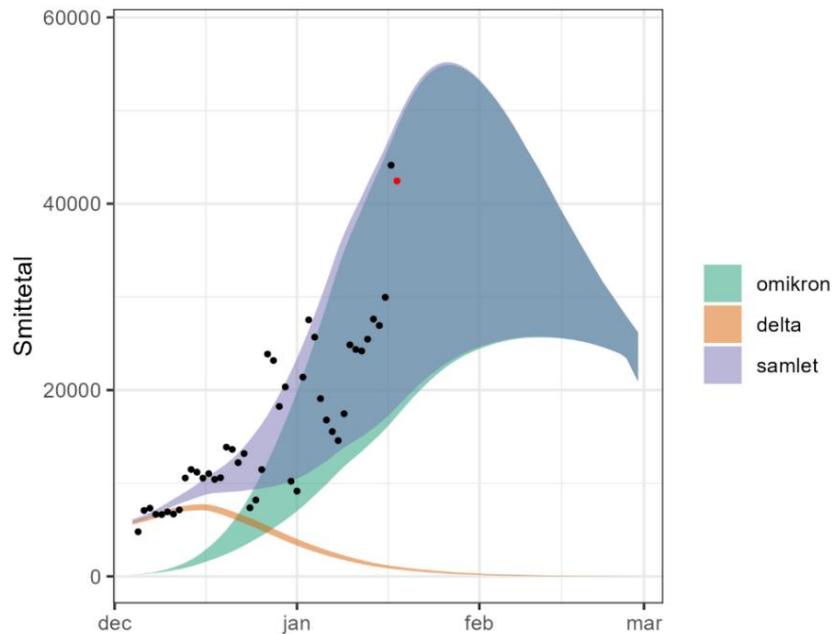


Figure 5. Daily simulated infection rates in pop10 from Supplementary Note of 6 January 2022. The expected infection rates are shown for the omicron variant (green), the delta variant (orange) and the total expected infection rate (purple). The observed total infection rates are marked with black dots. (D. January 18 is colored red to indicate that there are no responses to all samples from that day yet).

Figure 6 shows the expected daily new admissions, simulated on 22 December, with observed data up to 19 January, where it is noted that the observed figures for the new admissions in the previous weeks are within the simulated range. There will be a similar uncertainty about the time when the number of derived new admissions, due to high infection rates, will occur, and if the infection rates only fall later, the number of new admissions must be expected to follow this development.

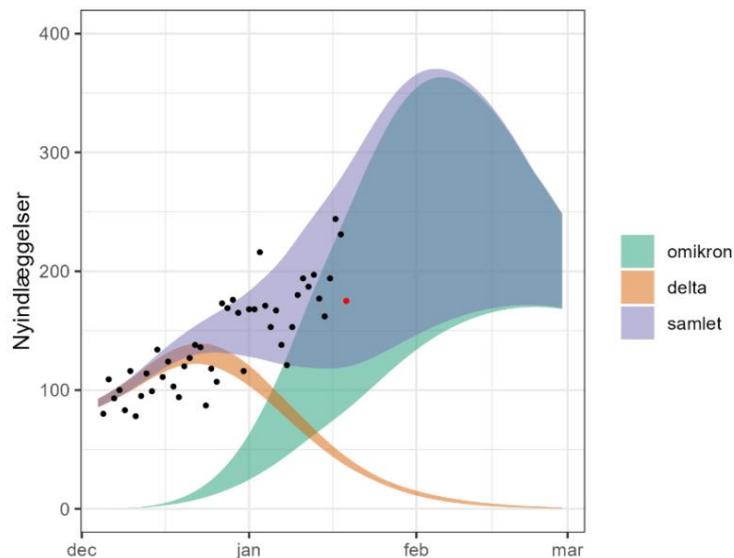


Figure 6. Daily simulated number of new admissions in pop10 from Supplementary Note of 6 January 2022. The expected number of new admissions is shown for the omikron variant (green), the delta variant (orange) and the total expected infection rate (purple). The observed total number of new admissions is marked with black dots. (January 19 is colored red to indicate that data from that day have not yet been fully calculated). It is assumed that the admission risk for the omikron variant is half as great as for the delta variant.

Overall assessment

The epidemic has been growing through the autumn, and with the introduction of omikron, the number of new cases has accelerated. The acceleration has occurred as a result of the increased scattering potential related to the omikron variant. In parallel with the rising infection rates, there has been a relatively lower growth in the number of covid-19 related admissions, and there is now a declining number of admissions to intensive care units.

With the omikron variant, infection rates have risen to the highest level during the entire epidemic, and in continuation of the start of school after the Christmas holidays, it is now the kindergarten and school children who have the highest infection rates. Data show that omikron is associated with a greater spread potential and lower risk of serious disease outbreaks compared to the delta variant. These characteristics, together with the roll-out of vaccination, help to explain the overall change that has taken place in the pattern of

epidemic. Despite historically high infection rates, a declining rate of hospitalization is observed as well as an increasing proportion of infected people who are assessed to be hospitalized for reasons other than covid-19. A significant effect on the risk of hospitalization between vaccinated and unvaccinated persons is still observed, and the vaccine efficacy against covid-19-related hospitalizations with the omikron variant is still considered to be high.

Omicron infection is primarily driven by BA.1 and BA.2, with BA.1 being the most prevalent subvariant to date. However, BA.2 has, especially in Denmark, had an increased growth, and is assessed since week 2 to be more frequent than BA.1. There are currently no data to support a major difference in the epidemiological distribution or severity of BA.2 compared to



BA.1, but SSI is following developments closely. If BA.2 is more contagious and / or has a better ability to evade immunity, it may mean that the omicron wave of infections will be higher than projected, and will probably extend further into February than previously projected. This development could lead to a further increase in the number of derivative new admissions.

In the risk assessment from 3 January, the projection of covid-19 related admissions was 150 to 360 daily new admissions at the beginning of February. SSI continues to assess that there is a risk of derivative admissions due to the high infection rates. But in parallel with the high daily infection rates, it must also be expected that an increasing proportion of admissions will occur for reasons other than covid-19. Most recently, the share of reasons other than covid-19 is estimated to be 31 per cent. in week 52. In addition, the incidence of omicron among admissions is increasing, which is generally expected to lead to shorter hospitalization process.

The high number of daily cases of infection already challenges a large number of socially critical functions, and within a number of specific occupations, very high and ever-increasing infections are seen, which can be expected to further challenge sickness absence in the coming weeks.

Overall, SSI estimates that the epidemic is still growing and that there is still a risk that infection rates will increase further in the coming weeks. These increases in the number of new cases continue to also carry a risk of an increase in the derivative admissions. When the infection will peak and how high infection rates will be registered will, among other things, depend on the further development of BA.2.