Copenhagen Economics

THE IMPACT OF REMDESIVIR IN THE EUROPEAN UNION

Increasing hospital capacity, generating cost savings, and saving lives

March 2023

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The benefits of remdesivir in the European Union

Saving lives and Increasing hospital capacity

In July 2020, remdesivir became the first antiviral therapy approved for COVID-19 in Europe

Soon after the outbreak of the COVID-19 pandemic, remdesivir was studied as a potential treatment for COVID-19 patients. In July 2020, remdesivir received conditional marketing authorisation for the treatment of COVID-19 in adults and adolescents from 12 years of age with pneumonia who require supplemental oxygen. Since December 2021, remdesivir is also indicated for adult COVID-19 patients who do not require supplemental oxygen but who are at an increased risk of progressing to severe COVID-19. Overall, clinical trials have demonstrated a strong potential for remdesivir to reduce patient hospitalisation days, limit the need for intensive care units (ICUs) for COVID-19 patients and keep many patients out of hospitals altogether. These results made a strong case for EU member states to rely on remdesivir in their battle against the pandemic.

In July 2022, Gilead Sciences signed a New Joint Procurement Agreement (JPA) with the European Commission[1]

The agreement covers purchases of remdesivir over a period of twelve months with the possibility for a six month extension, following the expiration of the original JPA[2] agreement with the EU Commission. With the new JPA for remdesivir, Gilead is able to continue helping governments across Europe ensure rapid access to a COVID-19 critical treatment for hospitalised patients.

Remdesivir saves patient lives and frees up capacity for the European healthcare systems

We have estimated the effects of remdesivir in 2021, 2022 and 2023 in terms of ICU capacity and lives saved. The clinical effect of remdesivir has previously been shown by Beigel JH, et al. in the ACTT-1 study[3] and by Gottlieb et al. in the PINETREE study.[4] We have based our analyses on these clinical trials to estimate the effect on hospital capacity and saved lives. Our estimations show a clear benefit from remdesivir.

We find that in 2021 remdesivir freed up 550,900 hospital beds and 377,800 beds at the ICU. For 2022, we estimate that remdesivir helped free up 1,484,000 hospital beds and 796,000 ICU beds.

For 2023, we project a lower patient number but continued use of remdesivir. With these assumptions, remdesivir could help free up 305,000 hospital beds and 164,000 ICU beds.

Our estimations rely on a model for benefits derived from remdesivir.

Our estimations of these benefits are based on a model relying on a combination of observed data, data from clinical trials, and conservative assumptions.

For 2021, the estimations assume that 50 percent of all eligible patients across the EU have been treated with remdesivir. Actual usage of remdesivir varies across EU member states, e.g., almost all eligible patients in Denmark and Romania have been treated. This was not considered in the estimations.

For 2022, the estimations rely on the number of COVID-19 cases in the EU and compare the scenario of treating all eligible patients with the scenario of not treating any patients.

For 2023, the estimations rely on modelled projections of the number of COVID-19 cases in the EU in 2023 and compare the scenario of treating all eligible patients with the scenario of not treating any patients.

Our estimations for ICU capacity are all based on freeing up resources of operating expenditures. This study has not considered the additional capital expenditures needed to tackle the pandemic, e.g., the extra costs of building up emergency hospital capacity, on top of historical health care requirements.

Sources: 1) European Commission (2022). European Health Union: Commission signs new Joint Procurement contract for COVID-19 therapeutic, Gilead Sciences (2022). Gilead Sciences Signs New Joint Procurement Agreement with the European Commission for Veklury® (Remdesivir) / 2) European Commission (2020). Coronavirus: Commission signs a joint procurement contract with Gilead for the supply of Remdesivir, Gilead Sciences (2020). Gilead Sciences Signs Joint Procurement Agreement With the European Commission for Veklury® (remdesivir) / 3) Beigel et al. (2020), remdesivir for the Treatment of Covid-19 — Final Report / 4) Gottlieb et al. (2022), Early Remdesivir to Prevent Progression to Severe Covid-19 in Outpatients

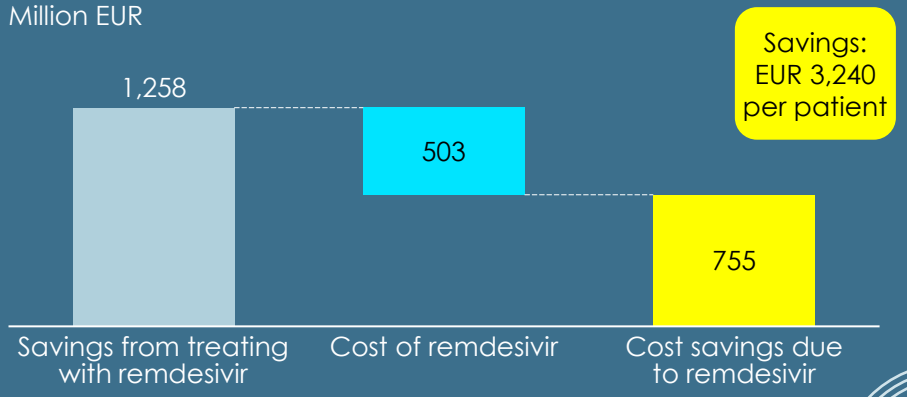
The estimated impact of remdesivir in the European Union in 2021

Saved lives, increased ICU capacity, and generated cost savings

Generated cost savings

Figure 1. Estimated cost savings due to remdesivir

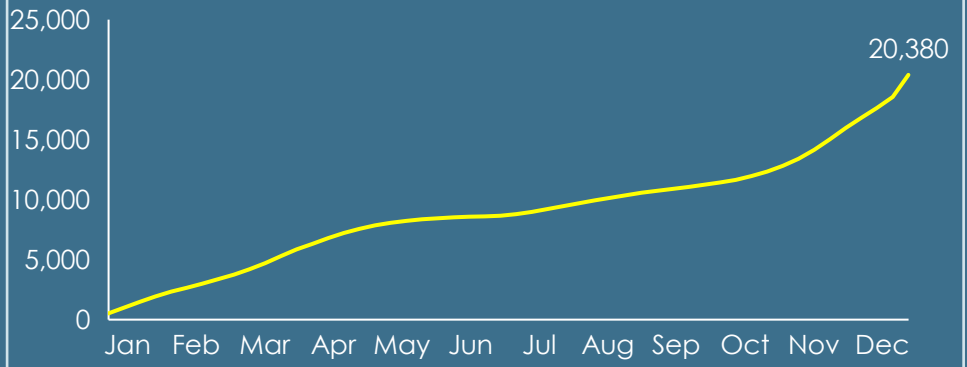
Million EUR



Lives saved

Figure 2. Estimated COVID-19 deaths avoided due to remdesivir

Accumulated number of deaths avoided



Delta

Increased Intensive Care Unit (ICU) capacity

Figure 3. Remdesivir's estimated effect on ICU capacity

Share of ICU capacity

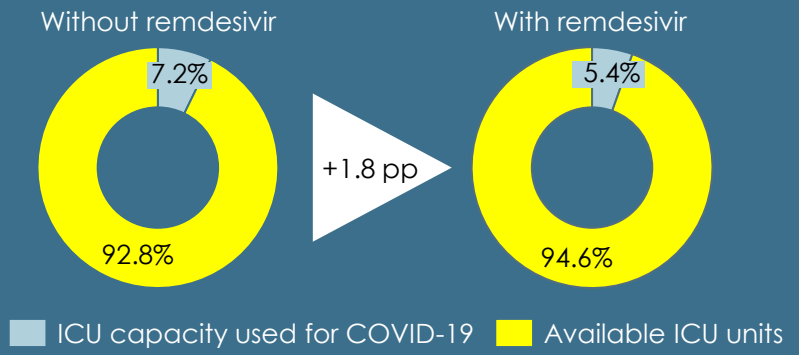
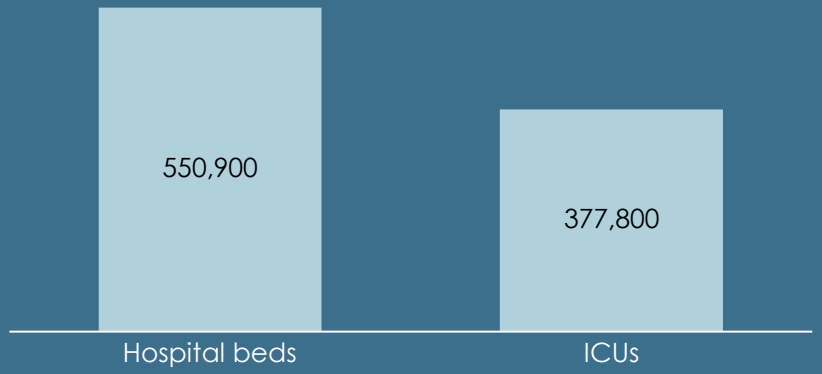


Figure 4. Remdesivir's estimated effect on available hospital beds and ICUs

Number of bed days saved



The benefits of remdesivir in the European Union in 2021

Our estimations combine clinical effects, epidemiological data, and conservative assumptions

Remdesivir has proven effective in multiple clinical trials

Remdesivir is superior to placebo in shortening the time to recovery in adults who have been hospitalised with COVID-19 and decreases the risk of respiratory tract infection, according to clinical trials.[1]

Remdesivir was initially indicated for hospitalised patients requiring supplemental oxygen.[2] The estimations presented for 2021 only include patients eligible for treatment when applying this label.

Number of cases and patient population in our model

The result in our model depends on the number of COVID-19 cases in 2021. In our model, we use the weekly number of cases in 2021 as our patient population.

Hospital admissions and transition between health states

In our model, we assume that 1.5% of people with the Delta variant of COVID-19 in 2021 were hospitalised.[3] We assume that 50% of people treated with supplemental oxygen received treatment with remdesivir, i.e., not all patients received the antiviral medicine. This assumption follows the 2021 EMA label for remdesivir. Specifically, we assume that 75% of all COVID-19 hospital admissions were patients requiring supplementary oxygen and that of these patients, only 50% received treatment with remdesivir.

The length of stay for each hospitalised patient depends on the state of their disease. In the clinical trials, patients were grouped into ordinal score (OS) groups ranging from 4 to 7 at the point of their admission. A higher number indicates a worse state of health. In our model, we assume that 25% of patients were hospitalised as OS4, 70% as OS5, 5% as OS6, and 0% as OS7. The transition into other OS groups and out of the hospital after the point of admission stems from clinical trials.[1]

As the label for remdesivir was expanded to include non-hospitalised adults at the end of 2021, we do not include any outpatients in this model.

Based on the number of patients, hospital admission distribution, and transition between OS groups with and without treatment with remdesivir, we arrive at two different scenarios: one where patients were treated with remdesivir and one where they were not. In the model with remdesivir treatment, in which hospitalised patients received an average of 6.25 vials, patients experience shorter lengths of stays, hence occupying fewer beds.

Deaths avoided

Treatment with remdesivir has a positive impact on the survival chances of COVID-19 patients. In a post hoc analysis, Beigel et al. (2020)[1] found a mortality hazard ratio of 0.73 following treatment with remdesivir. This corresponds to a reduction in the number of deaths among patients receiving treatment with remdesivir of 3.8 percentage points; from 15.2% to 11.4%.

ICU and hospital capacity

Treating COVID-19 patients with remdesivir decreases the duration of hospital admissions and frees up capacity in ICU and the general ward. When we estimate ICU and hospital beds occupied by COVID-19 patients, we use data on the number of hospital beds from Our World in Data and ICU beds from OECD.[4]

We estimate the number of occupied beds from the projected number of patients in each ordinal score (OS) group 15 days after treatment is initiated. We assume that the length of stay in the general ward for OS1-3, OS4, OS5, OS6, OS7, and OS8 is 2, 5, 7, 5, 5, and 2 days, respectively, in case of treatment without remdesivir. For the ICU, we assume the length of stay to be 0, 0, 0, 5, 2 and 2.5 days, respectively. For ICU plus ventilator, we assume the length of stay to be 0, 0, 0, 0, 10, and 12 days, respectively. To calculate the length of stay for patients treated with remdesivir, we use the rate ratios reported by Beigel et al. (2020).

Sources: 1) Beigel et al. (2020), remdesivir for the Treatment of Covid-19 — Final Report / 2) Gottlieb et al. (2022), Early Remdesivir to Prevent Progression to Severe Covid-19 in Outpatients / 3) Bager et al. (2022), Reduced risk of hospitalisation associated with infection with SARS-CoV-2 Omicron relative to Delta: A Danish cohort study / 4) OECD (2020), Health at a Glance: Europe 2020 – State of Health in the EU Cycle

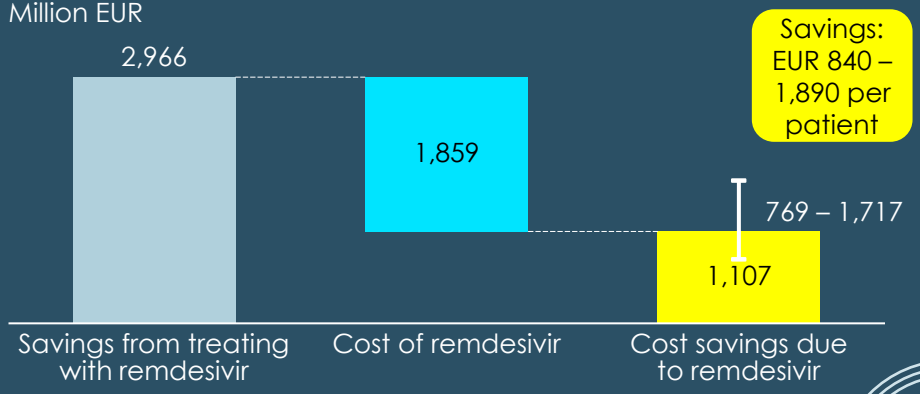
The estimated impact of remdesivir in the European Union in 2022

Saved lives, increased ICU capacity, and generated cost savings

Generating cost savings

Figure 5. Estimated cost savings due to remdesivir

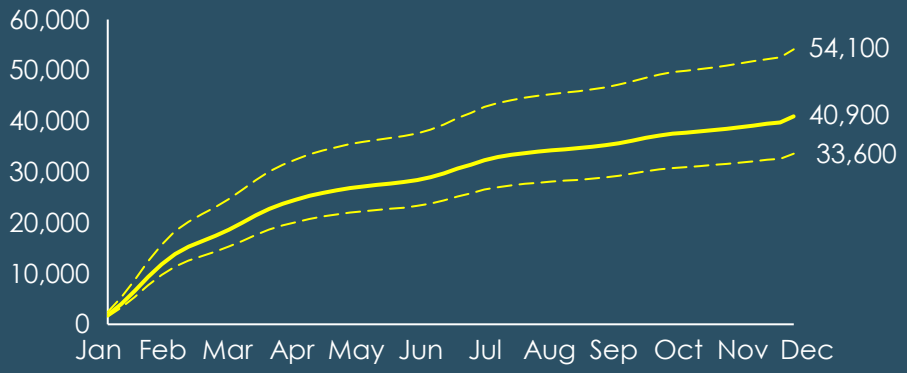
Million EUR



Saving lives

Figure 6. Estimated COVID-19 deaths avoided due to remdesivir

Accumulated range of number of deaths avoided



Omicron

Increasing Intensive Care Unit (ICU) capacity

Figure 7. Remdesivir's estimated effect on ICU capacity

Share of ICU capacity, range

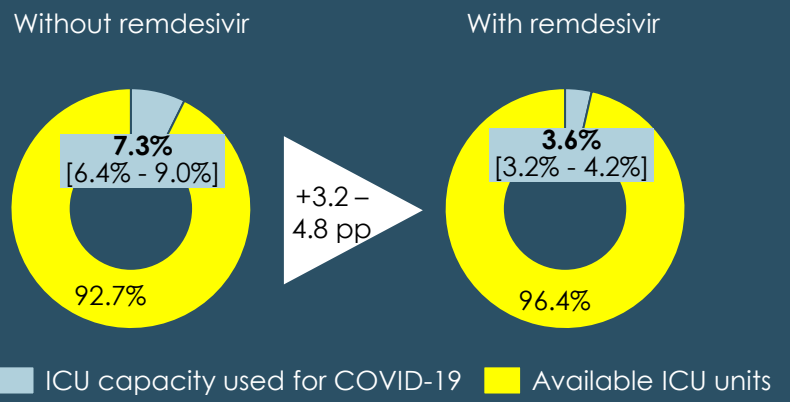
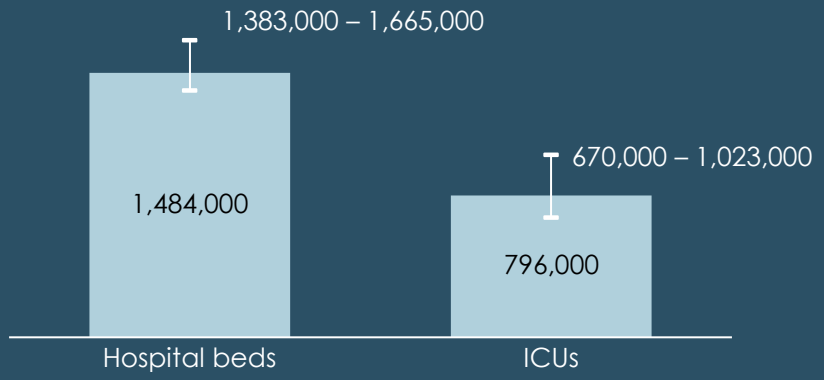


Figure 8. Remdesivir's estimated effect on available hospital beds and ICUs

Number of bed days saved, range



The size of the benefits of remdesivir in 2022 are uncertain and all results are therefore presented in ranges. These ranges are based on sensitivity analyses varying the assumption of the distribution of severity at hospitalisation, see further description on the next pages.

The benefits of remdesivir in the European Union in 2022

Our estimations combine clinical effects, epidemiological data, and conservative assumptions

Remdesivir has proven effective in multiple clinical trials

Remdesivir is superior to a placebo in shortening the time to recovery in adults who have been hospitalised with COVID-19 and decreases the risk of respiratory tract infection, according to clinical trials.[1]

In late 2021, the indication of remdesivir in the European Union was expanded to include non-hospitalised adults at an increased risk of progressing to severe COVID-19. Using remdesivir can keep a share of these high-risk patients out of hospital. Since then, remdesivir treatment has been used to reduce the number of patients admitted to hospitals due to COVID-19. Prior to the expansion, remdesivir was indicated only for hospitalised patients requiring supplemental oxygen.[2] This change of the indication to include outpatients is included in our modelling for 2022.

Number of cases and patient population in our model

The result in our model depends on the number of COVID-19 cases in 2022. In our model, we use the weekly number of cases in 2022 as our patient population.

Hospital admissions and transition between health states

In our model, we assume that 0.6% of people with the Omicron variant of COVID-19 in 2022 will be hospitalised.[3] We assume that all of these patients will be treated with remdesivir.

The length of stay for each hospitalised patient depends on the state of their disease. In the clinical trials, patients are grouped into ordinal score (OS) groups ranging from 4 to 7 at the point of their admission. A higher number indicates a worse state of health. In our model, we assume that 47.5% of patients are hospitalised as OS4, 47.5% as OS5, 5% as OS6, and 0% as OS7. The transition into other OS groups and out of the hospital after the point of admission stems from clinical trials.[1]

In addition to hospitalised patients being treated with remdesivir, our patient population includes some high-risk patients who tested positive for COVID-19. We assume that 29% of all new cases are high-risk patients. Of these, we assume that 5% will show severe symptoms, but only 10% of these will be directly hospitalised at the onset of their disease to be treated for three days.[4] Some of these high-risk patients will not respond to the treatment with remdesivir and their disease will progress and require supplementary oxygen. These patients will not receive additional remdesivir in their continued treatment as they did not respond to the initial treatment.

Based on the number of patients, hospital admission distribution, and transition between OS groups with and without treatment with remdesivir, we arrive at two different scenarios: one where patients are treated with remdesivir and one where they are not. In the model with remdesivir treatment, patients experience shorter lengths of stays, hence occupying fewer beds.

Hospitalised patients will on average receive 6.25 vials, and high-risk patients will receive a total of 4 vials during their three-day treatment at the hospital.

Avoided deaths

Treatment with remdesivir has a positive impact on the survival chances of COVID-19 patients. In a post hoc analysis, Beigel et al. (2020)[1] found a mortality hazard ratio of 0.73 following treatment with remdesivir. This corresponds to a reduction in the number of deaths among patients receiving treatment with remdesivir of 3.8 percentage points; from 15.2% to 11.4%.

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The benefits of remdesivir in the European Union in 2022

Our estimations combine clinical effects, epidemiological data, and conservative assumptions

ICU and hospital capacity

Treating COVID-19 patients with remdesivir decreases the duration of hospital admissions and frees up capacity in ICU and the general ward. When we estimate ICU and hospital beds occupied by COVID-19 patients, we use data on the number of hospital beds from Our World in Data and ICU beds from OECD.[1]

We estimate the number of occupied beds from the projected number of patients in each ordinal score (OS) group 15 days after treatment is initiated. We assume that the length of stay in the general ward for OS1-3, OS4, OS5, OS6, OS7, and OS8 is 2, 5, 7, 5, 5, and 2 days, respectively, in case of treatment without remdesivir. For the ICU, we assume the length of stay to be 0, 0, 0, 5, 2 and 2.5 days, respectively. For ICU plus ventilator, we assume the length of stay to be 0, 0, 0, 0, 10, and 12 days, respectively. To calculate the length of stays for patients treated with remdesivir, we use the rate ratios reported by Beigel et al. (2020).[2]

Sensitivity analyses

As the severity of COVID-19 and hospitalisation status used in the model are based on assumptions and data from 2021, we perform two sensitivity analyses. The purpose of these sensitivity analyses is to provide lower and upper bounds of the results by varying a main assumption in the model.

To arrive at the lower bound estimates, we change the admission assumption to 60% of patients hospitalised as OS4, 35% as OS5, 5% as OS6, and 0% as OS7. Increasing the share of patients hospitalised as OS4 represents a variant of the virus that is less severe than the current Omicron variant.

To arrive at the upper bound estimates, we change the admission assumption to 25% of patients hospitalised as OS4, 70% as OS5, 5% as OS6, and 0% as OS7. This admission distribution represents a variant as severe as the variant of concern in 2021, the Delta variant.

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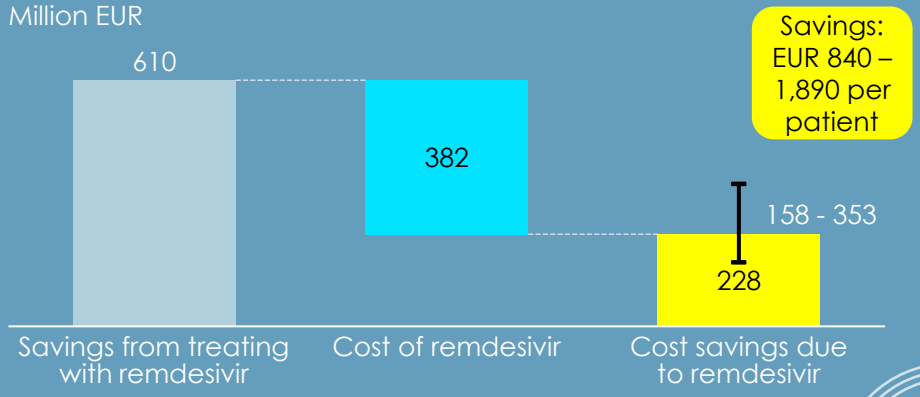
The estimated impact of remdesivir in the European Union in 2023

Saving lives, increasing ICU capacity, and generating cost savings

Generating cost savings

Figure 9. Estimated cost savings due to remdesivir

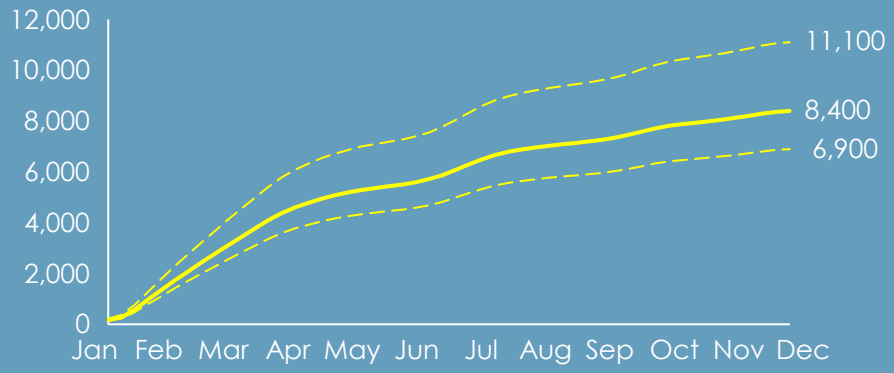
Million EUR



Saving lives

Figure 10. Estimated COVID-19 deaths avoided due to remdesivir

Accumulated range of number of deaths avoided



2023

Increasing Intensive Care Unit (ICU) capacity

Figure 11. Remdesivir's estimated effect on ICU capacity

Share of ICU capacity, range

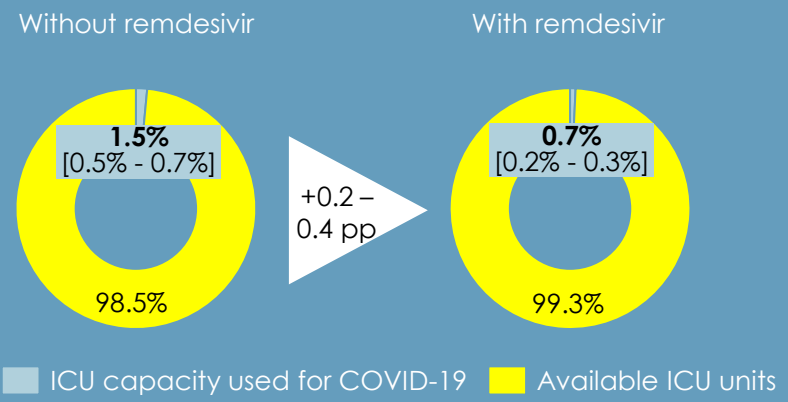
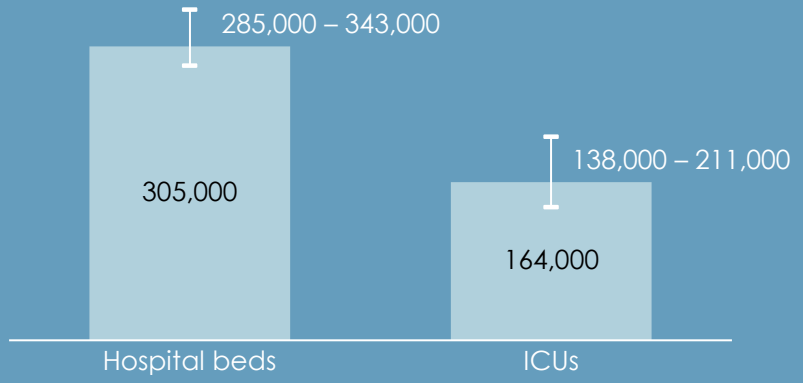


Figure 12. Remdesivir's estimated effect on available hospital beds and ICUs

Number of bed days saved, range



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The benefits of remdesivir in the European Union in 2023

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Number of cases and patient population in our model

The result in our model depends on the number of COVID-19 cases in 2023. In our model, we use the actual number of patients in the first two weeks of 2023. Hereafter, we use the patient projection made by IHME up until 1 April 2023.[3] Hereafter, we project the number of cases in 2023 based on the growth rate in the daily number of patients in 2022.

Hospital admissions and transition between health states

In our model, we assume that 0.6% of people with the Omicron variant of COVID-19 in 2022 will be hospitalised.[4] We assume that the same holds for 2023. We also assume that all of these patients will be treated with remdesivir.

The length of stay for each hospitalised patient depends on the state of their disease. In the clinical trials, patients are grouped into ordinal score (OS) groups ranging from 4 to 7 at the point of their admission. A higher number indicates a worse state of health. In our model, we assume that 47.5% of patients are hospitalised as OS4, 47.5% as OS5, 5% as OS6, and 0% as OS7. The transition into other OS groups and out of the hospital after the point of admission stems from clinical trials.[1]

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The benefits of remdesivir in the European Union in 2023

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