**Supplementary Material**

**The value of artificial intelligence for the treatment of mechanically ventilated intensive care unit patients: An early health technology assessment**

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*Equation 1*

$$ICER=\frac{Costs treatment - Costs care as usual}{QALYs treatment - QALYs care as usual}$$

*Equation 2*

$incremental NMB=\left(QALYs treatment – QALYs care as usual\right)\*WTP - (Costs treatment - Costs care as usual$).

*Equation 3*

$$Price per bed per year \left(2021\right)= \frac{Set up and installation +Training}{number of beds\*nunber of years system lasts}+hardware+service and remote support+licensing$$

$$=\frac{25,000+5,000}{20\*10}+\left(500+600+800\right)=€ 2,050$$

*Table 1. Parameters of the health-economic model*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Group of parameters** | **Parameter** | **Base case (i.e., mean)** | **Standard deviation** | **One-way sensitivity analysis boundaries** | **Distribution probabilistic sensitivity analysis** | **Source** | **Studied population in source** |
| *Population parameters* | Mechanically ventilated ICU bed occupancy1 | 4.4% | NA | NA | NA | European Centre for Disease Prevention and Control, 2022 (1) and Statisches Bundesamt, 2022 (2) and Zwerwer et al. (2024) (3) | German COVID-19 ICU patients |
|  | Age | 63 | NA | NA | NA | Zwerwer et al. (2024) (3) | German mechanically ventilated COVID-19 patients |
|  | Female | 37.49% | NA | NA | NA | Kloka, Blum, Old, Zacharoswki and Friedrichson, 2022 (4) | German ICU COVID-19 patients |
| *In-hospital parameters* | Length of stay general ward | 4.15  | 7.74 | 95% ci:  3.38-4.92  | Gamma | Based on data on file of Zwerwer et al. (2024) (3) | German mechanically ventilated COVID-19 patients |
|  | Length of stay ICU not mechanically ventilated | 5.31  | 6.72 | 95% ci 4.63 – 5.98  | Gamma | Based on data on file of Zwerwer et al. (2024) (3) | German mechanically ventilated COVID-19 patients |
|  | Duration of mechanical ventilation | 11.13 | 14.87 | 95%ci:  9.64 -12.62 | Gamma | Based on data on file of Zwerwer et al. (2024) (3) | German mechanically ventilated COVID-19 patients |
|  | In-hospital mortality | 33.36% | 0.001 | Base case +- 0,10\*base case: 30.02- 36.70  | Beta | Kloka, Blum, Old, Zacharoswki and Friedrichson, 2022 (4) | German ICU COVID-19 patients |
| *Recovery state* | Duration of mechanical ventilation for non-disabled or mildly disabled patients post discharge2,3,4A | 4.18 | 3.62 | Base case +- 0,10\*base case:3.76- 4.60 | Gamma | Hodgson et al. (2017) (5) | Australian mechanically ventilated ICU patients |
|  | Duration of mechanical ventilation for moderately to severely disabled patients post discharge2,3,4A | 6.06 | 6.14 | Base case +- 0,10\*base case:5.45-6.67 | Gamma | Hodgson et al. (2017) (5) | Australian mechanically ventilated ICU patients |
|  | Probability of being moderately to severely disabled post discharge3 | 24.81% | 0.03 | 95% ci: 19.79 – 30.58 | Beta | Hodgson et al. (2017) (5) | Australian mechanically ventilated ICU patients |
|  | Odds ratio of days of mechanical ventilation for being moderately to severely disabled post discharge  | 1.04 | 0.33 | 95% ci: 1.01-1.08  | Lognormal | Hodgson et al. (2017) (5) | Australian mechanically ventilated ICU patients |
|  | Six months mortality  | 6.21% | 0.003 | 95% ci: 5.65-6.83 | Beta | Günster et al. (2021) (6)  | German hospitalized COVID-19 patients |
|  | Time to post-discharge mortality2 | 15.63 | 4.44 | Base case +- 0,10\*base case: 14.07 – 17.19 | Gamma, bounded from above at 180 days after hospital admission | Moestrup et al. (2022) (7) | Danish ICU COVID-19 patients |
| *Life expectancy* | Life expectancy for a female of age 63 | 23.09 | NA | NA | NA | Federal Statistics Office (2022) (8) | General German population |
|  | Life expectancy male of age 63 | 19.83 | NA | NA | NA | Federal Statistics Office (2022) (8) | General German population |
| *Utilities* | General ward disutility4B,5 | 0.49 | 10% \* base case:0.05 | Base case +- 0,10\*base case:0.44 – 0.54 | Beta  | Institute for clinical and economic review (2020) (9) | Patients with influenza or *Clostridium difficile* infection |
|  | ICU not mechanically ventilated disutility4B,5 | 0.69 | 10%\* base case: 0.07 | Base case +- 0,10\*base case:0.62 – 0.76 | Beta  | Institute for clinical and economic review (2020) (9) | Patients with influenza or *Clostridium difficile* infection |
|  | Mechanical ventilation disutility4B,5 | 0.79 | 10%\*base case: 0.08 | Base case +- 0,10\*base case:0.71 – 0.87 | Beta  | Institute for clinical and economic review (2020) (9) | Patients with influenza or *Clostridium difficile* infection |
|  | Recovery state; not disabled to mildly disabled4C | 0.77 | 0.26 | 95% ci: 0.73- 0.81  | Beta  | Hodgson et al., 2017 (5) | Australian mechanically ventilated ICU patients |
|  | Recovery state; moderately to severely disabled4C | 0.5 | 0.26 | 95% ci: 0.44– 0.56 | Beta | Hodgson et al., 2017 (5) | Australian mechanically ventilated ICU patients |
|  | Post-recovery state; 55-64 female4D | 0.917 | 0.17 | 95% ci: 0.90 – 0.94 | Beta | Szende et al., 2014 (10) | German general female population |
|  | Post-recovery state; 65-74 female4D | 0.874 | 0.18 | 95% ci: -0.85 - 0.90 | Beta  | Szende et al., 2014 (10) | German general female population |
|  | Post-recovery state; 75+ female4D | 0.820 | 0.21 | 95% ci: 0.79 - 0.85  | Beta  | Szende et al., 2014 (10) | German general female population |
|  | Post-recovery state; 55-64 male4D | 0.927 | 0.14 | 95% ci: 0.91 – 0.94 | Beta  | Szende et al., 2014 (10) | German general male population |
|  | Post-recovery state; 65-74 male4D | 0.915 | 0.16 | 95% ci: 0.89 - 0.94 | Beta  | Szende et al., 2014 (10) | German general male population |
|  | Post-recovery state; 75+ male4D | 0.880 | 0.16 | 95% ci: 0.85 – 0.91 | Beta  | Szende et al., 2014 (10) | German general male population |
| *Costs* | Treatment costs for Sandman.ICU per mechanically ventilated ICU Day | 128 | NA | NA | NA | See section 2.2, OECD (2023) (11) | NA |
|  | General ward per day4E | 442.78 | 535.22 | 95% ci: 396.21 – 489.35 | Gamma | Zwerwer et al. (2024) (3), OECD (2023) (11) | German ICU COVID-19 patients |
|  | ICU not mechanically ventilated per day4E | 991.44 | 1098.92 | 95% ci: 895.84 - 1087.04 | Gamma | Zwerwer et al. (2024) (3), OECD (2023) (11) | German ICU COVID-19 patients |
|  | Mechanically ventilated per day4E | 2378.35 | 1695.69 | 95% ci: 2230.83 - 2525.88 | Gamma | Zwerwer et al. (2024) (3), OECD (2023) (11) | German ICU COVID-19 patients |
|  | Recovery state; not disabled to mildly disabled per 6 months4F,6 | 1521.21 | 10%\*base case: 152.12 |  Base case +- 0,10\*base case: 1369.08 – 1673.33 | Gamma | Assumption & Ong, Tay & Tham (2021)(12) The World Bank (2023) (13), OECD (2023) (14) | Assumption & Singaporean mechanically ventilated COVID-19 survivors |
|  | Recovery state; moderately disabled to severely disabled per 6 months4F,6 | 4563.61 | 10%\* base case: 456.36  | Base case +- 0,10\*base case: 4107.25 - 5019.98 | Gamma | Assumption & Ong, Tay & Tham (2021)(12) The World Bank (2023) (13), OECD (2023) (14) | Assumption & Singaporean mechanically ventilated COVID-19 survivors |
|  | Intervention effect on mortality | 1% | 0.1% | Base case +- 0,10\*base case: 0.9%-1.1% | Beta | Assumption based on expert opinion | Assumption based on expert opinion |
|  | Intervention effect on the duration of mechanical ventilation | 4 hours | 24 minutes | Base case +- 0,10\*base case: 3 hours and 36 minutes – 4 hours and 24 minutes | Gamma | Assumption based on expert opinion | Assumption based on expert opinion |

1. The mechanically ventilated ICU bed occupancywas estimated by multiplying the ICU bed occupancy with the proportion of mechanically ventilated patients. The ICU occupancy was obtained by taking the average COVID-19 ICU occupancy in 2022 (1) and dividing this by the most recent number of ICU beds available in Germany (2). The proportion of mechanically ventilated patients was obtained from Zwerwer et al (3).
2. Estimated using the method of moments.
3. The combination of the duration of mechanical ventilation for non-disabled or mildly disabled patients together with the duration of mechanical ventilation for moderately to severely disabled patients and the probability of being moderately to severely disabled were used to estimate the mean duration of mechanical ventilation for all patients in (5). This was estimated at 4.6 days. We assumed this to be the duration for which the base case probability of being moderately to severely disabled post-ICU holds. Hence, in our model, each additional day of mechanical ventilation above 4.6 days led to an increase in the odds of being moderately to severely disabled by 4% and each day of mechanical ventilation below 4.6 days decreased the odds of being moderately to severely disabled by 4%.
4. In the probabilistic sensitivity analysis ratios were kept fixed between these variables (grouped with letters).
5. Utilities in different hospitalization states were calculated by taking the utility for the post-recovery state of females and males of age 63, considering the ratio of males to females, and subtracting the disutilities for each state.
6. Rehabilitation costs for the full discharged patient population were taken from (12) and adjusted to 2022 German euros (13,14). Costs for not-disabled to mildly disabled patients and moderately to severely disabled patients were estimated using the proportion of moderately to severely disabled patients and using the assumption that costs for moderately to severely disabled patients were three times as high compared to not to mildly disabled patients.

*Table 2. Estimated annual costs AI system.*

|  |  |
| --- | --- |
| Costs | Price |
| Set up and installation | € 25,000 per 20 beds  |
| Training of users | € 5,000 per 20 users  |
| Hardware | € 500 per bed site, per year |
| Service and remote support | € 600 per bed site, per year |
| Licensing  | € 800 per bed site, per year |

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