**Appendix to** *Cost-Effectiveness of SARS-CoV-2 Testing and Isolation Strategies in Nursing Homes*

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*Costs and Economic Outcomes and Perspectives*

Each person accrues relevant intervention, direct medical costs, productivity losses, and health effects as he/she travels through the model and an event occurs (e.g., gets tested, is hospitalized, etc.). These then contribute to the calculation of cost-effectiveness of SARS-CoV-2 testing from different perspectives such as that of the third-party payer [e.g., Centers for Medicare and Medicaid Services (CMS)] and societal perspectives. The CMS perspective (a specific third-party payer) includes direct medical costs incurred by testing residents and staff as well as hospitalization costs for residents. Since 99% of U.S. adults 65 years and older were CMS beneficiaries in 20221, 2, we assume CMS incurs the costs for all residents. The total third-party payer perspective (e.g., CMS and other insurers/payers) includes all direct medical costs (e.g., testing, face masks, ambulatory care for staff, hospitalization for residents and staff). We assumed all intervention costs (testing, face masks) are direct medical costs and thus would eventually be borne by third-party payers. The societal perspective includes direct medical and indirect (i.e., productivity losses due to presenteeism and absenteeism) costs. Hourly wage serves as a proxy for productivity losses. Absenteeism (missing work/productive time due to illness) results in productivity losses for the duration of isolation, symptoms, or hospitalization, while presenteeism (lost productivity that occurs when employees are not fully functioning due to illness) results in losses for staff who work while ill. All COVID-19 cases accrue productivity losses, regardless of age, as everyone contributes to society.

Appendix Table 1. Key model input parameters, values, and sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Distribution Type** | **Mean/ Median** | **Range/ Standard Deviation** | **Source** |
| **Nursing Home Characteristics** |  |  |  |  |
| Number of: |  |  |  |  |
| Residents |  | 100 | - |  |
| Routine Care Staff |  | 120 | - |  |
| Specialty Care Staff |  | 19 | - |  |
| Non-Resident Facing Staff |  | 31 | - |  |
| Resident length of stay |  | 69.7 | 250.2 | 3 |
| Percentage of post-acute care residents (length of stay <100 days) |  | 0.87 | - | 3 |
| Number of non-mixing resident rooms |  | 32 | - |  |
| **COVID-19 Coronavirus Characteristics** |  |  |  |  |
| Incubation period (days) | Gamma | 3.5 | 2.4 | 4-7 |
| Days can transmit prior to disease onset | Point Estimate | 2 |  | 8 |
| Infectious period (days) | Beta Pert | 5 | 3-9 | 9 |
| **Intervention Characteristics** |  |  |  |  |
| Vaccine efficacy against infection |  |  |  |  |
| Primary series + booster (staff and residents)\* | Beta Pert | 0.348 | 0.313 – 0.383 | 10, 11 |
| Bivalent booster (staff and residents)\* | Beta Pert | 0.510 | 0.459 – 0.561 | 10-15\*\* |
| Vaccine efficacy against hospitalization |  |  |  |  |
| Primary series + booster (staff and residents) | Beta Pert | 0.55 | 0.46 – 0.62 | 12 |
| Bivalent booster (staff and residents) | Beta Pert | 0.80 | 0.71 – 0.85 | 12 |
| Vaccination coverage primary series and booster†† |  |  |  |  |
| Staff | Point Estimate | 0.879 | - | 16 |
| Residents | Point Estimate | 0.875 | - | 16 |
| Vaccination coverage bivalent booster†† |  |  |  |  |
| Staff | Point Estimate | 0.232 | - | 16 |
| Residents | Point Estimate | 0.485 | - | 16 |
| N95 respirator efficacy | Point Estimate | 0.99 | - | 17 |
| Surgical masks efficacy | Beta | 0.59 | 0.069 | 17 |
| Face mask compliance | Point Estimate | 0.80 |  | Expert Opinion |
| Antigen test sensitivity | Beta Pert | 0.81 | 0.78 – 0.84 | 18 |
| PCR test sensitivity | Beta Pert | 0.98 | 0.95 – 0.99 | 19 |
| SARS-CoV-2 test specificity | Point Estimate | 1.0 | - | 18, 19 |
| **Probabilities** |  |  |  |  |
| Staff leave job, daily (turnover not due to COVID-19) | Point Estimate | 0.00017 | - | 20 |
| Tell have COVID-19 symptoms given infection |  |  |  |  |
| Staff |  | 0.5 | - | Assumption |
| Residents |  | 0.5 | - | Assumption |
| Other respiratory illnesses, daily | Point Estimate | 0.0015 |  | Calibrated ‡ |
| Asymptomatic / non-overt infection\* | Beta Pert | 0.324 | 0.253-0.3951 | 21 |
| Ambulatory care |  | 0.167 | 0.150-0.184 | 22 |
| Hospitalization (unvaccinated) |  |  |  |  |
| Staff | Triangular | 0.025 | 0.0225– 0.0275 | Assumption, 23 |
| Residents | Triangular | 0.05 | 0.045 – 0.055 | 24 |
| ICU admission, given hospitalization |  |  |  |  |
| Staff | Beta Pert | 0.095 | 0.0855 - 0.1045 | 25 |
| Residents | Beta Pert | 0.147 | 0.1323 - 0.1617 | 25 |
| Mortality, given hospitalization |  |  |  |  |
| Staff\* | Beta Pert | 0.023 | 0.0207-0.0253 | 25 |
| Residents\* | Beta Pert | 0.10 | 0.09 – 0.11 | 25 |
| Ventilator use among hospitalized patients |  |  |  |  |
| Staff | Beta Pert | 0.023 | 0.0207-0.0253 | 25 |
| Residents | Beta Pert | 0.043 | 0.0387-0.0473 | 26 |
| **Costs (2023 US$)**‡‡ |  |  |  |  |
| Annual wages (all occupations; proxy for residents)◊ | Triangular | 45,760 | 23,980 – 68,590 | 27 |
| Daily wage, NH staff |  |  |  |  |
| Routine care | Triangular | 220.12 | 97.26 – 490.65 | 27 |
| Specialty care | Triangular | 369.66 | 247.57 – 518.65 | 27 |
| Non-resident facing | Triangular | 138.34 | 91.15 – 254.70 | 27 |
| Ambulatory care visit | Triangular | 133.66 | 94.81 – 188.56 | 28 |
| Over the counter medications, per dose | Gamma | 0.108 | 0.417 | 29 |
| Hospitalization |  |  |  |  |
| Staff | Gamma | 22,155.04 | 296.13 | 30 |
| Residents† | Gamma | 21,181.95 | 6,736.20 – 52,891.53 | 31 |
| COVID-19 antigen test | Point Estimate | 12 | - | 32 |
| COVID-19 PCR test | Point Estimate | 51.31 | - | 33 |
| Surgical mask (each) | Uniform | - | 0.20 – 0.60 | 34 |
| N95 respirator (each) | Uniform | - | 0.76 – 1.42 | 35 |
| **Durations (days)** |  |  |  |  |
| Isolation given positive SARS-CoV-2 test | Point Estimate | 10 | - | Assumption |
| NH bed held during resident hospitalization | Point Estimate | 10 | - | Assumption |
| Ambulatory care | Point Estimate | 0.5 | - | Assumption |
| Over the counter medication use | Uniform | - | 1 – 5 | Assumption based on symptom duration |
| Duration of symptoms with mild illness | Gamma | 6.87 | 5.21 | 23 |
| Duration of mild symptoms prior to hospital admission | Beta Pert | 7 | 3-9 | 36, 37 |
| Hospitalization LOS (ICU and general ward)^ | Gamma | 3.9 | 1.9-8.7 | 38 |
| **Numbers** |  |  |  |  |
| Over the counter medication doses per day | Uniform | - | 4 - 6 | Standard dosing |
| **Utility weights** |  |  |  |  |
| Healthy QALY |  |  |  |  |
| 18-64 years old | Point Estimate | 0.92 | - | 39 |
| ≥65 years old | Point Estimate | 0.84 | - | 39 |
| Mild non-specific symptoms | Beta | 0.8179 | 0.1210 | 40-50 |
| Severe infection, leading to hospitalization | Beta | 0.489 | 0.209 | 46, 51-58 |

◊Values are median, 10th and 90th percentiles

\*Values are +/-10% of median/mean value

^Values are median, interquartile range (IQR)

•Values are 95% confidence interval

†Average Medicare payment per fee-for-service COVID-19 hospitalization reported between January and June 2022

††Vaccination coverage of residents and staff reported through November 20, 2022

‡Value calibrated such that of those showing symptoms, 75% are due to COVID-19 and the remaining 25% are due to other respiratory pathogens during a respiratory virus season

\*\*Primary series plus booster value adjusted by average relative efficacy of bivalent booster to monovalent booster. Assumes individuals received bivalent booster within last 6 months, and has not waned much, based on titer data as randomized studies are not being conducted for vaccine efficacy against infection

‡‡All costs are reported in 2023 values, converting all past and future costs using a 3% annual rate

Appendix Table 2. Mixing parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Contact from** | **Contact with** | **Contact probability between groups** | **Average exposures per day** |
| Resident | Resident’s roommate | 1\* | 88 |
| Resident^ | Specialty care staff | 0.077 | 7.7 |
| Social residents | Social residents (excluding roommate) | 0.1 | 6 |
| Resident | Routine staff | 0.385 | 7.7 |
| Resident | Non-resident facing staff | 0 | 0 |
| Routine staff | Other routine staff | 0.051 | 4.3 |
| Routine staff | Specialty staff | 0.023 | 0.4 |
| Routine staff | Non-resident facing staff | 0.054 | 1.7 |
| Specialty care staff | Other specialty care staff | 0.26 | 4.7 |
| Specialty care staff | Non-resident facing staff | 0 | 0 |
| Non-resident facing staff | Other non-resident facing staff | 0.24 | 7.1 |

\*Assumes roommates will have a 100% probability of contact in a given day

^Value for all residents; however, specialty care staff only interact with residents with a length of stay <100 days (post-acute care residents)

Note: The daily contact probabilities between individuals derived from empirical data on the number of daily contacts for residents and staff from surveyed and observed interactions from investigators with longstanding ties to Orange County, CA NHs. Using detailed shift-based data, we calculated daily contact probabilities by dividing the weekly number of daily contacts within and across residents and staff types by the number of staff working that week and distributing the weekly contacts equally across 7 days.

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