Enhanced Infection Prevention Measures Including Universal N95 Usage and Daily Testing: The Impact on SARS-CoV-2 Transmission in Cohorted Hospital Cubicles Through Successive Delta and Omicron Waves

To the Editor—We read with interest the findings of Baker et al [1] in which rapid abatement of nosocomial transmission attributed to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) Omicron-variant was achieved after instituting universal usage of N95 respirators and daily SARS-CoV-2 inpatient testing at a large tertiary hospital; however, the relative contribution of N95 use vs daily testing could not be disentangled. We would like to share our experience with universal N95 usage and daily testing for coronavirus disease 2019 (COVID-19) cluster-control over a 9-month period, during successive waves attributed to the SARS-CoV-2 Delta and Omicron variants.

In Singapore, extensive infection prevention measures were implemented at onset of the COVID-19 pandemic, including universal N95 usage, mandatory surgical mask use for patients/visitors, visitor restrictions (2/day), employee vaccination programs, and free onsite testing for healthcare workers [2, 3]. However, a large nosocomial COVID-19 outbreak in April 2021 [4] provided impetus for inpatient surveillance via routine rostered testing (weekly polymerase chain reaction [PCR] and midweek rapid antigen testing) at our institution, the largest tertiary hospital in Singapore (1785 beds) [5]. Significantly, our patients are mostly housed in 5- to 6-bed cohorted cubicles with shared toilets, with beds spaced 6 feet apart, side to side. We classified possible hospital-onset SARS-CoV as follows [6]:

- Indeterminate hospital onset: PCR-positive 3–7 days after admission
- Probable hospital onset: PCR-positive 8–14 days after admission
- Definite hospital onset: PCR-positive ≥15 days after admission

Onward transmission (a COVID-19 cluster) was defined as ≥2 hospital-onset COVID-19 cases in the same cohorted cubicle, ending when no cases were diagnosed for 14 days. Whenever hospital-onset cases were identified, patients who had originally shared the cohorted cubicle were placed on enhanced surveillance (days 1/4/7 PCR and daily rapid antigen testing); however, new admissions were still continuously accepted to the cubicle. We describe the incidence of hospital-onset SARS-CoV-2 cases in cohorted cubicles from 21 June 2021 to 21 March 2022, and if there was onward transmission in the cohorted cubicle.

Over the study period, 294 hospital-onset COVID-19 cases were identified in cohorted cubicles, of which the majority (55.8%, 176/294) were probable/definite and the remainder were indeterminate. Up to December 2021, whole-genome sequencing revealed that all hospital-onset cases were attributable to the Delta variant (N = 42) [7]; hospital-onset cases formed 2.4% (42/1727) of all cases during the Delta wave. Conversely, by January 2022, all hospital-onset COVID-19 cases demonstrated S-gene dropout on PCR testing, indicative of the Omicron variant. Compared with the Delta wave, hospital-onset cases during the Omicron wave formed 17.0% (252/1483) of all cases (odds ratio, 8.21; 95% confidence interval [CI], 5.88–11.48), despite continuation of universal N95 usage and all other extensive infection prevention measures. Onward transmission occurred in 22.1% (65/294) of cases. On univariate analysis (Table 1) and multivariate logistic regression, being on enhanced surveillance (daily testing) was independently associated with lower odds of onward transmission (adjusted odds ratio [aOR], 0.19; 95% CI, 0.09–0.39), whereas aerosol-generating procedures (aOR, 4.31; 95% CI, 1.98–9.40), a cycle-threshold value of <20 on PCR testing (aOR, 2.12; 95% CI, 1.12–4.03), and being in a ward where the common toilet was shared with ≥1 cohorted cubicle (aOR, 1.92; 95% CI, 1.02–3.62) were independently associated with higher odds of onward transmission.

In conclusion, enhanced infection prevention measures including universal N95 usage did not fully abate nosocomial transmission of SARS-CoV-2 during successive waves attributed to the Delta and Omicron variants. However, daily SARS-CoV-2 inpatient testing for cluster control was associated with lower odds of onward transmission in cohorted cubicles. Our observations reinforce the importance of enhanced surveillance, especially in settings where infrastructural limitations make room sharing unavoidable, despite the high risk of transmission between patients in shared rooms [8].
Table 1. Analysis of Risk Factors for Onward Transmission of SARS-CoV-2 From Hospital-Onset COVID-19 Cases in Cohorted Cubicles (N = 294)

| Covariates (Index Cases)                                                                 | Onward Transmission Among Hospital-Onset Cases (N%) | 95% CI† | P Value |
|----------------------------------------------------------------------------------------|----------------------------------------------------|---------|---------|
| **Clinical characteristics**                                                            |                                                    |         |         |
| Aged <60 y                                                                              | 15/70 (21.4)                                       | 1.00    | 1.00    |
| Aged ≥60 y                                                                             | 50/224 (22.3)                                      | 1.05 (1.55–2.02) | .313    |
| Female                                                                                 | 21/112 (18.8)                                      | 1.00    | .313    |
| Male                                     | 44/182 (24.2)                                      | 1.38 (0.77–2.46) | .295    |
| ISARIC score < 7b                                                                   | 15/75 (20.0)                                       | 1.00    | .747    |
| ISARIC score ≥ 7                                                                     | 50/219 (22.8)                                      | 1.18 (0.82–2.26) | .313    |
| Not on hemodialysis                                                                   | 56/242 (23.1)                                      | 1.00    | .462    |
| On hemodialysis                                                                       | 9/52 (17.3)                                        | 0.70 (0.32–1.51) | .233    |
| Not immunocompromised                                                                 | 40/191 (20.9)                                      | 1.00    | .557    |
| Immunocompromised                                                                     | 25/103 (24.3)                                      | 1.21 (0.9–2.14) | .148    |
| Not mobile                                                                             | 30/112 (26.8)                                      | 1.00    | .148    |
| Mobile                                                                                 | 35/182 (19.2)                                      | 0.65 (0.37–1.14) | .295    |
| Fully vaccinated (<2 doses of mRNA vaccination)                                        | 10/62 (16.4)                                       | 1.00    | .731    |
| On enhanced surveillance (daily testing) prior to diagnosis                            | 11/129 (8.5)                                       | 0.19 (0.10–0.39) | .001    |
| Did not use common toilet                                                             | 26/98 (26.8)                                       | 1.00    | .233    |
| Aerosol-generating procedure                                                          | 40/196 (20.9)                                      | 0.69 (0.39–1.22) | .233    |
| No diarroa                                                                             | 20/44 (45.5)                                       | 3.80 (1.93–7.46) | .011    |
| SARS-CoV-2 testing results                                                             |                                                    |         |         |
| Cycle-threshold value ≥ 20                                                             | 23/147 (15.6)                                      | 1.00    | .011    |
| Cycle-threshold value < 20                                                            | 42/147 (28.6)                                      | 2.16 (1.22–3.82) | .001    |
| Delta variant                                                                          | 8/42 (19.0)                                        | 1.00    | .692    |
| Omicron variant                                                                        | 57/252 (22.6)                                      | 1.24 (0.55–2.83) | .001    |

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; mRNA, messenger RNA; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2. †95% confidence interval. ‡ISARIC score: risk stratification score that predicts in-hospital mortality for hospitalized COVID-19 patients, derived from the following variables: age, sex, number of comorbidities, respiratory rate, peripheral oxygen saturation, level of consciousness, urea level, and C-reactive protein (score range, 0–21 points). §Aerosol-generating procedures defined as: nebulizers, high-flow nasal cannula, noninvasive positive pressure ventilation, intubation. *P < 0.05.

Notes

Ethics statement. Because this study was conducted as part of outbreak investigation, ethics approval was not required under our institutional review board guidelines.

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