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Original Study

The Effect of COVID-19 Endemicity on the Mental Health of Health Workers

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A B S T R A C T

Objectives: A major surge in COVID-19 cases despite Singapore’s high vaccination has strained the health care system in October 2021. Our aim was to assess and compare Healthcare Worker (HCW) mental well-being in 2021 against a previously published cohort in 2020.

Design: Cross-sectional survey study.

Setting and Participants: HCWs from 4 public hospitals and a primary health care system over a 4-week duration in 2021 coinciding with a major surge compared with a similar period in 2020.

Methods: A survey comprising of the Oldenburg Burnout Inventory (OLBI), Hospital Anxiety and Depression Scale (HADS), and Safety Attitudes Questionnaire (SAQ) was distributed via email. Primary endpoints were the proportion meeting OLBI thresholds for both disengagement and exhaustion and being at risk for both Anxiety and Depression using HADS. Multivariate analysis identified significant predictors among demographic, workplace, and SAQ data. Subgroup analysis of overseas HCWs was performed.

Results: We surveyed 1475 HCWs. Significantly more HCWs met primary outcomes using OLBI and HADS than in 2020 (84.1% and 39.6% vs 68.2% and 23.3%, respectively; \( P < .001 \)). Burnout levels were uniformly high. A HADS score \( \geq 8 \) in either subscale was significantly associated with meeting burnout thresholds \( ( P < .001 ) \). Overseas HCWs \( ( P = .002 ) \), South Asian ethnicity \( ( P = .004 ) \), preuniversity educational qualifications \( ( P = .026 ) \), and longer shift work hours of 8 to \( < 12 \) \( ( P = .015 ) \) and \( \geq 12 \) \( ( P = .001 ) \) were significantly associated with meeting HADS thresholds. Among overseas HCWs \( ( n = 407 ) \), seeing family more than a year ago was significantly associated with worse OLBI disengagement scores and a greater proportion meeting HADS thresholds vs seeing them within a year or being local HCWs \( ( 47.2\% \text{ vs } 37.2\% \text{ and } 35.6\% \text{, respectively; } P = .001 ) \).

Conclusions and Implications: HCW mental health has objectively worsened between 2020 and 2021 in the pandemic’s second year. Avoiding prolonged shifts, adopting preventive mental health strategies, improving patient safety, and attention to HCWs of minority ethnicity, from overseas, and with preuniversity education may help.

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Numerous studies and media have reported high levels of burnout and reduced well-being among health care workers (HCWs) during the COVID-19 pandemic. In 2020, the pandemic was characterized by uncertainty about the disease, high patient loads, redeployment to unfamiliar and high-risk areas, inadequate personal protective equipment (PPE) and a lack of robust treatment or preventive options. Reduced physical interaction due to social distancing policies further compounded this by removing the supportive effects of peers and family. This was especially difficult for overseas HCWs, who comprise a large proportion of several countries’ health care workforces and are hindered by travel restrictions. Nevertheless, few studies assessing HCW burnout during this pandemic, as characterized by excessive exhaustion and detachment from one’s job, did not have objective local prepandemic baseline data to definitively conclude causality given that HCWs suffer a high preexisting prevalence of burnout. Indeed, mitigating factors, such as altruism, have emerged as themes during this pandemic, although opinions regarding the extent of their protective effects have been conflicting.

Although the second year of the pandemic has been characterized by a better understanding of COVID-19, the production of effective vaccines, a larger armamentarium of treatment options, and better PPE availability, it has also seen the emergence of more transmissible variants of concern such as the delta and omicron variants, which has increased uncertainty. Several countries, such as Singapore, are increasingly transiting from a zero-COVID policy to one that accepts COVID-19 endemicity. Despite our high vaccination rates, several factors such as the emergence of variants of concern, opening of travel lanes, and outbreaks among vaccinated populations have contributed to a paradoxical surge in cases since the start of the pandemic from less than 0.7 daily cases per 100,000 population (April to August 2020) to a record high of 58.1 (October 2021) (Figure 1). Although about 98% are asymptomatic or mild, serious cases have risen exponentially from less than 0.04 daily deaths per 1,000,000 population to 1.83 and a previous high of 31 critical care cases to a current peak of 67 over the same time frame.

At present, Singapore’s health care system is strained by a high volume of COVID-19 cases comprising individuals who are unvaccinated or have poor response despite home-based recovery being proposed as the standard of care. This additionally coincides with a return to prepandemic non-COVID-19 caseloads, which declined in 2020. The chronic, unrelenting volume of cases since the start of the pandemic combined with the continuation of restrictions have likely contributed to an exodus of health care workers from our workforce.

As more countries embark on this transition, it will be important to identify contributing factors to HCW mental health, well-being, and burnout in anticipation of possible strains on health care systems. In this follow-up study, we aim to compare the current prevalence of burnout and adverse mental health outcomes in HCWs with that derived from our previous study conducted in 2020 early in Singapore’s COVID-19 experience. Additionally, we aim to understand the effects on our HCWs from overseas.

Methods

We conducted a multicenter, cross-sectional study and disseminated a survey to all HCWs across 4 public hospitals and a network of primary health care centers (polyclinics) between September 19 and October 19, 2021 (Supplementary Table 1). This time frame coincided with the start of a surge in cases despite reaching milestone community vaccination levels. Health care workers surveyed comprised doctors, nurses, allied health care professionals (AHPs), administrative or managerial staff, and support staff. Support staff referred to nonclinical employees involved in hospital operations (eg, porters, housekeeping, and security staff). As cross-sectional studies are unable to assess temporal relationships between exposure and outcome, we sought to mitigate this by comparing results in an earlier study collected over a similar duration from May 29 to June 24, 2020, which coincided with the tail end of the first major surge. The survey was distributed to HCWs in the same health care institutions and via the same methods as the earlier study, that is, through a link to a questionnaire platform (FormSG; GovTech, Singapore) which was disseminated via corporate email and snowball sampling by word of mouth. An email reminder was disseminated twice at the middle and toward the end of each study period. This questionnaire was worded in English, which is Singapore’s lingua franca. The first page declared the questionnaire’s aim, its voluntary and anonymous nature, and that implied consent was associated with proceeding with the survey.

We collected basic demographic and workplace environment information data and organized respondents by categories such as (1) HCW roles, (2) gender, (3) ethnicity, (4) redeployment outside primary roles, (5) being tested for COVID-19, (6) primary site of work, (7) if work-from-home or working in offsite facilities was part of their job scope, (8) highest educational qualification, (9) number of workdays and average duration of shifts, (10) vaccination status, and (11) if they were HCWs from overseas. For redeployed HCWs, we further categorized them into (1) redeployed onsite (low risk), that is, not in direct contact with known COVID-19 cases; (2) redeployed onsite (high risk), that is, highly likely to be in direct contact with known COVID-19 cases; (3) redeployed offsite to high-risk areas (eg, foreign work dormitory, community care facility, swab isolation facility).

Responses to three validated questionnaires, that is, Oldenburg Burnout Inventory (OLBI), Safety Attitudes Questionnaire (SAQ), and Hospital Anxiety and Depression Scale (HADS) were collated. These tools have been described in our prior study. The OLBI comprises 16 positively and negatively framed questions rated on a 4-point Likert-type scale that are equally divided into 2 dimensions—exhaustion (which refers to feelings of emptiness, overwork, physical exhaustion, and a strong need for rest) and disengagement (which refers to distancing from the objects and content of one’s work) (Supplementary Table 2). An HCW was deemed to be burnt out if the mean score of both domains exceeded thresholds of ≥2.25 for exhaustion and ≥2.10 for disengagement, which have been correlated with physical symptoms. The HADS is a widely validated, self-reported questionnaire evaluating Depression and Anxiety with 7 items for each domain (Supplementary Table 3) rated on a 4-point Likert-type scale that are equally divided into 2 dimensions—exhaustion and disengagement (which refers to distancing from the objects and content of one’s work) (Supplementary Table 2). The SAQ covers 6 patient safety domains (ie, teamwork climate, safety climate, perceptions of management, job satisfaction, working conditions, and stress recognition) rated on a 5-point Likert-type scale comprising 30 core questions common to all versions of the SAQ and some additional relevant questions from the full SAQ bank. Nonclinical HCWs had the option to omit domains that were not relevant. A Safety Culture Score was calculated for each domain by the formula (Mean value of item scores within a domain −1) × 25.

A score of 1 is transformed to 0, 2 to 2, 3 to 50, 4 to 75, and 5 to 100. A score of ≥75 is a percentage “agree” for that domain, and a percentage agree rate (PAR) is the proportion of respondents with a percentage agree.
| 1 | Category | Variable | n (%) | Percentage Meeting Threshold<sup>a</sup> | OLBI Disengagement and Disillusionment | Adjusted OR (95% CI) | P-value | Percentage Meeting Threshold<sup>a</sup> | HADS Anxiety and Depression | Adjusted OR (95% CI) | P-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | Female | 1100 (77.4) | 83.4 | 1.46 (0.79, 2.68) | .23 | 26.4 | | 1.54 (0.81, 2.97) | .11 |
| | Male* | 321 (22.6) | 84.1 | | | | | | | |
| Roles | Doctor | 318 (21.9) | 85.2 | 2.38 (0.55, 10.29) | .25 | 35.9 | | 0.46 (0.15, 1.41) | .18 |
| | Nurse | 614 (41.7) | 88.5 | 2.09 (0.66, 6.12) | .15 | 42.7 | | 0.74 (0.28, 2.21) | .59 |
| | Support | 138 (9.4) | 77.5 | 1.42 (0.26, 7.96) | .69 | 45.7 | | 0.79 (0.25, 2.71) | .70 |
| | ARPs | 269 (18.3) | 82.5 | 2.25 (0.90, 10.21) | .29 | 32.0 | | 0.52 (0.27, 1.08) | .05 |
| | Administrative* | 134 (9.1) | 84.3 | | | 47.0 | | | |
| Age (y) | <29 | 419 (28.4) | 91.9 | 1.74 (0.78, 3.89) | .18 | 44.6 | | 1.02 (0.49, 2.23) | .95 |
| | 30-39 | 594 (40.3) | 84.2 | 0.67 (0.34, 1.32) | .25 | 40.4 | | 1.12 (0.46, 2.91) | .67 |
| | 40-49 | 273 (18.3) | 81.0 | 0.64 (0.31, 1.32) | .23 | 37.7 | | 1.10 (0.42, 2.95) | .76 |
| | ≥50* | 189 (12.8) | 70.9 | | | 28.6 | | | |
| Ethnicity | Malay | 120 (8.5) | 83.3 | 0.78 (0.33, 1.83) | .56 | 46.7 | | 1.18 (0.70, 1.99) | .93 |
| | South Asian | 126 (9.1) | 74.2 | 0.54 (0.25, 1.18) | .12 | 46.1 | | 2.13 (1.28, 3.55) | .004 |
| | Others | 158 (11.2) | 84.8 | 1.60 (0.40, 2.81) | .22 | 38.0 | | 0.95 (0.38, 2.31) | .78 |
| | Chinese* | 1001 (71.1) | 84.6 | | | 37.3 | | | |
| Highest educational qualification | Degree | 1100 (70.7) | 84.5 | 1.05 (0.49, 3.76) | .95 | 28.6 | | 2.71 (0.95, 8.11) | .08 |
| | Pre-University | 226 (15.3) | 85.8 | 1.21 (0.52, 3.40) | .26 | 46.9 | | 3.53 (1.56, 8.07) | .026 |
| | High School* | 59 (4.0) | 67.8 | | | 32.2 | | | |
| Readymade status | Low, onsite | 70 (4.7) | 87.1 | 0.92 (0.26, 3.20) | .90 | 52.9 | | 1.39 (0.72, 2.69) | .31 |
| | High, onsite | 106 (7.2) | 90.6 | 0.91 (0.36, 2.30) | .84 | 48.1 | | 1.13 (0.70, 1.83) | .61 |
| | Offsite | 38 (2.6) | 86.8 | 2.00 (0.47, 8.40) | .35 | 36.8 | | 0.94 (0.35, 2.50) | .90 |
| | Not redeployed* | 1261 (85.3) | 85.3 | | | 36.2 | | | |
| Role of work per shift | ≤12 h | 158 (10.7) | 93.0 | 2.99 (0.18, 11.16) | .10 | 40.8 | | 7.40 (2.65, 20.65) | .001 |
| | >12 h | 1240 (84.6) | 84.1 | 2.23 (0.67, 3.11) | .06 | 35.1 | | 3.21 (1.26, 8.18) | .026 |
| | *9 a* | 69 (4.7) | 63.6 | | | 17.4 | | | |

### Multivariate analysis for predictors of meeting thresholds for (1) OLBI disengagement and exhaustion and (2) HADS anxiety and depression.

**Fig. 1.** Multivariate analysis for predictors of meeting thresholds for (1) OLBI disengagement and exhaustion and (2) HADS anxiety and depression.
Comparison Between 2021 and 2020 Cohorts

Compared to the previous study in 2020 (3075 respondents, response rate 27.2%) (Table 2), there was no significant difference in age (mean age 36.37 vs 36.94, P = .29). However, the 2021 cohort had a slightly higher proportion of females (74.6% vs 71.5%, P = .004). Additionally, there were significant differences observed in ethnic composition, primary place of work, HCW role, highest education qualification, redeployment status, latest COVID-19 testing status, recently treating a COVID-19 patient and shift duration (all P < .001).

In the current 2021 study, the average OLBI disengagement and exhaustion scores were 2.65 and 2.78, respectively, with 90.2% and 88.9% reaching threshold in each domain and 84.1% reaching thresholds in both domains. This was significantly higher than in the 2020 cohort, where 68.2% met burnout threshold in both domains (P < .001). The HADS scores also showed a significantly higher proportion of respondents at risk of mental health issues in 2021, with 39.6% meeting threshold for risks of both anxiety and depression vs 23.3% in 2020 (P < .001). Finally, SAQ scores also showed a significantly poorer PAR in each domain in 2021, with only 16.9% reaching PAR for the total score compared with 25.9% in 2020 (P < .001).

Multivariate Analysis

In the multivariate analysis (Figure 1), we identified having a HADS score of 8 or more for either the anxiety (OR 4.85, 95% CI 2.72-8.65; P = .001) or depression domains (OR 4.85, 95% CI 2.35-10.0; P = .001) to be independently associated with meeting the thresholds for both OLBI disengagement and exhaustion. Furthermore, reaching a percentage agree in the SAQ domains for job satisfaction (OR 0.13, 95% CI 0.07-0.25; P < .001) and stress recognition (OR 0.25, 95% CI 0.09-0.75; P = .014) was negatively associated with meeting burnout thresholds.

For being at risk of both anxiety and depression, independent predictors included being HCWs of South Asian ethnicity (OR 2.13, 95% CI 1.28-3.55; P = .004), having a preuniversity educational certificate as the highest qualification (eg, diploma, A levels, technical college) (OR 3.53, 95% CI 1.16-10.7; P = .026), being an HCW from overseas (OR 1.74, 95% CI 1.23-2.45; P = .002), and working longer workhours per shift (8 to < 12 hours: OR 3.21, 95% CI 1.26-8.18; P = .015; and ≥ 12 hours: OR 7.40, 95% CI 2.65-20.63; P = .001). In the SAQ, having a percentage agree for safety climate (OR 0.68, 95% CI 0.47-0.98; P = .041), job satisfaction (OR 0.41, 95% CI 0.28-0.59; P < .001), stress recognition (OR 0.17, 95% CI 0.04-0.79; P = .024), and working conditions (OR 0.55, 95% CI 0.36-0.84; P = .006) were negatively associated.

Health Care Workers From Overseas

Among 407 HCWs from overseas (Table 1), 362 (88.9%) had last seen their families more than a year ago. OLBI disengagement scores for this group were significantly higher (2.70) compared with local HCWs and HCWs from overseas who had seen their families within a year ago (2.64 and 2.50, respectively) (P = .023), whereas the percentage meeting thresholds for being at risk of depression and anxiety was higher at 47.2% vs 37.2% and 35.6%, respectively (P = .001). There was no significant difference, however, in SAQ PARs, mean HADS scores, or the proportion meeting OLBI thresholds for both domains.

Discussion

Our study uniquely addresses the longitudinal impacts of a prolonged pandemic posture on HCW mental well-being by comparing outcomes in 2020 and 2021, in the face of a spike of new cases despite high population vaccination rates. We demonstrated that OLBI and HADS mean scores and proportion of HCWs meeting thresholds for
burnout and being at risk of both anxiety and depression has increased significantly between 2020 and 2021. The absolute percentage of HCWs meeting these thresholds in 2021 is at a worrying level of 84.1% and 39.6% respectively as opposed to 68.2% and 23.3% in 2020. Additionally, attitudes toward patient safety have also deteriorated, with a significantly lower PAR for the total score (16.9% vs 25.9% in 2020). This is despite increased awareness and the institution of several protective policies over the last 2 years.

When comparing independent predictors for burnout between our 2020 and 2021 cohort, only reaching threshold HADS scores for being at risk of depression and/or anxiety was common. Other predictors identified in 2020, such as being redeployed, and longer working hours per shift were no longer seen as independent predictors in our present cohort although this is likely due to uniformly high levels of burnout among different subgroups of our study population, limiting the power to detect significant differences.

Regarding adverse mental health outcomes, South Asian ethnicity (a minority ethnic group in Singapore), longer work hours per shift, holding a preuniversity certificate as the highest education qualification, and being an HCW from overseas were independently associated with risk of anxiety and depression. Although some studies have identified people of minority ethnicity as being at risk for mental health issues, there is conflicting evidence owing to poorly understood religio-cultural aspects, the role of community support, varied minority experiences in different countries, and significant intraethnic heterogeneity. Indeed, in Singapore’s multiethnic context, minorities in non-HCW populations have frequently demonstrated better self-reported mental health. This has been postulated to be due to stronger family, religious, and community networks and contrasts against collectivist cultures with Confucian roots among those of Chinese ethnicity that prioritize social and familial harmony over open displays of emotions. This reversal of trends may be due to negative impacts of the pandemic on important supportive community, religious, familial, and social networks. This is an area that warrants further study.

Achieving a percentage agree in several SAQ domains had a statistically significant negative association with the primary outcomes. Although the causal relationship between perceptions of patient safety and burnout, depression, or anxiety is unclear, institutional focus on improving patient safety in deficient domains of the SAQ may be protective. The relationship between long working hours and adverse mental health outcomes is well understood. Like our previous study, shifts lasting less than 8 hours may be protective against burnout, highlighting the importance of proper work-rest cycles and prevention of prolonged shift lengths as a potential way to prevent burnout.

Subgroup analysis of HCWs from overseas demonstrated a significant association between prolonged separation from families for longer than a year and higher HADS anxiety and depression mean scores. This supplements the scarce data pertaining to this important and vulnerable group that comprises a significant component of several countries’ HCW workforces. Finding ways to allow
HCWs from overseas to travel by facilitating and prioritizing leave to return home, enabling more efficient quarantining processes (if required), ensuring completion of vaccination, and expanding psychological support may be beneficial.

A very large proportion of our sample was fully vaccinated (98.7%) or undergoing regular SARS-CoV-2 testing (95.5%). This may be attributed to both of these being mandatory workplace requirements in the absence of valid contraindications, high levels of vaccine acceptance in Singapore, as well as a precedent for mandatory hepatitis B vaccinations and opt-out semiannual influenza vaccination exercises among HCWs. Nevertheless, this reduced the power of our study to determine the effects of these variables on our primary outcomes. The effects of these potentially protective factors should be further evaluated in settings with less HCW vaccination coverage or testing uptake either due to a lack of availability or personal preferences.

Despite an abundance of recommendations on how to combat burnout and adverse mental health outcomes among HCWs, there is limited evidence on their efficacy in this pandemic. The objective worsening of these outcomes highlights the need for renewed efforts to combat this. This may be through the formal creation of well-resourced internal mental well-being departments dedicated to HCWs at an institutional level with appointed welfare champions spread across departments and health care roles. Our study identified HCWs from overseas and of minority ethnicity as groups vulnerable to adverse mental health outcomes, which we postulate may be due to effects of the pandemic on community support structures. As poorer HADS scores was significantly associated with higher risks of burnout, ensuring good HCW mental health may be protective and this can be done by increasing access to trained counseling services, encouraging regular mental well-being breaks, disseminating reminders about self-care with emphasis on adequate rest, sleep, recreation, and maintaining connections with loved ones amid hectic schedules.

Policies should be enacted or reinforced at the institutional, state, and national level to guarantee the protection of rest cycles, leave taking, child and family care aspects, and manpower allocations. Factors contributory or indicative of work stress such as shift durations, patient numbers, leave taken, days off, and sick leaves should be tabulated with regular mental health surveys. Redline thresholds for escalation to senior management should be assigned. Finally, targeting deficient patient safety domains as guided by SAQ may complement the above recommendations.

### Limitations and Strengths

Although the 2021 study adopted the same methodology and recruitment strategy as the 2020 study over a similar study duration, we unexpectedly had fewer respondents (1475 vs 3075). This may have led to a sampling bias with some differences in baseline characteristics of the respondents. Nonetheless, the distribution of respondents’ age was similar, and these differences were adjusted for when performing multivariate analysis to study the primary outcomes. Furthermore, we sampled the same population that would have faced similar changes in workplace conditions and policies between the 2 study periods. Thus, although a similar response rate with equivalent demographic factors would have been ideal, we feel that our findings remain valid. Various factors may have contributed to our reduced response rate. We postulate that HCWs had reduced ability to respond to survey invitation as workloads in 2021 were significantly higher because of a large surge in COVID-19 cases coupled with a return to pre-pandemic levels of non-COVID cases. Significantly more HCWs treated COVID-19-positive patients in our present study (22.5% vs 15.0%). Additionally, because of difficulties with predicting case trajectories, the 2020 study coincided with the tail end of the initial surge whereas the 2021 one coincided with the peak of a much larger one (Figure 2).

The majority of studies in the current literature that evaluate mental health outcomes in HCWs during the COVID-19 pandemic are cross-sectional in nature, hence limiting their interpretation of causality. We believe a significant strength in our study is that we attempted to mitigate this by comparing the outcomes with our 2020 cohort. Nevertheless, longitudinal follow-up with individual subjects as part of a prospective cohort study design would have improved our understanding of how this relationship has changed with time. Additionally, mixed methods analysis can be employed to qualitatively understand other relevant factors contributing to these worrying trends.
| **Table 2** | Respondent Demographic, Work Environment Characteristics, and Baseline Measures of Emotional Well-Being |
|------------------|----------------------------------------------------------------------------------------------------------------------------------|
| **2021, n (%)**  | **2020, n (%)**  | **P** |
| **Total** 1475   | 3075             | .29  |
| **Age, y, mean (SD)** 36.37 (10.04) | 36.94 (9.95) | .004  |
| **Gender**       |                   |      |
| Male 321 (21.8)  | 794 (25.8)       |      |
| Female 1100 (74.6) | 2199 (71.5) |      |
| Not stated 54 (3.7) | 82 (2.7)     |      |
| **Ethnicity**    |                   | <.001|
| Chinese 1001 (67.9) | 1608 (52.3) |      |
| Malay 120 (8.1)  | 401 (13.0)       |      |
| South Asian 128 (8.7) | 410 (13.3) |      |
| Others, eg, Filipino, Burmese or from Myanmar, Eurasian, Caucasian, Vietnamese 158 (10.7) | 506 (16.5) |      |
| Not stated 68 (4.6) | 159 (4.9)     |      |
| **Current primary place of work** |                   | <.001|
| Hospital 1318 (89.4) | 2841 (92.4) |      |
| Polyclinic or general practice 157 (10.6) | 228 (7.4) |      |
| Not stated 0 (0) | 6 (0.20) |      |
| **Role**         |                   | <.001|
| Doctor 318 (21.6) | 458 (14.9) |      |
| Nurse 614 (41.6) | 1394 (45.3) |      |
| Allied health professional 269 (18.2) | 483 (15.7) |      |
| Support staff, ie, cleaners, porters, technicians, security 138 (9.4) | 491 (16.0) |      |
| Administrative and managerial 134 (9.1) | 247 (8.0) |      |
| Not stated 2 (0.1) | 2 (0.1) |      |
| **Highest education qualification** |                   | <.001|
| Degree and above 1190 (80.7) | 2132 (69.3) |      |
| Preuniversity (ie, associate degrees, diploma, A levels, technical college) 226 (15.3) | 699 (22.7) |      |
| High school or below 59 (4.0) | 244 (8.0) |      |
| **Redeployment to other areas** |                   | <.001|
| Not redeployed 1257 (85.2) | 2534 (82.4) |      |
| Redeployed 218 (14.8) | 541 (17.6) |      |
| Within hospital, low risk 81 (37.2) | 140 (25.9) |      |
| Within hospital, high risk 78 (35.8) | 245 (45.3) |      |
| Outside of hospital 43 (19.7) | 156 (28.8) |      |
| Not specified 2 (0.92) | 0 (0) |      |
| **Have you ever been infected with COVID-19?** |                   |      |
| Yes 17 (1.2) | Not Surveyed |      |
| No 1458 (98.8) |                   |      |
| **COVID-19 status in the last 1 wk** |                   | <.001|
| Negative 1400 (94.9) | 506 (16.5) |      |
| Positive 9 (0.6) | 21 (0.7) |      |
| Do not know or not tested 66 (4.5) | 254 (82.9) |      |
| **Vaccination status** |                   | N/A  |
| Completed 2 doses at least 1456 (98.7) |                   |      |
| Completed only 1 dose 9 (0.61) |                   |      |
| Not vaccinated 10 (0.68) |                   |      |
| **Have you treated a COVID-19 positive patient in the past week?** |                   | <.001|
| Yes 332 (22.5) | 462 (15.0) |      |
| No 1059 (71.8) | 2449 (79.6) |      |
| Don’t know 84 (5.7) | 164 (5.3) |      |
| **Average duration of your shift or daily work hours?** |                   | <.001|
| <8 h 69 (4.7) | 299 (9.7) |      |
| 8-12 h 1248 (84.6) | 2462 (80.1) |      |
| ≥12 h 158 (10.7) | 314 (10.2) |      |
| **Scales**       |                   |      |
| **OLBI** (n = 1475) |                   |      |
| Disengagement 2.65 (0.51) | 1311 (90.2) | 2.38 (0.46) | 2452 (79.7) | <.001 |
| Exhaustion 2.78 (0.46) | 1311 (88.9) | 2.50 | 2315 (75.3) | <.001 |
| Meeting threshold for both disengagement and exhaustion 1240 (84.1) | 2097 (68.2) |      |
| **HADS** (n = 1475) |                   |      |
| Depression 7.2 (4.1) | 685 (46.4) | 5.7 (3.9) | 979 (31.9) | <.001 |
| Anxiety 6.7 (3.2) | 855 (57.9) | 6.9 (4.0) | 1253 (40.7) | <.001 |
| Meeting threshold for both depression and anxiety 584 (39.6) | 716 (23.3) |      |
| **SAQ** |                   |      |
| n Mean (SD) | PAR, n (%) | n Mean (SD) | PAR, n (%) |
| Total mean (n=1224) 979 | 58.6 (15.8) | 165 (16.9) | 1931 | 64.0 (15.3) | 501 (25.9) | <.001 |
| Teamwork climate (n=1224) 979 | 67.8 (20.6) | 536 (36.3) | 2479 | 74.4 (18.8) | 1386 (55.9) | <.001 |
| Safety climate (n=1299) 1299 | 67.5 (19.1) | 544 (36.9) | 2525 | 72.3 (18.1) | 1329 (52.7) | <.001 |
| Stress recognition (n=1238) 1238 | 20.2 (20.9) | 32 (22.2) | 2501 | 31.5 (25.7) | 205 (8.2) | <.001 |
| Job satisfaction (n=1363) 1363 | 64.1 (24.0) | 542 (36.7) | 2725 | 74.6 (22.3) | 1613 (59.2) | <.001 |
| Perceptions of management (n=1341) 1341 | 57.8 (21.0) | 342 (23.2) | 2633 | 64.1 (20.0) | 932 (35.4) | <.001 |
| Working conditions (n=1322) 1322 | 55.6 (21.3) | 306 (20.7) | 2428 | 68.2 (20.8) | 1030 (42.4) | <.001 |

*Thresholds for deeming burnout for (1) OLBI disengagement ≥2.10 and (2) OLBI exhaustion ≥2.25. Thresholds for deeming risk of anxiety or depression for HADS was ≥8 in either subscale. PAR refers to the proportion of respondents who scored 75% or above for the Safety Culture Score in each domain.
Conclusions and Implications

Singapore’s paradoxical peak in COVID-19 cases despite high population vaccination rates is a cautionary message to all countries aiming to open their economies and accept COVID-19 endemicity. Furthermore, until global vaccine equality is achieved, the risk of future SARS-CoV-2 variants, such as omicron, exists and guarantees that COVID-19 will remain a long-term public health concern. Although HCW burnout and mental health issues have been a perennial problem, it has worsened over this pandemic despite increased awareness and support. Thus, as we transit to a state of COVID endemicity, we may face a second mental health epidemic among HCWs. We urge health care systems to comprehensively audit the state of mental health among their HCWs and to continually evaluate for contributory factors to guide formal steps toward protecting them and keeping health care delivery sustainable.

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Supplementary Data

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References

1. Hu D, Kong Y, Li W, et al. Frontline nurses’ burnout, anxiety, depression, and fear statuses and their associated factors during the COVID-19 outbreak in Wuhan, China: a large-scale cross-sectional study. EClinicalMedicine 2020;24:100424.

2. Tan BYQ, Kanneganti A, Lim UHJ, et al. Burnout and associated factors among health care workers in Singapore during the COVID-19 pandemic. J Am Med Dir Assoc 2020;21:1751–1758.e5.

3. Nanda A. More doctors in Singapore face burnout, anxiety amid the pandemic. Straits Times. August 3, 2021. https://www.straitstimes.com/life/more-doctors-in-singapore-face-burnout-anxiety-amid-the-pandemic. Accessed October 19, 2021.

4. Tan BYQ, Chew NWS, Lee GKJ, et al. Psychological impact of the COVID-19 pandemic on health care workers in Singapore. Ann Intern Med 2020;173:317–320.

5. Denning M, Goh ET, Scott A, et al. What has been the impact of Covid-19 on safety culture? A case study from a large metropolitan healthcare trust. Int J Environ Res Public Health 2020;17:7034.

6. Carenzio L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary care hospital during the COVID-19 outbreak in Italy. Anaesthesia 2020;75:928–934.

7. Kadri SS, Sun J, Lawandi A, et al. Association between caseload surge and COVID-19 survival in 558 U.S. hospitals, March to August 2020. Ann Intern Med 2020;75:928

8. Shanker S, Chia DJW, Ganti S. Difficulties faced by a medical team based at a COVID-19 quarantine facility. Singapore Med J. Published online. July 30, 2020. https://doi.org/10.11612/smj.20200115.

9. Burki T. Global shortage of personal protective equipment. Lancet Infect Dis 2020;20:785–786.

10.盯着(resting), Gonen T, Lustig Y, et al. Professional burnout among physicians and nurses in Asian intensive care units: a multinational survey. Intens Care Med 2018;44:2079–2090.

11. Peterson U, Bergström G, Demerouti E, Gustavsson P, Asberg M, Nygren A. Burnout levels and self-rated health prospectively predict future long-term sickness absence: a study among female health professionals. J Occup Environ Med 2011;53:788–793.

12. Shanafelt TD, Balch CM, Bechamps C, et al. Burnout and medical errors among American surgeons. Ann Surg 2010;251:955–1000.

13. Sumner RC, Kinsella EL. Grace under pressure: resilience, burnout, and well-being in frontline workers in the United Kingdom and Republic of Ireland during the SARS-CoV-2 pandemic. Front Psychol 2021;11:576229.

14. Wu P, Pang Y, Guan Z, et al. The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. Can J Psychiatry 2009;54:302–311.

15. Pramanick A, Kanneganti A, Wong JI, et al. A reasoned approach toward administering COVID-19 vaccines to pregnant women. Prenat Diagn 2021;41:311–315.

16. Shang L, Yee LC, Cao B. Contemporary narrative review of treatment options for COVID-19. Respiratory 2021;26:745–767.

17. Mahase E. COVID-19: Molnupiravir reduces risk of hospital admission or death by 50% in patients at risk. RMS reports. BMJ 2021;375:n2422.

18. Mahase E. Delta variant: what is happening with transmission, hospital admissions, and restrictions? BMJ 2021;373:n1513.

19. Chia PY, Xiang Ong SW, Chew CJ, et al. Virological and serological kinetics of SARS-CoV-2 Delta variant: vaccine-breakthrough infections: a multi-center cohort study. Clin Microbiol Infect; 2021.

20. Torjesen I. Covid-19: Omicron may be more transmissible than other variants and partly resistant to existing vaccines, scientists fear. BMJ 2021;375:e29843.

21. Karim SSA, Karim QA. Omicron SARS-CoV-2 variant: a new chapter in the COVID-19 pandemic. Lancet 2021;389:2126–2128.

22. Ministry of Health (Government of Singapore). Update on local COVID-19 situation (18 Oct 2021). Ministry of Health, Government of Singapore. Updated October 18, 2021. https://www.moh.gov.sg/news-highlights/details/update-on-local-covid-19-situation-(18-oct-2021). Accessed October 19, 2021.

23. Walensky RP, Walke HT, Fauci AS. SARS-CoV-2 variants of concern in the United States—challenges and opportunities. JAMA 2021;325:1037–1038.

24. Altman DM, Boyton RJ, Beale R. Immunity to SARS-CoV-2 variants of concern. J Infect 2021;83:371–1103–1104.

25. Leung K, Wu JT, Leung GM. Effects of adjusting public health, travel, and social measures during the global COVID-19 vaccination: a modelling study. Lancet Public Health 2021;6:e674–e682.

26. Bergwerk M, Gonen T, Lustig Y, et al. Covid-19 breakthrough infections in vaccinated health care workers. N Engl J Med 2021;385:1474–1484.

27. Shirkit P, Zuckerman NS, Mor O, Gottesman BS, Chowers M. Nosocomial outbreak caused by the SARS-CoV-2 Delta variant in a highly vaccinated population, Israel, July 2021. Euro Surveill 2021;26:2100822.

28. Brown CM, Vostok J, Johnson H, et al. Outbreak of SARS-CoV-2 infections, including COVID-19 vaccine breakthrough infections, associated with large public gatherings—Baltimore County, Maryland, July 2021. MMWR Mortal Wkly Rep 2021;70:1059.

29. Hannah R, Edouard M, Rodès-Guirao L, et al. Coronavirus pandemic (COVID-19) infection: an update on the clinical and laboratory characteristics of the SARS-CoV-2 Delta variant vaccine-breakthrough infections: a multi-center cohort study. BMJ 2021;375:n2422.

30. Shang L, Lye DC, Cao B. Contemporary narrative review of treatment options for COVID-19. Respiratory 2021;26:786–934.

31. Leung K, Wu JT, Leung GM. Effects of adjusting public health, travel, and social measures during the global COVID-19 vaccination: a modelling study. Lancet Public Health 2021;6:e674–e682.

32. Bergwerk M, Gonen T, Lustig Y, et al. Covid-19 breakthrough infections in vaccinated health care workers. N Engl J Med 2021;385:1474–1484.

33. Shirkit P, Zuckerman NS, Mor O, Gottesman BS, Chowers M. Nosocomial outbreak caused by the SARS-CoV-2 Delta variant in a highly vaccinated population, Israel, July 2021. Euro Surveill 2021;26:2100822.

34. Brown CM, Vostok J, Johnson H, et al. Outbreak of SARS-CoV-2 infections, including COVID-19 vaccine breakthrough infections, associated with large public gatherings—Baltimore County, Maryland, July 2021. MMWR Mortal Wkly Rep 2021;70:1059.

35. Hannah R, Edouard M, Rodès-Guirao L, et al. Coronavirus pandemic (COVID-19) infection: an update on the clinical and laboratory characteristics of the SARS-CoV-2 Delta variant vaccine-breakthrough infections: a multi-center cohort study. BMJ 2021;375:n2422.

36. Leung K, Wu JT, Leung GM. Effects of adjusting public health, travel, and social measures during the global COVID-19 vaccination: a modelling study. Lancet Public Health 2021;6:e674–e682.

37. Bergwerk M, Gonen T, Lustig Y, et al. Covid-19 breakthrough infections in vaccinated health care workers. N Engl J Med 2021;385:1474–1484.

38. Shirkit P, Zuckerman NS, Mor O, Gottesman BS, Chowers M. Nosocomial outbreak caused by the SARS-CoV-2 Delta variant in a highly vaccinated population, Israel, July 2021. Euro Surveill 2021;26:2100822.

39. Brown CM, Vostok J, Johnson H, et al. Outbreak of SARS-CoV-2 infections, including COVID-19 vaccine breakthrough infections, associated with large public gatherings—Baltimore County, Maryland, July 2021. MMWR Mortal Wkly Rep 2021;70:1059.
45. Sexton JB, Helmreich RL, Neilands TB, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Serv Res 2006;6:44.

46. Profit J, Sharek PJ, Amspoker AB, et al. Burnout in the NICU setting and its relation to safety culture. BMJ Qual Saf 2014;23:806–813.

47. National Population and Talent Division; Prime Minister’s Office (Government of Singapore). Projection of Foreign Manpower Demand for Healthcare Sector, Construction Workers and Foreign Domestic Workers. Prime Minister’s Office, Government of Singapore. Updated November 1, 2012. https://www.strategygroup.gov.sg/images/Press%20Release%20Images/PDFs/occasional-paper-projection-of-foreign-manpower-demand-healthcare-construction-foreign-domestic-workers.pdf. Accessed October 11, 2021.

48. Vandenberg RJ, Lance CE. A review and synthesis of the measurement invariance literature: suggestions, practices, and recommendations for organizational research. Organ Res Methods 2000;3:3–470.

49. Shariff M, Asadi-Pooya AA, Mousavi-Roknabadi RS. Burnout among healthcare providers of COVID-19: a systematic review of epidemiology and recommendations. Arch Acad Emerg Med 2020;9:e7.

50. Fessell D, Cherniss C. Coronavirus Disease 2019 (COVID-19) and beyond: micropractices for burnout prevention and emotional wellness. J Am Coll Radiol 2020;17:746–748.

51. Blake H, Berrington F, Johnson G, Tahner A. Mitigating the psychological impact of COVID-19 on healthcare workers: a digital learning package. Int J Environ Res Public Health 2020;17:2997.

52. Appelbom S, Bujacz A, Finnes A, et al. The rapid implementation of a psychological support model for frontline healthcare workers during the COVID-19 pandemic: a case study and process evaluation. Front Psychiatry 2021;12:713251.

53. Amanullah S, Ramesh Shankar R. The impact of COVID-19 on physician burnout globally: a review. Healthcare 2020;8:421.

54. Schilgen B, Nienhaus A, Handtke O, Schulz H, Mosko M. Health situation of migrant and minority nurses: A systematic review. PLoS One 2017;12:e0179183.

55. Gilleen J, Santaolalla A, Valdearenas L, Salice C, Fusté M. Impact of the COVID-19 pandemic on the mental health and well-being of UK healthcare workers. B JPych Open 2021;7:e88.

56. Prasad K, McLoughlin C, Stillman M, et al. Prevalence and correlates of stress and burnout among U.S. healthcare workers during the COVID-19 pandemic: a national cross-sectional survey study. J Clinical Medicine 2021;10:138.

57. Lim KY, Ma S, Heng D, Bhalla V, Chew SK. Gender, ethnicity, health behaviour & self-rated health in Singapore. BMC Public Health 2007;7:184.

58. Vaingankar JA, Subramaniam M, Abdin E, et al. Socio-demographic correlates of positive mental health and differences by depression and anxiety in an Asian community sample. Ann Acad Med Singap 2013;42:514–523.

59. de Sire A, Marotta N, Raimo S, et al. Psychological distress and work environment perception by physical therapists from southern Italy during COVID-19 pandemic: the C.A.L.A.B.R.I.A study. Int J Environ Res Public Health 2021;18:9676.

60. Spurgeon A, Harrington JM, Cooper CL. Health and safety problems associated with long working hours: a review of the current position. Occup Environ Health 1997;54:367–375.

61. Singh P, Aulak DS, Mangat SS, Aulak MS. Systematic review: factors contributing to burnout in dentistry. Occup Med 2016;66:27–31.

62. Patel RS, Bachu R, Adikey A, Malik M, Shah M. Factors related to physician burnout and its consequences: a review. Behav Sci (Basel) 2018;8:98.

63. Sokol D. Covid-19 vaccination should be mandatory for healthcare workers. BMJ 2021;375:n2670.

64. Lazarus JV, Ratzan SC, Palayew A, et al. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 2021;27:225–228.

65. Wise J. Covid-19: is the UK heading towards mandatory vaccination of healthcare workers? BMJ 2021;373:n1056.

66. Kyaw WM, Chow A, Hean AA, Lee LT, Leo YS, Ho HJ. Factors influencing seasonal influenza vaccination uptake among health care workers in an adult tertiary care hospital in Singapore: a cross-sectional survey. Am J Infect Control 2019;47:133–138.

67. Tog XJJ, Chew QH, Sim K. Psychological sequelae within different populations during the COVID-19 pandemic: a rapid review of extant evidence. Singapore Med J. Published online July 30, 2020. https://doi.org/10.11622/smedj.2020111.

68. Chew QH, Wei KC, Vasoo S, Sim K. Psychological and coping responses of health care workers toward emerging infectious disease outbreaks: a rapid review and practical implications for the COVID-19 pandemic. J Clin Psychiatry 2020;81:20r13450.

69. Iacobucci G. How is the pandemic affecting non-covid services? BMJ 2021;372:n215.

70. Birkmeyer JD, Barnato A, Birkmeyer N, Bessler R, Skinner J. The impact of the COVID-19 pandemic on hospital admissions in the United States. Health Aff (Millwood) 2020;39:2010–2017.

71. Smith A. Covid omicron variant linked to vaccine inequality, experts say. NBC News. Published November 30, 2021. https://www.nbcnews.com/news/world/omicron-linked-global-vaccine-inequality-experts-rca6916. Accessed December 4, 2021.

72. Dyer O. Covid-19: Delta infections threaten herd immunity vaccine strategy. BMJ 2021;374:n1933.

73. Scientific Advisory Group for Emergencies (Government of UK). Long term evolution of SARS-CoV-2. 26 July 2021. gov.uk. Updated July 30, 2021. https://www.gov.uk/government/publications/long-term-evolution-of-sars-cov-2-26-july-2021/long-term-evolution-of-sars-cov-2-26-july-2021. Accessed October 28, 2021.
### Supplementary Table 1
Health Care Institutions Included in This Study

| Health Institution                  | Address                              | Bed Capacity | COVID Cases at Time of Study |
|-------------------------------------|--------------------------------------|--------------|-----------------------------|
| National University Hospital        | 5 Lower Kent Ridge Rd, Singapore 119074, 6779 5555 | 1239 beds | More than 100 |
| Ng Teng Fong General Hospital       | 1 Jurong East Street 21, Singapore 609606, 6716 2000 | 700 beds   | More than 100 |
| Alexandra Hospital                  | 378 Alexandra Rd, Singapore 159964, 6472 2000 | 300 beds   | 50-100                     |
| Institute of Mental Health          | 10 Buangkok View, Buangkok Green Medical Park, Singapore 539747, 6389 2000 | 2010 beds | 24-49                      |
| National University Polyclinics     | Bukit Batok Polyclinic 50 Bukit Batok West Avenue 3, Singapore 659164, Choa Chu Kang Polyclinic 2 Teck Whye Crescent, Singapore 688846, Clementi Polyclinic Blk 451 Clementi Avenue 3 #02-307, Singapore 120451, Jurong Polyclinic 190 Jurong East Avenue 1, Singapore 609788, Pioneer Polyclinic 26 Jurong West Street 61, Singapore 648201, Queens town Polyclinic 580 Stirling Road, Singapore 148958 | Outpatient services |                                      |

### Supplementary Table 2
Oldenburg Burnout Inventory (4-Point Likert Scale)

| Question                                                                 | Domain | Reversed Questions |
|--------------------------------------------------------------------------|--------|--------------------|
| 1. I always find new and interesting aspects of my work.                 | D      |                    |
| 2. There are days when I feel tired before I arrive at work.             | E      |                    |
| 3. It happens more and more often that I talk about my work in a negative way. | D      |                    |
| 4. After work, I tend to need more time than in the past in order to relax and feel better | E      |                    |
| 5. I can tolerate the pressure of my work very well.                    | E      |                    |
| 6. Lately, I tend to think less at work and do my job almost mechanically. | D      |                    |
| 7. I find my work to be a positive challenge.                           | D      |                    |
| 8. During my work, I often feel emotionally drained.                    | E      |                    |
| 9. Over time, one can become disconnected from this type of work.       | D      |                    |
| 10. After working, I have enough energy for my leisure activities.       | E      |                    |
| 11. Sometimes I feel sickened by my work tasks.                         | D      |                    |
| 12. After my work, I usually feel worn out and weary.                   | E      |                    |
| 13. This is the only type of work that I can imagine myself doing.       | D      |                    |
| 14. Usually, I can manage the amount of my work well.                   | E      |                    |
| 15. I feel more and more engaged in my work.                            | D      |                    |
| 16. When I work, I usually feel energized.                              | E      |                    |

D, Disengagement; E, Exhaustion.
| Question                                                                 | Domain | Responses & Score                                      |
|-------------------------------------------------------------------------|--------|--------------------------------------------------------|
| 1. I feel tense or ‘wound up’                                            | A      | Most of the time                                       |
|                                                                          |        | A lot of the time                                      |
|                                                                          |        | From time to time, occasionally                       |
|                                                                          |        | Not at all                                             |
| 2. I still enjoy the things I used to enjoy                              | D      | Definitely as much                                     |
|                                                                          |        | Not quite so much                                      |
|                                                                          |        | Only a little                                          |
|                                                                          |        | Hardly at all                                          |
| 3. I get a sort of frightened feeling as if something awful is about to happen | A      | Very definitely and quite badly                        |
|                                                                          |        | Yes, but not too badly                                 |
|                                                                          |        | A little, but it doesn’t worry me                      |
|                                                                          |        | Not at all                                             |
| 4. I can laugh and see the funny side of things                          | D      | As much as I always could                              |
|                                                                          |        | Not quite so much now                                  |
|                                                                          |        | Definitely not so much now                             |
|                                                                          |        | Not at all                                             |
| 5. Worrying thoughts go through my mind                                  | A      | A great deal of the time                               |
|                                                                          |        | A lot of the time                                      |
|                                                                          |        | From time to time, but not too often                   |
|                                                                          |        | Only occasionally                                       |
| 6. I feel cheerful                                                       | D      | Not at all                                             |
|                                                                          |        | Not often                                              |
|                                                                          |        | Sometimes                                              |
|                                                                          |        | Most of the time                                       |
| 7. I can sit at ease & feel relaxed                                      | A      | Definitely                                             |
|                                                                          |        | Usually                                                |
|                                                                          |        | Not often                                              |
|                                                                          |        | Not at all                                             |
| 8. I feel as if I am slowed down                                         | D      | Nearly all the time                                    |
|                                                                          |        | Very often                                             |
|                                                                          |        | Sometimes                                              |
|                                                                          |        | Not at all                                             |
| 9. I get a sort of frightened feeling like ‘butterflies’ in the stomach  | A      | Not at all                                             |
|                                                                          |        | Occasionally                                           |
|                                                                          |        | Quite often                                            |
|                                                                          |        | Very often                                             |
| 10. I have lost interest in my appearance                                | D      | Definitely                                             |
|                                                                          |        | I don’t take as much care as I should                  |
|                                                                          |        | I may not take quite as much care                      |
|                                                                          |        | I take just as much care ever                          |
| 11. I feel restless as I have to be on the move                          | A      | Very much indeed                                       |
|                                                                          |        | Quite a lot                                           |
|                                                                          |        | Not very much                                          |
|                                                                          |        | Not at all                                             |
| 12. I look forward with enjoyment to things                              | D      | As much as I ever did                                  |
|                                                                          |        | Rather less than I used to                             |
|                                                                          |        | Definitely less than I used to                         |
|                                                                          |        | Hardly at all                                          |
| 13. I get sudden feelings of panic                                       | A      | Very often indeed                                      |
|                                                                          |        | Quite often                                            |
|                                                                          |        | Not very often                                         |
|                                                                          |        | Not at all                                             |
| 14. I can enjoy a good book or radio or TV program                        | D      | Often                                                  |
|                                                                          |        | Sometimes                                              |
|                                                                          |        | Not often                                              |
|                                                                          |        | Very seldom                                            |

D: Depression, A: Anxiety.
0-7: Normal, 8-10: Borderline abnormal, 11-21: Abnormal.
### Supplementary Table 4
Safety Attitudes Questionnaire (5-Point Likert Scale)

| Question | Domain | Reversed Questions |
|----------|--------|--------------------|
| 1. Nurse input is well received in this clinical area. | TW |
| 2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care. | |
| 3. Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient). | |
| 4. I have the support I need from other personnel to care for patients. | |
| 5. It is easy for personnel here to ask questions when there is something that they do not understand. | |
| 6. The physicians and nurses here work together as a well-coordinated team. | |
| 7. I would feel safe being treated here as a patient. | SC |
| 8. Medical errors are handled appropriately in this clinical area. | |
| 9. I know the proper channels to direct questions regarding patient safety in this clinical area. | |
| 10. I receive appropriate feedback about my performance. | |
| 11. In this clinical area, it is difficult to discuss errors. | |
| 12. I am encouraged by my colleagues to report any patient safety concerns I may have. | |
| 13. The culture in this clinical area makes it easy to learn from the errors of others. | |
| 14. I like my job. | JS |
| 15. Working here is like being part of a large family. | |
| 16. This is a good place to work. | |
| 17. I am proud to work in this clinical area. | |
| 18. Morale in this clinical area is high. | |
| 19. When my workload becomes excessive, my performance is impaired. | SR |
| 20. I am less effective at work when fatigued. | |
| 21. I am more likely to make errors in tense or hostile situations. | |
| 22. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure). | |
| 23. Management supports my daily efforts. | PM |
| 24. Management doesn’t knowingly compromise patient safety. | |
| 25. Management is doing a good job. | |
| 26. Problem personnel are dealt with constructively by our management. | |
| 27. I get adequate, timely info about events that might affect my work, from management. | WC |
| 28. The levels of staffing in this clinical area are sufficient to handle the number of patients. | |
| 29. This hospital does a good job of training new personnel. | |
| 30. All the necessary information for diagnostic and therapeutic decisions is routinely available to me. | |
| 31. Trainees in my discipline are adequately supervised. | |
| 32. I experience good collaboration with nurses in this clinical area. | No domain |
| 33. I experience good collaboration with staff physicians in this clinical area. | |
| 34. I experience good collaboration with pharmacists in this clinical area. | |
| 35. Communication breakdowns that lead to delays in delivery of care are common. | |
| 36. My suggestions about safety would be acted upon if I expressed them to management. | |

JS, Job satisfaction; PM, Perceptions of management; SC, Safety culture; SR, Stress recognition; TW, Teamwork; WC, Working conditions.

### Supplementary Table 5
Cronbach’s Alpha and Goodness-of-Fit Confirmatory Factor Analysis

| Subscale | Cronbach Alpha (>0.7) | Confirmatory Factor Analysis Model-Fit Indices | CFI (>0.9) | RMSEA (<0.06) | SRMSR (<0.08) |
|----------|------------------------|-----------------------------------------------|-----------|---------------|----------------|
| HADS     |                        |                                               |           |               |                |
| Depression | 0.830                  | 0.976                                         | 0.061     |               | 0.029          |
| Anxiety   | 0.865                  | 0.982                                         | 0.059     |               | 0.024          |
| OLBI      |                        |                                               |           |               |                |
| Disengagement | 0.825                 | 0.906                                         | 0.111     |               | 0.055          |
| Exhaustion | 0.833                  | 0.929                                         | 0.097     |               | 0.057          |
| SAQ       |                        |                                               |           |               |                |
| Teamwork  | 0.859                  | 0.994                                         | 0.038     |               | 0.016          |
| Safety climate | 0.812              | 0.988                                         | 0.047     |               | 0.021          |
| Job satisfaction | 0.892        | 0.981                                         | 0.105     |               | 0.025          |
| Stress recognition | 0.843      | 0.976                                         | 0.139     |               | 0.028          |
| Perception of management | 0.801    | 0.995                                         | 0.043     |               | 0.015          |
| Working condition | 0.768     | 0.990                                         | 0.078     |               | 0.019          |

CFI, comparative fit indices; HADS, Hospital Anxiety and Depression Scale; OLBI, Oldenburg Burnout Inventory; RMSEA, root mean square error of approximation; SAQ, Safety Attitudes Questionnaire; SRMSR, standardized root mean square residual.