

swabs, but it is time-consuming and requires constant changes in the primer composition due to the mutation of SARS-CoV-2 strains. We propose a method for the detection of SARS-CoV-2 in nasopharyngeal swabs using MALDI-TOF MS and machine learning. **Methods:** Nasopharyngeal swabs from patients with PCR-confirmed COVID-19 and control participants were tested (130 and 80 swabs, respectively) with MALDI-TOF MS MicroFlex LT using the HCCA matrix. MALDI spectra were preprocessed in R version 4.1.2 software with the MALDIquant R package using the workflow: sqrt transformation, wavelet smoothing, SNIP-based base removal, and PQN intensity calibration. Peaks were detected with MAD algorithms with following Peak alignment on the following parameters: minFreq 70% and tolerance 0.005. Machine learning was performed with the rtemis r package on GLM, random forest, and XGBoost models. **Results:** These models were characterized by specificity, sensitivity, and F1 score. GLM models (specificity 1 and sensitivity 0.5) showed a low F1 score of 0.71. However, the random forest and XGBoost models demonstrated sensitivity, specificity, and F1 score equaling 1. **Conclusions:** We propose a screening method for SARS-CoV-2 detection (sensitivity 1 and specificity 1). This methodology combines the analysis of nasopharyngeal swab samples using MALDI-TOF-MS with machine learning. It is suitable for screening patients with COVID-19 at the first stages of diagnosis. Random forest and XGBoost models demonstrated sensitivity, specificity, and F1 scores equaling 1.

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COVID-19 vaccine acceptance and hesitancy among primary healthcare workers in Singapore

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Objectives: Factors affecting COVID-19 vaccine acceptance and hesitancy among primary-care healthcare workers (HCWs) remain poorly understood. We sought to identify factors associated with vaccine acceptance and hesitancy among HCWs. **Methods:** A multicenter online cross-sectional survey was performed across 6 primary-care clinics from May to June 2021, after completion of the vaccination rollout. The following data were collected: demographics, profession, years working in healthcare, residential status, presence of chronic medical conditions, self-perceived risk of acquiring COVID-19, and previous influenza vaccination. HCWs who accepted the vaccine were asked to rank their 5 best reasons for vaccine acceptance. HCWs who were vaccine hesitant completed the 5C scale on psychological antecedents of vaccination. **Results:** Of 1,182 eligible HCWs, 557 responded (response rate, 47.1%) and 29 were excluded due to contraindications. Among 557 respondents, the vaccine acceptance rate was 94.9% (n = 501) and 5.1% were hesitant (n = 27). COVID-19 vaccine acceptance was not associated with sex, age, ethnicity, profession, number of years in healthcare, living status, presence of chronic diseases, self-perceived risk, or previous influenza vaccination. The 3 most common reasons for COVID-19 vaccine acceptance as ranked by 501 HCWs were (1) to protect their family and friends, (2) protect themselves from COVID-19, and (3) the high risk of acquiring COVID-19 because of their jobs. The 15-item questionnaire from the 5C psychological antecedents of vaccination was completed by 27 vaccine hesitant HCWs. The mean scores for the components of the 5Cs were ‘confidence’ (3.96), ‘complacency’ (3.23), ‘constraint’ (2.85), ‘calculation’ (5.79) and ‘collective responsibility’ (4.12). **Conclusions:** COVID-19 vaccine hesitancy is a minute issue among primary-care HCWs in Singapore, where the acceptance rate is 95% with a 5% hesitancy rate. Future studies can focus on other settings with higher hesitancy rates and acceptance of booster vaccinations with the emergence of

the SARS-CoV-2 δ (delta) variant. Trial Registration: This study was approved by the National Healthcare Group (NHG) Domain Specific Review Board (DSRB), Singapore on April 26, 2021 (Reg No. 2021/00213).

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Descriptive study on COVID-19 exposures in Singapore General Hospital

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Objectives: The highly transmissible SARS-CoV-2 has swept across the globe, causing large swaths of COVID-19, displacing medical resources and attention from patients with other life-threatening illnesses, and overwhelming healthcare institutions. Shifting toward endemicity, the Singapore Ministry of Health ceased issuing quarantine orders to close contacts of infected cases on October 11, 2021. However, contact tracing and exposure management within SGH continued with the same risk criteria. We have examined COVID-19 exposures in different hospital locations to determine the effectiveness of surveillance in breaking the chain of transmission. **Methods:** Contact tracing of COVID-19 exposures among Singapore General Hospital (SGH) staff and patients has been conducted since the first COVID-19 diagnosis in January 2020. The information collected is used to identify those at higher risk of infection for enhanced surveillance or isolation. The data analyzed in this study were collected during later periods of the SARS-CoV-2 δ (delta) pandemic wave between August 1, 2021, and December 31, 2021. **Results:** During the 4-month study period, there were 1,686 SARS-CoV-2 exposures in SGH. Among these 1,686 exposures, 1,157 (69%) were contacts with an infected patient. Among these infected source patients, 915 were emergency department patients, 210 were ward inpatients, and 32 were clinic outpatients. The remaining 524 exposure events (31%) were contacts with infected staff, of whom 441 were SGH employees and 83 were employees from other SingHealth institutions. The remaining 5 index cases were visitors to SGH. Of the 1,686 exposure events, 330 had associated at-risk contacts requiring exposure management. Among 330 patient index cases, 213 (64.5%) resulted in 699 exposed contacts (patients vs staff), whereas 117 staff index cases resulted in 435 exposed contacts (patients vs staff). For 434 exposed contacts who were staff, 204 (47%) of their exposures occurred in inpatient ward settings, followed by 153 (35.3%) that occurred in outpatient clinics, 36 (8%) that occurred common lounging areas, 16 (3.6%) that occurred in office sites, 15 (3.4%) that occurred in the community, 8 (1.8%) that occurred in occupation therapy, and 2 (0.5%) that occurred in the emergency department. For 688 exposed contacts who were patients, 579 (84.1%) exposures occurred in inpatient wards, 70 (10.2%) occurred in DEM, 19 (2.7%) occurred in other SingHealth institutions, 16 (2.3%) were exposures to roving porters, and 3 (0.4%) occurred in the community. During the study period, 3 hospital clusters were identified and investigated, one of which included secondary cases. **Conclusions:** Most SARS-CoV-2 exposures in SGH occurred in inpatient settings where patients were index cases. Despite intensive contact tracing and stringent surveillance and isolation measures, inpatient clusters could not be prevented.

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COVID-19 vaccine booster hesitancy among healthcare workers: A retrospective observational study in Singapore

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Objectives: COVID-19 booster uptake has remained poor among healthcare workers (HCWs) despite evidence of improved immunity against the SARS-CoV-2 δ (delta) and \omicron (omicron) variants. Although most studies have used a questionnaire to assess hesitancy, we aimed to identify factors affecting booster hesitancy by examining actual vaccine uptake across time. **Methods:** COVID-19 vaccination database records were extracted for HCWs working at 7 Singaporean public primary-care clinics between January and December 2021. Data included sex, profession, place of practice, vaccination type, and dates. Time to booster was calculated from the date of vaccination minus the date of eligibility. The χ^2 test was used to compare the relationship between first dose and booster hesitancy. The Kaplan-Meier method and the log-rank test were used to evaluate differences in cumulative booster uptake. Multivariate Cox regression was used to investigate predictors of timely booster vaccination. The vaccination rate was charted across time and was corroborated with media releases pertaining to legislative changes. **Results:** Of 891 primary-care HCWs, 877 (98.9%) were fully vaccinated and 73.8% of eligible HCWs had taken the booster. HCWs were less booster hesitant (median, 16 days; range, 5–31.3) compared to the first dose (median, 39 days; range, 13–119.3). First-dose-hesitant HCWs were more likely to be booster hesitant (OR, 3.66; 95% CI, 2.61–5.14). Adjusting for sex, workplace, and time to first dose, ancillary HCWs (HR, 1.53; 95% CI, 1.03–2.28), medical HCWs (HR, 1.8; 95% CI, 1.18–2.74), and nursing HCWs (HR, 1.8; 95% CI, 1.18–2.37) received boosters earlier than administrative staff. No temporal relationship was observed for booster uptake, legislative changes, or COVID-19 case numbers. **Conclusions:** Vaccine hesitancy among HCWs had improved from first dose to booster, with timely booster vaccination among medical and nursing staff. Tailored education, risk messaging, and strategic legislation might help reduce delayed booster vaccination. This study was approved by the National Healthcare Group (NHG) Domain Specific Review Board (DSRB), Singapore on December 28, 2021 (Reg No. 2021/01120).

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Sputnik-V postvaccination immunologic responses in nasal mucosa: A prospective cohort study in Kazakhstan

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Objectives: Sputnik-V (Gam-COVID-Vac) is a recombinant adenoviral (rAdv) vector-based, COVID-19 vaccine now used in >70 countries. Mucosal immunity is thought to be important for protection against COVID-19. We did a prospective cohort study to assess Sputnik-V-elicited mucosal SARS-CoV-2 antibody responses. **Methods:** We divided 82 COVID-19-free participants into prior COVID-19 and no prior COVID-19 groups and followed them at day 21 after Sputnik-V dose 1' (rAd5) and dose 2' (rAd26). Nasopharyngeal swabs and blood were collected to perform SARS-CoV-2 diagnostic and immunologic assays.

SARS-CoV-2 spike-specific IgG and IgA ELISAs were performed on both nasal swabs and blood. SARS-CoV-2 real-time RT-PCR testing was performed to exclude infectious influencing. **Results:** Nasal S-IgG levels increased 25-fold after dose 1' ($P < .001$) and remained high after dose 2 in all participants. Prior COVID-19 exposure was associated with both elevated baseline mucosal IgG and IgA and higher postvaccination IgG, but not IgA, boost. Nasal IgA levels increased 16.5-fold after dose 1' ($P < .001$) and remained high after dose 2' in all participants. Compared to dose 1', Sputnik-V dose 2' did not further increase either mucosal IgG levels ($P = .626$) or IgA levels ($P = .609$). **Conclusions:** A single dose of Sputnik-V boosted mucosal SARS-CoV-2 immunity. The effects of Sputnik-V dose 2' on mucosal immunity were minimal. These findings indicate (1) that intramuscularly administered adenoviral vaccines enhance SARS-CoV-2 immunity via both systemic and mucosal routes and (2) that cost-effectiveness and the efficacy of Sputnik-V vaccination could be improved by adjusting the current prime-booster regimen and extending the 21-day interval between the doses. Trial registration: Registered on ClinicalTrials.gov (no. NCT04871841).

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N95 mask concordance amongst female Muslim healthcare workers undergoing mask fitting with and without tudung

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Objectives: In August 2021, the Ministry of Health, Singapore revised the uniform policy in public hospitals to allow female Muslim staff, including nurses, to wear the tudung as an add-on to their uniforms. Institutions were advised that incorporation of the tudung should still align with current infection prevention guidelines. On May 2, 2021, in response to evolving evidence of SARS-CoV-2 transmission, our institution adopted the use of N95 masks for all HCWs in clinical settings. Prior to this revision in uniform policy, most female Muslim staff were mask fitted without tudungs. No existing international guidance recommends whether mask refitting of should be conducted with tudungs. As such, we looked at the N95 mask concordance for these staff undergoing mask fitting. **Methods:** Between November 1, 2021, and January 14, 2022, we mask fit-tested all new staff and refitted existing staff both with and without the tudung. We conducted qualitative fit-testing using their personal tudung, and we tested 2 models of N95 mask: 3MTM 1870+ and AIR+. When an HCW only passed the fitting of 1 or none of the models, additional N95 mask fit-testing was conducted with other available mask models according to our department's existing workflow. **Results:** In total, 334 staff underwent N95 mask fitting. Overall, 326 (97.6%) passed with the same N95 mask models both with and without the tudung. The remaining 8 staff (2.4%) had passed 2 N95 mask models without the tudung but required a different N95 mask model while wearing the tudung. No staff required quantitative fit testing. **Conclusions:** N95 mask concordance for female Muslim staff undergoing fit-testing both with and without the tudung was high at 97.6%. Further evaluation of the 8 staff who did not show concordance could be retested using a quantitative fit-testing method.

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Immunogenicity of Gam-COVID-Vac and Sinopharm BBIBP-CorV vaccines in seropositive and seronegative adults

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