into ghettos. The city of Lviv in western Ukraine was a center for typhus vaccine research, especially through the work of Fleck and Weigl (*3*). Ukraine now has an estimated 1.8 million persons ≥80 years of age (*4*), some of whom may have contracted *R. prowazekii* infection during the 1940s and are at risk for Brill–Zinsser disease. Body louse infestations among refugee and sheltering populations, living in overcrowded and unsanitary conditions because of war, may trigger epidemics of *R. prowazekii* infection. A further risk for these populations is infection with *Bartonella quintana* bacteria, the cause of trench fever, that is also transmitted by body lice.

The public health services of Ukraine and the Eastern Europe region face multiple threats. Does the current epidemic typhus risk warrant timely surveillance to curtail outbreaks? Public health organizations, including and organizations caring for refugees, might consider sending body lice specimens collected from patients for *R. prowazekii* PCR testing (a list of laboratories that can perform this test is available from the authors) to give early warning of outbreaks. When body lice are detected, these organizations could consider community treatment, including delousing and the administration of ivermectin (*1*,*5*) and doxycycline, while assays are performed.

Because PCR testing and tetracycline drugs are now available, we can respond in such dire circumstances to prevent *R. prowazekii* outbreaks before they occur. Public health officials could institute a system analogous to that for surveillance and control of plague and fleas. We now have the tools and treatments that can make it possible to avert and mitigate epidemic typhus outbreaks.

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Effectiveness of Booster and Influenza Vaccines against COVID-19 among Healthcare Workers, Taiwan

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Among previously uninfected healthcare workers in Taiwan, mRNA COVID-19 booster vaccine was associated with lower odds of COVID-19 after primary recombinant vaccine. Symptom-triggered testing revealed that tetravalent influenza vaccine was associated with higher odds of SARS-CoV-2 infection. COVID-19 vaccination continues to be most effective against SARS-CoV-2.

Border control, contact tracing, and adherence to nonpharmaceutical interventions enabled Taiwan to contain COVID-19 for >2 years (*1*). From the beginning of the pandemic in 2020 through March 31, 2022, Taiwan had just 16,224 domestic COVID-19 cases, an incidence of 0.07% for a population of 23.6 million (*2*). In this backdrop, we found no COVID-19 cases among healthcare workers (HCWs) at Taipei Tzu Chi Hospital, Taipei,

Taiwan, through April 10, 2022, despite symptom monitoring and surveillance.

Meanwhile, to overcome vaccine shortages and hesitancy among adults in Taiwan, homologous and heterologous regimens of the adenoviral vector vaccine ChAdOx1-S/nCoV-19 (AstraZeneca, https://www.astrazeneca.com), the adjuvanted subunit protein vaccine MVC-COV1901 (Medigen, https://www.medigenvac.com), and the mRNA vaccines mRNA-1273 (Moderna, https://www.modernatx.com) and BNT162b2 (Pfizer-BioNTech, https://www.pfizer.com) were used widely. All vaccines were given in a 2-dose primary series and for a 1-dose booster, except for ChAdOx-S/nCoV-19 (*3*).

To evaluate effectiveness of COVID-19 booster vaccines and the 2021–22 tetravalent seasonal influenza vaccine against COVID-19 during an Omicron variant–predominant surge, we conducted a retrospective study of HCW vaccination at Taipei Tzu Chi Hospital. We obtained an employee list with vaccination data and COVID-19 surveillance reports from the hospital for April 10–June 10, 2022. During this period, the hospital tested HCWs in 2 groups: the routine testing group comprised emergency department and COVID-19 ward staff who received regular, weekly testing; the symptom-triggered group comprised staff who were tested whenever symptoms developed or after a high-risk exposure. Nasopharyngeal swab samples were collected by professionals and tested for SARS-CoV-2 by reverse transcription PCR (RT-PCR) using a previously described RT-PCR protocol (*4*) or by Panbio rapid antigen test (Abbott, https://www.abbott.com). This study received approval from the Taipei Tzu Chi Hospital institutional review board with waiver for informed consent because the study used previously collected data (approval no. 11-X-106).

We compared data by using 2-tailed χ^2 and Kruskal-Wallis tests and considered $p<0.05$ statistically significant. We used a multivariate logistic regression model to assess the relationship between SARS-CoV-2 infection during April 10–June 10,

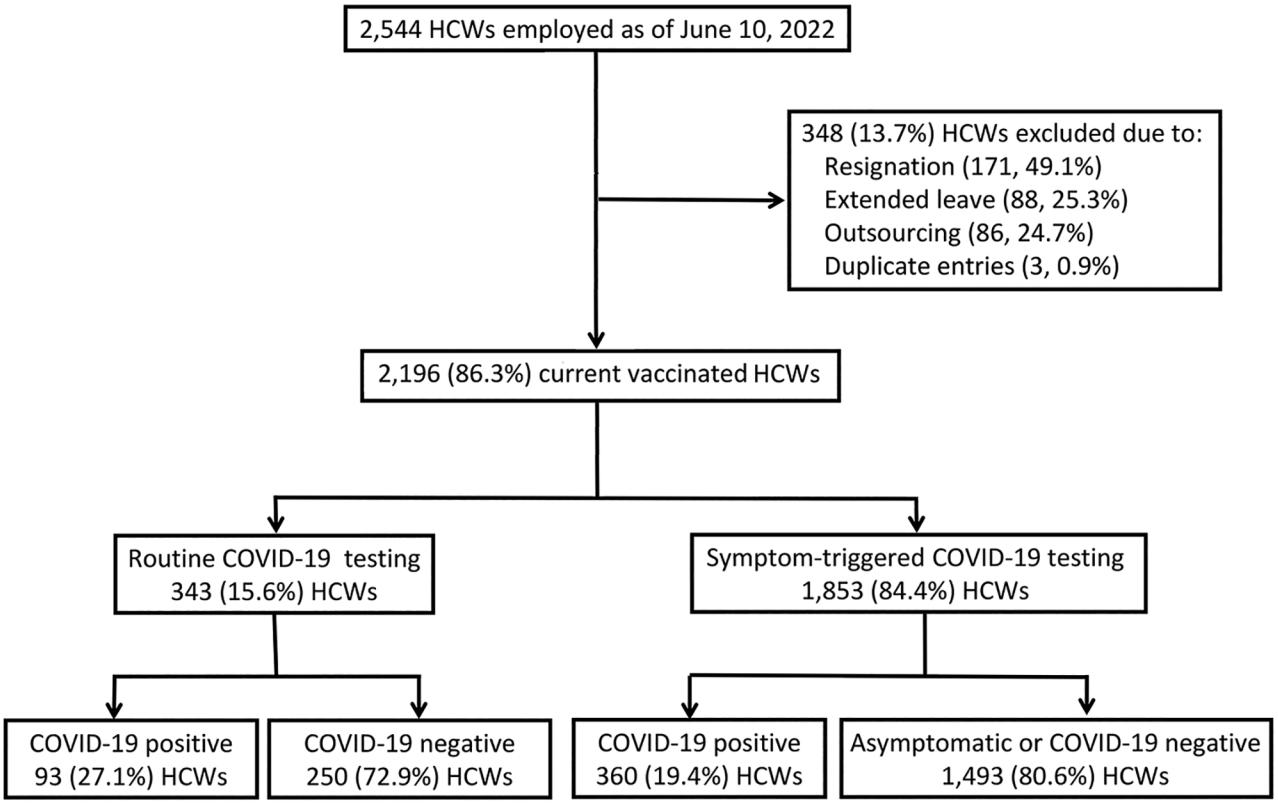

Figure. Worker exclusion and testing in a study of the effectiveness of booster and influenza vaccines against COVID-19 among healthcare workers, Taipei Tzu Chi Hospital, Taipei, Taiwan. Employment, vaccination, and testing data for April 10–June 10, 2022, were provided by the hospital's Human Resource Office and corroborated by the Occupational Safety and Health Administration Office and the hospital's Center for Infection Control. Workers in the routine testing group were tested weekly by reverse transcription PCR or rapid antigen test; workers in the symptom-triggered testing group were tested if COVID-19 symptoms developed or after they were exposed to COVID-19 cases. HCW, healthcare worker.

2022, and age, sex, work sector, COVID-19 booster vaccine, and seasonal influenza vaccination. We performed all analyses in SPSS Statistics 25.0 (IBM, https://www.ibm.com).

The employment list included a total of 2,544 HCWs; we excluded 348 (13.7%) staff who were outsourced, who were on extended leave, or who had resigned. Of the remaining 2,196 HCWs, 453 (20.6%) tested SARS-CoV-2 positive during the study period (Figure). COVID-19 incidence was highest (35.3%) among housekeeping staff and lowest (13.5%) among medical staff (Table). All COVID-19–positive HCWs experienced mild symptoms; none required intensive care.

Table. Characteristics of 2,196 healthcare workers tested for SARS-CoV-2 after receiving COVID-19 booster and influenza vaccines, Taipei Tzu Chi Hospital, Taipei, Taiwan*

	Regular testing, n = 343†				Symptom-triggered testing, n = 1,853			
Characteristics	Positive, no. (%)	Negative, no. (%)	p value	OR (95% CI)	Positive, no. (%)	Negative or no symptom, no. (%)	p value	OR (95% CI)
Total	93 (100)	250 (100)	NA	NA	360 (100)	1,493 (100)	NA	NA
Sex			0.051				0.084	
F	67 (72.0)	205 (82.0)	NA	1.4 (0.7–3.1)	278 (77.2)	1,085 (72.7)	NA	1.0 (0.7–1.4)
M	26 (28.0)	45 (18.0)	NA	Referent	82 (22.8)	408 (27.3)	NA	Referent
Age range, y			0.377				0.345	
71–80	1 (1.1)	0	NA	NA	1 (0.3)	8 (0.5)	NA	0.7 (0.1–6.0)
61–70	1 (1.1)	4 (1.6)	NA	0.7 (0.1–6.6)	6 (1.7)	55 (3.7)	NA	0.5 (0.2–1.3)
51–60	3 (3.2)	18 (7.2)	NA	0.5 (0.1–2.0)	33 (9.2)	160 (10.7)	NA	0.9 (0.6–1.3)
41–50	15 (16.1)	39 (15.6)	NA	0.9 (0.4–1.9)	93 (25.8)	362 (24.2)	NA	1.0 (0.7–1.4)
31–40	29 (31.2)	63 (25.2)	NA	1.1 (0.6–2.1)	92 (25.6)	391 (26.2)	NA	1.0 (0.7–1.3)
21–30	44 (47.3)	126 (50.4)	NA	Referent	135 (37.5)	517 (34.6)	NA	Referent
Work sector			<0.001				<0.001	
Nursing	52 (55.9)	175 (70.0)	NA	0.1 (0.1–0.4)	170 (47.2)	641 (42.9)	NA	0.9 (0.6–1.2)
Medical	15 (11.3)	37 (14.8)	NA	0.2 (0.1–0.5)	39 (10.8)	309 (20.7)	NA	0.5 (0.3–0.8)
Technical	6 (6.5)	9 (3.6)	NA	0.3 (0.1–1.1)	43 (11.9)	197 (13.2)	NA	0.8 (0.5–1.2)
Laboratory, pharmacy	3 (3.2)	20 (8.0)	NA	0.1 (0.0–0.3)	32 (8.9)	100 (6.7)	NA	1.1 (0.7–1.8)
Housekeeping	0	2 (0.8)	NA	NA	6 (1.7)	9 (0.6)	NA	2.8 (0.9–8.6)
Administration	17 (18.3)	7 (2.8)	NA	Referent	70 (19.4)	237 (15.9)	NA	Referent
No. COVID-19 vaccine doses			0.065				<0.001	
3	88 (94.6)	246 (98.4)	NA	0.2 (0.0–0.8)	319 (88.6)	1,416 (94.8)	NA	0.4 (0.2–0.6)
2	5 (5.4)	4 (1.6)	NA	Referent	38 (10.6)	73 (4.9)	NA	Referent
1	0	0	NA	NA	0	0	NA	NA
0	0	0	NA	NA	3 (0.8)	4 (0.3)	NA	NA
COVID-19 primary series‡			0.442				0.348	
Viral vector + viral vector	70 (75.3)	193 (77.2)	NA	NA	270 (75.0)	1,091 (73.1)	NA	NA
Viral vector + mRNA	7 (7.5)	27 (10.8)	NA	NA	45 (12.5)	189 (12.7)	NA	NA
mRNA + mRNA	15 (16.1)	30 (12.0)	NA	NA	41 (11.4)	206 (13.8)	NA	NA
Protein subunit + protein subunit	0	0	NA	NA	0	2 (0.1)	NA	NA
COVID-19 booster§			1.00				0.145	
mRNA	86 (92.5)	243 (97.2)	NA	NA	317 (88.1)	1,387 (92.9)	NA	NA
Protein subunit	0	2 (0.8)	NA	NA	2 (0.5)	27 (1.8)	NA	NA
Booster vaccine date¶			0.111				<0.001	
December 2021	23 (24.7)	68 (27.2)	NA	NA	70 (19.4)	319 (21.4)	NA	NA
January 2022	55 (59.1)	164 (65.6)	NA	NA	219 (60.8)	999 (66.9)	NA	NA
February 2022	4 (4.3)	4 (1.6)	NA	NA	17 (4.7)	35 (2.3)	NA	NA
March 2022	3 (3.2)	7 (2.8)	NA	NA	5 (1.4)	32 (2.1)	NA	NA
April 2022	0	3 (1.2)	NA	NA	6 (1.7)	24 (1.6)	NA	NA
May 2022	1 (1.1)	0	NA	NA	0	4 (0.3)	NA	NA
Tetravalent influenza vaccine, 2021–22 season			0.297				0.016	
Vaccinated	68 (73.1)	167 (66.8)	NA	1.5 (0.8–2.7)	265 (73.6)	1,001 (67.0)	NA	1.5 (1.1–2.0)
Not vaccinated	25 (26.9)	83 (33.2)	NA	Referent	95 (26.4)	492 (33.0)	NA	Referent

*p values calculated by using χ^2 test; OR and 95% CI calculated by using multinomial logistic regression. NA, not applicable; OR, odds ratio.
†For age 71–80 y and housekeepers of the regularly tested subgroup, estimates were not shown because the groups were too small.
‡Excluding 7 unvaccinated workers and 3 workers who did not report vaccine type. Data available for a total of 2,186 healthcare workers; regular testing subgroup included 92 positive cases and 250 negative cases; symptom-triggered testing subgroup included 356 positive cases and 1,488 negative cases; thus, percentages do not add up to 100%.
§Excluding 7 unvaccinated workers, 120 workers who did not receive a booster vaccine, and 5 workers who did not report booster vaccine type. Data available for a total of 2,064 healthcare workers; regular testing subgroup included 86 positive cases and 245 negative cases; symptom-triggered testing subgroup included 319 positive cases and 1,414 negative cases; thus, percentages do not add up to 100%.
¶Excluding 7 unvaccinated workers, 120 workers who did not receive a booster vaccine, and 7 workers who did not report month of booster vaccine. Data available for a total of 2,062 healthcare workers; regular testing subgroup included 86 positive cases and 246 negative cases; symptom-triggered testing subgroup included 317 positive cases and 1,413 negative cases; thus, percentages do not add up to 100%.

COVID-19 vaccine uptake was 99.7% for primary series and 94.5% for booster doses; booster uptake was highest (94.9%) among technicians and lowest (92.7%) among administrators. Influenza vaccine uptake was 68.4%, highest (74.3%) among nurses and lowest (52.9%) among housekeeping staff.

Compared with HCWs who had symptom-triggered testing, regularly tested HCWs were younger (median age 31.0 years, interquartile range [IQR] 26.0–40.0 years, vs. 36.0 years, IQR 28.0–45.5 years; p<0.001). Regularly tested HCWs also were more likely to be female (79.3% vs. 73.6%; p = 0.026), have had received booster vaccination (97.4% vs. 93.7%; p = 0.005), and have tested COVID-19–positive (27.1% vs. 19.4%; p = 0.002). Influenza vaccine uptake and types of primary and booster regimens were not greatly different for either subgroup (Table).

Regression analyses identified receiving booster vaccination and being medical staff were also associated with lower odds of COVID-19 for both testing subgroups. Tetravalent influenza vaccination was associated with higher odds of COVID-19, although we observed statistically significant results only for HCWs who underwent symptom-triggered testing (Table).

Effectiveness of primary ChAdOx-S/nCoV-19 series coupled with mRNA booster is limited because some countries suspended use of ChAdOx-S/nCoV-19 because of thromboembolic concerns (*5*,*6*). However, our study provides real-world insights into effectiveness of mRNA booster after primary homologous and heterologous ChAdOx-s/nCoV-19 regimens. Our results showed a booster dose was associated with much lower odds of COVID-19 among HCWs in both the routine and symptom-triggered testing subgroups compared with HCWs having no booster. These findings are similar to observations of fewer COVID-19 infections among BNT162b2-boosted HCWs (*7*) and observed effectiveness of mRNA-1273 (47.3%) and BNT162b2 (49.4%) boosters against symptomatic Omicron infection (*8*).

A meta-analysis suggested reduced COVID-19 susceptibility with influenza vaccination for the general population but not HCWs (*9*). However, we observed a statistically significant increase in odds for COVID-19 among HCWs in the symptom-triggered testing group but not the routine testing group (p<0.001). The effect of influenza vaccines against COVID-19 among HCWs remains to be elucidated.

Study limitations include lack of universal testing and use of self-reported symptoms, which might have missed some cases. Also, vaccinated HCWs can be asymptomatically infected (*10*); hence, COVID-19 infections might be underreported in our study. Causality could not be inferred due to the study's observational nature. We also did not account for individual behaviors and household exposures. Nevertheless, our study highlights the benefits of booster COVID-19 vaccination and its effectiveness against SARS-CoV-2 among HCWs.

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Three-Dose Primary Series of Inactivated COVID-19 Vaccine for Persons Living with HIV, Hong Kong

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In a cohort of persons living with HIV in Hong Kong, surrogate virus neutralization testing for COVID-19 yielded a median level of 89% after the third dose of an inactivated COVID-19 vaccine, compared with 37% after the second dose. These results support using a 3-dose primary series for enhanced immune protection.

Worldwide, inactivated vaccines are most widely used to prevent SARS-CoV-2 infection and severe COVID-19 disease (*1*). Vaccination effectiveness is of particular importance for protecting persons at increased risk for severe diseases, notably immunocompromised patients, including persons living with HIV (PLHIV). As recently reported in a prospective study in Brazil (*2*), immunogenicity of inactivated vaccine is lower in PLHIV than in healthy adults. This lower protection is a cause for concern, especially in populations with high burden of HIV/AIDS and COVID-19. In Hong Kong, both inactivated and mRNA vaccines are available free for all eligible healthy and immunocompromised citizens. Immunocompromised persons have been prioritized for receiving a third, booster, dose, 3 months after completion of a 2-dose series of any COVID-19 vaccine. In a real-world study conducted prospectively on PLHIV in Hong Kong, we measured vaccine immunogenicity by the surrogate virus neutralization test (sVNT) to compare the responses after completion of 2 versus 3 doses of CoronaVac (Sinovac, https://www.sinovac.com), the same inactivated vaccine used in the Brazil study (*2*). Based on antibody-mediated blockage of ACE2-spike receptor binding domain (RBD) interaction, the sVNT results were used to assess the amplitude of neutralizing antibody responses against SARS-CoV-2 (*3*,*4*).

During April 2021–March 2022, a total of 122 PLHIV who had received CoronaVac were enrolled at 2 major HIV specialist clinics providing comprehensive HIV care, including antiretroviral therapy, in Hong Kong. Participants provided informed consent. We measured sVNT after completion of 2 or 3 doses of CoronaVac, in addition to transcribing demographic and clinical data collected during routine clinical follow-up appointments (Appendix, https://wwwnc.cdc.gov/EID/article/28/10/22-0691-App1.pdf). The median age of recruited PLHIV was 49 (IQR 40–56.5) years of age; most (86%) were male, all were receiving antiretroviral therapy, and the median latest CD4 count was 564.5/μL (IQR 394–733/μL) (Appendix Table 1). We included in the analyses a total of 132 sVNT measurements made within 90 days (median 48 days, IQR 24–70 days) of the second and within 90 days (median 33 days, IQR 28–53 days) of the third dose. We expressed results as percentage inhibition, using a cutoff of 30% for positive neutralizing response.

The median sVNT level was 37% (IQR 24%–53%); 64% of participants tested positive (sVNT ≥30%) after the second dose. After the third dose, the median sVNT rose to 89% (IQR 58%–95%; Mann-Whitney U = 648.5;