Summary of Evidence Related to Travel,
Hospitality and Service Industries, and COVID-19 Risk
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Prior to the COVID-19 pandemic, travel was a large part of most individuals' lives – whether it was for work, leisure, or to visit family. Pre-departure and post-arrival testing and quarantining have become major public health surveillance components of traveling in the last year. Much of the travel industry has been affected by the pandemic, and despite many restrictions in response to the pandemic, essential workers have remained dedicated to their in-person responsibilities while individuals have continued to travel both domestically and internationally. **This document is a brief summary of published evidence related to the role of travel in the transmission of SARS-CoV-2 and considerations for traveling during the pandemic. Included are manuscripts published in peer-reviewed journals or on pre-print servers through April 1, 2021.** References summarized in this report were drawn from the COVID-19 Literature Report (Lit Rep) team database. **References that appeared in the daily Lit Rep are marked with an asterisk***, and the summary is shown in the annotated bibliography below.

Executive Summary of Evidence Related to Travel in the Context of COVID-19

- **Pre-departure testing for SARS-CoV-2 alone may not be effective at preventing positive individuals from traveling. Addition of post-arrival screening and testing procedures may reduce the risk of travelers spreading SARS-CoV-2 at their destinations. Symptom-based screening alone has been largely ineffective and resource-intensive given its low yield and misses a large proportion of infected travelers due to asymptomatic infections.**
- **A 10-day quarantine may be sufficient to reduce the risk of transmission. A 7-day quarantine may be feasible when coupled with a negative COVID-19 PCR test on the last day.**
- **CDC guidance recommends that people who are fully vaccinated with an FDA-authorized vaccine can travel safely within the US. Fully vaccinated travelers do not need to get tested before or after travel unless their destination requires it, and do not need to self-quarantine.**
- **In-flight transmission of SARS-CoV-2 can occur between passengers and crew members despite facemask use, with closer seating proximity associated with greater infection risk through aerosol and/or respiratory droplet transmission.**
- **Air travel played a major role in importation of cases internationally early in the pandemic, though domestic US travel is responsible for much of the subsequent spread of SARS-CoV-2 throughout the US.**
- **Workplace-related outbreaks have been reported across the US since March 2020, with bartenders, waiters, transport conductors and travel stewards at elevated risk of transmission in**

subsequent waves of the pandemic. In public-facing professions, transmission risk is lower when both employees and clients are wearing facemasks.

Pre-Departure & Post-Arrival COVID-19 Procedures

Pre-Departure Screening & Testing

While domestic and international travel slowed significantly during the COVID-19 pandemic, airports and airlines nonetheless continued to operate. As a result, airlines adopted new pre-departure policies including COVID-19 screening questions for travelers during flight check-in and some destinations have required a negative pre-departure SARS-CoV-2 test. A rapid field study conducted in the Kahului main airport in Maui, Hawaii showed that there is reason to be concerned that pre-departure testing will not fully eliminate importation of SARS-CoV-2 due to the delay between the time a person becomes infected and when they will have a positive test result (Hou*). This may be particularly true with self-administered home test that have a lower sensitivity in the presence of lower viral loads, which can occur early in infection.

- A rapid field study conducted at the Kahului main airport identified 2 SARS-CoV-2 PCR positive participants out of 279 consecutively sampled participants boarding for departure, despite all participants having a negative PCR test 72 hours prior (Hou*). This positivity rate corresponded to 7 cases per 1,000 travelers, which corresponds to an estimated 52-70 infected travelers arriving daily to Hawaii during November to December 2020.

Pre-departure testing alone does not appear to be sufficient to prevent positive individuals from traveling and it may be beneficial to combine pre-departure testing with post-arrival screening and testing procedures. A model showed that the effectiveness of testing depended on timing and quality of the test, with the combination of a pre-travel test and a post-travel test 2 to 3 days after arrival reducing the risk of transmission by 45% to 70% (Johansson*). A different mathematical model developed to quantify the probability of post-quarantine transmission in the context of travel found that SARS-CoV-2 testing on exit could reduce the duration of a 14-day quarantine by 50%, while testing on entry shortened quarantine by at most one day (Wells*).

In terms of traveling during the holidays, an online panel survey administered to individuals from 10 US states (n = 7,905) found that planned travel over the December holidays was more common among those who tested positive for SARS-CoV-2 in the prior 2 weeks (67%) compared with 25% of those who tested negative in the prior 2 weeks and 11% among those who were not tested. (Mehta*).

Post-Arrival Screening, Testing & Quarantining

Pre-departure testing alone does not appear to be sufficient to prevent positive individuals from traveling and it may be beneficial to combine pre-departure testing with post-arrival screening and testing procedures. While the responsibility for pre-departure screening and testing has primarily been on travelers and airlines, different countries and US states have adopted various post-arrival screening, testing, and quarantining tactics. Screening and testing individuals traveling by air upon arrival, and repeated testing during quarantine, can prevent community transmission in the destination country (Murphy*; Yang*). A model showed that the effectiveness of testing depended on timing and quality of the test, with the combination of a pre-travel test and a post-travel test 2 to 3 days after arrival reducing the risk of transmission by 45% to 70% (Johansson*). A different mathematical model developed to quantify the probability of post-quarantine transmission in the context of travel found that SARS-CoV-2

testing on exit could reduce the duration of a 14-day quarantine by 50%, while testing on entry shortened quarantine by at most one day (Wells*). Another study found that testing and 7-day quarantine could prevent 88% of secondary cases while 14-day quarantine without testing could prevent 84% of secondary cases (Dickens*). In a modeling study, quarantining an infected traced contact for 10 days was estimated to prevent 75% to 99% of their onward transmission (Ashcroft*). A quarantine period of eight days for air travelers arriving to the UK with a PCR test on day-7 was concluded to reduce the number of infectious arrivals released into the community by a median 94% when compared with no quarantine; this reduction is similar to the 99% median reduction achieved by a 14-day quarantine period (Clifford*). Thus, a 10-day quarantine may be sufficient to reduce the risk of onward transmission. A 7-day quarantine may be feasible when coupled with a negative COVID-19 PCR test on the last day.

Symptom-based screening has been shown to be largely ineffective and resource-intensive (Dollard*). Post-arrival COVID-19 testing is particularly important to identify asymptomatic carriers (Wong*, Al-Qahtani*). A study from Japan found that symptom-based testing of travelers missed most prevalent cases of SARS-CoV-2 at entry. Even with universal screening, nearly half of cases would have been missed without repeated testing over a 14-day period (Arima*).

- From mid-January to mid-September, a total of 766,044 travelers were screened, 298 (0.04%) of whom met criteria for public health assessment (Dollard*). 35 of those passengers (0.005%) were tested for SARS-CoV-2, and nine (0.001%) were positive. Overall, this approach yielded about one case for every 85,000 travelers screened.
- In January 2020, 566 Japanese nationals were repatriated from Wuhan, China and were monitored for 14 days following their return. Universal RT-PCR testing identified 12 cases of SARS-CoV-2 infection over this period. Entry screening only detected 7 of 12 cases, 2 of whom were symptomatic and 5 of whom were asymptomatic. Subsequent testing identified 5 additional cases among individuals whose first RT-PCR test result was negative (Arima*).

In-Flight (Airplane) Transmission of SARS-CoV-2

A number of studies have documented transmission of SARS-CoV-2 occurring during commercial flights, with evidence of in-flight transmission between passengers and crew members despite face mask use (Choi*, Swadi*, Yang*). Closer seating proximity has been associated with greater infection risk through aerosol and/or respiratory droplet transmission without direct person-to-person contact (Eichler, Hoehl*, Khanh*). There is evidence that transmission took place through shared spaces on the aircraft (e.g., the toilet) (Bae*). For longer flights, it has been estimated that the average infection probability can be reduced by approximately 73% for passengers wearing high-efficiency masks compared to 32% for passengers wearing low-efficiency masks (Wang*).

Geographic Spread of SARS-CoV-2 Through Travel

Domestic US Travel

The evolution of and increased geographic range of novel SARS-CoV-2 variants has been largely attributable to the spread of SARS-CoV-2 through individuals travelling domestically. For most states in the US, domestic travel contributed to the largest proportion of imported infections (Davis*) and subsequent localized outbreaks (McNamara*, Shen*, Zeller*). California has been central to introductions of SARS-CoV-2 into the US (Deng*, Shen*). The B.1.1.7 variant, which was first detected in

the UK, was introduced to the US by international travelers then likely subsequently spread from state-to-state through individuals who had traveled domestically (Firestone*, Long*). Phylogenetic analyses suggested that New York acted as a hub for B.1.1.7 importation and spread to other states, and the study found evidence for community transmission of B.1.1.7 in New York, New Jersey, Connecticut, and Illinois during January 2021 (Alpert*).

Strong dose-response relationships between frequency of movement (e.g., traveling for non-essential services) and self-reported SARS-CoV-2 positivity among Maryland residents (Clipman*). Travel using public transport such as trains and taxis are associated with a history of SARS-CoV-2 infection even after adjusting for social distancing (Clipman*; Sami*), and with longer travel duration times (Hu*). Further, more (60% vs. 32%) seropositive participants traveled by taxi after the cancellation of nonessential gatherings in Washington DC during March 2020 (Sami*). Prior to the Colorado stay-at-home order in March, the most common potential exposures of residents who tested positive for SARS-CoV-2 were gatherings of >10 people, domestic travel, working in or visiting a health care setting, and using public transportation (Marshall*).

International Travel

SARS-CoV-2 transmission through international travel has been a major topic of concern in regard to importation of novel variants. Early in the SARS-CoV-2 epidemic, most cases were linked to recent travel history from China or Europe, suggesting that air travel played a major role in importation of cases (De Salazar*), and was responsible for 90% of case importations by early February 2020 in South Africa, Algeria, and Kenya (Menkir*). The P.1 variant, which was first identified in Brazil, has been identified among travelers to Brazil upon returning to their home countries, including the US, Japan, and Italy (Firestone*, Fujino*, Maggi*). For the B.1.1.7 variant, two studies linked index cases in Minnesota and Texas to the individuals' recent travel history to the UK (Firestone*, Ojelade*). A modeling study assessing the global impact of travel restrictions due to COVID-19 concluded that restrictions are effective primarily in countries with low numbers of cases or that have strong travel links with countries experiencing high rates of infection (Russell*).

Transmission of SARS-CoV-2 During Travel Events

Large travel events have been associated with outbreaks of SARS-CoV-2 infections, sometimes referred to as 'superspreader' events, occurring largely because public health guidelines (e.g., physical distancing, avoidance of large gatherings, facemask use) were not followed. A college spring break trip in 2020 resulted in SARS-CoV-2 infection in 60 (28%) college-aged travelers and their contacts who were included in the outbreak investigation, one-fifth of whom were asymptomatic at the time of testing (Lewis*). Evidence suggests that the 2020 Mardi Gras celebration in New Orleans was likely a superspreading event, based on the unusual lack of genetic diversity of SARS-CoV-2, which was similar to cruise ship outbreaks, and the markedly increased infection rate in New Orleans immediately following the event (Zeller*). Among Chinese tour groups traveling in Europe in 2020, it was observed that initial SARS-CoV-2 transmission occurred in family groups and later transmission within and across tour groups (Kong*). High COVID-19 incidence was reported on a cruise ship from Uruguay to Australia, with the majority of cases being asymptomatic (42% vs. 14%), suggesting great underestimation of SARS-CoV-2 cases by symptom-based screening only (Bailie*). This is in concordance with the findings from other studies evaluating symptom screening vs. testing (see the **Post-Arrival Screening, Testing & Quarantining** section).

Occupational Risk in Travel and Hospitality Industries

Workplace-related outbreaks have been reported across the US since March 2020 (Bui*; Pasco*; Rao*; Sami*). In terms of public-facing occupations, average transmission risks were lower when both employees and clients were wearing facemasks (Harrichandra*; Hendrix*). In Columbia, among a cohort of airport workers, those who used public transportation had a high perception of COVID-19 risk and risk perception of strongly influenced by practices related to work conditions and environments, and most COVID-19 cases in the cohort were asymptomatic (84%) (Malagón-Rojas*). In the Netherlands, hospitality and public transport workers, driving instructors, hairdressers and aestheticians had higher test positivity compared with a reference group of individuals without a close-contact occupation, while workers in childcare, education and healthcare showed lower test positivity (de Gier). A study in Norway showed that nurses, physicians, dentists, physiotherapists, bus/tram and taxi drivers had 1.1- to 4-times the odds of COVID-19 during the 1st wave, whereas bartenders, waiters, transport conductors and travel stewards had 1.1- to 3-times the odds of COVID-19 during the 2nd wave (when compared to everyone else) (Magnusson).

There are a variety of precautions being taken among restaurants and bars to prevent transmission of SARS-CoV-2 between patrons and employees. Among interviews with 16 restaurants in Milwaukee, Wisconsin, 81% of restaurants required employees to wear face masks, 94% had disposable gloves available for employees, 38% did temperature checks on their employees, and 15 restaurants conducted specific sanitation procedures for COVID-19 and believed they were following CDC precautions, although only 4 of the 15 were actually following all of the current guidelines (Drake). In Europe, incidence of COVID-19 among bartenders and waiters declined by similar amounts in municipalities that implemented full bans on serving of alcohol in bars and restaurants (65% reduction) compared to municipalities that implemented partial bans (68% reduction) (Methi) and observations conducted in bars identified persistent potential risks of COVID-19 in many bars, especially when customers were intoxicated (Fitzgerald).

In the US, essential workers are disproportionally low-income persons of color who are more likely to face socioeconomic vulnerabilities, systemic racism, and health inequities (Roberts). Occupational segregation by race may contribute to racial disparities in SARS-CoV-2 infection (Chen*; Hawkins*). A study using death records from the California Department of Public Health found that during the COVID-19 pandemic, working age adults experienced a 22% increase in mortality compared to historical periods, which varied by race/ethnicity and occupational sector and occupation (Chen*). In Utah, 73% of persons with workplace outbreak-associated COVID-19 were identified as Hispanic or nonwhite, although these ethnic/racial groups represent <24% of Utah's workforce in the 15 affected industry sectors (Bui*). In June 2020, 46% of non-remote, non–health care workers used measures to prevent COVID-19 (e.g., physical barriers, masks, and other personal protective equipment), with higher-income workers more likely to report required use and to use preventive measures compared to lower-income workers (Billock*).

Vaccines

CDC recommends delaying travel until individuals are fully vaccinated, but released guidance that people who are fully vaccinated with an FDA-authorized vaccine can travel safely within the US (CDC). According to these guidelines, fully vaccinated travelers do not need to get tested before or after travel unless their destination requires it, and they do not need to self-quarantine. CDC recommendations are available to people who are not yet fully vaccinated and must travel. Additional information about vaccines and viral variants can be found in the synthesis summaries.

Other Resources for Travelling During COVID-19

- Accommodating Individual Travel History Global Mobility and Unsampled Diversity in Phylogeography: a SARS-CoV-2 Case Study – Biorxiv (June 23)
- Body Temperature Screening to Identify SARS-CoV-2 Infected Young Adult Travellers Is Ineffective – Travel Medicine and Infectious Disease (Aug 5)
- Occupational Safety and Health Administration (OSHA) and Worker Safety During the COVID-19 Pandemic – JAMA (Sept 16)
- In-Flight Transmission of SARS-CoV-2: A Review of the Attack Rates and Available Data on the Efficacy of Face Masks – Journal of Travel Medicine (Sept 25)
- Risk of COVID-19 During Air Travel – JAMA (Oct 1)
- The Hospitality Industry in the Face of the COVID-19 Pandemic: Current Topics and Research Methods – International Journal of Environmental Research and Public Health (Oct 2020)
- Navigating the Risks of Flying During COVID-19: A Review for Safe Air Travel – Journal of Travel Medicine (Nov 2020)
- Challenges of SARS-CoV-2 prevention in flights, suggested solutions with potential on-site diagnosis resembling cancer biomarkers and urgency of travel medicine – European Review for Medical and Pharmacological Sciences (Dec 2020)
- Covid-19: Air travelers should not be considered high risk, says European guidance – BMJ (Dec 4 2020)
- The International Health Regulations (2005) and the Re-Establishment of International Travel amidst the COVID-19 Pandemic – Journal of Travel Medicine (Dec 23)
- Risk of Symptomatic COVID-19 Due to Aircraft Transmission: A Retrospective Cohort Study of Contact-traced Flights during England's Containment Phase – Influenza and Other Respiratory Viruses (Mar 1)
- Cabin Crew Health and Fitness-to-Fly: Opportunities for Re-Evaluation amid COVID-19 – Travel Medicine and Infectious Disease (Mar 2021)
- Travel During COVID-19 – CDC (April 2021)

Annotated Bibliography

Adekunle et al. (July 22, 2020). Delaying the COVID-19 Epidemic in Australia: Evaluating the Effectiveness of International Travel Bans. Australian and New Zealand Journal of Public Health. https://doi.org/10.1111/1753-6405.13016

- Adekunle et al. estimated that there was a 79% reduction in imported COVID-19 cases in Australia as of March 2, 2020 and a one-month delay in the COVID-19 outbreak that was attributable to the travel bans imposed on January 24, 2020. Their model results aligned with the observed imported cases in Australia.

Al-Qahtani et al. (Nov 2, 2020). The Prevalence of Asymptomatic and Symptomatic COVID19 Disease in a Cohort of Quarantined Subjects. International Journal of Infectious Diseases. https://doi.org/10.1016/j.ijid.2020.10.091

- In a cohort of 2,714 travelers returning to Bahrain by air between February 25th and March 14th, 2020, 136 were SARS-CoV-2 positive on arrival, 68% of whom were asymptomatic. A further 52 became SARS-CoV-2 positive during the mandatory 14-day quarantine following arrival, 46% of whom remained asymptomatic until viral clearance.

Alpert et al. (Feb 2021). Early Introductions and Community Transmission of SARS-CoV-2 Variant B.1.1.7 in the United States. Pre-print downloaded Feb 17 from https://doi.org/10.1101/2021.02.10.21251540

- *[Pre-print, not peer-reviewed]* Using combined data from UK air travel into US airports, SARS-CoV-2 genomic sequencing, and clinical diagnostics, a study found evidence for multiple independent introductions of the SARS-CoV-2 B.1.1.7 variant (first described in the UK) into the US, many of which have led to sustained community transmission. The authors conclude that the high number of B.1.1.7 sequences supports the prediction, based on incoming air passenger volumes from the UK, that New York, California, and Florida would be at highest risk for importation. Phylogenetic analyses suggested that New York acted as a hub for B.1.1.7 importation and spread to other states, and the study found evidence for community transmission of B.1.1.7 in New York, New Jersey, Connecticut, and Illinois during January, 2021.

Arima et al. (Apr 10, 2020). Severe Acute Respiratory Syndrome Coronavirus 2 Infection among Returnees to Japan from Wuhan, China, 2020. Emerging Infectious Diseases. https://doi.org/10.3201/eid2607.200994

- In January 2020, 566 Japanese nationals were repatriated from Wuhan, China and were monitored for 14 days following their return. Universal RT-PCR testing identified 12 cases of SARS-CoV-2 infection over this period. Entry screening only detected 7/12 cases, 2 of whom were symptomatic and 5 of whom were asymptomatic. Subsequent testing identified 5 additional cases among individuals whose first RT-PCR test result was negative. This study found that symptom-based testing performed poorly and missed 5/7 prevalent cases at entry. Even with universal screening, nearly half of cases (5/12) would have been missed without repeated testing.

Ashcroft et al. (Sept 25, 2020). Quantifying the impact of quarantine duration on COVID-19 transmission. Pre-print downloaded Sept 25 from https://doi.org/10.1101/2020.09.24.20201061

- [Pre-print, not peer reviewed] In a modeling study, quarantining an infected traced contact for 10 days was estimated to prevent 75-99% of their onward transmission. In the scenario of a contact being infected on a return flight, a 10 day quarantine was estimated to prevent 99% of onward transmission.

Bae et al. (Nov 2020). Asymptomatic Transmission of SARS-CoV-2 on Evacuation Flight. Emerging Infectious Diseases. https://doi.org/10.3201/eid2611.203353

- Bae et al. report a single incidence of possible transmission of COVID-19 during an evacuation flight from Italy to South Korea. After airport screening, 299 asymptomatic passengers took an 11-hour flight to South Korea, during which most of them wore N95 respirators at all times. They were tested for SARS-CoV-2 by RT-PCR on days 1 and 14 during their subsequent quarantine period.
- Six passengers tested positive when the plane arrived in South Korea. One patient tested positive on day 14. She reported wearing an N95 mask at all times on the flight except for when she used a toilet. She was seated three rows away from one of the patients who tested positive on day 1 and used the same toilet during the flight.
- All 18 members of the cabin crew and medical staff tested negative at both day 1 and day 14 of quarantine after the flight.

Bailie et al. (Feb 10, 2021). Symptoms and Laboratory Manifestations of Mild COVID-19 in a Repatriated Cruise Ship Cohort. Epidemiology and Infection. https://doi.org/10.1017/S0950268821000315

- Among 49 passengers traveling from Uruguay to Australia on a cruise ship with high COVID-19 incidence in April 2020, 42% were asymptomatic and only 15% of symptomatic cases reported fever. Serial respiratory and rectal swabs were positive for 10% and 5% of participants, respectively, after a median of 3 weeks post-symptom onset. The authors suggest that in a similarly closed setting, true COVID-19 incidence could be almost double what is suggested by symptom-based screening.

Benenson et al. (Mar 23, 2021). BNT162b2 MRNA Covid-19 Vaccine Effectiveness among Health Care Workers. New England Journal of Medicine. https://doi.org/10.1056/NEJMc2101951

- Weekly incidence of COVID-19 among healthcare workers (HCWs) in a two-campus medical center in Jerusalem steadily declined after commencement of two-dose vaccinations with the Pfizer-BioNTech vaccine in December 2020. Decline in incidence occurred despite a surge of the B.1.1.7 variant (up to 80% of cases) within the community.

Billock et al. (Feb 19, 2021). Required and Voluntary Occupational Use of Hazard Controls for COVID-19 Prevention in Non-Health Care Workplaces - United States, June 2020. MMWR. Morbidity and Mortality Weekly Report. https://doi.org/10.15585/mmwr.mm7007a5

- 46% of non-remote, non–health care workers used hazard controls to prevent COVID (e.g., physical barriers, masks, and other personal protective equipment). Although 56% of workers surveyed reported required use at work, higher-income workers were more likely to report required use and to use hazard controls than were lower-income workers. Among workers not using hazard controls, 8% were prohibited from using them, 15% could not obtain them, and 77% did not believe they were needed.

Bui et al. (Aug 17, 2020). Racial and Ethnic Disparities Among COVID-19 Cases in Workplace Outbreaks by Industry Sector — Utah, March 6–June 5, 2020. MMWR. https://doi.org/10.15585/mmwr.mm6933e3

- During March 6–June 5, 2020, Utah reported 1,389 COVID-19 cases associated with 210 workplace-related outbreaks, defined as the occurrence of two or more laboratory-confirmed cases occurring within the same 14-day period among coworkers in a common workplace (median cases per outbreak=4; range=2–79) involving 15 industry sectors, most frequently in manufacturing (20%), construction (15%), and wholesale trade (14%). In total, 970 (73%) of persons with workplace

outbreak-associated COVID-19 were identified as Hispanic or nonwhite, although these ethnic/racial groups represent <24% of Utah's workforce in the 15 affected industry sectors. The authors conclude that mitigation strategies should be culturally and linguistically responsive to racial/ethnic minority workers disproportionately affected by COVID-19.

Chen et al. (Jan 22, 2021). Excess Mortality Associated with the COVID-19 Pandemic among Californians 18-65 Years of Age by Occupational Sector and Occupation March through October 2020. Pre-print downloaded Jan 25 from https://doi.org/10.1101/2021.01.21.21250266

- *[Pre-print, not peer-reviewed]* A study using death records from the California Department of Public Health found that during the COVID-19 pandemic, working age adults experienced a 22% increase in mortality compared to historical periods, which varied by race/ethnicity and occupational sector and occupation. Latino Californians experienced a 36% increase in mortality (59% among Latino food/agriculture workers), with mortality increases of 28% in Black Californians (36% increase for Black retail workers), 18% in Asian Californians (40% increase among Asian healthcare workers), and 6% in white Californians (16% increase among white food/agriculture workers).

Choi et al. (Sept 18, 2020). In-Flight Transmission of Severe Acute Respiratory Syndrome Coronavirus 2. Emerging Infectious Diseases. https://doi.org/10.3201/eid2611.203254

- Four individuals with SARS-CoV-2 infection had traveled on the same flight from Boston to Hong Kong on March 9, 2020. An epidemiologic investigation revealed that all four had identical virus genetic sequences belonging to a clade not previously identified in Hong Kong. The authors conclude that viral transmission likely occurred during the flight shared by these travelers.

Clifford et al. (July 24, 2020). Strategies to Reduce the Risk of SARS-CoV-2 Re-Introduction from International Travellers. Pre-print downloaded Aug 3 from https://doi.org/10.1101/2020.07.24.20161281

- *[Preprint, not peer-reviewed]* Clifford et al. estimated that a quarantine period of eight days for air travelers arriving to the UK with a PCR test on day-7 can reduce the number of infectious arrivals released into the community by a median 94% when compared with no quarantine. This reduction is similar to the 99% median reduction achieved by a 14-day quarantine period. Without quarantine, the current high prevalence of SARS-CoV-2 in the US would result in up to 23 introductions of infectious travelers per week.

Clipman et al. (Aug 1, 2020). Rapid Real-Time Tracking of Non-Pharmaceutical Interventions and Their Association SARS-CoV-2 Positivity: The COVID-19 Pandemic Pulse Study. Pre-print downloaded Sep 3 from https://doi.org/10.1101/2020.07.29.20164665

- *[Pre-print, not peer reviewed]* Clipman et al. found strong dose-response relationships between frequency of movement (e.g. traveling for non-essential services) and self-reported SARS-CoV-2 positivity. Social distancing practices were associated with a lower likelihood of reporting a history of SARS-CoV-2 infection. Travel using public transport and visiting a place of worship were also associated with a history of SARS-CoV-2 infection, even after adjusting for social distancing. These findings were based on sampling of 1,030 individuals in Maryland.

Davis et al. (July 7, 2020). Estimating the Establishment of Local Transmission and the Cryptic Phase of the COVID-19 Pandemic in the USA. Pre-print downloaded July 8 from https://doi.org/10.1101/2020.07.06.20140285

- *[Preprint, not peer-reviewed]* Davis et al. estimated that there was widespread community transmission of SARS-CoV-2 in the United States by February, 2020. Their modeling suggests that international travel could have seeded outbreaks in West and East Coast metropolitan areas as early as December, 2019. However, for most states, domestic travel contributed to the largest proportion of imported infections.

De Salazar et al. (Mar 24, 2020). Identifying Locations with Possible Undetected Imported Severe Acute Respiratory Syndrome Coronavirus 2 Cases by Using Importation Predictions. Emerging Infectious Diseases. https://doi.org/10.3201/eid2607.200250

- Early in the SARS-CoV-2 epidemic, most cases were linked to recent travel history from China, suggesting that air travel played a major role in importation of cases. Using data from February 2020, De Salazar et al. found that daily air travel volume was positively correlated with imported cases of SARS-CoV-2 infection. They estimated that increasing flight volume by 31 passengers/day was associated with 1 additional expected case.

Dejnirattisai et al. Antibody Evasion by the Brazilian P.1 Strain of SARS-CoV-2. Pre-print downloaded Mar 16 from https://doi.org/10.1101/2021.03.12.435194

- *[Pre-print, not peer-reviewed]* The SARS-CoV-2 P.1 variant, which has caused large outbreaks in Brazil, is less resistant to neutralization from both convalescent serum and vaccine-induced serum than the B.1.351 variant originally identified in South Africa, despite containing similar receptor binding domain (RBD) mutations (E484K, K417N/T and N501Y). Similar to the B.1.351 variant, mutations associated with the P1 variant completely abrogated the binding of multiple neutralizing antibodies directed against the RBD, including a variety of antibodies currently in development for therapeutic use. In contrast, the reduction in neutralization activity of convalescent plasma from recovered volunteers against the P.1 variant was only modest (~3-fold reduction versus the ancestral Victoria strain) when compared to the reduction in neutralization observed with B.1.351 variant (~13-fold reduction versus the Victoria strain). Sera from recipients of either the Pfizer-BioNTech or Oxford-Aztrazeneca vaccine had similar modest reductions in neutralization activity (~3-fold) when compared to the reductions in neutralization observed with the B.1.351 variant (~8-9 fold).

Deng et al. (June 8, 2020). Genomic Surveillance Reveals Multiple Introductions of SARS-CoV-2 into Northern California. Science. https://doi.org/10.1126/science.abb9263

- Phylogenetic analyses of samples from 36 patients in Northern California and the Grand Princess cruise ship showed at least 7 different SARS-CoV-2 lineages were introduced into California, including the epidemic WA1 strains associated with Washington State, with lack of a predominant lineage and limited transmission between communities. The authors conclude that these findings support contact tracing, social distancing, and travel restrictions to contain SARS-CoV-2 spread in California and other states.

Dickens et al. (Aug 25, 2020). Strategies at Points of Entry to Reduce Importation Risk of COVID-19 Cases and Re-Open Travel. Journal of Travel Medicine. https://doi.org/10.1093/jtm/taaa141

- An assessment of strategies to prevent transmission of SARS-CoV-2 from infected travelers estimated that 80% of infected travelers are infectious upon arrival and that testing and 7-day quarantine could prevent 88% of secondary cases while 14-day quarantine without testing could prevent 84% of secondary cases**.** More

Dollard et al. (Nov 13, 2020). Risk Assessment and Management of COVID-19 Among Travelers Arriving at Designated U.S. Airports, January 17–September 13, 2020. MMWR. https://doi.org/10.15585/mmwr.mm6945a4

- Symptom-based screening of travelers at US airports to prevent the spread of SARS-CoV-2 was found to be resource-intensive and ineffective. From mid-January to mid-September, a total of 766,044 travelers were screened, 298 (0.04%) of whom met criteria for public health assessment. 35 of those passengers (0.005%) were tested for SARS-CoV-2, and nine (0.001%) were positive. Overall, this approach yielded about one case for every 85,000 travelers screened.

Edara et al. (Mar 19, 2021). Neutralizing Antibodies Against SARS-CoV-2 Variants After Infection and Vaccination. JAMA. https://doi.org/10.1001/jama.2021.4388

- Neutralizing antibody activity against four SARS-CoV-2 variants, including B.1, B.1.1.7, and N501Y was maintain in sera from individuals with infection- and vaccine-induced antibodies. There was minimal reductions in serum neutralization observed across four representative SARS-CoV-2 strains. Serum was obtained from adults (n=20) hospitalized with COVID-19 5 to 19 days after symptom onset, convalescent individuals (n=2) 32 to 94 days after symptom onset, and individuals (n=14) 14 days after the 2nd dose in the Moderna vaccine phase 1 clinical trial. Neutralizing activity was evaluated by "live virus focus reduction neutralization tests" against the A.1 lineage similar to original Wuhan strain, the B.1 lineage containing the D614G mutation that has emerged worldwide, the B.1.1.7 variant originally identified in the UK, and the N501Y engineered variant containing mutation in spike protein present across multiple emerging variants. Neutralizing activity was not significantly different across the four variants for both hospitalized COVID-19 patients and convalescent individuals. Neutralizing activity induced by vaccines was reduced for all strains compared to the original A1 strain but was similar for the B.1, B.1.1.7, and synthetic N501Y strain.

Emary et al. (Mar 30, 2021). Efficacy of ChAdOx1 NCoV-19 (AZD1222) Vaccine against SARS-CoV-2 Variant of Concern 202012/01 (B.1.1.7): An Exploratory Analysis of a Randomised Controlled Trial. The Lancet. https://doi.org/10.1016/S0140-6736(21)00628-0

- Post-hoc analysis of the Oxford-AstraZeneca vaccine indicated that clinical vaccine efficacy against symptomatic, PCR-positive infection was 70.4% for the B.1.1.7 variant and 81.5% for non-B.1.1.7 lineages (not including the B.1.351 variant). Neutralization activity via vaccine-induced antibodies *in vitro* was also lower against the B.1.1.7 variant (geometric mean ratio 8.9). Participants 18 and older in efficacy cohorts (n=8534) were included in the analysis, and received either the COVID-19 vaccine or a control meningococcal conjugate vaccine. *[EDITORIAL NOTE: This paper was summarized as a pre-print on February 5, 2021]*

Firestone et al. (Feb 17, 2021). First Identified Cases of SARS-CoV-2 Variant B.1.1.7 in Minnesota — December 2020–January 2021. MMWR. https://doi.org/10.15585/mmwr.mm7008e1

- On January 9, 2021, the Minnesota Department of Health announced the identification of the B.1.1.7 SARS-CoV-2 variant (first described in the UK) in specimens from five people, and on January 25, this variant was found in samples from three additional people. The samples were collected between December 18, 2020 and January 11, 2021 from residents in five counties in the Minneapolis–St. Paul metropolitan area. Three people had a history of international travel during the 14 days before illness onset and three additional people had traveled to California. None had a history of travel to the United Kingdom.

Firestone et al. (Mar 3, 2021). First Identified Cases of SARS-CoV-2 Variant P.1 in the United States — Minnesota, January 2021. MMWR. https://doi.org/10.15585/mmwr.mm7010e1

- On January 25, 2021, the Minnesota Department of Health identified the first US cases of infection with the SARS-CoV-2 variant of concern P.1 (first identified in persons from Brazil) in two individuals, one of whom had a recent travel history to Brazil. Whole genome sequencing revealed identical sequences from both individuals, who lived in the same household, with 15 of the 17 mutations associated with the P.1 variant. No high-risk exposures were identified among health care personnel with whom these individuals interacted, among whom 22 (20%) submitted specimens for testing, and no positive test results were reported.

Fujino et al. (Feb 10, 2021). Novel SARS-CoV-2 Variant Identified in Travelers from Brazil to Japan. Emerging Infectious Diseases. https://doi.org/10.3201/eid2704.210138

- A novel SARS-CoV-2 strain was detected in 4 travelers flying from Brazil to Japan on January 2, 2021. Whole genome sequencing suggests the variant descends from the P.1 lineage with 12 nonsynonymous mutations in the receptor-binding domain (RBD) of the spike protein, including the K417T, E484K, and N501Y mutations also present in the B.1.1.7 and B.1.351 variants. Three travelers remained asymptomatic, while one experienced symptomatic COVID-19 infection.

Harrichandra et al. (Oct 21, 2020). An Estimation of Airborne SARS-CoV-2 Infection Transmission Risk in New York City Nail Salons. Toxicology and Industrial Health. https://doi.org/10.1177/0748233720964650

- An airborne SARS-CoV-2 transmission infection risk model for 12 New York City nail salons found the average transmission risk when not wearing face masks was 25% vs 7% when masks were worn. Utilizing previous estimates of outdoor airflow rates, increased outdoor airflow rates in the model strongly correlated with decreased risk, suggesting that businesses should employ multiple layers of infection control measures (e.g. social distancing, face masks, and outdoor airflow).

Hawkins. (June 15, 2020). Differential Occupational Risk for COVID-19 and Other Infection Exposure According to Race and Ethnicity. American Journal of Industrial Medicine. https://doi.org/10.1002/ajim.23145

- Using disaggregated employment data from the Bureau of Labor Statistics, Hawkins found that occupational segregation by race may contribute to racial disparities in SARS-CoV-2 infection. The author found that black Americans were more likely to be employed in essential industries (e.g. healthcare, animal slaughtering), occupations with higher exposure to infections (e.g. nursing), and occupations with close proximity to others (e.g. bus drivers, flight attendants).

Hendrix et al. (July 14, 2020). Absence of Apparent Transmission of SARS-CoV-2 from Two Stylists After Exposure at a Hair Salon with a Universal Face Covering Policy — Springfield, Missouri, May 2020. MMWR. https://doi.org/10.15585/mmwr.mm6928e2

- In a hair salon in Missouri, no symptomatic secondary cases were reported among 139 clients exposed to two hair stylists who were symptomatic with COVID-19 while both stylists and clients wore face masks. All tests were negative among 67 clients that were tested for SARS-CoV-2. All 4 cohabitants of one of the stylists later developed COVID-19 symptoms and had positive PCR test results.

Hoehl et al. (Aug 18, 2020). Assessment of SARS-CoV-2 Transmission on an International Flight and Among a Tourist Group. JAMA Network Open. https://doi.org/10.1001/jamanetworkopen.2020.18044

- Monitoring of commercial airline passengers (n=102) on an international flight, 24 of whom were part of a tourist group who came in contact with a hotel manager with COVID-19, identified 2 likely SARS-CoV-2 transmissions on the flight, with 7 index cases, indicating possible airborne transmission. Both passengers with likely onboard acquisition were seated within 2 rows of an index case. The airflow in the cabin from the ceiling to the floor and from the front to the rear may have been associated with a reduced transmission rate, though the authors hypothesize that the rate may have been reduced further had the passengers worn masks on the flight.

Hou et al. (Mar 8, 2021). A Rapid Method to Evaluate Pre-Travel Testing Programs for COVID-19 A Study in Hawaii. Pre-print downloaded Mar 9 from https://doi.org/10.1101/2021.03.06.21251482

- *[Pre-print, not peer-reviewed]* A rapid field study conducted in the Kahului main airport in Maui, Hawaii identified 2 SARS-CoV-2 PCR positive participants out of 279 consecutively sampled participants boarding for departure, despite all participants having a negative PCR test 72 hours prior. This positivity rate corresponded to 7 cases per 1,000 travelers, which corresponds to an estimated 52-70 infected travelers arriving daily to Hawaii during November to December 2020. Participants were sampled anonymously at the time of departure to avoid interfering with travel plans, but had to have a ≤14 day stay in Hawaii to be eligible for the study.

Hu et al. (July 2020). The Risk of COVID-19 Transmission in Train Passengers: An Epidemiological and Modelling Study. Clinical Infectious Diseases. https://doi.org/10.1093/cid/ciaa1057

- The risk of SARS-CoV-2 transmission among train passengers varied considerably depending on shared travel time and seat location, with a peak attack rate of 4% among passengers who were sitting adjacent to an index case. Transmission risk increased with longer duration of co-travel, increasing by 1.3% per hour for adjacent passengers. These findings are based on an analysis of the spatial and temporal distribution of SARS-CoV-2 transmission from index patients on high-speed trains in China (n=2,334) and close contacts (n=72,093) who had co-travel times of 0-8 hours.

Johansson et al. (Nov 24, 2020). Reducing Travel-Related SARS-CoV-2 Transmission with Layered Mitigation Measures Symptom Monitoring Quarantine and Testing. Pre-print downloaded Nov. 25 from https://doi.org/10.1101/2020.11.23.20237412

- *[Pre-print; not peer-reviewed]* A model built to assess the relative impact of symptom monitoring, testing, and quarantine practices on transmission of SARS-CoV-2 by infected travelers suggests that quarantining for 14 days almost eliminates risk of transmission. The effectiveness of testing depended on timing and quality of the test, with the combination of a pre-travel test and a post-travel test 2 to 3 days after arrival reducing the risk of transmission by 45 to 70%. When combined

with symptom monitoring and testing, a 7-day quarantine after arrival had similar effectiveness in preventing transmission to a 10-day or 14-day quarantine on its own.

Karatayev et al. (Sept 4, 2020). Local Lockdowns Outperform Global Lockdown on the Far Side of the COVID-19 Epidemic Curve. Proceedings of the National Academy of Sciences. https://doi.org/10.1073/pnas.2014385117

- Based on a modeling study based on Ontario, Canada, enacting lockdown policies at the county level would cause significantly fewer person-days of closure compared to enacting them at the province level, even under the same trigger threshold for cases and in a scenario with high intercounty travel. The authors conclude that these findings suggest local strategies may be better suited for handling the tail-end of the pandemic.

Khanh et al. (Sept 18, 2020). Transmission of Severe Acute Respiratory Syndrome Coronavirus 2 During Long Flight. Emerging Infectious Diseases. https://doi.org/10.3201/eid2611.203299

- Following a 10-hour flight from London, UK to Hanoi, Vietnam on March 2, 2020, 16 of 217 passengers (7%) were found to be positive for SARS-CoV-2 after contact tracing, of whom 12 (75%) were seated in business class along with the only symptomatic person (attack rate 62%). Seating proximity was strongly associated with increased infection risk (OR=7.3).

Kong et al. (July 13, 2020). Clusters of 2019 Coronavirus Disease (COVID-19) Cases in Chinese Tour Groups. Transboundary and Emerging Diseases. https://doi.org/10.1111/tbed.13729

- A contact investigation of a COVID-19 outbreak involving 11 confirmed cases and 10 suspected cases among Chinese tour groups traveling in Europe in late January 2020 suggests that transmission may have occurred on outbound and inbound flights and in shopping venues in Europe. Initial transmission occurred in family groups and later transmission within and across tour groups.

Lachassinne et al. (2021). SARS-CoV-2 Transmission among Children and Staff in Daycare Centres during a Nationwide Lockdown in France: A Cross-Sectional, Multicentre, Seroprevalence Study. The Lancet Child & Adolescent Health. https://doi.org/10.1016/S2352-4642(21)00024-9

- Children (n=327) and staff (n=197) attending daycare centers in France during the lockdown from March to May 2020 had similar seroprevalence (4% and 7%, respectively) to a comparator group consisting of laboratory or administrative personnel not occupationally exposed to COVID-19 patients or children (5%). In addition, seropositive children were 7-times as likely to have been exposed to an adult household member with confirmed COVID-19 compared to seronegative children. The authors suggest that during the French lockdown, household transmission seems more likely than transmission within daycare centers. *[EDITORIAL NOTE: It is also plausible that the association between child and household contact seroprevalence could be due to transmission from an infected child to a household contact].*

Lewis et al. (June 24, 2020). COVID-19 Outbreak Among College Students After a Spring Break Trip to Mexico — Austin, Texas, March 26–April 5, 2020. MMWR. Morbidity and Mortality Weekly Report. https://doi.org/10.15585/mmwr.mm6926e1

- Transmission of SARS-CoV-2 during and after a college spring break trip to Cabo San Lucas, Mexico (March 14–19) led to 64 cases, including 60 cases among 183 vacation travelers, one among 13

household contacts, and three among 35 community contacts. Approximately one-fifth of those who tested positive were asymptomatic at the time of testing.
- Prompt epidemiologic investigation, with effective contact tracing and cooperation between a university and a public health department, contributed to the control of the outbreak.

Long et al. (Mar 2, 2021). Sequence Analysis of 20453 SARS-CoV-2 Genomes from the Houston Metropolitan Area Identifies the Emergence and Widespread Distribution of Multiple Isolates of All Major Variants of Concern. Pre-print downloaded Mar 3 from https://doi.org/10.1101/2021.02.26.21252227

- *[Pre-print, not peer-reviewed]* Genomic sequencing of 20,453 virus specimens in Houston, Texas identified the presence of all variants of interest or concern (n=23 of B.1.1.7, n=2 of B.1.351, n=4 of P.1, and n=143 of B.1.429 and n=19 of B.1.427). None of the affected patients were from a common household or reported recent international travel, suggesting that infections were independently acquired locally or during domestic travel.

Madhi et al. (Mar 16, 2021). Efficacy of the ChAdOx1 NCoV-19 Covid-19 Vaccine against the B.1.351 Variant. New England Journal of Medicine. https://doi.org/10.1056/NEJMoa2102214

- Two doses of the Oxford-AstraZeneca (ChAdOx1 nCoV-19) vaccine did not show protection against mild-to-moderate COVID-19 among people infected with the B.1.351 variant in a multicenter randomized trial in South Africa. Mild-to-moderate COVID-19 developed in 23 of 717 placebo recipients (3.2%) and in 19 of 750 vaccine recipients (2.5%), for an efficacy of 21.9%. Among the 42 participants who developed COVID-19, 39 (92.9%) were infected with the B.1.351 variant. Vaccine efficacy against this variant, analyzed as a secondary end point, was 10.4%. The authors note that the demographic profile of enrolled participants contributed to the lack of severe COVID-19, and therefore trial results are inconclusive regarding the vaccine's potential to protect against severe disease. *[EDITORIAL NOTE: A pre-print related to this manuscript was summarized on February 12, 2020]*

Maggi et al. (Feb 10, 2021). Imported SARS-COV-2 Variant P.1 Detected in Traveler Returning from Brazil to Italy. Emerging Infectious Diseases. https://doi.org/10.3201/eid2704.210183

- An imported case of the P.1 SARS-CoV-2 variant (also known as the B.1.1.28 or 20J/501Y.V3 variant) was detected in an asymptomatic passenger traveling on an indirect flight from Brazil to Italy on January 17, 2021. The case patient and his family received PCR-negative results at the departure airport in Brazil, and was tested on January 21, 4 days after arriving in Italy.

Malagón-Rojas et al. (Jan 22, 2021). Seroprevalence and Seroconversions for SARS-CoV-2 Infections in Workers at Bogota Airport, Colombia 2020. Journal of Travel Medicine. https://doi.org/10.1093/jtm/taab006

- A study of workers (n=212) at the Bogata, Colombia airport conducted between June 1 and September 30, 2020 found that the cumulative incidence and seroprevalence of SARS-CoV-2 among workers was 23.6% and 16.0%, respectively. Most cases were asymptomatic (84%), and 61% of participants seroconverted during the study period, with no significant differences in seroconversion between asymptomatic and mild cases.

Marshall et al. (June 30, 2020). Exposures Before Issuance of Stay-at-Home Orders Among Persons with Laboratory-Confirmed COVID-19 — Colorado, March 2020. MMWR. https://doi.org/10.15585/mmwr.mm6926e4

- Marshall et. al. assessed COVID-19 exposures among a random sample of Colorado residents who had tested positive to SARS-CoV-2 in the 18-day period preceding Colorado's stay-at-home-order on March 26. Only 27% (99/364) reported known contact with a laboratory confirmed COVID-19 case, 47% of which occurred at work and 24% within their household.
- Among the remaining 73% (265/364) who did not have known contact with a laboratory confirmed COVID-19 case, only 30% reported contact with a person who had fever or respiratory symptoms. The most commonly reported potential exposures were gatherings of >10 people (44%), domestic travel (29%), working in a health care setting (28%), visiting a health care setting (23%), and using public transportation (22%).

McNamara et al. (June 19, 2020). High-Density Amplicon Sequencing Identifies Community Spread and Ongoing Evolution of SARS-CoV-2 in the Southern United States. Preprint downloaded June 22 from https://doi.org/10.1101/2020.06.19.161141

- *[pre-print, not peer reviewed]* McNamara et al. demonstrated SARS-CoV-2 evolution in a suburban Southern US region using high-density amplicon sequencing of 175 symptomatic cases. The presence of spike D614G variant, a mutation implicated in higher pathogenicity of the virus, was observed among 57% of strains and was associated with a higher genome copy number ($p<0.002$).
- The single nucleotide variant pattern is consistent with the idea that SARS-CoV-2 was introduced into North Carolina by travelers from the continental US. No strain had mutations in the target sites used in common diagnostic assays.

Mehta et al. (Dec 24, 2020). "There's No Place Like Home for The Holidays:" Travel and SARS-CoV-2 Test Positivity Following Thanksgiving Weekend. Pre-print downloaded Dec 28 from https://doi.org/10.1101/2020.12.22.20248719

- *[pre-print; not peer-reviewed]* An online panel survey administered December 4-18, 2020 to individuals from 10 US states (n = 7,905) found that many individuals reported spending Thanksgiving outside of their home (26%) or at home with at least one non-household member (27%). Planned travel over the December holidays was more common among those who tested positive for SARS-CoV-2 in the prior 2 weeks (67%) compared with 25% of those who tested negative in the prior 2 weeks and 11% among those who were not tested.

Menkir et al. (Jan 12, 2021). Estimating Internationally Imported Cases during the Early COVID-19 Pandemic. Nature Communications. https://doi.org/10.1038/s41467-020-20219-8

- Combined daily COVID-19 prevalence and flight passenger volume were used to estimate importations of SARS-CoV-2 from China. Researchers estimated that Wuhan was the primary source of global case importation from China in early January, but shifted to 18 other Chinese cities as the source in mid-February, particularly for importations to African destinations. The authors estimate that a total of 10 COVID-19 cases were imported to African locations by the end of February 2020, with the highest number of predicted imports in South Africa, Algeria, and Kenya. 90% of case importations in these locations occurred between January 17 and February 7.

Murphy et al. (Oct 22, 2020). A Large National Outbreak of COVID-19 Linked to Air Travel, Ireland, Summer 2020. Eurosurveillance. https://doi.org/10.2807/1560-7917.ES.2020.25.42.2001624

- An analysis of an outbreak of laboratory-confirmed cases of COVID-19 from across Ireland in the summer of 2020 linked the outbreak to an international flight. Onward transmission from 13 passenger cases on the flight resulted in a total of 59 cases in six of eight health regions in Ireland. Attack proportions among contacts were estimated to range from 10% to 18% despite low flight occupancy (17%) and well-spaced passenger seating on-board. The authors note that some individuals may have contracted the virus during the flight, while others were incubating or infected after the flight, and they recommend rapid contact tracing when a positive SARS-CoV-2 infection is linked to a flight.

Swadi et al. (Jan 5, 2021). Genomic Evidence of In-Flight Transmission of SARS-CoV-2 Despite Predeparture Testing. Emerging Infectious Diseases. https://doi.org/10.3201/eid2703.204714

- Genomic analysis of viral SARS-CoV-2 isolates obtained during a mandatory quarantine period after a Dubai-to-New Zealand flight demonstrate clear evidence of in-flight transmission. Among 86 passengers on a flight that arrived on September 29, 7 individuals in managed isolation and quarantine (MIQ) had positive test results during the quarantine period. Passengers originated from 5 different countries before a layover in Dubai, and 5 had negative predeparture SARS-CoV-2 test results. All 7 SARS-CoV-2 genomes were genetically identical, except for a single mutation in 1 sample. Multiple instances of in-flight SARS-CoV-2 transmission were determined to be likely despite 4 of 7 of infected passengers reporting mask use. MIQ has been mandatory for citizens and permanent residents returning to New Zealand since March 2020.

Ojelade et al. (Mar 3, 2021). Travel from the United Kingdom to the United States by a Symptomatic Patient Infected with the SARS-CoV-2 B.1.1.7 Variant — Texas, January 2021. MMWR. https://doi.org/10.15585/mmwr.mm7010e2

- On January 10, 2021, an individual infected with the SARS-CoV-2 B.1.1.7 variant was identified in Texas. No secondary cases with epidemiologic links to the patient have been identified to date. A case investigation revealed that the individual had traveled to the United Kingdom during November 13–December 30, 2020, and reported having been exposed to a relative experiencing COVID-19–compatible symptoms on December 24. In preparation for travel back to the US, the individual received a negative SARS-CoV-2 antigen test result on December 28. On December 30, the patient disclosed a runny nose during the pretravel interview but was cleared to fly from London to Dallas on that day.

Pan et al. (Aug 20, 2020). COVID-19 Effectiveness of Non-Pharmaceutical Interventions in the United States before Phased Removal of Social Distancing Protections Varies by Region. Pre-print downloaded Aug 21 from https://doi.org/10.1101/2020.08.18.20177600

- *[pre-print, not peer-reviewed*] Pan et al. quantified the effectiveness of non-pharmaceutical interventions on the spread of COVID-19 in the United States and found that only the most stringent level of restrictions (e.g, sheltering in place / stay-at-home, public mask requirements, or travel restrictions) significantly decreased COVID-19 cases and deaths in the US. These policies achieved at least a 50% reduction in case rates in six days, compared to eight days for the next highest level of policies (e.g. non-essential business closures, suspending non-violent arrests, suspending elective medical procedures, suspending evictions, or restricting mass gatherings of at least 10 people).

Pasco et al. (Oct 29, 2020). Estimated Association of Construction Work With Risks of COVID-19 Infection and Hospitalization in Texas. JAMA Network Open. https://doi.org/10.1001/jamanetworkopen.2020.26373

- A decision analytical model for COVID-19 found that resuming unrestricted construction work during shelter-in-place orders in Texas was associated with a higher risk of community hospitalizations due to SARS-CoV-2 (0.38 to 1.5 per 1000 residents) and increased risk of hospitalization of workers (0.22 to 9.3 per 1000 construction workers). Construction workers in central Texas had a nearly 5-fold higher risk of hospitalization compared with other occupational categories among adults aged 18 to 64 years (RR=4.9). Safety measures such as thorough cleaning of equipment, use of PPE, and limiting numbers of works at a given site were associated with a 50% decrease in transmission.

Rao et al. (Feb 23, 2021). Occupational Exposures and Mitigation Strategies among Homeless Shelter Workers at Risk of COVID-19. Pre-print downloaded Feb 24 from https://doi.org/10.1101/2021.02.22.21251646

- *[Pre-print, not peer-reviewed]* An online survey of 106 workers at homeless shelters in 17 shelter networks in Washington, Massachusetts, Utah, Maryland and Georgia found that 15% of workers reported testing positive for SARS-CoV-2, with 80% believing they were infected at work. The survey was conducted to assess occupational exposures to SARS-CoV-2, characterize job practices, and assess COVID-19 mitigation measures in the workplace. All shelter networks had implemented at least one prevention measure. Nearly 40% of workers reported having close contact with a person with known SARS-CoV-2 infection and believed the contact occurred at work. Reported frequent close contact with clients was significantly associated with testing positive for SARS-CoV-2 (prevalence ratio=3.97).

Russell et al. (Dec 07, 2020). Effect of internationally imported cases on internal spread of COVID-19: a mathematical modelling study. The Lancet Public Health. https://doi.org/10.1016/S2468-2667(20)30263-2

- A modeling study assessing the global impact of travel restrictions due to COVID-19 finds the restrictions are effective primarily in countries with low numbers of cases or that have strong travel links with countries experiencing high rates of infection. The authors suggest that strict untargeted travel restrictions are probably unjustified in many countries, other than those that have both high levels of international travel connections and very low local COVID-19 incidence.

Sami et al. (Feb 24, 2021). SARS-CoV-2 Infection and Mitigation Efforts among Office Workers, Washington, DC, USA. Emerging Infectious Diseases. https://doi.org/10.3201/eid2702.204529

- Two SARS-CoV-2 outbreaks in April, 2020 were identified among office workers in Washington, DC. The study identified two factors potentially associated with SARS-CoV-2 infection and transmission in the workplace: a significantly higher percentage of seropositive participants lived with someone who had a confirmed positive test result (13%) than those who were seronegative (1%), and more (60% vs. 32%) seropositive participants traveled by taxi after the cancellation of nonessential gatherings on March 11, 2020. There was no significant difference in workplace mitigation activities between seropositive and seronegative participants, including using a face covering most of the

time or always, maintaining a distance of ≥6 feet, and washing hands or using hand sanitizer ≥5 times per day.

Schlosser et al. (Dec 3, 2020). COVID-19 Lockdown Induces Disease-Mitigating Structural Changes in Mobility Networks. Proceedings of the National Academy of Sciences. *https://doi.org/10.1073/pnas.2012326117*

- An analysis of the impacts of lockdowns in Germany indicated that reductions in long-distance travel resulted in loss of connectivity between different regions of the country, leading to more locally clustered contact networks and potentially slowing the spatial spread of COVID-19. Using movement data from mobile phones, the authors found that mobility did not decrease homogenously across the country, with greater reductions seen primarily in large cities.

Shen et al. (Sept 3, 2020). Comprehensive Genome Analysis of 6,000 USA SARS-CoV-2 Isolates Reveals Haplotype Signatures and Localized Transmission Patterns by State and by Country. Frontiers in Microbiology. https://doi.org/10.3389/fmicb.2020.573430

- Genomic analysis of 6,359 SARS-CoV-2 isolates from the US identified a pattern of strongly localized outbreaks, which may point to the effectiveness of travel restriction policies and other public health measures. The authors identified prominent trends of localized haplotype patterns, which are the collection of variants in a viral genome, particular to Washington and California as well as other states.

Supasa et al. (Feb 18, 2021). Reduced Neutralization of SARS-CoV-2 B.1.1.7 Variant by Convalescent and Vaccine Sera. Cell. https://doi.org/10.1016/j.cell.2021.02.033

- The B.1.1.7 variant has a 7-fold higher binding affinity to the angiotensin converting enzyme-2 (ACE2) receptor in human cells than a parent SARS-CoV-2 strain isolated from Wuhan, suggesting a mechanism for the rapid emergence of this variant. Serum from individuals vaccinated with either the Pfizer-BioNTech or the Oxford-AstraZeneca and serum recovered from infection with the Wuhan strain, had only a modest 2-3-fold reduction in neutralization titers against the B.1.1.7 variant. Sera obtained from B.1.1.7-infected individuals show no reduction in titers against the parent strain compared to the B.1.1.7 variant.

Wang et al. (Feb 19, 2021). Inflight Transmission of COVID-19 Based on Experimental Aerosol Dispersion Data. Journal of Travel Medicine. https://doi.org/10.1093/jtm/taab023

- A study simulating aerosol dispersion in a B77-200 aircraft to estimate SARS-CoV-2 infection probability calculated that the MID-AFT (economy class) portion of the cabin exhibited the highest infection probability, with the average individual infection probability (without masks) for a 2-hour flight in this section varying from 0.1% for a 'Mild Scenario' to 2.5% for a 'Severe Scenario'. This implies that 1.9 of 75 passengers seated in this section are likely to be infected. For a 12-hour flight, the average infection probability varied from 0.8% to 10.8%. If all passengers wore masks throughout the longer flight, the average infection probability was reduced by approximately 73% for high-efficiency masks vs. 32% for low-efficiency masks.

Wells et al. (Jan 7, 2021). Optimal COVID-19 Quarantine and Testing Strategies. Nature Communications. https://doi.org/10.1038/s41467-020-20742-8

- A mathematical model developed to quantify the probability of post-quarantine transmission in the context of travel found that SARS-CoV-2 testing on exit could reduce the duration of a 14-day quarantine by 50%, while testing on entry shortened quarantine by at most one day. The authors tested this approach in a real-world scenario involving offshore oil rig employees and found 47 positive cases were identified with testing on entry and exit to quarantine, among whom 16 had tested negative at entry, preventing an estimated nine transmission events.

Wong et al. (Oct 7, 2020). Stringent Containment Measures without Complete City Lockdown to Achieve Low Incidence and Mortality across Two Waves of COVID-19 in Hong Kong. BMJ Global Health. https://doi.org/10.1136/bmjgh-2020-003573

- Prompt and stringent containment measures in Hong Kong led to some of the lowest SARS-CoV-2 incidences and mortalities in the world (135.5 and 0.5/1,000,000 population, respectively) by April 2020. Aggressive border control measures reduced R_t from 1.35 to 0.57 and 0.92 to 0.18 in the first and second waves, respectively. Implementation of COVID-19 tests for travelers returning from overseas correlated with an upsurge in asymptomatic cases and shortened containment delay from 6.8 to 3.7 days between the first and second waves. First wave cluster events were mostly family gatherings, while the second wave clusters were often leisure activities among young people.

Yang et al. (July 31, 2020). In-Flight Transmission Cluster of COVID-19: A Retrospective Case Series. Infectious Diseases. https://doi.org/10.1080/23744235.2020.1800814

- Yang et al. described a case series of 12 people who likely acquired SARS-CoV-2 on a 5-hour flight carrying 325 passengers and crew members. All passengers and crew were asymptomatic and without fever at the time of boarding. A single passenger was found to be febrile on arrival in China and tested positive for SARS-CoV-2. Consequently, all passengers and crew were quarantined and monitored for 14 days. Eleven additional passengers subsequently tested positive for SARS-CoV-2; no crew were infected. Seat assignment was not described. The median age of cases was 33 years; 70% were female. The median incubation period (from flight to symptom onset) was 3 days. No patients were admitted to the intensive care unit, and no patients died in the initial month of observation.

Zeller et al. (Feb 8, 2021). Emergence of an Early SARS-CoV-2 Epidemic in the United States. Pre-print downloaded Feb 9 from https://doi.org/10.1101/2021.02.05.21251235

- *[Pre-print, not peer-reviewed]* Genome sequencing combined with epidemiological and mobility data suggest show that SARS-COV-2 was likely introduced in Louisiana from a single source via domestic travel and was being locally spread prior to the Mardi Gras celebrations in February 2020. However, further evidence suggests that Mardi Gras was likely a superspreading event, based on the unusual lack of genetic diversity of SARS-CoV-2, which was similar to cruise ship outbreaks, and the markedly increased infection rate in New Orleans immediately following the event.