

Report 7: Estimating infection prevalence in Wuhan City from repatriation flights

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Summary

Since the end of January 2020, in response to the growing COVID-19 epidemic, 55 countries have repatriated over 8000 citizens from Wuhan City, China. In addition to quarantine measures for returning citizens, many countries implemented PCR screening to test for infection regardless of symptoms. These flights therefore give estimates of infection prevalence in Wuhan over time. Between 30th January and 1st February (close to the peak of the epidemic in Wuhan), infection prevalence was 0.87% (95% CI: 0.32% - 1.89%). As countries now start to repatriate citizens from Iran and northern Italy, information from repatriated citizens could help inform the level of response necessary to help control the outbreaks unfolding in newly affected areas.

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1. Background

Following the outbreak of a novel coronavirus (COVID-19, formerly 2019-nCoV) in Wuhan City, China and the subsequent travel and movement restrictions implemented in the city, foreign governments began the process of chartering flights to repatriate citizens from the epicentre of the outbreak. These flights began on 29th January 2020 and continued throughout February with the last flight returning on 27th February 2020.

In addition to quarantining citizens returning on these flights to prevent any potential secondary transmission after arrival, many countries implemented PCR screening of returning citizens to test for infection. These repatriation flights therefore provide snapshots of the infection prevalence over time and insights into the levels of transmission in Wuhan City.

We present an overview of these repatriation flights within this timeframe. Information on: i) the number of individuals repatriated; ii) their destination country; iii) whether individuals were tested for the pathogen responsible for COVID-19 regardless of symptoms; iv) and their outcomes where available were sourced from publicly available sources. These are provided in a supplementary data file.

2. Results

A total of 8597 persons have been repatriated over 56 flights from Wuhan City carrying citizens from 55 different countries (Table 1). The first flight left Wuhan on 29 January 2020 and the last flight left almost a month later on 27th February 2020. In addition, there were 3 flights repatriating citizens from Beijing to Kazakhstan and Kyrgyzstan.

Figure 1 highlights the countries (and the number of repatriation flights by country) where repatriated persons have been undergoing their quarantine periods. As some flights were shared between two or more countries e.g. USA and Canada, the map shows the countries that chartered the primary flight out of Wuhan and as such the destination of quarantine for the majority of passengers on board. Quarantine periods were defined and carried out by governments following the arrival of the charter flights in country. Most countries implemented 14-day quarantine periods to help mitigate the potential for local onward transmission from this at-risk population. This follows WHO advice based on estimates that the maximum incubation period of the virus is 14 days [1]. During this time, most, but not all, countries have tested for the presence of coronavirus in symptomatic and asymptomatic repatriates, at multiple time points. The supplementary table outlines the testing procedures that have been made publicly available.

Countries that repatriated citizens from China

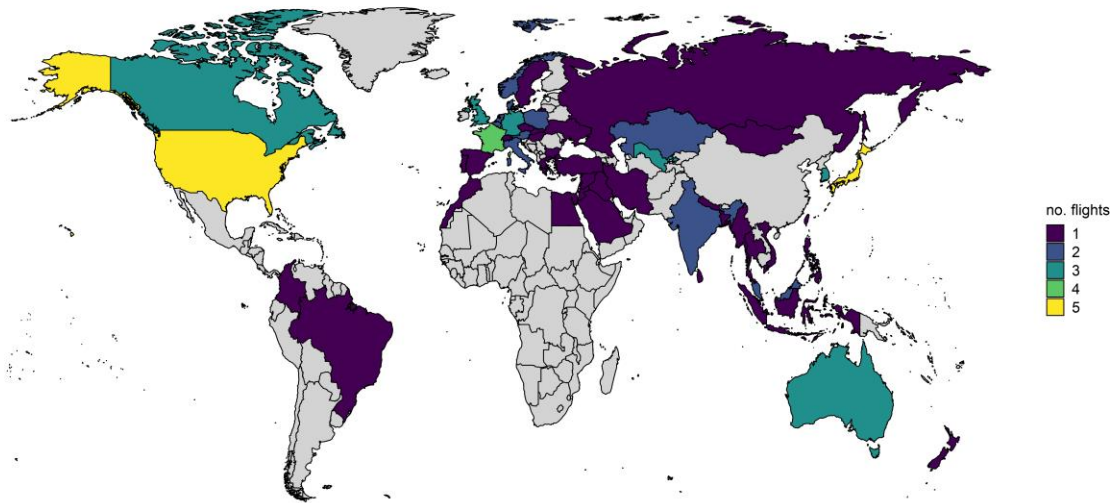


Figure 1: Countries where citizens who have been evacuated from Wuhan City have undergone quarantine. Note some countries offered quarantine for citizens of other countries and as such these nations while having repatriated citizens are not shown in this map.

While screening procedures varied, we have been able to identify 47 flights that screened for COVID-19 infection in their evacuees. This resulted in a total screened population of 5720, of these evacuees a total of 36 tested positive for the novel coronavirus resulting in an overall infection prevalence of 0.63% (95% CI: 0.44% - 0.87%). However, only 32 out of the 47 repatriation flights implementing testing tested everyone regardless of symptoms (we include the first Japanese flight where 204 of 206 passengers were tested). Only considering these flights, the overall infection prevalence was 0.60% (95% CI: 0.41% - 0.86%).

It is important to note that at the time of analysis (6 March 2020) some evacuees had not yet completed their 14-day quarantine period and therefore may still test positive. For the passengers of the 30 flights which have completed the 14-day quarantine period, the overall infection prevalence was 0.61% (95% CI: 0.41% - 0.88%).

Finally, repatriation flights had different testing protocols (supplementary table), and amongst the 47 flights that screened for COVID-19 infection, 20 tested upon arrival. Quarantine measures also differed slightly by country, with some individuals undergoing quarantine at home rather than in a designated facility. Accounting for the possibility individuals may be infected on the flight itself and thus later test positive, to estimate a conservative point prevalence of infection, we estimated infection prevalence from flights that tested passengers immediately upon arrival. Of 2433 passengers tested immediately upon arrival, 13 individuals tested positive upon the initial test, giving an infection prevalence of 0.53% (95% CI: 0.28% - 0.91%). Over the 6 flights arriving between 30 January and 1 February inclusive (close to the peak of the epidemic in Wuhan) where everyone was tested on arrival, the infection prevalence was 0.87% (6/689, 95% CI: 0.32% - 1.89%).

Figure 2 shows the infection prevalence (amongst those who tested positive on the first test) from each of the repatriation flights that tested all passengers upon arrival based on the flight date from Wuhan City. Although not all repatriated flights have completed their 14-day quarantine periods, infection prevalence was generally low (<3%) across these flights. We also observe a similar trend in infection prevalence over time amongst the repatriated individuals to the observed epidemic trend in Wuhan City thus far [2].

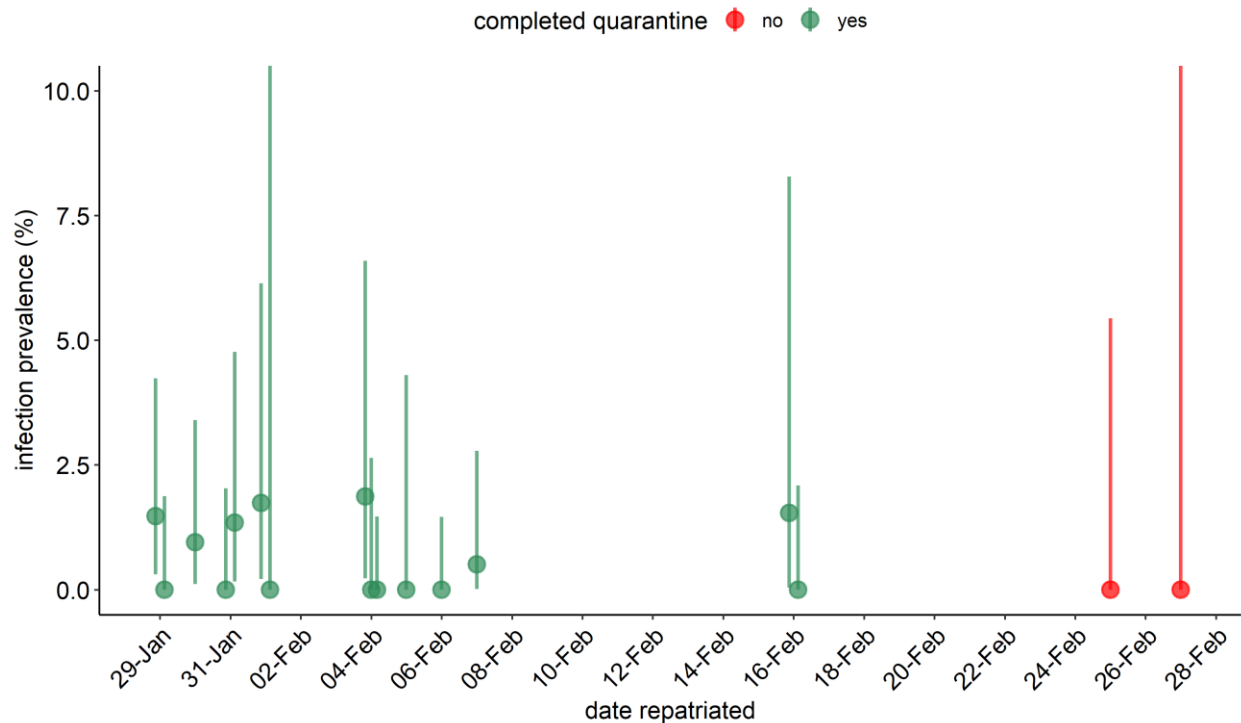


Figure 2: Infection prevalence (points, bars = exact binomial 95% CI) amongst repatriation flights where all passengers were tested for COVID-19 regardless of symptoms by date of repatriation. Where multiple flights departed on the same day the points are offset.

3. Conclusion

The number of new cases reported from Wuhan City has declined substantially in recent weeks indicating a declining epidemic at the epicentre. Although it remains to be seen if this decline can be sustained after travel restrictions are lifted in the city, our estimates of infection prevalence over time from repatriation flights supports this decline. However, available information on testing protocols and the delay from repatriation to testing was sparse. The conditions of quarantine are also likely to differ by country. Thus, analysis primarily considered the infection prevalence amongst individuals from repatriation flights who were tested upon arrival.

These estimates of infection prevalence provide important insights into the potential level of transmission within the first affected region. As countries now start to repatriate citizens from Iran and northern Italy, information from repatriated citizens could inform the level of response necessary to help control the outbreaks unfolding in newly affected areas.

4. References

1. World Health Organization. Key considerations for repatriation and quarantine of travellers in relation to the outbreak of novel coronavirus 2019-nCoV. 2020 [cited 2 Mar 2020]. Available: <https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international->
2. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020. *China CDC Wkly.* 2: 113–122.

Table 1: Summary of repatriation flight from Wuhan City, China

Flight ID	Date repatriated	Num repatriated	Num tested	Total positive confirmed	Point tested	Positive at initial test	Symptomatic at initial test	Asymptomatic at initial test	Later developed symptoms	Total symptomatic	Remained asymptomatic	Date quarantine ended	Quarantine ended*
japan_fl1	2020-01-29	206	204	5	arrival	3	1	2	1	4	1	2020-02-12	yes
usa_fl1	2020-01-29	195	195	0	arrival	0	0	0	0	0	0	2020-02-11	yes
japan_fl2	2020-01-30	210	210	5	arrival	2	0	2	0	3	2	2020-02-07	yes
singapore_fl1	2020-01-30	92	92	5	unknown	1	1	0	0	2	3	2020-02-13	yes
japan_fl3	2020-01-31	149	149	3	arrival	2	1	1	1	2	1	2020-02-14	yes
uk_fl1	2020-01-31	109	25	0	-	0	0	0	0	0	0	2020-02-15	yes
southkorea_fl1	2020-01-31	368	368	2	unknown	2	0	0	0	0	0	2020-02-15	yes
france_fl1	2020-01-31	180	180	0	arrival	0	0	0	0	0	0	2020-02-14	yes
germany_fl1	2020-02-01	115	115	2	arrival	2	0	0	0	0	0	2020-02-16	yes
southkorea_fl2	2020-02-01	333	333	0	unknown	0	0	0	0	0	0	2020-02-16	yes
jordan_fl1	2020-02-01	71	25	0	later	0	0	0	0	0	0	2020-02-10	yes
india_fl1	2020-02-01	324	324	0	unknown	0	0	0	0	0	0	2020-02-18	yes
mongolia_fl1	2020-02-01	31	31	0	arrival	0	0	0	0	0	0	2020-02-19	yes
turkey_fl1	2020-02-01	42	42	0	unknown	0	0	0	0	0	0	2020-02-14	yes
saudi Arabia_fl1	2020-02-02	10	10	0	unknown	0	0	0	0	0	0	2020-02-17	yes
indonesia_fl1	2020-02-02	243	0	0	-	0	0	0	0	0	0	2020-02-15	yes
france_fl2	2020-02-02	254	215	1	unknown	1	0	0	0	0	0	2020-02-16	yes
kazakhstan_fl1	2020-02-02	89	89	0	unknown	0	0	0	0	0	0	2020-02-16	yes
india_fl2	2020-02-02	330	330	0	unknown	0	0	0	0	0	0	2020-02-19	yes
italy_fl1	2020-02-03	56	56	1	later	1	1	0	0	1	0	2020-02-21	yes
taiwan_fl1	2020-02-03	247	5	1	arrival	1	1	0	0	1	0	2020-02-18	yes
morocco_fl1	2020-02-03	167	167	0	unknown	0	0	0	0	0	0	2020-02-22	yes
egypt_fl1	2020-02-03	301	301	0	unknown	0	0	0	0	0	0	2020-02-17	yes
uzbekistan_fl1	2020-02-04	250	250	0	arrival	0	0	0	0	0	0	2020-02-18	yes
thailand_fl1	2020-02-04	138	138	1	arrival	0	5	0	0	1	0	2020-02-22	yes
malaysia_fl1	2020-02-04	107	107	2	arrival	2	0	2	0	0	0	2020-02-18	yes
australia_fl1	2020-02-04	242	14	0	unknown	0	0	0	0	0	0	2020-02-18	yes
usa_fl2	2020-02-05	178	1	0	unknown	0	0	0	0	0	0	2020-02-18	yes
usa_fl3	2020-02-05	166	5	1	unknown	1	1	0	0	1	0	2020-02-18	yes

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Flight ID	Date repatriated	Num repatriated	Num tested	Total positive confirmed	Point tested	Positive at initial test	Symptomatic at initial test	Asymptomatic at initial test	Later developed symptoms	Total symptomatic	Remained asymptomatic	Date quarantine ended	Quarantine ended*
<i>¹We inferred that quarantine had ended if more than 14 days had passed since the date of repatriation. For these flights we were not able to find exact reports or dates of release.</i>													
uzbekistan_fl2	2020-02-05	84	84	0	arrival	0	0	0	0	0	0	2020-02-19	yes
newzealand_fl1	2020-02-05	193	2	0	unknown	0	0	0	0	0	0	2020-02-19	yes
russia_fl1	2020-02-05	144	144	0	unknown	0	0	0	0	0	0	2020-02-19	yes
iran_fl1	2020-02-05	141	56	0	unknown	0	0	0	0	0	0	2020-02-17	yes
canada_fl1	2020-02-06	176	0	0	-	0	0	0	0	0	0	2020-02-21	yes
uzbekistan_fl3	2020-02-06	251	251	0	arrival	0	0	0	0	0	0	2020-02-20	yes
japan_fl4	2020-02-07	198	198	1	arrival	1	1	0	0	1	0	2020-02-21	yes
usa_fl4	2020-02-07	104	2	1	unknown	1	1	0	0	1	0	2020-02-20	yes
usa_fl5	2020-02-07	148	2	1	unknown	1	0	0	0	0	0	2020-02-20	yes
brazil_fl1	2020-02-08	40	34	0	arrival	0	0	0	0	0	0	2020-02-23	yes
brunei_fl1	2020-02-08	2	0	0	-	0	0	0	0	0	0	NA	yes inferred
singapore_fl2	2020-02-09	174	174	2	unknown	0	0	0	0	0	2	NA	yes inferred
philippines_fl1	2020-02-09	49	0	0	-	0	0	0	0	0	0	2020-02-22	yes
uk_fl2	2020-02-09	200	179	0	unknown	0	0	0	0	0	0	2020-02-23	yes
australia_fl2	2020-02-09	266	0	0	-	0	0	0	0	0	0	2020-02-25	yes
vietnam_fl1	2020-02-10	30	30	0	unknown	0	0	0	0	0	0	2020-02-21	yes
canada_fl2	2020-02-11	185	0	0	-	0	0	0	0	0	0	NA	yes inferred
southkorea_fl3	2020-02-12	147	145	0	arrival	0	0	0	0	0	0	2020-02-13	yes
japan_fl5	2020-02-16	65	65	1	arrival	1	1	0	0	1	0	2020-02-17	yes
nepal_fl1	2020-02-16	175	175	0	arrival	0	0	0	0	0	0	2020-03-02	yes
ukraine_fl1	2020-02-20	74	74	0	later	0	0	0	0	0	0	NA	yes inferred
france_fl3	2020-02-20	63	43	1	unknown	0	0	0	0	0	1	NA	yes inferred
malaysia_fl2	2020-02-25	66	66	0	arrival	0	0	0	0	0	0	NA	no
colombia_fl1	2020-02-27	15	15	0	arrival	0	0	0	0	0	0	NA	no
sri lanka_fl1	2020-02-01	33	0	0	-	0	0	0	0	0	0	NA	yes inferred
bangladesh_fl1	2020-01-31	312	0	0	-	0	0	0	0	0	0	2020-02-16	yes
myanmar_fl1	2020-02-02	59	0	0	-	0	0	0	0	0	0	NA	yes inferred

¹We inferred that quarantine had ended if more than 14 days had passed since the date of repatriation. For these flights we were not able to find exact reports or dates of release.

Supplementary table: Summary of testing procedures where available for countries who repatriated citizens from Wuhan City, China

Country of Quarantine	PCR Testing	Information on Testing Procedures	References
Australia	Yes	Tested only if a person becomes symptomatic during quarantine, with medical health checks daily. Before release repatriates were “medically cleared” and were screened for symptoms throughout quarantine – <i>inferred did not test everyone</i>	Link1 ; Link2 ; Link3
Austria	Yes	Tested upon arrival in quarantine and then again before release from quarantine, and if a person was symptomatic during quarantine.	Link4 ; Link5 ; Link6
Bangladesh	No information found		
Belgium	Yes	All evacuees were tested six times during quarantine.	Link7
Brazil	Yes	Tested three times during quarantine, on arrival, the second tests on 17 th Feb 2020 with results on 19 th Feb 2020. The final tests were performed on 21 st Feb 2020 with results on 22 nd Feb 2020	Link8 ; Link9 ; Link10
Brunei	No information found		
Bulgaria	Yes	Tested everyone in quarantine at least once. Tested on arrival.	Link11 ; Link12
Canada	Yes	Tested if person becomes symptomatic during quarantine and medically cleared after quarantine period ended – <i>inferred did not test everyone</i>	Link13 ; Link14 ; Link15
Colombia		Tested everyone on the day of arrival with routine medical checks during quarantine and testing anyone who is symptomatic.	Link16 ; Link67
Czech Republic		Tested everyone at least once	Link17
Denmark	Yes	Tested everyone upon arrival - then citizens went into home quarantine with temperature monitoring and daily outreach from health professionals. Tested anyone with symptoms.	Link18 ; Link19
Egypt	Yes	Tested everyone before release (date unknown)	Link20 ; Link21
France	Yes	Tested everyone several times during quarantine and before release from quarantine.	Link22
Germany	Yes	Tested everyone on arrival, if symptomatic and before release from quarantine.	Link23 ; Link24
Greece	Yes	Tested, no additional information.	
Hungary		Tested everyone multiple times	Link25
India	Yes	Tested everyone before release from quarantine	Link26
Indonesia	No	Not testing during quarantine	Link27

Iran	Yes	Tested everyone multiple times	Link28
Iraq		Unknown	Link29
Italy	Yes	All evacuees tested during quarantine and before release from quarantine	Link30 ; Link31
Japan	Yes	Tested everyone multiple times during quarantine, on arrival, if symptomatic and before release	Link32
Jordan	Yes	Tested everyone five days after arrival into quarantine	Link33 ;
Kazakhstan	Yes	Tested everyone before release from quarantine	Link34
Kyrgyzstan	No info		
Lebanon	No info		
Malaysia	Yes	Repeated testing of everyone	Link35
Mexico	Yes	Tested on arrival in Colombia before second repatriation flight to Mexico and from there are undergoing home quarantine with medical checks with health services	Link68 ; Link69
Mongolia		Tested everyone on 3 rd Feb 2020	Link36 ; Link37
Morocco	Yes	Underwent a 20-day quarantine with testing of everyone twice before release from quarantine	Link38 ; Link65 ; Link66
Myanmar	No information found	Samples sent to Thailand	Link39
Nepal	Yes	Tested everyone on arrival (16-18 th Feb 2020), results on 21 st Feb 2020, testing again at the end of 14 days and then follow up tests 2 nd March 2020.	Link40
Netherlands	Yes	Evacuees were self-isolating at home and should contact health services if developed symptoms for testing.	Link41 ; Link42
New Zealand	Yes	Tested if a person becomes symptomatic during quarantine – <i>inferred they did not test everyone</i>	Link43
Norway	Yes	Home quarantine with testing of suspected cases	Link44 ; Link45
Philippines	Yes	Tested if person becomes symptomatic of suspected COVID19	Link46
Poland	Yes	Tested everyone 4 times during quarantine - cleared before release from quarantine	Link47
Portugal	Yes	Tested everyone on arrival and before release from quarantine	Link48 ; Link49
Russia	Yes	Tested everyone on arrival and before release from quarantine	Link50
Saudi Arabia	Yes	Tested everyone twice, on arrival and before release from quarantine	Link51
Singapore	Yes	Tested everyone upon arrival, during quarantine and before release from quarantine	Link52

Slovakia	Yes	Tested everyone on arrival in quarantine	Link53
South Korea	Yes	Tested everyone on arrival, if symptomatic and before release from quarantine	Link54
Spain	Yes	Tested all evacuees on arrival and monitored symptoms	Link55
Sri Lanka	No information found		
Sweden	No	Evacuees were self-isolating at home and should contact health services if they developed symptoms for testing	Link56
Syria	No information found		
Taiwan	Yes	Tested those upon arrival who were symptomatic and throughout quarantine	Link57
Thailand	Yes	Testing everyone on arrival, and if symptomatic	Link58
Turkey	Yes	Tested everyone every three days	Link59
UK	Yes	Tested all evacuees three times during quarantine	Link60
Ukraine	Yes	Tested everyone three days into quarantine	Link61
USA	Yes	Tested everyone on board the first repatriation flight 195 persons; after this testing only if person becomes symptomatic of suspected COVID19	Link62
Uzbekistan	Yes	Tested before release from quarantine and upon arrival.	Link63
Vietnam	Yes	Tested everyone, unclear at what timing.	Link64