

### Laboratory Surveillance of COVID-19 Variants in Taiwan

Ji-Rong Yang\*, Chuan-Yi Kuo, Yun-Tong Lin, Yu-Chi-Lin, Hsiao-Jung Chen,  
Hsiang-Yi Huang, Bao-Shan Chen, Chih-Tsun Hsieh,  
Jung-Jung Mu, Ming-Tsan Liu, Shu-Ying Li

#### Abstract

Since the novel coronavirus (SARS-CoV-2) first appeared in Wuhan, China in December 2019, it has rapidly spread to other countries around the world in a short period of time, leading to a global pandemic. In order to strengthen the efficacy of epidemic prevention and control, it is very important to grasp the genetic changes of the circulating viruses from virus-infected cases through genome sequence analysis in real time. The National Reference Laboratory in Taiwan Centers for Disease Control has completed the establishment of the viral genetic surveillance process through genome sequencing since the official publication of the whole genome sequence of the world's first SARS-CoV-2 strain. The analysis is performed on clinical specimens of confirmed COVID-19 cases or their virus isolates and the resultant data are handed over to the Central Epidemic Command Center to be released at the daily press conference in an open and transparent manner, which are applicable for optimizing national intervention strategies such as vaccines, drugs and pathogen diagnostic tools. It can also improve the efficiency of the causal investigation of various cluster events by exploring the genetic relationship of different SARS-CoV-2. This article describes in detail the entire laboratory monitoring process for SARS-CoV-2 genetic surveillance and the temporal identification results of various SARS-CoV-2 variants in Taiwan from 2020 to 2022.

**Keywords:** SARS-CoV-2, COVID-19, genome sequencing, virus variant

Center for Diagnostics and Vaccine Development,  
Taiwan Centers for Disease Control,  
Ministry of Health and Welfare, Taiwan  
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Corresponding author: Ji-Rong Yang\*  
E-mail: ggyang@cdc.gov.tw  
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# The Experience of International Medical Evacuation for Citizens Abroad During COVID-19 Pandemic at Kaohsiung International Airport

Fang-Yu Lin\*, Yu-Zhu Wang, Min-Nan Hung, Ching-Li Lin, Hui-Chen Lin

## Abstract

When citizens abroad suffer severe injury or illness, they might encounter several situations, such as expensive fees, impoverished medical resources or language barrier. However, by taking international medical evacuation, citizens abroad can continue their treatment after back to Taiwan. At the beginning of the COVID-19 pandemic, Taiwan announced border restrictions and initiated strict quarantine measures immediately. In August 2020, Taiwan Centers for Disease Control (TCDC) also established guidelines for Taiwan citizens applying for international medical evacuation during the COVID-19 pandemic.

During September 2020 to September 2021, there had been eleven patients entered to Kaohsiung International Airport by international medical evacuation. Three of them, including one confirmed COVID-19 patient, had suspected symptoms of COVID-19 and were reported by quarantine officers to the Smart Quarantine Multifunctional System (SQMS), with which the local health authority would be able to follow up these patients. To be prepared for the first entry of confirmed COVID-19 patient to Kaohsiung International Airport, Kaohsiung-Pingtung regional center of TCDC held several training sessions of donning and doffing the personal protective equipment to staffs from different units in advance, and also coached them on the scene. To facilitate the entry of the evacuated patients more efficiently, we will gain experience by learning from every execution.

**Keywords:** International Medical Evacuation, quarantine, COVID-19, Kaohsiung International Airport, border quarantine

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Kaohsiung-Pingtung Regional Center,  
Centers for Disease Control, Ministry  
of Health and Welfare, Taiwan  
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Corresponding author: Fang-Yu Lin\*  
E-mail: fangyu@cdc.gov.tw  
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Weekly Data of Notifiable Inases (by week of diagnosis)

Case diagnosis year		Week 28★		Week 1-28			
Classification	Disease Diagnosed	2022	2021	2022		2021	
				Total cases★	Imported cases	Total cases★	Imported cases
Category I	Plague	0	0	0	0	0	0
	Rabies	0	0	0	0	0	0
	SARS	0	0	0	0	0	0
	Smallpox	0	0	0	0	0	0
Category II	Acute Flaccid Paralysis	0	0	16	0	15	0
	Acute Viral Hepatitis type A	0	1	101	1	39	0
	Amoebiasis	2	2	106	27	105	40
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	0	0	0	1	1
	Cholera	0	0	0	0	0	0
	Dengue Fever	1	0	9	9	5	5
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	0	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus syndrome	1	0	3	0	0	0
	Malaria	0	0	2	2	1	1
	Measles	0	0	0	0	0	0
	Meningococcal Meningitis	1	0	1	0	2	0
	Paratyphoid Fever	0	0	0	0	2	0
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	0	0	0	0
	Shigellosis	3	1	46	2	80	0
	Typhoid fever	0	0	1	0	1	0
	West Nile Fever	0	0	0	0	0	0
Zika virus infection	0	0	0	0	0	0	
Monkeypox	1	-	2	2	-	-	
Category III	Acute Viral Hepatitis type B	3	2	55	0	81	2
	Acute Viral Hepatitis type C	5	17	242	1	317	0
	Acute Viral Hepatitis type D	0	0	0	0	0	0
	Acute Viral Hepatitis type E	0	0	7	0	5	0
	Congenital Syphilis	0	0	0	0	0	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	0	0	1	0
	Haemophilus Influenza type b Infection	0	0	1	0	1	0
	Japanese Encephalitis	2	4	7	0	14	0
	Legionnaires' Disease	0	5	184	1	183	0
	Mumps	6	6	111	0	235	1
	Neonatal Tetanus	0	0	0	0	0	0
	Pertussis	0	0	0	0	0	0
Tetanus	0	0	2	0	2	0	
Category IV	Botulism	0	0	0	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	1	15	0	30	0
	Endemic Typhus Fever	0	0	6	0	21	0
	Herpesvirus B Infection	0	0	0	0	0	0
	Influenza Case with Severe Complications	0	0	0	0	1	0
	Invasive Pneumococcal Disease	5	3	107	0	148	0
	Leptospirosis	1	1	21	0	22	0
	Listeriosis	5	8	78	0	108	0
	Lyme Disease	0	0	1	1	0	0
	Melioidosis	1	0	4	1	8	0
	Q Fever	0	0	2	0	7	0
	Scrub Typhus	9	3	110	0	133	0
Toxoplasmosis	0	0	13	0	7	0	
Tularemia	0	0	0	0	0	0	
Category V	Ebola Virus Disease	0	0	0	0	0	0
	Lassa Fever	0	0	0	0	0	0
	Marburg Hemorrhagic Fever	0	0	0	0	0	0
	Middle East Respiratory Syndrome	0	0	0	0	0	0
	Coronavirus Infections	0	0	0	0	0	0
	Novel Influenza A Virus Infections	0	0	0	0	1	0
	Rift Valley Fever	0	0	0	0	0	0
Severe Pneumonia with Novel Pathogens	182735	173	4247579	13785	14579	528	
Yellow Fever	0	0	0	0	0	0	

- ★The weekly and cumulative total numbers include indigenous and imported cases of notifiable infectious diseases.
- MDR-TB, Tuberculosis, Syphilis, Gonorrhoea, HIV Infection, AIDS, Hansen's Disease and Creutzfeldt-Jakob Disease are excluded from the table.
- Numbers of mumps and tetanus cases are summed up by the week of report.
- Since 2022/6/23, " Monkeypox " was listed as a Notifiable Infectious Disease.

## Suspected Clusters

- Nine clusters related to diarrhea (3), tuberculosis (6) were reported during week 28.

## Imported Infectious Diseases

- There were 519 imported cases from 29 countries during week 28.
  - Severe Pneumonia with Novel Pathogens:** 514 cases from USA 38, Vietnam 24, Netherlands 15, Thailand 11, Germany 11 and the remaining 24 countries have less than 10 cases, 346 unknowns.
  - Shigellosis:** 2 cases from Indonesia 1, unknown 1.
  - Dengue Fever:** 1 case from Vietnam.
  - Melioidosis:** 1 case from unknown.
  - Monkeypox:** 1 case from USA.
- During week 1–28, there were 13832 imported cases from 119 countries. The top three countries are Vietnam (2405), USA (1516), Indonesia (1069).
- During week 1–28, the notifiable diseases with the highest number of imported cases are Severe Pneumonia with Novel Pathogens (13785).

## Summary of Epidemic

- **Severe Pneumonia with Novel Pathogens :** Taiwan is in the stage of widespread transmission of COVID-19, and the epidemic is slow down gradually. Global COVID-19 cases increase, the risk of COVID-19 transmission remains high. The activity of the Omicron subvariants and their impact need continuous monitoring.
- **Japanese Encephalitis:** Taiwan is in the midst of Japanese Encephalitis season, individuals living in all counties in Taiwan are at risk of infection.

### Weekly Data of Notifiable Inases (by week of diagnosis)

Case diagnosis year		Week 29★		Week 1-29			
Classification	Disease Diagnosed	2022	2021	2022		2021	
				Total cases★	Imported cases	Total cases★	Imported cases
Category I	Plague	0	0	0	0	0	0
	Rabies	0	0	0	0	0	0
	SARS	0	0	0	0	0	0
	Smallpox	0	0	0	0	0	0
Category II	Acute Flaccid Paralysis	0	1	16	0	16	0
	Acute Viral Hepatitis type A	2	2	103	1	41	0
	Amoebiasis	8	4	114	28	109	40
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	0	0	0	1	1
	Cholera	0	0	0	0	0	0
	Dengue Fever	2	0	11	11	5	5
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	0	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus syndrome	0	0	3	0	0	0
	Malaria	0	0	2	2	1	1
	Measles	0	0	0	0	0	0
	Meningococcal Meningitis	0	0	1	0	2	0
	Paratyphoid Fever	0	0	0	0	2	0
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	0	0	0	0
	Shigellosis	1	1	47	2	81	0
	Typhoid fever	1	0	2	1	1	0
	West Nile Fever	0	0	0	0	0	0
Zika virus infection	0	0	0	0	0	0	
Monkeypox	0	-	2	2	-	-	
Category III	Acute Viral Hepatitis type B	1	2	56	0	83	2
	Acute Viral Hepatitis type C	8	13	250	1	330	0
	Acute Viral Hepatitis type D	0	0	0	0	0	0
	Acute Viral Hepatitis type E	0	0	7	0	5	0
	Congenital Syphilis	0	0	0	0	0	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	0	0	1	0
	Haemophilus Influenza type b Infection	0	0	1	0	1	0
	Japanese Encephalitis	3	2	10	0	16	0
	Legionnaires' Disease	1	6	185	1	189	0
	Mumps	6	8	117	0	243	1
	Neonatal Tetanus	0	0	0	0	0	0
	Pertussis	0	0	0	0	0	0
Tetanus	0	0	2	0	2	0	
Category IV	Botulism	0	0	0	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	0	15	0	30	0
	Endemic Typhus Fever	1	0	7	0	21	0
	Herpesvirus B Infection	0	0	0	0	0	0
	Influenza Case with Severe Complications	0	0	0	0	1	0
	Invasive Pneumococcal Disease	2	1	109	0	149	0
	Leptospirosis	3	2	24	0	24	0
	Listeriosis	2	2	80	0	110	0
	Lyme Disease	0	0	1	1	0	0
	Melioidosis	1	2	5	1	10	0
	Q Fever	0	0	2	0	7	0
	Scrub Typhus	5	5	115	0	138	0
Toxoplasmosis	1	0	14	0	7	0	
Tularemia	0	0	0	0	0	0	
Category V	Ebola Virus Disease	0	0	0	0	0	0
	Lassa Fever	0	0	0	0	0	0
	Marburg Hemorrhagic Fever	0	0	0	0	0	0
	Middle East Respiratory Syndrome	0	0	0	0	0	0
	Coronavirus Infections	0	0	0	0	0	0
	Novel Influenza A Virus Infections	0	0	0	0	1	0
	Rift Valley Fever	0	0	0	0	0	0
	Severe Pneumonia with Novel Pathogens	165956	182	4413494	16049	14761	558
Yellow Fever	0	0	0	0	0	0	

1. ★The weekly and cumulative total numbers include indigenous and imported cases of notifiable infectious diseases.
2. MDR-TB, Tuberculosis, Syphilis, Gonorrhoea, HIV Infection, AIDS, Hansen's Disease and Creutzfeldt-Jakob Disease are excluded from the table.
3. Numbers of mumps and tetanus cases are summed up by the week of report.
4. Since 2022/6/23, " Monkeypox " was listed as a Notifiable Infectious Disease.

## Suspected Clusters

- Eleven clusters related to diarrhea (5), tuberculosis (6) were reported during week 29.

## Imported Infectious Diseases

- There were 2261 imported cases from 36 countries during week 29.
  - Severe Pneumonia with Novel Pathogens:** 2258 cases from Germany (144), USA (127), Vietnam (67), Thailand (46), Singapore (43), Turkey (37), UK (37), Australia (25), Japan (23), The Philippines (22), Netherlands (20), France (20), Canada (16), Malaysia (14), Indonesia (14), Korea (13), UAE (13) and the remaining 19 countries have less than 10 cases, 1504 unknowns.
  - Dengue Fever:** 2 cases from Vietnam 1, Singapore 1.
  - Typhoid Fever:** 1 case from unknown.
- During week 1–29, there were 16100 imported cases from 120 countries. The top three countries are Vietnam (2473), USA (1648), Indonesia (1085).
- During week 1–29, the notifiable diseases with the highest number of imported cases are Severe Pneumonia with Novel Pathogens (16049).

## Summary of Epidemic

- **Severe Pneumonia with Novel Pathogens :** Taiwan is in the stage of widespread transmission of COVID-19, and the epidemic is slow down gradually. Global COVID-19 cases increase, the risk of COVID-19 transmission remains high. The activity of the Omicron subvariants and their impact need continuous monitoring.
- **Japanese Encephalitis:** Taiwan is in the midst of Japanese Encephalitis season, individuals living in all counties in Taiwan are at risk of infection.

### Weekly Data of Notifiable Inases (by week of diagnosis)

Case diagnosis year		Week 30★		Week 1-30			
Classification	Disease Diagnosed	2022	2021	2022		2021	
				Total cases★	Imported cases	Total cases★	Imported cases
Category I	Plague	0	0	0	0	0	0
	Rabies	0	0	0	0	0	0
	SARS	0	0	0	0	0	0
	Smallpox	0	0	0	0	0	0
Category II	Acute Flaccid Paralysis	0	1	16	0	17	0
	Acute Viral Hepatitis type A	0	1	103	1	42	0
	Amoebiasis	4	0	118	28	109	40
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	0	0	0	1	1
	Cholera	0	0	0	0	0	0
	Dengue Fever	4	0	15	15	5	5
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	0	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus syndrome	0	0	3	0	0	0
	Malaria	0	0	2	2	1	1
	Measles	0	0	0	0	0	0
	Meningococcal Meningitis	0	0	1	0	2	0
	Paratyphoid Fever	0	0	0	0	2	0
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	0	0	0	0
	Shigellosis	0	2	47	2	83	0
	Typhoid fever	0	0	2	1	1	0
	West Nile Fever	0	0	0	0	0	0
Zika virus infection	0	0	0	0	0	0	
Monkeypox	0	-	2	2	-	-	
Category III	Acute Viral Hepatitis type B	2	4	58	0	87	2
	Acute Viral Hepatitis type C	7	6	257	1	336	0
	Acute Viral Hepatitis type D	0	0	0	0	0	0
	Acute Viral Hepatitis type E	0	0	7	0	5	0
	Congenital Syphilis	0	0	0	0	0	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	0	0	1	0
	Haemophilus Influenza type b Infection	0	0	1	0	1	0
	Japanese Encephalitis	2	2	12	0	18	0
	Legionnaires' Disease	8	9	193	1	198	0
	Mumps	3	6	120	0	249	1
	Neonatal Tetanus	0	0	0	0	0	0
	Pertussis	0	0	0	0	0	0
Tetanus	0	0	2	0	2	0	
Category IV	Botulism	0	0	0	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	1	15	0	31	0
	Endemic Typhus Fever	0	2	7	0	23	0
	Herpesvirus B Infection	0	0	0	0	0	0
	Influenza Case with Severe Complications	0	0	0	0	1	0
	Invasive Pneumococcal Disease	8	1	117	0	150	0
	Leptospirosis	3	3	27	0	27	0
	Listeriosis	0	0	80	0	110	0
	Lyme Disease	0	0	1	1	0	0
	Melioidosis	1	0	6	1	10	0
	Q Fever	0	0	2	0	7	0
	Scrub Typhus	11	7	126	0	145	0
Toxoplasmosis	0	0	14	0	7	0	
Tularemia	0	0	0	0	0	0	
Category V	Ebola Virus Disease	0	0	0	0	0	0
	Lassa Fever	0	0	0	0	0	0
	Marburg Hemorrhagic Fever	0	0	0	0	0	0
	Middle East Respiratory Syndrome	0	0	0	0	0	0
	Coronavirus Infections	0	0	0	0	0	0
	Novel Influenza A Virus Infections	0	0	0	0	1	0
	Rift Valley Fever	0	0	0	0	0	0
Severe Pneumonia with Novel Pathogens	157637	117	4571090	17636	14878	571	
Yellow Fever	0	0	0	0	0	0	

1. ★The weekly and cumulative total numbers include indigenous and imported cases of notifiable infectious diseases.
2. MDR-TB, Tuberculosis, Syphilis, Gonorrhoea, HIV Infection, AIDS, Hansen's Disease and Creutzfeldt-Jakob Disease are excluded from the table.
3. Numbers of mumps and tetanus cases are summed up by the week of report.
4. Since 2022/6/23, " Monkeypox " was listed as a Notifiable Infectious Disease.

## Suspected Clusters

- Twelve clusters related to diarrhea (6), tuberculosis (6) were reported during week 30.

## Imported Infectious Diseases

- There were 1591 imported cases from 48 countries during week 30.
  - Severe Pneumonia with Novel Pathogens:** 1587 cases from USA(85), Vietnam(53), Thailand(38), Germany(31), UK(28), The Philippines(25), Singapore(25), Australia(21), Netherlands(17), Cambodia(17), Italy(14), Malaysia(13), France(13), India(10), Spain(10), Indonesia(10) and the remaining 32 countries have less than 10 cases, 1087 unknowns.
  - Dengue Fever:** 4 cases from Vietnam (2), The Philippines (2).
- During week 1–30, there were 17691 imported cases from 122 countries. The top three countries are Vietnam (2535), USA (1738), Indonesia (1095).
- During week 1–30, the notifiable diseases with the highest number of imported cases are Severe Pneumonia with Novel Pathogens (17636).

## Summary of Epidemic

- **Severe Pneumonia with Novel Pathogens :** Taiwan is in the stage of widespread transmission of COVID-19, and the epidemic is slow down gradually. Global COVID-19 cases remain serious, and the activity of the Omicron subvariants increase, the risk of imported cases in Taiwan raise.
- **Japanese Encephalitis:** Taiwan is in the midst of Japanese Encephalitis season, individuals living in all counties in Taiwan are at risk of infection.

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**Address:** No.6, Linsen S. Rd, Zhongjheng District, Taipei City 10050, Taiwan (R.O.C.)

**Telephone No:** +886-2-2395-9825

**Website:** <https://www.cdc.gov.tw/En>

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