

Laboratory-Acquired Infections And Biosafety of High Pathogenic Risk-Group 3 Bacteria

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Abstract

With the global development of research on infectious diseases and medical microbiology, the biosafety management of the risk group 3 (RG3) bacteria in the laboratory cannot be ignored. Laboratory workers and medical practitioners should have sufficient knowledge about the most frequent laboratory infection accidents, types of exposure and transmission routes, potential biosafety risks and the preventive measures of these RG3 bacteria. This article reviewed 39 articles of the laboratory-acquired infections of RG3 bacteria reported in the literature during 1961–2019 and identified 1,347 cases. Among them, the *Brucella* (*Brucella spp.*) is the most frequent one and constituted 56.05%, followed by *Francisella tularensis* (21.38%) and *Mycobacterium tuberculosis* (17.22%). The main routes of infection include respiratory inhalation of aerosols or spores, wound or mucosal contact, needle sticks, and animal bites. Laboratory precautions include operating the RG3 pathogens in a laboratory that meets biosafety level three or higher and wearing appropriate personal protective equipment. We recommend providing vaccination or prophylactic administration and collecting blood for serological examination and follow-up of workers who may be exposed to these pathogens.

Keywords: Risk group 3 bacteria, biosafety level, biosecurity, laboratory-acquired infections, biosafety accidents

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Weekly Data of Notifiable Infectious Diseases (by week of diagnosis)

Case diagnosis year		Week 47★		Week 1-47			
Classification	Disease Diagnosed	2020	2019	2020		2019	
				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	1	1	28	0	59	1
	Acute Viral Hepatitis type A	0	4	72	8	91	24
	Amoebiasis	4	6	223	119	310	172
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	1	3	3	110	89
	Cholera	0	0	1	0	0	0
	Dengue Fever	1	16	138	67	606	506
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	1	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus Pulmonary Syndrome	0	0	0	0	0	0
	Hemorrhagic Fever with Renal Syndrome	0	1	11	0	2	1
	Malaria	1	0	2	2	7	7
	Measles	0	0	2	2	134	54
	Meningococcal Meningitis	0	0	6	0	6	0
	Paratyphoid Fever	0	0	0	0	7	6
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	0	0	22	17
	Shigellosis	4	7	142	24	128	43
Typhoid fever	1	0	8	3	23	19	
West Nile Fever	0	0	0	0	0	0	
Zika virus infection	0	0	2	2	4	4	
Category III	Acute Viral Hepatitis type B	3	4	101	2	103	4
	Acute Viral Hepatitis type C	10	13	542	4	551	3
	Acute Viral Hepatitis type D	0	0	0	0	0	0
	Acute Viral Hepatitis type E	0	0	8	0	9	4
	Congenital Syphilis	0	0	0	0	0	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	4	7	0	61	1
	Haemophilus Influenza type b Infection	0	0	4	0	1	0
	Japanese Encephalitis	0	0	21	0	21	2
	Legionnaires' Disease	1	4	258	8	240	16
	Mumps	11	3	452	6	541	8
	Neonatal Tetanus	0	0	0	0	0	0
	Pertussis	0	0	8	0	25	0
Tetanus	0	0	7	0	4	1	
Category IV	Botulism	0	0	1	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	0	48	0	57	1
	Endemic Typhus Fever	0	0	19	0	28	3
	Herpesvirus B Infection	0	0	0	0	0	0
	Influenza Case with Severe Complications	0	32	548	6	2022	8
	Invasive Pneumococcal Disease	5	12	217	0	392	2
	Leptospirosis	0	0	78	0	111	1
	Listeriosis	2	2	123	0	161	1
	Lyme Disease	0	0	0	0	1	1
	Melioidosis	1	1	17	1	44	1
	Q Fever	0	1	13	0	23	5
	Scrub Typhus	10	7	380	1	429	6
Toxoplasmosis	0	2	14	0	15	3	
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	0	0
	Rift Valley Fever	0	0	0	0	0	0
Severe Pneumonia with Novel Pathogens	11	-	611	556	-	-	
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 2020/1/15, "Severe Pneumonia with Novel Pathogens" was listed as a Notifiable Infectious Disease.

Suspected Clusters

- Thirty-eight clusters related to diarrhea (21), upper respiratory tract infection (7), varicella (4), tuberculosis (3), fever of unknown origin (2), and enterovirus (1) were reported during week 47.

Imported Infectious Diseases

- There were 16 imported cases from 7 countries during week 47.

Diseases	Countries							Total
	Indonesia	USA	Turkey	Myanmar	Uganda	Japan	Philippines	
Severe Pneumonia with Novel Pathogens	6	2	1	1		1		11
Amoebiasis	3						1	4
Malaria					1			1
Total	9	2	1	1	1	1	1	16

- As of week 47, there were 808 imported cases from 55 countries. The top three countries are Indonesia (203), USA (103), and Philippines (101).
- The three notifiable diseases with the highest number of imported cases are Severe Pneumonia with Novel Pathogens (556), Amoebiasis (119), and Dengue Fever (67).

Summary of Epidemic

- **Severe Pneumonia with Novel Pathogens** : The COVID-19 pandemic is still critical, and risks of importation and local transmission persist.
- **Dengue Fever** : The peak of dengue fever season has passed. The risk of infection in the community decrease gradually, but new cases might continue to occur.
- **Influenza-like illness** : The epidemic status increase gradually. The respiratory syncytial virus (RSV) dominant in the community.

Weekly Data of Notifiable Infectious Diseases (by week of diagnosis)

Case diagnosis year		Week 48★		Week 1-48			
Classification	Disease Diagnosed	2020	2019	2020		2019	
				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	28	0	59	1
	Acute Viral Hepatitis type A	0	4	72	8	95	25
	Amoebiasis	4	9	227	119	319	179
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	3	3	3	113	92
	Cholera	0	0	1	0	0	0
	Dengue Fever	0	6	138	67	612	512
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	1	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus Pulmonary Syndrome	0	0	0	0	0	0
	Hemorrhagic Fever with Renal Syndrome	0	0	11	0	2	1
	Malaria	0	0	2	2	7	7
	Measles	0	1	2	2	135	55
	Meningococcal Meningitis	1	1	7	0	7	0
	Paratyphoid Fever	0	0	0	0	7	6
	Poliomyelitis	0	0	0	0	0	0
Rubella	0	1	0	0	23	17	
Shigellosis	3	4	145	24	132	43	
Typhoid fever	1	1	9	3	24	20	
West Nile Fever	0	0	0	0	0	0	
Zika virus infection	0	0	2	2	4	4	
Category III	Acute Viral Hepatitis type B	4	2	105	2	105	4
	Acute Viral Hepatitis type C	9	16	550	4	567	3
	Acute Viral Hepatitis type D	0	0	0	0	0	0
	Acute Viral Hepatitis type E	0	0	8	0	9	4
	Congenital Syphilis	0	0	0	0	0	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	3	7	0	64	1
	Haemophilus Influenza type b Infection	0	0	3	0	1	0
	Japanese Encephalitis	0	0	21	0	21	2
	Legionnaires' Disease	6	6	264	8	246	16
	Mumps	5	8	457	6	549	9
	Neonatal Tetanus	0	0	0	0	0	0
	Pertussis	0	0	8	0	25	0
Tetanus	0	0	7	0	4	1	
Category IV	Botulism	0	0	1	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	0	48	0	57	1
	Endemic Typhus Fever	1	0	20	0	28	3
	Herpesvirus B Infection	0	0	0	0	0	0
	Influenza Case with Severe Complications	0	29	548	6	2051	8
	Invasive Pneumococcal Disease	5	11	222	0	403	2
	Leptospirosis	4	2	82	0	113	1
	Listeriosis	2	0	125	0	161	1
	Lyme Disease	0	0	0	0	1	1
	Melioidosis	0	1	17	1	45	1
	Q Fever	0	0	13	0	23	5
	Scrub Typhus	7	10	387	1	439	6
Toxoplasmosis	2	1	16	0	16	4	
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	0	0
	Rift Valley Fever	0	0	0	0	0	0
Severe Pneumonia with Novel Pathogens	37	-	648	593	-	-	
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 2020/1/15, "Severe Pneumonia with Novel Pathogens" was listed as a Notifiable Infectious Disease.

Suspected Clusters

- Twenty-seven clusters related to diarrhea (19), tuberculosis (4), upper respiratory tract infection (3), and varicella (1) were reported during week 48.

Imported Infectious Diseases

- There were 37 imported cases from 4 countries during week 48.

Diseases	Countries				Total
	Indonesia	USA	Philippines	Ghana	
Severe Pneumonia with Novel Pathogens	29	4	3	1	37
Total	29	4	3	1	37

- As of week 48, there were 845 imported cases from 56 countries. The top three countries are Indonesia (232), USA (107), and Philippines (104).
- The three notifiable diseases with the highest number of imported cases are Severe Pneumonia with Novel Pathogens (593), Amoebiasis (119), and Dengue Fever (67).

Summary of Epidemic

- **Severe Pneumonia with Novel Pathogens** : The COVID-19 pandemic is still critical and the number of returning Taiwanese citizens is increasing, therefore it is expected that the number of imported cases and the risk for local transmission will raise.
- **Dengue Fever** : The peak of dengue fever season has passed. The risk of infection in the community decrease gradually.
- **Influenza-like illness** : The influenza activity is expected to increase gradually because the temperature is fluctuating. The respiratory syncytial virus (RSV) dominant in the community.
- **Enterovirus** : The epidemic status increase gradually.

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