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Original Article

Application of Next-Generation Sequencing in Public Health —Analysis of NDM-5-Carrying Bacteria, 2014–2017

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Abstract

Next-Generation Sequencing(NGS) has the advantage of high throughput sequence capacity which provides information on unlimited pathogen targets, resistance genes, as well as outbreak surveillance. In this study, we applied NGS for epidemiological surveillance on the bacterial antimicrobial resistance. From 2014 to 2017, 8 carbapenem-resistant *Enterobacteriaceae*（CRE）isolates carrying NDM-5 were identified and originated from 2 hospitals in northern Taiwan (HH and TH) and 1 from a hospital in southern Taiwan (CH), respectively. Among them, 5 isolates from HH hospital had high similarity in PFGE phylogenetic analysis, similar plasmid replicon type and size and identical NDM-5-containing contigs. Taken together, these 5 isolates were considered as epidemiologically related strains. Two isolates from TH hospital had lower similarity in PFGE phylogenetic analysis, differences in plasmid types and size. However, the NDM-5-containing contigs were identical, presumably due to the insertion sequence IS26 which is responsible to transmission of the antimicrobial-resistance genes. As of the isolate from CH hospital, the sequence of its NDM-5-containing plasmid was similar tothe internationally epidemic NDM-5 plasmid,

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indicating that the plasmid might be imported. This study shares the vision on the use of NGS to provide the CRE antimicrobial-resistance information and benefit the epidemiological surveillance in the future. We recommended that CRE in Taiwan should be monitor continuously to follow the distribution and trends of antimicrobial resistant bacteria.

Keywords: Next-generation sequencing, NGS, CRE, NDM-5, IS26

Evaluation of Immunochromatographic Rapid Test for Norovirus

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Abstract

Noroviruses are the major viral pathogen in domestic diarrhea outbreaks. About 40% of the diarrhea outbreaks were attributed to norovirus infection. Because of its high infectiousness, a rapid and accurate detection method is key to the control of norovirus outbreaks. In this study, we randomly selected 101 fecal samples from21 diarrhea outbreaks from January to June 2018 to evaluate the sensitivity and specificity of RIDA® QUICK Norovirus test. The sensitivity of the rapid test was 67.2%, and the specificity was100%. Positive test results confirm the existence of norovirus in fecal samples, but negative test results still needs to be further confirmed by the real-time RT-PCR as the gold standard. Therefore, rapid tests provide a quick preliminary screening, but still cannot replace real-time RT-PCR in laboratories. In order to avoid false negative results that lead to the expansion of the epidemic, submitting the specimens to the laboratory for further confirmation as soon as possible is still necessary.

Keywords: Norovirus, rapid test reagent, real-time RT-PCR

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

Case diagnosis year		Week40★		Week 1–40			
				2018		2017	
Classification	Disease Diagnosed	2019	2018	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	2	2	49	1	56	0
	Acute Viral Hepatitis type A	2	1	73	20	70	28
	Amoebiasis	13	9	260	138	248	122
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	5	1	96	75	6	6
	Cholera	0	1	0	0	7	0
	Dengue Fever	13	20	509	417	373	227
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	1	0	0	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	1	0	1	0
	Malaria	1	1	6	6	4	4
	Measles	1	0	130	52	35	9
	Meningococcal Meningitis	0	0	4	0	5	1
	Paratyphoid Fever	0	0	7	6	6	5
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	21	17	9	8
	Shigellosis	1	4	104	35	130	45
	Typhoid fever	2	0	23	19	13	10
	West Nile Fever	0	0	0	0	0	0
Category III	Acute Viral Hepatitis type B	0	1	4	4	2	2
	Acute Viral Hepatitis type C	4	3	85	1	112	8
	Acute Viral Hepatitis type D	10	5	462	2	350	3
	Acute Viral Hepatitis type E	0	0	0	0	0	0
	Congenital Syphilis	0	0	8	3	6	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	0	0	0	0
	Haemophilus Influenza type b Infection	3	0	44	1	33	0
	Japanese Encephalitis	0	0	1	0	5	0
	Legionellosis	0	0	20	0	35	0
	Mumps	6	6	207	13	156	5
	Neonatal Tetanus	19	16	468	6	470	8
	Pertussis	0	0	0	0	0	0
	Tetanus	0	0	24	0	25	2
Category IV	Botulism	1	0	3	0	5	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	0	0	0	0	0
	Endemic Typhus Fever	1	1	52	1	43	0
	Herpesvirus B Infection	1	0	24	3	20	1
	Invasive Pneumococcal Disease	0	0	0	0	0	0
	Leptospirosis	8	5	334	2	370	0
	Listeriosis	6	6	94	0	66	0
	Lyme Disease	4	4	148	1	133	1
	Melioidosis	0	1	1	1	2	2
	Q Fever	2	2	37	0	22	1
	Scrub Typhus	0	0	18	4	13	1
	Severe Complicated Influenza	12	4	371	4	271	0
	Toxoplasmosis	48	14	1818	7	1020	5
	Tularemia	1	0	13	2	12	1
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 Coronavirus	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
	Yellow Fever	0	0	0	0	0	0
	Zika virus infection	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, Gonorrhea, 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 2018/1/1, "Listeriosis" was listed as a Notifiable Infectious Disease.

Suspected Clusters

● Fifty clusterswere reported during week 40, including8tuberculosis clusters,15 diarrhea clusters, 10upper respiratory tract infection clusters, 13 influenza-like illness clusters,2varicella clusters, and 2 enterovirus clusters.

Imported Infectious Diseases

●There were 27imported cases from 9 countries during week 40of 2019.

Countries / Diseases	Indonesia	Philippines	Vietnam	Myanmar	Singapore	Cambodia	Thailand	Papua New Guinea	Canada	Total
Amoebiasis	7	2					1			10
Dengue Fever	1	2	3		2	1				9
Chikungunya Fever				2			1			3
Typhoid fever	1	1								2
Malaria								1		1
Measles						1				1
Acute Hepatitis A									1	1
Total	9	5	3	2	2	2	2	1	1	27

Note: The table summarized the number of imported cases that were either **confirmed** or **updated** in the given week.

●There are 835imported cases from 38 different countries in 2019. The top 3 countries areIndonesia (233), Vietnam (123),and the Philippines (104).

●Top 3 imported diseases are Dengue Fever (417), Amoebiasis (138), and Chikungunya Fever(75).

Summary of Epidemic

●**Enterovirus**：The epidemichasgradually slowed down, but it is stillin the epidemic period.EV71 is still circulating in the community.

●**Dengue and Chikungunya**：Because of the recent rainfall in Northern Taiwan, and the potential overseas travel on the coming holidays,the risk of epidemic is persistence.

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

Case diagnosis year		Week 41★		Week 1–41			
				2018		2017	
Classification	Disease Diagnosed	2019	2018	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	2	1	51	1	57	0
	Acute Viral Hepatitis type A	3	0	76	20	70	28
	Amoebiasis	7	6	267	140	254	125
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	0	96	75	6	6
	Cholera	0	0	0	0	7	0
	Dengue Fever	14	12	523	428	385	233
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	1	0	0	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	1	0	1	0
	Malaria	0	1	6	6	5	5
	Measles	0	1	130	52	36	9
	Meningococcal Meningitis	0	0	4	0	5	1
	Paratyphoid Fever	0	1	7	6	7	6
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	0	21	17	9	8
	Shigellosis	3	3	107	35	133	46
	Typhoid fever	0	0	23	19	13	10
	West Nile Fever	0	0	0	0	0	0
Category III	Acute Viral Hepatitis type B	0	0	4	4	2	2
	Acute Viral Hepatitis type C	1	6	86	1	118	8
	Acute Viral Hepatitis type D	16	11	478	2	361	3
	Acute Viral Hepatitis type E	0	0	0	0	0	0
	Congenital Syphilis	0	0	8	3	6	0
	Congenital Rubella Syndrome	0	0	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	0	0	0	0
	Haemophilus Influenza type b Infection	4	1	48	1	34	0
	Japanese Encephalitis	0	0	1	0	5	0
	Legionellosis	0	0	20	0	35	0
	Mumps	3	4	210	13	160	7
	Neonatal Tetanus	8	12	476	7	482	8
	Pertussis	0	0	0	0	0	0
	Tetanus	0	1	24	0	26	2
Category IV	Botulism	0	0	3	0	5	0
	Brucellosis	0	0	0	0	0	0
	Complicated Varicella	0	0	0	0	0	0
	Endemic Typhus Fever	0	3	52	1	46	0
	Herpesvirus B Infection	0	2	24	3	22	1
	Invasive Pneumococcal Disease	0	0	0	0	0	0
	Leptospirosis	6	6	340	2	376	0
	Listeriosis	4	9	98	0	75	1
	Lyme Disease	1	0	149	1	133	1
	Melioidosis	0	0	1	1	2	2
	Q Fever	2	0	39	0	22	1
	Scrub Typhus	0	1	18	4	14	1
	Severe Complicated Influenza	8	11	379	4	282	1
	Toxoplasmosis	33	15	1851	8	1035	5
	Tularemia	0	0	13	2	12	1
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 Coronavirus	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
	Yellow Fever	0	0	0	0	0	0
	Zika virus infection	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, Gonorrhea, 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 2018/1/1, "Listeriosis" was listed as a Notifiable Infectious Disease.

Suspected Clusters

●Thirty-sevenclusterswere reported during week 41, including5tuberculosis clusters,12 diarrhea clusters,5upper respiratory tract infection clusters, 13 influenza-like illness clusters,and 2varicella clusters.

Imported Infectious Diseases

●There were 14imported cases from 7 countries during week 41of 2019.

Diseases \ Countries	Vietnam	Philippines	Cambodia	Myanmar	Thailand	Indonesia	Japan	Total
Dengue Fever	4	2	3	1	1			11
Amoebiasis		1				1		2
Severe Complicated Influenza							1	1
Total	4	3	3	1	1	1	1	14

Note: The table summarized the number of imported cases that were either **confirmed** or **updated** in the given week.

●There are 849imported cases from 38 different countries in 2019. The top 3 countries areIndonesia (234), Vietnam (127),and the Philippines (107).

●Top 3 imported diseases are Dengue Fever (428), Amoebiasis (140), and Chikungunya Fever(75).

Summary of Epidemic

●**Enterovirus**：The epidemichasgradually slowed down, but it is stillin the epidemic period.EV71 is still circulating in the community.

●**Dengue**：There is a new indigenous cluster inShulin District, New Taipei City, and there are new indigenous cases in Taichung and Tainan City; the risk of epidemic is persistence.

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