

A bronchofiberoscopy-associated outbreak of multidrug-resistant *Acinetobacter baumannii* infection in an intensive care unit

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Law

 Infectious Disease Control & prevention in People's Republic of China (2004)

Regulations

- Regulation on Hospital Infection Management (2006)
- Regulation on Medical Waste Management (2003)
- Regulation on Disinfection Management (2002)



Technical guidelines

- Guideline for Prevention and Control of Surgical Site Infection (GJB 7480—2012)
- Guideline for Diagnosis of Nosocomial Infection (trial) (2001)
- Guidelines for Clinical Application of Antimicrobial drugs (2016)
- Guideline for Endoscope Cleaning and Disinfection (2016)
- Guideline for Dental Equipment Disinfection in Healthcare Settings (2016)
- Specification of Nosocomial Outbreak Reporting and Disposal Management (2016)
- Standard for construction of Hospital Clean Operation Department (2016)



Technical guidelines

- Central Sterile Supply Department (CSSD): WS 310—2009
- Part I : management standard
- Part II :standard for operating procedure of cleaning , disinfection and steriliztion
- Part III: surveillance standard for cleaning ,disinfection and steriliztion
- Guideline for isolation in hospitals (WS/T 311—2009)
- Guideline for nosocomial infection surveillance (WS/T 312— 2009)
- Guideline for hand hygiene of healthcare workers in healthcare settings (WS/T 313—2009)



Technical guidelines

- Guideline of Hospital Air Purification management (WS/T368—2012)
- Guidelines for washing and disinfection technique of medical textiles in healthcare facilities (2016)
- Guidelines for prevention and control of healthcare associated infection in intensive care unit (2016)



Our Mission

- Surveillance on healthcare-associated infections
- Investigations on nosocomial infection Outbreak
- Generation of recommendations and Standards
- Perform Intervention Implementation
- Research:

Epidemiological analysis of MDRO (Acinetobacter and Fungus); Infection mechanism, especially in the lung



Outbreak investigation

An ICU ward

- A large open bedroom with ten beds, a buffer room, treatment room, and equipment room.
- Every bed was equipped with an alcohol-based hand rub.
- 15 doctors and 31 nursesin total, and 12 nurses were on duty every day.



Outbreak investigation





Epidemiological investigation

- 5th August 2009 to 30th November 2009,
- 153 patients were admitted to the ICU.
- Medical records including paper and electronic charts.
- Any patient who had at least one clinical or screening sample that was positive for a MDR-Ab who had the corresponding clinical symptoms (e.g., pneumonia, bacteremia, peritonitis) detected at least 48 h after ICU admission was noted.
- Multidrug resistance was defined as resistance to ≥3 of the following classes of antibiotics: penicillins, cephalosporins, aminoglycosides, fluoroquinolones, and carbapenems



Environmental sampling

- Every two days
- Hands and nasal cavities of the ICU staff
- Multiple surfaces:
- ICU environment including: bed sheets, bedrails, and bedside tables associated with cases and controls; healthcare workers' clothes, computer keyboards, and calculators;
- the surfaces of invigilators,
- ventilators, hemofiltration machines, bronchofiberscopes, electrocardiography machines, ultrasound machines, and laryngeal endoscopes.



Case study

• Case definition:

patient with at least one isolate identified as the outbreak MDR-Ab strain in clinical culture (out-break strain carrier) at least 48 h after ICU admission during the period

Control:

a patient who stayed ≥ 48 h in the ICU during the same period without the identification of an outbreak strain in any clinical culture

The ratio of controls to cases was 2.7:1.



- A total of 12 patients (seven males and five females ages 39–97), MDR-Ab carriers. Statistically significant (P < 0.001).
- The average interval between ICU admission and MDR-Ab identification was 6.3 ± 3.8 days.
- Eight of the 12 patients had received bronchofiberscopy and five had BSIs. Six patients (50%) died in the ICU and three patients' deaths (B, D, E) were possibly related to MDR-Ab infection.
- A total of 22 MDR-Ab isolates were available from seven patients who underwent bronchofiberscopy. 16 have identical type.
- 26/78 MDR-Ab, 22/26 are identical to A. 13/22 around the case patients
- no MDR-Ab isolates were detected from the healthcare workers' hand or nasal cavity samples.



Outbreak investigation



Xia, et al. BMC Infect Dis. 2012

(sri



Clinical characteristics of multidrug-resistant Acinetobacter baumannii (MDR-Ab) carriers in the intensive care unit

Patient	MDR-Ab culture site	Bronchofiberscopy	Patient outcome	MDR-Ab strain	
А	Sputum	Yes	Survived	NA	
В	Ascites, sputum	No	Died	G	
С	Sputum, blood	No	Survived	С	
D	Blood, sputum, catheter	Yes	Died	А	
Е	Blood, sputum, pleural fluid	Yes	Died	А	
F	Bile, catheter, sputum	No	Survived	А	
G	Blood, sputum, catheter	Yes	Died	А	
Н	Blood, sputum, catheter	Yes	Died	А	
Ι	Sputum	Yes	Survived	А	
J	Blood, sputum, wound	Yes	Survived	А	
K	Sputum	Yes	Died	В	
L	Sputum	No	Survived	D	

MDR-Ab, minitidrug-resistant Acinetobacter Daumannii, NA, isolate not available for analysis,



Timeline of the patients in the ICU





Bronchoscopy in this ICU

- Only one bronchofiberscope in the ICU and bronchofiberscopy was performed once or twice each day for diverse examination and treatment indications such as corpus alienum, removal, secretion clearance, tracheal intubations, and bronchoalveolar lavage.
- Reprocessed by the professional staff in the Center for Cleaning and Disinfection of the hospital according to the Chinese guidelines for endoscopy cleaning and disinfection.
- The standard Reprocession: pre-cleaning, cleaning with an enzymatic detergent, rinsing, disinfecting, final rinsing, drying, and storing.
- Emergently and frequently, it was reprocessed directly and manually by a doctor in the ICU after each use.
- Neither a doctor nor a nurse was specifically appointed to reprocess the bronchofiberscope and no automatic reprocessing machine was used.















KS 11.020 中华人民共和国卫生行业标准 WS 507-2016

软式内镜清洗消毒技术规范

Regulation for cleaning and disinfection technique of flexible endoscope





Comparison of selected risk factors for healthcare-associated infection or colonization with multidrug-resistant *Acinetobacter baumannii* in the intensive care unit

	No.	(%)	- Odda ratio		
Risk factors	Cases $(n = 7)$	Controls $(n = 19)$	(95% CI)	value	
ICU stay, days [median (IQR)]	6 (4–8)	3 (2–6)	-	0.001	
Bedside diagnostic ultrasonography	6 (85.7)	5 (41.7)	16.8 (1.60–176.23)	0.02	
Bronchofiberscopy	6 (85.7)	4 (21.1)	22.50 (2.07-244.84)	0.005	
Electrocardiography	1 (14.3)	3 (15.8)	0.89 (0.08–10.30)	1	
Hemodialysis	3 (42.9)	2 (10.5)	6.38 (0.78–51.78)	0.10	
Presence of central line	2 (28.6)	2 (10.5)	3.40 (0.38–30.66)	0.29	
Surgical operation	3 (42.9)	4 (36.4)	2.81 (0.44–18.06)	0.34	
Septic shock	4 (57.1)	1 (5.3)	24.00 (1.95-295.06)	0.01	
Multiple organ failure	3 (42.9)	1 (5.3)	13.50 (1.10–165.89)	0.05	
Pulmonary diseases	6 (85.7)	8 (42.1)	8.25 (0.82-82.67)	0.08	
Renal diseases	5 (71.4)	3 (15.8)	13.33 (1.71–103.75)	0.01	
Fluoroquinolone administration	2 (28.6)	3 (15.8)	2.13 (0.27–16.60)	0.59	
Carbapenem administration	5 (71.4)	1 (5.3)	45.00 (3.35-603.99)	0.002	



Potential Problems

- First, from the end of July 2009, bronchofiberscope was frequently reprocessed in the ICU by doctors after emergent patient examinations
- and treatments.
- Second, the bronchofiberscope reprocessing procedure was not strictly in accordance with the Chinese guidelines for endoscopy cleaning and disinfection. For instance, the pre-cleaning time was not adequate and the specific enzyme-containing detergent was seldom used.
- In addition, the patients who received bronchofiberscopy were seldom covered during emergent treatment, and the potentially contaminated environmental surface was not disinfected immediately and thoroughly after the bronchofiberscopy procedure was performed.



Intervention

- First, reprocessing by doctors within the ICU was stopped, the bronchofiberscope was sent to the Center for Cleaning and Disinfection of the hospital. More bronchofiberscopes were prepared for use in emergent situations in the ICU.
- Second, surveillance culturing for MDR microorganisms from the bronchofiberscope regularly after every reprocessing round.
- Third, the ICU environmental surfaces were cleaned thoroughly and disinfected with a solution containing electrolyzed acid water
- Fourth, education and training were enhanced for endoscopy reprocessing and general infection control procedures in this ICU.



Architectural composition of ICU









- Bronchofiberscopy was associated with this MDR-Ab outbreak.
- Infection control precautions including appropriate bronchofiberscope reprocessing and environmental decontamination should be strengthened.



Dissemination and Characterization of NDM-1-Producing Acinetobacter pittii

- NDM-1, new metallo-β-lactamase highly resistant to carbapenem, frequently found in *Enterobacteriaceae*, world-wide spread.
- Predominantly in Acinetobacter baumannii, no transmission in ICU was reported.





All NDM-1 positive strains were Acinetobacter pittii

Source	Total isolates N	NDM-1 Positive N(%)			
Patients					
Swab sample	1425	5(0.4)			
Clinical sample	230	0(0.0)			
Heath care workers	104	0(0.0)			
Environmental sampling	1354	22(1.6)			
Total	3114	27(0.9)			
		23201-30			

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Distribution and antibiotic susceptibilities of NDM-1positive Acinetobacter pittii isolates of sequence type 63

Order of	Strains	Date of	Sames of comple	PFGE	1	finima	l inhibito	ry con	centrati	on (mg	(L)
isolating	No.	isolating	Source or sample	type	стх	IMP	MEM	AK	LEV	COL	MN
1	D039	2008-6-11	Bed 7 Button	А	512	>32	>32	16	2	1	<0.125
2	D129	2008-6-21	Dispensing table	А	512	>32	>32	4	2	2	<0.125
3a	D147	2008-6-23	Water tap	А	512	24	>32	8	2	2	<0.125
3b	D151	2008-6-23	Bed 6 Button	А	512	>32	>32	16	2	2	<0.125
3c	D153	2008-6-23	Bed 7 Button	А	512	>32	>32	16	1	4	<0.125
4	D163	2008-6-25	Air	А	512	>32	>32	4	0.5	4	<0.125
5a	D185	2008-6-27	Air	А	512	>32	>32	16	1	2	<0.125
5b	D186	2008-6-27	Drawer handle	А	512	>32	>32	8	1	4	<0.125
ба	D225	2008-7-1	Air	А	512	>32	>32	16	2	4	<0.125
бь	D228	2008-7-1	Water tap	А	512	>32	>32	16	2	4	<0.125
7	D240	2008-7-3	Air	А	512	>32	>32	16	2	1	<0.125
8	D265	2008-7-5	Dispensing table	Α	512	>32	>32	16	2	4	<0.125
9a	D286	2008-7-7	Water tap	А	512	>32	>32	16	2	2	<0.125
9Ъ	D287	2008-7-7	Dispensing table	А	512	>32	>32	16	2	4	<0.125
9c	D293	2008-7-7	Bed 6 Chart file	А	512	>32	>32	8	1	2	<0.125
9d	D294	2008-7-7	Bed 7 Chart file	Α	512	>32	>32	8	2	2	<0.125
9e	D298	2008-7-7	Bed 4 Chart file	A	512	>32	>32	8	2	2	<0.125
10	D321	2008-7-9	chair	А	512	>32	>32	16	2	2	<0.125
11a	D330	2008-7-11	Air	A	512	>32	>32	8	1	2	<0.125
11b	D335	2008-7-11	Nurse's station desk	A	512	>32	>32	16	2	2	<0.125
11c	D336	2008-7-11	Air	А	512	>32	>32	8	2	4	<0.125
12	D353	2008-7-17	Air	А	512	>32	>32	16	2	4	<0.125
13	D424	2008-8-6	Patient 1 Forehead	Α	512	>32	>32	8	1	4	<0.125
14	D499	2008-8-12	Patient 2 Forehead	А	>512	>32	>32	8	1	2	<0.125
15	H699	2009-5-6	Patient 3 Groin	в	512	>32	>32	8	2	4	<0.125
16	H924	2009-6-13	Patient 4 Groin	с	512	>32	>32	4	0.25	4	0.25
17	H944	2009-6-17	Patient 4 Groin	с	512	>32	>32	8	0.25	4	0.25





ALL ALL





The distribution of the NDM-1-positive and – negative A. pittii isolates with identical PFGE type.





S1 digestion of DNA, pulsed-field gel electrophoresis (PFGE) and hybridization results for NDM-1-positive isolates





GENOME ANNOUNCEMENT

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Draft Genome Sequence of an *Acinetobacter* Genomic Species 3 Strain Harboring a *bla*_{NDM-1} Gene

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Finally, we obtained 30 contigs with a total length of 4,103,824 bp, including one 47.1-kb circular contig identified as a $bla_{\text{NDM-1}}$ bearing plasmid. Fifty-two and 3,844 CDSs were predicted on the plasmid and the other 29 contigs, respectively. The average nucleotide identity (ANI) between strains D499 and SH024 is 98.8%. The $bla_{\text{NDM-1}}$ -encoding plasmid is different from the previously reported one in *E. coli* (5). The $bla_{\text{NDM-1}}$ region in the plasmid harbored a high-GC% island (61.98%; the average GC% of the strain is 38.85%) flanked by two insertion sequence elements (ISAba125 and ISAba11), implying that this island might be transferred by recombination. Besides the $bla_{\text{NDM-1}}$ gene, 19 other antibiotic resistance-related genes were predicted on the assembled genome (8).



New gene envrionment around NDM-1 gene





Establishment of the Africa CDC

January 31st, 2017

January 30th, 2018







Plague Outbreak in Madagascar - October 2017





Africa CDC's Actions:

- Strengthen public health emergency
- management system
- Develop data analysis tool
- Provide financial support



Major cholera outbreaks 2017*





Threats from Antimicrobial Resistance by 2050



Source: O'neill report 2014

- Attribute to 4.1 Million death per year
- Highest Mortality will be in Africa
- Estimated \$42 trillion lost to African economy by 2050



Africa CDC Strategic Focus

Five Strategic Pillars



Africa CDC Operating Model – Networking at different levels





Note: Roughly 24 African countries have formally established NPHIs and joined the International Association of National Public Health Institutes (IANPHI)



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Our Group

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Thanks for your attention!