

Containment of Sustained Transmission of Drug-resistant *Acinetobacter baumannii* by Pulsed-Xenon Ultraviolet Disinfection of the Patient Room in the Intensive Care Unit

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ABSTRACT

Background:

No-touch environmental disinfection has been highlighted in the last decade to control transmission of multidrug-resistant Gram-positive organisms including MRSA and VRE, but its effectiveness to control gram-negative bacteria has not been well examined. Also, its effectiveness outside the US healthcare setting is seldom reported.

Methods:

This study was conducted in the intensive care unit (ICU) of Yamagata University Hospital, a 637-bed tertiary referral hospital. Sporadic acquisition of two drug-resistant *Acinetobacter baumannii* (2DRA) began in late 2013. Despite various infection control practices including hand hygiene promotion and intensified manual terminal cleaning, transmission of this pathogen continued. In February 2018, pulsed-xenon ultraviolet (PX-UV) disinfection was added. The study periods were defined as follows: the baseline period (August 2016 to January 2018, intensified manual cleaning) and the intervention period (February 2018 to December 2021, addition of PX-UV). Throughout the study periods, all patients were regularly screened for 2DRA to detect acquisition of those pathogens in the ICU.

Results:

The incidence of newly acquired 2DRA significantly declined over time (4.45 per 1,000 patient days in the baseline period to 1.21 in the intervention period, relative risk (RR): 0.27, 95% confidence interval: 0.12-0.61). Notably, horizontal transmission of 2DRA was completely contained, not only in the ICU but also throughout the hospital.

Conclusion:

Adding PX-UV after through manual terminal cleaning is effective in controlling acquisition of 2DRA in the ICU patients and led to termination of transmission of 2DRA in our hospital. The effectiveness of PX-UV in controlling gram-negative MDROs in the non-US healthcare settings is suggested.

INTRODUCTION / BACKGROUND

- Environmental contamination by *Clostridioides difficile*, vancomycin-resistant enterococci (VRE) and multidrug-resistant *Acinetobacter* can lead to continuous horizontal transmission and also outbreaks
- Environmental manual cleaning by cloths may not be sufficient
- No-touch environmental disinfection has been highlighted in the last decade to control transmission of these pathogens
- Among various methods, ultraviolet disinfection has been shown to be effective for this purpose by a number of studies, and increasingly used as an adjunct to terminal cleaning
- However, those studies and practices were mostly performed and observed in the United States, where most of the rooms are private
- Also, its effectiveness to control gram-negative bacteria has not been well examined
- The objective of this study is to evaluate the effect of pulsed xenon ultraviolet (PX-UV) disinfection in a Japanese healthcare setting on the transmission of healthcare-associated *Acinetobacter baumannii*

MATERIALS AND METHODS

Study Design & Setting:

- Yamagata University Hospital, a 637-bed tertiary referral hospital in Japan
- Intensive Care Unit (ICU): 6 beds, with non-private rooms dominant
- Sporadic acquisition of two drug-resistant *Acinetobacter baumannii* (2DRA) began in late 2013
- Despite various infection control practices including hand hygiene promotion and intensified manual terminal cleaning by cloths soaked into diluted sodium hypochlorite solution after every patient discharge from the ICU, transmission of 2DRA continued
- In February 2018, PX-UV disinfection (two, 5-minute cycles per manufacturer's recommendation) was added
- The study periods were defined as follows:
Baseline period: August 2016 to January 2018
Intervention period: February 2018 to December 2021
- Throughout the study periods, all patients were regularly screened for 2DRA to detect acquisition of those pathogens in the ICU.

Analysis and Statistics

- Incidences of acquired two drug-resistant *Acinetobacter* (2DRA) were compared by chi-square test

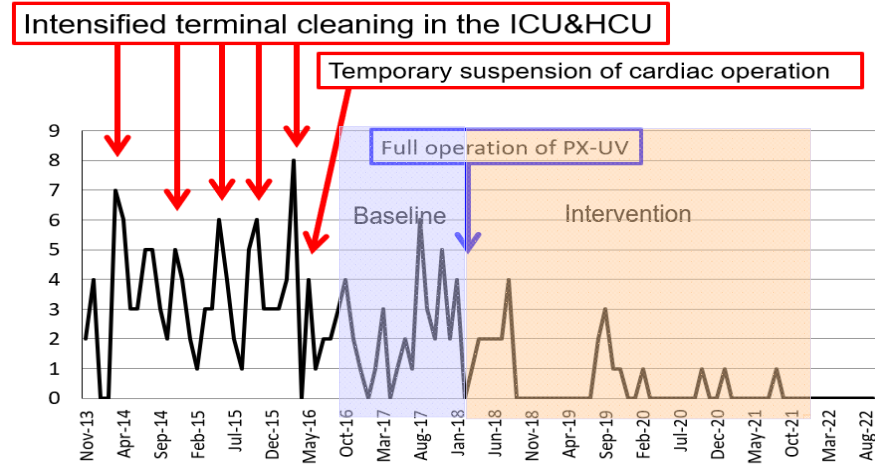
RESULTS

1. Change in the Incidence of 2DRA

Aug 2016 – Jan 2018 (Baseline period)	ICU	HCU	All other wards
Infections	14	13	18
Patient days	3,145	6,494	299,873
Infection incidence	4.45	2.00	0.060
Feb 2018 – Dec 2021 (Intervention period)	ICU	HCU	All other wards
Infections	10	6	8
Patient days	8,298	13,694	733,359
Infection incidence	1.21	0.44	0.011
Percent Change in incidence	-72.8%	-78.0%	-81.7%
Relative Risk	0.27	0.22	0.18
95% CI	0.12-0.61	0.083-0.57	0.079-0.42

- Remarkable, statistically significant reduction in the acquisition of 2DRA in ICU, HCU and other units was observed

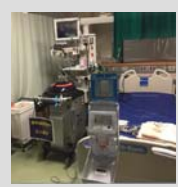
2. Trend in monthly acquisition of 2DRA (all wards)



- Addition of PX-UV disinfection effectively reduced and contained continuous transmission of 2DRA in our hospital

DISCUSSIONS

- Sporadic, but sustained transmission of 2DRA has been observed in our ICU from 2013 to 2017
- Even after introduction of PX-UV disinfection, transmission of 2DRA continued for several months
- Routine use of PX-UV gradually decreased 2DRA bioburden in the ICU environment
- No new isolation of 2DRA from patients was observed in any of the wards for 11 months (August 2018 to July 2019)
- Sporadic transmission was observed afterwards
- PX-UV prevents transmission via environmental route, but not via direct contact transmission by healthcare workers
- This route of transmission can be prevented through rigorous adherence of hand hygiene opportunity and contact precaution
- Continuous application of PX-UV, in conjunction with other infection control practices, was useful in controlling transmission of 2DRA



LIMITATIONS

- Before-after study with no non-intervention arm
- Screening of patients for acquisition of colonization were limited only in the ICU and HCU

CONCLUSIONS

- Adding PX-UV after through manual terminal cleaning is effective in controlling acquisition of 2DRA in the ICU patients and led to termination of transmission of 2DRA in our hospital
- The effectiveness of PX-UV disinfection in controlling gram-negative MDROs in the non-US healthcare settings is suggested

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