Journal of Microbiology, Immunology and Infection (2017) 50, 133—144

Available online at www.sciencedirect.com

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ORIGINAL ARTICLE

Presence of multidrug-resistant organisms in the residents and environments of long-term care facilities in Taiwan

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Received 3 December 2016; accepted 14 December 2016
Available online 20 February 2017

KEYWORDS
environment;
infection control;

Abstract *Objectives:* This study investigated the prevalence of multidrug-resistant organisms (MDROs) in the residents and environments of long-term care facilities (LTCFs) in Taiwan. *Methods:* We prospectively investigated the distribution of MDROs in residents of six LTCFs and

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http://dx.doi.org/10.1016/j.jmii.2016.12.001

long-term care facility;
multidrug-resistant organisms;
residents

their environments from January 2015 to December 2015 (intervention period). Active surveillance of colonization of MDROs was performed by culturing rectal and nasal swab samples every 3 months for the residents: 63, 79, and 73 in the first, second, and third surveillance investigations, respectively. If MDROs, including methicillin-resistant *Staphylococcus aureus*, carbapenem-resistant Enterobacteriaceae, carbapenem-resistant *Pseudomonas aeruginosa*, and MDR *Acinetobacter baumannii* were identified, then swab specimens from environmental sources were also collected and cultured. During the study period, several infection control measures were also implemented.

Results: The overall infection density decreased significantly from 2.69 per 1000 patient—days in the preintervention (January 2014 to December 2014) to 2.39 per 1000 patient—days during the intervention period ($p < 0.001$). A total of 154 samples from residents and environmental sources were positive for MDROs. Methicillin-resistant *S. aureus* ($n = 83$, 53.9%) was the predominant organism, followed by carbapenem-resistant Enterobacteriaceae ($n = 35$, 22.7%), MDR *A. baumannii* ($n = 30$, 19.5%), and carbapenem-resistant *P. aeruginosa* ($n = 6$, 3.9%). The rates of detection of MDROs were 27.9% (60/215) in nasal swabs, 15.8% (34/215) in rectal swabs, and 11.1% (60/542) in the environmental sources.

Conclusions: The distribution and persistence of MDROs varied among the different LTCFs and time periods.

Introduction

Long-term care facilities (LTCFs), including nursing homes, rehabilitation facilities, and long-term chronic care hospitals, provide rehabilitative, restorative, and/or ongoing skilled nursing care for patients with significant disabilities.[1] These institutions are also the last medical resource for patients who have survived acute illnesses in hospitals. Infection or colonization with multidrug-resistant organisms (MDROs), such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), carbapenem-resistant Enterobacteriaceae (CRE), carbapenem-resistant *Pseudomonas aeruginosa* (CRPA), and multidrug-resistant *Acinetobacter baumannii* (MDRAB) have become an important issue not only for hospitals but also for LTCFs.[2–9] In a recent study, Liu et al[10] found that clinical isolates obtained from 215 (45.5%) of 473 nursing home residents harbored extended-spectrum β-lactamase-producing Enterobacteriaceae.

In this prospective study, we investigated the distribution and persistence of MDROs in six LTCFs in Northern and Central Taiwan. Once the presence of MDROs was documented in the LTCFs, several infection control measures were also implemented. Infection densities of these LTCFs before and during intervention were also evaluated.

Materials and methods

Study design, setting, and participants

This prospective study was conducted from January 2015 to December 2015 and included six LTCFs (A—F) located in Northern ($n = 1$, LTCF-A) and Central ($n = 5$, LTCF-B—F) Taiwan. The total bed number of the six LTCFs was 621, ranging from 45 (LTCF-E) to 153 beds (LTCF-B; Table 1). A total of 313 residents staying at the same areas or floors of the six LTCFs were initially designated and screened for enrollment in this study (Table 1). Characteristics of each facility and clinical data of the residents designated for participating this study, including age, sex, daily activities, underlying conditions, and devices used, were collected by infection control nurses. The study protocol was approved by the Institutional Review Boards of the Chung Shan Medical University Hospital (CS15022), National Taiwan University Hospital (201502026RINB), and Mackay Memorial Hospital (15MMHISO016e), and written informed consent was obtained from each enrolled resident of the participating LTCFs.

Infection control interventions

During the study period (January 2015 to December 2015, intervention period), several infection control measures were implemented. Adenosine triphosphate testing of various environments was periodically conducted before and after cleaning to determine the degree of sterility of the facilities and whether a disinfection education program was needed. We also instituted an education program regarding MDRO control for healthcare workers and then periodically evaluated the effectiveness of the program. Monitoring hand hygiene adherence and active enhancing contact precautions to interrupt transmission, including hand washing and the use of disposable gloves and gowns were also conducted. Regular meetings between infection control experts and representatives of the six LTCFs were conducted every 3 months to monitor the progress of the intervention programs. All of the above intervention measures were conducted in six LTCFs during the intervention period. We also calculated the number of episodes of infection per 1000 patient—days in each LTCF in the