

Volume 37, No 11

ICHE



NOVEMBER 2016

FLORENCE NIGHTINGALE

Go Mobile

CJO Mobile (CJOm) is a streamlined
Cambridge Journals Online (CJO)
for smartphones and other
small mobile devices



- Use CJOm to access all journal content including *FirstView* articles which are published online ahead of print
- Access quickly and easily thanks to simplified design and low resolution images
- Register for content alerts or save searches and articles – they will be available on both CJO and CJOm
- Your device will be detected and automatically directed to CJOm via: journals.cambridge.org



CAMBRIDGE
UNIVERSITY PRESS

CONTENTS

SHEA White Papers

- 1265** Research Methods in Healthcare Epidemiology and Antimicrobial Stewardship—Mathematical Modeling
Sean L. Barnes, Parastu Kasaie, Deverick J. Anderson and Michael Rubin
- 1272** Research Methods in Healthcare Epidemiology: Survey and Qualitative Research
Nasia Safdar, Lilian M. Abbo, Mary Jo Knobloch and Susan K. Seo
- 1278** Research Methods in Healthcare Epidemiology and Antimicrobial Stewardship: Use of Administrative and Surveillance Databases
Marci Drees, Jeffrey S. Gerber, Daniel J. Morgan and Grace M. Lee

Original Articles

- 1288** Antimicrobial-Resistant Pathogens Associated With Healthcare-Associated Infections: Summary of Data Reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2011–2014
Lindsey M. Weiner, Amy K. Webb, Brandi Limbago, Margaret A. Dudeck, Jean Patel, Alexander J. Kallen, Jonathan R. Edwards and Dawn M. Sievert
- 1302** Healthcare-Associated Infections in Pediatric and Neonatal Intensive Care Units: Impact of Underlying Risk Factors and Antimicrobial Resistance on 30-Day Case-Fatality in Italy and Brazil
Laura Folgori, Paola Bernaschi, Simone Piga, Michaela Carletti, Filippa Pirrone Cunha, Paulo Henrique Rodriguez Lara, Nicholas Cafieiro de Castro Peixoto, Bárbara Gomes Alves Guimarães, Mike Sharland, André Ricardo Araujo da Silva and Marta Ciofi degli Atti
- 1310** Prevalence of Multidrug-Resistant Organisms in Hospitalized Pediatric Refugees in an University Children's Hospital in Germany 2015–2016
Tobias Tenenbaum, Klaus-Peter Becker, Bettina Lange, Anka Martin, Peter Schäfer, Stefan Weichert and Horst Schrotten
- 1315** A Model-Based Strategy to Control the Spread of Carbapenem-Resistant Enterobacteriaceae: Simulate and Implement
Mirian de Freitas DalBen, Elisa Teixeira Mendes, Maria Luisa Moura, Dania Abdel Rahman, Driele Peixoto, Sania Alves dos Santos, Walquiria Barcelos de Figueiredo, Pedro Vitale Mendes, Leandro Utino Taniguchi, Francisco Antonio Bezerra Coutinho, Eduardo Massad and Anna Sara Levin
- 1323** Elimination of Routine Contact Precautions for Endemic Methicillin-Resistant *Staphylococcus aureus* and Vancomycin-Resistant *Enterococcus*: A Retrospective Quasi-Experimental Study
Elise M. Martin, Dana Russell, Zachary Rubin, Romney Humphries, Tristan R. Grogan, David Elashoff and Daniel Z. Uslan
- 1331** Mortality and Costs in *Clostridium difficile* Infection Among the Elderly in the United States
Andrew F. Shorr, Marya D. Zilberberg, Li Wang, Onur Baser and Holly Yu
- 1337** A Regional Outbreak of *Clostridium difficile* PCR-Ribotype 027 Infections in Southeastern France from a Single Long-Term Care Facility
Nadim Cassir, Jean-Christophe Delarozière, Gregory Dubourg, Marion Delord, Jean-Christophe Lagier, Phillipe Brouqui, Florence Fenollar, Didier Raoult and Pierre Edouard Fournier
- 1342** Household Transmission of *Clostridium difficile* to Family Members and Domestic Pets
Vivian G. Loo, Paul Brassard and Mark A. Miller

- 1349** Improving the Understanding of Publicly Reported Healthcare-Associated Infection (HAI) Data
Max Masnick, Daniel J. Morgan, Mark D. Macek, John D. Sorkin, Jessica P. Brown, Penny Rheingans and Anthony D. Harris
- 1355** Internal and External Validation of a Computer-Assisted Surveillance System for Hospital-Acquired Infections in a 754-Bed General Hospital in the Netherlands
H. Roel A. Streefkerk, Ivar O. Lede, John L. V. Eriksson, Marije G. Meijling, Conrad P. van der Hoeven, Jan C. Wille, Titia E. M. Hopmans, Alex W. Friedrich, Henri A. Verbrugh and Nashwan al Naiemi
- 1361** Experience With Rapid Microarray-Based Diagnostic Technology and Antimicrobial Stewardship for Patients With Gram-Positive Bacteremia
Elizabeth A. Neuner, Andrea M. Pallotta, Simon W. Lam, David Stowe, Steven M. Gordon, Gary W. Procop and Sandra S. Richter
- 1367** Healthcare Personnel Attire and Devices as Fomites: A Systematic Review
Nicholas Haun, Christopher Hooper-Lane and Nasia Safdar

Concise Communications

- 1374** Evaluation of Hospital Floors as a Potential Source of Pathogen Dissemination Using a Nonpathogenic Virus as a Surrogate Marker
Sreelatha Koganti, Heba Alhmidi, Myreen E. Tomas, Jennifer L. Cadnum, Annette Jencson and Curtis J. Donskey
- 1378** Standardized Infection Ratio for Surgical Site Infection after Colon Surgery: Discord in Models Measuring Healthcare Quality
Raymond Chinn, Jason M. Lempp, Susan S. Huang, Rekha Murthy, Francesca J. Torriani, Jacqueline Daley, Elaine Dekker, Barbara Goss-Bottorff, Wendy Kaler, Karen Meyer, Frank Myers, Amy Nichols, Kathleen Quan and David Birnbaum
- 1383** Surgical Site Infections Following Birmingham Hip Resurfacing
Ashish Bhargava, Madiha Salim, Harsha V. Banavasi, Vijay Neelam, Richmund Wenzel, Kristin L. Sims, Sorabh Dhar and Keith S. Kaye

Research Briefs

- 1387** Hospital-Acquired Vector-Transmitted Dengue Fever: An Overlooked Problem?
Juliana Almeida-Nunes, Isabel Marcilio, Maura S. Oliveira, Elenice M.N. Gonçalves, Marjorie V. Batista, Alfredo Mendrone Jr, José E. Levi, Silvia F. Costa and Anna S. Levin
- 1389** Utility of the Central Venous Catheter-Related Bloodstream Infection Patient Safety Indicator
Alexandre R. Marra, Debra B. Jansen and Michael B. Edmond

Letters to the Editor

- 1392** Attention on Infection Following Transcatheter Aortic Valve Implantation
Tian-Yuan Xiong and Mao Chen
- 1392** Comment on: The Carbapenemase Menace: Do Dual Mechanisms Code for More Resistance?
Georgios Meletis, Efthymia Protonotariou, Dimitra Papadopoulou and Lemonia Skoura

Erratum

- 1394** Research Methods in Healthcare Epidemiology and Antimicrobial Stewardship: Use of Administrative and Surveillance Databases – ERRATUM

MICROBIAL SURVEILLANCE TESTING MADE EASY

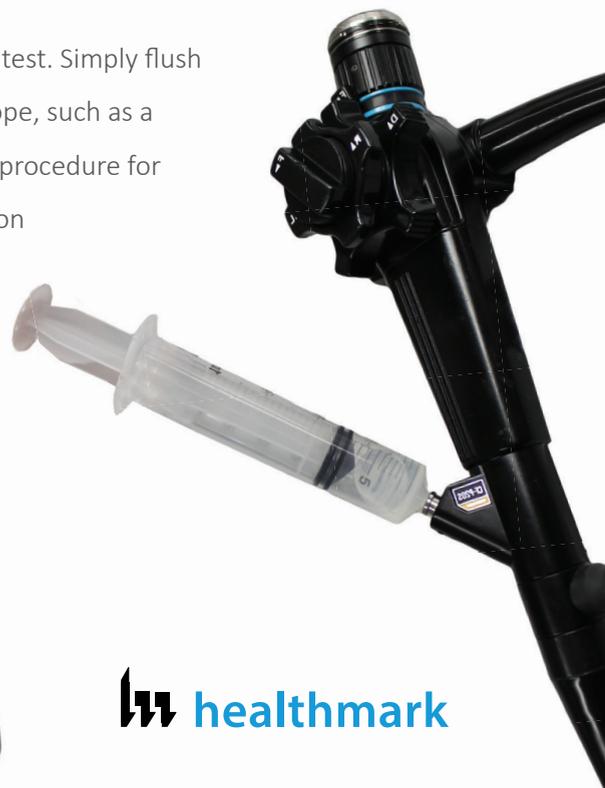
Healthmark offers the One-Two Punch to Identify and Document the Efficacy of Your Endoscope Reprocessing

SCREEN WITH THE NOW! TEST

*Rapid Indicator of
Gram-Negative bacteria*

Immediate, practical screening test. Simply flush the lumen of a flexible endoscope, such as a duodenoscope, and follow the procedure for gram-negative bacteria detection in less than 12 hours.

< 10 CFU



 **healthmark**

AUDIT WITH THE FLEXIBLE ENDOSCOPE SAMPLING KIT

Surveillance tool for the random testing of duodenoscopes in compliance with CDC guidelines - In association with Nelson Laboratories



A simple and complete kit. After flushing and brushing the lumen and elevator mechanism of a duodenoscope, simply follow the procedure to have the sample solution & brush heads quickly sent to Nelson Laboratories - the leader in independent testing of flexible endoscopes. All tools are included for testing and shipment.


**NELSON
LABORATORIES**

An Official Publication of the Society for Healthcare Epidemiology of America

EDITOR

Suzanne F. Bradley, MD • Ann Arbor, MI

DEPUTY EDITOR

Carol A. Kauffman, MD • Ann Arbor, MI

SENIOR ASSOCIATE EDITORS

C. Glen Mayhall, MD • Galveston, TX
Gina Pugliese, RN, MS • Chicago, IL
William Schaffner, MD • Nashville, TN

ASSOCIATE EDITORS

Carol Chenoweth, MD • Ann Arbor, MI
Ebbing Lautenbach, MD, MPH • Philadelphia, PA
David Weber, MD, MPH • Chapel Hill, NC

STATISTICS CONSULTANTS

Jon P. Furuno, PhD • Portland, OR
Jessina C. McGregor, PhD • Portland, OR

SECTION EDITOR FOR GUIDELINES, POSITION PAPERS, AND INVITED REVIEWS

Eli Perencevich, MD, MS • Iowa City, IA

MANAGING EDITOR

Meighan Schreiber, MSSA • New York, NY

PAST EDITORS

Infection Control

Richard P. Wenzel, MD, 1980-1987 (vols. 1-8)

Infection Control & Hospital Epidemiology

Richard P. Wenzel, MD, 1988-1992

(vols. 9-13)

Michael D. Decker, MD, 1993-2001 (vols. 14-22)

Barry M. Farr, MD, 2002-2004 (vols. 23-25)

William R. Jarvis, MD, 2005-2006 (vols. 26 and 27)

EDITORIAL ADVISORY BOARD

Deverick Anderson, MD, MPH • Durham, NC
Anucha Apisarnthanarak, MD • Pratumthani, Thailand
Lennox Archibald, MD, FRCP • Alachua, FL
Shailen Banerjee, PhD • Atlanta, GA
Elise M. Beltrami, MD, MPH • Atlanta, GA
Jo Anne Bennett, RN, PhD • New York, NY
David Birnbaum, PhD, MPH • Sidney, BC
Marc Bonten, MD • Utrecht, Netherlands
Christian Brun-Buisson, MD • Creteil, France
John P. Burke, MD • Salt Lake City, UT
David P. Calfee, MD, MS • New York, NY
Yehuda Carmeli, MD, MPH • Tel Aviv, Israel
Donald E. Craven, MD • Burlington, MA
Christopher Crnich, MD, MS • Madison, WI
Erika D'Agata, MD, MPH • Boston, MA
Daniel Diekema, MD • Iowa City, IA
Erik Dubberke, MD, MSPH • St. Louis, MO
Charles E. Edmiston, Jr., PhD • Milwaukee, WI
Theodore C. Eickhoff, MD • Denver, CO
Mohamad Fakhri, MD, MPH • Grosse Pointe Woods, MI
Petra Gastmeier, MD • Berlin, Germany
Jeffrey Gerber, MD, PhD • Philadelphia, PA
Dale N. Gerding, MD • Hines, IL
Donald A. Goldmann, MD • Boston, MA
Nicholas Graves, PhD • Brisbane, Australia
Donna Haiduvén, RN, PhD, CIC • Tampa, FL
Anthony D. Harris, MD, MPH • Baltimore, MD
Elizabeth Henderson, PhD • Calgary, AB
David K. Henderson, MD • Bethesda, MD
Loreen A. Herwaldt, MD • Iowa City, IA
Peter N. R. Hestline, MD • Brea, CA

John A. Jernigan, MD, MS • Atlanta, GA
Mini Kamboj, MD • New York, NY
James T. Lee, MD, PhD • St. Paul, MN
L. Clifford McDonald, MD • Atlanta, GA
Allison McGeer, MD • Toronto, ON
Leonard A. Mermel, DO, ScM • Providence, RI
Robert R. Muder, MD • Pittsburgh, PA
Linda Mundy, MD • Collegeville, PA
Joseph M. Mylotte, MD, CIC • Buffalo, NY
Jan Evans Patterson, MD • San Antonio, TX
David A. Pegues, MD • Philadelphia, PA
Didier Pittet, MD, MS • Geneva, Switzerland
Isaam Raad, MD • Houston, TX
Manfred L. Rotter, MD, DipBact • Vienna, Austria
William A. Rutala, PhD, MPH • Chapel Hill, NC
Lisa Saiman, MD, MPH • New York, NY
Sanjay Saint, MD, MPH • Ann Arbor, MI
Sorana Segal-Maurer, MD • Flushing, NY
Lynne M. Schulster, PhD • Atlanta, GA
John A. Sellick, DO • Amherst, NY
Andrew E. Simor, MD • Toronto, ON
Philip W. Smith, MD • Omaha, NE
Kurt Stevenson, MD, MPH • Columbus, OH
Nimalie Stone, MD • Atlanta, GA
Thomas Talbot, MD, MPH • Nashville, TN
Paul Tambyah, MBBS • Singapore
William Trick, MD • Chicago, IL
Antoni Trilla, MD, PhD • Barcelona, Spain
Robert A. Weinstein, MD • Chicago, IL
Andreas Widmer, MD, MS • Basel, Switzerland
Marcus Zervos, MD • Detroit, MI

Infection Control & Hospital Epidemiology (ISSN 0899-823X) is published monthly by Cambridge University Press, One Liberty Plaza, New York, NY 10006, USA.

Editorial Office

Communications should be addressed to the Editor, *Infection Control & Hospital Epidemiology*, One Liberty Plaza, New York, NY 10006 (email: mschreiber@cambridge.org; telephone: 212-337-5954, fax: 212-337-5959). Contributors should consult the Instructions for Contributors, which is available at the journal's Web site.

Advertising

Please direct advertising inquiries to M. J. Mrvica Associates, 2 West Taunton Avenue, Berlin, NJ 08009 (e-mail: mjmrvica@mrvica.com; telephone: 856-768-9360, fax: 856-753-0064). Publication of an advertisement in *Infection Control & Hospital Epidemiology* does not imply endorsement of its claims by the Society for Healthcare Epidemiology of America, by the Editor, or by Cambridge University Press.

Permissions

Articles may be copied or otherwise reused without permission only to the extent permitted by Sections 107 and 108 of the US Copyright Law. Permission to copy articles for personal, internal, classroom, or library

use may be obtained from the Copyright Clearance Center (<http://www.copyright.com>, email: info@copyright.com). For all other uses, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale, please contact Cambridge University Press. Full details may be found at: www.cambridge.org/about-us/rights-permissions.

Subscriptions

The individual subscription rate for 2016 is \$235. Individuals have the option to order directly from Cambridge University Press. Institutional print + electronic and e-only subscriptions are available from Cambridge University Press and include unlimited online access; rates are tiered according to an institution's type and research output and may be reviewed at the journal's CJO homepage: <http://journals.cambridge.org/ICE>.

Please direct subscription inquiries and requests for back issues to Customer Services at Cambridge University Press, e-mail: subscriptions_newyork@cambridge.org (USA, Canada, and Mexico) or journals@cambridge.org (outside of USA, Canada, and Mexico).

Postmaster: Send address changes to *Infection Control & Hospital Epidemiology*, Cambridge University Press, One Liberty Plaza, New York, NY 10006 USA.

About the cover:



The cover format of each volume of *Infection Control & Hospital Epidemiology* honors one of the many professionals throughout history who recognized not only how disease might be spread but also how the principles of epidemiology could be applied to reduce healthcare-associated infections.

Florence Nightingale (1820–1910) was named after the Italian city where she was born to affluent and well-educated English landowners. As a middle-class woman in Victorian England, Florence recognized that she was destined for a life of domesticity and “trivial occupations.” Her choice of nursing, given its reputation at the time as a vocation for poor elderly spinsters, was met with significant familial opposition. During her European travels, Ms. Nightingale visited the Deaconess Mutterhaus in Kaiserswerth, Düsseldorf, one of the most forward thinking nursing training schools of the day. She returned to Düsseldorf to complete her training and then studied with the Sisters of Charity in Paris. She later assumed the role of superintendent at a hospital for invalid gentlewomen in London.

In 1854, the Minister of War invited Ms. Nightingale to oversee the introduction of nurses at British Army hospitals in Scutari, Turkey. Up to that point, 20% of men who fought in the Crimean War died, and approximately 70% of those deaths were due to infections such as typhus, cholera, typhoid, and dysentery. The germ theory of disease had not yet been formulated, but Florence Nightingale recognized that most problems were caused by “inadequate diet, dirt, and drains.” She adopted the concept of “sanitary nursing” ensuring that patient care focused on prevention of infection through adequate diet, fresh air, light, warmth, and cleanliness. She was an early advocate for hand hygiene and the need for clean water, adequate ventilation, and appropriate sewage disposal. Each night, she traveled through more than 6 km of hospital wards carrying a Turkish lamp; thus the media referred to her as “The Lady with the Lamp.” With her interventions, mortality rates declined to 2%–6%.

In response, a grateful nation raised £50,000 for the Nightingale Fund, and the first professional training school for nurses at St. Thomas’ Hospital, London, was established under her direction. Florence Nightingale was one of the first to apply statistical analysis to her observations. She made important recommendations regarding the optimal design of hospitals and patient wards, saying, “The very first requirement in a hospital is that it should do the sick no harm.” Training schools have been established worldwide based on her ideas. Florence Nightingale was the first woman to receive Britain’s highest civilian decoration, the Order of Merit. She died at the age of 90 after many years of being bed-ridden due to chronic illness, possibly brucellosis.

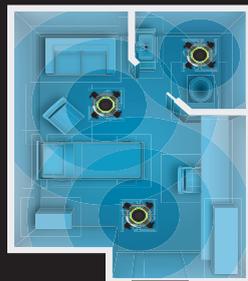
surfacide®

Leading Professional in Infection Prevention Recommends the Use of Automated UV Disinfection:

***“This technology [UV] should
be used for terminal room
disinfection after discharge of
patients on contact precautions.
If you don’t have these systems,
you should have them in your
capital budget.”***

—Dr. William Rutala, PhD, MS MPH, CIC
Endoscopes and the Environment are Ripe
for Improvements in Reducing Infections.”
APIC Daily News Monday (13 June 2016): 1; 6.

surfacide®
20 minutes



FIRST-GENERATION
UV ROOM CLEANING
51-146.3 minutes,*
moving three to five times



Terminal Decontamination of Patient
Rooms Using an Automated Mobile
UV Light Unit, *Infect Control Hosp
Epidemiol* 2011;32(8):737-742.

3 ARE BETTER THAN 1
To schedule a live demonstration,
call toll free: 844-390-3538

Surfacide.com