

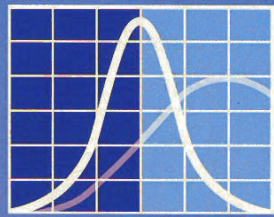
Volume 39, No 1

ICHE

JANUARY 2018



JOHN SNOW & THE BROAD  
STREET PUMP



**SHEA**  
The Society for Healthcare  
Epidemiology of America

SHEASPRING.ORG | #2018SHEA

SHEA Spring 2018 Conference  
**SCIENCE GUIDING PREVENTION**

**April 18-20, 2018**

HILTON PORTLAND DOWNTOWN  
PORTLAND, OR

**FEATURING**

Education on Innovative Topics Addressing Unanswered Issues in Healthcare Epidemiology,  
Antibiotic Stewardship, and Post-Acute & Long Term Care



New Pre-Conference Workshop –  
Get Hands On Experience



Sessions Focused on  
Communication and Three  
Specialty Training Tracks



Opportunity to Submit &  
Present Scientific Abstracts

## CONTENTS

## Original Articles

- 1 Pathogen Distribution and Antimicrobial Resistance Among Pediatric Healthcare-Associated Infections Reported to the National Healthcare Safety Network, 2011–2014  
*Jason G. Lake, Lindsey M. Weiner, Aaron M. Milstone, Lisa Saiman, Shelley S. Magill and Isaac See*
- 12 Readmissions With Multidrug-Resistant Infection in Patients With Prior Multidrug Resistant Infection  
*Jason P. Burnham, Jennie H. Kwon, Margaret A. Olsen, Hilary M. Babcock and Marin H. Kollef*
- 20 No-Touch Disinfection Methods to Decrease Multidrug-Resistant Organism Infections: A Systematic Review and Meta-analysis  
*Alexandre R. Marra, Marin L. Schweizer and Michael B. Edmond*
- 32 Quantifying Hospital-Acquired Carriage of Extended-Spectrum Beta-Lactamase-Producing Enterobacteriaceae Among Patients in Dutch Hospitals  
*Marjolein F. Q. Kluytmans-van den Bergh, Suzan P. van Mens, Manon R. Haverkate, Martin C. J. Bootsma, Jan A. J. W. Kluytmans and Marc J. M. Bonten, for the SoM Study Group and the R-GNOSIS Study Group*
- 40 Vancomycin-Resistant Enterococci (VRE) in The Intensive Care Unit in a Nonoutbreak Setting: Identification of Potential Reservoirs and Epidemiological Associations Between Patient and Environmental VRE  
*Hélène McDermott, Mairead Skally, James O'Rourke, Hilary Humphreys and Deirdre Fitzgerald-Hughes*
- 46 Risk Factors for *Staphylococcus aureus* Acquisition in the Neonatal Intensive Care Unit: A Matched Case-Case-Control Study  
*Matthew C. Washam, Andrea Ankrum, Beth E. Haberman, Mary Allen Staat and David B. Haslam*
- 53 Importation, Mitigation, and Genomic Epidemiology of *Candida auris* at a Large Teaching Hospital  
*Emil P. Lesho, Melissa Z. Bronstein, Patrick McGann, Jason Stam, Yoon Kwak, Rosslyn Maybank, Jodi McNamara, Megan Callahan, Jean Campbell, Mary K. Hinkle and Edward E. Walsh*
- 58 Manual and Automated Cleaning Are Equally Effective for the Removal of Organic Contaminants From Laparoscopic Instruments  
*Tamara Carolina de Camargo, Alda Graciele Claudio dos Santos Almeida, Camila Quartim de Moraes Bruna, Caroline Lopes Ciofi-Silva, Flávia Moraes Gomes Pinto and Kazuko Uchikawa Graziano*
- 64 The Value of Electronically Extracted Data for Auditing Outpatient Antimicrobial Prescribing  
*Daniel J. Livorsi, Carrie M. Linn, Bruce Alexander, Brett H. Heintz, Traviss A. Tubbs and Eli N. Perencevich*
- 71 Do Experts Understand Performance Measures? A Mixed-Methods Study of Infection Preventionists  
*Sushant Govindan, Beth Wallace, Theodore J. Iwashyna and Vineet Chopra*
- 77 Reducing Inappropriate Urinary Catheter Use in the Emergency Department: Comparing Two Collaborative Structures  
*M. Todd Greene, Mohamad G. Fakh, Sam R. Watson, David Ratz and Sanjay Saint*

## Guideline

- 85 Israeli National Policy for Carbapenem-Resistant Enterobacteriaceae Screening, Carrier Isolation and Discontinuation of Isolation  
*Ester Solter, Amos Adler, Bina Rubinovitch, Elizabeth Temkin, David Schwartz, Debby Ben-David, Samira Masarwa, Yehuda Carmeli and Mitchell J. Schwaber*

**Cover image: A replica of the original 1854 Broad Street Pump has stood at the corner of Broadwick and Lexington Streets in Soho, London since 1992. The John Snow Pub can be seen in the background. Image “John Snow memorial and pub,” copyright Justinc - made available under a Creative Commons Attribution-Share Alike 2.0 Generic license.**

### Concise Communications

- 90 Prevalence of MRSA ST398 Carriage in Nursing Home Residents in an Area of Spain With a High Density of Pig Farming  
*Esteban Reynaga, Carmen Torres, Marian Garcia-Nuñez, Marian Navarro, Anna Vilamala, Emma Puigoriol, Gianni Enrico Lucchetti, Daniella Nunes, Adriana Silva and Miquel Sabrià*
- 94 Relative Resistance of the Emerging Fungal Pathogen *Candida auris* and Other *Candida* Species to Killing by Ultraviolet Light  
*Jennifer L. Cadnum, Aaron A. Shaikh, Christina T. Piedrahita, Annette L. Jencson, Emily L. Larkin, Mahmoud A. Ghannoum and Curtis J. Donskey*
- 97 A Randomized Trial of Two Cover Gowns Comparing Contamination of Healthcare Personnel During Removal of Personal Protective Equipment  
*Thriveen S. C. Mana, Myreen E. Tomas, Jennifer L. Cadnum, Annette L. Jencson, Christina T. Piedrahita and Curtis J. Donskey*
- 101 Direct Costs of a Contact Isolation Day: A Prospective Cost Analysis at a Swiss University Hospital  
*Jan A. Roth, Claudia Hornung-Winter, Isabel Radicke, Balthasar L. Hug, Monika Biedert, Christian Abshagen, Manuel Battegay and Andreas F. Widmer*
- 104 Fit Characteristics of N95 Filtering Facepiece Respirators and the Accuracy of the User Seal Check among Koreans  
*Yu Jung Huh, Hye Min Jeong, Juhye Lim, Ha Yan Park, Min Young Kim, Hong Sang Oh and Kyungmin Huh*
- 108 Water Cultures Are More Sensitive Than Swab Cultures for the Detection of Environmental *Legionella*  
*Brooke K. Decker, Patricia L. Harris, Diana L. Toy, Robert R. Muder, Ali F. Sonel and Cornelius J. Clancy*
- 111 Accuracy of Provider-Selected Indications for Antibiotic Orders  
*Emily L. Heil, Lisa Pineles, Poonam Mathur, Daniel J. Morgan, Anthony D. Harris, Arjun Srinivasan and Kerri A. Thom, and the CDC Prevention Epicenters*

### Research Brief

- 114 Environmental Cleaning of Outpatient Exam Rooms: How Frequent is Enough?  
*Shela Sridhar, Mary Beth Graham, Sabrina Savage-Taft, John Fangman and L. Silvia Munoz-Price*

### Letters to the Editor

- 116 Risk Factors for Extended-Spectrum Beta-Lactamase-Producing *Enterobacteriaceae* Carriage Upon Pediatric Intensive Care Unit Admission  
*David X. Li, Anna C. Sick-Samuels, Nuntra Suwantararat, Rebecca G. Same, Patricia J. Simner and Pranita D. Tamma*
- 118 Colistin-Resistant *Klebsiella* Infections Among Pediatric Oncology and Hematopoietic Stem Cell Transplantation Patients in Eastern India  
*Mammen Chandy, Anirban Das, Arpita Bhattacharyya, Sudeep Banerjee, Kingshuk Dhar, Gaurav Goel and Sanjay Bhattacharya*
- 121 Coordination of Infection Control Activities at the Healthcare System Level: Survey Results  
*Julie Jefferson and Leonard A. Mermel*
- 122 Adherence to Central-Line Insertion Practices (CLIP) with Peripherally Inserted Central Catheters (PICC) and Central Venous Catheters (CVC): A Prospective Study of 50 Hospitals in China  
*Wensen Chen, Yiqun Yang, Huifen Li, Xiaoqiang Huang and Weihong Zhang*
- 124 The Need for Rotavirus Vaccine Introduction in the National Immunization Program of More Than 100 Countries around the World  
*Manoochehr Karami and Zeinab Berangi*

*An Official Publication of the Society for Healthcare Epidemiology of America*

## EDITOR

Suzanne F. Bradley, MD • Ann Arbor, MI

## DEPUTY EDITOR

Carol Chenoweth, MD • Ann Arbor, MI

## SENIOR ASSOCIATE EDITORS

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

## ASSOCIATE EDITORS

David P. Calfee, MD, MS • New York, NY  
Lindsay E. Nicolle, MD • Winnipeg, Manitoba  
Trevor C. Van Schooneveld, MD • Omaha, NE  
David Weber, MD, MPH • Chapel Hill, NC

## STATISTICS CONSULTANTS

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

## MANAGING EDITOR

Sara Marcus • 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  
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. Hensel, MD • Brea, CA  
John A. Jernigan, MD, MS • Atlanta, GA  
Mini Kamboj, MD • New York, NY

Carol A. Kauffman, MD • Ann Arbor, MI  
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. Sehulster, 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: [iche.managingeditor@cambridge.org](mailto:iche.managingeditor@cambridge.org)). 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](mailto: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](mailto: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](http://www.cambridge.org/about-us/rights-permissions).

## Subscriptions

The individual subscription rate for 2018 is \$260. 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: [cambridge.org/ICHE](http://cambridge.org/ICHE).

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



Since 2015, the cover format of each volume of *Infection Control & Hospital Epidemiology* has been designed to honor one of the many professionals throughout history who not only recognized how disease might be spread but also how to apply those principles to reduce healthcare-associated infections.

John Snow (1813–1858) was 1 of 9 children born to a working-class family in York, England. At the age of 14, he was apprenticed as a surgeon-apothecary with a family friend in Newcastle. He was sent to tend the afflicted in a nearby mining town during a cholera outbreak in 1832. He pursued his medical degree at the University of London, with the sponsorship of a wealthy uncle, and he initially set up a general practice in Soho. He gained fame as a practitioner of the new discipline of anesthesia and tended to Queen Victoria during the births of her children.

On August 24, 1854, a baby died of cholera on Broad Street near Soho. Shortly thereafter, 700 deaths from cholera occurred within a radius of 250 yards, and Snow happened to live nearby. As an anesthetist, he recognized how gases dissipated, and he rejected the prevailing dogma that cholera was spread through the inhalation of atmospheric vapors from decaying material because it would not explain how patients were affected miles away from the source. Snow hypothesized that water, contaminated with some cholera agent in feces, was the more likely explanation.

Using epidemiological principles, he identified who was affected using death certificates and where the illness was acquired (e.g., where case patients lived), then he determined what water supply they had used. He discovered that most households with a cholera case obtained water from the Broad Street pump. Snow ordered that the pump handle be removed. A local curate, Henry Whitehead, initially sought to disprove Snow's suspicions through further surveillance. Instead, Whitehead found that 8-fold more case patients had drunk from the pump than had not. Furthermore, he revealed that deaths occurred more often among residents who resided closest to the pump than in houses located farther away or that used a different water source. Ultimately, a leak between the Broad Street pump and a neighboring cesspool was discovered.

John Snow continued to carefully study the relationship between water contamination and cholera. Unfortunately, his work in epidemiology was ignored or pilloried in editorials in major journals. Snow would not live long enough to be recognized as a founder of modern epidemiology; he died of "apoplexy" or stroke at the age of 45 years. The John Snow Inn and a replica of the Broad Street pump can still be found in what is now called Broadwick Street in Soho, central London.

---

**Cover image: A replica of the original 1854 Broad Street Pump has stood at the corner of Broadwick and Lexington Streets in Soho, London since 1992. The John Snow Pub can be seen in the background. Image "John Snow memorial and pub," copyright Justinc - made available under a Creative Commons Attribution-Share Alike 2.0 Generic license.**