SHEA
The Society for Healthcare Epidemiology of America

Infection Control & Hospital Epidemiology

Volume 39, No 7

ICHE



JOHN SNOW & THE BROAD STREET PUMP

JULY 2018

CAMBRIDGE UNIVERSITY PRESS

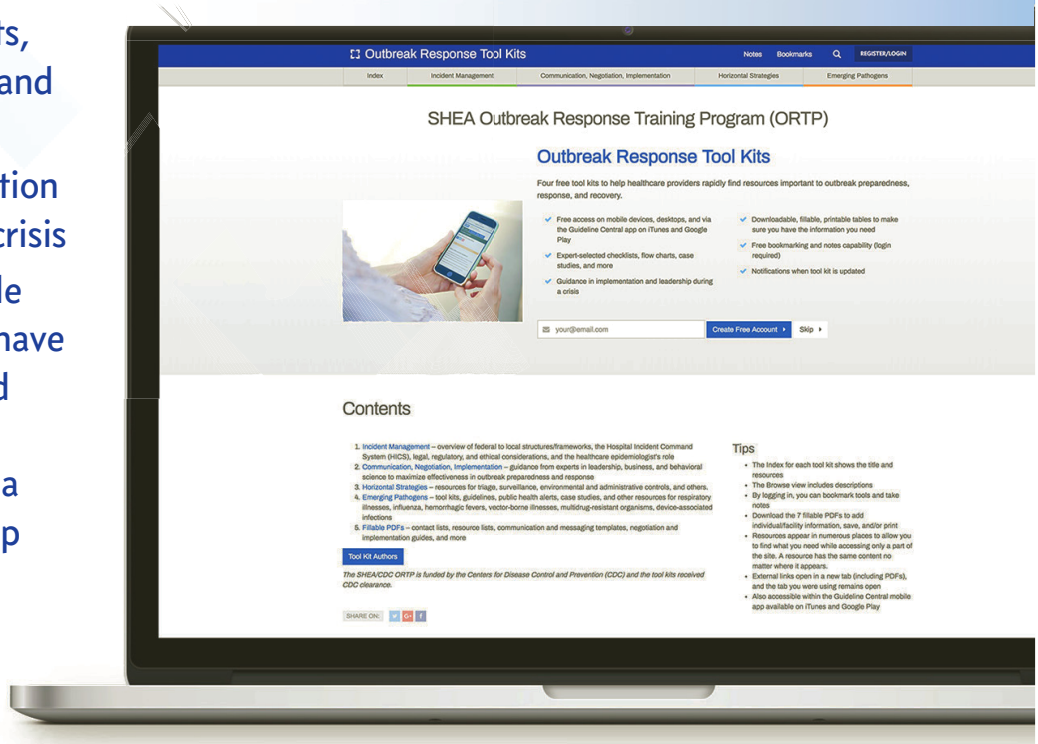
https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press

SHEA
The Society for Healthcare Epidemiology of America

OUTBREAK RESPONSE TOOL KITS

The SHEA/CDC Outbreak Response Training Program (ORTP) tool kits are your source for quick, concise information and resources to help you and your facility effectively manage outbreaks.

- Expert-selected checklists, flow charts, summaries, and diagrams
- Guidance in implementation and leadership during a crisis
- Downloadable and fillable tables to make sure you have the information you need
- Free access on mobile devices, desktops, and via the Guideline Central app
- And more...



View the tool kits online

ORTP.GuidelineCentral.com

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press

Infection Control & Hospital Epidemiology

Volume 39 2018 Number 7

CONTENTS

Original Articles

765 Effectiveness of Probiotic for Primary Prevention of *Clostridium difficile* Infection: A Single-Center Before-and-After Quality Improvement Intervention at a Tertiary-Care Medical Center
William E. Trick, Stephen J. Sokalski, Stuart Johnson, Kristen L. Bunnell, Joseph Levato, Michael J. Ray and Robert A. Weinstein

771 Microbial Preparations (Probiotics) for the Prevention of *Clostridium difficile* Infection in Adults and Children: An Individual Patient Data Meta-analysis of 6,851 Participants
Bradley C. Johnston, Lyubov Lytvyn, Calvin Ka-Fung Lo, Stephen J. Allen, Duolao Wang, Hania Szajewska, Mark Miller, Stephan Ehrhardt, John Sampalis, Deniz G. Duman, Pietro Pozzoni, Agostino Colli, Elisabet Lönnermark, Christian P. Selinger, Samford Wong, Susan Plummer, Mary Hickson, Ruzha Pancheva, Sandra Hirsch, Bengt Klarin, Joshua Z Goldenberg, Li Wang, Lawrence Mbuagbaw, Gary Foster, Anna Maw, Behnam Sadeghirad, Lehana Thabane and Dominik Mertz

782 High Prevalence and Frequent Acquisition of *Clostridium difficile* Ribotype 002 Among Nursing Home Residents in Hong Kong
Shik Luk, Alex Yat Man Ho, Eliza Hoi Ying Chan, Iris Hoi Ling Tsang, Tak Keung Ng, Wing Kin To, Kin Wing Choi and Andrew Tin Yau Wong

788 Noninfectious Hospital Adverse Events Decline After Elimination of Contact Precautions for MRSA and VRE
Elise M. Martin, Brandy Bryant, Tristan R. Grogan, Zachary A. Rubin, Dana L. Russell, David Elashoff and Daniel Z. Uslan

797 Hospital-Level Variability in Broad-Spectrum Antibiotic Use for Children With Acute Leukemia Undergoing Hematopoietic Cell Transplantation
Caitlin W. Elgarten, Staci D. Arnold, Yimei Li, Yuan-Shung V. Huang, Marcie L. Riches, Jeffrey S. Gerber, Richard Aplenc, Wael Saber and Brian T. Fisher

806 Predictors of Antimicrobial Stewardship Program Recommendation Disagreement
Laura L. Bio, Jenna F. Kruger, Betty P. Lee, Matthew S. Wood and Hayden T. Schwenk

814 Modified Reporting of Positive Urine Cultures to Reduce Inappropriate Treatment of Asymptomatic Bacteriuria Among Nonpregnant, Noncatheterized Inpatients: A Randomized Controlled Trial
Peter Daley, David Garcia, Raheel Inayatullah, Carla Penney and Sarah Boyd

820 Assessing a National Collaborative Program To Prevent Catheter-Associated Urinary Tract Infection in a Veterans Health Administration Nursing Home Cohort
Sarah L. Krein, M. Todd Greene, Beth King, Deborah Welsh, Karen E. Fowler, Barbara W. Trautner, David Ratz, Sanjay Saint, Gary Roselle, Marla Clifton, Stephen M. Kralovic, Tina Martin and Lona Mody

826 Real-Time, Automated Detection of Ventilator-Associated Events: Avoiding Missed Detections, Misclassifications, and False Detections Due to Human Error
Erica S. Shenoy, Eric S. Rosenthal, Yu-Ping Shao, Siddharth Biswal, Manohar Ghanta, Erin E. Ryan, Dolores Suslak, Nancy Swanson, Valdery Moura Junior, David C. Hooper and M. Brandon Westover

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.

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press

834 Different Types of Heater-Cooler Units and Their Risk of Transmission of *Mycobacterium chimaera* During Open-Heart Surgery: Clues From Device Design
Richard Kuehl, Florian Banderet, Adrian Egli, Peter M. Keller, Reno Frei, Thomas Döbele, Friedrich Eckstein and Andreas F. Widmer

841 Barriers and Facilitators to Injection Safety in Ambulatory Care Settings
Claire Leback, Diep Hoang Johnson, Laura Anderson, Kelli Rogers, Daniel Shirley and Nasia Safdar

849 *Commentary*: Human Factors and Systems Engineering: The Future of Infection Prevention?
Priti R. Patel and Alexander J. Kallen

852 An Outbreak of *Streptococcus pyogenes* in a Mental Health Facility: Advantage of Well-Timed Whole-Genome Sequencing Over *emm* Typing
Sarah M. Bergin, Balamurugan Periaswamy, Timothy Barkham, Hong Choon Chua, Yee Ming Mok, Daniel Shuen Sheng Fung, Alex Hsin Chuan Su, Yen Ling Lee, Ming Lai Ivan Chua, Poh Yong Ng, Wei Jia Wendy Soon, Collins Wenhan Chu, Siyun Lucinda Tan, Mary Meehan, Brenda Sze Peng Ang, Yee Sin Leo, Matthew T. G. Holden, Partha De, Li Yang Hsu, Swaine L. Chen, Paola Florez de Sessions and Kalisvar Marimuthu

Commentary

861 More Than a Cold: Hospital-Acquired Respiratory Viral Infections, Sick Leave Policy, and A Need for Culture Change
Eric J. Chow and Leonard A. Mermel

Concise Communications

863 Clinical Characteristics and Outcomes of Hematologic Malignancy Patients With Positive *Clostridium difficile* Toxin Immunoassay Versus Polymerase Chain Reaction Test Results
Matthew Ziegler, Daniel Landsburg, David Pegues, Kevin Alby, Cheryl Gilmar, Kristen Bink, Theresa Gorman, Amy Moore, Brittaney Bonhomme, Jacqueline Omorogbe, Dana Tango, Pam Tolomeo and Jennifer H. Han

867 The Perils of Multiplex Gastrointestinal Pathogen Panels: Pseudo-outbreaks of Salmonellae and *Entamoeba histolytica* in Immunocompromised Hosts
Elizabeth Robilotti, Eleanor Powell, Shauna Usiak, Ying Taur, N. Esther Babady and Mini Kamboj

871 Blood Stream Infection in Patients on Venovenous Extracorporeal Membrane Oxygenation for Respiratory Failure
Soo Jin Na, Chi Ryang Chung, Hee Jung Choi, Yang Hyun Cho, Jeong Hoon Yang, Gee Young Suh and Kyeongman Jeon

875 The Risk of Adverse Events Related to Extended-Dwell Peripheral Intravenous Access
Sara Campagna, Silvia Gonella, Pietro Antonio Zerla, Gianvito Corona, Tiziana Correggia, Baudolino Mussa, Paola Berchialla and Valerio Dimonte

878 The Impact of 2015 NHSN Catheter-associated Urinary Tract Infection (CAUTI) Definition Change on Central Line-associated Bloodstream Infection (CLABSI) Rates and CLABSI Prevention Efforts at an Academic Medical Center
Sonali D. Advani, Rachael A. Lee, Martha Long, Mariann Schmitz and Bernard C. Camins

Research Briefs

881 Outbreak of Hepatitis A Virus Infection Among Adult Patients of a Mental Hospital — Los Angeles County, 2017
Curtis Croker, Susan Hathaway, Amy Marutani, Margilane Hernandez, Crystal Cadavid, Shobita Rajagopalan, Bessie Hwang and Moon Kim

882 Association of an Active Surveillance and Decolonization Program on Incidence of Clinical Cultures Growing *Staphylococcus aureus* in the Neonatal Intensive Care Unit
Annie Voskertchian, Ibukunoluwa C. Akinboyo, Elizabeth Colantuoni, Julia Johnson and Aaron M. Milstone

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press

884 Comparison of Two Glove-Sampling Methods to Discriminate Between Study Arms of a Hand Hygiene and Glove-Use Study
Gwen L. Robinson, Linda Otieno, J. Kristie Johnson, Laura J. Rose, Anthony D. Harris, Judith Noble-Wang and Kerri A. Thom, for the CDC Epicenter Prevention Program

Letters to the Editor

886 Impact of 2018 Changes in National Healthcare Safety Network Surveillance for *Clostridium difficile* Laboratory-Identified Event Reporting
Alexandre R. Marra, Michael B. Edmond, Bradley A. Ford, Loreen A. Herwaldt, Abdullah R. Algwizani and Daniel J. Diekema

888 What Really Works for Scope Reprocessing?
Neha Nanda, Preciosa Marasigan, Stephanie Hall and Evan Mosier

889 Do Periarticular Joint Injections Present an Increase in Infection Risk?
Jessica Seidelman, Arthur W. Baker, Deverick J. Anderson, Daniel J. Sexton and Sarah S. Lewis

Corrigenda

892 Do Periarticular Joint Injections Present an Increase in Infection Risk? – CORRIGENDUM

893 Improved Outcomes When Antibiotic Prescribing Guidelines Are Followed by Healthcare Providers: A Colombian Example to Encourage Adherence in Hospital Settings – CORRIGENDUM

894 Microbial Preparations (Probiotics) for the Prevention of *Clostridium difficile* Infection in Adults and Children: An Individual Patient Data Meta-analysis of 6,851 Participants – CORRIGENDUM

Erratum

895 Outbreak of Hepatitis A Virus Infection Among Adult Patients of a Mental Hospital—Los Angeles County, 2017 – ERRATUM

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY

cambridge.org/ICHE

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 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
Gennifer Levey • 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 Fakih, 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 Haiduven, 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. Heseltine, 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. 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 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.

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:



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.

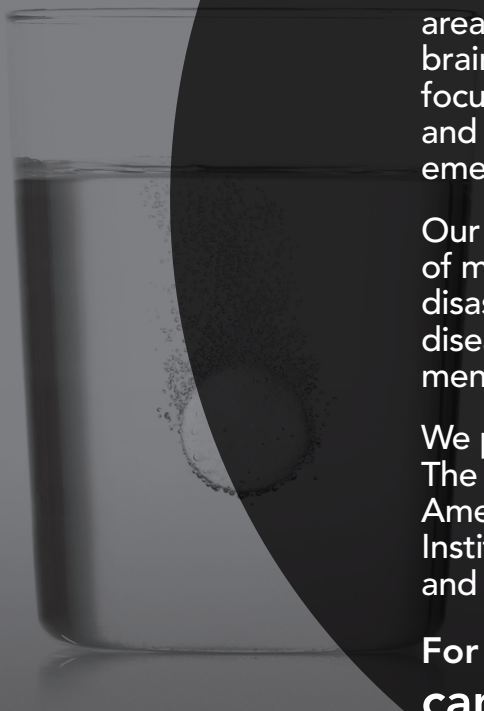
On August 24, 1854, a baby died of cholera on Broad Street near Soho. Shortly thereafter, 700 deaths from cholera occurred within a radius of 250 yards, and Snow happened to live nearby. As an anesthetist, he recognized how gases dissipated, and he rejected the prevailing dogma that cholera was spread 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.

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press



Medicine

Books and Journals from Cambridge University Press

The Cambridge Medicine programme focuses its book publishing in a defined set of core clinical areas with our great strength in the clinical brain sciences. Other specialties of significant focus include reproductive medicine/obstetrics and gynaecology, anaesthesia and critical care, emergency medicine and pathology.

Our journals programme covers a broad spectrum of medical disciplines including emergency and disaster medicine, epidemiology and infectious diseases, biomedical science, genetics, nutrition, mental health and psychiatry, and neuroscience.

We partner with many learned societies including The Society for Healthcare Epidemiology of America, and the Neuroscience Education Institute, and the Royal College of Obstetricians and Gynaecologists.

For further details visit:

cambridge.org/core-medicine

Cambridge Core

CAMBRIDGE UNIVERSITY PRESS

https://doi.org/10.1017/ice.2018.140 Published online by Cambridge University Press