"All-Time Top" Infection Control Literature part 2

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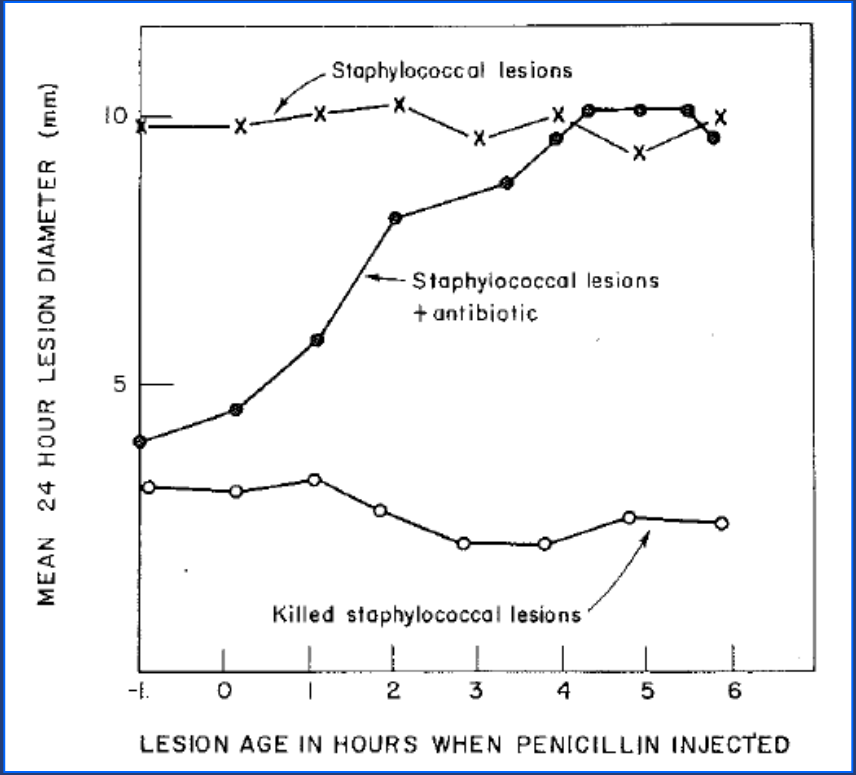
Disclosures: Sage Inc (Remote) & CDC (Current) Funding

Topics

1. Antimicrobial Resistance
2. Key Epidemiologic Risk Factors
3. Five General Control Measures
4. Surgical Site Infection Control
5. Device-associated Infection Control
6. Major Outbreaks
7. Quality Improvement
8. Statistics and Modeling
9. Molecular Advances
10. The Microbiome

The effective period of preventive antibiotic action in experimental incisions and dermal lesions

JOHN F. BURKE, M.D.
BOSTON, MASS.
From the Department of Surgery, Harvard Medical School, and the Surgical Services, Massachusetts General Hospital

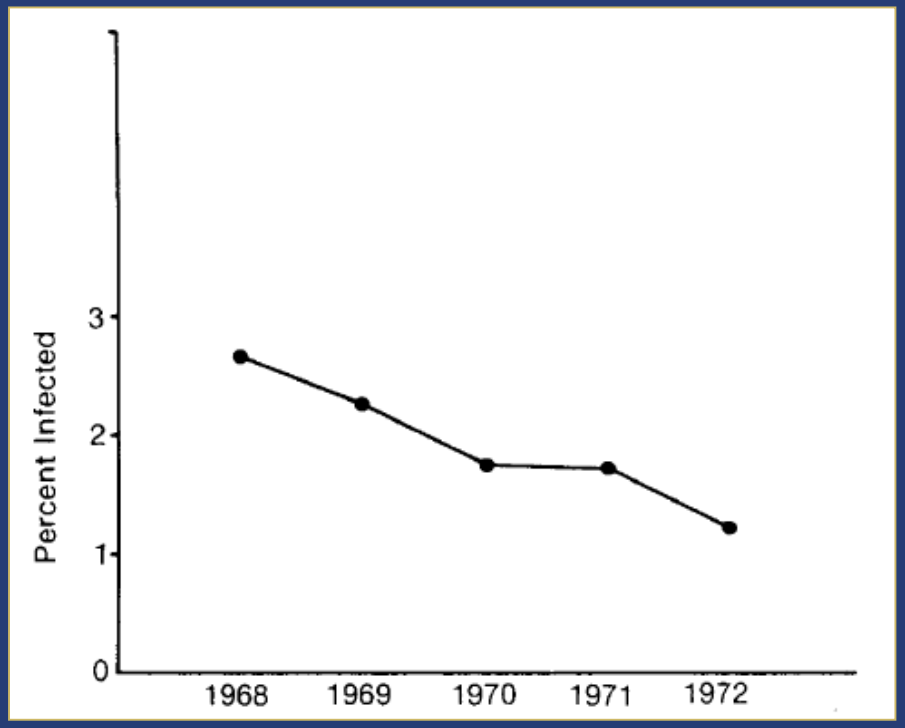


Decreasing effect of penicillin on lesion diameter as lesion age on penicillin injection increases

Burke, *Surgery* 1961; 50:161-8

A Five-Year Prospective Study of 23,649 Surgical Wounds — Introduces Public Reporting

(1) Graph indication the clean-wound infection rate and the overall infection rate is posted in the operating room and in all the surgical and gynecological wards
(2) Wound infection rate for various departments are discussed at monthly departmental business meetings
(3) A detailed analysis of the wounds that became infected during the previous months published and displayed on notice boards in the hospital and discussed at the infection control committee meetings
(4) Every surgeon receives a six-month computer report with a note stating his own, his/her department's and the hospital's clean and overall infection rates



Steady fall in clean-wound infection rate demonstrated during five-year study

Cruse & Foord, *Arch Surg* 1973; 107:206-10

Other Surgical Wound Infection Prevention Interventions

The Influence of ultraviolet irradiation of the operating room and of various other factors, *Ann Surg* 1964

Kurz et al, Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization, *N Engl J Med* 1996

Furnary et al, Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiac surgical procedures, *Ann Thorac Surg* 1999

Greif et al, Supplemental perioperative oxygen to reduce the incidence of surgical-wound infection, *N Engl J Med* 2000

Brandt et al, Operating room ventilation with laminar airflow shows no protective effect on the surgical site infection rate in orthopedic and abdominal surgery, *Ann Surg* 2008

Bode et al, Preventing surgical-site infections in nasal carriers of *Staphylococcus aureus*, *N Engl J Med* 2010

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A Basic Question for Device-related Infections – Technologic Fixes?

Do We Need Technology to Trump Bad Behavior?

If you had to change human behavior
(e.g., improve attention to hygiene and asepsis)

or

Design a more "fool-proof" device. . .

WHAT IS THE ROLE OF INFECTION CONTROL AND WHAT IS THE ROLE OF DEVICES AND TOPICAL ANTISEPTICS?

Do We Need Randomized Trials?

Charles Frederick Mosteller (1916-2006)
Leading statistician and pioneer of evidence based medicine

"Mosteller would insist that if you did something other than a randomised controlled trial when you were looking into something, you weren't experimenting with people, you were fooling around with people."

Oransky, *Lancet* 2006; 368:1062

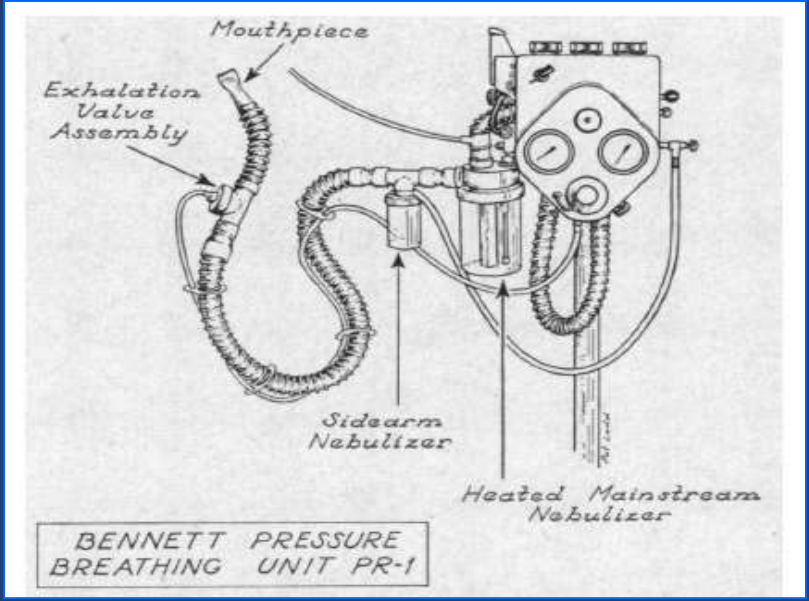
A Study of Antibiotic Prophylaxis to Prevent Pneumonia in Patients with Acute Heart Failure

- 150 patients over 7 months with acute heart failure; randomized, double-blinded evaluation of oral chloramphenicol (72) vs placebo (78)
- Pneumonia (x-ray, clinical, &/or autopsy findings): 11% in chloro group vs 8% in placebo group
- Mortality: 29% in chloro group vs 22% in placebo group

Petersdorf and Merchant, *NEJM* 1959; 260:565-75

The Potential Role of Inhalation Therapy Equipment in Nosocomial Pulmonary Infection

Diagram of representative intermittent positive pressure machine illustrating model with reservoir nebulizer assembly



Appearance of contaminated aerosols in "clean" IPPB machines not used in patient care

Machine no.*	Bacterial counts at sequential time intervals†		
	0 hour	12–18 hours	24–36 hours
1	27	49	72
2	>2,500	>2,500	>2,500
3	1	8	88
4	2	>2,500	172
5	230	>2,500	>2,500
6		102	>2,500

* Samples obtained from four Bird respirators and two Bennett respirators.

† Bacterial counts expressed as number of viable 1.4- to 3.5-μ particles per 7.5 L of air.

Reinarz, et al, *J Clin Invest* 1965; 44(8):831-9

The New England
Journal of Medicine

Volume 306 JUNE 24, 1982 Number 25

CONTAMINATION OF MECHANICAL VENTILATORS WITH TUBING CHANGES EVERY 24 OR 48 HOURS

DONALD E. CRAVEN, M.D., MICHAEL G. CONNOLLY, JR., B.S., DEBORAH A. LICHTENBERG, R.N., PHILIP J. PRIMEAU, B.S., AND WILLIAM R. MCCABE, M.D.

Abstract We studied the contamination of ventilator circuits in order to assess the need for daily changes of tubing. Patients requiring continuous mechanical ventilation were randomly selected for tubing changes at 24 hours (Group 1) or at 48 hours (Group 2). Samples of inspiratory-phase gas from ventilators with standardized settings were cultured according to the tube-broth method of Edmondson and Sanford. The frequency of positive cultures from 128 ventilators in Group 1 (30 per cent) was not significantly different from that for 112 ventilators in Group 2 (32 per cent). Gram-negative bacteria were most frequently isolated from patient's sputum and ventilator inspiratory-phase gas, but no species predominated in either group of patients. Further studies performed with the Aerotest and Andersen air samplers confirmed that the levels of inspiratory-phase-gas contamination were low in both groups. In addition, quantitative analysis of colonization of the tubing demonstrated no significant increase in colonization between 24 and 48 hours. The absence of a significant difference in inspiratory-phase-gas contamination or tubing colonization suggests that ventilator tubing need be changed only every 48 hours. (N Engl J Med. 1982; 306:1505-9.)

Craven et al, *N Engl J Med* 1982; 306(25):1505-9

Comparison of 8 vs 15 Days of Antibiotic Therapy for Ventilator-Associated Pneumonia in Adults

A Randomized Trial

Jean Chastre, MD
Michel Wolff, MD
Jean-Yves Fagon, MD
Sylvie Chevret, MD
Franck Thomas, MD
Delphine Wermert, MD
Eva Clementi, MD
Jesus Gonzalez, MD
Dominique Jusserand, MD
Pierre Asfar, MD
Dominique Perrin, MD
Fabienne Fieux, MD
Sylvie Aubas, MD
for the PneumA Trial Group

Context The optimal duration of antimicrobial treatment for ventilator-associated pneumonia (VAP) is unknown. Shortening the length of treatment may help to contain the emergence of multiresistant bacteria in the intensive care unit (ICU).

Objective To determine whether 8 days is as effective as 15 days of antibiotic treatment of patients with microbiologically proven VAP.

Design, Setting, and Participants Prospective, randomized, double-blind (until day 8) clinical trial conducted in 51 French ICUs. A total of 401 patients diagnosed as having developed VAP by quantitative culture results of bronchoscopic specimens and who had received initial appropriate empirical antimicrobial therapy were enrolled between May 1999 and June 2002.

Intervention A total of 197 patients were randomly assigned to receive 8 days and 204 to receive 15 days of therapy with an antibiotic regimen selected by the treating physician.

Main Outcome Measures Primary outcome measures—death from any cause, microbiologically documented pulmonary infection recurrence, and antibiotic-free days—were assessed 28 days after VAP onset and analyzed on an intent-to-treat basis.

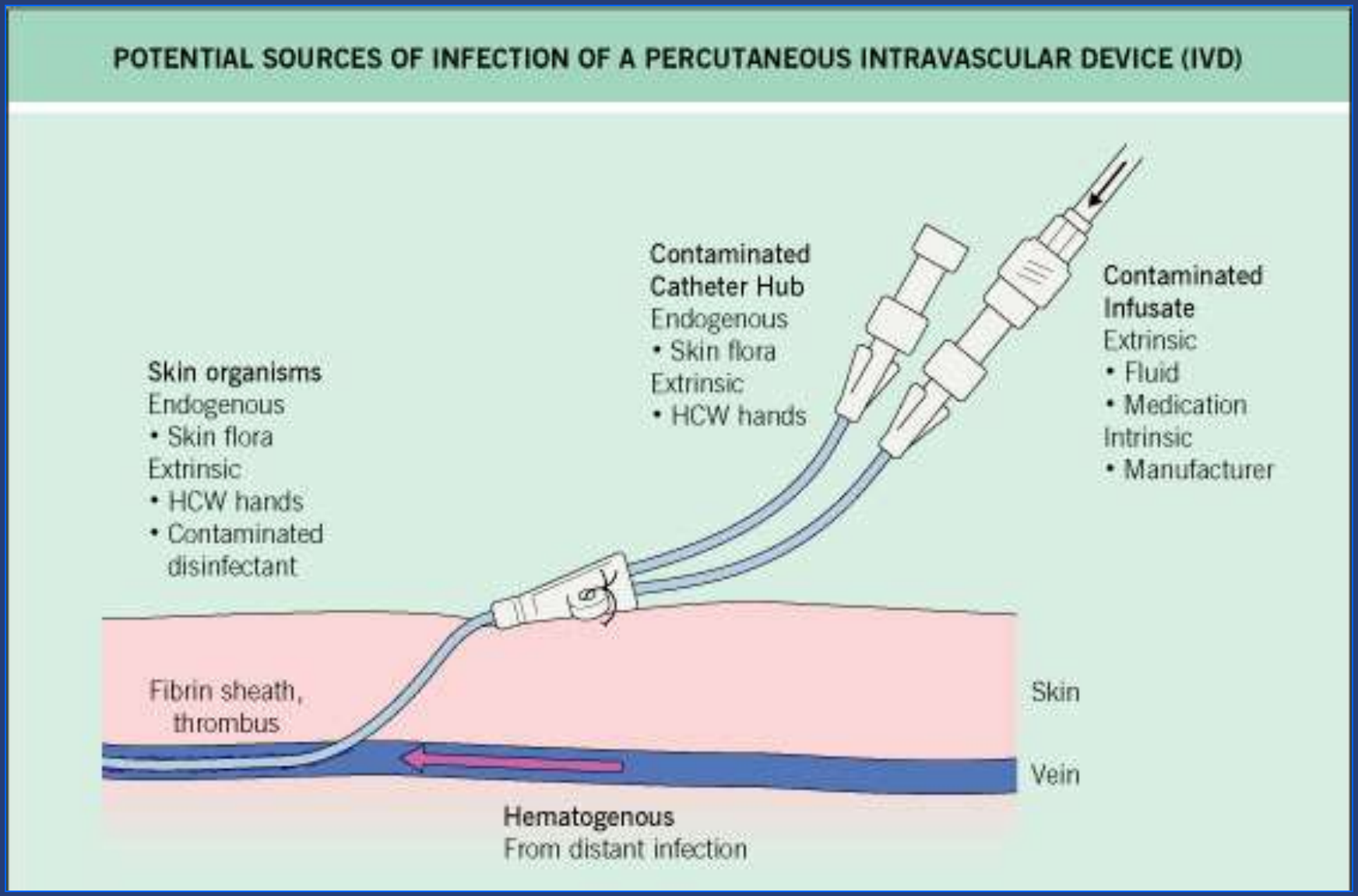
Results Compared with patients treated for 15 days, those treated for 8 days had neither excess mortality (18.8% vs 17.2%; difference, 1.6%; 90% confidence interval [CI], −3.7% to 6.9%) nor more recurrent infections (28.9% vs 26.0%; difference, 2.9%; 90% CI, −3.2% to 9.1%), but they had more mean (SD) antibiotic-free days (13.1 [7.4] vs 8.7 [5.2] days, $P<.001$). The number of mechanical ventilation–free days, the number of organ failure–free days, the length of ICU stay, and mortality rates on day 60 for the 2 groups did not differ. Although patients with VAP caused by nonfermenting gram-negative bacilli, including *Pseudomonas aeruginosa*, did not have more unfavorable outcomes when antimicrobial therapy lasted only 8 days, they did have a higher pulmonary infection-recurrence rate compared with those receiving 15 days of treatment (40.6% vs 25.4%; difference, 15.2%, 90% CI, 3.9%-26.6%). Among patients who developed recurrent infections, multiresistant pathogens emerged less frequently in those who had received 8 days of antibiotics (42.1% vs 62.0% of pulmonary recurrences, $P=.04$).

Conclusions Among patients who had received appropriate initial empirical therapy, with the possible exception of those developing nonfermenting gram-negative bacillus infections, comparable clinical effectiveness against VAP was obtained with the 8- and 15-day treatment regimens. The 8-day group had less antibiotic use.

JAMA. 2003;290:2588-2598 www.jama.com

HOSPITALS AND PARTICULARLY intensive care units (ICUs) are faced with the emergence and rapid dissemination of multiresistant bacteria.[1-4] In some cases, the choice of potential therapies is limited or even nonexistent.[5-8] The response to this challenge lies in a policy of prevention and better utilization of antimicrobial therapy, notably shortening the duration and decreasing the number of antibiotics given to ICU patients to contain the emergence and dissemination of such pathogens.[3,9-12] Because of its frequency and severity,[13,14] nosoco-

Chastre et al, *JAMA* 2003; 290:2588-98



Potential sources of infection of a percutaneous intravascular device (IVD). These include contiguous skin flora, contamination of the catheter hub and lumen, contamination of infusate and hematogenous colonization of the IVD from distant, unrelated sites of infection. HCW, health care worker.

Adapted from Crnich & Maki, *Clin Infect Dis* 2002; 34:1232-4

CDC/HICPAC IV Catheter Infection Prevention Guidelines Use this "Bundle" for a "Checklist"

- Education of personnel
- Is catheter needed?
- Avoid routine central line replacement as an infection control strategy
- Chlorhexidine skin prep (other uses of chlorhexidine?)
- Maximum barrier precautions
- Use of coated catheters (if after full implementation of above, goals are not met)

http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf
HICPAC, Healthcare Infection Control Practices Advisory Committee

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., and Christine Goeschel, R.N., M.P.A.

ABSTRACT

BACKGROUND

Catheter-related bloodstream infections occurring in the intensive care unit (ICU) are common, costly, and potentially lethal.

METHODS

We conducted a collaborative cohort study predominantly in ICUs in Michigan. An evidence-based intervention was used to reduce the incidence of catheter-related bloodstream infections. Multilevel Poisson regression modeling was used to compare infection rates before, during, and up to 18 months after implementation of the study intervention. Rates of infection per 1000 catheter-days were measured at 3-month intervals, according to the guidelines of the National Nosocomial Infections Surveillance System.

RESULTS

A total of 108 ICUs agreed to participate in the study, and 103 reported data. The analysis included 1981 ICU-months of data and 375,757 catheter-days. The median rate of catheter-related bloodstream infection per 1000 catheter-days decreased from 2.7 infections at baseline to 0 at 3 months after implementation of the study intervention ($P \leq 0.002$), and the mean rate per 1000 catheter-days decreased from 7.7 at baseline to 1.4 at 16 to 18 months of follow-up ($P < 0.002$). The regression model showed a significant decrease in infection rates from baseline, with incidence-rate ratios continuously decreasing from 0.62 (95% confidence interval [CI], 0.47 to 0.81) at 0 to 3 months after implementation of the intervention to 0.34 (95% CI, 0.23 to 0.50) at 16 to 18 months.

CONCLUSIONS

An evidence-based intervention resulted in a large and sustained reduction (up to 66%) in rates of catheter-related bloodstream infection that was maintained throughout the 18-month study period.

- *108 ICUs (Michigan)*
- *Studied up to 18 months*
- *375,757 Catheter-days*
- *Bundled intervention with Checklist*
- *Up to 66% decrease in Central Vascular Catheter Bloodstream Infection rates*
- *Median rate was ZERO after intervention*

Pronovost et al, *N Engl J Med* 2006; 355:2725-32

Effectiveness of Chlorhexidine Bathing to Reduce Catheter-Associated Bloodstream Infections in Medical Intensive Care Unit Patients

Susan C. Bleasdale, MD; William E. Trick, MD; Ines M. Gonzalez, MD; Rosie D. Lyles, MD; Mary K. Hayden, MD; Robert A. Weinstein, MD

Objective: To determine whether patients bathed daily with chlorhexidine gluconate (CHG) have a lower incidence of primary bloodstream infections (BSIs) compared with patients bathed with soap and water.

Methods: The study design was a 52-week, 2-arm, crossover (ie, concurrent control group) clinical trial with intention-to-treat analysis. The study setting was the 22-bed medical intensive care unit (MICU), which comprises 2 geographically separate, similar 11-bed units, of the John H. Stroger Jr (Cook County) Hospital, a 464-bed public teaching hospital in Chicago, Illinois. The study population comprised 836 MICU patients. During the first of 2 study periods (28 weeks), 1 hospital unit was randomly selected to serve as the intervention unit in which patients were bathed daily with 2% CHG-impregnated washcloths (Sage 2% CHG cloths; Sage Products Inc, Cary, Illinois); patients in the concurrent control unit were bathed daily with soap and water. After a 2-week washout period at the end of the first period, cleansing methods were crossed over for 24 more weeks. Main outcome measures included incidences of primary BSIs and clinical (culture-negative) sepsis (primary outcomes) and incidences of other infections (secondary outcomes).

Results: Patients in the CHG intervention arm were significantly less likely to acquire a primary BSI (4.1 vs 10.4 infections per 1000 patient days; incidence difference, 6.3 [95% confidence interval, 1.2-11.0). The incidences of other infections, including clinical sepsis, were similar between the units. Protection against primary BSI by CHG cleansing was apparent after 5 or more days in the MICU.

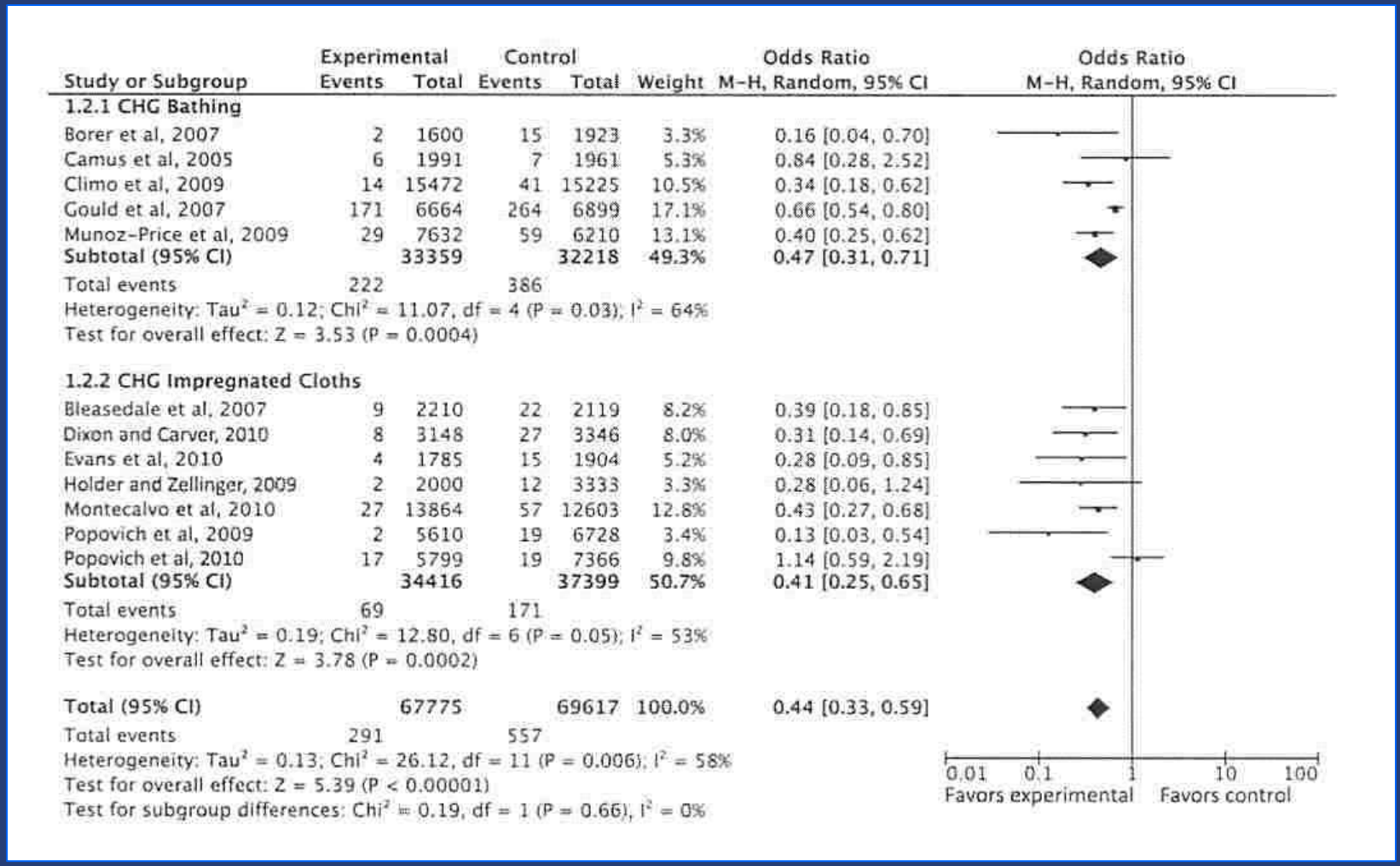
Conclusions: Daily cleansing of MICU patients with CHG-impregnated cloths is a simple, effective strategy to decrease the rate of primary BSIs.

Trial Registration: clinicaltrials.gov Identifier: NCT00130221

Arch Intern Med. 2007;167(19):2073-2079

Bleasdale et al, *Arch Intern Med* 2007; 167:2073-9

Risk of Healthcare-associated Bloodstream Infection with Chlorhexidine (CHG) Bathing — Meta-Analysis



Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
1.2.1 CHG Bathing						
Borer et al, 2007	2	1600	15	1923	3.3%	0.16 [0.04, 0.70]
Camus et al, 2005	6	1991	7	1961	5.3%	0.84 [0.28, 2.52]
Climo et al, 2009	14	15472	41	15225	10.5%	0.34 [0.18, 0.62]
Gould et al, 2007	171	6664	264	6899	17.1%	0.66 [0.54, 0.80]
Munoz-Price et al, 2009	29	7632	59	6210	13.1%	0.40 [0.25, 0.62]
Subtotal (95% CI)		**33359**		**32218**	**49.3%**	**0.47 [0.31, 0.71]**
Total events	222		386			
Heterogeneity: $Tau^2 = 0.12$; $Chi^2 = 11.07$, df = 4 (P = 0.03); $I^2 = 64\%$						
Test for overall effect: Z = 3.53 (P = 0.0004)						
1.2.2 CHG Impregnated Cloths						
Bleasedale et al, 2007	9	2210	22	2119	8.2%	0.39 [0.18, 0.85]
Dixon and Carver, 2010	8	3148	27	3346	8.0%	0.31 [0.14, 0.69]
Evans et al, 2010	4	1785	15	1904	5.2%	0.28 [0.09, 0.85]
Holder and Zellinger, 2009	2	2000	12	3333	3.3%	0.28 [0.06, 1.24]
Montecalvo et al, 2010	27	13864	57	12603	12.8%	0.43 [0.27, 0.68]
Popovich et al, 2009	2	5610	19	6728	3.4%	0.13 [0.03, 0.54]
Popovich et al, 2010	17	5799	19	7366	9.8%	1.14 [0.59, 2.19]
Subtotal (95% CI)		**34416**		**37399**	**50.7%**	**0.41 [0.25, 0.65]**
Total events	69		171			
Heterogeneity: $Tau^2 = 0.19$; $Chi^2 = 12.80$, df = 6 (P = 0.05); $I^2 = 53\%$						
Test for overall effect: Z = 3.78 (P = 0.0002)						
Total (95% CI)		**67775**		**69617**	**100.0%**	**0.44 [0.33, 0.59]**
Total events	291		557			
Heterogeneity: $Tau^2 = 0.13$; $Chi^2 = 26.12$, df = 11 (P = 0.006); $I^2 = 58\%$						
Test for overall effect: Z = 5.39 (P < 0.00001)						
Test for subgroup differences: $Chi^2 = 0.19$, df = 1 (P = 0.66), $I^2 = 0\%$						

O'Horo et al, *Infect Control Hosp Epidemiol* 2012;33(3):257-67

Targeted versus Universal Decolonization to Prevent ICU Infection

Susan S. Huang, M.D., M.P.H., Edward Septimus, M.D., Ken Kleinman, Sc.D., Julia Moody, M.S., Jason Hickok, M.B.A., R.N., Taliser R. Avery, M.S., Julie Lankiewicz, M.P.H., Adrijana Gombosev, B.S., Leah Terpstra, B.A., Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. Jernigan, M.D., Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherine Haffenreffer, B.S., Eric Cui, B.S., Rebecca E. Kaganov, B.A., Karen Lolans, B.S., Jonathan B. Perlin, M.D., Ph.D., and Richard Platt, M.D., for the CDC Prevention Epicenters Program and the AHRQ DECIDE Network and Healthcare-Associated Infections Program*

CONCLUSIONS

In routine ICU practice, universal decolonization was more effective than targeted decolonization or screening and isolation in reducing rates of MRSA clinical isolates and bloodstream infection from any pathogen. (Funded by the Agency for Healthcare Research and the Centers for Disease Control and Prevention; REDUCE MRSA ClinicalTrials.gov number, NCT00980980.)

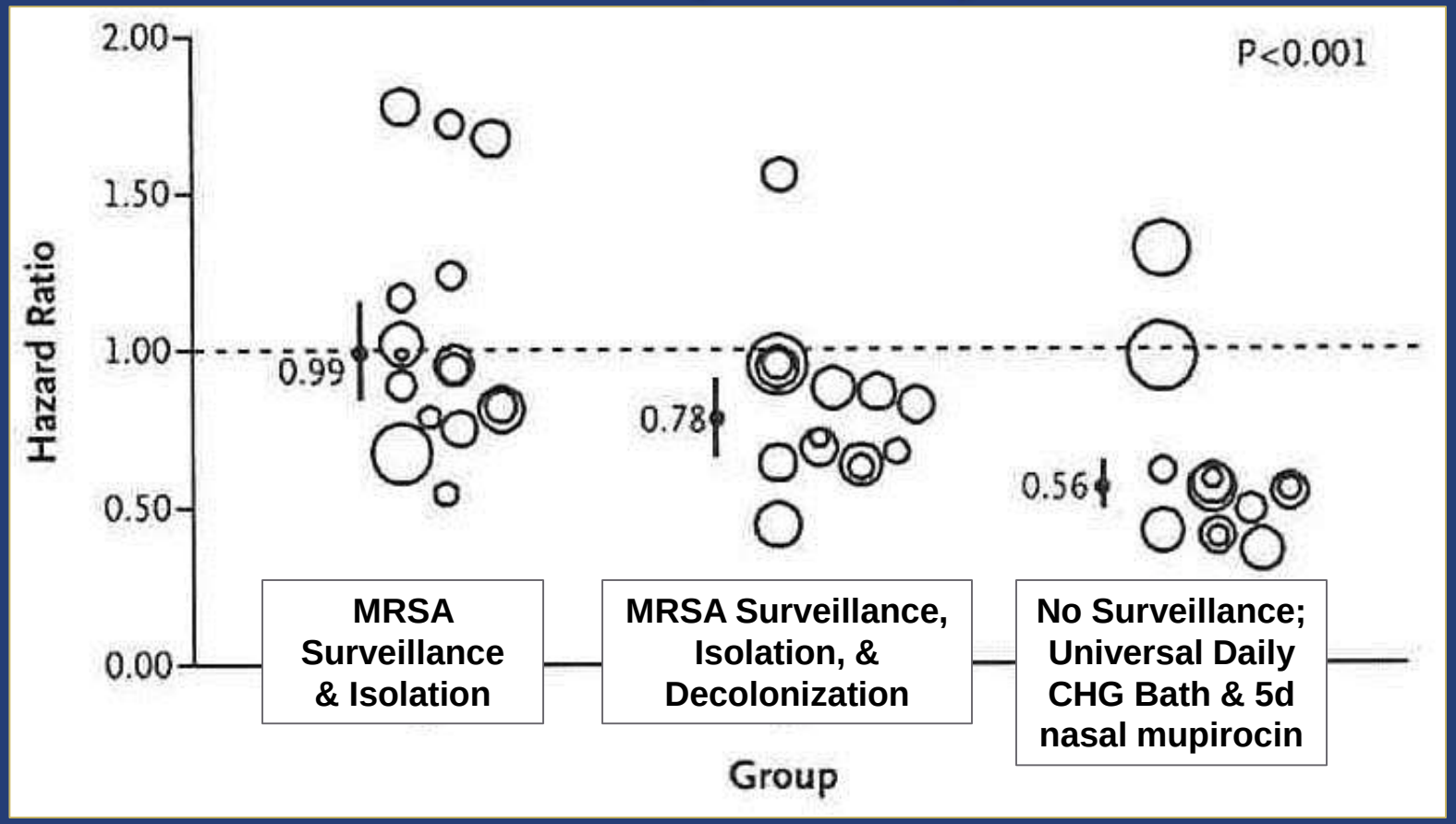
A total of 43 hospitals (including 74 ICUs and 74,256 patients during the intervention period) underwent randomization. In the intervention period versus the baseline period, modeled hazard ratios for MRSA clinical isolates were 0.92 for screening and isolation (crude rate, 3.2 vs. 3.4 isolates per 1000 days), 0.75 for targeted decolonization (3.2 vs. 4.3 isolates per 1000 days), and 0.63 for universal decolonization (2.1 vs. 3.4 isolates per 1000 days) ($P=0.01$ for test of all groups being equal). In the intervention versus baseline periods, hazard ratios for bloodstream infection with any pathogen in the three groups were 0.99 (crude rate, 4.1 vs. 4.2 infections per 1000 days), 0.78 (3.7 vs. 4.8 infections per 1000 days), and 0.56 (3.6 vs. 6.1 infections per 1000 days), respectively ($P<0.001$ for test of all groups being equal). Universal decolonization resulted in a significantly greater reduction in the rate of all bloodstream infections than either targeted decolonization or screening and isolation. One bloodstream infection was prevented per 54 patients who underwent decolonization. The reductions in rates of MRSA bloodstream infection were similar to those of all bloodstream infections, but the difference was not significant. Adverse events, which occurred in 7 patients, were mild and related to chlorhexidine.

CONCLUSIONS

In routine ICU practice, universal decolonization was more effective than targeted decolonization or screening and isolation in reducing rates of MRSA clinical isolates and bloodstream infection from any pathogen. (Funded by the Agency for Healthcare Research and the Centers for Disease Control and Prevention; REDUCE MRSA ClinicalTrials.gov number, NCT00980980.)

Huang et al, *N Engl J Med* 2013; 368(24):2255-65

Effect of Interventions on Bloodstream Infection from Any Pathogen



Shown are hazard ratios and 95% confidence intervals (vertical lines) for outcomes attributable to intensive care unit. Results based on unadjusted proportional-hazard models that accounted for clustering within hospitals. Bubble plots of hazard ratios (predicted random effects or exponentiated frailties) from individual hospitals relative to group effects are shown. Bubble size indicates relative number of patients contributing data to trial.

Huang et al, *N Engl J Med* 2013; 368(24):2255-65

Preventing Catheter-associated Urinary Tract Infections – Don't Open Closed Systems!

ANTIBIOTIC IRRIGATION AND CATHETER-ASSOCIATED URINARY-TRACT INFECTIONS

JOHN W. WARREN, M.D., RICHARD PLATT, M.D., ROBERT J. THOMAS, M.D., BERNARD ROSNER, PH.D., AND EDWARD H. KASS, M.D.

Abstract To investigate the efficacy of antibiotic irrigation in preventing catheter-associated urinary-tract infection, we carried out a randomized, controlled trial of a neomycin-polymyxin irrigant administered through closed urinary catheters. Eighteen of 98 (18 per cent) of the patients not given irrigation became infected, as compared with 14 of 89 (16 per cent) of those given irrigation, yielding a mean daily incidence of 5 per cent in each group. The distribution of organisms and their antibiotic sensitivities differed in the two groups, the organisms from the patients with irrigation being more resistant. Disconnections of the catheter junctions were associated with high rates of infection. The rate of disconnections of the junctions in the group given irrigation was almost twice that of the control group because of the presence of the extra junction used for irrigation. The lack of effect of irrigation on overall infection rate represents the result of two opposing phenomena: the increased entry of organisms and the suppression of a portion of them. (N Engl J Med 299:570-573, 1978)

Warren et al, *N Engl J Med* 1978; 299(11):570-3

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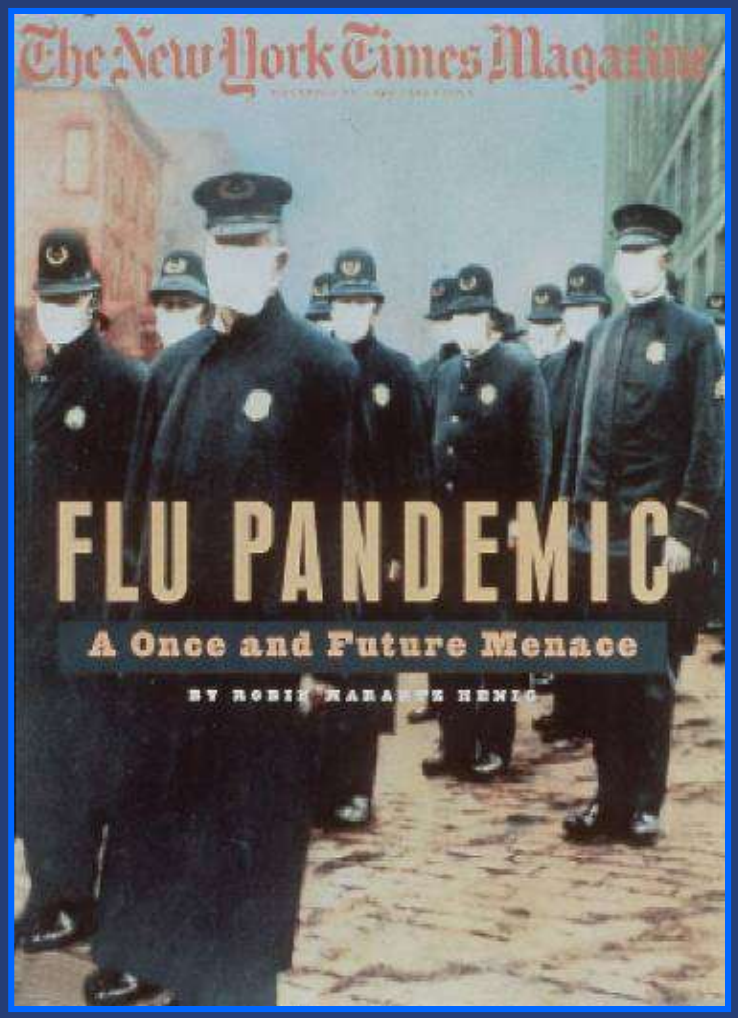
The H1N1 Influenza Pandemic of 1918-1919



- 25%-30% of world's population (~500 million people) fell ill
- >40 million deaths worldwide; ~60% in people ages 20-45
- >500,000 deaths in United States; 196,000 in October, 1918 alone

Heinig R, The Flu Pandemic, *New York Times Magazine*, November 29, 1992

The New England
Journal of Medicine

Volume 297 DECEMBER 1, 1977 Number 22

LEGIONNAIRES' DISEASE

Description of an Epidemic of Pneumonia

DAVID W. FRASER, M.D., THEODORE R. TSAI, M.D., WALTER ORENSTEIN, M.D., WILLIAM E. PARKIN, D.V.M., DR. P.H., H. JAMES BEECHAM, M.D., ROBERT G. SHARRAR, M.D., JOHN HARRIS, M.D., GEORGE F. MALLISON, M.P.H., STANLEY M. MARTIN, M.S., JOSEPH E. MCDADE, PH.D., CHARLES C. SHEPARD, M.D., PHILIP S. BRACHMAN, M.D., AND THE FIELD INVESTIGATION TEAM*

Abstract An explosive, common-source outbreak of pneumonia caused by a previously unrecognized bacterium affected primarily persons attending an American Legion convention in Philadelphia in July, 1976. Twenty-nine of 182 cases were fatal. Spread of the bacterium appeared to be air borne. The source of the bacterium was not found, but epidemiologic analysis suggested that exposure may have occurred in the lobby of the headquarters hotel or in the area immediately surrounding the hotel. Person-to-person spread seemed not to have occurred. Many hotel employees appeared to be immune, suggesting that the agent may have been present in the vicinity, perhaps intermittently, for two or more years. (N Engl J Med 297:1189-1197, 1977)

Fraser et al, *N Engl J Med* 1977; 297(22); 1189-1203

Blood-Borne Pathogens

TRANSFUSION-ASSOCIATED ACQUIRED IMMUNODEFICIENCY SYNDROME

Evidence for Persistent Infection in Blood Donors

PAUL M. FEORINO, PH.D., HAROLD W. JAFFE, M.D., ERSKINE PALMER, PH.D., THOMAS A. PETERMAN, M.D., DONALD P. FRANCIS, M.D., V.S. KALYANARAMAN, PH.D., ROBERT A. WEINSTEIN, M.D., RAND L. STONEBURNER, M.D., W. JAMES ALEXANDER, M.D., CATHY RAEVSKY, JANE P. GETCHELL, DR.P.H., DONNA WARFIELD, HARRY W. HAVERKOS, M.D., BARBARA W. KILBOURNE, M.P.H., J.K.A. NICHOLSON, PH.D., AND JAMES W. CURRAN, M.D.

Abstract To investigate whether infection with human T-cell lymphotropic virus/lymphadenopathy-associated virus (HTLV-III/LAV) may be persistent in asymptomatic persons and to correlate infection with seropositivity, we performed virologic and serologic studies in 25 of 30 persons who were identified as being at high risk for the acquired immunodeficiency syndrome (AIDS) and who had donated blood to patients who later contracted transfusion-associated AIDS. High-risk donors were those who belonged to a high-risk population, had AIDS or a closely related condition, or had a low ratio of helper to suppressor T lymphocytes. We performed similar studies in 6 of the 24 patients with AIDS who had received donations from this group. HTLV-III/LAV was isolated from 22 of the 25 donors, between 12 and 52 months (mean, 28) after they had donated blood, and from all 6 recipients, between 14 and 37 months (mean, 26) after they had received blood.

Of the 22 virus-positive donors, 2 have contracted AIDS, 5 have generalized lymphadenopathy, and 15 (68 per cent) remain asymptomatic. Antibodies to HTLV-III/LAV were detectable by the enzyme-linked immunosorbent assay in serum samples obtained from each person at the time the virus was isolated.

We conclude that infection with HTLV-III/LAV may be persistent and asymptomatic for years. This demonstration that viremic patients may be asymptomatic supports the use of serologic screening of donated blood to supplement current procedures for the prevention of transfusion-associated AIDS. (N Engl J Med 1985; 312: 1293-6.)

Feorino et al, *N Engl J Med* 1985; 312:1293-6.

Public Health Measures to Control the Spread of the Severe Acute Respiratory Syndrome during the Outbreak in Toronto

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ABSTRACT

BACKGROUND

Toronto was the site of North America's largest outbreak of the severe acute respiratory syndrome (SARS). An understanding of the patterns of transmission and the effects on public health in relation to control measures that were taken will help health officials prepare for any future outbreaks.

METHODS

We analyzed SARS case, quarantine, and hotline records in relation to control measures. The two phases of the outbreak were compared.

RESULTS

Toronto Public Health investigated 2132 potential cases of SARS, identified 23,103 contacts of SARS patients as requiring quarantine, and logged 316,615 calls on its SARS hotline. In Toronto, 225 residents met the case definition of SARS, and all but 3 travel-related cases were linked to the index patient, from Hong Kong. SARS spread to 11 (58 percent) of Toronto's acute care hospitals. Unrecognized SARS among inpatients with underlying illness caused a resurgence, or a second phase, of the outbreak, which was finally controlled through active surveillance of hospitalized patients. In response to the control measures of Toronto Public Health, the number of persons who were exposed to SARS in nonhospital and nonhousehold settings dropped from 20 (13 percent) before the control measures were instituted (phase 1) to 0 afterward (phase 2). The number of patients who were exposed while in a hospital ward rose from 25 (17 percent) in phase 1 to 68 (88 percent) in phase 2, and the number exposed while in the intensive care unit dropped from 13 (9 percent) in phase 1 to 0 in phase 2. Community spread (the length of the chains of transmission outside of hospital settings) was significantly reduced in phase 2 of the outbreak ($P<0.001$).

CONCLUSIONS

The transmission of SARS in Toronto was limited primarily to hospitals and to households that had had contact with patients. For every case of SARS, health authorities should expect to quarantine up to 100 contacts of the patients and to investigate 8 possible cases. During an outbreak, active in-hospital surveillance for SARS-like illnesses and heightened infection-control measures are essential.

Svoboda et al, *N Engl J Med* 2004;350:2352-2361

The Index Case for the Fungal Meningitis Outbreak in the United States

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SUMMARY

Persistent neutrophilic meningitis presents a diagnostic challenge, because the differential diagnosis is broad and includes atypical infectious causes. We describe a case of persistent neutrophilic meningitis due to *Aspergillus fumigatus* in an immunocompetent man who had no evidence of sinopulmonary or cutaneous disease. An epidural glucocorticoid injection was identified as a potential route of entry for this organism into the central nervous system, and the case was reported to the state health department.

Pettit et al, *N Engl J Med* 2012; 367(22):2119-25

Hospital Outbreak of Middle East Respiratory Syndrome Coronavirus

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ABSTRACT

BACKGROUND

In September 2012, the World Health Organization reported the first cases of pneumonia caused by the novel Middle East respiratory syndrome coronavirus (MERS-CoV). We describe a cluster of health care–acquired MERS-CoV infections.

METHODS

Medical records were reviewed for clinical and demographic information and determination of potential contacts and exposures. Case patients and contacts were interviewed. The incubation period and serial interval (the time between the successive onset of symptoms in a chain of transmission) were estimated. Viral RNA was sequenced.

RESULTS

Between April 1 and May 23, 2013, a total of 23 cases of MERS-CoV infection were reported in the eastern province of Saudi Arabia. Symptoms included fever in 20 patients (87%), cough in 20 (87%), shortness of breath in 11 (48%), and gastrointestinal symptoms in 8 (35%); 20 patients (87%) presented with abnormal chest radiographs. As of June 12, a total of 15 patients (65%) had died, 6 (26%) had recovered, and 2 (9%) remained hospitalized. The median incubation period was 5.2 days (95% confidence interval [CI], 1.9 to 14.7), and the serial interval was 7.6 days (95% CI, 2.5 to 23.1). A total of 21 of the 23 cases were acquired by person-to-person transmission in hemodialysis units, intensive care units, or in-patient units in three different health care facilities. Sequencing data from four isolates revealed a single monophyletic clade. Among 217 household contacts and more than 200 health care worker contacts whom we identified, MERS-CoV infection developed in 5 family members (3 with laboratory-confirmed cases) and in 2 health care workers (both with laboratory-confirmed cases).

CONCLUSIONS

Person-to-person transmission of MERS-CoV can occur in health care settings and may be associated with considerable morbidity. Surveillance and infection-control measures are critical to a global public health response.

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DOI: 10.1056/NEJMoa1306742

Assiri et al, *N Engl J Med* 2013; 369(5):407-16

Original Investigation

New Delhi Metallo-β-Lactamase–Producing Carbapenem-Resistant *Escherichia coli* Associated With Exposure to Duodenoscopes

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IMPORTANCE Carbapenem-resistant Enterobacteriaceae (CRE) producing the New Delhi metallo-β-lactamase (NDM) are rare in the United States, but have the potential to add to the increasing CRE burden. Previous NDM-producing CRE clusters have been attributed to person-to-person transmission in health care facilities.

OBJECTIVE To identify a source for, and interrupt transmission of, NDM-producing CRE in a northeastern Illinois hospital.

DESIGN, SETTING, AND PARTICIPANTS Outbreak investigation among 39 case patients at a tertiary care hospital in northeastern Illinois, including a case-control study, infection control assessment, and collection of environmental and device cultures; patient and environmental isolate relatedness was evaluated with pulsed-field gel electrophoresis (PFGE). Following identification of a likely source, targeted patient notification and CRE screening cultures were performed.

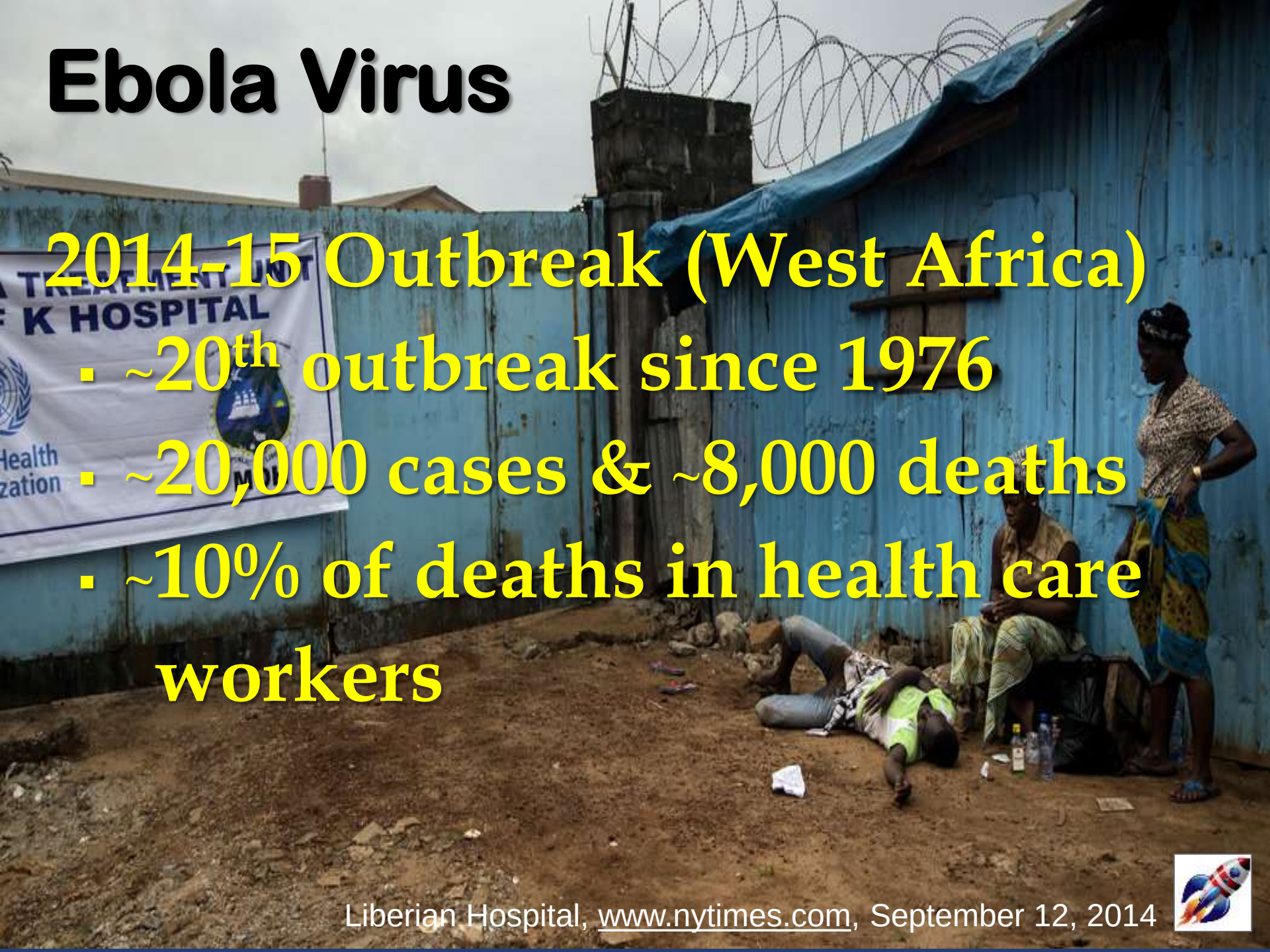
MAIN OUTCOMES AND MEASURES Association between exposure and acquisition of NDM-producing CRE; results of environmental cultures and organism typing.

RESULTS In total, 39 case patients were identified from January 2013 through December 2013, 35 with duodenoscope exposure in 1 hospital. No lapses in duodenoscope reprocessing were identified; however, NDM-producing *Escherichia coli* was recovered from a reprocessed duodenoscope and shared more than 92% similarity to all case patient isolates by PFGE. Based on the case-control study, case patients had significantly higher odds of being exposed to a duodenoscope (odds ratio [OR], 78 [95% CI, 6.0-1008], $P < .001$). After the hospital changed its reprocessing procedure from automated high-level disinfection with ortho-phthalaldehyde to gas sterilization with ethylene oxide, no additional case patients were identified.

CONCLUSIONS AND RELEVANCE In this investigation, exposure to duodenoscopes with bacterial contamination was associated with apparent transmission of NDM-producing *E coli* among patients at 1 hospital. Bacterial contamination of duodenoscopes appeared to persist despite the absence of recognized reprocessing lapses. Facilities should be aware of the potential for transmission of bacteria including antimicrobial-resistant organisms via this route and should conduct regular reviews of their duodenoscope reprocessing procedures to ensure optimal manual cleaning and disinfection.

Epstein et al, *JAMA* 2014; 312(14):1447-55

Ebola Virus



2014-15 Outbreak (West Africa)

- ~20th outbreak since 1976
- ~20,000 cases & ~8,000 deaths
- ~10% of deaths in health care workers

Liberian Hospital, www.nytimes.com, September 12, 2014

Topics

1. Antimicrobial Resistance
2. Key Epidemiologic Risk Factors
3. Five General Control Measures
4. Surgical Site Infection Control
5. Device-associated Infection Control
6. Major Outbreaks
7. Quality Improvement
8. Statistics and Modeling
9. Molecular Advances
10. The Microbiome

Four Quality Approaches for Improving Patient Outcomes, Eliminating Healthcare-acquired Infections, and Reducing Costs

- Quality Improvement (QI) Initiatives
- Public Reporting
- Monetary Incentives (i.e., Pay for "Good" Performance)
- Monetary Penalties (i.e., Don't Pay for "Bad" Performance)

Reduced Mortality with Hospital Pay for Performance in England

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- In 2008, a program called Advancing Quality, based on the U.S. Hospital Quality Incentive Demonstration, introduced in all National Health Service (NHS) hospitals in northwest England (population 6.8 million).
- Compared with a similar U.S. program, the U.K. program had larger bonuses and a greater investment by hospitals in quality-improvement activities
- Risk-adjusted, absolute mortality for the conditions included in the pay-for-performance program decreased significantly
- Largest reduction, for pneumonia, was significant (1.9 percentage points; 95% CI, 0.9 to 3.0; $P<0.001$)

18-month period. The largest reduction, for pneumonia, was significant (1.9 percentage points; 95% CI, 0.9 to 3.0; P<0.001), with nonsignificant reductions for acute myocardial infarction (0.6 percentage points; 95% CI, −0.4 to 1.7; P=0.23) and heart failure (0.6 percentage points; 95% CI, −0.6 to 1.8; P=0.30).

CONCLUSIONS

The introduction of pay for performance in all NHS hospitals in one region of England was associated with a clinically significant reduction in mortality. As compared with a similar U.S. program, the U.K. program had larger bonuses and a greater investment by hospitals in quality-improvement activities. Further research is needed on how implementation of pay-for-performance programs influences their effects. (Funded by the NHS National Institute for Health Research.)

Sutton et al, *N Engl J Med* 2012; 367(19):1821-8

Effect of Nonpayment for Preventable Infections in U.S. Hospitals

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- 398 hospitals or health systems contributed 14,817 to 28,339 hospital unit-months
- We found no evidence that the 2008 CMS policy to reduce payments for central catheter–associated bloodstream infections and catheter-associated urinary tract infections had any measurable effect on infection rates in U.S. hospitals

for both targeted and nontargeted infections long before the policy was implemented. There were no significant changes in quarterly rates of central catheter–associated bloodstream infections (incidence-rate ratio in the postimplementation vs. preimplementation period, 1.00; P=0.97), catheter-associated urinary tract infections (incidence-rate ratio, 1.03; P=0.08), or ventilator-associated pneumonia (incidence-rate ratio, 0.99; P=0.52) after the policy implementation. Our findings did not differ for hospitals in states without mandatory reporting, nor did it differ according to the quartile of percentage of Medicare admissions or hospital size, type of ownership, or teaching status.

CONCLUSIONS

We found no evidence that the 2008 CMS policy to reduce payments for central catheter–associated bloodstream infections and catheter-associated urinary tract infections had any measurable effect on infection rates in U.S. hospitals. (Funded by the Agency for Healthcare Research and Quality.)

Lee et al, *N Engl J Med* 2012; 367(15):1428-37