

# Hospital-Associated *Clostridium difficile* Infections Prevention & Policy Implications in an Acute Hospital Setting

Ali Al-Rajhi

Public Health Day Presentation

April 17, 2009

MPH Advisor

Rada Dagher, Ph.D., MPH

Preceptors

Loretta Litz-Fauerbach, MS, CIC

Lennox K. Archibald, MD, Ph.D., FRCP (Lond), FRCP (Glasg), DTM&H

# Why *Clostridium difficile* Infections (CDI)?

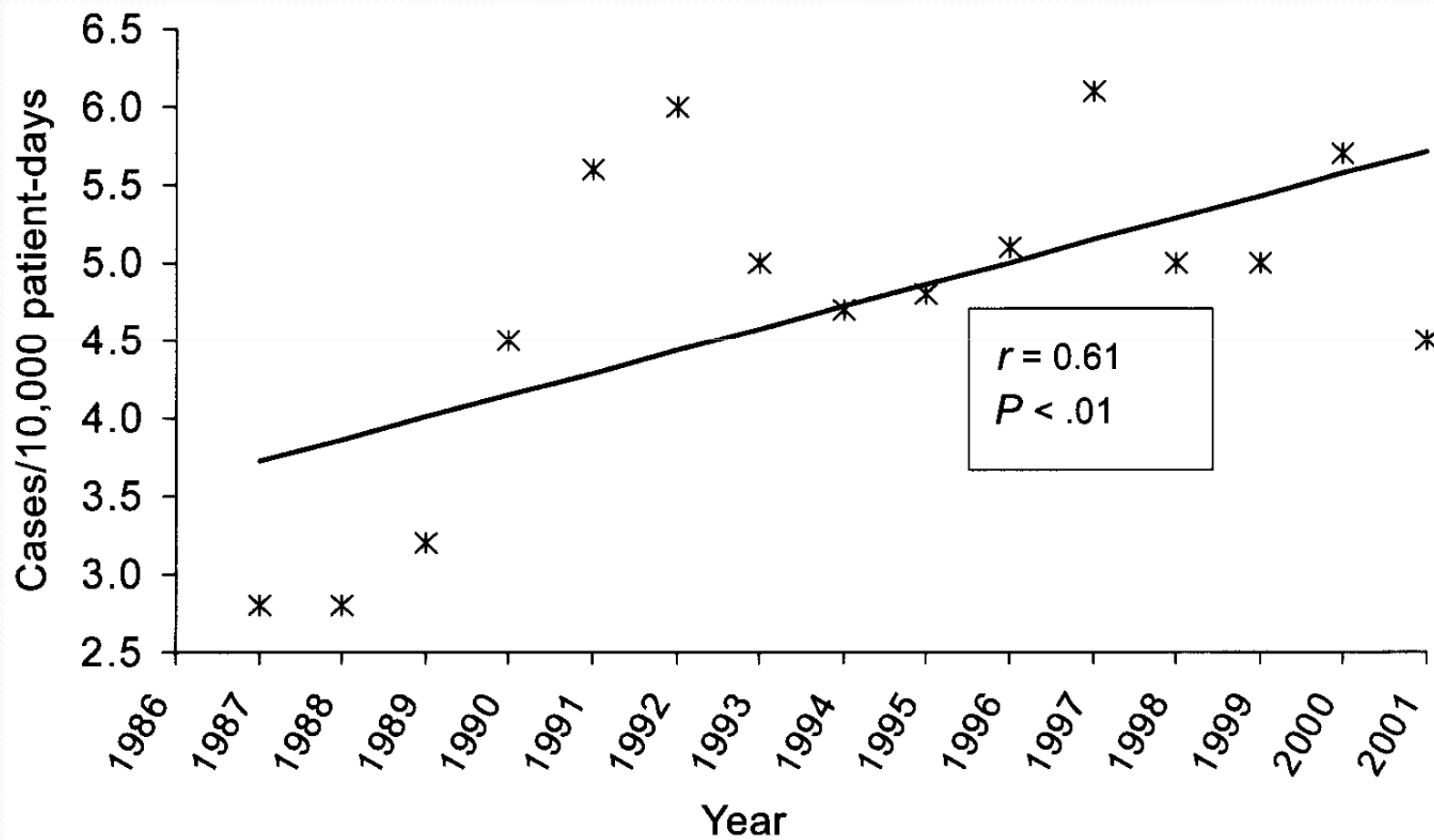
- Increasing Hospital Rates
  - Hospital discharges with CDI have more than doubled\*
    - 149,000 cases (2001) to 300,000+ (2005)
  - U.S. Mortality Rates
    - 5.7 per million population (1999) to 23.7 per million (2004)\*\*
- Impact on Patient
  - Pseudomembrane formation
  - Colitis
  - Watery diarrhea
- Mandated Hospital Policy
  - Joint Commission's National Patient Safety Goal # 7.03.01 to reduce the risk of hospital-associated infections (HAI)



\*APIC *C. difficile* Elimination Guide

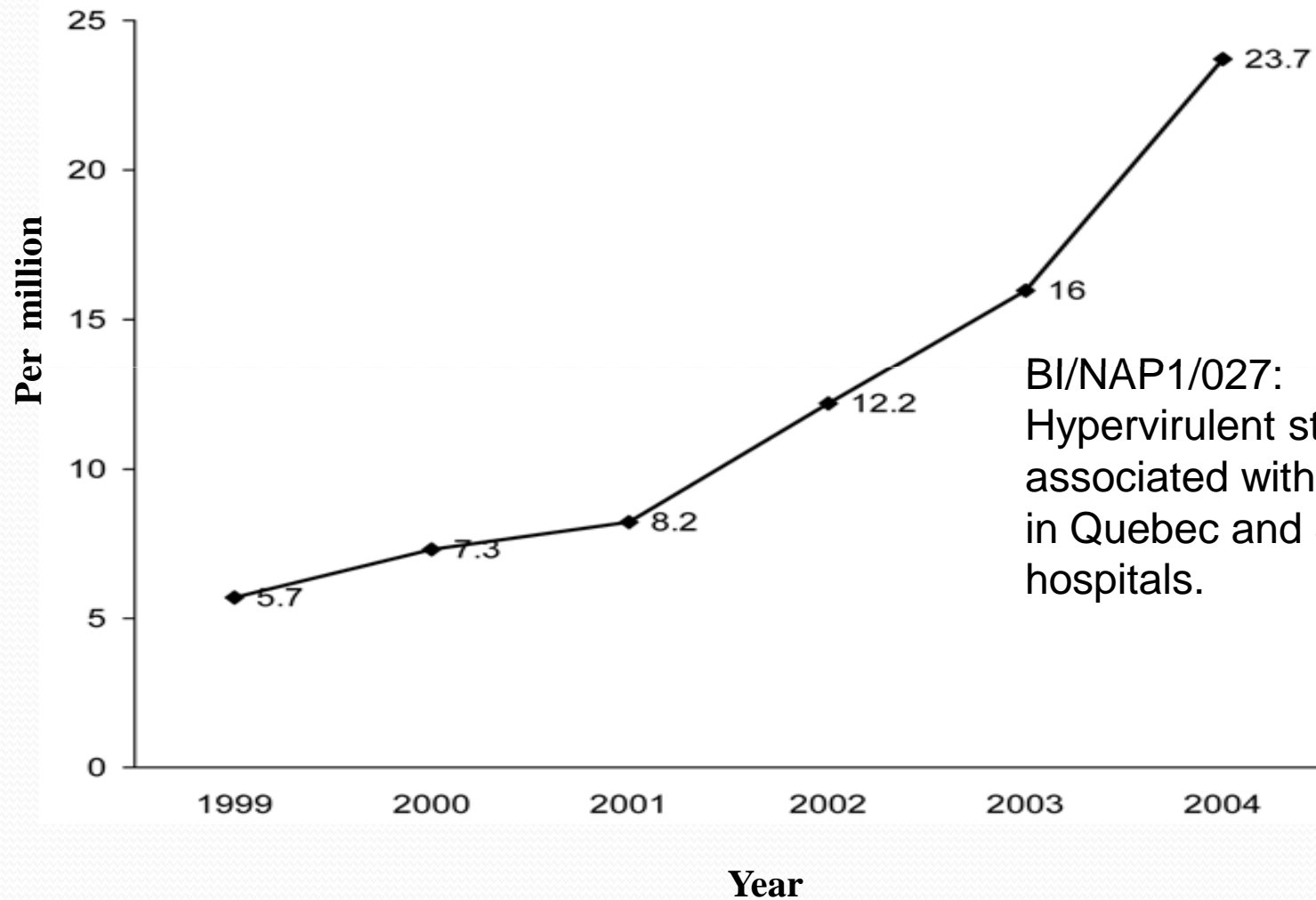
\*\*McDonald et al. CDI in Patients Discharged from US Short-stay Hospitals; CDC, 2006

# CDI Annual Rates



Archibald *et al.* Secular Trends in Hospital-Acquired *C. difficile* disease in U.S.(NNIS hospitals), 1987-2001.

# Mortality Rates of CDI



McDonald et al. CDI in Patients Discharged from US Short-stay Hospitals; CDC, 2006

# Susceptible Patients

- Elderly 64+ yrs of age
- Immuno-compromised
- Healthy individuals on antibiotics
- CDI less common in children than in adults\*
  - Colonization rates decrease as children age
    - 6% <2yrs; 3% > 2yrs
- Infants\*
  - For infants <1yr, most studies fail to show “epidemiological association between colonization and disease”
- Other short-stay hospital patients\*\*

\*APIC *C.difficile* Elimination Guide

\*\* McDonald et al. CDI in Patients Discharged from US Short-stay Hospitals; CDC, 2006

# Modes of Transmission

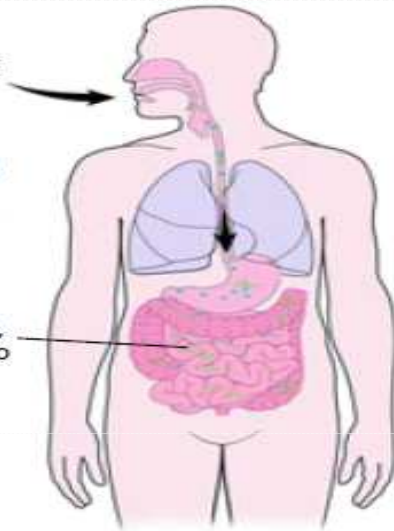
- 2 major Reservoirs
  - Patient Reservoir (symptomatic/asymptomatic)
  - Environmental Reservoir
- How does the Patient get *C. difficile*?
  - Direct or Indirect contact with contaminated environment or hands/gown of healthcare worker
- How does the Environment/devices get contaminated?
  - Shedding from patient
  - Healthcare workers' hands



# *C. difficile* Pathogenesis

*Clostridium difficile* is spread via the fecal-oral route. The organism is ingested either as the vegetative form or as hardy spores, which can survive for long periods in the environment and can traverse the acidic stomach.

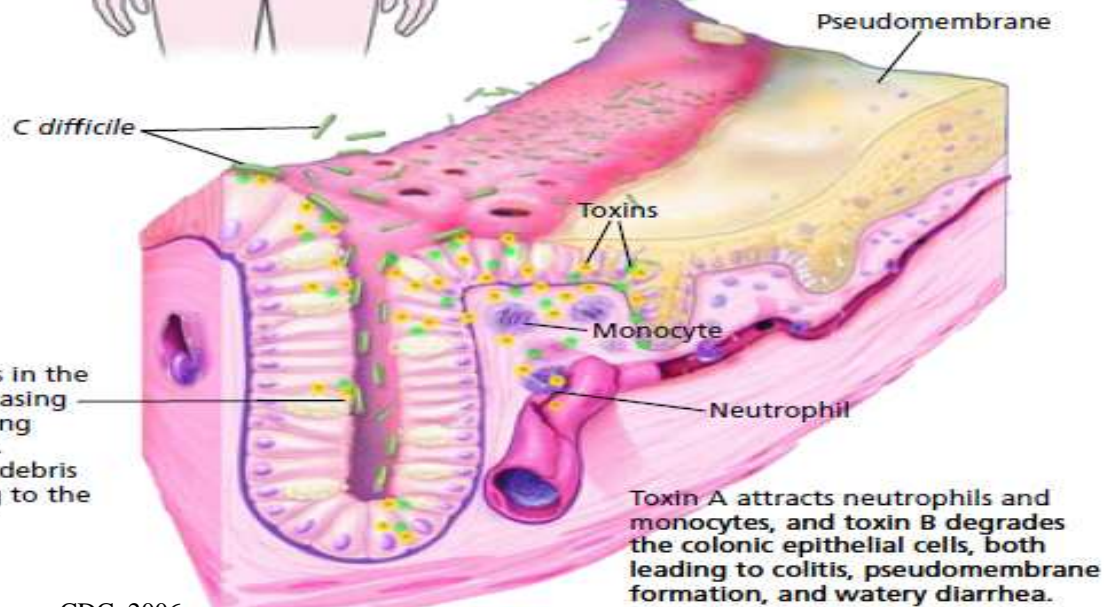
In the small intestine, spores germinate into the vegetative form.



In the large intestine, *C. difficile*-associated disease can arise if the normal flora has been disrupted by antibiotic therapy.



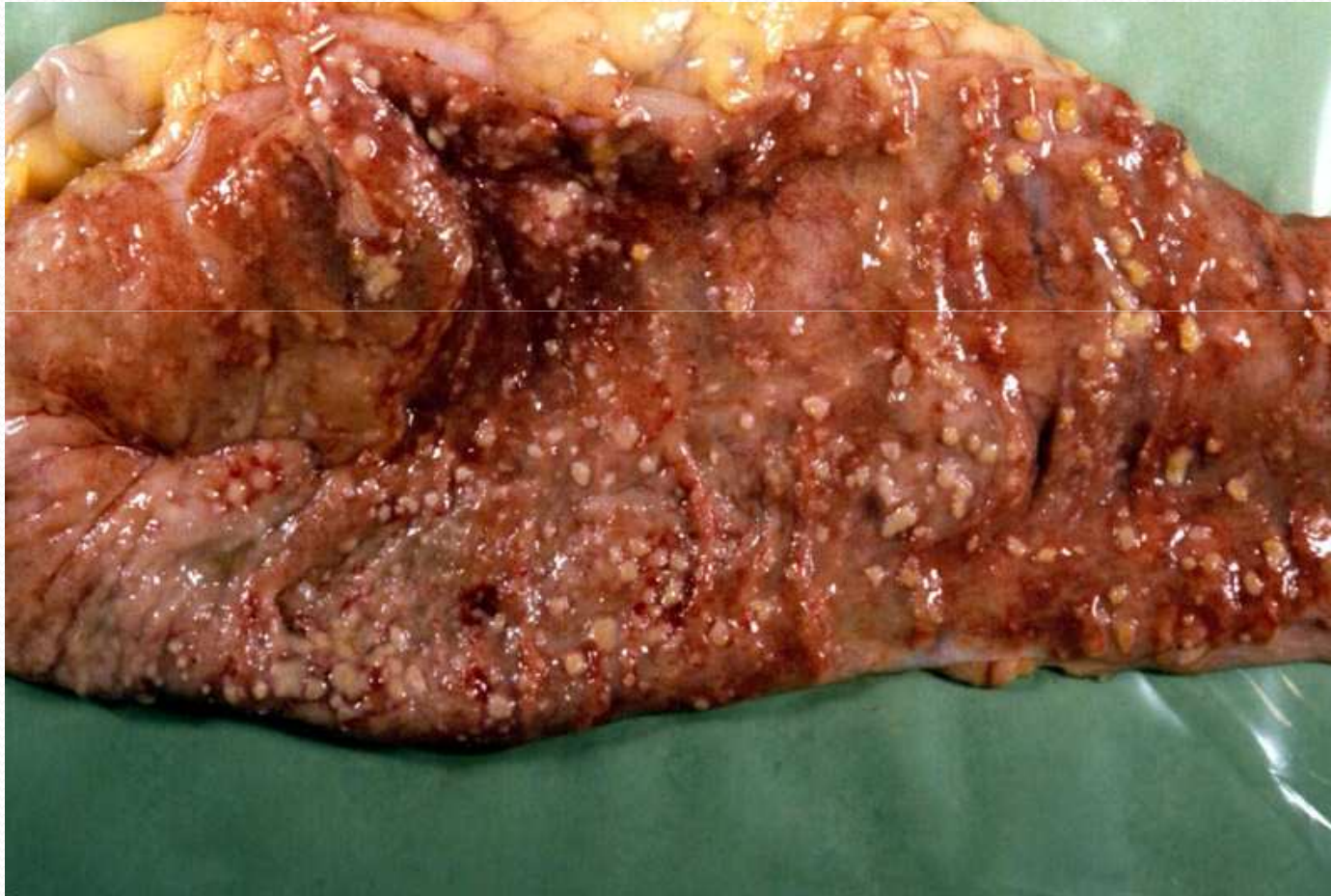
*C. difficile* spores



*C. difficile* reproduces in the intestinal crypts, releasing toxins A and B, causing severe inflammation. Mucous and cellular debris are expelled, leading to the formation of pseudomembranes.

Toxin A attracts neutrophils and monocytes, and toxin B degrades the colonic epithelial cells, both leading to colitis, pseudomembrane formation, and watery diarrhea.

# Pseudomembraneous Colitis



Source: Care Bundle for Minimizing Cross Transmission of *C. difficile* Presentation; Health Protection Scotland, 2009

# CDI Prevention and Control for Healthcare Workers (HCW)

- Most Important: Practice proper hand hygiene\*
  - Soap & Water = Visibly soiled and Spores
  - Alcohol Gels/Rubs = All other
- Contact Precautions\*\*
  - Patient placement, PPE, Limiting movement outside room, Environmental disinfection
  - Continue Contact Precautions for two days after diarrhea stops
  - Assess adherence to isolation precautions
- Environmental Cleaning\*\*\*
  - Chlorine-based disinfectants
  - Vaporized Solution of Hydrogen Peroxide
  - UV

\*MMWR; CDC guidelines, October 2002

\*\*APIC *C.difficile* Elimination Guide

\*\*\* Guidelines for Environmental IC in Healthcare Facility; CDC, 2003



# Rationale/Need for Project

- The Joint Commission's 2009 National Patient Safety Goals (NPSG)
  - 16 goals to be reached by January 1, 2010
  - Purpose: To promote improvements in patient safety
- NPSG Highlights
  - Problematic areas in health care (e.g., HAI)
  - Describe evidence and expert-based solutions to these problems.
  - The Requirements focus on system-wide solutions.
  - Sets the National/International tone for Hospitals
- NPSG #7.03.01\*

“Implement evidence-based practices to prevent HAI due to multi-drug resistant organism (MDRO) and *C. difficile* in acute care hospitals”

\* Joint Commission's 2009 NPSG



# Public Health Value – Ethics!

- Prevention and Control
- HCW ethically responsible to ensure patient's safety
- Relationship to project
  - Short-term: Identify Rates of CDI
  - Long-term: Continuous Prevention of CDI



# Objective for Internship

- Understanding the process behind developing and implementing hospital-wide Infection Prevention & Control Policies from an epidemiological perspective.\*
  - Gain basic knowledge about infection prevention and control and hospital epidemiology.
  - Research and understand evidence-based data from the APIC, CDC, HICPAC, Joint Commission, and SHEA.

\*Time Frame: To be achieved by April 3<sup>rd</sup>, 2009

# Objective for Special Project

- Understand the critical components for preventing *C. difficile*, to assist in evaluating current state of practice.\*
  - Analyze the CDI database for trends by using Epi Info.
  - Examining the correlation between Hospital-Associated *C. difficile* and hospital units
  - Explaining findings in relation to hospital infection control policy and practices

\*Time Frame: To be achieved by April 3<sup>rd</sup>, 2009



## Four Study Questions (SQ) Asked

SQ1. What is the total new CDI-patient case count for each Hospital Unit (HU) and Hospital Service (HS) over a five-year period (2004-2008)?

SQ2. How do CDI-patient incidence rates (per 1,000 patient days) vary with HU from 2004 to 2008?

SQ3. Are there any new insights based on CDI-patient incidence rates and other aspects of the descriptive study?

SQ4. What are the implications of the results in relation to NPSG #7 and hospital policy?

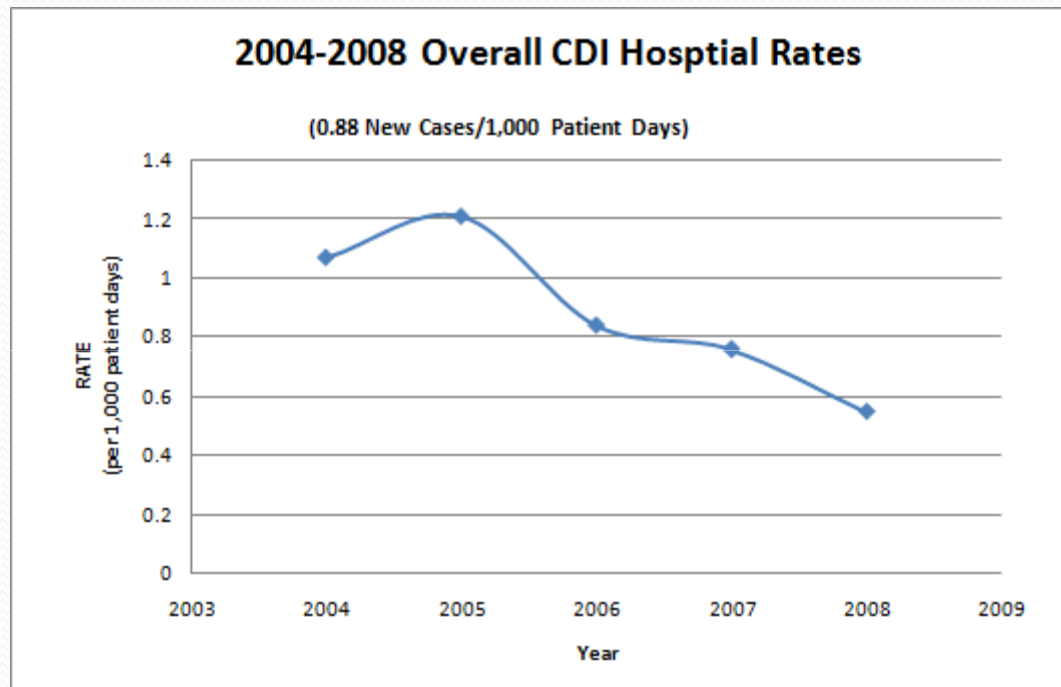
# Study Methods

- Study Population:
  - 752 Hospital-Associated CDI-positive patients in an Acute Hospital
  - Data from 2004 – 2008
- Study Design: Descriptive Study of infection rates in 21 hospital units
  - Justification: appropriate design to calculate CDI-infection rates
- Epi-Info utilized to evaluate Acute Hospital CDI database
  - Variables: Incidence Rate (IR), Hospital Unit (HU)
  - Rate: New cases per 1,000 patient days
- Note: ALL identifiable information removed prior to project start

# Study Methods Cont.

- Issues with application
  - Descriptive study provides limited information
    - No data on patient demographics
    - No information on length-of-stay or antimicrobial usage
- Stakeholders
  - Hospital A's Infection Control Department
  - HCW (physicians, nurses, technicians, etc)
  - Patients

# Results

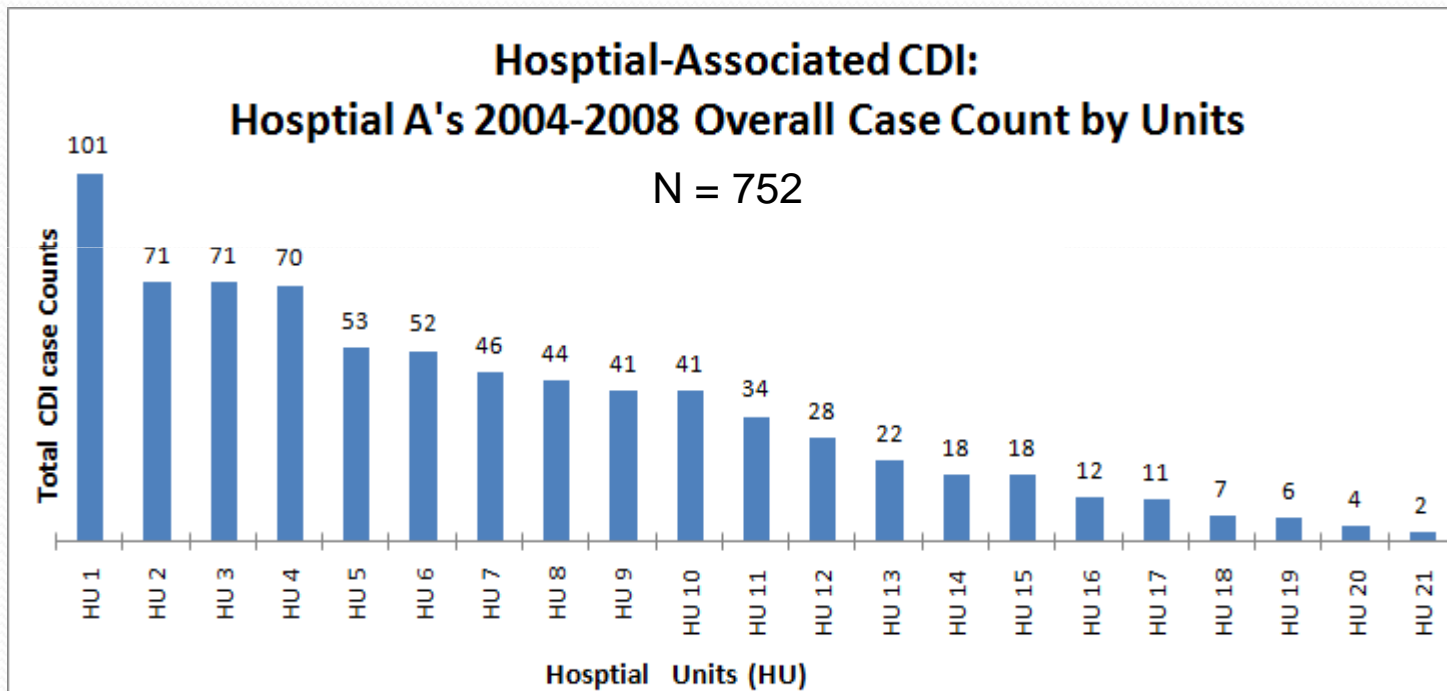


Overall CDI rates have been **DECREASING!**

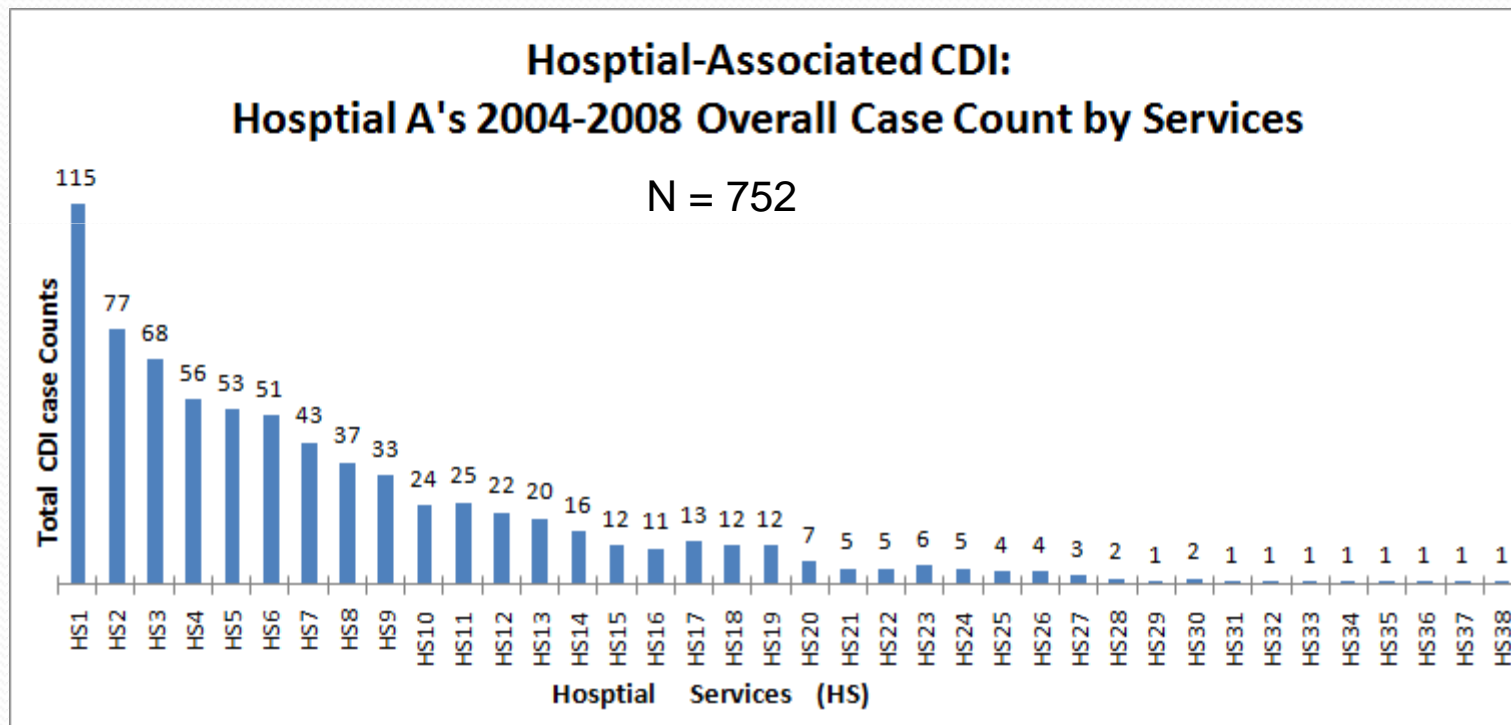
Highest (2005): 1.21 new cases/1,000 patient days

Lowest (2008): 0.55 new cases/1,000 patient days

# CDI-Patient Case Counts for each HU (2004-2008)

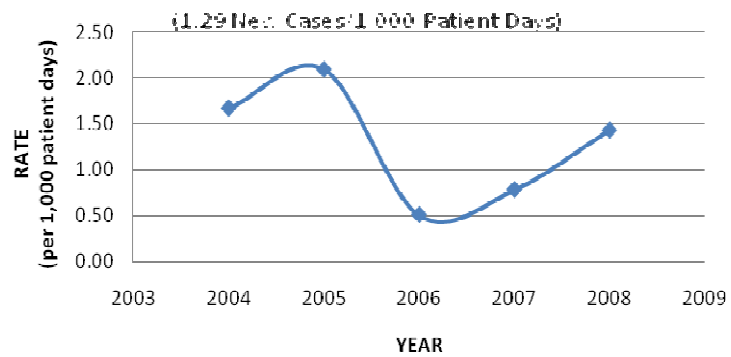


# CDI-Patient Case Counts for each HS (2004-2008)

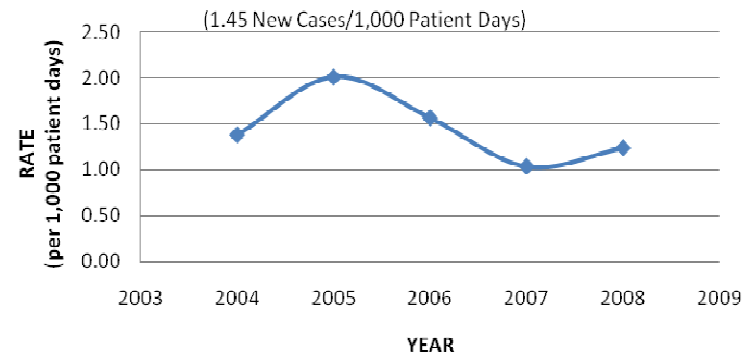


# Medical/Surgical Units

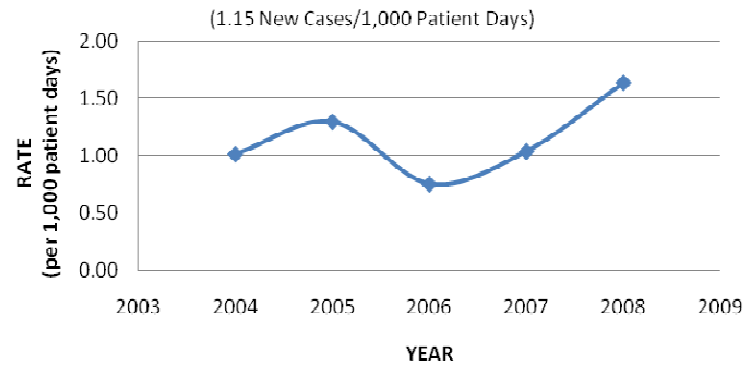
### 2004-2008 Incidence Rates for HU 2



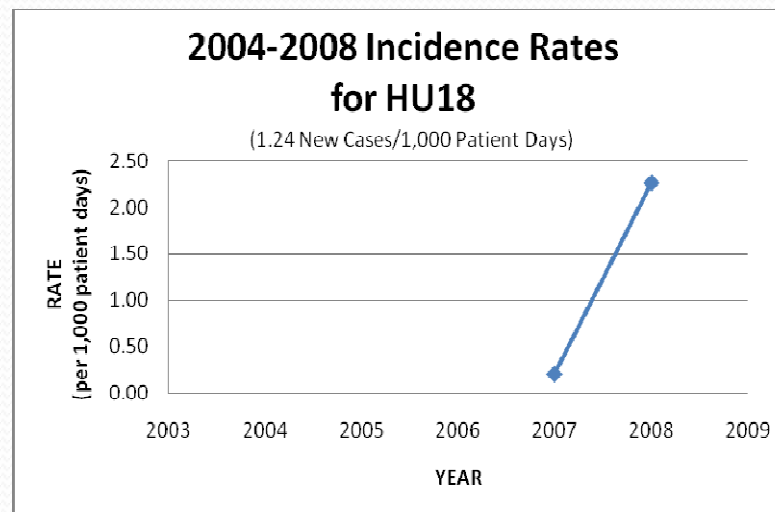
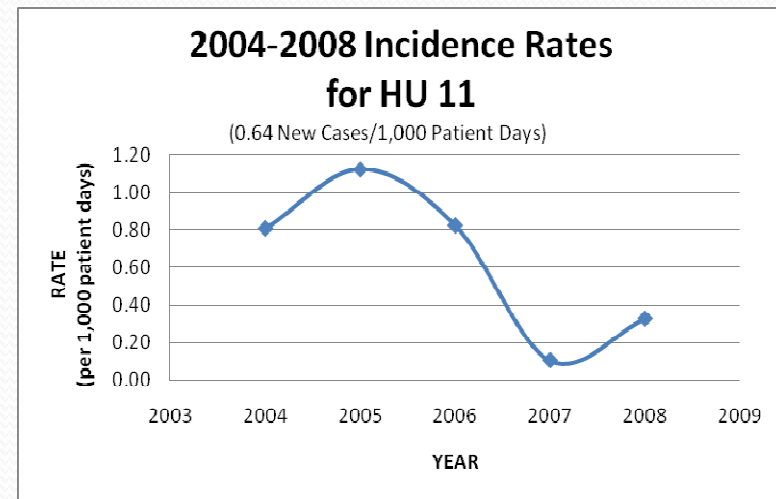
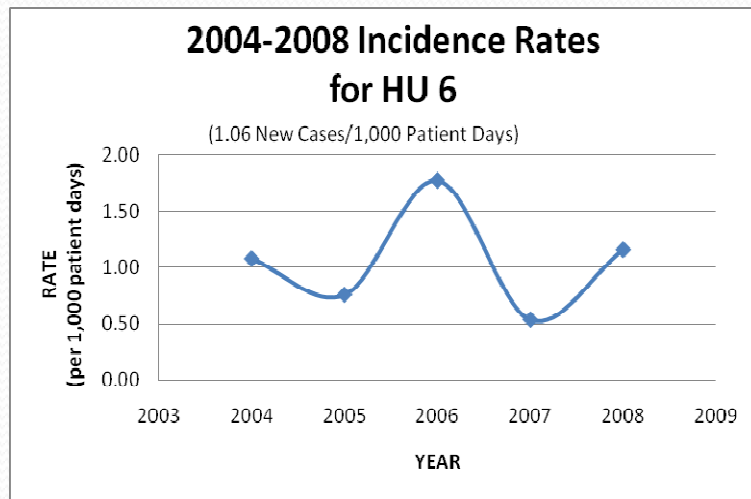
### 2004-2008 Incidence Rates for HU 3



### 2004-2008 Incidence Rates for HU 5

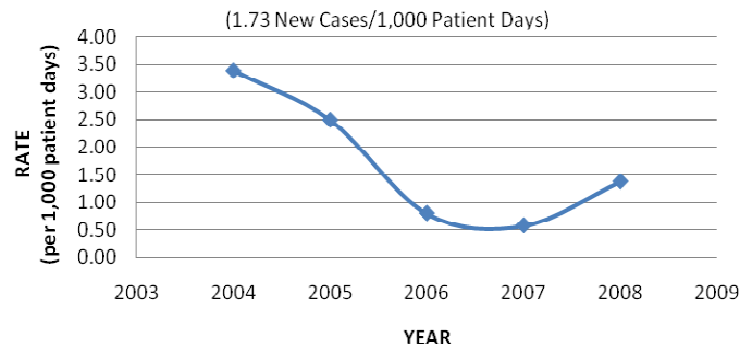


# Medical/Surgical Units

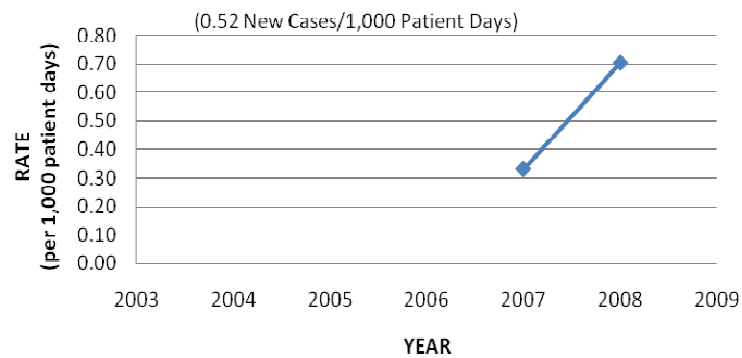


# Intensive Care Units

**2004-2008 Incidence Rates  
for HU 9**



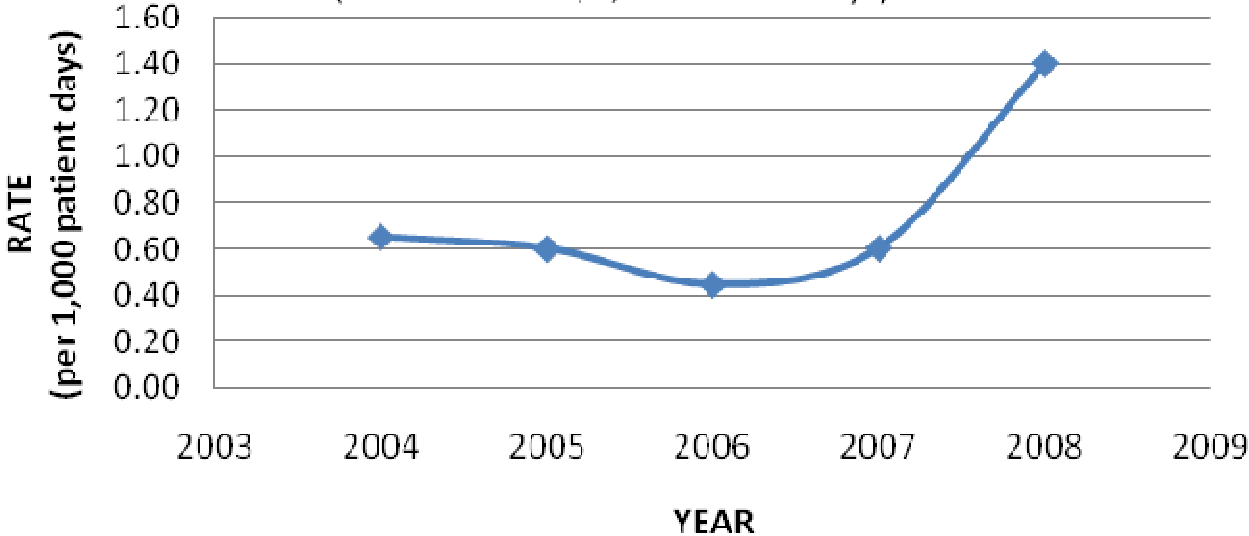
**2004-2008 Incidence Rates  
for HU 19**



# Pediatric Unit

## 2004-2008 Incidence Rates for HU 8

(0.74 New Cases/1,000 Patient Days)



# What do the results suggest?

- Overall decrease may be due to CDI-intervention
- Increase of the 9 units may be due to combination of lack of hand hygiene, improper environmental cleaning, and/or changes in antibiotic usage
  - It's hard to figure out which one is "the" reason
    - *C. difficile* is a 3-Hit Disease\*

\*Johnson, S. and Gerding, D.N. *Clostridium difficile*- Associated Diarrhea; Clinical Infectious Disease, 1998

# Strengths, Limitations & Generalizability

- **Strength:**
  - Primary data to conduct study
  - Large patient population
  - Identified HUs with increased rates of CDI
- **Limitation:**
  - Could not trend demographics
  - Could not determine causality of CDI
- **Generalizability**
  - Results are mainly applicable to Hospital A
  - Starting-point to identify susceptible units and to intervene
  - Other hospitals can calculate rates for *C. difficile*/MDROs

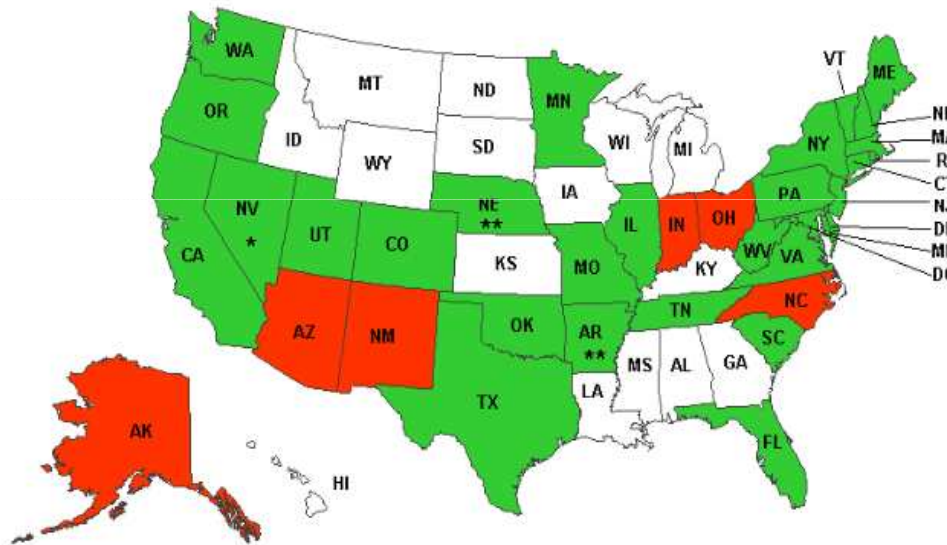


# Implications of Findings To the Larger Field of Public Health

- Infection Control and Prevention: Ensuring Patient Safety
  - *Clostridium difficile* is a major problem. Patients may suffer from diarrhea and other ailments; thus policies, like the NPSG, are set to reduce *C. difficile* from the patient's environment, enforce proper hand hygiene practices when handling patients, educating staff, and maintaining surveillance.

# Implications of Findings To Health Policy

## Healthcare-Associated Reporting Laws and Regulations



- States with study laws
- Mandates public reporting of infection rates
- Mandates reporting only to state government
- Voluntary

Florida law allows patients to obtain information regarding hospital infection rates in an understandable format.\*



# Relevance of Findings To Health Policy – Congressional Bills

- The American Recovery and Reinvestment Act of 2009 (HR 1)
  - \$787 billion economic recovery bill provides \$1 billion for Prevention and Wellness Fund, of which \$50 million shall be provided to States to carry out activities to implement HAI reduction strategies.
- Omnibus Appropriation Act of 2009 (HR1105)
  - This legislation would finalize federal funding for programs such as...
    - HAI reduction strategies
    - Funding to carry out Health and Human Services HAI Action Plan

# MPH Competencies

- Monitoring health status to identify and solve community health problems.
  - Hospital A's CDI-patient data came from surveillance of *C. difficile*
- Conducting research for new insights and innovative solutions to health problems.
  - Epidemiological research approach
  - Identify HU with increasing CDI rates
- Communicating effectively with public health constituencies in oral and written forms.
  - Discuss findings with Hospital A's Infection Control Department
  - Visualize data (i.e., graphs and research paper)

# Management & Policy Competencies

- Identifying, retrieving, summarizing, managing, and communicating public health information.
  - Identified 9 of 21 HU
  - Graphs to communicate findings
- The application of principles and methods of policy development and analysis of key public health issues.
  - An evidence-based approach to policy development
  - Acknowledged legislation for HAI reduction efforts



## Lessons learned/Future Recommendations

- Well-formulated hospital policies rely on evidence-based data
- Conduct a multivariate study to determine causality of CDI
- Evaluate the effectiveness of *C. difficile* intervention program implemented by the hospital



## A Question to Ask

Should hospitals implement prevention strategies immediately or wait on legislation to mandate nationwide prevention?

# Questions?



# Works Cited

- s.1: CDC. Morbidity and Mortality Weekly Report. October 2002. Vol. 51, no. RR-16.
- s.2: Duce, G., Fabry, L. et al. Prevention of hospital-acquired infections. Dpt of Communicable Diseases 2002; Vol. 2; 1-72.
- s.3: Kleven, R. et al. Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals. CDC, 2002.
- s.4 150 years of hand disinfection. [www.cdc.gov/ncidod/eid/vol7no2/pittet.htm#1](http://www.cdc.gov/ncidod/eid/vol7no2/pittet.htm#1). Accessed January 2009.
- s.5 Doebbeling BN, et al. Comparative efficacy of alternative hand-washing agents in reducing nosocomial infections in intensive care units. *N Engl J Med* 1992;327:88-93.
- s.6 Jarvis WR. Handwashing—the Semmelweis lesson forgotten? *Lancet* 1994;344:1311-1312.
- s.7. Albert RK, Condie F. Hand washing patterns in medical IC units. *N Engl J Med* 1981;304:1465-1465.
- s.8. Graham M. Frequency and duration of hand washing in an IC unit. *Am J Infect Control* 1990;18:77-81.
- s.9. Thompson BL, Dwyer DM, Ussery XT, Denman S, Vacek P, Schwartz B. Handwashing and glove use in a long-term care facility. *Infect Control Hosp Epidemiol* 1997;18:97-103.
- s.10. Pittet D, Mourouga P, Perneger TV, and the members of the Infection Control Program. Compliance with handwashing in a teaching hospital. *Ann Intern Med* 1999;130:126-130.
- s.11. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *Am J Infect Control* 1995;23:251-269.
- s.12 Rotter ML. Hand washing and hand disinfection. In: Mayhall G, editor. Hospital epidemiology and infection control. Baltimore: Williams & Wilkins; 1996. p. 1052-68.
- s.13 Lowbury E, Lilly HA, Bull JP. Disinfection of hands: removal of transient organisms. *BMJ* 1964;2:230-233.
- s.14 Patrick DR, Findon G, Miller TE. Residual moisture determines the level of touch-contact-associated bacterial transfer following hand washing. *Epidemiol Infect* 1997;119:319-25.
- s.15 Pittet, D. Improving Adherence to Hand Hygiene Practice: A Multidisciplinary Approach. *Emerging Infectious Disease* 2001; 7: 234-240.
- s.16 Larson, E. Skin hygiene and infection prevention: more of the same or different approaches? *Clinic Infect Disease* 1999;29:1287-94.
- s.17 Marcel, J.P, Alfa, M. et al. Healthcare-associated infections: think globally, act locally. *CMI* 2008; 14:895-907.
- s.18 Duce, G., Fabry, L. et al. Prevention of hospital-acquired infections. Dpt of Communicable Disease 2002; Vol.; 1-72.
- s.19 UTI. [http://www.cdc.gov/ncidod/dhqp/dpac\\_uti\\_pc.html](http://www.cdc.gov/ncidod/dhqp/dpac_uti_pc.html). Accessed January 2009.
- s.20 SSI. [http://www.cdc.gov/ncidod/dhqp/dpac\\_ssi.html](http://www.cdc.gov/ncidod/dhqp/dpac_ssi.html). Accessed January 2009.
- s.21 MMWR. <http://www.cdc.gov/mmwr/preview/mmwrhtml/00045365.htm>. Accessed January 2009.
- s.22 VAP. [http://www.cdc.gov/ncidod/dhqp/dpac\\_ventilate.html](http://www.cdc.gov/ncidod/dhqp/dpac_ventilate.html). Accessed 2009.
- s.23 C. difficile [http://www.cdc.gov/ncidod/dhqp/id\\_Cdiff.html](http://www.cdc.gov/ncidod/dhqp/id_Cdiff.html). Accessed January 2009
- s.24 MRSA [http://www.cdc.gov/ncidod/dhqp/ar\\_mrsa.html](http://www.cdc.gov/ncidod/dhqp/ar_mrsa.html). Accessed January 2009.
- s.25 VRE [http://www.cdc.gov/ncidod/dhqp/ar\\_vre.html](http://www.cdc.gov/ncidod/dhqp/ar_vre.html). Accessed January 2009.
- s.26 CDC Preventing Transmission. <http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf>. Accessed January 2009.
- s.27 Fauerbach, LL et al. APIC Guide to the Elimination of *Clostridium difficile* in Healthcare setting. Still under review.
- s.28 C. difficile facts. [http://www.cdc.gov/ncidod/dhqp/id\\_CdiffFAQ\\_general.html](http://www.cdc.gov/ncidod/dhqp/id_CdiffFAQ_general.html). Accessed January 2009.
- s.29 CDC environmental cleaning. [http://www.cdc.gov/ncidod/dhqp/id\\_Cdiff\\_excerpts.html](http://www.cdc.gov/ncidod/dhqp/id_Cdiff_excerpts.html). Accessed February 2009.
- s. 30 Joint Commission's 2009 National Patient Safety Goals. <http://www.jointcommission.org/>
- s.31 Mayfield, J.L., Leet, et al. Environmental Control to Reduce Transmission of *C. difficile*. *CID* 2000; 995-999.
- s.32 Zafar, A.B., Gaydos, L.A., Furlong, W.B. et al. Effectiveness of Infection Control program in Controlling Nosocoial *C. difficile*. *AJIC* Vol. 26, no. 6; 588-593.
- s.33 Archibald, L.K., Banerjee, S.N., William, R.J. Secular Trends in Hospital-Acquired *C. difficile* Disease in the United State, 1987-2001. *Journal of Infectious Disease* 2005; 1585-1589.
- s.34 Henrich, T.J., Krakower, Douglas, et al. Clinical Risk Factors for Severe *Clostridium difficile*-associated Disease. *CDC Emerging Infectious Disease* Vol 15, no. 3-March 2009.
- s.35 Johnson, S. and Gerding, D.N. *Clostridium difficile*- Associated Diarrhea. *Clinical Infectious Disease* 1998; 1027-1036.
- s.36 Fauerbach, LL, Gross, MA, et al. *Clostridium difficile* Disease in Bone Marrow Transplant Unit. Poster presentation. 2005-2006.