International Infection Control Council
Global Consensus Conference

Infection Prevention and Control Practice

Clostridium difficile Associated Diarrhea (CDAD)

August 23-24, 2007, Toronto, Ontario, Canada
Proceedings and Recommendations

Funding
This conference was sponsored by the Ontario Ministry of Health and Long Term Care, the Ontario Provincial Infectious Diseases Advisory Committee, the Public Health Agency of Canada, and Wyeth Pharmaceuticals. Expert participation was by invitation and all of their travel and accommodation costs were met from the sponsorship funds. In addition, the U.S. Centers for Disease Control and Prevention, Division of Healthcare Quality Promotion, provided speaker support.

Many thanks to PIDAC members who added valuable comments to the workshop discussions. Thanks also to Kristi VanderHyde, RN, MSN, who edited this document.

Conference Planning Office
c/o CHICA-Canada
PO Box 46125 RPO Westdale, Winnipeg MB R3R 3S3 Canada
Telephone: 1-866-999-7111/1-204-897-5990
Fax: 1-204-895-9595
chicacanada@mts.net
COURIER ONLY: 67 Bergman Crescent, Winnipeg MB R3R 1Y9 Canada

Table of Contents

Invited Experts	4
Scribes and Facilitators	4
Organising Committee	4
Background/Executive Summary	5
Conference Agenda	6-7
Invited Experts Biography	8-10
Welcomes	11-12
Plenary Sessions	
United States	13-25
United Kingdom/Europe	26-36
Canada	37-51
Workshop Discussions	52
Surveillance and Epidemiology	53-65
Control Measures	66-85
Environment and Equipment	86-93
Treatment/Antimicrobials	94-99
Synthesis of Questions and Consensus	
Surveillance and Epidemiology	100-102
Control Measures	102-106
Environment and Equipment	106-109
Treatment/Antimicrobials	109-111
Emerging Issues	111-112
Glossary	113-114
References	115-116

Invited Experts

Michelle Alfa PhD FCCM
Daryl DePestel PharmD
Erik Dubberke MD
Rosemary Gallagher RN
Michael Gardam MSc MD MSc FRCPC
Carolyn Gould MD MSc
Dinah Gould BSc MPhil PhD RN
Jim Hutchinson MD FRCPC
Tom Louie MD FRCPC
Jennie Mayfield BSN MPH CIC
Mark Miller MD
G. Gopal Rao MBBS MD FRCPath
Mike Rollins
Mary Vearncombe MD FRCPC

Scribes and Facilitators

Anne Bialachowski RN BN CIC
Nora Boyd RN MEd CIC
Sandra Callery RN MHSc CIC
Teri Lee Dyke RN BSN CIC
Cathy Egan CIPHI(C) MBA CIC
Sarah Hahn
Annette Jeanes RN DipN DipIC MSC
Sweetsy Joseph BSc
Christine Marton
Shirley McDonald ART CIC
Sue Sebazco RN BS CIC
Grace Volkening MLT CIC

Organising Committee

Sandra Callery RN MHSc CIC
Teri Lee Dyke RN BSN CIC
Candace Friedman MPH CIC
Sarah Hahn
Gerry Hansen BA
Annette Jeanes RN DipN DipIC MSC
Sweetsy Joseph BSc
Cassandra Lofranco
Pat Piaskowski RN HBScN CIC
Mary Schantz BA
Sue Sebazco RN BS CIC

BACKGROUND

The International Infection Control Council is comprised of three infection prevention and control organizations headquartered in the United States, Canada and the United Kingdom: The Association for Professionals in Infection Control and Epidemiology, Inc. (APIC), the Community and Hospital Infection Control Association – Canada (CHICA-Canada), and The Infection Control Nurses Association (ICNA, now known as the Infection Prevention Society).

The International Infection Control Council was established in 1997. The concept for its inception was to add to the expert resources available to members of the three organizations through collaborative development of projects of mutual interest. The first project was a consensus conference on infection prevention and control issues and antimicrobial resistance. It was held in Toronto in 1999. The recommendations from that consensus conference can be found on the associations' websites.

In addition to the planning of this conference, the Council undertook the development and publication of three toolkits: The Infection Control Toolkit for Pandemics and Disasters (2004), The Infection Control Toolkit for Emergencies and Disasters (revised 2007) and the Toolkit for Best Infection Control Practices for Patients with Extended Spectrum beta Lactamase Enterobacteriaceae (ESBL) (2005).

The purpose of the current consensus conference was to bring experts from the three countries together to discuss issues surrounding *Clostridium difficile* associated disease. There were three plenary sessions that framed the issues for each country (US, Canada and UK). Then each invited expert was assigned to two of four workshops: Surveillance and Epidemiology; Environment and Equipment; Treatment/Antimicrobials; and Control Measures. Members of the Ontario Provincial Infectious Diseases Advisory Committee and others in Ontario involved in infection prevention and control issues participated as observers.

EXECUTIVE SUMMARY OF CONFERENCE

With the increase in *C. difficile* disease in the 21st century, the International Infection Control Council recognized the need to address various infection prevention and control questions. This conference brought together experts from the United States, Canada and the United Kingdom to discuss these questions and propose consensus recommendations. Areas for further research were also outlined. The discussions focused on fours areas: Surveillance and Epidemiology; Environment and Equipment; Antibiotics and Treatment; and Control Measures. Questions were posed by facilitators and scribes outlined the recommendations.

All groups determined that practices should be consistent regardless of healthcare setting. Key points made include the following:

1. Surveillance is important for healthcare facilities. However there is little value in nominal reporting to public health.
2. Consistent case definitions and rate denominators will assist in making comparisons.
3. Use of Contact Precautions is important to control spread of disease. Hand hygiene using soap and water or alcohol based hand rub is a critical part of the precautions.
4. Environmental cleaning must occur using a sporicidal agent.
5. A major equipment issue is the use and management of bedpans.
6. Antibiotic stewardship is as important as any other control measure.

CONFERENCE SESSIONS AND WORKSHOPS

Thursday, August 23, 2007

7:30 am – 8:30 am
OPENING SESSION — Opening Remarks – Candace Friedman MPH CIC

8:45 am – 9:00 am
WELCOME BY ORGANIZERS AND CONFERENCE SPONSORS

Ontario Ministry of Health and Long Term Care - Cassandra LoFranco
Public Health Agency of Canada - Dick Zoutman, MD
Wyeth Ayerst
International Infection Control Council - Sandra Callery, RN MHSc CIC

PLENARY SESSIONS
MODERATOR – Sandra Callery, RN MHSc CIC

9:00 am – 9:30 am — Carolyn Gould MD MSc

This session will address the current status of *C. difficile* in the United States, any potential new requirements, the status of reporting in states, and how healthcare organizations are responding to the disease

9:30 am – 10:00 am — Gopal Rao MBBS MD FRCPath

This session will address the current status of *C. difficile* in the United Kingdom, any potential new requirements, the status of reporting in the country, and how healthcare organizations are responding to the disease.

10:00 am – 10:30 am — Mark Miller MD

This session will address the current status of *C. difficile* in Canada, any potential new requirements, the status of reporting in provinces, and how healthcare organizations are responding to the disease

CONCURRENT WORKSHOPS
FACILITATORS - Cathy Egan CIPHI(C) MBA CIC, Anne Bialachowski RN BN CIC
10:30 am – 4:30 pm — Control Measures

This workshop will focus on various types of measures and when they should be implemented. Hand hygiene issues are included in the workshop

4:30 pm – 4:45 pm — Housekeeping/Next Steps (Annette Jeanes, RN Dip.N Dip IC MSC)

Thursday, August 23, 2007 (continued)

FACILITATOR - Grace Volkening MLT CIC

10:30 am – 4:30 pm Treatment/Antimicrobials

This workshop will focus on antibiotic stewardship and alternative treatments.

4:30 pm – 4:45 pm Housekeeping/Next Steps (Pat Piaskowski RN HBScN CIC)

Friday, August 24, 2007

8:00 am – 9:00 am

DEBRIEFING

Review of previous day's discussions - Sandra Callery RN MHSc CIC

CONCURRENT WORKSHOPS

FACILITATOR - Grace Volkening MLT CIC

9:00 am – 3:30 pm Environment and Equipment

This workshop will focus on environmental cleaning, disinfection of items and facility design.

FACILITATOR - Sandra Callery RN MHSc CIC

9:00 am – 3:30 pm Surveillance and Epidemiology

This workshop will focus on definitions, making *C. difficile* reportable, and outbreak issues.

FACILITATOR – Candace Friedman MPH CIC

3:30 pm – 5:00 pm Consensus Building

5:00 pm Closing Remarks – Candace Friedman MPH CIC

INVITED EXPERT PARTICIPANTS

Michelle Alfa PhD FCCM is a Clinical Microbiologist at the St. Boniface Hospital, Winnipeg, Manitoba, who has worked in the healthcare environment for over 18 years. Her specific areas of research interest include: the role of spores in the environment as a basis for the nosocomial spread of *Clostridium difficile*, as well as nosocomial infections associated with improperly reprocessed medical devices.

Daryl DePestel PharmD is currently a Clinical Assistant Professor at the University of Michigan College of Pharmacy, Clinical Pharmacist in Infectious Diseases, and Co-Director of the Antimicrobial Management Program at the University of Michigan Health System (UMHS) in Ann Arbor, MI. He earned his PharmD from the University of Michigan college of Pharmacy in 1999 and completed his Infectious Diseases Residency training at the UMHS in 2001. Dr. DePestel practices, teaches, and conducts research in the areas of adult Infectious Diseases. He has coauthored more than 15 journal articles and serves as a reviewer for Pharmacotherapy, Annals of Pharmacotherapy, Infection Control and Epidemiology, and several professional te4xtbooks. He is responsible for precepting students and residents in Infectious Diseases Pharmacotherapy and in 2005 was appointed to Program Director of the Infectious Diseases Specialty Residence at the UMHS. Dr. DePestel is currently the Chair of the American College of Clinical Pharmacy Infectious Disease Practice and Research Network and is also Chair of the membership committee for the Society of Infectious Diseases Pharmacists. He is also active in other professional organizations such as the American Society of Health-Systems Pharmacists and the American Society of Microbiology.

Erik R. Dubberke MD received his MD from University of Illinois College of Medicine. Dr. Dubberke did his internal medicine internship and residency at Barnes-Jewish Hospital / Washington University School of Medicine in St. Louis and stayed at Washington University School of Medicine for his Infectious Diseases fellowship. Dr. Dubberke joined the Infectious Diseases Division faculty at Washington University School of Medicine in 2005 as an Instructor of Medicine. He helped develop the Infectious Diseases Transplant consult service and clinic, and he is an Associate Hospital Epidemiologist at Barnes-Jewish Hospital and the Medical Director of Infection Prevention and Control at Missouri Baptist Medical Center. Dr. Dubberke's research focuses on the prevention, risk factors, and outcomes of *Clostridium difficile*-associated disease in the general hospitalized patient population as well as stem cell transplant recipients. He is also active in developing and evaluating infection prevention and treatment protocols in stem cell and solid organ transplant recipients.

Rosemary Gallagher RN is the senior nurse infection control at Stoke Mandeville hospital. She has recently begun a secondment to the Royal College of Nursing. Rosemary was leading the team at Stoke Mandeville during the first UK outbreak of 027 *Clostridium difficile* which led to the death of 33 patients between October 2003 and June 2005. The work of Rosemary and her team was commended by the Department of Health as exemplary and she has subsequently used her experience and expertise to advise and support others in the UK in control of this organism.

Michael Gardam MSc MD MSc FRCPC completed his undergraduate degree, master's degree, and medical school training at McGill University in Montreal. He completed training in internal medicine and infectious diseases and became a Fellow of the Royal College of Physicians and Surgeons of Canada in Infectious Diseases in 1998. He subsequently moved to Toronto to complete additional research training in infection prevention and control and completed a second master's degree in health policy, management and evaluation at the University of Toronto in 2003. Dr. Gardam has been Medical Director of the Tuberculosis clinic at the Toronto Western Hospital since 2000 and Director of the Infection Prevention and Control Unit at the University Health Network since 2001. He is an assistant professor of medicine and faculty at the Department of Public Health Sciences at the University of Toronto. Dr. Gardam has acted as a consultant on infection control issues, such as SARS, tuberculosis, pandemic influenza, and *Clostridium difficile*– at the provincial, national, and international levels. Within Ontario, he has helped a number of hospitals control outbreaks and develop their infection control programs. Dr. Gardam's research interests include the molecular and clinical epidemiology of hospital-acquired infections and tuberculosis, as well as health policy and program evaluation.

Carolyn Gould MD MSc is an Infectious Diseases trained physician and is currently at Medical Epidemiologist in the Division of Healthcare Quality Promotion at the Centers for Disease Control and Prevention. She is also on faculty at Emory University in the Division of Infectious Diseases and previously served as Associate Hospital Epidemiologist at Emory Crawford Long Hospital. She has a special interest in prevention of antibiotic resistance and Nosocomial infections, including *C. difficile*. Her primary roles at CDC are responding to healthcare-associated infectious disease outbreaks and developing guidelines for infection prevention and control. DR. GOULD IS SPONSORED BY THE CENTERS FOR DISEASE CONTROL AND PREVENTION.

Dinah Gould BSc MPhil PhD RN was an infection control nurse before moving into higher education. Currently, she is a Professor in the School of Nursing and Midwifery at City University, London, England. She has undertaken a range of research projects focusing on infection prevention. Her particular interests include hand hygiene, the contribution of organizational climate to the success of infection prevention programmes and educating the healthcare workforce about infection prevention. She has led a Cochrane review exploring the effectiveness of strategies to increase hand hygiene compliance on healthcare-associated infection and is currently developing a project to increase health service user involvement in infection prevention**.**

Jim Hutchinson MD FRCPC received his MD from the University of Alberta in 1985, worked in General Practice after which he returned to the U of A and University of Calgary and completed Royal College training in Medical Microbiology in 1992. He has been on faculty at Memorial University, St. John's, Newfoundland Labrador, from 1994 to present and has developed a large interest in clinical epidemiology. His work centers on antibiotic utilization in hospital and the community locally, nationally and internationally. Dr. Hutchinson is active on several national committees including chairmanship of the Canadian Committee on Antibiotic Resistance (CCAR) – a federally funded body mandated to improve all aspects of antibiotic utilization in human and food animals.

Tom Louie MD FRCPC is Medical Director for the infection control program for the Calgary Health Region. The interests in *C. difficile* include outbreak control by antibiotic control measures, clinical trials on new therapies for *CDAD*, epidemiology of *C. difficile*/strain characterization, ecology of *C. difficile* and interplay with the normal flora.

Jennie Mayfield BSN MPH CIC received a BSN from the University of Colorado and MPH from the University of North Carolina and has worked in infection control and prevention in community and academic settings for over 25 years. Jennie is currently a clinical epidemiologist in the Infection Prevention Department at Barnes-Jewish Hospital/Washington University Medical School in St. Louis, MO. Her focus for the last 5 years has been patients with cancer, and she is responsible for the infection prevention program in inpatient and outpatient treatment facilities of the Siteman Cancer Center at Barnes-Jewish/Washington University. In 2005, Jennie received the Advanced Practice Infection Control Professional award from the Society for Healthcare Epidemiology of America for her accomplishments and contributions to the science of infection control and healthcare epidemiology. She is a 2007 APIC Hero of Infection Prevention. Jennie is currently the chairperson of the Comprehensive Cancer Centers Infection Control group, a group of infection prevention professionals from fourteen National Cancer Institute-designated Comprehensive Cancer Centers who are working together to benchmark infection data and identify best practices for the prevention of healthcare-associated infections in oncology populations.

Mark Miller MD did subspecialty training in Montreal at McGill University in the fields of Infectious Diseases and in Medical Microbiology and then pursued a Master's degree in Epidemiology and Statistics. He has been a staff microbiologist and infectious disease specialist at the SMBD-Jewish General Hospital since 1993, where he has become the Chair of Infection Prevention and Control, the Chief of Microbiology, and the Head of the Division of Infectious Diseases. The bulk of his research has been in the epidemiology, prevention, and treatment of Nosocomial infections, where he has described the rapid emergency of mupirocin resistance among MRSA, chaired the cross-Canada group studying the morbidity, health effects, and death rate from hospital-acquired *C. difficile*-associated diarrhea (CDAD), and headed the Canadian team which surveyed the reuse of single-use medical devices. He is currently studying CDAD in depth, including the recent epidemiology of severe CDAD in Canada, CDAD prevention using Lactobacillus probiotics, CDAD therapy with

novel antibiotics and IVIG, and the use of laser-induced emissions for the ultra-rapid diagnosis of CDAD from stool samples. He has also helped establish the Quebec province-wide guidelines for physicians, dentists, and other healthcare workers infected with blood-borne diseases and is the Chairman of the Infection Control Working Group of McGill University, which harmonizes infection prevention and control practices in the Faculty of Medicine and in all McGill-affiliated health institutions. He has co-authored over 80 scientific publications and presented over 90 abstracts. He is a past-president of the Association of Medical Microbiology and Infectious Disease of Canada (AMMI Canada), the professional society of over 500 Canadian physicians involved in the prevention, treatment, and research in the field of Infectious Diseases.

Gopal Rao MBBS MD FRCPath has been a Consultant Microbiologist and Infection Control Specialist for 18 years. He has a special interest in prevention and control of healthcare-associated infections including *C. difficile*, MRSA and ESBL. He is currently interested in developing innovative antibiotic guidelines, improving compliance, and assessing the impact of antibiotic guidelines on clinical outcomes, *C. difficile*, and antibiotic resistance organisms such as MRSA and ESBL. Dr. Rao is a member of the Hospital Infection Society Council and Advisor to the Department of Health and the Royal College of Pathologists. He is the author of over 50 papers in clinical microbiology and infection control.

Michael Rollins has a commercial background in International Marketing, specializing in the healthcare and built environment antimicrobial protection sectors. He joined University College London Hospitals (UCLH) Infection Directorate in 2004 as Project Manager for the Department of Health Research study into emerging cleaning technologies: microfibre and steam vapor. Subsequent Department of Health studies have included investigation of nurses uniforms, linen and laundry validation with specific regard to contamination of textiles with MRSA, *Acinetobacter* and *C. difficile* spores. Mr. Rollins currently leads the UCLH Environmental Research Unit and is Project Manager on a year long investigation, funded by the Department of Health, in the ITU of two hospitals, studying the impact of enhanced cleaning of clinical equipment in the near patient environment. The Environmental Research Unit also supports the development and validation of new practices and policy for the Director of Infection Prevention and Control.

Mary Vearncombe MD FRCPC is a Medical Microbiologist and is Medical Director, Infection Prevention and Control, for Sunnybrook and Women's College Health Sciences Centre, Toronto. She is an Associate Professor in the Department of Laboratory Medicine and Pathobiology of the Faculty of Medicine, University of Toronto. Dr. Vearncombe is Chair of the Infection Control subcommittee of the provincial Infectious Diseases Advisory Committee; Chair of the OHA/OMA Joint Committee for development of Communicable Disease Surveillance Protocols for Ontario Hospitals; Chair of the Expert Panel on Infection Control for the Faculty of Medicine University of Toronto; and Member of the Steering Committee on Infection Control Guidelines of Health Canada. She has over 25 years experience in Infection Control, with specific areas of interest in perinatal infection control and infection control issues in occupational health.

Welcome – Candace Friedman

Welcome. I want take this opportunity to provide a bit of history on our group. The International Infection Control Council (I2C2) was born in 1997. The idea was to gain value by having people from the US (Association for Professionals in Infection Control and Epidemiology), Canada (Community Hospital Infection Control Association—Canada) and the United Kingdom (Infection Control Nurses Association [now Infection Prevention Society]) work on projects together. Our first activity was to develop a consensus conference on infection prevention and control issues and antimicrobial resistance. It was held in Toronto in 1999. We have also produced a few toolkits, one on ESBLs and another, the latest product, on disasters.

The purpose of this conference is to bring people together to discuss issues surrounding *Clostridium difficile*. Our hope is to gain knowledge by bringing people together who have had different experiences to help the profession determine what we should be doing to prevent this disease. We are looking to you to answer the questions that will be posed.

There are three plenary sessions that will frame the issues for each country (US, Canada and UK). Then each of you is assigned to two of four workshops.

Welcome from Ontario Ministry of Health and Long Term Care – Cassandra LoFranco

I want to pass along to you sincere regrets from Dr. George Pasut our acting chief medical officer of health for the province of Ontario. Due to prior commitments his schedule could not accommodate the request to join us here today. So I am here to pass on this welcoming address to you.

We want to welcome you, our international colleagues, to Ontario. I am the manager of Infectious Diseases Research and Policy and I also manage the Provincial Infectious Diseases Advisory Committee, PIDAC.

PIDAC is a group of experts that represent the health care continuum. They are passionate about infection prevention and control (IPC) of infectious diseases. Many members are here in the audience today. We are pleased to be a part and be able to support the I2C2 in the development and delivery of this conference. Much work has gone on behind the scenes and it is wonderful to see this conference materialize and this day finally arrive. We thank the committee and the other sponsors and volunteers for their tremendous efforts to bring us together today.

We are pleased that experts from Ontario, including medical officers of health, members of PIDAC, infection control practitioners, and ministry staff, are involved in this conference. We at the ministry feel that the importance and profile of CDAD as a serious public health issue is growing. Since 2000 we have seen an increased rate of *C. difficile* in healthcare settings. *C. difficile* is not reportable in the province of Ontario and as such we do not provide provincial-wide statistics on *C. difficile* infections. However, hospitals conduct ongoing surveillance and collect data enabling them to monitor their own infection rates. PIDAC developed a surveillance tool to facilitate monitoring in institutions. It was recently pilot tested in 10 sites across our province. The data along with the tool are presently being assessed by PIDAC and ministry staff for future expansion and to determine how the tool can be implemented in a wider Ontario fashion.

As many of you know, the ministry considers this area a priority and has dedicated resources and funding toward many initiatives. Since 2004 the Ontario government has launched a number of initiatives to build Ontario's capacity to prevent and control CDAD. Fourteen regional infection control networks (RICN) have been created across the province. The purpose and objective of these RICNs is to promote a common approach to IPC and utilization of best practices. We have also supported a hand hygiene program and have invested over $3 million dollars this year alone to institute that program in Ontario hospitals. An additional 112 infection prevention and control practitioners have been allocated to hospitals across the province. An extensive educational program for infection prevention and control is being developed by the ministry in partnership with IPC experts. PIDAC has developed many best

practice documents on the management of *C. difficile* in all health care settings. It has recently hosted a video conference where over 50 sites participated to hear about the status of *C. difficile* in Ontario and the ministry-PIDAC initiatives to assist organizations in the management of CDAD.

Many hospitals and public health units in Ontario have experienced challenges in the management and control of CDAD over the past year. We look forward to learning from our invited guests and colleagues about recent developments and discoveries on *C. difficile* and experiences in the management of CDAD and the results and outcomes of this conference. On behalf of the chief medical officer of health for the province of Ontario, our best wishes for a successful conference.

Welcome on behalf of the Public Health Agency of Canada – Dr. Dick Zoutman

I am not an employee or representative of the Public Health Agency of Canada (PHAC), however I have been asked to acknowledge the support of PHAC in these proceedings. PHAC has been a key supporter and leader in infection prevention and control for many decades – through their guidelines, through the Canadian Nosocomial Infection Surveillance program and through a number of other activities. They play an essential role. PHAC has lead two large national surveys at a population level on *C. difficile* in 1997 and 2005. We should all acknowledge the excellent support of PHAC and their leadership and support for this meeting.

Welcome from International Infection Control Council - Sandra Callery

I first want to acknowledge a few other groups here. Wyeth Pharmaceuticals welcomed the opportunity to provide an unrestricted educational grant to I2C2. They send their best wishes to the participants of this event. Wyeth has a long-standing reputation in supporting educational events and we thank them for this support.

On behalf of our group, the International Infection Control Council, I wish to welcome all of you to our consensus workshop on *Clostridium difficile*. We first started to informally discuss the impact of this microorganism in 2006. We suddenly realized the opportunity for us to share both our knowledge and our ideas for the management of this serious disease. As we began to move forward with our ideas we gained new partners, namely the Ministry of Health and Long Term Care through the Provincial Infectious Diseases Advisory Committee and the Public Health Agency of Canada. Along with our partners on this event and on behalf of the International Infection Control Council, welcome and thank you very much for your participation in this conference.

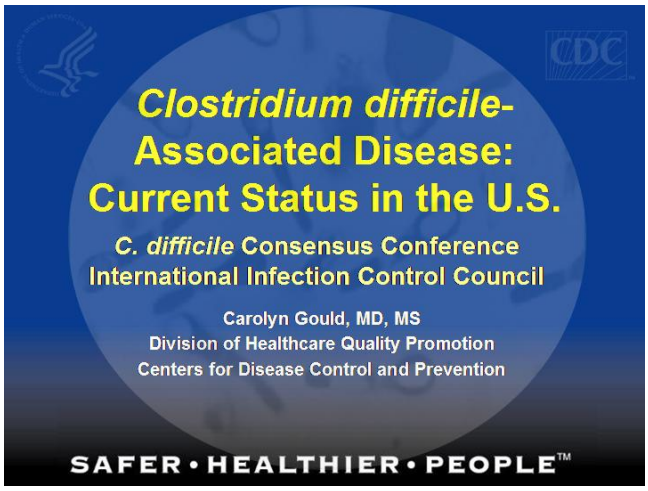
PLENARY SESSIONS

Sandra Callery - moderator

The plenary sessions are an opportunity to hear the latest information on *C. difficile* from three perspectives – from the United Kingdom, from the United States, and from Canada.

Our first speaker is Dr. Carolyn Gould. Dr. Gould is an infectious disease-trained physician and is currently a medical epidemiologist in the Division of Healthcare Quality Promotion at the Centers for Disease Control and Prevention (CDC). She is also on faculty at Emory University in the Division of Infectious Diseases. She previously served as the associate hospital epidemiologist at Emory Crawford Long Hospital. She has a special interest in prevention of antibiotic resistance and nosocomial infections including *Clostridium difficile*. Her primary roles at the CDC are responding to healthcare-associated infectious diseases and outbreaks and developing guidelines for infection prevention and control. CDC's Division of Healthcare Quality Promotion (DHQP), the National Center for Preparedness, Detection, and Control of Infectious Diseases supported the participation of Dr. Carolyn Gould in this conference.

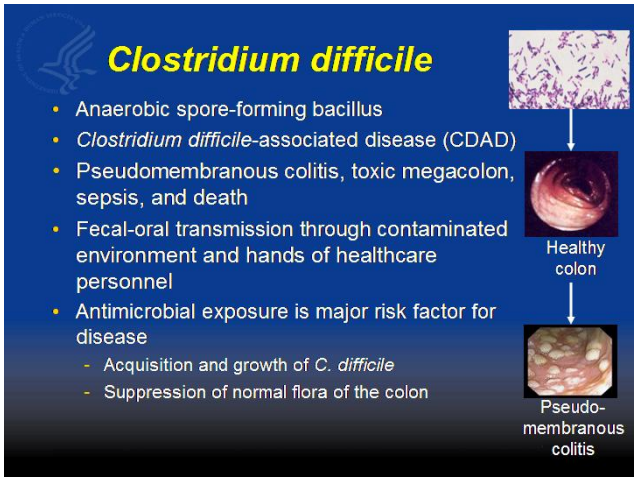
Clostridium difficile – associated disease: Current status in the US



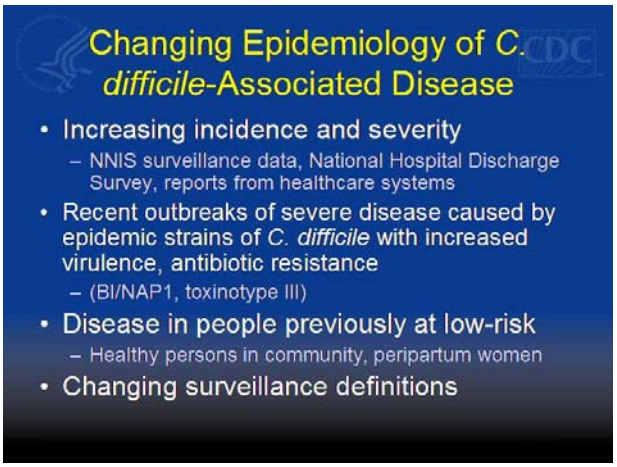
In the United States, the Centers for Disease Control and Prevention (CDC) have investigated reports from several states of increased rates of *C. difficile*-associated disease (CDAD). CDC efforts have included collaborating with academic partners to study antimicrobial and other risk factors for *C. difficile*-associated disease for this and other strains. CDC's Division of Healthcare Quality Promotion (DHQP), the National Center for Preparedness, Detection, and Control of Infectious Diseases supported the participation of Dr. Carolyn Gould in this conference.

Carolyn Gould, MD, MSc, a medical epidemiologist in the Division of Healthcare Quality Promotion, CDC, faculty at Emory University in the division of Infectious Diseases. She previously served as the associate healthcare epidemiologist at Emory Crawford Long Hospital in Atlanta.

I am very happy to be here. I want to thank the I2C2 for having me here to speak to you today. I will be focusing my talk on the current status of *C. difficile* in the US.

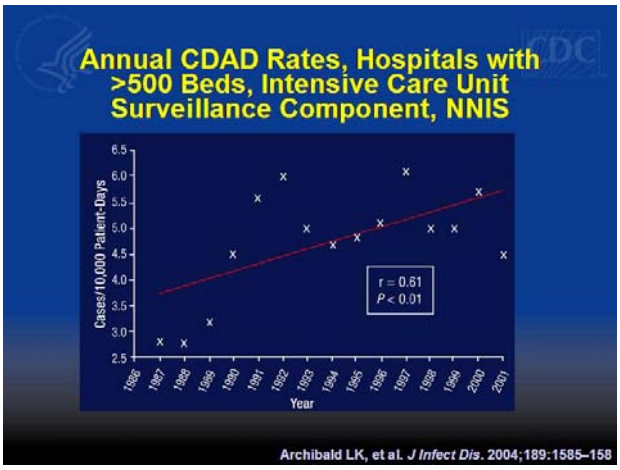


Just a brief overview of information I'm sure all of you know very well. *C. difficile* is an anaerobic spore-forming bacillus. It is associated with a range of diseases from a mild diarrheal illness to more severe diseases such as pseudomembranous colitis, toxic megacolon, sepsis, and death. Fecal-oral transmission in hospital settings is thought to occur through a contaminated environment and the hands of healthcare personnel. Antimicrobial exposure is the major risk factor for disease. There are 2 requirements for CDAD: the acquisition and growth of *C. difficile* suppression of the normal flora of the colon, most commonly through broad spectrum antimicrobial exposure.



The epidemiology of *C. difficile* has changed dramatically in the last few years. In the US, the incidence of CDAD has been increasing and the severity also has been increasing over the last 1-2 decades. This can be seen through surveillance data from NNIS, the National Nosocomial Infection Surveillance system, National Hospital Discharge data as well as reports from individual healthcare systems. We've also seen reports in hospitals of more severe disease caused by epidemic strains of *C. difficile* with increased virulence, antibiotic resistance. We are now seeing CDAD in populations that were previously thought to be at low-risk, including healthy persons in the community with minimal or no exposure to healthcare settings as well as peripartum women.

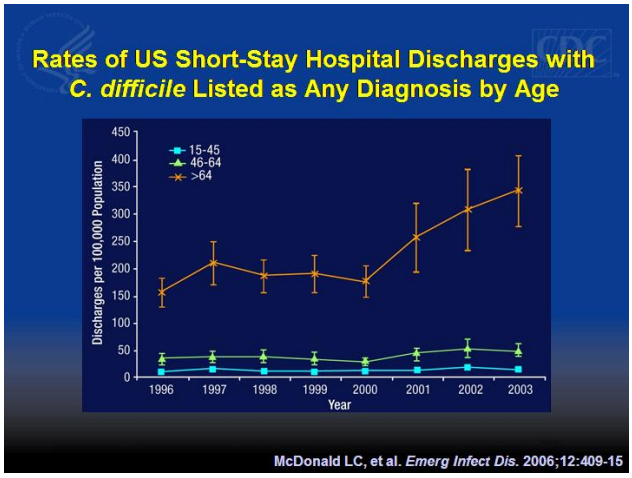
In the face of the changing epidemiology of *C. difficile* interim recommendations for surveillance definitions have been developed. I will briefly review them. These definitions are likely to evolve as we learn more about CDAD, the incubation periods, and more data on community-associated and community-onset CDAD.



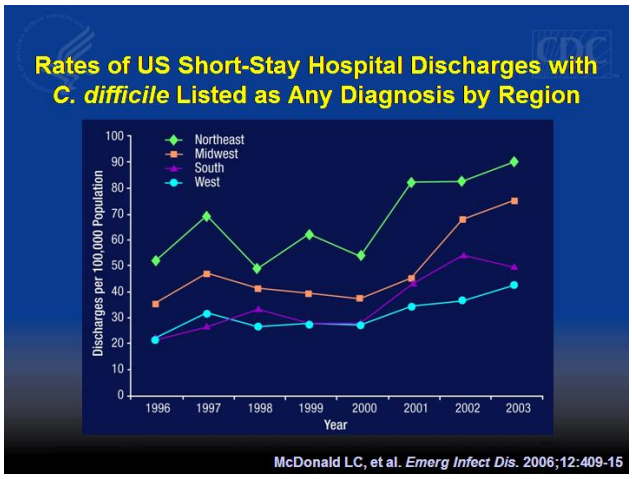
I am going to start by showing you some data that we have from the US about trends and incidence of *C. difficile*. Between 1987 and 2001, annual CDAD rates in intensive care units (ICU) participating in the NNIS system increased significantly in hospitals with greater than 500 beds.

CDAD also correlated with duration of ICU stay. During this time, hospital-wide rates increased in hospitals with less than 250 beds and in general medicine patients versus surgery patients.

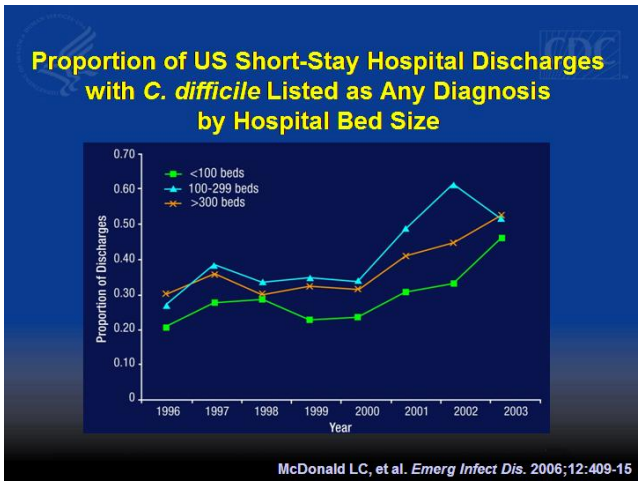
The National Hospital Discharge Survey (or NHDS) is conducted annually by the National Center for Health Statistics at the CDC, and consists of diagnosis and demographic data from a national probability sample. This includes approximately 500 hospitals and over 300,000 discharges which are sampled each year. From this, national estimates of rates can be made. McDonald et al used NHDS data to determine the number of discharges with an ICD9 code specific for "intestinal infection due to *C. difficile*" listed as a discharge diagnosis. US hospital discharges for which CDAD was listed as any diagnosis doubled from 82,000 or 31/100,000 population in 1996 to 178,000 or 61/100,000 in 2003. These increases in CDAD as both the first-listed discharge diagnosis or as any diagnosis increased significantly between 2000 and 2003. So that is really where we are seeing steep increases in incidence.



The overall CDAD rate was several fold higher in persons > 64 years of age compared to the middle-age group of 46-64 years. Incidence in this group was significantly higher than in the younger age group. Also, in the two older age groups, the increasing trends between 2000 and 2003 were both significant. Although, as you can see, the slope is much steeper in the ≥ 65 year age group.

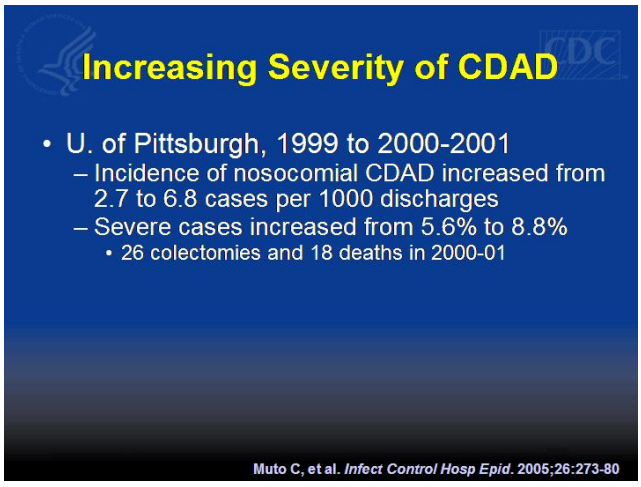


This graph shows the regional rates of CDAD as any discharge diagnosis. Overall during 1996 - 2003, the rate of CDAD was highest in the Northeast. Although rates in all regions appear to be increasing between 2000-2003, only the increases in the Midwest and Southern US were significant.

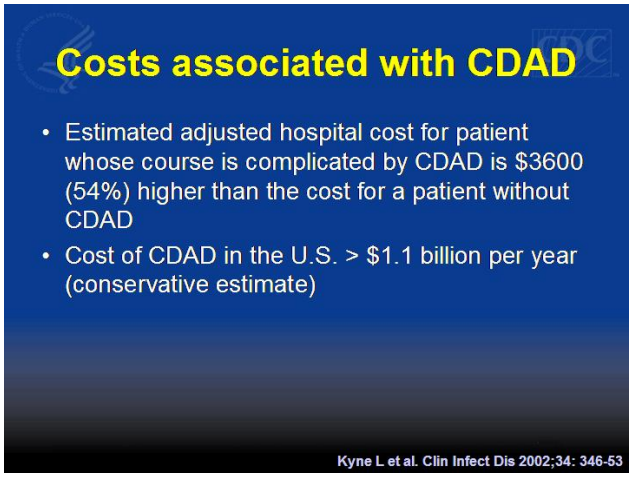


Here are the proportions of discharges with CDAD listed as any diagnosis, stratified by number of hospital beds. Significant increasing trends were seen again between 2000-2003 in hospitals with 100-299 beds and greater than 300 beds. Overall for the time period, rates in hospitals with less than100 beds were lower than rates in the 2 larger sized hospital groups.

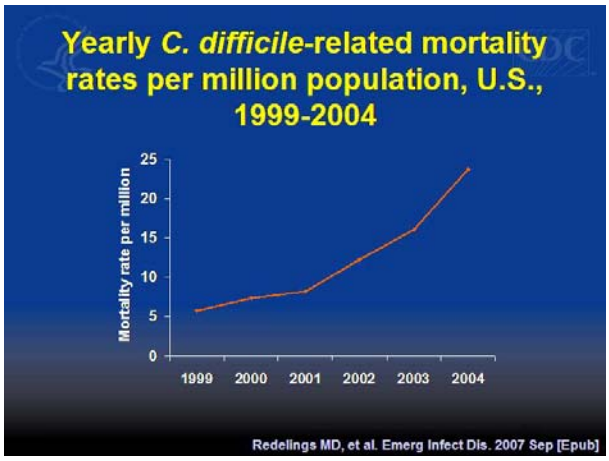
So CDAD is increasing rapidly in the US and is disproportionately affecting older persons.



We have reports from individual hospitals of increasing incidence and severity of nosocomial CDAD. This is an example from the University of Pittsburgh Medical Center. From 1999 to 2000-2001, the incidence of nosocomial CDAD increased from 2.7 to 6.8 cases per 1000 discharges. Severe cases also increased from 5.6% to 8.8% during this time period. In 2000 and 2001, there were 26 colectomies and 18 deaths directly related to *C. difficile* infection.



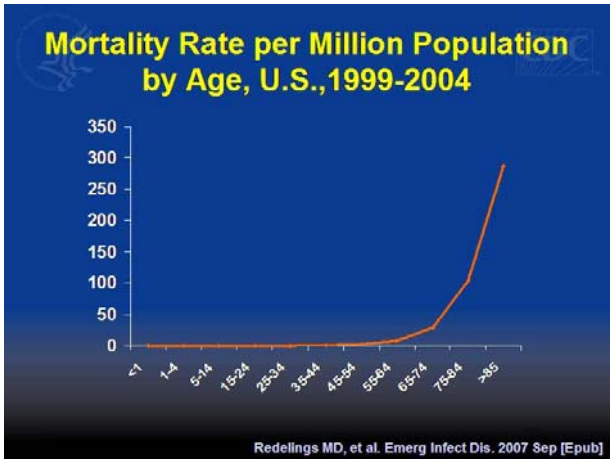
Kyne et al has estimated the costs associated with CDAD in the US. The estimated adjusted hospital cost for a patient whose course is complicated by CDAD is $3600 (54%) higher than the cost for a patient without CDAD. A conservative estimate is a cost greater than $1.1 billion per year in the US.



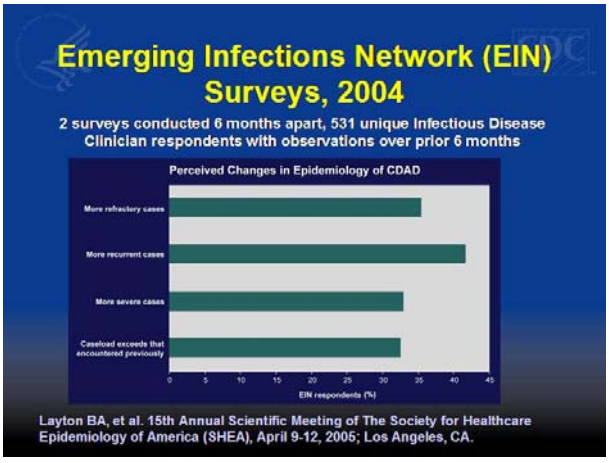
In this study, conducted by members of the Los Angeles County Department of Public Health using data from national mortality records, mortality rates from CDAD in the US increased from 5.7 per million population in 1999 to 23.7 per million in 2004.

Poisson regression analysis estimated an increase in mortality rates of 35% per year. Of note, CDAD-related deaths were defined as all deaths for which the underlying cause of death or any of the contributing causes of death included the ICD-10 code for enterocolitis due to *C. difficile*. This may make the numbers a bit higher than in previous studies.

Age-adjusted mortality rates were higher for whites compared to other racial/ethnic groups. Most CDAD-related deaths occurred in hospitals (81%). 4% occurred in long term care facilities.

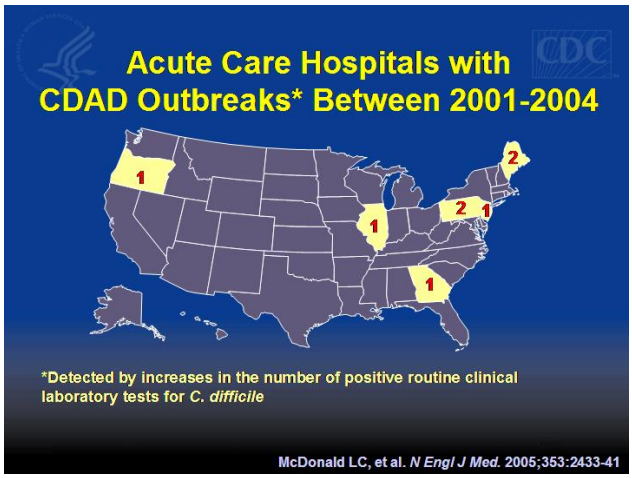


Breaking it down by age groups, the authors found a steep increase in CDAD-related mortality beginning in the 65 and older age group. So again, the disease is disproportionately affecting older persons.

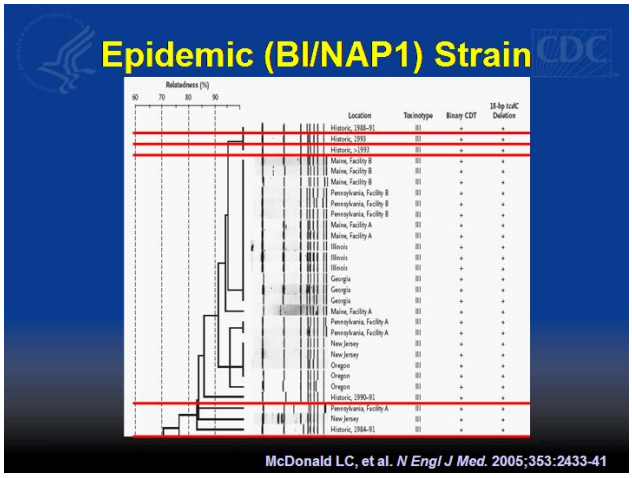


These data are from an abstract presented at the Society of Healthcare Epidemiologists of America in 2005. In a 2004 national survey of US infectious diseases physicians through the CDC's Emerging Infections Network. They found that 30-40% of physicians observed changes in the epidemiology of *C. difficile* over the past year, with increases in case loads, more severe and recurrent cases, and increases in cases refractory to therapy.

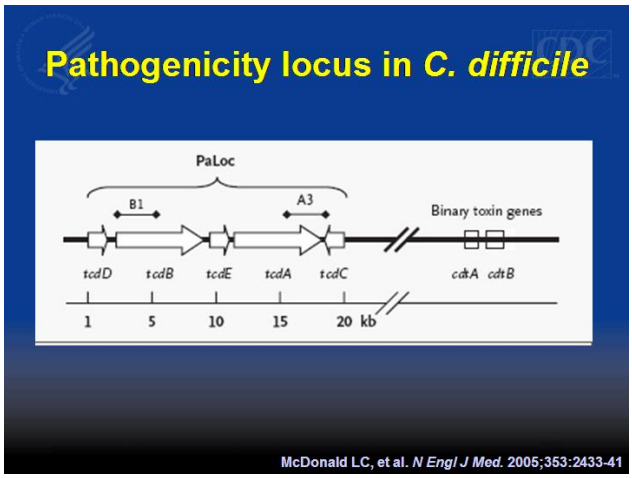
There are several potential reasons for the increases in CDAD incidence and severity. These include changes in underlying host susceptibility with a larger proportion of sicker, elderly patients; changes in antimicrobial prescribing; the presence of a new strain with increased virulence; and changes in infection control practices.



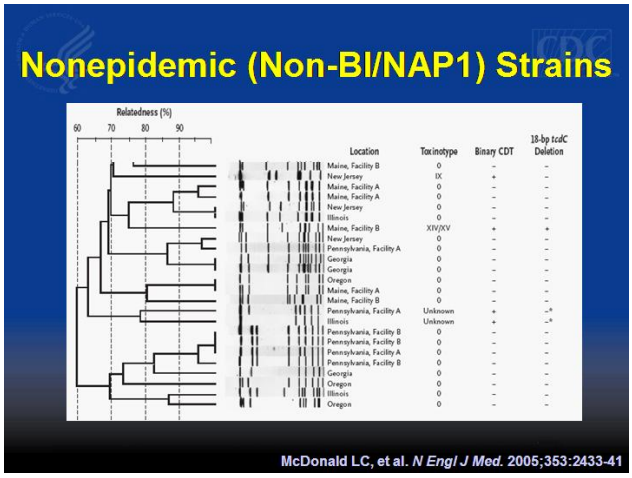
McDonald et al characterized *C. difficile* isolates from outbreaks in 8 healthcare facilities in 6 states (Oregon, Illinois, Georgia, Pennsylvania, New Jersey, and Maine) between 2001-2004.



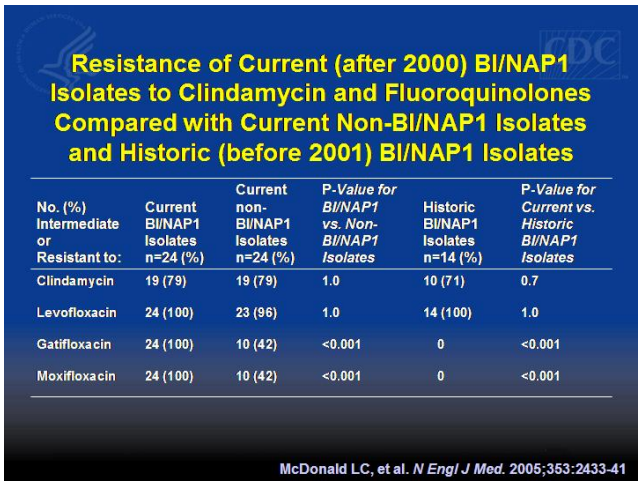
This shows the pulse field gel electrophoresis (PFGE) results and dendrogram for representatives of the epidemic strain. This strain, which was found at all 8 facilities, was characterized as restriction enzyme analysis (REA) group "BI, North American Pulsed Field Type 1 (NAP1), and PCR ribotype 027. It was also characterized via REA of the toxin and surrounding regulatory genes as "toxinotype III," a previously uncommon toxinotype. Historic BI/NAP1 isolates, shown here, have the same characteristics. These historic isolates were not as common and were not associated with outbreaks.



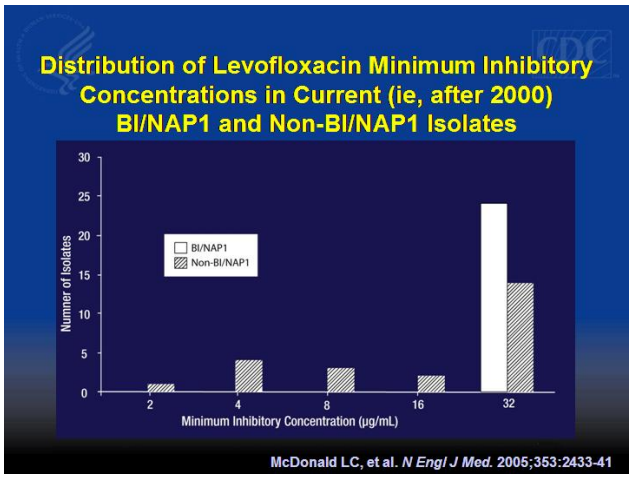
In addition to the clostridial toxins A and B, both historic and current BI/NAP1 isolates were positive for an extra toxin known as binary toxin. The role of binary toxin in *C. difficile* is unclear but may be associated with more severe disease. In addition, the epidemic strain contains an 18-bp deletion in the *tcdC* gene, which is thought to be a negative regulator of toxin A and B production.



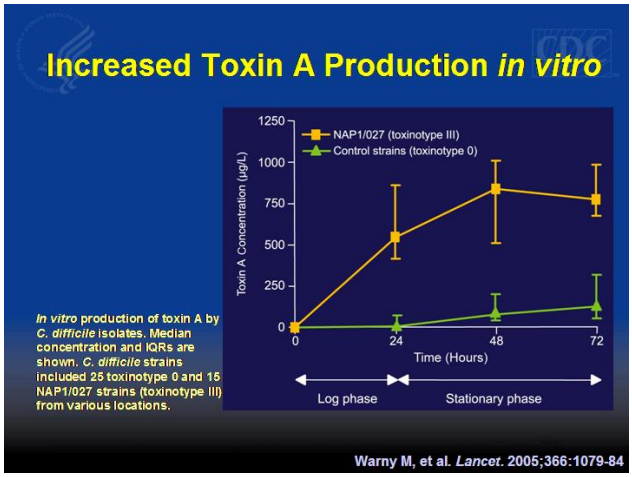
In contrast to the close relatedness among geographically diverse BI/NAP1 strains, few of the non BI/NAP1 isolates were closely related and most did not have the binary toxin or the 18 bp deletion in *tcdC*. Most of them were also of toxinotype 0 instead of 3.



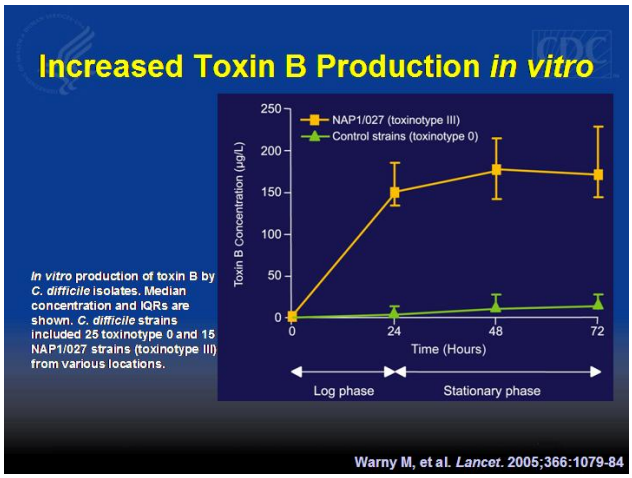
Susceptibility testing found that all of the current BI/NAP1 isolates were uniformly resistant to gatifloxacin and moxifloxacin, compared to about 40% of current non-BI/NAP1 isolates. In contrast, none of the historic BI/NAP1 isolates was resistant to gatifloxacin or moxifloxacin. Resistance to levofloxacin among all isolates was almost universal, and about 70-80% of current isolates were resistant to clindamycin.



Although both BI/NAP1 and non BI/NAP1 isolates were largely resistant to levofloxacin, the BI/NAP1 isolates had higher minimum inhibitory concentrations to levofloxacin as a group. They had a greater level of resistance.

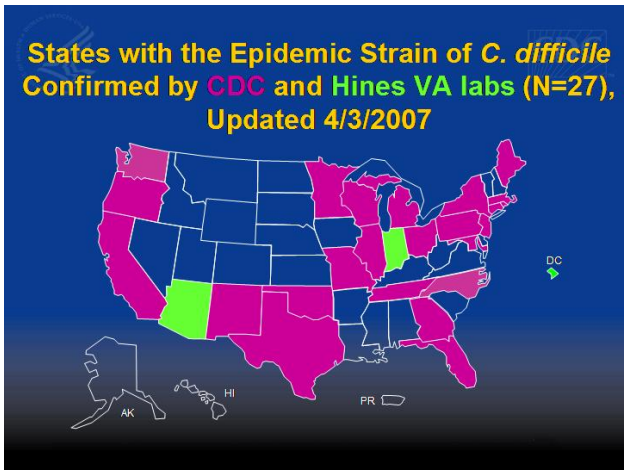


In vitro studies by Warny et al showed the BI/NAP1 toxinotype III strains have been shown to produce approximately 16 times more toxin A than toxinotype O strains…and



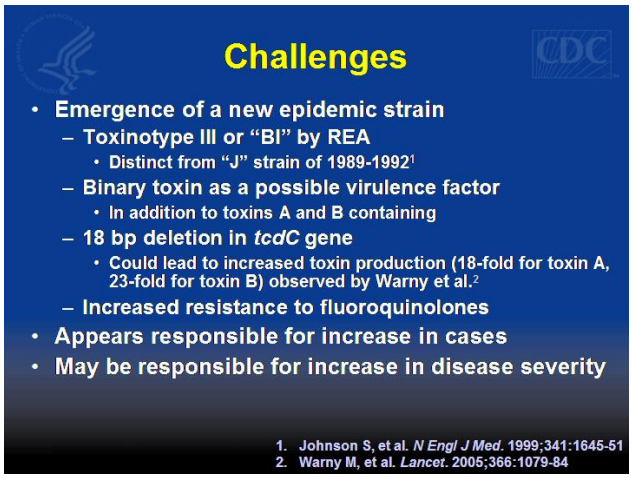
…. approximately 23 times more toxin B in vitro. This may be due to a deletion in the negative regulatory gene.

The BI/NAP1 strain appears to cause more severe disease, possibly as a result of increased toxin A and B production, binary toxin, or unknown virulence factors.



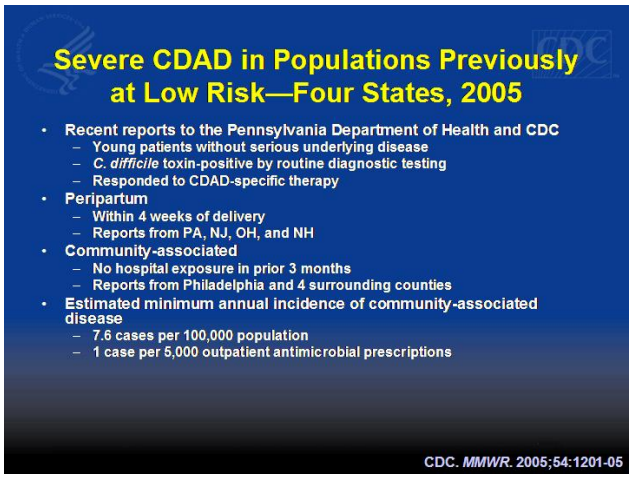
As of April of this year, the epidemic strain has been identified in 26 states and the District of Columbia, and has caused similar outbreaks as you know in Canada, the UK and other parts of Europe, so it is becoming potentially a global epidemic strain.

An updated map may be found at http://www.cdc.gov/ncidod/dhqp/pdf/infDis/StateMapNAP1_11_2007.pdf



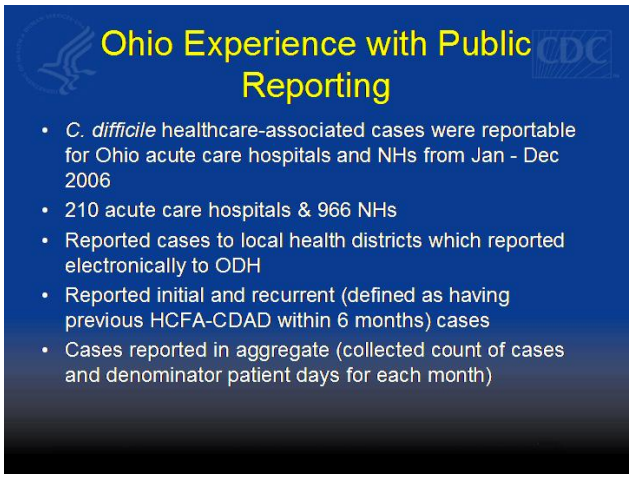
So there are major challenges associated with the emergence of a new epidemic strain which is distinct from the "J" strain implicated in U.S. outbreaks in the late 1980's to early 90s. The current epidemic strain has potential virulence factors including a binary toxin and the 18 bp deletion in the *tcdC* gene which could lead to increased toxin A and B production. Also, this strain has increased resistance to fluoroquinolones (FQ) which could explain in part why it has emerged concurrently with a global increase in the use of FQs. This strain appears to be responsible for an increase in cases as well as increased disease severity.

There is more recent information on virulence factors of the epidemic strain. The increased toxin A and B production is most likely related to the presence of an early frame-shift mutation identified in *tcdC* rather than the 18 base pair deletion. This doesn't appear to alter the function of the *tcdC* protein.



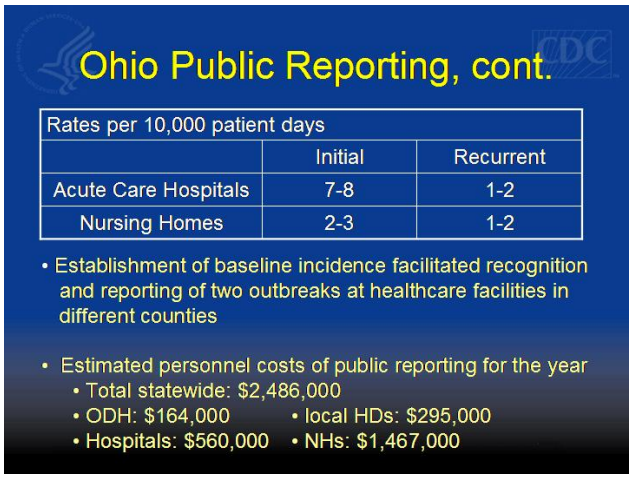
CDAD is also appearing in patients previously considered to be at low risk for the disease. In 2005, the CDC received reports of severe CDAD in several peripartum women and young patients in the community with no recent exposure to healthcare settings.

The estimated annual incidence of CA-CDAD in Philadelphia and surrounding counties was 7.6 cases per 100,000 population, with approximately one case for every 5,000 outpatient antimicrobial prescriptions. This is twice as high as the less than one case per 10,000 antimicrobial prescriptions incidence cited in previous studies.



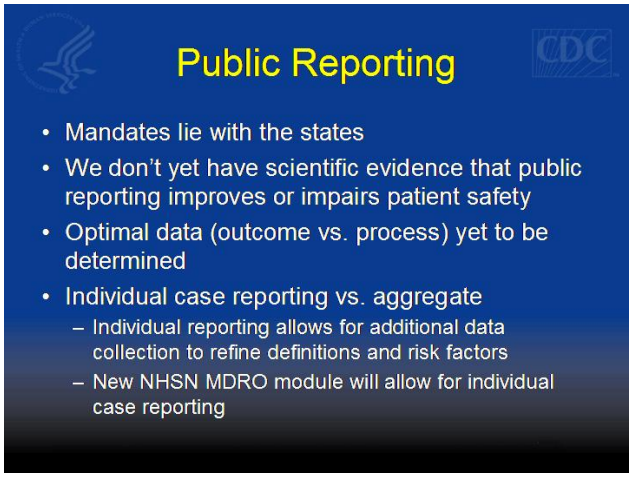
In talking about public reporting of CDAD, I just wanted to give you some data about one state, Ohio, which had mandated public reporting of CDAD in acute care hospitals and nursing homes for one year in 2006. 210 acute care hospitals and 966 nursing homes reported data to their local health districts which then reported data electronically to the Ohio Department of Health (DOH).

Both initial and recurrent cases were reported. Their definition of a recurrent case as a case that had had a previous episode of Healthcare Facility Associated (HCFA)-CDAD within the past 6 months [differs from new CDC definitions]. Cases were reported in aggregate by collecting counts of cases and denominator patient days for each month.

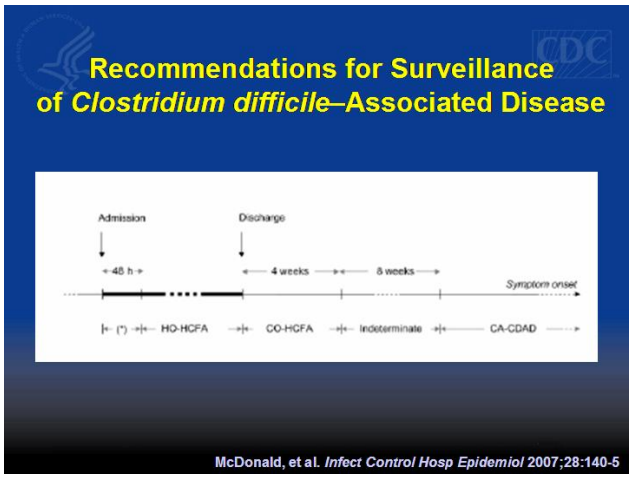


These data are available on the ODH website where you can find the final report of *C. difficile* cases during the reporting period. For initial cases, rates in acute care hospitals were 7-8 cases per 10,000 patient days, compared to 2-3 cases per 10,000 patient days in nursing homes. Rates of recurrent disease were similar in hospitals and nursing homes.

Some of the effects that were noted as a result of the reporting: the establishment of baseline incidence facilitated the recognition and reporting of 2 outbreaks at healthcare facilities in different counties. Also, the estimated personnel costs for reporting were given: almost $2.5 million for the state.



Mandates reside with each state. There is no evidence that public reporting improves or impairs patient safety. We need more data. Do not yet know the optimal data (outcome data vs. process measures) to collect. We're not sure if individual case reporting or aggregate reporting is best. Individual reporting allows for additional data collection to refine definitions and risk factors and may be the preferred method. The National Healthcare Safety Network (NHSN) is developing a multi-drug resistant organism module that will allow for individual case reporting.



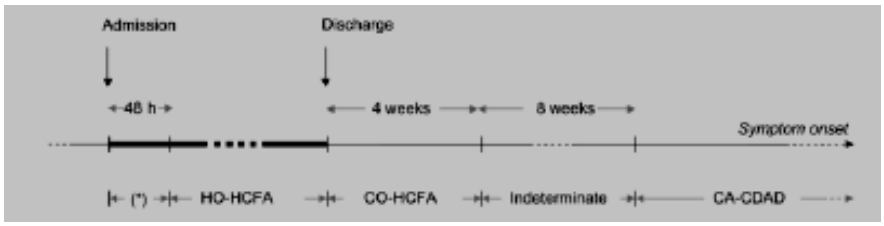
In response to the changing epidemiology of *C. difficile* and the need for standardized surveillance definitions, an ad hoc *C. difficile* surveillance working group was formed to develop interim surveillance definitions.

Healthcare facility-onset, healthcare facility associated CDAD is considered the minimum surveillance required for healthcare settings [occurring within the hospital 48 hours after admission], although hospitals can also track community-onset healthcare facility CDAD which is defined as CDAD developing within 4 weeks of discharge from a facility.

Community Associated-CDAD is defined as having an onset > 12 weeks after the last discharge. Everything in the middle is indeterminate.

The guidance also discusses the denominators that should be used when reporting healthcare facility-associated vs. community-associated CDAD (per 10,000 patient days and per 100,000 person-years, respectively). It also gives a definition for severe disease which will help standardize surveillance of complicated disease.

As I mentioned previously, some of these definitions may be fine-tuned as we gain more information on incubation periods and community onset vs. community associated disease.



Refinements to the definitions require research involving stain typing of isolates. Epidemiologic studies, however, are hampered by the lack of cultures performed in diagnosing CDAD. In most cases, isolates are not available to investigators to be able to correlate epidemiologic findings with strain typing. This makes it difficult to determine the role of epidemic strains vs. other risk factors in outbreaks. *C. difficile* cultures are also important in studies of colonization pressure and determining the sources of community-onset disease, for example.

Hospitals should conduct surveillance for CDAD using the recently proposed surveillance recommendations. Emphasis should be placed on early diagnosis and treatment in order to reduce severe outcomes.

Strict infection control should be practiced, including contact precautions, an environmental cleaning and disinfection strategy, and hand washing in the event of an outbreak [vs. alcohol hand gel]. Further research is needed on the role of antimicrobial controls in stemming this epidemic.

Thank you very much.

Q: I wonder if you can comment on the impact in the increasing numbers that are being seen in CDAD with an increased recognition of this as a disease and an increased 'attributation' of the mortality and severity of that pathogen as opposed to just a real increase in the actual numbers.

A: That is always a potential confounder in these studies – that people are more aware of it and may be testing for it more frequently. There certainly have been both perceptions of increased incidence and severity that we are seeing that probably supersede just the reporting. So I think the occurrence of more severe disease may have led to more reporting which increased the rates even more. But I think that the first thing that occurred was hospitals were noticing these outbreaks that were occurring and the colectomies and deaths.

Q: Did the group come up with denominators?

A: Yes. The denominator for nosocomial or HCFA is per 10,000 patient days. The community-associated is per 100,000 person-years.

Q: You gave a cost for the aggregate reporting of $2.5 million and you said you are going to look at individual case reporting. Do you have a budget for individual case reporting?

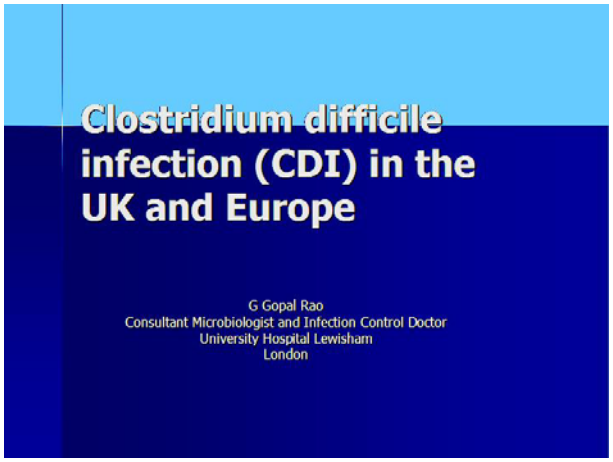
A: The data were actually from the state of Ohio, not national data. I'm not aware of any cost estimates for individual case reporting.

Q: Do you have any information on the epidemiology of *C. difficile* transmission – not necessarily CDAD. Example: rates of carriage in the community, in health populations. Are there any studies?

A: Rates of asymptomatic colonization in hospitalized patients vary substantially depending on the population studied. Some studies have indicated rates of 20% or higher and risk increases in direct proportion to length of stay. In contrast, rates of colonization in the community are on the order of 3%. The risk of transmission from symptomatically colonized patients is not well understood, however it is thought to be much lower than from symptomatic patients with CDAD.

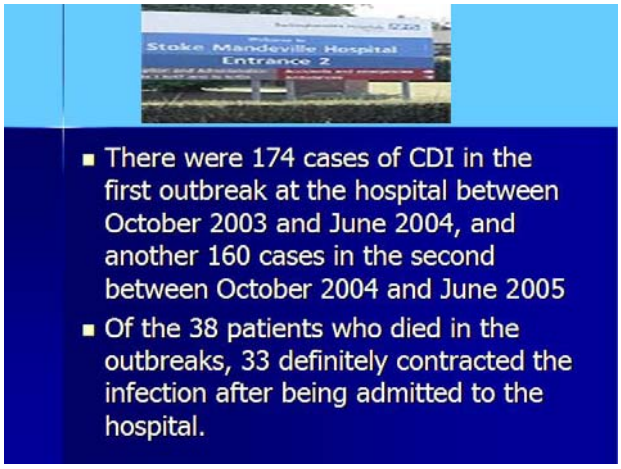
Sandra Callery - moderator

Our next speaker comes from the United Kingdom—Dr. G. Gopal Rao. Dr. Rao has been a consultant microbiologist and infection control specialist for 18 years. He has a special interest in infection prevention and control of healthcare-associated infections including *Clostridium difficile*, MRSA, and ESBLs. He is currently interested in developing innovative antibiotic guidelines, improving compliance, and assessing the impact of antibiotic guidelines on clinical outcomes, especially for *C. difficile* and antibiotic-resistant organisms, such as MRSA and ESBLs. Dr. Rao is a member of the Hospital Infections Society council and an advisor to the Department of Health and the Royal College of Pathologists. He is the author of over 50 papers on clinical microbiology and infection control.

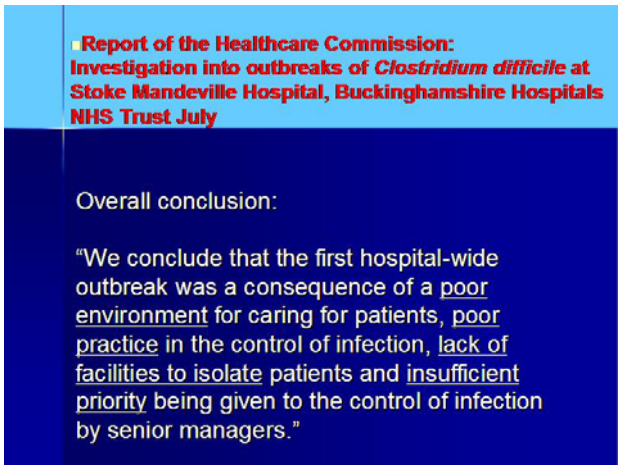


This presentation summarises the current situation with *C. difficile* infection (CDI) in the United Kingdom. Whilst the UK has one central government, health care is delivered differently in each of the four countries. This is particularly noticeable in surveillance systems.

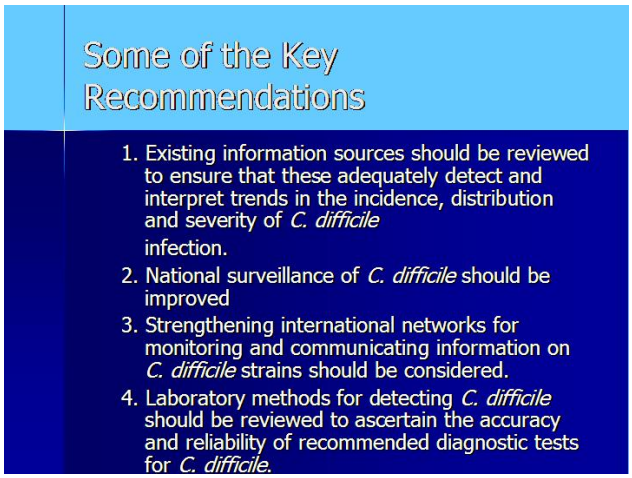
The life of *C. difficile* in the UK can be seen from before and after the Stoke-Mandeville incident. This was the first place we saw the 027 or NAP1 or B1 strain.



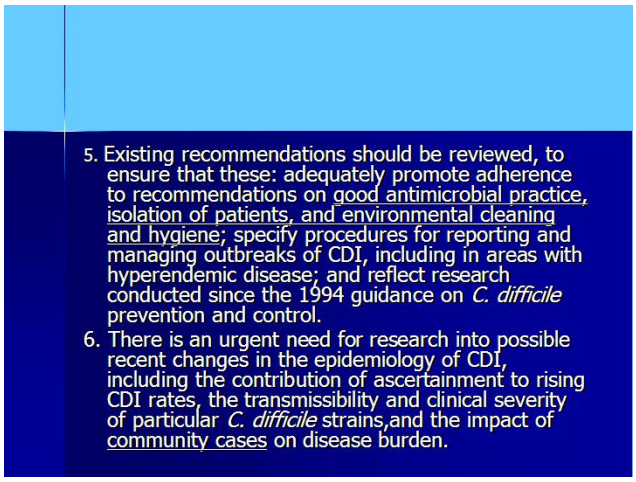
There were 174 cases of CDI with 38 deaths. There was uproar in the local press and a great deal of anxiety among patients. This lead to a Healthcare Commission inquiry [an independent authority that reviews hospitals when there are problems and ensures standards are maintained]. They concluded that there was increased focus by the hospital on managing waiting lists; there was a mandate that no one shall wait more than 4 hours in the accident and emergency department and no one shall wait more that 12 hours before being admitted to the hospital. There were other such targets too. What happened was the hospital managers were focused on these targets and were paying scant attention to infection control problems.



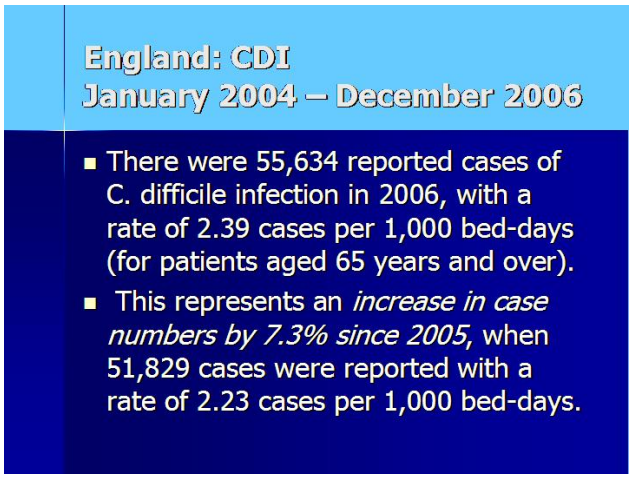
The conclusion was a poor environment, poor practices, lack of isolation, and insufficient attention to infection control (IC).



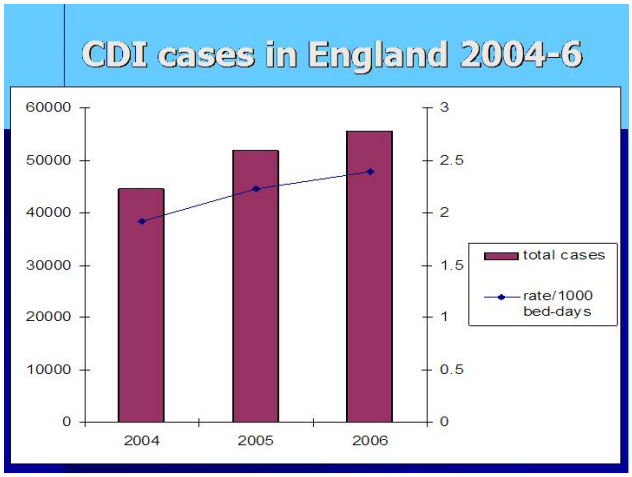
The commission produced several recommendations. Generally the focus is on surveillance, practices and learning more about the scale of the problem.



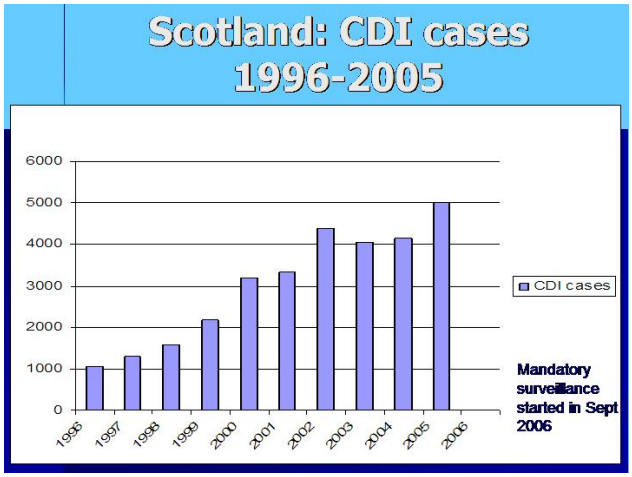
A key point to emphasise is the importance of good antimicrobial practice, isolation of patients and environmental cleaning and hygiene.



What is the burden of disease in the UK? As in other parts of the world, ascertainment, testing methods and surveillance methods are issues that may affect the estimation of the true burden of infection. In 2004 England introduced mandatory surveillance. Surveillance was only on individuals greater than 65 years of age. This is being rethought because cases are being seen in younger populations. There has been a real increase in both rates and number of cases.



This graph shows an upward trend.

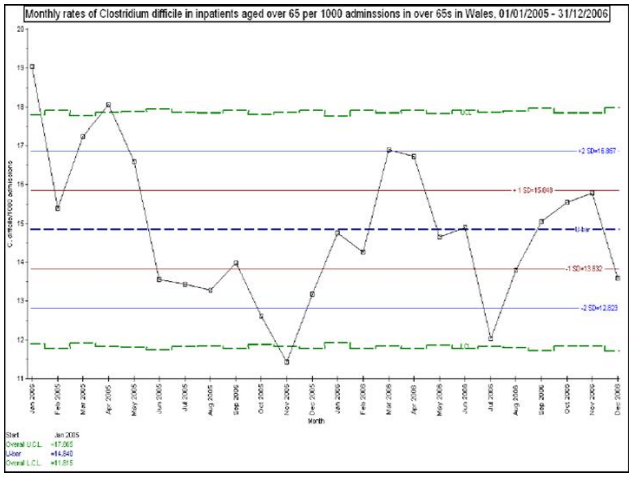


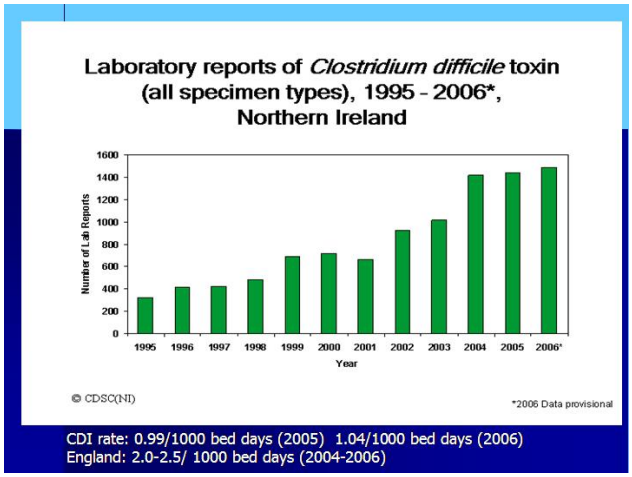
Scotland started mandatory surveillance in September 2006. Before then the data are questionable; however, since 2006 a true increase can be seen.

Wales: CDI cases 2005-2006

- The total CDI rate per 1000 admissions in in-patients over 65 years in Wales for this period was **14.84,** this compares with a rate of 14.79 in 2005.
- The range of rates was from 6.48 – 32.78 cases per 1000 admissions >65 years.
- CDI rates in Wales have remained steady over the 2 year period of the mandatory surveillance scheme so far.
- These data are NOT comparable with the English data as the cases in England are looked at per 1000 patient bed day > 65 years rather than per 1000 admissions.

Wales has also noted an increase in cases – even though the denominator used is different. This points to the need for uniformity in surveillance definitions.



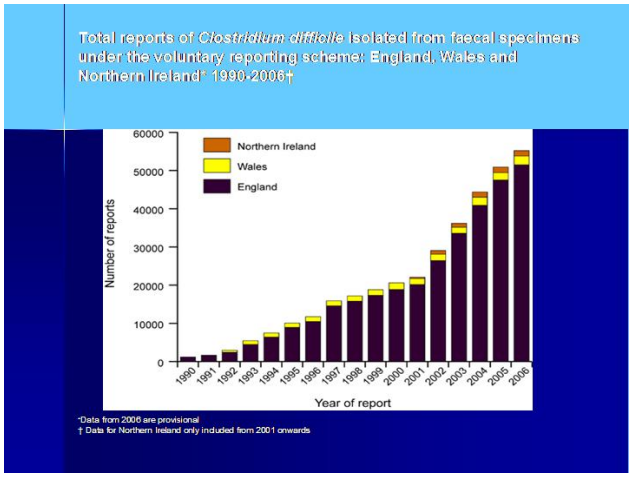


These data are from Northern Ireland. They have good surveillance systems. Mandatory surveillance began in 2004. The rate is 0.99 per 1,000 bed-days compared to England's 2-2.5. In general, Northern Ireland has the lowest rate of hospital-acquired infections of the four countries in the UK. These data are from a national hospital-acquired infection prevalence survey conducted in 2006.

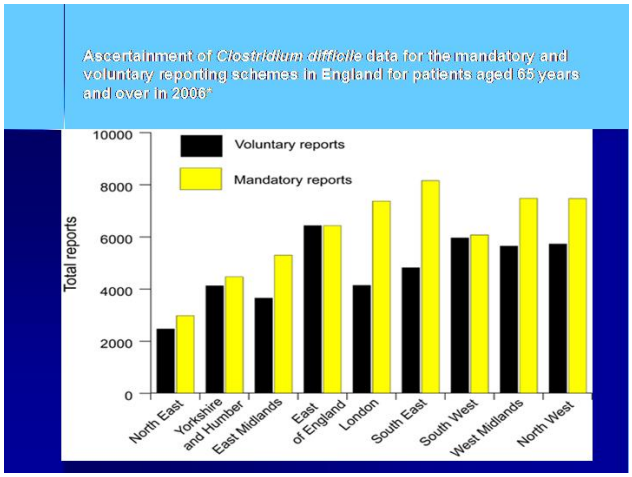
Latest HPA (England) Report

- Number of CDI reports (data from 168 NHS acute Trusts)
  - January – March 2006: 15,342 cases
  - April – June 2006: 14,681 cases
  - July – September 2006: 12,814 cases
  - October – December 2006: 12,797 cases
  - January – March 2007: 15,592 cases (22% increase over previous quarter but comparable to same quarter last year)
    - Source: HPA England

The latest data are from January – March 2007. There has been no real difference compared to the rate for January – March 2006.



Putting the three countries together, there has certainly been an increase in numbers of cases. England, being the larger country, accounts for most cases; however the numbers are increasing in all three countries.



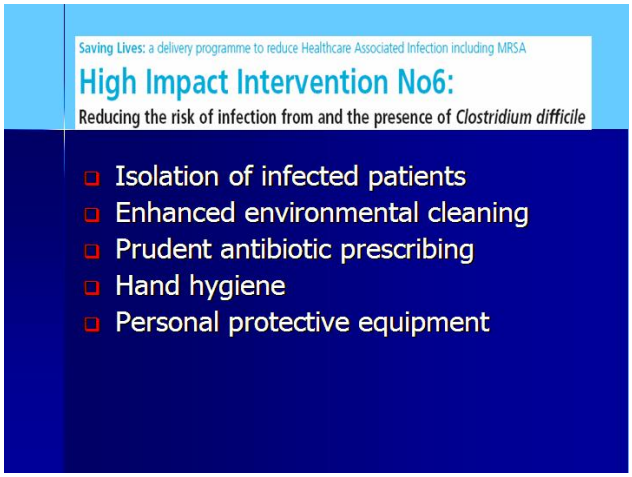
This is a graph to demonstrate the variation noted between voluntary and mandatory reporting. Certain areas of England were better than others in voluntary reporting. Note the huge difference in London. Unless there is a mandatory requirement to report disease the data will be variable.

Mandatory reporting brings a sense of uniformity. However, even with mandatory requirements for reporting, if no stool is sent for testing on patients with diarrhoea, there will be no detection of *C. difficile* and, therefore, no reporting. So there may be a bias in the data. Some clinicians test semi-formed stool [using the Bristol Stool Scale which ranges from 1-7] and others do not. [NOTE—See page 82]

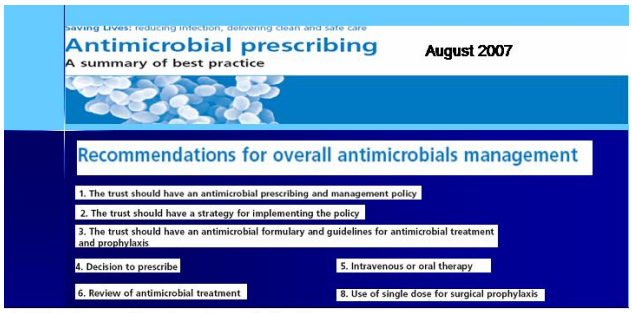
Performance monitoring: there are performance management teams in each strategic health authority. They have led to an increased focus on *C. difficile*.

Legislation (England): The new Code of Practice has hygiene as an important aspect. This code has the same level of authority as the Health and Safety Act. Thus, there can be inspections with findings placed on the Internet as a public document. There can be notices served and if they are not complied with, the chief executive can be taken to court.

Funding: There is a bit more funding available now for infection prevention and control.



The Department of Health in England has produced a number of policies and documents to reduce hospital-acquired infections. These include a document outlining the 'high impact' interventions designed to reduce CDI. The implementation of these interventions are checked when the Health Care Commission inspects hospitals regarding compliance with the Code of Practice as outlined earlier.



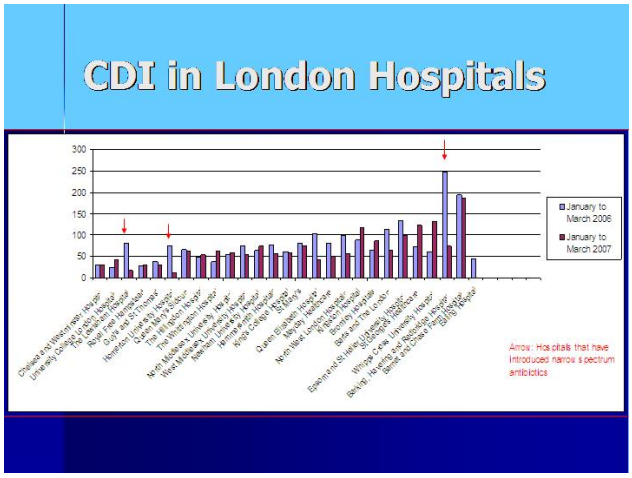
7. Minimising use of broad-spectrum antimicrobials
As observed above, the use of broad-spectrum antimicrobial agents is a major factor in inducing CDAD. Clinicians should therefore avoid the widespread use of cephalosporins, quinolones, broad-spectrum penicillins (including amoxicillin) and clindamycin unless there are clear clinical indications for their use.

Broad-spectrum antimicrobials should be restricted to the treatment of serious infections when the pathogen is not known or when other effective agents are unavailable.

Restricted antimicrobials should not be held in main ward stocks and should only be issued on advice from a microbiologist/infectious diseases consultant or under an agreed policy.

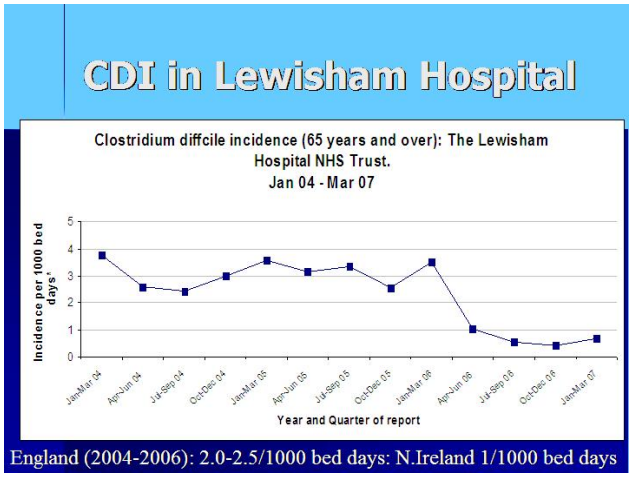
These antimicrobial prescribing guidelines are 'hot off the press'. Antimicrobial prescribing in the UK is treated as if we are giving essential nutrients to patients. Junior doctors are often the individuals making these decisions so these guidelines are welcome.

Point #7 states – minimize the use of broad spectrum antimicrobials. Avoid cephalosporins, quinolones, broad-spectrum penicillins, and amoxocillin. This goes against many guidelines for the treatment of community acquired pneumonia and chronic obstructive pulmonary disease.

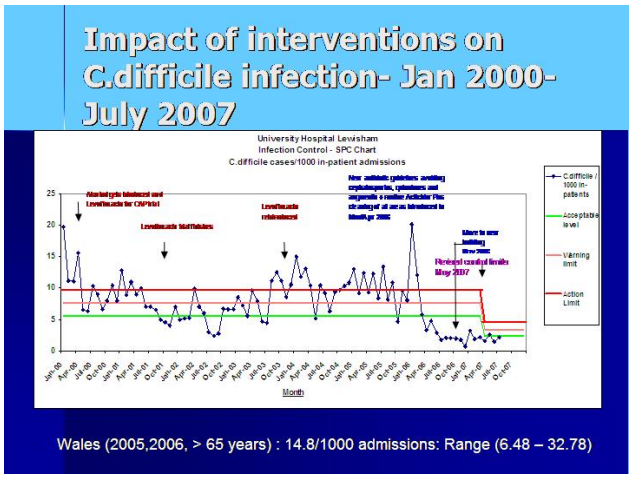


I want to focus on London where I work. Note the three hospitals with the red arrows. These data compare the first quarter of 2006 with the first quarter of 2007. These three hospitals have had a substantial reduction in *C. difficile*. One of the hospitals is where I work – Lewisham. The others are Homerton and Barking.

What is common to these three hospitals? Lewisham Hospital uses very narrow-spectrum antibiotics: trimethoprim, nitrofurantoin, benzyl penicillin, penicillin V, as does Homerton Hospital. Barking has adopted this practice as well. This has had an immediate impact.



Lewisham was far worse than the national average – about 3 cases of CDI per 1,000 bed-days. After visiting [and learning from] Stokes-Mandeville, I convinced my hospital that we needed to do something to stop this trend. We intervened and are now at 0.5 per 1,000 bed-days.



Interventions noted above, from left to right:

- Alcohol gels introduced and levofloxacin for CAP trial
- Levofloxacin trial finishes
- Levofloxacin reintroduced
- New antibiotic guidelines avoiding cephalosporins, quinolones and augmentin + routine Actichlor Plus cleaning of all areas introduced in March/April 2006
- Move to new building, November 2006
- Revised control limits, May 2007

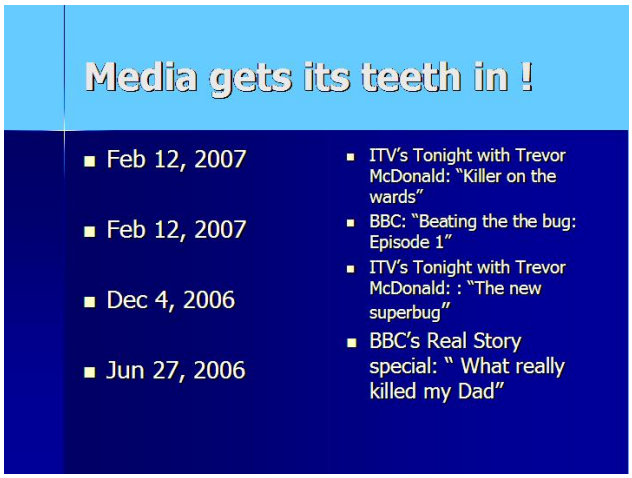
This is the statistical process control chart from our hospital. It shows the impact of interventions. We were the first hospital to use alcohol gels in 1999-2000; our *C. difficile* and methicillin-resistant *S. aureus* rates came down. At the same time we performed a trial to compare *C. difficile* – associated diarrhoea in patients with community-acquired lower respiratory infection treated with levofloxacin compared with beta-lactam-based therapy.

The main outcome measure was the incidence of CDI rather than patient improvement. We saw a decrease that I attributed to the levofloxacin. When the trial was completed we return to our old practices and *C. difficile* started creeping up – seemingly associated with conclusion of the trial. We then successfully argued to get levofloxacin included on the formulary in light of the reduction in CDI seen during the trial.

Following the reintroduction of levofloxacin, my colleagues told me they were seeing more diarrhoea on the wards than before. However I remained unconvinced and sought other reasons for the diarrhoea – such as excessive use of laxatives, etc. The fact was that we were indeed seeing more cases of CDI since introducing levofloxacin into the formulary. We were using it for chest infections and norfloxacin for urinary tract infections. So, between the two we were using a lot of quinolones.

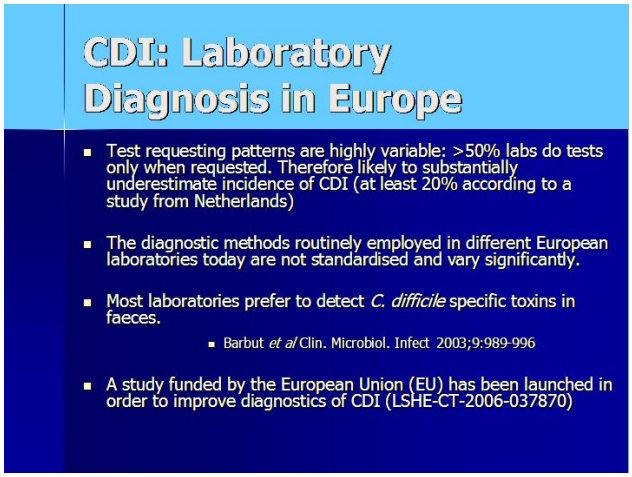
In January 2006 we decided to implement 'narrow-spectrum' antibiotic guidelines. They are absolutely stringent. We review them on ward rounds daily and seek out individuals who have 'strayed from the straight and narrow'.

We also started cleaning <u>all</u> clinical areas with a detergent/chlorine product – not just those associated with *C. difficile* patients. I have been very impressed by the low levels we have achieved.

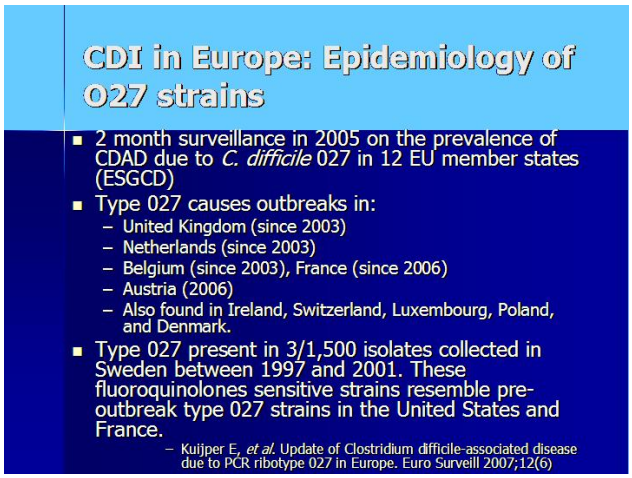


The media has also had a role to play in this issue.

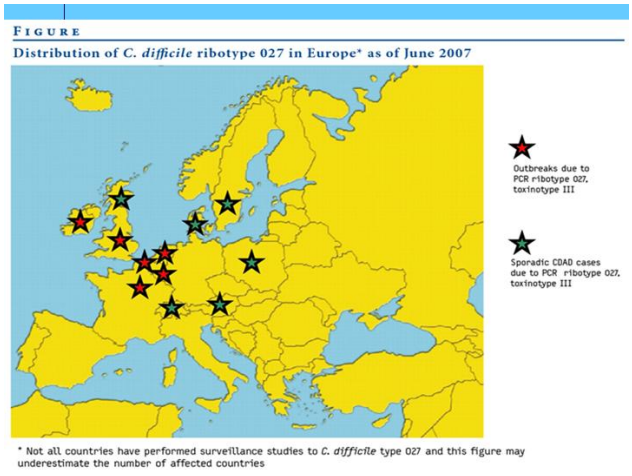
So, what is happening in Europe? The answer is unclear.



The diagnosis is variable. The data are not reliable in all countries. They have started a new project to look at the laboratory diagnosis of CDI.



A two-month surveillance project during 2005 found strain 027 prevalent in 12 EU states. There were outbreaks in England, the Netherlands, Belgium, Austria, and sporadic cases in Ireland, Switzerland, Luxembourg, Poland, and Denmark. They also found that the same strain, although not quinolone-resistant, was in historical isolates from Switzerland. Similar strains were found in the UK.



If you look at the map of Europe, you can divide it into those with red and green stars and those with none (no data available). You can see in Eastern Europe, Spain and Italy there are no stars at all. This may be partly due to testing and surveillance mechanisms.

Q: Part of the expected backlash from physicians is when the national health system comes up with guidelines that suggest avoiding fluoroquinolones, cephalosporins, amoxicillin, and lindamycin. As a practicing infectious diseases doctor or hospitalist my question is – what's left? Is it better for people to die of nosocomial pneumonia or *C. difficile*? I think it is very hard to tell a physician we're going to take away all your tools and this is how you are going to control X or Y infection. They look at you and say the guidelines are essentially worthless because you are not leaving me anything with which to treat my patients.

A: That's an excellent question. I was acutely aware of this issue when the guidelines were introduced. Three months after introducing the guidelines we performed an audit. Using ICD-9 codes, we compared respiratory and urinary infections before and after [600 patients in each group] the introduction of the guidelines. We evaluated length of stay, readmission due to the same condition within 1 month, and in-hospital mortality. After controlling for some variables, e.g., age and sex, we found no difference between the groups. However, there was a dramatic reduction in *C. difficile* infections. We will now be looking back at an entire year. These data were important in convincing physicians.

Q: Regarding the high impact interventions you mentioned, are these best practices legislated? Are hospitals required to implement them or are they only recommendations?

A: There is no legislative basis. However, if a hospital is not performing well, the hospital will be asked to introduce these measures. If it does not, that fact will be made known to the public.

Q; You mentioned means of identifying *C. difficile* and interventions that you believe had a lot of success. How do you do it? Many of us want to do these things too, however we don't have the personnel, the time, etc.

A: We did it with difficulty! I had a passion and was trying to prove a point. What helped: I perform ward rounds daily and we removed all the other antibiotics from the wards. The dispensary lets me and the antibiotic pharmacist know if any of the other antibiotics are ordered and by whom. Say ciprofloxacin is being prescribed for hepatobiliary sepsis – that is fine. However, if it is being used because that is what they used in a previous hospital, I will discuss it with the junior doctor and describe why we don't use quinolones in this hospital. It is a tremendous amount of effort. However after 1½ years, it is now becoming part of the psyche of the hospital. The physicians realize that our hospital is different from the others.

Q: What are your diagnostic methods for *C. difficile*?

A: We use only toxin-based assays for both A and B. We perform cultures when we suspect an outbreak. We consider a cluster of four cases an outbreak. The London Strategic Authority collects strains from every hospital every so often. These strains are then typed. The majority of isolates are the common 001 strain.

Q: I noted you moved to a new building in late 2006. Can you comment on how facility design may have had an impact on your reduction?

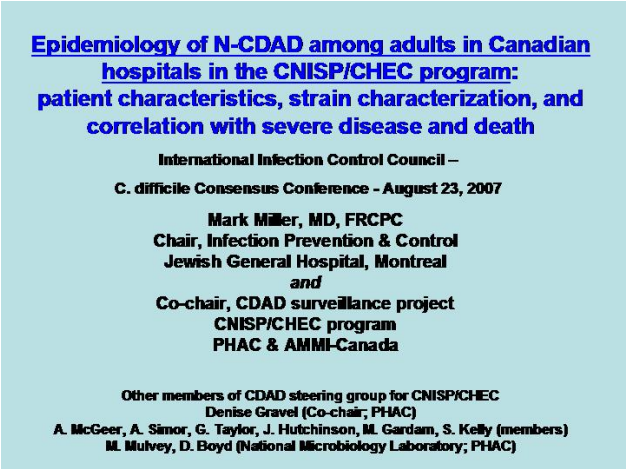
A: We have not yet assessed this issue. However, I do think it has allowed us to contain problems more quickly. We now have 4-bedded bays with very separated beds. 30-40% are single rooms. It has been very, very useful operationally.

Q: Because you have had the luxury of moving to a new hospital, did you do any environmental testing to see what your spore background rates were in the old facility vs. the new facility?

A: It did cross my mind. Unfortunately we did not. However, we tested the new one prior to moving in and have been monitoring ever since. We haven't found any spores in the environment thus far.

Sandra Callery - moderator

Our next speaker is Dr. Mark Miller. Dr. Miller's subspecialty training was in Montreal at McGill University in the field of infectious diseases and medical microbiology. He then pursued a masters degree in epidemiology and statistics. He has been a staff microbiologist and an infectious disease specialist in Montreal's Jewish General Hospital since 1993. He has become the chair of the infection prevention and control committee, the chief of microbiology and the head of the division of infectious diseases. The bulk of his research has been in the epidemiology, prevention, and treatment of nosocomial infections, where he has described the rapid emergency of mupirocin resistance among MRSA, chaired the cross-Canada group studying the morbidity, health effects, and death rate from hospital-acquired *C. difficile*-associated diarrhea (CDAD), and headed the Canadian team which surveyed the reuse of single-use medical devices. He is currently studying CDAD in depth, including the recent epidemiology of severe CDAD in Canada, CDAD prevention using Lactobacillus probiotics, CDAD therapy with novel antibiotics and IVIG, and the use of laser-induced emissions for the ultra-rapid diagnosis of CDAD from stool samples. He has also helped establish the Quebec province-wide guidelines for physicians, dentists, and other healthcare workers infected with blood-borne diseases and is the Chairman of the Infection Control Working Group of McGill University, which harmonizes infection prevention and control practices in the Faculty of Medicine and in all McGill-affiliated health institutions. He has co-authored over 80 scientific publications and presented over 90 abstracts. He is a past-president of the Association of Medical Microbiology and Infectious Disease of Canada (AMMI Canada), the professional society of over 500 Canadian physicians involved in the prevention, treatment, and research in the field of infectious diseases.



The information I am going to give you is from a Canada-wide survey. It is 'hot off the press' after a year of difficult data-gathering due to computer and web-based glitches.

Canadian Nosocomial Infection Surveillance Program (CNISP)

•CNISP is a collaboration between:

Canadian Hospital Epidemiology Committee (CHEC), a sub-committee of AMMI-Canada

29 participating members in 9 provinces

41 teaching hospitals

12 with affiliated LTCFs

13 with pediatrics

6 stand alone pediatric hospitals

AND

The Public Health Agency of Canada (PHAC)

- Nosocomial and Occupational Infections Section
- National Microbiology Laboratory (NML)

The Canadian Nosocomial Infection Surveillance Program (CNISP) is a collaborative effort of the Canadian Hospital Epidemiology Committee (CHEC), a subcommittee of the Association of Medical Microbiologists and Infectious Disease (AMMI) and the Centre for Infectious Diseases Prevention and Control (CIDPC) of the Public Health Agency of Canada [Nosocomial and Occupational Infections section and the National Microbiology Laboratory].

Established in 1994, the objectives of CNISP are to provide rates and trends on hospital-acquired infections at Canadian health care facilities thus enabling comparison of rates and providing evidence-based data that can be used in the development of national guidelines on clinical issues related to hospital-acquired infections. At present, 41 university-affiliated hospitals from 9 provinces participate in the CNISP network. 12 hospitals have long-term care facilities, 13 are combined adult-pediatric institutions, and 6 are stand alone pediatric hospitals.

1997 CNISP N-CDAD Surveillance Project

- Six week prospective surveillance study within 19 CHEC hospitals in 8 Canadian provinces
- The mean number of N-CDAD cases was 5.9 cases/1000 patient admissions (6.6 cases/10,000 pt-days)
- 41 (15.2%) died, of which 4 (1.5%) were directly or indirectly related to N-CDAD

The only multi-center Canadian study which examined the healthcare burden of *C. difficile* on Canadian hospitals was conducted in 1997 by the CNISP. The study was a six week prospective surveillance within 19 CHEC hospitals in 8 provinces.

I will be using the same denominators consistently through this presentation. The two denominators I will use are: 1,000 patient admissions and 10,000 patient days.

During this period, the participating CHEC hospitals tested all diarrhoea stools from hospitalized patients for *C. difficile* toxin detection. Among inpatients with diarrhoeal stools, 13% were caused by *C. difficile*. The mean number of nosocomial or N-CDAD cases was 5.9 cases/1000 patient admissions or 6.6 per 10,000 patient days.

A sub-section of the initial project addressed morbidity, mortality and healthcare burden of N-CDAD in the same hospitals. Of the 269 patients that satisfied the N-CDAD case definition, 41 (15.2%) died, 4 (1.5%) of these were directly related to CDAD. The only literature at the time that looked at mortality due to *C. difficile* found rates of 0.8-1.2%.

This report was pivotal as it provided baseline rates to which other Canadian hospitals could compare.

2004-5 HA-CDAD* Surveillance Project

- To determine the incidence and burden of illness associated with HA-CDAD in CNISP hospitals again, in 2004/05
- To determine if there is a change in incidence, morbidity and mortality compared to 1997
- To establish a large national Canadian collection of clinical isolates *(linked to clinical outcomes)*, on which analyses could be conducted in order to investigate the molecular epidemiology, pathogenicity, and spread of *C. difficile;* and determine if certain strains (including NAP1/027) are associated with severe clinical outcomes across all patient groups
- To determine the geographic distribution of C. difficile isolates, including NAP1/027, and be able to track their spread over time and across the country

* N-CDAD replaced by HA-CDAD (Healthcare-Associated)

After this study we had major outbreaks and decided to perform a second surveillance project looking at Hospital Acquired (HA) – CDAD. [Cliff McDonald's article suggests additional names for this disease related to hospitalization and disease after one has been in the hospital. It is not easy to figure out which term to use.]

CNISP will be funding this study annually since CDAD is such an important disease now in Canada. The study in 2004-5 evaluated the incidence and burden of illness. In addition, strains were collected from each patient to establish a large collection of Canadian clinical isolates linked to their clinical outcome. This is the largest world-wide collection of strains and clinical outcomes in existence.

METHODS

- 6 months prospective surveillance in 34 CNISP hospitals from 9 provinces including 4 stand-alone pediatric hospitals.
  - November 1st,2004 – April 30th,2005
- Eligible patients
  - all hospitalized patients at least 1 year of age, meeting the case definition for HA-CDAD

The study lasted 6 months [2004-2005] in 34 hospitals from 9 provinces. Pediatric facilities were included.

CASE DEFINITION FOR CDAD*

- Diarrhea ***or*** abdominal pain with fever ***and/or*** ileus ***and***
  a positive toxin assay for *C.difficile*
  OR
- Diagnosis of pseudomembranous colitis on sigmoidoscopy or colonoscopy or pathological diagnosis of CDAD (biopsy and/or autopsy)

*Fulfillment of definition ≥ 72 hrs post-admission *or* required readmission

We used the standard definitions for CDAD.

Clinical outcomes

- Clinical outcomes were assessed 30 days after the date of diagnosis of CDAD
- Severe outcome defined as:
  - Death directly related to CDAD
  - Death indirectly related to CDAD
  - ICU admission for complications of CDAD
  - Colectomy because of CDAD

We evaluated the same clinical outcomes described in our 2005 *New England Journal of Medicine* article: 30 day mortality and a determination as to whether it was related to CDAD – directly, indirectly or not related. We had 85% inter-rater reliability. [Loo]

Severe outcomes were death and intensive care unit admission or colectomy due to CDAD. These are hard endpoints.

Epidemiology

***

Patient Characteristics

***

Severe Outcomes

RESULTS

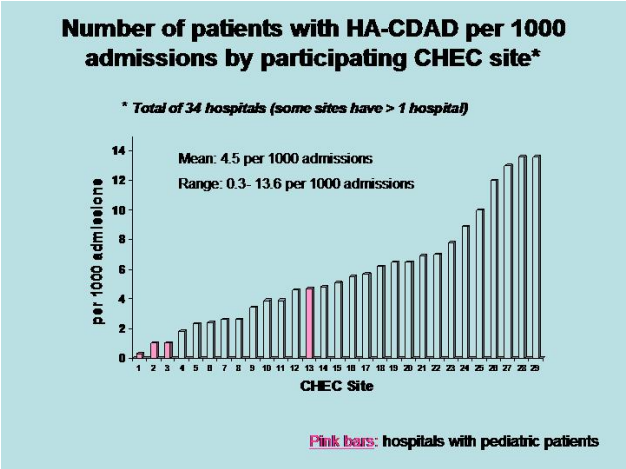
- 1493 patients with HA-CDAD

Adults 1430 **(95.8%)** **Children** (≤ 18 yo) 63 **(4.2%)**

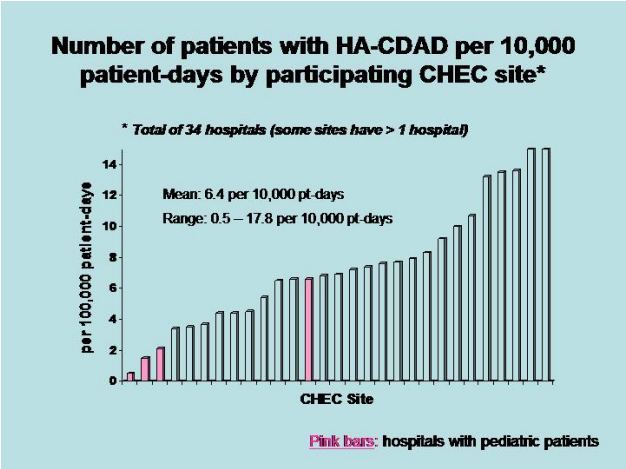
- **For adults only:**
  - Male/Female: 733/697 (1.05:1)
  - Mean age 70 ± 16 years (Range 19-101)
- **For children only:**
  - Male/Female: 27/36 (1.33:1)
  - Mean age 7 ± 6 years (Range 1-18)

There were 1493 patients in the study with HA-CDAD. 1430 were adults and 63 children. I will not be discussing data on the children during this talk.

The male to female ratio was 1.05. The elderly bear the major brunt of the disease as seen elsewhere with the mean age 70±16 years.

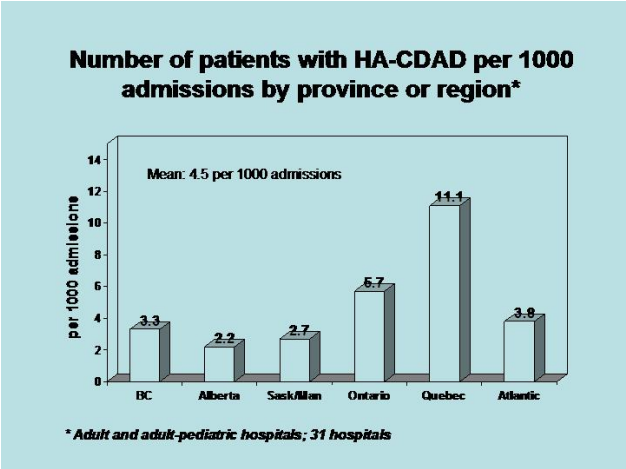


The mean CDAD rate for all hospitals was 4.5 [compared to 6 in the 1997 study]. It looked as if the rate had actually gotten better. However, there are more hospitals above the mean in this survey than in 1997. And there were more hospitals way above the mean in this survey. You can see the range is quite large with some hospitals being 3-4 times the mean.

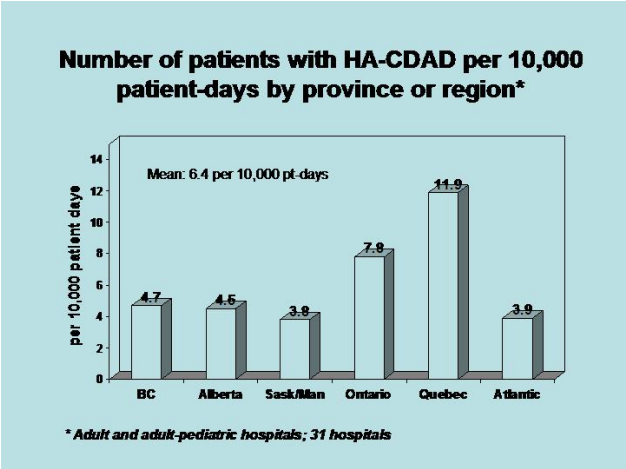


These are the data per 10,000 patient days. You can see the same kind of scatter. The mean is 6.4 which is about the same as in 1997 [6.6]. Again, more hospitals are above and way above the mean.

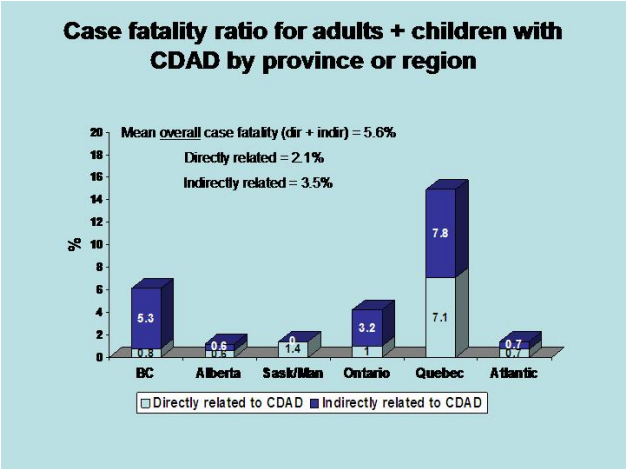
This is Canada. All of the following tables will go from west to east in listing the provinces.



In looking at the number of patients with hospital acquired -CDAD per 1,000 admissions by province or region note that Quebec is the hardest hit with 11.1 per 1,000 admissions. Ontario is second with 5.7 [above the mean] Outbreaks have been occurring across Ontario with the NAP1 strain. Atlantic provinces are below the mean.



There is the same type of spread looking at the data per 10,000 patient days.



Here is the case fatality – directly and indirectly related to *C. difficile*. This study was performed during the outbreaks in Quebec and there was a 14.9% rate; during this two year period it is estimated that 2000-3,000 patients died due to *C difficile*.

In Ontario indirectly related deaths were 3.2%; directly related were 1%. This rate is 3 times higher than the national average in 1997. There also appears to be a problem in British Columbia. The rest of the provinces seem consistent with 1997 data.

SEVERE OUTCOMES* IN ADULTS

- Colectomy
  - 12 (1.0%) patients
- ICU admission for CDAD
  - 31 (2.0%) patients
- Died: 233 (16.3%) patients
  - Directly related to CDAD: 31 (2.1%)
  - Indirectly related to CDAD: 51 (3.5%)
  - Unrelated to CDAD: 151 (10.6%)

*Some patients may have had > 1 severe outcome

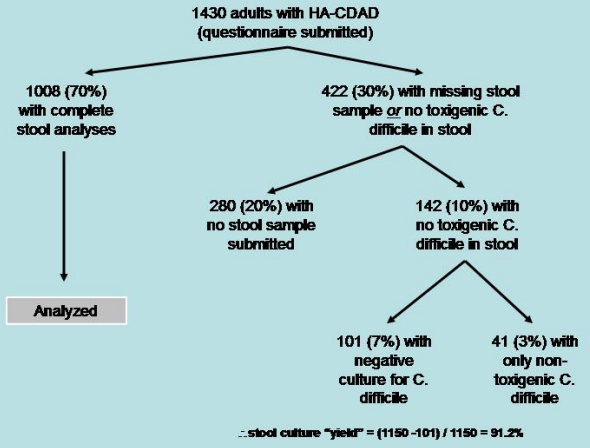
There were 12 patients who had colectomies for a rate of 1%. 31 patients went to the intensive care unit (ICU) because of CDAD for a rate of 2%. Both similar to what was seen previously. The death rate was 5.6% - about 3.5 times the 1997 rate. Why did this happen?

Strain characteristics

****

Patient outcomes

We looked at the strain characteristics related to patient outcomes. It was clear the NAP1/0127 had reared its ugly head in Quebec and it was probably in the rest of the country as well.



We had 1430 adults with HA-CDAD who submitted a complete questionnaire. Of those, 1,008 had a stool analysis completed [stools were frozen at the hospitals and sent to the central laboratory. Mike Mulvy in the National Microbiologic Laboratory performed all the analyses over a 6 month period.

After testing there was a culture yield of about 91.2%. This is consistent with other laboratories.

Analysis of *C. difficile* isolates

- Susceptibility testing to selected antibiotics
  - CDAD-therapy antibiotics: vanco, mtz, teicoplanin
  - Cephalosporins (1º, 2º, 3º generation)
  - Clindamycin
  - Fluoroquinolones (levo, gati, moxi)
- PFGE (typing)
- tcdB (toxin B) PCR
- tcdA (toxin A) PCR
- tcdC (negative regulator gene) PCR
- cdtB (Binary toxin beta unit) PCR

We performed susceptibility testing, PFGE typing, the usual toxin A & B analysis to make sure the isolates were toxigenic, evaluation of the *tcdC* mutation, and looked for binary toxin.

1008 patient isolates linked with clinical information

311 (31%) NAP1

283 (28%) NAP2/J

11 (1%) NAP3

36 (4%) NAP4

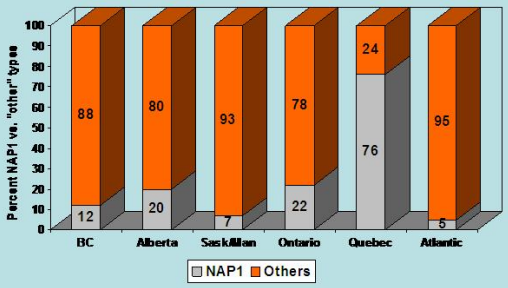
3 (0.3%) NAP5

31 (3%) NAP6

333 (33%) "others"

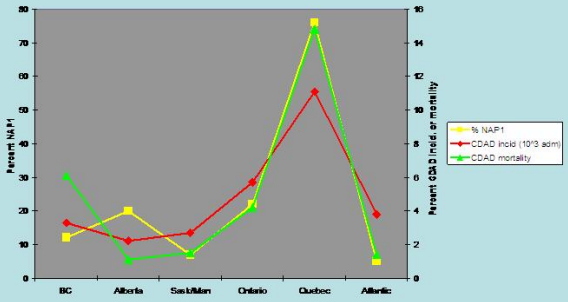
Of 1,008 patients where we had clinical information and the isolates, 31% were NAP1/0127. 28% were NAP2 or the old 'J' strain. The rest were a variety of strains.

Distribution of C. difficile NAP1 in adults, by province or region (n=1008)



If you look at the distribution of NAP1/0127 by province or region, Quebec is the leader in the country with Ontario and Alberta tied for second place. The other provinces have much less.

Distribution of C. difficile NAP1/027 and both CDAD incidence & attributable mortality, by province or region (n=1008)



I think this is one of the most interesting slides. If we superimpose the percentage of NAP1 strains infecting the patients in this study over the CDAD incidence and mortality for that province, we get remarkable parallel curves.

Quebec had the highest rates and the highest mortality. One caution: in 2004-5 there were only 2 hospitals in Quebec that participated in the study. In each hospital, approximately 70-75% of the *C. difficile* patients had NAP1. Currently in my hospital 80% of the CDAD patients had NAP1/0127.

Clinical outcome and presence of NAP1/027 strain

	NAP1/027	Other types	*TOTAL*
Severe CDAD	39 **(12.5%)**	41 **(5.9%)**	80
Survived; no severe outcome	272 **(87.5%)**	656 **(94.1%)**	928
TOTAL	311 **(100%)**	697 **(100%)**	1008

P = 0.0003 (Chi-Square Test)

I think this study will put to rest the question: Is NAP1 associated with more mortality? Comparing patients with severe CDAD [death and intensive care unit admission or colectomy due to CDAD] to patients with no severe outcome, 12.5% of patients with NAP1 died. 5.9% of patients without NAP1/0127 died. The p-value was extremely significant.

Put another way……..

- 12.5% of patient with a NAP1/027 strain developed severe disease

while only

- 5.9% of patients with a non-NAP1/027 strain developed severe disease

↓

Patients infected with NAP1/027 were *TWICE* as likely to experience a severe outcome

In other words, 12.5% of adults infected with NAP1 are going to develop severe disease. Only 5.9% of adults who developed non-NAP1 disease will develop severe disease. Adults infected with NAP1/0127 were twice as likely to experience a severe outcome.

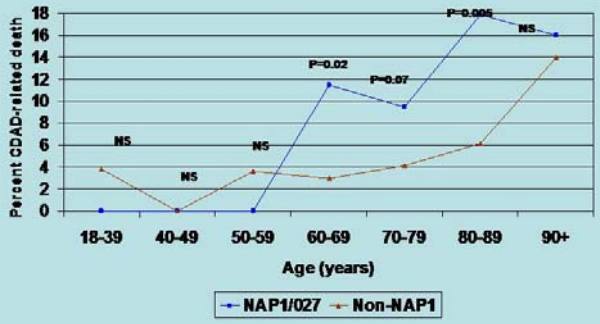
But the question remains.....

- Why do only 12.5% of NAP1/027 – infected patients develop severe disease?
- What makes them different?
- What "protects" the other 87.5%, who don't progress to severe disease?
  - – ? Rapidity of diagnosis and onset of therapy
  - – ? Type of therapy (vanco vs. mtz)
  - – ? Immunodeficiency
  - – ? Age

However, why do only 12.5% of adults infected with NAP1 develop severe disease? What makes them different? What protects the other 87.5% who do not progress to severe disease?

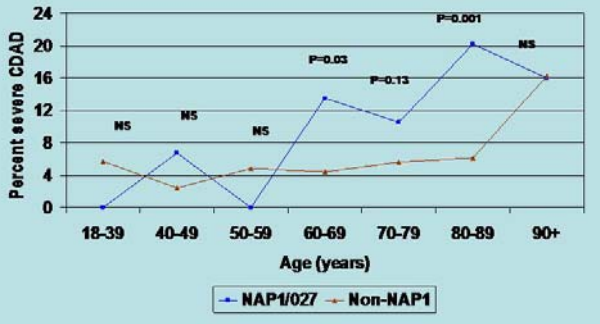
Is it delayed diagnosis and therapy? Are they receiving the wrong type of therapy [there is controversy regarding vancomycin vs. metronidazole]? Are they immunodeficient? Is there something else?

Effect of strain type on *CDAD-related death*, by age (n=1008)



The highlight of our analysis was age. Under the age of 60 your outcome is the same in terms of severe outcome regardless of the strain of *C. difficile*. However, above the age of 60, it makes a great deal of difference whether you are infected with NAP1 or not. Above the age of 90, individuals do not tolerate *C. difficile* well at all regardless of strain. These patients have the highest mortality and severe outcome rate.

Effect of strain type on *severe outcomes*, by age (n=1008)



The strain that infects patients makes the biggest difference between the ages of 60-90 years.

Age-related CDAD-attributable mortality (%)
Comparison of Quebec* & Canadian (CNISP/CHEC) data

	Quebec*	CNISP/CHEC
< 40	2.6	3.0
41-50	1.2	0
51-60	3.2	2.8
61-70	5.1	5.4
71-80	6.2	5.9
81-90	10.2	10.4
>90	14.0	14.7

*Loo, Poirier, Miller et al. NEJM 2005;353:2442-9

Looking at all data across Canada in comparison with the Quebec outbreak you can see the columns match almost identically in each decade. The rate increases decade by decade except in the 40-50 year old group.

Conclusion: impact of age on CDAD outcome

- Under the age of 60, strain type does not (on average) seem to be associated with severe outcomes
- Over the age of 60 (but not in the "extreme" elderly >90 yo), infection with NAP1/027 is highly associated with severe outcomes (approx. 3x incidence)
- In the "extreme" elderly (>90 yo), severe outcomes are frequent, regardless of the infecting strain type
- The cross-Canada data is remarkably similar to the Quebec outbreak data, in terms of the incidence of age-related CDAD-attributable mortality

The conclusions:

1. Under the age of 60 strain type does not appear to be related to severe outcomes.
2. Over the age of 60 infection with the NAP1 strain is highly associated with severe outcomes. Approximately 3 times the incidence.
3. In the extreme elderly, severe outcomes are frequent, regardless of strain type.

What is it about "age"?

- Immunologic senescence?
  - "global" immunologic weakening?
  - Specific C. difficile immunologic deficiency?
- Previous studies in adults showed increased risk of disease when levels of anti-Toxin A IgG were low

What is it about age? I don't know, however I suspect it is a global immunological senescence. There is an immunological weakening as we age. Studies have shown there is increased risk of disease when there are decreased levels of anti-toxin A IgG.

Antibiotic susceptibility results

Antibiotic susceptibility results

- **No** isolate was resistant to metronidazole
- **No** isolate was resistant to vancomycin
- **No** isolate was resistant to teicoplanin

- **All** isolates resistant to ciprofloxacin
- **All** isolates resistant to cefuroxime
- **All** isolates resistant to cefotaxime

The antibiotic susceptibility results showed that there was no resistance to any of the drugs we use to treat disease in vitro regardless of strain. All the isolates were resistant to ciprofloxacin, cefuroxime, and cefotaxime.

	NAP1/027 % R	Others % R	P value
Clindamycin	82	88	0.02
Levofloxacin	92	66	<0.001
Gatifloxacin	83	59	<0.001
Moxifloxacin	83	60	<0.001
Cefazolin	99	93	<0.001
Ceftriaxone	79	59	<0.001

NAP1 differs with other strains in its resistance to levofloxacin, gatifloxacin, moxifloxacin, cefazolin, and ceftriaxone.

Summary

SUMMARY - 1

- Coordinated national attempts to survey for HA-CDAD can be accomplished with excellent clinical information and isolate recovery, given sufficient planning time and resources, to create a linked clinical-microbiological CDAD database
- There are wide variations in HA-CDAD rates among hospitals, the underlying reasons remaining as yet unclear (i.e. Antibiotic use? Physical plant? Isolation practices?)
- Compared to the national average, Ontario has 20% more CDAD and Quebec has twice the incidence of CDAD
  - Quebec: 11.1 vs. 4.5 per 1,000 pts & 11.9 vs. 6.4 per 10,000 pt-days
  - Ontario: 5.7 vs. 4.5 per 1,000 pts & 7.8 vs. 6.4 per 10,000 pt-days

SUMMARY - 2

- There is an overall small decrease in the mean rate of HA-CDAD in Canada since 1997, but more deaths and severe outcomes.
- The incidence of deaths directly or indirectly related to CDAD in Canada has increased almost 4-fold, compared to the 1997 study
  - 5.6% vs. 1.5%, $p < 0.0001$
- Mortality rates from CDAD are much higher in Quebec (as previously described elsewhere), followed by Ontario
- 2% of CDAD patients required ICU care and 1% of patients underwent colectomy

In summary, a coordinated national attempt to survey for HA-CDAD can be accomplished with good clinical information and isolate recovery. We have additional data, including utilization of treatments, diagnosis methods, etc.

There must be time, planning and lots of resources.

There are wide variations in rates among hospitals; the underlying reasons for the variation are unclear. We are now working with Jim Hutchinson and others to determine if this difference is driven by antibiotic utilization or poor infection control practices.

Compared to the national average, Ontario had 20% more CDAD and Quebec had twice the incidence of CDAD than other areas of Canada.

There is an overall small decrease in the mean rate of HA-CDAD across Canada since 1997, but there have been many more deaths and severe outcomes.

The incidence of deaths directly or indirectly related to CDAD in Canada has increased almost 4-fold, compared to the 1997 study, from 1.5% to 5.6%.

Mortality rates from CDAD are much higher in Quebec followed by Ontario.

2% of CDAD patients required ICU care and 1% of patients underwent colectomy. If you have an outbreak as we did, many of the ICU beds are occupied by *C. difficile* patients. We had to cancel elective surgery because of lack of ICU beds.

SUMMARY - 3

- The presence of the NAP1/027 strain closely mirrors CDAD incidence and severe outcomes, across all provinces
- The "hyper-virulent" NAP1/027 strain is now found in 7 provinces, but mostly in BC, Alberta, Ontario, and Quebec
- Disease caused by the NAP1/027 strain leads to severe outcomes much more frequently (approx. 3x incidence) in adults 60-90 years old, while those over 90 years have a 14-16% attributable mortality, regardless of infecting strain

The presence of the NAP1/027 strain closely mirrors incidence and severe outcomes, across all provinces. The "hyper-virulent" NAP1/027 strain is now found in 7 provinces, but mostly in BC, Alberta, Ontario, and Quebec. This preceded the outbreaks that occurred in the last year or two in Ontario.

Disease caused by the NAP1/027 strain leads to severe outcomes much more frequently in adults 60-90 years old, while those over 90 years have much more severe disease.

SUMMARY - 4

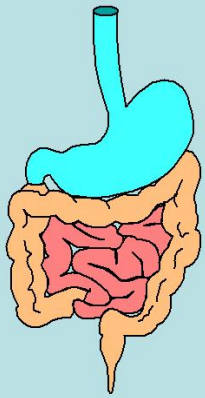
- No Canadian isolates have demonstrated *in vitro* resistance to metronidazole or vancomycin or teicoplanin
- Follow-up studies in the same hospitals will allow us to follow the spread of this pathogen in Canada, in order to assist with control methods

No Canadian isolates have demonstrated *in vitro* resistance to typical treatments used.

Follow-up studies performed yearly in the same hospitals will allow us to watch the spread over time, through facilities, of NAP1/0127. This will help with control methods and planning.

Thank

You !



Q: What is your view on our diagnostic methods? I worry that the *C. difficile* toxin assays are lousy and we are missing cases. This inhibits our ability to control this disease.

A: Diagnosis is a problem. Essentially the current toxin test we use is ELISA in the majority of hospitals. It has a sensitivity of about 80%.

Cell culture is much more reliable, however specific technology is required. Even in an outbreak, the majority of liquid stools are not due to *C. difficile*. Reasons include tube feeding, antibiotics, and laxatives. There is no answer to the question – we are stuck with what we have.

Q: Can you share your thoughts on why there is such a different geographic outcome of strains in facilities? Yet it appears to be the same hypervirulent strain.

A: When looking at historical isolates, the NAP1 strain was in Montreal. However, it wasn't quinolone resistant although it was binary positive and *tcdC* mutated. It was around, yet we didn't have outbreaks. I'm not sure that we understand this strain and why it causes much more fulminate outbreaks. Why is it geographic; why did it appear in Quebec first? It didn't even appear in one of the two largest cities in Quebec. I don't really understand this. It started in Pittsburgh, came to Quebec and went to Oregon.

Q: I understand you do not have strain data from 1997, however the incidence is the same as in the 2004-5 survey yet there is a higher proportion case-fatality rate linked to the NAP1 isolate. Would you be willing to speculate that the NAP1 has been increasing?

A: That is the hypothesis. We were able to show the difference in proportion of NAP1 between old and new strains in the Quebec outbreak.

Q: However it doesn't look like the NAP1 is increasing the incidence.

A: I think this is driven by numbers. There are a lot of low incidence hospitals diluting out the mean.

Q: The previous speakers suggest that the increase is due to sensitivity bias [i.e., looking for disease more intensively, mandatory monitoring]. How much of the increase in the two prospective studies might be due to a bias in reporting?

A: I do not know. We asked what percent of stool samples are positive for *C. difficile*, how many stools per day received. We compared 1997 to 2004-5 to determine if there was increased sensitivity to sending stools or looking for *C. difficile.* We didn't see that. So, in Canada it is not increasing through case-finding. Certainly in areas where there have been problems people start to look for *C. difficile*.

WORKSHOP DISCUSSIONS

During this conference four workshops were organized to generate discussion and gather information on issues surrounding *Clostridium difficile* associated disease. The workshops included:

Surveillance and Epidemiology;
Environment and Equipment;
Treatment Measures/Antimicrobials; and
Control Measures.

The participants in these workshops included experts in the diagnosis, control and management of *C. difficile* as well as invited public health representatives and other participants from the Ontario Ministry of Health and Long Term Care.

Key discussion questions were posed by facilitators and scribes recorded these proceedings. Invited experts and other participants comments are reflected in the discussions.

This section outlines the actual content of the various discussions and opinions that were expressed during the workshops. Generally, a new paragraph indicates a new speaker. From this lively discussion and the various opinions expressed, the groups were able to reach consensus on the actual content for recommendations that are the cited later in these proceedings (see page 100).

Surveillance and Epidemiology

Assumptions:

- Surveillance is a valuable component to the control of CDAD.
- Those carrying out surveillance are skilled in those procedures.
- When using the term reportable it means mandatory reporting of cases to the "region" or "state".
- There has to be a reasonable time delay so information is actually useful (annual is not useful for tracking, need more frequent reports so can actually act on data should there be a problem).

General discussion

In thinking about the presentation on the Ohio experience (See Dr. Gould's presentation on page 21) and the high cost to gather summary information on *C. difficile*, I kept thinking - What is the cost of one sink and one bathroom? If I had to divide up the $2.5 million into sinks in all places or gather data on *C. difficile*, I would take sinks in a heartbeat. We realize that we have to expend resources to gather the numbers and we can expend resources to fix the problem. We need to temper our thoughts about surveillance.

The only prospective study that used a close-to-unbiased approach showed that the incidence in Canada was the same in 1997 and 2005; there may have been different strains and more variation. The mean was the same, but the distribution was different. The high rates in 2005 were offset by even lower rates among the low incidence hospitals.

In the UK, when we saw the huge jump in incidence between 2003-4 after Stoke-Mandeville and the introduction of mandatory surveillance – it was not a true increase it was just good case finding. There was a subtle increase between 2004 and 2006, but very subtle. In fact, there was almost a plateau between 2004 and 2006. These are the patterns you can't see without proper surveillance.

I wholeheartedly agree that any measure depends on the structure of the measurement. But again it depends on what you want to do with surveillance. When the problems haven't changed and the reasons for the problems haven't changed, is surveillance necessary?

From what I recall, most of the cost in the Ohio study was used in developing a surveillance structure within infection prevention and control in the hospitals. This would have multiple benefits – not just in reporting *C. difficile*. Incremental costs were small (1-2 employees state-wide). I don't personally believe *C. difficile* should be considered for mandatory reporting. We need to be careful regarding start up costs.

Point is very well taken. But whatever the amount is, it is an amount. And it's competing with other priorities.

Clearly there is an ongoing issue regarding reporting in Quebec. Is there a plan to stop surveillance in Quebec, to dial it back and let institutions move on with their own system? It does seem that when emails go to chief executives regarding rates and they call infection control that action is going to happen. It seems that the system is working in large part because it benchmarks institutions against each other. This demonstrates where you are with peers and over time. I don't believe that Quebec is going to stop mandatory surveillance at any time. There is a need to separate political reasons from it as well. It was implemented at the time of an epidemic.

Let's go back - Why do you do surveillance? I came from a hospital that did lots of surveillance, put it into a computer, but never generated reports over 10 years. I was amazed by their use of the word surveillance. Then I was trained by someone who really knew about surveillance.

What is our objective? Why are we doing this? Let's go back to see how to set up a surveillance system – if we need one at all.

What are we trying to do? My objective is based on the belief that people don't know when they have a problem. The other objective is to benchmark. We know that benchmarking (getting that feedback) pushes you to do something about the problem. There is a loop of quality assurance that goes on that actually leads to improved outcomes. If we think things haven't really changed, there is no problem – then we don't really need surveillance as a tool.

Surveillance and Epidemiology

I think that there is a statement that needs to be made that surveillance of *C. difficile* the way we envision it - is a tool for improvement and not a tool for punishment by government or for remunerative disenchantment (e.g., penalizing payment for some diseases). It's for quality improvement of patient outcomes.

We should consider how to conduct surveillance in places where there is limited capacity, such as long term care facilities. A knowledge base of how to practice surveillance may be true in acute care, but it may not be true in other areas, e.g., long-term care. If *C. difficile* is a problem in these settings as well, we should determine how they can perform surveillance when they have limited training. There must be skilled staff to perform surveillance.

My general reaction is you can't manage what you can't measure. We must be able to invest in surveillance.

Question. Is there an implication for the public?

It depends on the purpose of the public reporting. The public tends to misinterpret many of the publicly reported rates of infections in hospital. They don't have the experience to interpret the information.

There is a benefit. It does provoke the chief executive officer to provide funding to prevent *C. difficile*, so that is a positive side effect. We are all struggling with resources. Obviously we are pushed to give more data at the expense of intervening. They are both important components.

We don't have a lot of information regarding community *C. difficile*. It is very difficult to split it into different settings. Does hospital *C. difficile* have an implication for the public? Not necessarily. We don't know if an increase in the hospital will spill over into the community or the other way around.

Are you saying that surveillance should monitor the general public? We don't have enough data to prove whether or not surveillance should be performed as public reporting, outside of healthcare institutions. This is a research question – should there be surveillance of the general public, e.g., in physician offices?

Just to follow up on that, the minimal surveillance for a hospital should be health care onset. If there are resources available then can also look at community-associated illness. Most hospitals do not have data/resources for community associated specific diseases.

Historically infection control has provided information to the hospital to improve care. Now there is a need to look at this community wide. The hospital is but a node in the community – patients flow back and forth. There seems to be a blending of infection control issues between community and hospitals.

What is our main objective? We do not want to create fear of antibiotics when antibiotics are needed, but want to give the public the information they need. We just don't know enough about *C. difficile* in the community. Advertisement of inappropriate use of antibiotics is an important message.

We would like to know the state of *C. difficile* in our community. We are not advocating this to show to the pubic necessarily. We are advocating it because we want to have a handle on how this affects the public and multiple institutions. We need to add a definition for how to address health care associated versus community associated disease. From a public health perspective, community associated CDAD is a huge issue.

Is it only a hospital problem or is it a public health problem? The answers are unclear. Why do 3% of us carry *C. difficile* in our stools when we come in the hospital? We haven't been on antibiotics. Is it possible we cycle *C. difficile* through the food that we eat? A study has shown that 20% of food has *C. difficile* – it's in sausages. [Rodriguez-Palacios and Rupnik] How has NAP1 spread throughout North America? How does it get around? Surveillance shouldn't just be for the hospital it should be for the whole population.

We underutilize active sentinel surveillance opportunities to look at prevalence. Is CDAD prevalence enough to be understood? Aetiology needs to be looked at and risk factors outside of the institution.

Surveillance and Epidemiology

Is there enough presumptive evidence that says we should be looking a CDAD outside the institution to understand it and get a handle on what the prevalence/ risk factors/temporal trends are on the community? These are important factors. I think there is some argument for active surveillance in the community.

Does what happens within the hospitals have an impact on the community? YES it does. We saw that in Montreal. At the time of the epidemic there was a lot of diarrhoea in the emergency rooms at hospitals - they thought there was an active pathogen in the community and they alerted public health. We were commissioned by public health to go through every chart in the hospital that had diarrhoea as a diagnosis to determine what the aetiology was; over 60% were *C. difficile*.

So there was an overflow of people in the community going in and out of hospitals with *C. difficile*, although most of it was hospital acquired. So is there a need to measure what is going on in the community? Is measuring what is going on in the facilities enough?

You get down to how many are originating in the community and how many are nosocomial. In Montreal we decided not to measure community CDAD. If I told you tomorrow, you have more community *C. difficile*, what are you going to do about it? We don't have the wherewithal to know how to act. How am I going to give you rates? Based on what - population, prescriptions? How can we standardize rates in the community? I don't see much use today in looking at the community.

I believe that health care facilities should perform surveillance for *C. difficile*. If you don't know how much you have, it's difficult to control it. But at the same time, if everyone is performing surveillance, there should be a method for providing anonymous reporting. Then we can create benchmarks. Should we be performing community surveillance? That is a research issue. Most community patients have some healthcare exposure.

We don't want to exclude some limited targeted, methodologically sound sentinel surveillance for community associated CDAD, in order to get a baseline to determine if this is a community issue. We may see different patterns develop; we can then determine if changes are needed in diagnosis, etc.

My question is how exactly are we defining community? I think that performing surveillance within individual hospitals is a given for management, however what public health wants is something that goes beyond that. We can identify issues in hospitals. We have to look at a broad system across hospitals, nursing homes, etc., in terms of looking at patterns.

Are you saying we should use the word institutions, acute, LTC, etc? Should there be surveillance systems in place among them? Yes.

In a non-outbreak situation, between 30-40% of our CDAD is in the community and is related to antibiotic use.

Most hospitals do not know what their rates are 90% of the time. As an infection control officer, we need to do the basics for surveillance and focus on facilities. As a public health person, I know the next big wave will be in the community.

Question. What should be the role of Public Health? Are there implications regarding disclosure? Should rates be provided to the general public? Who should have access to the surveillance reports?

In general, disseminate this information widely. The primary objective should be to raise awareness of the deficiencies in infection control and antibiotic utilization. Then it can be discussed widely.

Each unit/person who has access to data needs to know what to do with it and what their role is. The main goal is to improve patient care. Institutions need it, local public health needs it. We have begun a functional merger of hospital and community infection control. It has changed the way we behave.

We're coming to an agreement that the purposes of surveillance need definition and one is to provide opportunities for benchmarking. We should encourage hospitals to do this. The role of public health is to set the standard definitions, perform the analyses and deter-

Surveillance and Epidemiology

mine the best way to report.

It is not so much who should have access, but who is demanding access. People are demanding data in their own formats, using their own benchmarks and definitions. An example is accreditation. This is a real workload issue. There is real benefit for us to develop these systems - other groups need to recognize that systems are already in place and to use that system.

In Canada, the Ontario Regional Infection Control Networks (RICN) or equivalents would be an appropriate target or a more important target to deal with surveillance data results than public health. They offer better resources and infection control experience.

I also want to raise an issue with benchmarks. Do we have good ways to risk adjust or ecology-adjust benchmarks? What is a benchmark relevant to Quebec versus other parts of the province? Is there one benchmark or numerous benchmarks? It would strike me as oversimplified to say that there is only one benchmark across jurisdictions. Comparability is an important factor. This complicates presentation of data.

For *C. difficile*, we don't have a benchmark yet, mainly because there has not been a standardized surveillance definition. The Quebec system may be a potential benchmark. Stratification is a very difficult issue (even in the US CDC's National Healthcare Safety Network - NHSN). Quebec is stratifying by the proportion of the population that is 60-65 years old. It is still not entirely applicable. There is an inherent limitation when using aggregate data. If the same definition is used we can develop reasonable stratification decisions.

One group absent from our list is the public. We know that the information available in Quebec is public and disseminated to the press. In the UK data are published on a Web site by hospital name.

The reason for public disclosure is public education and I think that is the most important goal. There is a need for public disclosure; however it needs to be put in the public context. You should not act as though you have something to hide.

You have to be clear about communicating with the public and this has to be well organized. You can end up with large amounts of misinterpretation. In Canada, you don't have a choice with respect to which hospital you go to. We should not be scaring people. You can enlist the public's help in moving the issue forward politically. This might be an objective of the surveillance system.

Public disclosure is okay. There are more benefits to do it than to hide it. Might get the public to recognize issues like hand hygiene, etc.

In the UK, they want to be transparent with surveillance data and access of information to the general public. All the hospitals are named, the rates are shown on the public Website and anyone can access it. They also give information to the press. One thing they started doing is to make it more of an effort for the media to get information from hospitals – they used to provide information by rank order, it is now in alphabetical order. What we do not have is outcome data – how many people died, were placed in an intensive care unit, etc. We also have enhanced *C. difficile* surveillance by collecting extra information. These data haven't been analyzed yet. We do report cases over 65 years of age as well. Data are produced on a quarterly basis. Infection prevention and control gets the figures one week before publishing and confirms they are right. Each month the chief executive has to sign off on the information.

Question. Should *C. difficile* be reportable? What is the rationale? If yes, should it be reportable by name or by rate only? Should rates be provided to the general public? What denominators should be used?

I think we need to distinguish between surveillance and public reporting. We don't have data about the impact of public reporting on the public (regarding making informed health care decisions). In Ohio the reason they performed public reporting was due to media attention.

We have to make sure we separate out what is necessary to improve implementation and our rates of *C. difficile*, and the effects of public reporting and how should

Surveillance and Epidemiology

public reporting be performed, i.e., what methods.

We need to distinguish between making a disease reportable to public health officials or the public health service, versus surveillance for informing and meeting objectives. These are two very different things. There is overlap. Surveillance means collecting high quality data that serves a purpose. Reporting is in law, it has a whole different meaning and we must not muddle the two.

Is mandatory reporting as it currently exists necessary? Do we feel that nominal reporting is necessary?

We have no evidence to support nominal [providing names] versus non-nominal. Is there a reason or justification for a nominal report? I can't imagine this would help me to manage *C. difficile*.

I think it depends on the setting; if you're looking at a hospital, you don't need mandatory reporting for hospital-based epidemiology. If you are looking at the community, then you need sentinel surveillance or mandatory reporting. But what about the long term care setting? How are you going to get data from a LTC setting? One option is mandatory reporting.

Having a laboratory report is a simple way of getting the data. Most of the mandatory reporting today is through the laboratory. If we evaluate *C. difficile* patients and they all went to the same dentist and received clindamycin – we can then look at prevention. The laboratory can report name, physician, etc.

Our understanding of *C. difficile* in transmission in pathogens is still far behind compared to Salmonella. Provision of nominal data for *C. difficile* would be very labour intensive without that much benefit.

If we can obtain data from all the institutions then we can benchmark between institutions. If a hospital doesn't comply, then what do we do? What mechanism do we put in place to ensure hospitals gather surveillance data on *C. difficile*? Make it reportable? Have public reporting? Do we wait until a huge outbreak before they perform surveillance? Or does it have to be mandatory in order to ensure that surveillance data are gathered?

If the assumption is that hospitals are doing this, than mandatory reporting is useless. If the assumption is that hospitals are not doing this, than mandatory reporting might be of use. Then individuals charged with controlling *C. difficile* will do it. This may be beneficial in a framework where there are explicit reasons and manoeuvres to use it as a tool for improvement. If areas, e.g., Ohio or Quebec, need to have the data regionally, then reporting is useful. If all hospitals are already collecting the data, there is no need for reporting.

There are institutions in Ontario that are not performing surveillance. We're living in a province right next door to Quebec, your rates are rising, and hospitals are still not reporting - that is an issue. It doesn't need to be nominal; you just need to know your rates at least within the health system. It doesn't need to go public to the press. We may need more resources in infection control.

Mandatory surveillance is very different than reportability in the Ontario context. Mandatory surveillance programs in institutions are much more desirable than a reportable regulatory requirement.

Because this is a disease control document, we should state that at the present time, for control of this disease, there is no evidence that nominal reporting is of any benefit on top of knowing your regular rates.

I'm struggling with this idea. If we only report numbers, how do we know the patient hasn't relapsed? Patients may be counted 3-4 times. Nominal surveillance helps with tracking. Need to only count a person once.

I would say that you do want a double count because of relapse – it provides information on how that contributes to the spread of *C. difficile* in facilities. You want to count episodes and not people. Episodes are not nominal. It's important to the institution. This patient is a risk to any institution they are in.

I don't believe that nominal reporting in the public health sense has any justification. But I do think there is extreme value in institutional reporting becoming systematic. Data need to be evaluated and displayed. We are trying to have fewer cases of people acquiring

Surveillance and Epidemiology

CDAD – this is the most important component.

I would like to see identifiers that are by provincial health care numbers. So that I can say I have this patient in my institution today, but the patient may also show up in another institution two months down the line. So then I can tell how many people in the health system have *C. difficile* – the denominator is the whole population.

The US CDC's NHSN reporting of *C. difficile* will be based on individual reporting – hospitals can participate on a voluntary basis. States that have mandating reporting have opted to use NHSN because it is a system that is already available.

Question. What are the criteria for case definition of CDAD?

We should mirror the definition of the McDonald article. [McDonald 2007] One of the biggest problems with *C. difficile* is that we don't have a standardized definition. We don't want a different definition.

One definition - when no other obvious cause is found in the presence of toxin. We need to also define diarrhoea and what it means. What is not a *C. difficile* case? Exclusion criteria would be useful.

There has been an incredible evolution over the definition of diarrhoea. Fifteen years ago, three bowel movements over 24 hours or five over 72 hours, was considered diarrhoea. Then NAP1 came along and not all patients had diarrhoea, and it was defined as two bowel movements over 24 hours – loose stools. Then it was realized that elderly patients have no diarrhoea. Then people decided to focus instead on the McDonald consensus – they do not define diarrhoea - which is a loose a bowel movement that conforms to the container and not based on frequency. We don't want to get stuck with a definition of diarrhoea.

What about using the Bristol stool scale system? Diarrhoea is 6-7 on the scale in terms of consistency but not frequency. Patients cannot self report consistency – maybe nurses can. [See page 84 for information on the Bristol scale]

Most of the patients are older and do not pay attention to consistency and self-report on this. My experience has not been overwhelmingly positive with respect to scales.

The main purpose we are discussing this is for surveillance purposes, as long as you pick what you are looking for we don't need to identify all cases.

It would make sense to me that we try to make the definitions and structure and way we report similar so that we can compare data properly. All surveillance definitions can be argued. The key is consistency across places.

For the purpose of surveillance, we do not have to be overly prescriptive in definition. It can be purely laboratory-based surveillance unless tests are performed on formed stools. The vast minority diagnosed *with C. difficile* in our hospital did not have a positive toxin; it is important to make a distinction between toxin assay or not.

We want a surveillance definition of CDAD versus a clinical definition. A clinical index of suspicion is very different than surveillance purposes. Need reproducibility and simplicity.

This is mostly laboratory based surveillance for this disease. The Canadian National Infection Surveillance Program (CNISP) found that we will overcall *C. difficile* by about 3-5% using laboratory data. That error is terrific. Surveillance won't be perfect. We only need to have a comparable system. Leave the diarrhoea definition as conforms to the container. Don't define too much.

It would be good to look at a definition with respect to sensitivity and specificity and the issue of whether or not you want false positives or false negatives. What I'm hearing is we don't want false negatives and keep to objective not subjective areas in the definition.

We can't control for laboratory tests. As long as the definition remains constant over time it doesn't matter, for surveillance purposes. If we change the assay it may make a difference.

Surveillance and Epidemiology

In the UK, we found a shift from 10-30% when we moved from Assay A alone to also include Assay B. Should we test for both? Yes. That's the standard now.

We are locked into EIA testing; we will not be going to toxigenic culture. The laboratory has to make sure the positive test is correct. If it is negative on a first test and the clinician thinks the patient has *C. difficile*, they should get another test. Also, patients on antibiotics may have a negative test. That's why it is so important to get a test prior to any treatment. The specificity of the test is good – it misses 10-20%.

Most patients wait three days while having diarrhoea to see a physician. We should allow nurses to order the test. However, they must look at the stool of the patient.

If you are going to establish a definition for diarrhoea, there must be a rule that the stool must be looked at. I've been in outbreak situations where we've taken handles off the toilets so it couldn't be flushed until staff looked at the stool.

A generic concern is that there are some reports that the *C. difficile* toxin assays may be problematic with respect to sensitivity. A recent Baltimore report indicated that sensitivity was way below 50%. A number of people have to be tested at least 2-4 times, which may be a problem with respect to sensitivity of the assay. If diarrhoea persists, we will identify them. 3% will have negative EIAs. The labs should consider instituting CDAD culturing in the tough to diagnose cases. This is more for patient management of selected cases.

A definition is the best one you can come up with that is the easiest one to apply in the situation. It is not a diagnostic test. Surveillance works in a different method, you look for trends and must be consistent. If your definition is non specific, it is fine as long as it is consistent over time.

We have been concentrating on clinical surveillance. But there is a role for laboratory surveillance – to know infecting strains and how they change over time. We need this to know what is going on.

The laboratory is often forgotten when any additional surveillance system is set up. I don't have the capacity/resources in my laboratory to set up culture testing as well as additional reporting.

It is a horrific onus to culture *C. difficile* – this must be relearned by many laboratories. If I think there is an outbreak, I culture.

One way is to do rolling testing in sentinel labs. This gives you a snapshot in time. For three weeks every year, all hospitals test, so that we can get what percentages of *C. difficile* are NAP1. The specimens can be sent to a centralized lab.

Question. What constitutes an outbreak? Is there a magic number?

Well, I think in the setting of an institution performing surveillance, any rate above the baseline rate is an outbreak. It may also be the presence of new/more cases, if the facility has never seen a case. It depends on the facility's experience and surveillance activities. What about transmission occurring? We must follow the definition for a healthcare-associated case - a case developing after 48 hours of admission. If you can identify that a case is associated with your facility that would constitute transmission. Just having a cluster of cases means an investigation should occur.

Anything above baseline constitutes an outbreak. Looking at the Montreal data, in 2001 one hospital had a rate of 10-13 – that was baseline for them. At what point does a case rate result in epidemic spread? At a certain number it will explode. But when? Any number you select will be okay, but you need to know where the danger zone is. It's a moving target. May be two per 1000 in a good hospital and 10 per 1000 in a bad hospital.

I agree. I have gotten used to having 10-15 cases/month. I thought that was what was achievable. We were having an outbreak all the time.

It would be useful to set standards for this meeting to say what is an acceptable level and an unacceptable level? What is a dire level? What is achievable? That fits

Surveillance and Epidemiology

more with the epidemiology rather than a single explosive outbreak.

I agree. We can fall into the danger of accepting something because that is just the way it is. What it's been all along. We are moving away from benchmarking; saying we're at this rate so that's okay. We are aiming for how low can we possibly get. We should not accept an endemic rate as okay.

There is danger in assuming rates. I have some experience in Holland. There, a rate above 1/1000 will spark an investigation. I don't think saying a rate of 5-6 in an endemic state is alright. Just because others are higher doesn't mean it's a good state where you are. We are aiming for zero. You can get close to zero by giving people bathrooms.

I don't think there can be a zero rate at the moment if 3% of the population carry *C. difficile* at any one time. We don't know if the same person will carry the same bug all the time or if there is transient passage, cycling through the gut. If they then get antibiotics and go to hospital they will be a case. Not everyone who carries the bug gets disease – although recent acquisition and spread is an issue. We need more data on the ecology and immunology of the disease, especially in the elderly. Outbreaks have helped us understand the disease better. I'm in favour of no target number. An outbreak constitutes additional cases of the same clone above some statistical number – two standard deviations above something.

I don't know why we are reinventing the wheel for *C. difficile*; it is a nosocomial infection like any other. There are definitions for outbreaks. The best rate is the lowest rate possible. An outbreak is an increase in the number of cases over space and time than what would be normally expected. Hospitals that claim they don't have an outbreak because the overall rate is the same may have an outbreak in a certain area, e.g., their surgical ward. So it depends on how you define it as to whether you are good or bad. When the press asks if we have an outbreak I say no – we have a cluster.

I agree with you. The problem is no comparability if all institutions are making the definitions themselves. How much above the baseline is what is asked. How do we achieve comparability across the board if each definition varies per hospital? I would welcome more detail than above the baseline.

I don't think it's possible. Having a goal to get below is great. We don't have "goal benchmark" data, this is not possible. We don't have benchmark data, so how can we have a goal benchmark to get below? It's the same as other nosocomial infections. One case may be an outbreak for some.

With this view we can fall into the trap of methicillin-resistant *S. aureus*. Lots of organizations have accepted a degree of endemicity because we don't know what the rates should be. Why not aim for the best hospital rate as a benchmark?

The make up of the organization may differ. In the UK the smaller hospitals had higher rates than the teaching hospitals.

Question. What denominators should be used?

Within the institution? The standard is patient days but either 1000 admissions or 10,000 patient days may be used. We should be using one or the other, but I'm not sure we are there yet. McDonald's group said to forget about admissions – only use patient days. [McDonald 2007] We can use both until we know why one is better than the other.

Those data are available now. Do you count intensive care units, Paediatric vs. Adults, etc? We need to delineate. Do you combine rates if you have 3 campuses or separate the data?

They chose patient days because it reflects days at risk – this can help in inter-facility comparisons where there are different lengths of stay.

I support both – for different reasons. If we use risk per 10,000 patient days – the public has difficulty understanding it. They would understand if you told them the rate was 2 per 1000 admissions, they can calculate the risk of getting CDAD in that hospital is 1 in 500 – that says low. That's why it's useful.

Surveillance and Epidemiology

If we also compare to antibiotic use it helps if we look at the data by unit or kind of place; surgery vs. medicine vs. cardiac. However, it then becomes complex to gather the information.

I have found if you lump the whole institution together, then some areas will water down the rate – e.g., obstetrics.

CNISP does not use the entire hospital population in rates. Institutions must use the denominator of only the patients at risk. If the risk is rare that group should not be included. Exclude neonatology, psychiatry, dedicated long term care wards in the facility. This will leave an at-risk denominator. Obstetrics will water it down – we have to live with that.

Why did the UK choose only those over 65 years of age? The numbers and rates are so high. It was used because it is the highest risk group. The trouble now is they are stuck with its use to compare data historically.

I do agree that the denominator of 10,000 bed days does not make sense to the public – we should use admissions. The reason for 10,000 is that with 1,000 you get into decimal points. That's a problem when discussing the data.

We should be calculating facility-wide rates and unit-specific rates. That will help with the dilution effect. We can then see what the true risks are for specific groups. It's a method of stratification.

It would help to describe the type of hospital and population at risk – more or less paediatric beds, etc. Outline type of hospital, teaching, paediatric, or specialty. We want to compare like with like. Clearly define setting and population at risk.

If using unit specific rates (using per patient days) - be cautious that the population changes day to day. May need to use service instead – if you have that capability.

We should also capture community-acquired illness; differentiate with hospital-acquired and then provide both rates. It has been shown that a decrease in hospital rates leads to a decrease in the community.

What terms are to be used? Nosocomial vs. non-nosocomial vs. healthcare-associated or acquired. Associated doesn't imply blame.

How should we determine healthcare-associated? Use 48 hours? We really don't know what the correct number is. The CDC Epicenters will be looking at this issue. They will be comparing different rates and the variability of rates over time so see how important it is to perform a look-back or whether 48 or 72 hours should be used. They are also determining how to identify an abnormal change in the rates. Identifying all cases is labour intensive and may not be necessary in regard to the purpose of surveillance activities.

To keep us all in same playing field we should use 48 hours – it is also consistent with other infections.

It doesn't matter as long as you picked a number and stick with it. As far as clinical context – if a patient has diarrhoea on the 3rd day after admission, we need to make sure the patient didn't have diarrhoea during the first two days. If they did it must have started in the community. Functionally, 48 hours works.

Some facilities are looking back and attributing cases to their facility and others may only be looking at healthcare-associated cases based on the 48 hour definition. Rates are then not comparable.

The CDC definition uses two months of prior healthcare association to attribute the case to the hospital. This hasn't been used in the UK. We are only using the 48 hour definition.

What are you going to use as a denominator for those cases that develop under 48 hours? Use bed days or 100,000 patient years? I think we should use the 1,000 or 10,000 bed days even for those who are under 48 hours.

I think another group we need to look at are the transfers with CDAD from other facilities. How do we capture them?

We still have not tweaked the definition of hospital

Surveillance and Epidemiology

acquired for those patients that were in the hospital, discharged home and now are readmitted to the same facility. How many weeks should be used for hospital acquired? There are no data to support any recommendation other than the CDC document. At a minimum we should track the >48 hour onset. If we can track other cases, e.g., look back in time, we need to be able to pull out the after 48 hour onset cases.

For many hospitals that don't have long lengths of stay a large part of their patients with *C. difficile* are going to be at home or at rehabilitation. Then the patient is readmitted back into the hospital. We need to collect information on all hospital-associated CDAD, including the ones that have been out of hospital for 2 months and have come back. We need to know the length of time post-discharge when it will be considered hospital-acquired.

This must be considered. A substantial number of cases could be missed – patients discharged recently and coming back with CDAD are most likely to be hospital - associated.

CNISP used 4 weeks. There is also an indeterminate category.

We have no data to decide on time. Each hospital should understand that many cases present after discharge and should expand their definition to include patients who come back between 4-8 weeks after discharge.

Remember this is a surveillance definition and we may capture too many. If a patient has a relapse within 4 weeks you are relatively sure that your facility is associated. In the 5-8 week range you are less sure.

An interesting question is the issue of relapses and recurrences. What if someone has gone home within 4 weeks and comes back with diarrhoea? They had diarrhoea during the previous admission. Do you recount the person? In the UK there is a one month leeway. If the patient develops diarrhoea after one month, for surveillance purposes, we call that a new case. Thirty percent relapse or recur. The definition needs to outline what constitutes a new case and what is a relapse.

In Canada there is no standardized definition outside of CNISP.

I think we should go on the natural history of disease – if most people treat for 10-14 days (and most people treat 14 days with NAP1) and if the average recurrence is at 6 days – that would be 20 days out from treatment. Have a 10 day leeway to relapse. Then the relapse definition is 8 weeks.

Are we counting from diagnosis – not end of treatment?

No, from discharge.

Maybe make a statement that the proper duration (to determine relapse or recurrence) is unknown: the US CDC says 4 weeks; CNISP 8 weeks.

What about counting reinfection and relapses? When is it a new case? If a patient has a recurrence within 8 weeks – do not count it. If the patient has diarrhoea or relapse within 8 weeks it is not counted in the numerator as a new case.

Question. Can surveillance be used to show the impact of physical design?

We do need to make a positive statement about design. There are developing data that there is a huge problem in dated designs. We transitioned a medical unit from an average of 6 patients per toilet to one where everyone has a private room. The rates of *C. difficile* and MRSA fell. It has been enough to convince the designers that private rooms are necessary on new buildings. It is great that the new AIA guidelines [AIA] include single rooms. We have seen a 75% reduction in infections by doing nothing else different.

This is a research issue. We need to have someone look at the close association between design and impact on infection and investigate other things that might have an impact on disease rates. This can be ratios of patient/toilet, nursing, housekeeping, sinks, length of stay, etc.

We need to look at the effect of interventions. It's often hard to state that A leads to B. Orion provides a

Surveillance and Epidemiology

framework. [http://www.idrn.org/orion.php] Surveillance will be key to determine if changes make an effect; such as adding toilets, etc. We need to show it will make a difference in different institutions and different settings. This will convince administrators to spend money.

If there is difficulty controlling *C. difficile,* i.e., if most cases occur in different patient rooms, then it may be an issue of staff practices vs. finding a room association where it may be an environmental cleaning or education issue. Surveillance can be a useful tool.

I understand the limitations of the process. We have been trying at CNISP to stratify hospitals by number of beds per person. It would be interesting to look at the number of bathrooms per patient. If we could find a correlation with lower rates, we can stratify hospitals. Have to start getting people to think about having better facilities.

In Calgary we have found a relationship between the number of patients per toilet and infection rates. We can bring down rates with having one patient per toilet.

In the UK we have completed a study to determine if infection control makes a difference in MRSA rates. The answer is no. The only independent variable was the number of incontinent patients which may be a marker for how dependent the patient is. We need to be prepared – we assume the denominators will make a case of association between fewer toilets and higher rates of infection. However it may not show any association.

Healthcare-associated infections were the public's number one concern in the UK this last election. Now more new hospitals are being built; 50% of beds are single rooms.

Question. Should surveillance information include capturing information on severity of illness? Follow people up to 30 days for outcome?

Severity can have some benefit, but people get desensitized with *C. difficile*. If you can show this many colectomies, this many patients dying, this many intensive care admissions, it puts teeth in it.

As soon as you mention outcome, it requires a chart review and is a massive undertaking. It can take the focus away from routine surveillance. Stress good numbers, basic surveillance, and good calculation of rates. Then this would be a next step if there is a problem. We should not make this a recommendation for routine work.

I have been asked by reporters many times - how many people died in your institution, so there may be a time you would want these numbers. It may keep the agenda going.

Keep both. Mandatory piece - You should be able to know your CDAD rate and number of cases you have. The severity issue - There should be less labour intensive ways to get these severe case rates. Let the information systems help us do surveillance more efficiently. It can determine how many patients get colectomies and how many require intensive care.

Can we prioritize how to perform surveillance? First focus on healthcare -associated infections. Then we can add additional recommendations for infrastructure and information systems. Then look at cases that are more than 8 weeks (non-nosocomial). Last look at outcomes (ICU admissions, colectomies and related deaths).

Question. Should there be different surveillance practices for different settings? What about syndromic surveillance?

I don't think *C. difficile* is any different from any other healthcare -associated infection. There are various methods to perform internal surveillance, laboratory based, ward rounds, coding. *C. difficile* is generally laboratory based, but other methods including ward rounds, discharge data, etc., may be useful.

Is this okay? We don't want to give people an option to do things other than what's been outlined.

There are really good data if you just use discharge diagnoses and can follow *C. difficile* over time in your own institution. Just using ICD-9 codes [ICD-9] at discharge will capture about 80% of cases and you would be able to follow your hospital rates. It is not the best

Surveillance and Epidemiology

tool, however if there is no money or resources, you can do this.

In the UK coding is very incomplete. I'm sceptical that we can gather good information from the discharge diagnosis.

This should be laboratory based surveillance. Laboratory numbers are pretty good numbers. We need standard definitions to compare across facilities.

Laboratory identification is a decent focus. You can follow crude rates and it takes less time. Transfers, etc., make it a bit difficult.

Do you require a physicians' order/initiation for a laboratory test? In the U.S. the test has to come by a physician's order to get reimbursed, although you can have a standing order established on admission . A nurse can call the physician at onset of diarrhoea.

In the UK, 99% of samples are sent by nurses. They just add the name of the physician. They are the first to notice diarrhoea symptoms. They then inform the physician. We have a sheet that outlines when to and when not to test.

Calgary is similar to the UK. Other areas in Canada are driven by physician order.

There should be a recommendation if there is a problem with *C. difficile* in the facility for the nurse to go ahead and send off a specimen and not wait for the physician. Especially if the endemic rate is high or there is an outbreak.

If you are having rates that are still not controlled what do you reevaluate? One thing is to make sure stool samples are sent off to ensure you are detecting patients.

If the infection control practitioner (ICP) is on the floor regularly we should empower them to go ahead and order the test.

In the UK, infection control (IC) nurses look at all requests for analysis during rounds – helps to determine if there is clustering from a ward.

What are the criteria for the laboratory to test? Some test only on physician order, some only on patients over 65 years. In Canada it is pretty standard that any stool will be tested for *C. difficile* if the patient is over 72 hours in hospital.

The test report has to be noticed by physicians and IC and the unit to initiate Contact Precautions immediately.

In the US some labs will test formed stools for *C. difficile*. I would like to come to consensus against this. It wastes nursing and laboratory time.

Question. Any value in screening all patients?

There are no data to support this. We don't know the sensitivity of the toxin test on formed stools; could have more false positives. No across- the- board screening should be performed. There are data against prophylaxis for asymptomatic carriers. Screening would promote unnecessary treatment.

We should only screen those on antibiotics who have diarrhoea.

No to screening healthcare workers.

Question. Flag previously known positives?

Yes. But for how long? Once identified, flag for up to two months from the time of discharge.

I wouldn't flag anyone. Who puts it on and then removes the flag? If we flag someone it means we are going to do something.

If we flag a patient that means we want to do something when they come back in. What is that plan?

If they have diarrhoea and a history of CDAD we would put them on Contact Precautions on admission.

But we do that anyway in Canada.

In the US Contact Precautions is used only if the diarrhoea is uncontained.

Surveillance and Epidemiology

I would then say if you are in an area where you treat all diarrhoea as *C. difficile* then you would not need to flag. If all diarrhoeas are treated the same a flag might not be useful.

There is no need to flag to determine relapses – people with *C. difficile* diarrhoea in the recent past are likely to remember.

I would go softly on the flag situation. It is simply a tool to help identify prior patients. Most important is to take an adequate history. A flag should be optional. Given new information systems, may be able to put on a time sensitive flag.

Can a patient be identified upon reentry within two months as having *C. difficile*? Flagging is all about initiating Contact Precautions and also about initiating treatment. If a patient returns with diarrhoea we need to treat.

Question. What contributes to transmission?

We've talked about age, medical floors. This is what you would like everybody to evaluate to help you risk stratify.

Stratify by place, characteristics, medical condition, co-morbidity, physical plant, practices.

What are risks that aid in transmission that may need to be monitored?

Would be interesting if we can incorporate defined daily doses per 1000 bed days/admissions for different classes of antibiotics.

What about colonization pressure? It's not really useful beyond the unit level surveillance. How many patients with *C. difficile* are on a unit/ward?

The antibiotic attributable ratio is useful and easy to conceptualize. [Valiquette] What percent of cases are caused by a preceding drug? If you add antibiotic review to surveillance you can look at the ratio of patients that got a certain drug prior to onset of *C. difficile*.

What contributes to transmission of CDAD? Who are the spreaders/wild disseminators of *C. difficile*? It's probably the elderly person and those who are incontinent with uncontrolled stools. They require a lot of care and bed baths and use a commode.

We can also collect nurse: patient ratios. Look at age distribution, bed occupancy and nursing work indices. Then look at process measures, such as hand hygiene and Contact Precautions compliance and cross reference the information.

Invited Experts:

Eric Dubberke
Daryl Depestel
Carolyn Gould
Dinah Gould
Jim Hutchison
Tom Louie
Mark Miller
Gopal Rao

Control Measures

ASSUMPTIONS:

- Action taken for all patients at the onset of diarrhoea and after a risk assessment for CDAD is completed. (See risk assessment below.)
- Ingestion of spores is the most common mode of transmission – contaminated hands (patient and staff) are assumed to be main vector.
- Patients who have had a colectomy following CDAD – should be managed as if they are infectious, although the period of infectivity is unknown.
- A common definition of diarrhoea is established for the institution.
- Standard Precautions/Routine Practices will be used for all patient care.
- Contact Precautions refers to specific measures taken to prevent transmission by both direct and indirect routes. Contact Precautions are part of the guidelines for transmission-based precautions from the Centers for Disease Control and Prevention and Public Health Agency of Canada.

Risk assessment for CDAD:

- Rule out other causes
- Clinical symptoms and history
- Prior antimicrobial exposure

Question. When and what kind of control measures are needed for *Clostridium difficile*? Are recommendations different between symptomatic patients and asymptomatic patients?

Studies have shown that the levels of spores in an asymptomatic carrier are much lower than symptomatic patients. Patients who have had *C. difficile* are treated and considered clear, yet they still represent a risk for transmission. There are anywhere from 10^2 to 10^5 *C. difficile* spores recovered from a patient's immediate area even though there is no visible diarrhoea contaminating that area. High levels of spores can be recovered from 'clean' areas.

C. difficile should be managed like vancomycin-resistant Enterococci (VRE). Colonized individuals represent an important reservoir for environmental contamination; even if they are completely asymptomatic they still spread disease. A key to prevent environmental contamination is to identify the patient reservoir. Some healthcare facilities are using methods like polymerase chain reaction (PCR) to find out who is colonized with *C. difficile* and then isolating them.

We don't have any evidence that this asymptomatic patient plays a large role in transmission in hospitals. The continent patient who can use the toilet and wash hands afterward represents a low risk.

A recent study found no spores in the rooms of patients without diarrhoea and lots of spores in the rooms of patients with diarrhoea. So if there is a contribution, it is minimal. Further, *C. difficile* is an environmental organism. We will never be free of it in the environment; you can get it in your home. Routine practices, practiced well, should take care of the asymptomatic colonized person.

This group should focus on the risks associated with the symptomatic person.

What are the normal control measures we should use daily with a symptomatic person and what additional control measures are to be used in an outbreak situation? There may be different control measures for different stages and some control measures might work for all stages.

We must consider both the symptomatic and asymptomatic patient when developing control recommendations. The patient who is asymptomatic today is symptomatic tomorrow. The patient who is *C. difficile* negative now can be *C. difficile* positive an hour from now, when the diarrhoea starts. On any given day we don't know who has *C. difficile*, who is carrying it, who will be symptomatic soon and who won't.

We do not have a good reliable test to identify *C. difficile* carriers. Most laboratories don't culture for *C. difficile*. My thought is we're not going to know who is going to develop diarrhoea today, tomorrow or tomorrow night. My approach in hospitals where *C. difficile* is a problem is to focus on good Contact Precautions, Standard Precautions /Routine Practices, and consistent infection control measures for all patients, assuming that anyone can become symptomatic an hour from now.

Control Measures

I don't understand why we would use bleach in the bathroom of a symptomatic patient but not in the bathroom of an asymptomatic patient. The asymptomatic patient on ciprofloxacin may become symptomatic with more spores two hours from now. Then all of a sudden I change to bleach? It doesn't make sense. We're being lax with the ones who might develop symptoms soon. And we're being crazy about the ones who are already in Contact Precautions and have little risk of spreading it since they are sequestered. My suggestion, taking all of this into account, is that we should use routine control measures every day for all patients and enhanced control measures in an epidemic situation, taking into account that you don't know who is positive or negative at any given moment.

When tests are developed so we can tell who is positive and negative, we are going to proceed and respond like we do with VRE and methicillin-resistant *S. aureus* (MRSA). We can't do that now with *C. difficile*.

In London we are pooling specimens to look at molecular testing. When we track back those specimens, 20% of patients were negative two weeks before the test. They may have had enough symptoms to have a stool specimen sent. We have had a policy change treating all patients exactly the same. I support what you are saying. It's not about whether patients are symptomatic; it's about a completely common approach. By the time you get a positive test, it is too late and they've already contaminated the environment.

We undertook a prospective study following patients who had diarrhoea. We were monitoring their toilets for *C. difficile* and found that *C. difficile* detection rates in toilets became positive at least three days before they had another diagnostic test. At that time there was enough toxin to detect it. Asymptomatic is one thing, but even for patients who go on to develop CDAD, it takes a few days to get a stool sample and complete the diagnostic test. They will be shedding very high levels before being recognized as having *C. difficile*.

We performed a prospective study looking at culture, GD antigen detection and toxin A and B. We found the GD antigen is a sensitive screening test. [GD is a marker on the surface of the *C. difficile* microbe itself]. If the GD results are positive, it doesn't tell you if it's a toxogenic *C. difficile* or not, however the majority will be. So we use GD as a patient screen. However, I think the biggest problem for transmission is people with active disease who are environmental hyper-shedders. The carriage of *C. difficile* at the beginning of disease is when shedding occurs in high numbers and is a concern. Also *C. difficile* is an environmental organism. Newborns pick up *C. difficile* as one of the earliest organisms in their gastrointestinal tract. Why? - because it is in the environment. When we've tested the environment in hospital rooms, we find a background contamination level of about 10% *C. difficile* positivity in rooms of patients without diarrhoea, usually in the toilet. What can we do the most about to prevent spread?

We do need to look at people with disease. I understand that positive patients are placed in Contact Precautions, however that's not preventing the spread. Perhaps there are other control measures we need to take into consideration.

Question. What are the control measures for facilities with sporadic cases?

Facilities need to provide some form of isolation for all patients. The lack of private rooms and multi-room transfers compounds the problem of the efficacy of existing isolation precautions. There should be no roommates unless they have the same disease. Infected patients should not share toilets with non-infected patients and should not be transferred to additional rooms. In long-term care facilities this is easier said than done. What can they do when private rooms are rarely available?

Contact Precautions should be implemented in both acute care and long-term care facilities. However, the way Contact Precautions are implemented may vary between the two types of care facilities.

I would like to pick up on a theme I think I keep hearing. We talk about control of disease and I think we really need to strongly reinforce the need for what we call in Canada, "Routine Practices". Routine Practices are general infection prevention and control measures. We know that we don't have good environmental clean-

Control Measures

ing. We know that we have problems with hand hygiene compliance. We know that we don't clean equipment consistently between patients. Until we are certain that we have a handle on these general infection control measures, we must make compliance to these measures an absolute priority for every organization. Talking about control is kind of shutting the barn door after the horse is out. So I would like to see us reinforce general infection control practices. That has to be the base on which everything gets built.

And maybe that is the day-to-day practices you are talking about. We should suggest a general statement that consistent compliance to routine practices is important to reduce the spread of all infectious diseases, including *C. difficile*. When that is achieved, we then can look at additional control measures for sporadic, known cases.

The first statement whether you're talking sporadic or outbreak is the reinforcement of exactly those general infection control measures, such as good hand washing, good practices, education and things that are often left aside because everyone is crisis managing. When you have sporadic *C. difficile* or outbreak *C. difficile* you need to first start by having a re-look at your basic practices, redo your education and reinforce hand washing compliance.

I would just like to address what we in Quebec have learned. We had guidelines for *C. difficile*, VRE and MRSA, but we didn't make a difference. We didn't monitor transmission that could occur between acute care, long term acute care, long term care and special care cases; they were ignored completely. Guidelines for preventing spread of CDAD must be modified for long term care and special care facilities; they can't do what is done in acute care settings. Most long term care facilities do not have private rooms and can't remove someone from a room. You can't place a long term care patient into sequestration isolation; there are quality of life issues. The patients are elderly and they are enduring the brunt of this problem because they do get *C. difficile* and die from it. We can do all the right things in our own facilities to prevent transmission, but if we admit patients from facilities who continue to have ongoing transmission, we will not be successful without working with them collaboratively to prevent transmission of *C. difficile*.

We all agree that routine practices are a good thing and if they were practiced to the appropriate standards I think that we would have fewer problems. The exact biological gradient that leads to transmission remains unknown. But we all know that routine practices are practiced as anything but routine. The baseline data for Ontario's hand hygiene rates in all the early pilot studies are in the high 30's/early 40's in terms of percentage adherence, that's not routine.

I would like to ask the question again as a proposal. We understand that if we put people with a different disease on some form of isolation precautions with patients that are symptomatic for CDAD, we face the problem of shared rooms with other patients that don't have the disease. I personally think it's sacrilegious to admit a patient who doesn't have CDAD to the room of another patient that has *C. difficile* diarrhoea. I really think we should be able to come to consensus that this should not happen. Another thing that I really feel strongly should not happen is the frequent movement within the facility of a patient who has diarrhoea.

I know bed utilization is a huge issue in all acute health care facilities and long term care facilities. I know we have bed space limitations, but I find it very frustrating that there is such frequent patient movement. These patients do not just have *C. difficile* but VRE and MRSA and they move all over the place. So I really think we should be able to come to consensus that once someone is diagnosed with *C. difficile* then we really shouldn't move them around because we are just spreading their faecal veneer. I think that we should strongly suggest a consensus about the issues of patient placement and frequent movement of infected patients. It is unethical to put other patients at risk for exposure to *C. difficile* when it is unnecessary.

It's probably not surprising that when an outbreak is occurring and the intensification of control measures begins, there are a couple of traditional patterns; one is that you don't get an immediate effect. Immediate effect is not occurring because people who are emerging in your outbreak are people who were infected previously and so the impact of control measures will not be appreciated until one or two incubation periods from

Control Measures

when intensive measures were implemented. So in terms of the control of an outbreak situation or even in sporadic cases, you are probably doing the right thing with consistent use of routine practices. We all know you are doing the right thing by intensifying efforts from routine control when sporadic cases turn into an outbreak.

I think the thing that is most important is the basic standard of control that exists to prevent the early transmission of infections because that will prevent the outbreak from occurring in the first place. It's almost impossible to quantify basic control efforts because it's like going into a hospital and saying this hospital didn't have an outbreak, what are they doing right? Why are control measures working there and not elsewhere? So again, I think it is an important point that you have to realize that once you start seeing an outbreak, your ability to intervene and stop transmission is only going to have an effect for uninfected patients. For patients who have already been infected, it is too late.

I think that another issue we need to discuss is what is routine practices' hand hygiene vs. hand hygiene for sporadic cases and if there is anything different to be practiced during outbreaks?

Hand hygiene practices are important, as well as good environmental cleaning; do we choose a hospital disinfectant that's going to work for everything vs. something that is going to work when we have outbreaks. I think those are issues we definitely need to address when it comes to the environment, because we know *C. difficile* is a heavy environmental contaminator and environmental cleaning is important.

So do we have a difference between our routine state of practices and our response to a sporadic case? I think this is one of the things we are trying to figure out.

I'd like to go back to the previous point on isolation. There are risk factors for patients that we cannot alter, such as age, co-morbidities and the need for antibiotics to treat other infections. And then there are risk factors that we can do something about. I think we need to focus on those. So in terms of isolation, I think one of the greatest risk factors for transmission is physical proximity to symptomatic patients. You may not actually know when a patient has *Clostridium difficile* infection in the early stages. So I'm just wondering if there isn't a need to, perhaps, take one step back. You may feel like we're going around in circles, however there is the management of patients who develop diarrhoea until *Clostridium difficile* is ruled out.

We had an opportunity recently to look at attempts at contact tracing of infections in the hospital. What we were really interested in was what their roommate's exposure was and then trying to figure out whether those roommates were at risk. One of the things that became interesting during this process is that we realized when someone was diagnosed with *C. difficile* there was an escalation of control and environmental cleaning measures but these measures were only applied to the room the person was in when they were diagnosed. The measures weren't applied backwards to the rooms that person had been transferred from over the previous two or three days.

I'm not sure what your hospital settings are like, but in our hospital setting, room transfers sometimes last as little as five or six hours and there can be three or four room transfers prior to the patient being diagnosed. So one of the issues of environmental cleansing and control really needs to involve looking back at the environment the infected patient was contaminating prior to the point of their diagnosis.

I think in starting out with recommendations for control we need to go back to the basics. I know in the US, adherence to hand hygiene is now required by The Joint Commission, so everybody is starting or has started performing hand hygiene compliance monitoring. My health care system is monitoring hand hygiene compliance and we're going to monitor adherence to Contact Precautions. So maybe the starting point for good routine practice is that we recommend routine monitoring of adherence to hand hygiene and adherence to Contact Precautions, as a starting point. Then maybe drill down into some of the other issues once diarrhoea has started.

I like your suggestion about intervening at the point the patient develops diarrhoea. Now, I realize there are a million reasons for diarrhoea, I cover oncology and

Control Measures

every single one of the patients has diarrhoea when they are on chemotherapy, but still, every single one of them has *C. difficile* as well.

Just to make a point about risk, it's relatively predictable that some people are at increased risk for acquiring *C difficile*. So when you're prescribing antibiotics one of the things you can do is ask the patient to inform healthcare workers about the onset of diarrhoea. In the oncology world we find that everyone has diarrhoea. One of the first things is to identify the potential risk to the patient and tell them what the risks are, so they can then prompt you when they are starting to have diarrhoea so that you can start precautions.

I think one of the really important things to think about is the standardized definition of diarrhoea. When I talk to patients and staff, I quickly realize that what I thought was diarrhoea and what the patient thought was diarrhoea and what the nurse on the ward thought was diarrhoea were three completely different things. So that really creates problems in terms of identifying patients that have diarrhoea and, therefore, being able to make decisions whether or not to isolate them, whether or not to send a stool specimen or even make a decision on whether or not they truly have diarrhoea. So I think that's something that is really basic but important. One of the things that can help is the use of stool charts. When you have pictures it really helps, they are very graphic. When everybody talks about a liquid stool or type '7' you know there is diarrhoea or if one with fluffy rugged edges than you know you've got loose stools. Stool charts can be useful and people may want to consider using those. [See UK http://www.thewvsr.com/bristolstoolchart.htm and page 84]

What I'm hearing is that we do have concerns regarding placing people in rooms with people who have diarrhoea unless they also have diarrhoea of the same origin. And that we don't move people around here, there and everywhere.

Multiple bed transfers make more work for everybody. Theoretically I agree that patients shouldn't be moved from room to room. I think we need to ask ourselves why they are moving patients so much. Many times a patient becomes positive for MRSA and has to be placed in isolation. This results in a whole cascade of patients getting transferred around. I'm suggesting is that we look at the issue of room-to-room transfers very carefully.

We did talk about roommates and infected patients. Patients with CDAD should be placed in isolation with Contact Precautions with no roommates unless the roommate also has CDAD. No room transfers of patients with CDAD and no CDAD patients sharing toilets with non-CDAD patients.

In real life, a patient who is diagnosed with *C. difficile* may not be in a private room at the time of diagnosis. It may take hours to a day or more to get a patient moved into a private room. There is much competition for private rooms – tuberculosis, VRE, MRSA, etc. – I think the recommendations have to include what to do in the *interim,* while waiting for optimal precautions rooms to become available. We may suggest that there be dedicated commodes for multi-bed rooms.

Some hospitals don't have single-bed rooms. They also do not have washrooms within the room – they have a shared washroom in a central corridor of the hallway. These are older facilities. We need to determine what to do under those circumstances.

Sharing toilets between rooms is a real problem if one person is on Contact Precautions and the other isn't. In this circumstance, the toilet/commode must be cleaned between patients.

An unstudied area is the aerosolization of spores. These spores are less than one micron in size and remain suspended in the air for considerable periods of time contaminating the environment. I agree that a dedicated commode located within their restricted area until they are cleared is a suitable strategy.

Consensus is that Contact Precautions must be used whether there is a single room available or not and a commode or toilet should be dedicated to the patient. The patient should not be transferred unless medically necessary.

Certain patients represent a risk for contaminating the

Control Measures

environment. If patients are judged to increase the risk for environmental contamination, symptoms or not, they must be treated as if they have *C. difficile*.

Perhaps we need to stratify the recommendations. We want to make sure we recommend ideal guidelines in addition to secondary ones, when a private room with an attached toilet is not available.

Do we assume than that once diarrhoea starts, these precautions will need to be implemented and not wait for a CDAD diagnosis?

In all practicality most places make decisions based on a combination of clinical symptoms and patient risk factors. If a patient just has diarrhoea, has not been on antibiotics, or been in hospital for one day, it is unreasonable to expend all your efforts to isolate this patient. However, if the patient is 75 years old, has been on ciprofloxacin for 3 days and has diarrhoea, your decision to isolate will be different. So what we do is put the characteristics (i.e., diarrhoea, age) together with the risk factors (i.e., been in the hospital more than two days, been on antibiotics the past 30 days) -- then the patient is placed on precautions for presumed CDAD until proven otherwise.

The decision to institute Contact Precautions is based on a risk assessment.

Question. Do we need to close doors?

This is not really an issue of doors, but a need to delineate bed space by a curtain. There is something about physical segregation that helps delineate the bed space for isolation purposes. Spores are small and easy to spread. Should we say these facilities must have a door that is able to be closed?

I'm not sure I agree with the statement that doors must be closed. What are we accomplishing by closing doors? Generally speaking we don't insist on doors being closed except in airborne isolation. What is the evidence? I agree with the delineation of the bed space, but not the door closing.

Closing doors may be a sort of delineation of bed space. We need a standard to "define" bed space to determine how to delineate.

We know that there is a large burden of contamination in the environment with *C. difficile*. It settles out and is easily disturbed by activities of health care. Bed changing in particular will throw spores into the environment. The ability to contain the air flow within the contained space makes sense.

If we focus on high spore load areas I can see toilet doors being closed during use. Keeping the room door closed may not be necessary.

Doors shouldn't be closed 24 hours a day. There are issues of patient safety and visibility that need to be taken into account. I completely agree that there are activities which are going to impose a higher risk. Bed making and other activities, like cleaning, for example, may require that doors should remain closed as with MRSA during chest therapy.

So what you are suggesting is doors must be able to be closed during activities that may generate aerosolization of spores. I think that is what we want to capture and then you might want to say, for example, during commode use, linen changing, etc., the door should be closed.

I was just going to make a comment about what I think of the idea of the closed doors. I don't know about the aerosolization of spores, I guess it's certainly conceivable. What I think about with doors is how people have blinders on when they walk into patient's rooms. You can have signage there, but they walk right by it. They don't put on barriers. Doors closed might remind staff that this room is different from others and you need to do something. Doors are like part of the signage – to get people to stop and think before they walk in there.

What I am suggesting is we need clear signage or a closed door to help healthcare workers realize that it is an isolation room requiring the use of personal protective equipment. Signs may be hidden and have too small type. These signs need to smack you in the face to show that this room is different.

Are doors an issue? I don't believe there are data to

Control Measures

show that spore aerosolization contributes to spread. No one has looked at it. I find it a bit draconian to close the doors of patients in isolation with *C. difficile*.

We are recovering spores from areas that are away from the patient. This is a work in progress. Can we assume they are moving from the patient to the curtain, rail top, and other surfaces in the patient's environment? In California there was a *C. difficile* outbreak in 24 bed wards. They found that spores will migrate throughout the whole unit.

How are they migrating? They can just as easily be migrating on people's hands. We know our hand hygiene compliance is pretty poor. Just because they are somewhere else in the room doesn't mean they've migrated through the air.

The group is not in agreement that doors for these isolation rooms need to be closed.

Question. Should the patient be restricted to their isolation room?

Are we letting these patients out of the room - is that okay or not? It would seem reasonable if the patient is continent, able to get to the washroom and has good hand hygiene practice.

It is important that patients be mobilized as long as they are not faecally incontinent. This can be difficult if the patient is confused. It may be difficult to confine some patients to their room. If some patients don't move around they don't rehabilitate and as a result they stay in the hospital longer and get infections. Their outcomes are more likely to be negative. They must be able to ambulate.

We don't restrict mobility unless the patient is incontinent or likely to be incontinent. There is no reason to restrict patient mobility if there is no active or copious diarrhoea. Isolation and mobility restriction affects patients both psychologically and physically. I'm very much against imposing restrictions.

What about specific places? We have a lovely sun room. Are they allowed there with other patients? What about going to the cafeteria? What about physical therapy, art therapy? I think yes.

I agree. I think we need to be clear about patients coming out of the room - they need to perform hand hygiene.

Question. What about patients wearing a gown & gloves?

Patients should have unrestricted activity assuming the patient can perform good hand hygiene and there is no uncontrolled diarrhoea. We would suggest patients must have clean gowns when they leave the room or that personal clothes are not visibly soiled.

Question. When are gowns and gloves necessary?

Gloves and gowns are to be worn for Contact Precautions before entering the patient's room or designated patient bed space.

Question. When should the use of these measures be initiated and when should they be discontinued?

There has to be an established mechanism for communication and appropriate implementation of precautions. At onset of diarrhoea, use Contact Precautions until the diagnosis is known.

The Best Practice document states to place the patient in Contact Precautions. It should be done by whoever makes the call that the patient has diarrhoea.

Does this happen currently? Usually isolation precautions are implemented when the diagnostic test result is received. However, that may not be the right thing. The horse is out of the barn by the time this happens. What are we asking for – is it feasible?

Remember only 10-13% of patients with diarrhoea actually have CDAD. There are a huge number of other patients with diarrhoea who might be placed on Contact Precautions unnecessarily.

Control Measures

I'd love to see patients placed in Contact Precautions at the onset of diarrhoea. We haven't been able to get staff to buy into that due to a reduced bed availability issue. If we did this we'd have no beds available. We would be more likely to do this if we see clusters. Clusters are defined as two or more cases in a geographic area in a specified period of time. We run trend reports that are broken down by ward and site which we review every two weeks. Placing all patients with diarrhoea in Contact Precautions is not feasible in my facility.

This is a real challenge if there are not enough isolation rooms. If you are in an outbreak situation, then it's different. Having institutional definitions for clusters and outbreaks is important. I might suggest we produce a mathematical matrix that prioritizes patients based on risk factors (e.g., length of stay, exposure to antibiotics, and physical proximity to another *C. difficile* infected patient). Then you can prioritize the placement of patients into scarce isolation rooms.

Another thing about being very strict with isolation is it can help contain problems with norovirus and other enteric microbes that may be as problematic. So there are benefits. Isolating patients with diarrhoea certainly is challenging and will depend on individual organizations.

In order to know your situation and implement control measures, you need to conduct surveillance. Institutions have to keep track of *C. difficile*. To know which *C. difficile* approach to take, you must know your data. Control measures will depend on whether one is in an endemic or epidemic situation.

These comments are from the perspective of a hospital in the middle of an epidemic that does place patients in Contact Precautions when there is diarrhoea and risk factors (antibiotics in the past 30 days). At two in the morning there are not enough nurses or available rooms to transfer the patient. So, until an isolation room is available, the patient is put in interim Contact Precautions with a separate commode (patient no longer shares the bathroom with roommates), curtains drawn, tagged as a *C. difficile* rule-out, stool sent, etc. A room may never become available. In that case you prolong the interim precautions until the morning when there is more staff, more movement of patients and a room can be found. It is difficult. That means in 1 in 10 cases you are going to have someone in a 2- or 4-bed room with CDAD and they are going to be spreading it to other patients. Placement into Contact Precautions at the onset of diarrhoea may not be useful in a non-outbreak situation. We would have to buy 45 more commodes. I could accept interim measures – they are better than what we are doing now.

So patients with true diarrhoea with risk factors, no matter the time of day, would be moved into a private room if available. If not, at minimum, a commode is assigned, curtains are drawn and the patient is treated using interim precautions until diagnostically proven to have or not have CDAD. This is a good suggestion to accept and adopt interim measures until the diagnostic test result is available.

We are in agreement. Who will assimilate those risk factors? They need to be clearly spelled out. In the middle of the night staff needs to know what to do. Nurses must be empowered to make decisions. If the patient has been on antibiotics greater than 30 days, is over the age of X, and they have diarrhoea, they go into Contact Precautions.

We do the same even in non-outbreak situations. If patients have uncontrollable diarrhoea they are placed into Contact Precautions. It's also a reason the ICP is on call 24 hours a day. If there is confusion, we can answer questions. The next day IC can make a risk assessment.

Question. Who may implement isolation precautions?

Nursing staff on the ward must have the authority, no matter the time of day. They can use established criteria. They can use interim precautions until the results of a diagnostic test are available.

This seems logical. Reality is IC sees results before the unit – we'd often make the phone call. Whoever finds out about test results first would implement Contact Precautions. Nurses should be empowered to initiate Contact Precautions independently – without a physician order or IC involvement.

Control Measures

Lab should be calling these as urgent/stat reports. As soon as results are available, they must call the ward and IC.

If the rate represents an endemic rate, that is acceptable. If the institution is in an epidemic situation, they would have to have a dedicated person to perform rounds to isolate identified new patients. This type of syndromic surveillance would capture patients that the nurses might miss. Nurses may be too busy and patients may not tell nurses they have diarrhoea.

Question. When should Contact Precautions be discontinued?

It's harder to say when isolation should be stopped. In our facility IC has no role in this. Ward staff want the patient taken off Contact Precautions when diarrhoea stops. However, when diarrhoea redevelops they then need to place the patient back on precautions. We should have a defined person to place and remove isolation precautions consistently. Patients should not be removed from precautions until all the criteria have been evaluated for that patient.

Anyone should have the authority to place a patient in isolation precautions, however only IC should be authorized to remove them. This is consistent with Canada's Best Practice document. [Canada Best Practice]

Question. What time period is appropriate to discontinue Contact Precautions after diarrhoea has ceased - - 48 or 72 hours and why? Also what about the person with recurrent diarrhoea, are they kept in Contact Precautions indefinitely?

We looked at standard definitions of the symptom-free patient closely. Our patients experienced numerous diarrhoea relapses. Patients were "ping-ponging" in and out of Contact Precautions, probably perpetuating our outbreak. We changed our definition from 48 hours to classifying stool type '5', '6' or '7' stools [Note: using the Bristol scale on page 84]. A designation of '5' is loose for 72 hours with a minimum of one formed stool. This classification system helped reduce our outbreak. These classifications showed that the patient's bowels were returning to normal.

We require a known positive patient to complete their full course of therapy before consideration to remove them from precautions. Patients are removed when there is no diarrhoea for 24 hours after antibiotics are stopped. We occasionally place patients on precautions until the diagnosis is excluded. If their *C. difficile* toxin is negative, they will be removed from Contact Precautions.

If using regular diagnostic tools, we recommended two negative tests for *C. difficile* before a patient can come out of isolation precautions. For presumptive positive patients with diarrhoea, it would take 2-3 days before any determination could be made. If we strongly suspected *C. difficile*, we would submit another test sample. No one knew what to do with persistently positive patients and they were isolated for the duration of treatment. Our criteria usually didn't include time for diarrhoea relapse (24-48 hours), which averaged 6.5 days. We took patients out of isolation after 24-48 hours and then three days later they would relapse and be placed back into isolation precautions. This doesn't make sense.

We also include an IC evaluation before making a decision to remove patients from Contact Precautions.

As far as discontinuing isolation precautions, there simply aren't enough ICPs to review every isolation room, every day. We are overstretched already. I can't agree to IC involvement for the decision to discontinue precautions. Nurses should be empowered and educated for when to discontinue isolation precautions. They should be able to make decisions based on established criteria or contact IC if there are remaining questions. ICPs aren't there 7 days a week.

I understand that, but the reality is nurses have pressure (e.g., need for beds) to take people off precautions prematurely and as a result the patients may be taken off too early, even with criteria. Removing patients from Contact Precautions should be a collaborative decision between IC and the unit's nurses.

I agree that ICPs need to review cases before removal from any type of isolation precautions. Often the physi-

Control Measures

cians want the patient to be removed from isolation precautions prematurely. We also have rapid turnover of staff and use agency nurses, thus continued training is a problem. There is a need for consistency by using someone who knows the criteria to make the decision.

I would concur. Nursing staff are under lots of pressure from physicians and administration to increase the flow of patients.

For many of us this is a challenge. We may not have fulltime ICPs employed. We can, however, ask IC to designate a knowledgeable person, e.g., a nursing supervisor.

I do not believe that ICPs can be made solely responsible for removing patients from isolation precautions. If the criteria are explicit, others can be designated.

This is really a management statement. These decisions should be left up to the individual hospitals to decide.

We should provide options for making the decision. The discontinuation of isolation precautions plays a big role in the spread of *C. difficile*.

I agree with both sides. We have a flag in our computer system that identifies a CDAD patient and anyone can put it on. The only personnel who can remove it are IC and admitting. If a nurse calls requesting discontinuation of isolation precautions or flagging a patient, we review the criteria with them. We should recommend IC involvement somewhere.

We are suggesting then that we discontinue Contact Precautions if nursing staff states the patient meets established criteria and they get IC approval for it. We need to reinforce to nurses to double check with IC to decide what to do.

We are agreed that IC makes the decision based on information provided by staff. Decisions can be based on nursing notes if needed. This may be an audit opportunity with results provided back to the unit. This is a reasonable compromise.

Question. Do we really need to wait until therapy completed? If responding to it – do they need isolation precautions?

We remove patients from isolation precautions while still on therapy as long as they are symptom free. Our decision depends on the individual patient circumstances.

We maintain precautions while the patient is on therapy because we worry about risk of recurrence. Our issue is primarily with the intensive care patient and bone marrow transplant patients. They typically stay in the hospital longer. Also not all patients will resolve diarrhoea with treatment. I have not seen any data to support duration of precautions.

If patients are on therapy and responding, can isolation precautions be removed? In prospective studies looking at *C. difficile* infected patients, they will shed spores for a fairly long period despite being on therapy. Spores will still be there. If patients are removed from isolation precautions, we need to thoroughly clean their area.

I am still struggling with how long after the patient has had no diarrhoea can isolation precautions be discontinued. We know patients on treatment and post treatment still shed spores. They may shed less, but they still shed spores. If patients are asymptomatic and have no diarrhoea, they are less likely to shed spores, whether on treatment or post treatment. Therefore it doesn't make any sense logically to keep them on isolation precautions until the end of treatment. Relapse can happen a week later so that doesn't make sense either. Taking patients off isolation precautions when they are asymptomatic makes most sense. But my question is, after how many days of being asymptomatic may we discontinue isolation precautions? I have no idea. The most common answer is 48 or 72 hours, however there is no rationale for it.

There is no logic behind the use of 72 hours. It would be feasible if the patient on therapy could be taken off isolation precautions after 4-5 days. In our facility, the mean time of recurrence of diarrhoea in our study was 6 days and a lot of them had recurrence 3 days after starting therapy.

Control Measures

In randomized studies on the use of vancomycin and other drugs, the average number of days to stool being normal is 3.5 days. If we add 3 days on to that we will be recommending that isolation precautions be considered for 6-7 days anyways. This would be consistent with 7 day treatment. What are the data to say this?

Should we leave this as undecided? We don't know how long they should be left in isolation precautions. A reasonable approach is to recommend 48-72 hours.

Agree. We should also add a statement that patients with a history of CDAD who develop diarrhoea, should be placed on isolation precautions immediately.

Laboratory tests

Can we make a clarification regarding the presumptive patient with diarrhoea and two negative stools? Are those two samples collected in a single day or on separate days?

Studies that looked at this did not specify. If you're dealing with NAP1, the massive diarrhoea water loss dilutes the test and you will get a false negative. The test is 70% sensitive. The negative predicative value is high 90%. Two stools seem right, one is too few and three is overkill.

The laboratory will "pool" specimens that are sent on the same day. I would suggest a minimum of at least a day apart.

A positive *C. difficile* laboratory result should be a panic value and communicated immediately to the floor/unit. We suggest that *C. difficile* testing in all hospitals should be available 7 days a week. If a patient develops diarrhoea on Saturday, no testing will occur until Monday if testing is not provided on weekends.

Agree. This is particularly important during an outbreak situation.

The timely receipt of laboratory results have an impact on timely patient treatment and resources allocated, therefore an earlier diagnosis is important. The rationale is mainly in the impact of whether you should treat or not.

The issue of timely receipt of laboratory results for the long term care setting may be different. However, the needs are no different. Rural sites will have more difficulty as well. Acute care facilities should definitely have laboratory testing available 7 days a week.

I believe that there should be access to testing if the need arises [i.e., emergent, outbreak], which is reasonable. We can't specify that testing should be available 7 days per week, because they will get whatever is available. They should however have some access. Access to laboratory results during an outbreak must be 7 days a week.

Some laboratories for LTC and other facilities may not be open Sundays. It may be unreasonable to suggest that 24 hour instant access be available when it may not always be feasible.

Our message is that this not acceptable. Just because lack of laboratory access exists doesn't mean it is okay. It is not unrealistic that access to *C. difficile* testing be available 7 days a week, regardless of the setting. This should be standard for all. LTC facilities have a high percentage of people at risk for *C. difficile*, therefore they need to have access to the laboratory.

A caveat of that is to suggest patients with diarrhoea remain in isolation precautions until test results are available. If laboratory results are not available 7 days a week, at least the patient will remain in isolation precautions.

If improved patient outcomes can be related to starting therapy sooner, it would be a persuasive argument in favour of this statement. Having laboratory test results sooner will have an impact on whether you treat or not, because not everyone treats while waiting for results. So test result availability can affect how long patients wait for treatment. Facilities having an epidemic may treat as soon as the patient is placed in Contact Precautions, in endemic situations they may not. It also affects the facilities' bed availability for using multiple isolation rooms; facilities may have some backup for patient bed placement in the Emergency Department (ED). The use of isolation precautions in LTC will have an effect on the quality of life of the patient, including

Control Measures

the use of gowns and gloves. Families don't like isolation precautions.

Why is 24/7 access to laboratory results suggested only in outbreak situations? If it is that important, why not have 24/7 access anytime? In outbreaks, more patients are certainly affected; more resources are being used, so the faster we know the better.

Thinking of resources, in an ideal world you are right. Reality though is that there is an added expense to testing on weekends. Laboratories may need to open specially for only a few samples to test which is not cost effective. We need to deal with reality and build in a bit more wiggle room.

The information is important for outbreaks because it will determine if wards need to be closed and other public relations issues. There are many reasons beyond just timely treatment of patients.

If in doubt, should Contact Precautions be continued or should we take another sample?

We did discuss taking two samples before ruling out *C. difficile* and that 3 are not necessary. If the patient still has symptoms of CDAD after two negative laboratory results, the laboratory people may have to conduct additional testing, e.g., culture. ICPs should recommend continued Contact Precautions pending further tests.

Question. What is the most effective method of hand hygiene and under what circumstances?

We must understand the level of the infectivity of the spores. Alcohol based hand rub (ABHR) doesn't work on the spores, only on vegetative bacteria.

It's easy to kill the vegetative form. The assumed mechanism of acquisition of *C. difficile* is ingestion of the spores and the vegetative form. The vegetative forms die off as they sit in the environment. There is inconclusive evidence regarding infectious dose and duration of time elapsed for people who are going to get sick. The presence of spores represents a potential source of infection for patients.

The debate as to what is the infectious load is sort of a moot point. When there is a case of *C. difficile* there are millions of spores in the environment. In one millilitre of faecal diarrhoea, there will be at least 1 million spores which will readily spread in the environment.

Because there are not a lot of data, we conducted studies and have found 10^4 to 10^8 spores per gram of liquid faeces. If you look at bedpans, people think the load is low because the disease is caused by active replicating organisms. That's true; the toxin is produced by the vegetative organism. But if you have stool that contain a load of 10^8 spores per gram, it is a massive load. We looked at food acquisition of spores, with meat as a source and found the load of spores per gram of meat is actually quite low.

The challenge I have had is with the statement that soap and water should be used along with ABHR. It gets us into trouble. Some facilities don't have hand hygiene sinks. One reason we've moved to ABHR is there is better compliance than with soap and water alone. I understand the rationale. But if no hand hygiene sink is available, people just won't cleanse their hands.

Some of the references talk about why ABHR doesn't work for *C. difficile* and refer back to observational studies which really don't specify cause and effect. I'm not saying soap and water may not be better. But there is a real problem with recommending it so strongly. It may cause more harm than good.

I completely agree with you. I think we are undoing all our past efforts by ignoring the value of ABHR. It kills *C. difficile* vegetative forms and all the other microbes we are worried about being transmitted. I do not know of any conclusive evidence that the use of ABHR alone has contributed to CDAD rates. Some studies do suggest this anecdotally. ABHR should be a minimum recommendation. Some centres are taping over the ABHR dispensers in patient's isolation rooms. I support endorsing ABHR. Banning ABHR is not right in these circumstances. I fully support endorsement of having alcohol dispensers and hand washing sinks in all patients' rooms.

I would disagree that soap and water should be used

Control Measures

along with ABHR.

In the last iteration of Canada's best practice guideline it states wash your hands if you can at a dedicated hand washing sink in the patient's environment. Failing that, use ABHR. Remember that staff is wearing gloves and when gloves are removed properly they are a major barrier to transmission.

We discuss how often people wash their hands but we don't talk about how well they do it. It's difficult to get people to decontaminate their hands at all. So we should encourage people to use whatever is available. There are data that show that people who use ABHR tend to decontaminate less well than those who use soap and water. So whatever they use, technique must be good. Alcohol evaporates quickly and people using ABHR must rub it in properly. Whatever they use they should use a good technique.

This is a very difficult issue and the literature is equivocal. We saw a 30% reduction in CDAD rates with a big hand hygiene program in 2003. I believe in ABHR if used properly. My concern with soap and water is that people don't do that well.

Skin integrity is an issue of concern if using both alcohol and soap. This practice will reduce skin integrity by drying the skin of hands. We push ABHR to decrease skin breakdown.

ABHR reduces the amount of *C. difficile* on hands by over three logs. Soap and water is better, however alcohol is good. Observational studies that show CDAD rates do not go up when using ABHR are very important.

Washing with soap and water is preferred when caring for patients with CDAD. In the absence of easily available hand hygiene sinks, one should use ABHR at a minimum. We have to take into account that sinks are not always around.

Are we suggesting that patients must perform hand hygiene prior to eating and when leaving the room?

Hand wipes should be recommended for patients who cannot get to the sink for hand hygiene. We've used them successfully for bed-bound patients in the past.

There are varieties available, we use a soapy wipe. Our selection was based on a product that was easy to open, of adequate size, and the need to use towel afterward.

Some facilities can't get soap and water to most patients so they will use the soapy wipes and ABHR for patient hand hygiene.

I can see it for patient use, but I can't see it as a recommendation for staff. Staff presumably has access to gloves. When their hands aren't visibly soiled, AHBR should be sufficient to use after gloves are removed.

It is important to emphasize that staff are wearing gloves. The risk of having contamination on their hands is quite low. This must be taken into consideration.

What evidence supports health care workers not using the sink in the patient's bathroom? What if the only hand hygiene sink is in the patient's bathroom? Sometimes it's in a space just next to the bathroom and is intended as the patient's sink. Has this practice been associated with transmission?

This is a "black box". If the only hand hygiene sink is located in the patient's bathroom I would feel more comfortable using ABHR outside the room. We may be exposed by entering into their bathroom after they've had a diarrhoeal episode and just washed their hands in that sink. If washing with soap and water is optimal, it must be in a non-patient care sink and not in an area likely to be contaminated with *C. difficile* spores.

I am not in agreement that soap and water should not be used where a hand hygiene sink is immediately available near/in patient care area. Our data do not show that. We're also worried about other microorganisms such as VRE.

That's the controversy. The US Centers for Disease Control and Prevention is saying that spores are not killed by alcohol. There is an impression that soap and water are preferred over the ABHR. We are trying to note that you don't throw the baby out with the bath

Control Measures

water, but have to marry these two ideas.

Should we consider suggesting the use of soap and water in case of an outbreak?

We need to proactively make a statement regarding the recommendation for use of ABHR. Many people think it is taboo to use it in a room of patients with CDAD. I like the wording about considering the use of ABHR for improved hand hygiene compliance.

Hand hygiene is not just important when having contact with the patient, but we also want to include a consideration for the environment.

We should make a statement that meticulous hand washing is recommended as a control measure. If there is a choice, the use of soap and water is theoretically preferred and if a hand wash sink is not available, use the ABHR. Whatever you do, do it meticulously. I am not sure which one is best.

I don't want to exclude the use of ABHR just because the patient has *C. difficile*. I don't want to throw ABHR out the window, especially if there are inadequate hand wash facilities.

Soap and water is theoretically more effective at removing spores than ABHR. When a hand washing sink is immediately available, hands should be washed with soap and water after glove removal. If hand washing sinks are not immediately available, then hands should be cleaned with ABHR after glove removal. Hand hygiene should not be carried out at a patient's sink as this will re-contaminate the health care workers hands. We also need to educate staff in proper hand hygiene practice.

This is all theoretical. For routine patient care (not an outbreak), we do not recommend soap and water over ABHR and hence I cannot endorse this as the preferred method.

If we didn't have data showing an additional log of *C. difficile* is killed when using soap and water vs. ABHR I would agree with you. With the data being out there, it shows an additional 10 fold log kill with using soap and water. We are stuck with preferring soap and water.

We need to remember that the purpose of hand washing is not killing bacteria with soap and water, it's physical removal. There is a big difference between the two. I agree there is at least some evidence, maybe not the best, that the physical removal of spores and the net result of what is left on your hands are lower with soap and water than with alcohol. We won't kill spores with ABHR and there is no physical removal of the spore from the hands.

We should also factor in the fact that most people do not wash using soap and water. If there is less kill with alcohol but more people use it, the results may be better. We don't want to suggest that soap and water is preferred over ABHR. People comply better with ABHR. We are having a hard time with this because there is theory and then there is reality.

If soap and water are available, should we suggest going the extra step to specify usage of antibacterial soap for a full 15-30 seconds?

We need an introductory statement on the capacity for hand hygiene in the facility and suggest the use of meticulous hand hygiene using soap and water or ABHR.

We can add a concept that data are available regarding the impact on the incidence of CDAD in wards using ABHR and hand washing; however there isn't enough evidence to completely abandon the use of ABHR.

Question. Should there be different practices for different settings?

There are three issues that need to be emphasized when talking about control outside of acute care. Rehabilitation facilities have the patient care acuity of acute care, yet they have the rooms of the alternative care facilities (e.g., few private/single rooms), and they have staff that are half-way in between semi-skilled and skilled.

There may need to be facility-specific modifications on what we are recommending, e.g., availability of private room vs. no private room.

Control Measures

For any other alternate health care facilities; long term care (LTC), rehabilitation, etc., there can't be any other standard applicable than what is offered in acute care. The way you implement practices may be different. I suggest that we separate out home and ambulatory settings.

We don't provide much instruction to people when they get community CDAD or get discharged and go home with CDAD. We need to give people information on what to do when they go home. We may need to suggest guidance on patient's discharge information.

We also need to suggest guidance for community practitioners; specifically, how to manage patients with *C. difficile* or patients that may present with relapse or how to prescribe antibiotics in the community.

Question. How should LTC facilities handle isolation precautions?

In LTC, it is very difficult to move the resident. Facilities should institute Contact Precautions as you would in a multi-bed acute care facility. Designate the resident bed space as the isolation area. Patient mobility should be contingent on their capacity for hand hygiene, maintaining clean clothes and remaining continent.

The susceptibility of these LTC patients is critical and hence I suggest offering them the same level of protection as is offered in acute care settings.

I also would suggest that the *C. difficile* infected person use a separate commode and the other person (i.e., roommate) use the bathroom. Some individuals have said it makes more sense for the person with CDAD to use the bathroom. The rationale is that the commode contents gets disposed of in the bathroom and will contaminate it. My answer is they should not be discarding waste in the bathroom. If a commode is used for a patient with *C. difficile*, there should be proper handling of bedpans and commodes, which are based on the foundations of good commode/bedpan handling. Emptying an "infected" commode into toilets that will be used by other people is not good practice.

The Public Health Agency of Canada recommendations for Contact Precautions in LTC and ambulatory care are different than acute care. [Routine Practices]

In managing someone with an acute diarrhoeal illness, where there will be a lot of soiling, the use of Contact Precautions means the use of gown and gloves.

We have established transmission rates in the acute care setting. Do we have direct evidence of the transmission rate of active *C. difficile* in non-acute or LTC settings? In non-acute care settings such as rehabilitation or geriatric centres, my observation is that the rate of transmission is low.

That has also been our observation in LTC. People aren't having the same interventions or possess the risk factors for developing CDAD, so we may be transmitting it and not seeing disease. We must interrupt transmission among this group because they are the ones who will get really sick and die. My belief for Contact Precautions in these alternate settings is to use the same level of protection as in acute care.

If the patient has active disease and is shedding I agree 100%. Sometimes we get confused with carriers vs. those with active disease. How it is orchestrated needs to be worked out in the facility.

Question. What is the most effective method to determine compliance?

I suggest creating tools for measuring compliance for both implementation and isolation precautions.

I have difficulty with measuring compliance. What is going to happen if they don't comply? Nothing. Are we going to tie compliance rates to accreditation? We need to suggest an action if compliance is poor.

We should look at the number of patients they are unable to isolate because it poses a risk on the ward. In the UK we found that this data can be powerful.

Have we established that the use of Standard Precautions/Routine Practices is an assumption? And that they are using Contact Precautions in addition to Standard Precautions/Routine Practices? I am suggesting that we

Control Measures

monitor compliance to using Standard Precautions/Routine Practices.

With rapid staff turnover, we should be monitoring compliance in terms of the educational component of staff. Are they aware of the protocols for implementing *C. difficile* Contact Precautions? Compliance monitoring should tie in with the educational tools used for staff. Accreditation agencies may ask staff about unit/facility rates or compliance with equipment cleaning protocols.

An additional compliance measure may be how appropriately patients are discontinued from precautions, implementation of precautions, negative outcomes, turn around times (i.e., laboratory results reporting), time for sending a specimen to the laboratory, laboratory results, sample quality, time for it to arrive in the laboratory, and assessment time. Hand hygiene audit tools such as those used in Ontario and the UK, have been published—see http://www.cpsa.ab.ca/collegeprograms/attachments_ipac/IPAC-Best_Practices_general.pdf and http://www.documents.hps.scot.nhs.uk/hai/infection-control/national-hand-hygiene-campaign/audit-report.pdf

Laboratories should look at their turn around times. These issues are significant. An additional suggested audit includes whether the laboratories are receiving diarrhoeal stools or formed stools, a type of sample quality. Timing of transport of the specimen and arrival into the laboratory is an additional monitoring criterion.

Here is an opportunity for the promotion of link nurses. In the UK we have link nurses/practitioners, who are representatives from ward/clinical based staff, mostly nurses, but also radiology practitioners, physiotherapy. We provide training in IC and they work within IC teams. They are able to help perform audits and it helps to disseminate practices this way.

We have a liaison program which sounds similar. There are representative care givers from all departments. We hold quarterly educational programs and they are the eyes and ears for infection control in their respective clinical areas. They also can perform hand hygiene and other observations. This group is invaluable to communicate information.

This group would be useful for monitoring compliance in addition to the provision of education.

Question. If control measures are identified as non-effective, what are the next steps?

In an outbreak we have difficulty in the determination of who to cohort in addition to finding rooms to use for cohorting. Options are not available. Staff education has to be conducted before, during and after an outbreak.

One thing we do is all-facility education. We work with housekeeping only to find out that nurses thought that housekeeping was doing the job and housekeeping thought nurses did it, so in the end the job of cleaning something goes undone. It would be good to evaluate that actions are really being carried out, as sometimes communication gets garbled. We would go back to check that nurses are using dedicated equipment and discarding supplies after the completion of isolation. We found that room hording can/does occur.

We might want to make a recommendation to ensure that equipment gets cleaned. A need to review practices again might suggest that there is room for improvement.

When we cohort patients we need to also ensure that we cohort the staff. The reduction of transmission won't work unless you do both. Another issue is to look at other areas of the facility that are interacting with the outbreak unit. Contact tracing is facilitated by determining the interaction between diagnostic services, patient transfers off the unit in the last few days, who was sent to LTC, etc. We also might need to ensure communication with others in the community. Since we don't know the exact incubation period for this organism, we can't suggest a time period to look back for the purpose of contact tracing.

We face another challenge with physicians in that they create difficulty with hand hygiene compliance, their use of antibiotics and not placing patients on Contact Precautions. So the big groups I try to tackle first are physicians. We conduct special informational sessions only for physicians in terms of their own practices. We can't leave physicians out of the communication loop. We have established specific auditing of physicians.

Control Measures

In an outbreak setting where you can't get control, the following measures may be useful in order to gain control:

To review practices that are in place and ensure they are performed:

- Additional staff education
- Review antibiotic prescribing and review further restrictions on antibiotic prescribing
- Closing wards is a hospital decision - a group decision

Further measures:

- Have someone who is not involved review activities to get their perspective.
- Consider the availability of side rooms to meet the demand. This will affect the decision to cohort or, in extreme cases, to create a ward for CDAD patients.
- May need to consider novel methods to decontaminate the environment besides hypochlorite.
- There will also be a requirement for increased resources, either human or financial, in addition to more IC teams. Infection control personnel resources are very stretched during outbreaks.

Question. What about visitor screening?

Requirements for visitor screening comes up a lot, especially the question about how many visitors are allowed in Contact Precautions. Families are not doing what they are supposed to do.

Visitors won't get the disease, so any recommendation is not adding much. The only issue we have is the number of people in the room. The numbers of people visiting should be restricted.

Visitors can be problematic in allowing domestic staff to get in and clean properly and they are a problem in any ongoing outbreak management.

Do visitors play a role in transmission? Not really. We have to go back to where it's found in the patient's room and who is going from room to room to room.

We may want to include information on limiting the number of visitors in patient informational packets. Visitors should be restricted if at risk.

I agree. They do need information. The issue of compliance to hand hygiene is important when they leave the room.

We have minimal restriction for visitors. I would recommend a reasonable amount of visitors; however it gets chaotic in a 6-bed room. I would suggest facilities try to follow their own visitor restriction policy. Guidelines for visitors may include a restriction for sitting on a patient's commode or restrictions for borrowing items from other patients.

Question What about thorough contact tracing?

Are people who are colonized cycling back into the system unrecognized? Do people verify that contacts transferred to other units do not have diarrhoea to ensure they are not part of the outbreak? For example, if you sent someone from ward A to B, do you make sure that the patient is not part of the outbreak? We also look at patients who are recently discharged who might come back through a clinic. We communicate with clinics if a patient comes back with diarrhoea.

Question. What about closure decisions?

This decision is at the bottom of the list. After all measures are in place and we have validated they are being followed, if they're still having a problem or if there is a heavy burden of illness, then make the decision to close.

Closing a ward is sort of an intuitive response. But think about it – why would I close a ward, what will it do? It's different from VRE and MRSA. We screen everybody for those microbes and know who is positive and who is negative. When they re-open the ward we will know who is with whom and restrict transmission.

Control Measures

With *C. difficile* this is not the case. The only reason to close a ward is less people will be coming in to get CDAD. It is not ethical to have a ward open when transmission is occurring and people may get a disease that can kill them.

The reason to close a ward is to reduce those at risk. It should be the last thing to do.

Is there anything in place to inform newly admitted patients of an outbreak so patients understand the situation?

This question borders on a legal issue. If we really think there is a risk we shouldn't admit patients to that ward.

Is there anything that can be done with the public in terms of a media campaign? Patients will be phoning and wondering should I come in for treatment. What about the public perception?

Yes, involve your public affairs department. The public demands total transparency, we accomplished this by putting our CDAD rates on the website framed in an educational way. We involved the communications department to transmit accurate information and had dedicated phone lines to answer questions.

Question. What role do pets play in transmission?

Can pets visit someone with CDAD? Dogs have been found at the University of Guelph to be colonized with potentially toxogenic *C. difficile.* Are dogs fomites?

If we are going to restrict pet therapy animals from coming in, then we need to restrict visitors from coming in, because we won't know which visitors may carry NAP1. Without screening, why selectively focus on animals over visitors when visitors outnumber animals? There are so many other fomites that are routes of transmission that we haven't controlled. I don't see why one dog will make a difference.

I don't recommend restricting animals. We need good handling of animals, the use of routine practices and restriction for entering isolation rooms.

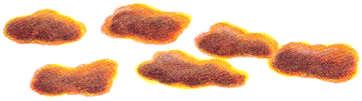
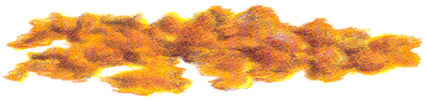
We restrict pet visits from patients in isolation and high risk areas. We also require that dogs be certified by a vet, be bathed in the morning of the visit and require strict hand hygiene.

Invited experts

Michelle Alfa
Rosemary Gallagher
Michael Gardam
Annette Jeanes
Jennie Mayfield
Mark Miller
Mike Rollins
Mary Vearncombe

Control Measures

THE BRISTOL STOOL FORM SCALE

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on its surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges (passed easily)
Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces ENTIRELY LIQUID

Control Measures

For all patients with diarrhoea of uncertain cause:

Send a specimen for microscopy, culture and sensitivity (M, C & S).

If the patient has had antibiotics recently, or is over 65 years of age, please request *Clostridium difficile* investigation (a single specimen may be sent for M, C & S and *Clostridium difficile*).
Please state on request form if diarrhoea could be related to food, foreign travel or bowel disease.
If possible send a specimen of stool that is not contaminated by urine. However, if this is not possible, a specimen of stool can be processed if urine is present but please state that this is the case on the form.

Definition of Diarrhoea: ***An increased number (2 or more) of watery/liquid stools (i.e. type 6 & 7) that is greater than normal for the patient, within a duration of 24 hours.***

STOOL RECORD CHART

Name: **Date of Birth/Hospital No :**

Date sample sent:

DATE	TIME	TYPE No.	DESCRIPTION/COMMENTS (please refer to chart overleaf)

Environment and Equipment

ASSUMPTIONS:

- It is cost effective to invest and ensure that good standards are present in healthcare
- Adequate resources are available to deliver appropriate cleaning
- There is training and education of staff and reassessment of knowledge and competence of cleaning staff
- There are performance standards and feedback of performance
- Cleaning departments have enough staff and enough time to clean

Question. Based on Standard Precautions or Routine Practices, do you need to do anything differently for environmental cleaning (non-critical) when the patient has *C. difficile*? What, how and at what frequency? Any areas more critical than others?

First, is it clear as to what should be normal or routine in hospitals? One of the biggest deficiencies in the healthcare system is the lack of compliance with housekeeping standards. We need to define routine cleaning. What are the standards?

There are too few housekeepers to perform thorough, frequent cleaning; it is hard to get compliance with even once-a-day complete cleaning. Outsourcing of housekeeping services is also an issue. We need to get compliance with basic cleaning. Housekeeping staff need to be trained when they are hired. It is cost effective for senior managers to ensure there is appropriate training for cleaning staff.

A UK hospital [Scottish] has posted its cleaning practice guidelines on the Web: http://www.hfs.scot.nhs.uk/guest/HaiInitiatives/NatEducationFramework.pdf - Healthcare Facilities Scotland. [HFSScotland] Association of Healthcare Cleaning Practitioners – it brings together training information.

But, it's not enough to just train cleaning staff; you may have to assess their cleaning frequently. People may think they are doing a good job. The outcome of cleaning can be evaluated – e.g., using adenosine triphosphate (ATP) or ultraviolet (UV) markers – not to punish anyone, but to validate the training process and provide feedback.

The cleaning team must be part of the infection prevention culture. They need to know the importance of their job and understand the role of cleaning versus disinfection. Cleaning is most important and disinfection will not overcome poor cleaning.

The institution can be divided into high (e.g., intensive care), medium (e.g., wards) and low risk areas. Then housekeepers can target their efforts. In low risk areas, such as outpatient areas, not as many resources are needed.

Really good cleaning is needed in all patient rooms – it is too late if we wait until a patient is identified with *C. difficile*. The major consideration for *C. difficile* is the spores; there needs to be great emphasis on the environment. It's not just the frequency of cleaning but the technique that is important.

Areas of contamination are driven by the patient. There is no need to perform high dusting or worry about the floors so much – the focus should be on high contamination areas such as bathrooms, commode, faucet, flush handles, bed rails and common touch areas. Data from the UK show that hand-touched surfaces in patient's rooms are contaminated within three hours after cleaning; there needs to be special focus on objects/surfaces that are frequently contacted or touched by infected patients. Portable commodes need to be cleaned as thoroughly as toilets.

The cleaning schedule should be modified if there is an increase in *C. difficile* incidence or a *C. difficile* outbreak. Then there is a need to clean more often, e.g., twice a day. For example, may clean floors once per day and common touch areas two times per day, e.g., bathrooms.

In the UK, some hospitals have a rapid response team to clean rooms of infected patients. As soon as a patient is detected to have *C. difficile* they come in and clean. It is a SWAT team – a group of specialized individuals for cleaning isolation rooms.

The minimum schedule in isolation rooms should be twice a day cleaning. It is important to also ensure iso-

Environment and Equipment

lation rooms are cleaned to a certain standard. May need specially trained staff with a special status in the organization; resources are needed. Even once a day is okay if cleaning is really good. Modify the schedule based on the acuity of the patient .Two times per day cleaning may make sense in patient rooms where there are critically ill patients.

What is really needed is adequate staffing – sometimes staff get pulled to do other jobs. Also, the pressure on cleaning staff to get the room cleaned quickly is huge. We are not allowing them to do a good job. Adequate contact times are not allowed. We push them to not do their job properly.

We also need to clearly state who cleans what; define it. Outline all equipment, areas and who is responsible. A document that lists each piece of equipment that should be cleaned is useful.

Question. Do we have to increase the normal frequency of cleaning and cleaning agent?

Older studies showed that after two hours the same microbes are in the environment as before using a disinfectant on surfaces. Times are different – we can use a detergent-disinfectant now.

If a disinfectant isn't applied to a clean surface, it won't have an effect. It is important to clean well first. The physical action of removal of contaminants is a major part of cleaning.

With *C. difficile* the environment should be cleaned with a sporicidal agent. When there's an outbreak, double clean with a sporicidal agent. Hydrogen peroxide vapour is a new cleaning agent – a neat idea, but really new in North America. If there is an ongoing outbreak, we may want to consider this. Currently, many hospitals are not using sporicidal agents for terminal cleaning of a *C. difficile* patient's room. This should change.

Question. How do we clean a room inhabited by a patient with *C. difficile* who has been discharged or removed from precautions?

The room/dedicated space (of a multi-patient area) inhabited by a patient with *C. difficile* needs to be "terminally cleaned" including the bathroom. Start by removing the disposable items that have been contaminated. Start from the top and work your way down. End with the floor. Finish by changing the curtains.

Bed linen can contain a large number of spores. It is a reservoir. However, we don't know if it is a risk.

Question. Is there any difference in practice for terminal cleaning in a sporadic case room than a *C. difficile* outbreak?

Not routinely. May need to do something different in a major outbreak – might double clean then.

Question. Based on Standard or Routine practices, do you need to do anything differently for equipment cleaning (semi-critical, critical) when the patient has *C. difficile*? What, how and at what frequency?

Equipment must be dedicated to the patient and it should be cleaned or disinfected with an appropriate agent by specialized staff. Follow current guidelines for critical and semi-critical items. For non-critical items: assign someone to make sure it is cleaned; it must be cleaned before use on another patient. There should also be a checklist monitored by supervisors.

The bed should be considered part of the equipment that must be cleaned as part of terminal cleaning. It is a non-critical item. There should be a specific policy for handling beds – put on protective garb, take pieces apart, clean, apply disinfectant, dry, and then put it back together again. Responsibility would be assigned accordingly.

If you move the patient's bed with him/her, e.g., a specialty bed, you may be infecting a new area with a contaminated bed. Bed clothing is very contaminated. Should clean the bed, perhaps replace the mattress. The bed would then require terminal cleaning. The choice for nurses when moving a patient is to strip the bed, clean it, and use it to move the patient or use a trolley. In a UK hospital, they do this for all patient movements. Assure that the ability to clean the bed is included in the

Environment and Equipment

criteria for purchasing patient care products. Must only buy beds that can be properly and adequately cleaned.

Is the bed a higher risk with *C. difficile*? Should we use a sporicidal agent? Beds and carts are really part of the actual room. I am concerned about how products affect beds – warranties on beds, mattresses, etc. However, it could be that use of the cleaning agent will result in fewer cases and less possible damage to the bed.

There shouldn't be restrictions for hydrotherapy if patients are continent and proper disinfection processes of the tank are carried out. A lot of these people are elderly and not too mobile.

Question. How should we manage containment of faecal material?

There is really no good bedpan process. All ideas have issues. There are also no good data to support what to do. There are data to show there are spores on the bedpan. The used bedpan should definitely not be kept in an area like a nightstand or bedside table beside the patient.

How are healthcare workers disposing of faeces? Carrying it to a hopper? Should it be disposed of in the patient's toilet? To prevent aerosolisation, do not use sprayers or sluice – regardless of whether it is in the patient's room or a utility room on the ward.

If there is a one patient toilet – why not dispose into the toilet? The bedpan must be cleaned though. When using a toilet – just pour it in and flush into the sewer system. Then throw out the bedpan in the garbage in a plastic bag. It isn't medical waste by definition. However there will be spores in the bag.

The issues here are containment – properly disposing of faecal matter and reducing aerosols - and logistics. We need to recommend against anything that leads to aerosolisation of the spore. Limit the use of a sprayer to rinse the bedpan which will aerosolize the spores.

How do you get the material out of the room? Bedpans should not be transported uncovered; use paper covers or a plastic bag. Covers can fit the shape of the bedpan. The bedpan must be contained at the point of disposal.

Use processes that minimize healthcare worker exposure to the spores; healthcare workers need to wear gowns and gloves that were worn in the room with the patient since the patient is on Contact Precautions.

Process in the UK:

> Cover bedpan, walk down the hall with gown and gloves to the dirty utility room,. Dispose of contents of bedpan by placing it in washer or macerator (do not use hopper). Remove gloves/gown/apron in sluice area and wash hands.

A four bed room will have 4 bedpans. It is not uncommon for bedpans not to be labelled with patients' names. They are probably being used unintentionally for more than one patient.

What about using macerators rather than traditional bedpans? They have issues as well.

Generally we can't guarantee that bedpans are being cleaned. A macerator will help with that. For macerators there are holders for the disposable insert. There is a need to take the bedpan to another area where the macerator is located and discard the insert. There is also an issue with the holder and its contamination. Maceration doesn't deal with all issues, e.g., walking with a loaded bedpan down the hall.

Bedpan washers can be used by placing a loaded bedpan into it. There is also contamination around the washer. However it is nothing compared to the sprayer/wand at the toilet.

Bedpan washers only address cleaning. Bedpan washers do not have thermal conditions that kill spores. The bedpan is still contaminated when it comes out. The UK has a standard for effectiveness of bedpan washers [Health Technical Memorandum].

Bedpan washers are fine for disposal of waste to reduce aerosols – but the bedpans that come out still have spores on them. The washed bedpan must go to the Central Sterile Department to make sure it is adequately decontaminated. Manufacturers need to come up with detergents and systems to make bedpan wash-

Environment and Equipment

ers adequately decontaminate the bedpan. More research is needed.

Reprocessing in Central Sterile Department – why is it necessary? What evidence is there that it is needed? Reusable ones will need final disinfection between uses on different patients. Not after every use on the same patient.

What about disposable bedpans? Can get rid of waste by emptying into the toilet, then discard the bedpan. Then there is no need to clean it. This is convenient but very costly. Also, there are issues such as where to store it.

There is a bedpan with a plastic bag and a gel in it, like cat litter gel; faeces and urine form a solid mass when exposed to the gel. Take the plastic bag, invert it inside out, tie it and discard.

Each unit should have access to either a bedpan washer or a disposable system like a macerator in good operational order. Nurses should not manually wash bedpans in a sluice sink.

An intensive care unit patient is less mobile and acutely ill. We can consider the use of faecal incontinence containment (not a faecal/rectal tube) to minimize environmental contamination. It sticks to bum cheeks – like a diaper. It can be used for patients other than those in intensive care too. Patients still pose a risk, however it will decrease the amount of shedding. It will also decrease accidents if there is severe diarrhoea.

Toilet brushes should be disposable or dedicate a reusable one. Discard at discharge, transfer or when the patient is no longer symptomatic. Do not keep it on a cleaning cart. Store properly so it doesn't contaminate anything else. If the toilet brush sits in a suboptimal concentration of disinfectant, some detergents may actually stimulate production of spores.. This is laboratory-based data only – the increase in production of spores occurs after 72 hours.

Other issues

Discard the roll of remaining toilet tissue. Some patients have difficulty getting tissue out of the holder and end up soiling the tissue. Enclosed containers are available too.

All reading material that could be shared between people should be removed. Throwing out Bibles has been contentious. It is considered sacrilegious. If the rate of *C. difficile* is high, then there is a need to evaluate this.

Patient paper records are an issue – workers need to wash hands before touching medical records. Can have vinyl covers so they can be cleaned easily at the time of terminal cleaning. Any 'stuff' in the room needs to be cleanable. Do whatever we can to decrease spread. We have no idea if these items pose a real risk.

Question. Based on Standard or Routine practices, do you need to do anything differently for personal care equipment (shavers, clippers, chiropodist supplies) cleaning when the patient has *C. difficile*? What, how, at what frequency?

Items should be dedicated to the patient and reprocessed after each use. Either perform terminal disinfection or discard if it cannot be cleaned.

Each individual should have their own personal care items; there should not be shared items. For example, individuals should have their own disposable equipment such as shavers.

Question. If disinfectants are necessary, which can be used and how should they be used?

An agent with some sporicidal activity should be used. We need data to evaluate the efficacy against spores. Use it both for sporadic cases and in outbreaks. However, may not see an effect if there are low numbers of cases. We must remove the dirt and detritus before the disinfectant is applied.

If there are sporicidal agents that can be used throughout the facility [not focused only on CDAD cases] this would be ideal. The horse is out of the barn for patients with disease – it's the ones who don't have CDAD yet when it is important.

The U.S. Centers for Disease Control and Prevention guidelines [CDC Guidelines] focus on use of 1:10 dilu-

Environment and Equipment

tion bleach – 500 parts per million. Bleach can harm staff; fumes are an issue. It must have an adequate contact time. There are safety concerns about both bleach and other sporicidal agents. There needs to be more research. Ideally we want to be able to use a product hospital-wide.

4.5% accelerated hydrogen peroxide comes in two formulations – gel for toilets and commodes and one without glycerine in it, a liquid. It provides a 6 log reduction in spores with adequate contact time. It does require water cleansing after use. One advantage is a shorter contact time – about 5 minutes. Wipes are 0.5% and are not sporicidal.

One UK hospital uses a hypochlorite – detergent combined product throughout the hospital [not in paediatrics or maternity]. There were issues regarding fumes – often due to not diluting it properly or using hot water.

Both bleach and hydrogen peroxide can damage equipment. Bleach is cheap and there is more experience with bleach. It should only be used for specific items in a room – all dedicated equipment. All the sporicidal agents will leave an unsightly film.

It is important to keep equipment to a minimum. Remove all unnecessary objects and fabric chairs (which cannot be adequately be cleaned) from the room of the patient with *C. difficile*. Need to be able to clean properly. Vinyl covers that can be wiped down are recommended.

For cleaning the environment, micro-fibre products will remove a lot of spores from surfaces; can actually achieve a rapid decontamination of the environment without any disinfection at all. Micro-fibre products can also be used with the sporicidal agent; it is extremely effective and mitigates residue on the surface to decrease destruction of surfaces.

In outbreak situations clean with an agent with sporicidal activity throughout the ward or hospital. This should be conducted only under the advice of infection prevention and control staff.

Product considerations

- Sporicidal
- May have differing concentrations, formulations
- Check manufacturer's recommendations for disinfection, i.e., one or two-step process, also length of contact time crucial
- Pre-cleaning is an important consideration for disinfection – it must occur

Question. What about fogging?

There are at least two companies in this type of business now. They use different systems. Hydrogen peroxide vapour is one. It works very well. The downside is cost and it interferes with fire systems. It hasn't really been implemented in healthcare yet.

We can consider this in an outbreak, however there is insufficient information now to give a recommendation. Everything needs to be cleaned before use – this is very resource intensive. Also need to discard anything it won't penetrate, like disposables. There is a trial currently regarding routine use in the U.S.

Alternate methods of cleaning/decontamination include steam vapour (thermal cleaning) for difficult to clean surfaces. It can work very well with micro-fibre. New tools are being developed for delivery of steam to healthcare surfaces with reduced likelihood of aerosolisation or dispersion. It is not effective for spores. It is good for deep cleaning and getting into nooks and crannies. It has no smell however it is noisy due to the vacuum. It removes materials from surfaces effectively; might be used for a generic cleaning approach.

Question. Would temporary barriers or covers be effective in certain circumstances (e.g. sheets over wheelchair, sheet over porter bed, plastic covering over charts)? If so, when and what would be effective?

Patients should ideally be appropriately dressed. There is no place for plastic covers as long as an item can be cleaned.

In Contact Precautions, charts would not go normally into the room or be exposed to the contaminated patient. If a patient's chart is being transported too, there are ways to protect it. If it is potentially contaminated or may become contaminated cover it. However there

Environment and Equipment

is no evidence to drive this.

Question. What about gurneys, wheelchairs?

It depends on the risk for contamination; there should be no bare skin contact. If the patient is continent, is it necessary to go to this level? If incontinent, there is a risk of contaminating wheelchairs, etc.

We use incontinent pads or a sheet, however the wheelchair will still need to be disinfected after use. So why do it? Covers are to prevent CDAD spores from getting on to another surface. Therefore we would need to use a water resistant product. With continent and properly clothed patients there is no need for covers. If the patient is incontinent, transport should be limited or use full barriers to contain incontinence.

If a patient is continent, take a common sense approach to transporting. Have a barrier between the device and a bare bottom. There should be no direct skin contact with transport equipment. If a patient is incontinent, take precautions to ensure no faecal soiling of the transport device. These recommendations should be standard – not just for CDAD patients.

Question. What about storage of items around patients, bed linen storage, etc.?

There is aerosolisation of spores around the patient. Spores can be found on high horizontal surfaces. Items can also get contaminated by healthcare workers' hands. Supplies in patient's room should be kept in a cupboard. Assuming spores settle out this will keep supplies clean. Why do this in a CDAD patient's room? They are being used on that patient anyway and being discarded at discharge. It is lots of extra work – why cover? Want items to be put away as much as possible to allow for cleaning and minimise clutter.

Question. What are the issues and resolutions for cleaning multi-bed rooms/settings?

If a patient with CDAD is in multi-bed room, use Contact Precautions and define the bed space. It is important to terminally decontaminate items in the vicinity of the patient at discharge. The infection prevention and control team needs to provide advice. This is true in recovery room, operating room, etc. Still need to use Contact Precautions.

If there is a cohort, then clean equipment in the room that is shared. Use single gown and gloves within the patient's specific bed space. Staff thinks they can go from patient to patient without changing gown and gloves. They use the same equipment. They function as if the individual patients are not on Contact Precautions. Personal protective equipment must be changed between patients even in a cohort setting.

Can use 'interim precautions' – if suspect CDAD then initiate Contact Precautions. If the test is positive, clean as with any patient with CDAD. If the test turns out negative, no special cleaning is needed.

Question. Should there be different practices for different settings? Long term care, Paediatrics, Home care, Acute care, Dialysis, Day care, Schools, Other congregate settings?

There should be the same recommendations regardless of setting; the epidemiology and principles are the same. The specifics and logistics used to prevent spread need to be individually assessed depending on the setting.

Cleaning of areas is a bit more difficult. These settings may have carpets and need steam cleaning; may also have more soiling of the environment. Need to determine what to clean based on individual facility issues.

Home cleaning will be different for patients with *C. difficile*. Provide an information sheet that outlines environmental cleaning details, methodology, product, hand washing, washing clothes, etc. There should be a general information sheet for patient, families and visitors regarding CDAD which includes what to do when discharged. Suggest a dedicated bathroom for use by the CDAD infected patient, cleaned with beach after each bowel movement. An example is at http://www.hpa.org.uk/factsheets/clostridium.htm

Environment and Equipment

Equipment needs to be designated to clients for home health. Medical equipment used in the home should not be shared.

Treat the boarded setting, prison/jail, and group home like a long term care setting. Day care setting - if a child has diarrhoea, send the child home. There are existing guidelines for cleaning day care settings.

Question. How do you measure effectiveness of these measures? Is testing/culturing the environment and or equipment appropriate? If measures are ineffective what are the next steps?

Compliance with cleaning as part of quality assurance program should have monitoring to provide feedback. It is important to ensure compliance. Visual inspection is still important – does it look clean?

There are also methods in addition to inspection (consider expense, validation, availability, includes feedback of results in CDAD rooms to units). They can be used for both cleaning of the environment and equipment.

The ATP method identifies blood/bacteria, needs validation. Used in food preparation areas. Sophisticated method that answers the question – are there bacteria in levels higher than we would want? Excellent for research. Quantifiable with level of microbes, however there is a need to define a benchmark.
http://195.92.246.148/knowledge_network/documents/Bioluminescence_20070620104921.pdf

The UV method will be either positive or negative. Cheap and easy. Only answers the question – was there a physical wipe of the surface? It is a good tool for feedback. No benchmark is needed.

These methods can be used for routine monitoring, not just CDAD. Want to make sure basic cleaning is being performed.

Develop a frequency with infection prevention and control staff. Determine the frequency based on issues – outbreak or not, etc. The cost of failure is so great should monitor practices periodically. It is especially important with cohorting. May want to increase the frequency during outbreaks.

It is also important to confirm cleaning is completed, especially in high risk areas. Develop a checklist to assure all areas are cleaned and responsibility is assigned for areas and equipment. It can outline what is cleaned, who does it, with what, etc.

Should the checklist be initialled by staff [like cleaning bathrooms]? In the UK the cleaner must sign to say they did it and the nurse signs to state s/he saw it - daily.

A study in Canada showed that in toilet areas of patients with CDAD initialling did have an impact on cleaning.

Disseminate data from audits so appropriate steps can be taken. Environmental Services needs to review data routinely. A monitor report can go to the infection prevention and control team periodically. Report the information like other quality improvement initiatives. It also needs to get to the staff that is doing the work. Appropriate actions need to be taken. It can also be linked to CDAD surveillance reports. Can then review processes if it is not working.

Question. What are optimal facility designs for environmental equipment cleaning and disinfection?

Involve infection prevention and control staff in new equipment purchase and facility design issues. Lobby companies so they will make devices that are cleanable, have few crevices, etc. Manufacturers must have cleaning guidelines that will really work.

General and Contact Precautions design considerations:

- Private/single rooms – private/ensuite bathrooms
- Wipeable surfaces
- No shared toilets
- Where to not place patients – use of positive pressure rooms?
  - *issue not resolved*
- Call-light/bells (those with push up device are difficult to clean).
  - Surfaces must be sealed and cleanable.

Environment and Equipment

  - Often add gauze to items – need cleanable material so doesn't need gauze.
  - Need research on wireless systems.
- Dedicate hand washing sink/basins separate from the patient bathroom sink.
- Hands free faucets/taps and soap dispensers minimize sink contamination.
- Equipment in patient room designed with minimum of nooks, crevices, sealed.
- Bathrooms allow storage of commodes.
- Patient room should be sized to be ergonomically friendly and barrier free.
- Ensure enough portable commodes accompanied by space for storage and cleaning.
- Storage space for IV poles and equipment.
- Medical devices used in patient care have the capacity to be disinfected with appropriate chemical.
- Consider the design and adequate space of housekeeping closet to accommodate requirements for cleaning.
- Toilet design
  - No sprayers
  - No closets that minimize space.
  - Cupboard-type (swivette) gets contaminated.
  - Wall-mounted to allow space to clean around.
  - No exposed pipe work.
  - Difficult to clean floor-mounted toilets.
  - There should be a toilet seat so can cover it when flushing.
  - Need better designs.
- Personnel responsible for environmental cleaning despite the setting are all trained in bloodborne pathogens, i.e., the need to pre-clean the stool spill prior to attempting to disinfect the area.
- Need space to clean equipment, e.g., IV poles
- Areas without single rooms – emergency department, dialysis
  - Have isolation rooms available
  - Need sufficient commodes in the area
  - Need large enough soiled utility area, separate clean/dirty areas
  - Need space for storage
  - Need bedpan washer/macerator

Invited Experts:

Michelle Alfa
Rosemary Gallagher
Michael Gardam
Jennie Mayfield
Gopal Rao
Michael Rollins
Mary Vearncombe

Treatment/Antimicrobials

ASSUMPTIONS:

- Antibiotic stewardship requires a multidisciplinary team with a focus, structure, as well as administrative support.
- Antibiotic stewardship is a patient safety initiative.

Question. How effective are all other control measures without antibiotic stewardship?

There are many good reasons to try and stop microorganisms from spreading in hospitals and many good reasons for using antibiotics well. These are two goals that have an impact on *Clostridium difficile. C. difficile* has always been the poster child of antibiotic misuse.

If the subtext of the question is NOT focusing on antibiotic stewardship and only using control measures, such as cleaning and isolation, then the answer is that both are needed. They cannot be separated. We must continue to focus on using antibiotics properly. We must look at antibiotic usage and other infection control aspects as an entire bundle.

One aspect of antibiotic stewardship is changing therapy once you know what you're dealing with. If the organism is sensitive to penicillin, then there may be a need to change antibiotics. Constant vigilance and wise antibiotic use is needed, both in hospitals and in long term care. The enemy is indiscreet prescribing of antibiotics.

We have to go back to the basics of good medicine: obtaining appropriate cultures and treating wisely. Most community illness can be treated with first line drugs. Physician practice is an issue. This is a key piece of a *C. difficile* prevention and control program. It can be done, but it takes work.

This particular issue is not rocket science. Clean up the bathrooms and use antibiotics well. Having an antibiotic stewardship program with clinical pharmacists can have a huge effect.

Antibiotic stewardship, infection control and education are like legs of a stool. The fourth leg of the stool is infrastructure. These need to work together. You can't have one without the other three or the stool falls.

If we don't have systems in our organizations to make a proper diagnosis, you have nothing to determine if the organism is sensitive or resistant to an antibiotic. The patient is managed with broad spectrum antibiotics. A culture is necessary to know what to treat. Treatment needs to start with a proper diagnosis. We have the same issue with patients not getting a good laboratory workup before being placed on antibiotics.

There are two prerequisites for getting *C. difficile* disease: new acquisition and having colonic flora wiped out by use of antibiotics. Both infection control and antibiotic management needs to be addressed.

Question. What are the key components of an antibiotic stewardship program relevant to *Clostridium difficile* disease?

Each institution has its own practices for prescribing antimicrobials and one needs to look at these practices. One type of antibiotic management program will not be adequate for all. In one hospital when an antibiotic management program was instituted, they kept track of which prescribers were the biggest offenders. They found a core group of worst offenders despite repeated reminders. They had to keep providing feedback to get them to change and alter patterns of prescribing. People fall into habits that are hard to break.

If the model of antibiotic stewardship has been proven, what are the barriers to why facilities aren't adopting it? It seems to be a behavioural barrier; therefore, education is required. In Canada, there is a lack of doctors to deal with this problem and a lack of training on how to use antibiotics. Infectious disease physicians focus on very sick patients. A champion is needed, especially with physicians. There needs to be a structure that says we are going to do this.

Antibiotics, in general, are inexpensive. Compared to other drugs, antibiotics are the fifth most expensive class in Canada. It's difficult to get them onto the agenda. Antibiotics need a totally different regulatory structure than other drugs.

There are guidelines from the Infectious Disease Society of America and the Society for Healthcare Epidemi-

Treatment/Antimicrobials

ology of America that outline antibiotic stewardship. [Dellit] There is a need to fund someone to focus on such initiatives, yet funding for this issue is problematic in some institutions.

Another issue is rational antibiotic use. If a physician has a bad outcome in one patient they won't want to experience that again. When that physician is not sure what a patient has, a broad spectrum antibiotic will likely be chosen to treat the patient. Most often physicians will worry about the one patient in front of them. However, with *C. difficile*, what you do to one patient affects the next patient.

Antibiotics should be considered as any other life-saving intervention. Use of broad spectrum antibiotics should be based on assessment of the patient.

There is a need for ambassadors for antibiotic stewardship. Having administrators and chiefs of surgery and medicine on board is important to change the culture in a facility.

Medical students are not taught much about antibiotics in medical school. Fellows and senior residents need to be taught about the ecology of antibiotics.

The broad use of quinolones has lead to a rising tide of resistance. *C. difficile* is part of the tide. We should drop some drugs off of the formulary, such as third generation cephalosporins. More cotrimoxazole should be used, which is an ecologically kind drug like gentamicin. Cephalosporins are damaging.

The right thing to do is to have a national council with academics and non-academics that would work to change practices. A multi-disciplinary approach is needed along with funding and information technology support. This approach should include physicians and pharmacists with support from all physician groups and administration. There should be a focus on the appropriate initiation and duration of antibiotics.

The individual physician's perception of the risk/benefit ratio is part of the issue. The use of antibiotics is often seen as a low risk activity. If an antibiotic is started in someone without a bacterial infection the physician may consider this a low risk. However, the same physician is likely to consider it a high risk if an antibiotic is not started in someone with a bacterial infection. Education is important in order to define risk/benefit. Everyone is affected when one patient is treated. Broad spectrum antibiotic use begets resistance which begets broad spectrum antibiotic use. [Lautenbach]

Antibiotic stewardship is extremely important in the hospital, but it also has to move into the community. For instance, drugs marketed today include new quinolones with a dosage of one pill a day . Although the new quinolone may not be the appropriate antibiotic for a particular illness, patients want the convenience of once a day dosing and physicians wish to please their patients. In Ontario, there is a committee that publishes recommendations from an interdisciplinary expert group for antibiotics in community-acquired infections (orange book).

Key points:

- Antibiotics should be viewed like other heroic life-saving measures.
- Education should be provided regarding de-escalating therapy and duration of therapy.
- There must be a practice change; it should be the exception to prescribe antibiotics without a culture.

Antibiotic stewardship must be multidisciplinary, including laboratory, clinical pharmacy, infectious diseases, infection control, and other disciplines. There should be a focus and structure with administrative support. Antibiotic stewardship should be marketed as important and the information dispersed to all hospital clinicians. Clinicians should understand that antibiotic stewardship makes sense and helps with practice.

Data from one's own institution should be used to persuade clinicians that the antibiotics suggested by your program are useful. Physicians would like to know which antibiotics they prescribe are causing CDAD and the program needs to arm them with this information. A component of any antibiotic stewardship program should be comparative measurement of the use of antibiotics. This gets the attention of the CEO, administrators, and physicians. This will draw attention to why

Treatment/Antimicrobials

proper use of antibiotics is important in healthcare and is a patient safety strategy. There are many competing issues.

There has to be an effective infection control team with support from senior management.

How do we control pharmaceutical companies? What is the role of the pharmaceutical industry? Most private practice physicians get their information from pharmaceutical representatives. Are the recommendations useful? Do they pay attention to them? There may be a need for regulations.

30%-40% of *C. difficile* cases are in the community and do not come to the hospital; the problem is medical intelligence in the community. How can we get at that? We must get a handle on all the community cases and will this will lead to getting a handle on institutional cases.

A root cause analysis on each case of CDAD is important. What was the treatment, was diarrhoea identified quickly, etc., and share the information with clinicians immediately.

In the UK, *C. difficile* has been taken up by the National Patient Safety Agency – a new independent agency. A key area of intervention is antibiotic use.

For mild illnesses antibiotics are not needed. Patients are driving this issue and think antibiotics are like vitamins. There was a study showing that if parents of children being seen by a physician wanted antibiotics, they are prescribed 60% of the time, whereas antibiotics were prescribed only 6% of the time if antibiotics were not the parents' expectation. Physicians didn't think antibiotics were necessary 6% of the time and the patient didn't want them, but they were prescribed anyway. A paradigm shift is needed to understand conservative therapy. In outpatients, the question is not which antibiotic to use, but rather, are antibiotics needed. Patients should be empowered to ask physicians prescribing antibiotics about side effects such as antibiotic-resistant disease. The message has to get out to the public that there is such a thing as inappropriate antibiotic use.

Current guidelines from medical groups do not take resistance into consideration. Guidelines are only one tool to be used with local data and antibiograms. The first principle should be narrow spectrum, directed therapy that is ecologically kind for the right duration.

In Canada, the *C. difficile* problem is linked to the guidelines on community acquired pneumonia. Thus, many hospitals are using quinolones more and more.

Question. Have the antibiotics that trigger CDAD changed?

Yes. There is no question that fluoroquinolones are associated with CDAD. It is time to back track. *C. difficile* rates will drop with more narrow therapy. It is difficult to stop cross-transmission in hospitals and so there is a need to focus on antibiotics to help prevent wiping out colonic flora.

The overall rates of antibiotic use have gone up. In many hospitals the use of quinolones is 50% of antibiotic use. Two to three years ago it was 5%. This has been a massive shift. Clindamycin also needs to be restricted. In one facility, restricting use of clindamycin resulted in a clonal decrease of *C. difficile*.

The influence of order sets and computer physician order entry in hospitals is immense. This can standardize care. There is also a need to monitor prescribing activity.

Fluoroquinolones cover a lot of microorganisms; they are good in the right hands. The problem is utilization.

A structure is needed to support a low *C. difficile* formulary - it may cost more. Stewards need to provide feedback to ensure proper use.

The three groups of over-used drugs are cephalosporins, quinolones, and clindamycin. Broad use of these antibiotics is too often and too long. These should be considered specialty drugs. The use of clindamycin in the community is rising.

One hospital took quinolones off the formulary due to a *C. difficile* outbreak and all antibiotic use went down. When they added quinolones back in, use went right

Treatment/Antimicrobials

back up. There was no difference in mortality in the time periods; removing quinolones from the formulary wasn't detrimental. It shows that a good portion of quinolones use is inappropriate.

Mismatches between susceptibility and therapy can be flagged through electronic systems. A clinical pharmacist can get the information. We sustain organisms (e.g., *C. difficile*) by what we use in our institutions. Through technology we can look at results immediately on the computer during rounds. This can cut down on usage and inappropriate prescribing.

In the community the amount of antibiotics prescribed can be limited with quick test results, e.g., group A streptococcus. There is a need for better and more rapid tests. Rapid test results help physicians NOT prescribe antibiotics if the test is negative. For example, the urine antigen test for pneumococcus/legionella is great. It takes five minutes and helps drive treatment.

Guidelines advocate Penicillin VK for group A streptococcus pharyngitis. However, in Canada we use almost no Pen VK for this disease, while in Demark they use 20 fold Pen VK.

Targets must be set to create a sense of urgency, e.g., 90% reduction in quinolone use in a certain timeframe. What is the acceptable level?

In Canada there were no set expectations for *C. difficile*, but there were expectations for methicillin-resistant *S. aureus* (MRSA) bacteraemia. Every hospital is looking under every stone at what can be done better. All are working towards reducing MRSA. Performance is linked to funding. In the last year the commissioners met with hospitals to develop targets for *C. difficile*.

Institutions need to be provided with the tools to achieve a target. If they don't achieve the target, there needs to be consequences.

Question. Who is the actual steward?

Examples:

- The physician who oversees infection prevention and control
- Clinical experts in infection
- Hospitalists (need to be trained)
- Clinical pharmacist (excellent resource)

The laboratory director is the key for antibiograms in the facility. The laboratory should not report out certain drug susceptibility results.

Should the laboratory director be medically trained? How can non-physicians give a good opinion?

Central to stewardship is that certain cultures not be collected and comments should be added to some culture results to assist with therapy.

Laboratories need better diagnostic tools - this will take awhile. Current viral diagnostics are labour intensive.

The steward should be compensated.

There is a need for financial carrots to start a program. The issue of enforcement and compliance is key. The overriding issue is money. The average general practitioner is not interested in this issue.

There may be merit in antibiotic ordering teams and this concept needs to be more attractive. The use of antibiotic ordering teams would require more clinical pharmacists, more physicians and more medical microbiologists. It may take something like severe acute respiratory syndrome (SARS) to get attention and resources. However, in Ontario, more patients died in 2007 from *C. difficile* than ever died from SARS.

There may be a case of putting the cart before the horse. Begin with appointing a steward and ensure conditional dedicated funding, e.g. grants, and not funding that gets diverted. Targets should be in place also. Ensure that to qualify for money, systems approved by the chief executive officer should be in place.

In one study in Canada only 15% of CDAD cases had their inciting antibiotics stopped. Therefore, more active programs with a steward that look at therapies are needed.

Treatment/Antimicrobials

Question. Do alternative treatments alter infection prevention and control management?

How are we defining alternative treatments? Yoghurt and probiotics?

All probiotics were removed from the formulary in one hospital because they were being prescribed for patients in whom they were contraindicated. There is no benefit in the inpatient arena. A major risk factor for getting an infection with a probiotic microbe is having a vascular access device.

There is no evidence that Lactinex is effective for *C. difficile*. [A probiotic supplement is used to replace microorganisms in the intestines. This brand is a registered trademark of Becton, Dickinson and Company. It may be used to treat diarrhoea resulting from infection or when an antibiotic regimen destroys harmful bacteria and gut flora alike.]

Human studies have quality control, whereas there is none at the health food store or with commercial products. In one randomized trial it seemed like there was benefit in probiotic use with recurrent *C. difficile*. There was a paper published in the *British Medical Journal* several weeks ago, which found that probiotics worked and resulted in fewer episodes of diarrhoea. There was no overall benefit however, and no control or randomization to antibiotics. Clinically, probiotics don't work. Many patients were excluded and a milk-based placebo was used. [Hickson]

Most reports of *Sacchromyces* infections are in patients on probiotics who usually are neutropenic or elderly. Twenty percent have endocarditis. There was no good clinical benefit.

Brewer's yeast tablet (dead yeast) is being given in some hospitals. There was no difference with *C. difficile*. Brewer's yeast tablets are not inexpensive and are not worth it.

Another alternative treatment is stopping laxative use. What are the guidelines in North America for use of laxatives? In the UK if a patient hasn't emptied their bowels in 48 hours a laxative is given. What is the threshold for use? When should they be stopped? There is the same issue with gastric acid suppression.

Use of immodium, loperamide, and opiates for persistent diarrhoea is an issue. There is little evidence regarding toxic megacolon development with use of anti-diarrhoeals. There is little evidence for the use of anti-diarrhoeals for persistent chronic diarrhoea. These agents may be used if *Clostridium difficile* diarrhoea is controlled. There is no consensus. It was noted that one needs to be patient before starting an anti-diarrhoeal, since some people take longer to settle down to a normal bowel pattern. Further study may be warranted. A retrospective study on the use of anti-diarrhoeals should be considered.

There is a hamster model study looking at the use of a *C. difficile* vaccine. Hamsters were inoculated with attenuated *C. difficile*. Those who were inoculated did not get CDAD. This is now being evaluated for human safety. If one receives a non-toxic *C. difficile* strain it will be resistant to toxic strains. Perhaps anyone being placed on antibiotics should have such a vaccine. The gaps and the research opportunities need to be identified. Also in study is the capability of giving antibody vaccine.

There are groups working on making *C. difficile* glide through the bowel, thereby preventing intestinal adherence. *C. difficile* needs adherence to mucosal surface to cause disease.

Changing the gut flora by colonizing it with 'friendly' flora is also being studied, but this seems to be difficult.

Televemer, a toxin AB blocker, is being studied as an alternative therapy for CDAD and may be promising in preventing relapse in patients. The response rate was 47% vs. 72% for metronidazole vs. 82% for vancomycin. All received greater than 48 hours of therapy. Original analysis excluded people with less than 5 days of therapy [50 patients]. The relapse rate with the toxin AB blocker was 3%. The relapse rate with vancomycin and metronidazole was 28%. It was a three arm study.

Many of these alternative therapies are so new that more research is needed There is no treatment that

Treatment/Antimicrobials

guarantees response or no relapse, but some good drugs are coming down the pike.

These alternative therapies may affect infection control in that fewer patients will need Contact Precautions. They may also help with cohorting. If therapy can stop diarrhoea, there would be less soiling of the environment. The same is true if relapse could be prevented.

Question. Are there infection prevention and control issues with recalcitrant or relapsed patients, or other complex cases?

There are no changes to infection prevention and control management. Relapsed patients keep soiling the hospital environment. Getting diarrhoea to subside quickly is desirable.

If a patient has been treated carefully and diarrhoea has stopped for 48 hours [3 or fewer bowel movements], would you leave the patient in isolation or send them back to the ward? This is the current recommendation. More data are necessary to determine if patients are contagious when diarrhoea has stopped. There is always a debate about what resolution is, and is often based partly on what the individual's pre -*C. difficile* bowel habits were.

Patients who have had previous CDAD should be flagged. If they develop diarrhoea and come back in, use Contact Precautions. How far back do you go for *C. difficile* history? It can be 1-6 months. The majority of relapses occur within 30 days, so the limit can be 2 months. This is the U.S, CDC recommendation. If a patient is readmitted with diarrhoea, the patient should be isolated and one should presume *C. difficile and* treat to prevent shedding.

Should anyone entering the hospital with diarrhoea be isolated? Yes. If patients come in with *C. difficile*, *Salmonella*, *Shigella*, etc., it would be necessary to isolate anyway. Screening for CDAD is important.

There needs to be quick turn around times for laboratory tests. Every hospital in the UK has to turn around the *C. difficile* result within 24 hours.

If a new patient has a recent history of CDAD, beginning presumptive treatment is beneficial. People treated for CDAD should be monitored closely. The Bristol stool chart classifies stool from very hard [1] to very loose and runny [7]. Pictures are available for the staff to evaluate. Nurses should use this stool chart every day to evaluate effectiveness of treatment. [See page 82]

General

If the index of suspicion for *Clostridium difficile* is high enough to start treatment, the patient should be placed on Contact Precautions as well.

CDAD is facilitated by a mismatch between antibiotic spectrum and the bacteria causing illness. There is a need for more field investigation into the use of narrow spectrum antibiotics. Physicians may not want to change drugs. They need to know that If they change from using one CDAD inciting antibiotic to another antibiotic it may result in less severe disease or less relapse with same therapeutic outcome. There is a need to stop the offending antimicrobial.

The Orion statement published in the *Journal of Hospital Infections* is invaluable to understand the impact of various interventions. [Cooper, Stone]

Invited Experts:

Carolyn Gould
Daryl Depestel
Jim Hutchison
Gopal Rao
Tom Louie

SYNTHESIS OF QUESTIONS AND CONSENSUS

Surveillance and Epidemiology

ASSUMPTIONS:

- Surveillance is a tool for quality improvement and better patient outcomes.
- Objectives and criteria of surveillance should be clearly defined.
- It is part of a quality management system and is a valuable component to control CDAD.
- Surveillance is necessary to track trends and pose questions for control.
- Surveillance requires skills, knowledge and definitions to collect and analyze information.

1. Is there an implication for the public?

There should be increased public awareness regarding adverse effects of inappropriate and appropriate use of antibiotics.

There is limited information about C. *difficile* spread into the community or community-associated CDAD. Using sentinel sites would provide a baseline to use for later comparison. Objectives for surveillance are different depending on the sector. There is no evidence to support community surveillance but institutional surveillance of healthcare-facility-associated cases of CDAD is necessary. There may be a role for sentinel sites performing community surveillance (tracking disease burden, trends, and changing epidemiology).

Institutions should capture cases of CDAD at point of entry which will assist with a better understanding of the risk of CDAD in the community.

2. What should be the role of Public Health? Are there implications regarding disclosure?

- The purpose of public reporting is education, for instance:
  - Public messaging about the adverse effects of antibiotic use.
  - Raising public awareness of infection control, hygiene, etc.
  - Disclosure of new diseases or increasing incidence of a known disease.
- Information must be easy to understand with consistency in methodology of data.
- Non-disclosure may lead to more problems as there will be the perception that something is being hidden.

3. Should *C. difficile* be reportable? What is rationale? If yes, should it be reportable by name or by rate only?

The value of mandatory reporting to Public Health is unclear. Mandatory reporting may be beneficial in a framework for improvement. There is no evidence that nominal reporting (i.e., names and pertinent demographic data) is of any benefit in the control of CDAD.

Methods of reporting may vary however laboratory reporting of positive CDAD results or aggregate data per health care institution seem appropriate.

4. Should rates be provided to the general public? Who should have access to the surveillance reports?

The following groups should have this information:

Institutions
Local public health
State/regional/provincial health authority
Regional infection control networks (where they exist)
Public

SYNTHESIS OF QUESTIONS AND CONSENSUS

Disseminating surveillance reports

- When surveillance information is provided to people, they need to know what to do with it and how to use it appropriately.
- Define the purpose for dissemination of surveillance reports such as opportunities for benchmarking and to improve patient care.
- Disseminate surveillance reports widely within the institution to raise the awareness of deficiencies in infection prevention and control and drive appropriate antibiotic usage.

5. Can surveillance data be used to show other benefits?

Surveillance can determine if interventions have had their expected impact. Surveillance data can be used to investigate associations with other things that might impact healthcare-associated infection rates (e.g., length of stay, ratios of bathrooms/patient).

6. What are the criteria for a case definition of CDAD?

1. Positive toxin assay A or B/culture of toxigenic strain AND diarrhoea (loose bowel movement that conforms to shape of the container) or symptoms of ileus or toxic megacolon
2. Pseudomembranous colitis or histopathology consistent with *C. difficile*

Laboratory

Do not test formed stools or asymptomatic patients. It is preferable to perform toxin testing prior to initiation of antibiotic treatment for CDAD. Test stool for the presence of Toxin A and B. This may be achieved by screening stool for GD (glutamate dehydrogenase) antigen and then testing those stools that are GD (+) using an assay that detects both Toxin A and B. If toxin tests (e.g. two or more) are negative and there is a suspicion of CDAD, re-test using an alternative test such as culture (any *C. difficile* isolates detected need to be confirmed as toxigenic) or the CPE assay.

Laboratory must be adequately resourced for testing and typing that is required (e.g., culturing).

All facilities should have *C. difficile* testing available 7 days per week, especially in outbreak situations. Laboratory results have an impact on treatment and resource allocations, therefore earlier diagnosis is imperative.

7. What denominators should be used?

Be consistent; use the same denominator over time. Patient-days is a better indication of patient risk, particularly in facilities with long-term stays. [Exclude psychiatry and neonatology]. Patient-days facilitate inter-institution comparisons. However, describing rates per patient-admissions may be more intelligible to the general public.

Rates:

Determine institution-wide rates, unit rates, and service/program-specific rates. Clearly define hospital setting and population at risk. Use onset after 48 hours of admission for defining nosocomial *C. difficile*. Post-discharge, consider CDAD to be nosocomial if discharged and readmitted within 4-8 weeks. If symptoms recur within 8 weeks, this is considered to be a relapse.

8. What role does patient screening or HCW screening play in reducing CDAD?

- No evidence to support the effectiveness of toxin assay testing on formed stool or culture of asymptomatic individuals.
- Consider focusing screening on all patients with diarrhoea who are on antibiotics.

SYNTHESIS OF QUESTIONS AND CONSENSUS

- There is no value in routine screening of healthcare workers.

9. Is benchmarking an effective management strategy?
Benchmarking is used for comparability, can provide feedback that leads to actions and improved outcomes however:

- There are no established benchmarks for *C. difficile*
- Aggregate data have limitations in the identification of cases due to relapse or detecting multiple transfers of the same case
- Risk stratification is difficult

Best rate is lowest rate possible and ideally the goal should be zero.

10. What constitutes an outbreak? What are the criteria for transmissibility?

- Cases are those that occur 48 hours after admission
- Increase in number of cases that are related in space and time above baseline
- Any cluster of cases should spark an investigation
- Be aware of the possibility of inter-institution transmission
- In any institution that has not had CDAD cases, presence of any number of new cases could be an outbreak

11. Should surveillance information include capturing information on severity of illness?
This is resource intensive and not required for routine surveillance. However, it may be possible for short-term or targeted surveillance.

12. Should there be different surveillance practices for different settings?
There should be no difference in methods.

13. Should previously known cases be identified (electronically flagged) in an institution?
If a setting treats all patients with diarrhoea as presumptive CDAD, the flag is not of value. In other settings, a flag will initiate action. If a previously identified case is readmitted with diarrhoea, Contact Precautions can be initiated immediately and can be a tool to assist in earlier treatment.

Control Measures

ASSUMPTIONS:

- Action taken for all patients at the onset of diarrhoea and after a risk assessment for CDAD is completed. (See risk assessment below.)
- Ingestion of spores is the most common mode of transmission – contaminated hands (patient and staff) are assumed to be main vector.
- Patients who have had a colectomy following CDAD – should be managed as if they are infectious, although the period of infectivity is unknown.
- A common definition of diarrhoea is established for the institution.
- Standard Precautions/Routine Practices will be used for all patient care.
- Contact Precautions refers to specific measures taken to prevent transmission by both direct and indirect routes. Contact Precautions are part of the guidelines for transmission-based precautions from the Centers for Disease Control and Prevention and Public Health Agency of Canada.

SYNTHESIS OF QUESTIONS AND CONSENSUS

Risk assessment for CDAD:

- Rule out other causes
- Clinical symptoms and history
- Prior antimicrobial exposure

1. When and what kind of control measures are needed?

Use Contact Precautions:

- NO roommates (unless roommate has CDAD)
- NO room transfers (unless medically necessary)
- NO shared toilets
- Clear signage (at door, effective to stop people at entry requiring them to apply personal protective equipment)

Interim measures if no private room

- Contact precautions even if not in single room.
- Dedicated commode to patient with CDAD.
- Rooms with more than one bed should have clear demarcation of individual bed space.
- Delineation of bed space can be accomplished with marks on the floor, e.g., with tape, and curtains drawn as a temporary measure.

Patient mobility

- Important to continue mobilization unless patient has faecal incontinence; restrict only if incontinent.
- Unrestricted activity is permissible as long as hand hygiene is performed and information provided for patient regarding dedicated toilet use.
- Isolation gowns and gloves are not required to be worn by the patient when outside their room.
- Clothes worn by the patient should be clean and should not be physically soiled.

Hydrotherapy is permitted as long as patient is continent and proper disinfection processes for pool or tub are followed.

Personal Care Items:

- are to be dedicated to the patient
- discard or reprocess after the patient is discharged
- do not share items such as lotion containers

Education/Information sheet: to be provided for patients, family/visitors, staff.

Personal Protective Equipment:

- Gloves and gowns are required upon entering room or bed space (donning and removal as per Contact Precautions).
- Requirements for personal protective equipment should be listed on the signage at point of entry to the room or bed space.

Healthcare workers and other staff should remain off work when experiencing diarrhoea (unless there is a known underlying non-infectious cause).

SYNTHESIS OF QUESTIONS AND CONSENSUS

2. When should the use of these measures be initiated and when should they be discontinued?

IMPLEMENTATION

At onset of diarrhoea or after notification of *C. difficile* lab result – 'whichever comes first'

- If challenged for single rooms, consider a matrix for prioritizing patients who require Contact Precautions
- Conduct daily ward rounds to identify people with diarrhoea (syndromic surveillance) particularly during outbreak situations

DISCONTINUATION

Presumptive/suspect patient with diarrhoea

- Two stools, at least one day apart, that are negative for *C. difficile* toxin
- Other laboratory investigation (e.g. culture or CPE assay) may be required if clinical symptoms highly suggestive of CDAD despite two stools that are negative for *C. difficile* toxin antigen.

Confirmed CDAD positive patient

- Discontinue isolation precautions when clinical staff deem the diarrhoea has resolved according to established criteria, in consultation with Infection Prevention and Control
- A reasonable approach is to discontinue precautions when patient is symptom free (i.e., no diarrhoea) for 48-72 hours (regardless of whether patient is on or off of CDAD therapy).
- Terminal room cleaning must occur prior to admitting other patients to share the same room.

Test results

- Early diagnosis is important, therefore rapid test methods are recommended.
- Ensure positive CDAD results are urgently reported as "critical results" to ward/unit and Infection Prevention and Control.
- It is not necessary to have a negative laboratory result to discontinue precautions for patient with confirmed CDAD as spores will continue to be excreted on a sporadic basis even when diarrhoea resolves and patient is not ill (i.e., do NOT perform any "laboratory test of cure"). Transmission is not likely with a patient with formed stool.

3. Who starts Contact Precautions?

- Caregiver/Ward to implement Contact Precautions (recommend that Infection Prevention and Control follow-up to ensure patient is on isolation)
- Nurses empowered to implement Contact Precautions

4. What is the most effective method of hand hygiene and under what circumstances?

- Observe meticulous hand hygiene with soap and water or alcohol based hand rub (ABHR).
  - Soap and water for full 15-30 seconds is **theoretically** more effective in removing spores from *C. difficile* contaminated hands than ABHR.
  - When a hand wash sink is immediately available for staff then hands should be washed with soap and water after glove removal.
  - Gloves are to be used per Contact Precautions. When gloves are worn ABHR may be used after glove removal when a sink for soap and water hand washing is not readily accessible.
  - ABHR has been used to successfully control outbreaks.

SYNTHESIS OF QUESTIONS AND CONSENSUS

Optimally, hand hygiene should not be carried out in a patient sink as this will re-contaminate healthcare worker's hands.

Education should be provided to the patient on the need and procedure to be used for hand hygiene e.g. prior to eating, when leaving room. Hand wipes should be available for patients who cannot get to hand sink.

Maintenance of skin integrity is an integral part of hand hygiene.

5. Should there be different practices for different settings?

Regardless of setting, all health care providers should follow the same principles: implementation may vary.

- These include: long term care, residential, nursing home, ambulatory care, dialysis, home care, and clinics.

Home setting

- Provide information sheet for patient/family which includes information on toileting and room cleaning/disinfection
- Perform hand hygiene before and after contact with patient

Community physicians/Primary Care – require guidance on how to manage patients

Schools**:** People with symptoms of diarrhoea suspicious of an infectious process should not attend schools or day care facilities.

6. What is the most effective method to determine compliance?

Indicators of compliance include:

- Time to implementation of Contact Precautions for suspect and confirmed cases
- Practice of appropriate precautions
- Compliance with criteria for the discontinuation of precautions
- Hand hygiene practice
- Laboratory turnaround time for results
- Measure staff awareness of protocols (CDAD protocol) and what the CDAD rates are for their institution
- Environment cleaning protocols

7. Are animals an issue?

- Animals do not provide an important route of transmission
- Maintain Routine Practices/Standard Precautions
- All visiting animals should be healthy
- Visiting animals should not enter rooms where patients require Contact Precautions
- For further information refer to current documents on pet therapy

8. If control measures are identified as non-effective (i.e., transmission continues to occur), what are the next steps?

Any or all of the following may be helpful:

- Report outbreak to Public Health if legislation mandates
- Communicate to other settings that there may be a potential problem

SYNTHESIS OF QUESTIONS AND CONSENSUS

- Notify institution and allied services of outbreak situation
- Cohort patients and staff; create ward/area for patients with CDAD
- Review practices: e.g., compliance with Contact Precautions; ensure that equipment is actually being dedicated; supplies within the room are being discarded after precautions are discontinued. Consider an objective observer to assess practices.
- Dedicate personnel to clean and disinfect equipment.
- Re-clean areas previously occupied by patients with CDAD. Refer to infection prevention and control team for advice.
- In clusters or in outbreaks use disinfection throughout the ward or area on the advice of the infection prevention and control team.
- Audit environmental cleaning.
- Identify additional cases – including discharges and transfers.
- Staff education (including housekeeping staff).
- Patients confined to room except for critical tests.
- Ask for help from experts – and secure necessary resources (financial, human resources, Infection Prevention and Control professionals).
- Review antimicrobial prescribing.
- Visitors - follow existing policies. Provide education on *C. difficile* transmission/precautions and to avoid visiting if at risk for CDAD.
- Public messaging – develop message with public affairs office if required; provide message on telephone lines if necessary.
- Close wards to new admissions (institutional decision) – this is a last resort. (Reasons to close ward for *C. difficile* - reduces those at risk; unethical to admit to ward where transmission is occurring.)

Environment and Equipment

ASSUMPTIONS:

- It is cost effective to invest and ensure that good standards are present in healthcare
- Adequate resources are available to deliver appropriate cleaning
- There is training and education of staff and reassessment of knowledge and competence of cleaning staff
- There are performance standards and feedback of performance
- Cleaning departments have enough staff and enough time to clean

1. Based on Standard Precautions or Routine Practices, do you need to do anything differently for environmental cleaning (non-critical) when the patient has *C. difficile*? What, how and at what frequency?

- Twice daily for high contact/frequently touched areas and once daily for the rest as a minimum standard.
  - High contact areas include commode, toilet, mattress, sink handles, door knobs, and bedrails.
- Need to remove superfluous or uncleanable equipment or furniture from the environment.
- During an outbreak consider increasing the frequency of cleaning and monitoring.

Extra cleaning for *C. difficile*

- Once the patient is discharged or precautions are discontinued, clean the patient environment with a sporicidal agent. Note that precautions should continue until cleaning is complete.
- Clean room or area from high level to floor removing disposables, clean all equipment as per policy, change

SYNTHESIS OF QUESTIONS AND CONSENSUS

curtains.
- If the patient's space is in a multi bed area, clean the defined patient space. Clean toilet or commode.
- Use same cleaning method for terminal cleaning for single cases or outbreak of CDAD.
- In outbreaks consider alternative methods of terminal cleaning e.g., hydrogen peroxide fogging or other disinfectant with sporicidal activity against *C. difficile*.

2. Based on Standard Precautions or Routine Practices, do you need to do anything differently for equipment cleaning (semi-critical, critical) when the patient has *C. difficile*? What, how and at what frequency?

- Nothing different for critical or semi critical items for CDAD: follow current guidelines
- Non critical items: ensure that practices follow the existing protocols and that there is an assigned responsibility for cleaning
- Need formalized check list for cleaning

Non Critical Equipment Cleaning issues

- If patient moves to another area may need to replace with clean equipment or clean equipment before move to reduce load, e.g., beds.
- Use disposable toilet brushes and dispose of brush at patient discharge/transfer.
- Throw out all disposables, e.g., toilet paper, hand towels, books, magazines which are shared at terminal cleaning.
- Place vinyl covers on shared books which then are wipeable with a sporicidal disinfectant.
- Any shared item that is visibly soiled and cannot be cleaned must be discarded.

Bedpan Issues

- There should be access to bedpan washer or macerator for disposal.
- Bedpans – dispose of faeces in bedpan washer or macerator.
- Do not use sprayers in patient's bathroom for cleaning; do not manually clean bedpans in patient's bathroom.
- Avoid sluicing of bedpans and other such containers in order to reduce aerosols.
- Consider condition of bedpans particularly if chipped or scratched. These are more difficult to clean.

Options to consider:

- Do not transport used bedpan from one place to another without cover. Consider use solidifying gel to enhance containment of faeces.
- Consider single patient use bedpans if there is space for storage.
- Sanitize bedpan between patients (including holder of macerated bedpan).
- Allocate a bedpan to an individual patient.

3. Based on Standard Precautions or Routine Practices, do you need to do anything differently for personal care equipment (e.g. shavers, clippers, chiropodist supplies) cleaning when the patient has *C. difficile*? What, how and at what frequency?

- Dedicate personal care equipment
- If it cannot be cleaned then discard or use disposable

4. If disinfectants are necessary, which can be used and how should they be used?

- Dirt and detritus must be removed in order for effective disinfection to occur.

SYNTHESIS OF QUESTIONS AND CONSENSUS

- A disinfectant agent with sporicidal activity should be used.
- If and when moving a patient with CDAD, ensure that any previous bed space and toilet occupied by the patient with CDAD be terminally cleaned.

Other cleaning issues:
  - Physical cleaning, e.g., micro fibres, may be effective in removing spores
  - Any agent may damage the environment. Products should be reviewed prior to implementation.

5. Would temporary barriers or covers be effective in certain circumstances (e.g., sheets over wheelchair, sheet over porter bed, plastic covering over charts)? If so, when and what would be effective?

- Barriers may be used to both confine and contain or to reduce bioburden on an item.
- There is no evidence to support the use of temporary covers in the patient's room.
- Minimal patient care items should be stored in the patient's room. Items such as linen should be stored centrally.
- Patient chart and records should not go into patient's room.
- If an item which accompanies the patient is contaminated it should be covered for transport.
- Transportation of patient – patient should be dressed in a clean gown or pyjamas.
- The wheelchair/trolley should be decontaminated following transfer according to normal guidelines if the patient is continent.
- If the patient is incontinent then there should be a protective barrier between the patient and the piece of equipment or transporting vehicle.

6. What are the issues and resolutions for cleaning multi-bed settings?

Treat each patient with CDAD bed space as you would in a single room such as changing PPE and cleaning cloths between each bed space.

- When there is a single case of CDAD in a multi bed room, define affected area and clean.
- Shared equipment in the room – change gloves and gown/apron between patients and disinfect equipment between each patient.
- To reduce the bioburden from patients with incontinence, consider containment devices such as diapers, rectal tubes or faecal incontinence devices.

7. Should there be different practices for different settings?

- There are no differences in cleaning principles in various settings.
- In the Home Setting:
  - Information should be given to patients/family regarding CDAD, hand hygiene, cleaning of linen, cleaning of bathroom and equipment.
  - If possible, one toilet/bathroom should be dedicated for the patient with CDAD in the home.
- Facilities should handle the environment and equipment according to standard guidance. It is assumed that all staff will have training and education cleaning and hygiene.
- In other residential settings such as group homes, prisons, and boarding schools: the same cleaning principles as in healthcare settings will apply and information should be supplied. Some of the advice should be adapted to reflect the challenges of these environments, e.g., carpets.

8. How do you measure the effectiveness of these environmental measures?

- Housekeeping/environmental services should discuss the frequency of cleaning and monitoring with the

SYNTHESIS OF QUESTIONS AND CONSENSUS

Infection Prevention and Control Team.
- Compliance with cleaning should be monitored and feedback provided.
- Measure effectiveness through the use of tools such as adenosine triphosphate monitors and ultraviolet markers (investigational).
- Compliance measurements should compliment other audit systems, checklists and accountability.

9. What are optimal institution designs for environmental /equipment cleaning and disinfection?
- Single/private rooms with en suite bathroom/shower/toilet.
- Call bells and other such devices should be designed to be smooth, sealed and cleanable.
- Toilets should be designed for effective cleaning in and around the toilet. (e.g., wall mounted toilets).
- There should be adequate storage space for commodes in bathrooms.
- No exposed pipe work.
- Sufficient numbers of commodes should be available.
- Size of the dirty utility room should accommodate functions in the area in addition to having separate space for equipment cleaning and storage of clean equipment.
- Encourage companies to develop equipment which is easily cleanable with clear guidelines for cleaning.
- Hand washing sink for staff should be separate from patient's sink and clearly marked for staff use only.
- Hands-free taps/faucet handles.
- Air pressure issues and ventilation are currently unresolved.

Treatment/Antimicrobials

ASSUMPTIONS:
- Antibiotic stewardship requires a multidisciplinary team with a focus, structure, as well as administrative support.
- Antibiotic stewardship is a patient safety initiative.

1. How effective are all other control measures without antibiotic stewardship?
- Antibiotic stewardship is as important as other control measures and cannot be separated from them.
- The components of *C. difficile* control are like the "legs of the stool": Antibiotic stewardship, infection prevention and control, education and infrastructure.
- A multi-disciplinary approach to antibiotic stewardship is required, including pharmacy, physicians, technology support, laboratory, infection prevention and control, nursing.
- Designate ambassadors/champions for antibiotic stewardship (e.g., chief of surgery, infectious disease physicians).
- One approach will not work for all areas. There should be different antimicrobial management programs for acute care, complex continuing care, community care, long-term care.
- Antibiotic stewardship needs to be marketed to the public with a clear marketing strategy and messages.

- Education:
  - Need "back to basics" teaching in medical schools and teaching hospitals, regarding antibiotic resistance and prescribing practices.
  - Important to obtain appropriate specimens based on clinical suspicion of disease and use culture and susceptibility results to guide diagnosis and treatment of infections.

SYNTHESIS OF QUESTIONS AND CONSENSUS

  - Guidelines should be developed for community physicians when prescribing antibiotics for community-acquired infections. In private practice, practitioners work alone, and should be supported and educated about antibiotic stewardship on an ongoing basis.
  - Education should focus on initiation of antibiotics, appropriateness of antibiotic spectrum, and ending or changing antibiotics as soon as possible.

2. What are the key components of an antibiotic stewardship program relevant to *C. difficile* disease?

- Develop a multi-disciplinary program that includes:
  - Bring awareness of antibiotic stewardship to a higher level of administration to obtain funding, resources.
  - Education of physicians to change old prescribing practices.
  - Include other health disciplines such as nursing, pharmacy, laboratory
  - Include mechanisms for enforcement and compliance.
  - Use susceptibility data to drive antibiotic choices and demonstrate efficacy.
  - Include an effective marketing program.
- Consider "Antibiotic Stewards" who are clinical experts in infection (e.g., clinical pharmacists, Microbiologists, Infectious Disease physicians and others)
  - Stewards require a high level of support and training
  - Take ownership and make decisions regarding antibiotic use in facilities
  - Restrict choices
  - Perform antibiotic rounds
  - Community prescribers need to participate in the stewardship programme
- Funding to be made available to support those who have antibiotic stewardship systems and programs in place.
- Need to develop a paradigm shift in the physician community to use antibiotics only when necessary and no longer than necessary.
- A standardized approach to treatment for community physicians regarding community acquired infections.
- Need rapid diagnostic testing available to all clinicians: For example, with community-acquired pneumonia (CAP) a rapid viral diagnostic test available to community practitioners will drive appropriate antibiotic use.
- Use laboratory controls to support antibiotic stewardship – identify antibiotic susceptibility tests to be used, place "canned comments" on laboratory reports to assist with antibiotic choice, and provide summary data on antibiotic resistance. There should be linkages to pharmacy and formulary.
- Link antibiotic awareness with patient safety campaigns.

3. Have the antibiotics that trigger CDAD changed?

- All antibiotics have the potential to cause CDAD.
- Certain antibiotics with a propensity for disrupting normal bowel flora have a greater risk of causing CDAD, e.g., fluoroquinolones, cephalosporins, clindamycin.
- Develop a formulary that reduces the risk of *C. difficile*.

4. Do alternative treatments alter infection prevention and control management?

- Alternative treatments should not be available through the formulary:
  - There are no data to support the effectiveness/benefits of probiotics such as *Saccharomyces* or *Lactobacillus* for prevention or treatment.
  - There might be a potential risk to using some probiotics and radical treatments.

SYNTHESIS OF QUESTIONS AND CONSENSUS

  - There is no quality control of these "over the counter" natural products and therefore they cannot be compared.
- Other treatments that may put patients at risk for CDAD:
  - There should be guidelines for the threshold for use and discontinuation of laxatives.
  - Gastric acid suppression might be a risk for *C. difficile*.

Fecal transplant therapy has been used for patients with multiple recurrences of CDAD but there is insufficient published data in controlled studies to provide a consensus recommendation.

5. Are there infection prevention and control issues with recalcitrant or relapsed patients?

- The offending antimicrobial should be stopped whenever possible!
- Relapses:
  - Goal is to stop diarrhoea quickly without relapsing
  - Starting treatment as soon as possible leads to quicker resolution of diarrhoea and less shedding of *C. difficile*
  - Anyone being readmitted with diarrhoea who had CDAD within past 2 months should be considered to have CDAD, be tested and be started on precautions and considered for treatment
  - Infection prevention and control management does not change for relapsed patients
- Have a high level of suspicion for *C. difficile* infection if there has been an outbreak or high numbers of CDAD
- If the suspicion of CDAD is high enough to begin treatment, then precautions should be started as well

Emerging issues and research directions

The following are areas identified in each of the workshops that require additional research.

- Evaluate the potential benefits and risks of the use of loperamide and opiates in the control of diarrhoea in patients.
- Vaccine development for CDAD prevention.
- AB toxin blocker as a treatment for relapse.
- To evaluate cleaning processes (manual and automated) for reusable bedpans.
- The benefit of disposable bedpans.
- Further studies into the transmission of *C. difficile* spores via equipment to patients.
- Value of tracing previous locations of patients with CDAD in institution and then terminally cleaning the area.
- Need further study of risks of transmission within the environment in long term care facilities.
- Adenosine triphosphate (ATP) monitoring as a measure of cleaning effectiveness against *C. difficile* requires validation.
- Evaluate the impact of ventilation and air pressure gradients on control of CDAD.
- Develop safe and environmentally friendly cleaning products that can be used routinely (a universal cleaner and disinfectant) and are effective against *C. difficile*.
- What is the infectious potential of patients who have had interventions such as a colectomy?
- What is the rate of transmission of CDAD in LTC?
- What is the risk of transmission by asymptomatic carriers?
- When is the best time to discontinue Contact Precautions? (48 hours? 72 hours?)

SYNTHESIS OF QUESTIONS AND CONSENSUS

- Create validated audit tools for compliance with control measures.
- Need more epidemiologic studies on CDAD in the elderly.
- Evaluate feasibility of Surveillance Systems for CA-CDAD.
- Further research to determine time frame definitions for healthcare - associated CDAD.
- Need more data on the benefits of single rooms with own toilets for the prevention and control of *C. difficile*.
- Do hyper - spreaders exist and if so who are they?
- Studies to relate CDAD rates to nurse/patient ratios.
- Determine if there are benefits using the process of root cause analysis.
- Develop a mechanism to combine CDAD surveillance with antibiotic consumption from pharmacy data.

Glossary

Ambulatory Care: Health care provided in an outpatient setting either in or outside of another care setting, usually with no requirement for an overnight stay or admission.

Antibiotic Stewardship:Strategies focused on optimizing the use of antibiotics; implies a careful assessment of the actual need and selection of an agent, its dose and duration.

Benchmarking: Periodically comparing an individual care settings rate of infection with benchmark targets (best of class) obtained from other similar organizations with similar data and\or with published rates in the literature

Clinics: Outpatient settings where health care professionals provide primary health care for individuals.

Clostridium difficile: A spore-forming, gram positive anaerobic bacillus that produces two exotoxins: toxin A and B. It is a common cause of antibiotic-associated diarrhea (CDAD). *C. difficile* is the leading cause of healthcare associated diarrhea. Outbreaks of CDAD occur in a variety of health care settings.

Clostridium difficile associated disease (CDAD): Either a positive toxin assay A or B AND Diarrhea OR Symptoms of toxic megacolon or pseudomembranous colitis or histopathology consistent with *C. difficile.* [The term *Clostridium difficile* infection is now used]

Community: Entire health care delivery system outside hospitals and long term care facilities.

Contact Precautions: A set of precautions to reduce the risk of transmission of infectious agents via contact with an infectious person or their environment. Contact precautions are used in a addition to Routine Practices/Standard Precautions.

Fecal transplant: A medical treatment for patients with pseudomembranous colitis (caused by *Clostridium difficile*), which involves restoration of colon homeostasis by reintroducing normal bacterial flora from stool obtained from a healthy donor. t is also known as fecal transfusion or human probiotic infusion (HPI),

General Practitioner: A general practitioner (GP) is a medical doctor who provides primary care and treats acute and chronic illnesses, provides preventive care and health education for all ages and both sexes

Hand Hygiene: The process of removing visible soil and or the removal or killing of transient microoganisms on hands. May be accomplished by alcohol based hand rubs or through washing with soap and water when hands are visibly soiled.

Healthcare Associated Infection: see Nosocomial

Home Care: Health care delivery to an individual in their home.

Infection Prevention and Control: Evidence-based practices and procedures, which when consistently applied can prevent or reduce the risk of transmission of microorganisms between and among health care workers, clients, patients, residents and others in the health care setting.

Infection Prevention and Control Team: A group of individuals in a health care setting responsible for the guidance and direction of the Infection Prevention and Control program in conjunction with the infection control professional in that setting.

Glossary

Long-term care: A range of personal support, community, physical and mental care services provided in a facility or institution for individuals who are limited in their ability to carry out normal daily activities on a long-term basis and whose family or friends are no longer able to provide the necessary care. This care may be provided in a setting such as a nursing home

Mandatory reporting: Reporting to other authorities or individuals which is required by law, legislation or statute.

Non-critical equipment: Equipment used in the health care setting that touches only the intact skin of patients, residents, or clients or has no direct contact with these individuals.

Nosocomial infection (also known as Health Care Acquired Infection): Infection acquired during or due to the provision of health care.

Personal Care Equipment: Equipment used in the delivery of health care to an individual

Personal Protective Equipment: Clothing or equipment worn by health care workers for protection against various hazards including infection.

Primary Care: Care provided by physicians specifically trained for and skilled in comprehensive first contact and continuing care for persons with any undiagnosed sign, symptom, or health concern (the "undifferentiated" patient) not limited by problem origin (biological, behavioral, or social), organ system, or diagnosis.

Probiotics: Live microorganisms which when administered in adequate amounts confer a health benefit on the host

Residential home: A setting where individuals reside and receive basic support (meals, activities and accommodation. Needs for active health care may be minimal in these settings.

Routine Practices:The system of infection prevention and control practices used in Canada for all care delivery for all clients, patients or residents, regardless of their confirmed or suspected diagnosis, to prevent the transmission of infection from their blood or other body fluids.

Screening: A systematic process to identify specific individual at risk for a specific disease process or infection. May involve history taking and\or obtaining screening cultures from the individual

Standard Precautions: Combine the major features of Universal Precautions (UP) and Body Substance Isolation (BSI) and are based on the principle that all blood, body fluids, secretions, excretions except sweat, nonintact skin, and mucous membranes may contain transmissible infectious agents. Standard Precautions include a group of infection prevention practices that apply to all patients, regardless of suspected or confirmed infection status, in any setting in which healthcare is delivered.

Surveillance: A systematic and ongoing collection, collation and analysis of data. This includes the process of sharing this information with individuals who require this information in order to modify practices and\or make improvements.

References

REFERENCED IN THE PROCEEDINGS

AIA 2006 Guidelines for Design & Construction of Health Care Facilities. Facility Guidelines Institute, AIA Academy of Architecture for Health, US Dept. of Health & Human Services. 2006. AIA Bookstore, Washington, DC.

Archibald LK. Banerjee SN. Jarvis WR. Secular trends in hospital-acquired *Clostridium difficile* disease in the United States, 1987-2001. *J Infect Diseases 2004;189(9):1585-9.*

Canada—Infection Prevention and Control Best Practice. June 2007. The Canadian Committee on Antibiotic Resistance. http://www.cpsa.ab.ca/collegeprograms/attachments_ipac/IPAC-Best_Practices_general.pdf

CDC. Severe *Clostridium difficile*--Associated Disease in Populations Previously at Low Risk --- Four States, 2005. *MMWR* 2005; 54:1201-05

CDC Guideline for Isolation Precautions, 2007. http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf

Cooper BS, et al. Introducing the ORION Statement, a CONSORT equivalent for infection control studies. *J Hosp Infect.* 2007; 65(Supplement 2): 85-87. ORION.

Dellit TH, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Diseases 44(2):159-77, 2007.*

Gerding DN. New definitions will help, but cultures are critical for resolving unanswered questions about *Clostridium difficile. Infect Control Hosp Epidemiol 2007; 28(2):113-5.*

Health Technical Memorandum (HTM) 2030. Washer – Disinfectors. Operational management. NHS Estates 1997.

Hickson M, et al. Use of probiotic Lactobacillus preparation to prevent diarrhoea associated with antibiotics: Randomized double blind placebo controlled trial. *Brit Med J* 2007; 335:80.

ICD9 codes. http://www.cms.hhs.gov/ICD9ProviderDiagnosticCodes/

Kuijper E, *et al*. Update of *Clostridium difficile*-associated disease due to PCR ribotype 027 in Europe. *Euro Surveill* 2007; 12(6).

Kyne L. Hamel MB. Polavaram R. Kelly CP. Health care costs and mortality associated with nosocomial diarrhea due to *Clostridium difficile. Clin Infect Diseases 2002; 34(3):346-53, 2002.*

Lautenbach E, Fishman NO. Wagging the dog: antibiotic use and the emergence of resistance. *J General Internal Med 1999;14(10):643-5.*

Layton BA, et al. 15th Annual Scientific Meeting of The Society for Healthcare Epidemiology of America (SHEA), April 9-12, 2005; Los Angeles, CA.

Loo VG, Poirier L, Miller MA, et al. A predominantly clonal multi-institutional outbreak of *Clostridium difficile*-associated diarrhea with high morbidity and mortality. *New England J Medicine 2005; 353(23):2442-9.*

Johnson S, Samore MH, Farrow KA, et al. Epidemics of diarrhea caused by a clindamycin-resistant strain of *Clostridium difficile* in four hospitals. *New England J Medicine 1999; 341(22):1645-51.*

McDonald LC, Killgore GE, Thompson A, et al. An epidemic, toxin gene-variant strain of *Clostridium difficile. New England J Medicine 2005; 353(23):2433-41.*

McDonald LC, Owings M, Jernigan DB. *Clostridium difficile* infection in patients discharged from US short-stay hospitals, 1996-2003. *Emerging Infectious Diseases 2006; 12(3):409-15.*

McDonald LC, et al. Recommendations for surveillance of *Clostridium difficile*-associated disease. *Infect Control Hospi Epidemiol 2007; 28(2):140-5.*

References

Muto CA, Pokrywka M, Shutt K, et al. A large outbreak of *Clostridium difficile*-associated disease with an unexpected proportion of deaths and colectomies at a teaching hospital following increased fluoroquinolone use. *Infection Control Hospital Epidemiol 2005; 26(3):273-80.*

Redelings MD, Sorvillo F, Mascola L. Increase in *Clostridium difficile*-related mortality rates, United States, 1999-2004. *Emerging Infectious Diseases 2007; 13(9):1417-9.* [Epub]

Rodriguez-Palacios A, et al. *Clostridium difficile* in retail ground meat, Canada. *Emerging Infectious Diseases 2007; 13(3):485-7.*

Routine Practices and Additional Precautions for Preventing the Transmission of Infections in Health Care. 1999. Public Health Agency of Canada. Http://www.phac.aspc.gc.ca/publicat/ccdr-rmtc/99vol25/25s4/index.html

Rupnik M. Is *Clostridium difficile*-associated infection a potentially zoonotic and foodborne disease? *Clinical Microbiology Infection 2007; 13(5):457-9.*

Stone S, et al. P7.02 The ORION Statement: a CONSORT Equivalent for Infection Control Studies - Guidelines for Transparent Reporting of Outbreak Reports and Intervention Studies of Nosocomial Infection. *J Hosp Infect.* 2006; 64 (S1):S40.

Valiquette L, et al. Impact of a reduction in the use of high-risk antibiotics on the course of an epidemic of *Clostridium difficile*-associated disease caused by the hypervirulent NAP1/027 strain. *Clinical Infectious Diseases 2007; 45 Suppl 2:S112-21.*

Warny M, Pepin J, Fang A, Killgore G. Thompson A. Brazier J. Frost E. McDonald LC. Toxin production by an emerging strain of *Clostridium difficile* associated with outbreaks of severe disease in North America and Europe. *Lancet 2005; 366(9491):1079-84.*

ADDITIONAL REFERENCES SENT TO PARTICIPANTS PRIOR TO CONFERENCE

Blossom D, et al. The Challenges Posed by Reemerging *Clostridium difficile* Infection. *Clinical Infect Diseases* 2007; 45:222–7.

Bouza E, et al. Clinical manifestations, treatment and control of infections caused by *Clostridium difficile*. *Clinical Microbiol Infect* 2005; 11 (Suppl. 4): 57–64.

Dubberke, ER, et al. Prevalence of *Clostridium difficile* environmental contamination and strain variability in multiple health care facilities. *Amer J Infect Control* 2007; 35:315-318.

McFarland, LV, et al. Implications of the changing face of *Clostridium difficile* disease for health care practitioners. *Amer J Infect Control* 2007; 35:237-253.

Price MF, et al. Epidemiology and incidence of *Clostridium difficile*-associated diarrhoea diagnosed upon admission to a university hospital. *J Hosp Infect* 2007; 65:42-46.

Sunenshine RH, et al. *Clostridium difficile*-associated disease: New challenges from an established pathogen. *Cleveland Clinic J Med* 2006; 73: 187-197.

Whitaker, J, et al. Designing a protocol that eliminates *Clostridium difficile*: A collaborative venture. *Amer J Infect Control* 2007; 35:310-314.

c/o APIC
1275 K Street NW, Suite 1000
Washington DC 20005-4006
HYPERLINK IICC@nta.net

International Infection Control Council

Association for Professionals in Infection Control and Epidemiology, Inc. (APIC)
Community and Hospital Infection Control Association – Canada (CHICA-Canada)
Infection Control Nurses Association (ICNA)