Control of MDRO: a quality and safety perspective

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Evolving Threat of Antimicrobial Resistance

World Health Organization

Why are MDROs important?

- Limited treatment options
- Associated with:

  increased cost

  increased length of stay

  increased morbidity and mortality
- Worse outcomes for patients with MDROs and c *difficile*

Mortality associated with MDROs

Patients with an MDRO have an increased risk of death compared to patients with a susceptible strain

- Any MRSA infection – 2 x Risk
- VRE bloodstream infection – 2-2.5 x Risk
- MDR acinetobacter bloodstream infection - 5 x Risk
- ESBL bloodstream infection - 2 x Risk

Impact of MDRO

Table 5. Mean Cost and Length of Stay for Patients with Antimicrobial-Resistant Infection (ARI), Compared with Matched Control Subjects

Propensity score	Patients with ARI	Patients without ARI	Mean difference	*P*
Propensity score 2[a]				
No. of patients	169	169	…	
Total cost, US$	53,863 ± 60,720	24,794 ± 23,231	29,069	<.001
Total length of stay, days	23.8 ± 20.3	12.8 ± 10.2	11.0	<.001
Propensity score 3[b]				
No. of patients	138	138	…	
Total cost, US$	52,211 ± 59,456	31,003 ± 26,325	21,208	<.001
Total length of stay, days	22.5 ± 20.1	15.9 ± 11.3	6.7	<.001

NOTE. Data are mean ± standard deviation, unless otherwise indicated.

[a] Comorbidities, surgery, and intensive care unit stay.

[b] Comorbidities, surgery, intensive care unit stay, and health care–acquired infection.

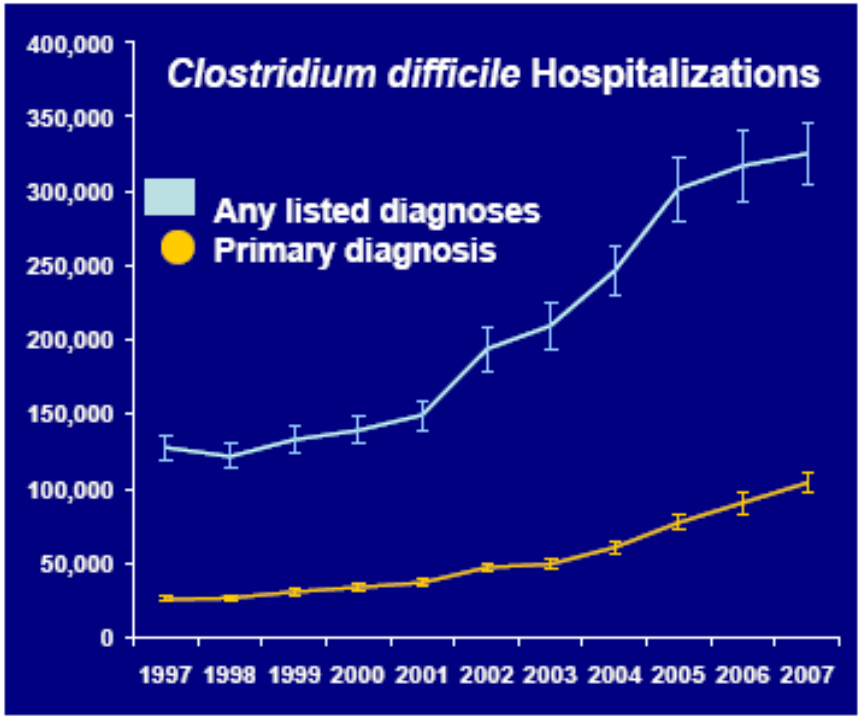
Roberts RR CID 2009

Is it Necessary? Does it matter?

- The incidence, mortality, and medical care costs of CDIs have reached historic highs
  - 3,000 CDI attributable deaths/yr in 1999–2000
  - 14,000 CDI attributable deaths/yr in 2006–2007
  - $5,042–$7,179 excess costs per case of HO-CDI
  - Nationally excess $897 million to $1.3 billion

CDC Vital Signs March 2012

Impact of C. *difficile* infection (CDI)



- Hospital-acquired, hospital-onset: 165,000 cases, $1.3 billion in excess costs, and 9,000 deaths annually
- Hospital-acquired, post-discharge (up to 4 weeks): 50,000 cases, $0.3 billion in excess costs, and 3,000 deaths annually
- Nursing home-onset: 263,000 cases, $2.2 billion in excess costs, and 16,500 deaths annually

Campbell et al. Infect Control Hosp Epidemiol. 2009:30:523-33.

Dubberke et al. Clin Infect Dis. 2008;46:497-504.

Dubberke et al. Emerg Infect Dis. 2008;14:1031-8.

Elixhauser et al. HCUP Statistical Brief #50. 2008.

Carbapenem-Resistant Enterobacteriacie

CRE are epidemiologically important for several reasons:

•CRE have been associated with high mortality rates (up to 40 to 50% in some studies).

•In addition to β-lactam/carbapenem resistance, CRE often carry genes that confer high levels of resistance to many other antimicrobials, often leaving very limited therapeutic options. “Pan-resistant” KPC-producing strains have been reported.

•CRE have spread throughout many parts of the United States and have the potential to spread more widely.

What is the Scope of the Problem?

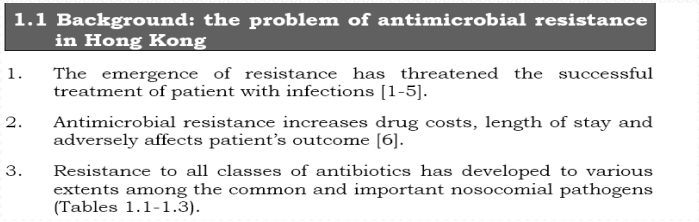
Multidrug-Resistant Organisms (MDROs):

Multidrug-Resistant Organism Colonization in a US Military Healthcare Facility in Iraq
Julie Ake, MD, MSc,[12] Paul

Mortality attributable to nosocomial infection: a cohort of patients with and without nosocomial infection in a French university hospital. *Infect Control Hospital Epidemiol* 2007; 28:265-272

Fabbro-Perray P, Sotto A, Defez C, et al.

Greece



1.1 Background: the problem of antimicrobial resistance in Hong Kong

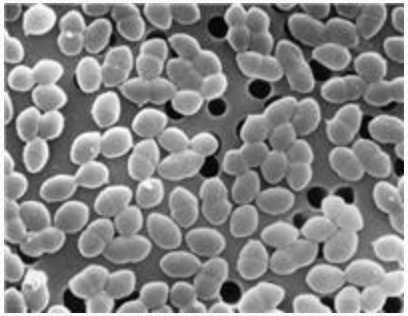
1. The emergence of resistance has threatened the successful treatment of patient with infections [1-5].
2. Antimicrobial resistance increases drug costs, length of stay and adversely affects patient's outcome [6].
3. Resistance to all classes of antibiotics has developed to various extents among the common and important nosocomial pathogens (Tables 1.1-1.3).

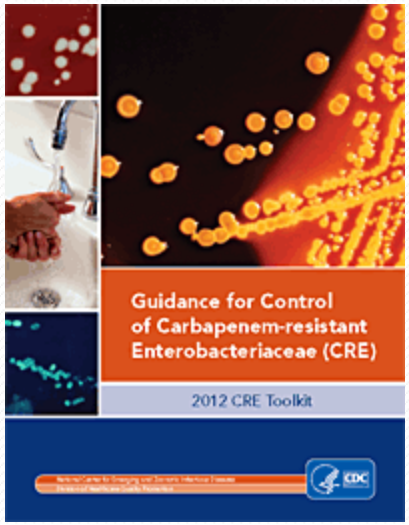
Why is resistance increasing in the healthcare enviornment?

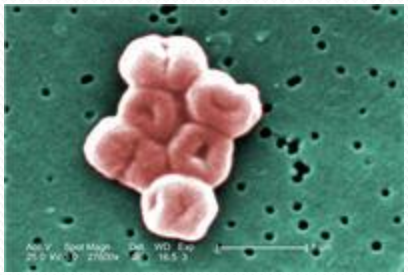
- Increasingly complex healthcare delivery
- Overuse of antibiotics
- Increasing prevalence of MDRO's- colonization pressure
- Increasing risk of enviornmental contamination
- Lack of resources or institutional will to enforce compliance

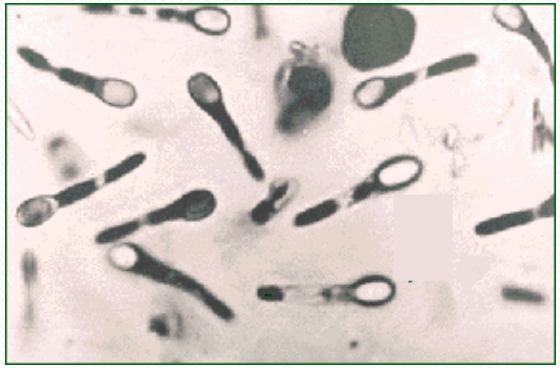
Bad Bugs, No Drugs: No ESKAPE! An Update from the Infectious Diseases Society of America

Helen W. Boucher,[1] George H. Talbot,[2] John S. Bradley,[3,4] John E. Edwards, Jr,[5,6,7] David Gilbert,[8] Louis B. Rice,[9,10] Michael Scheld,[11] Brad Spellberg,[5,6,7] and John Bartlett[12]









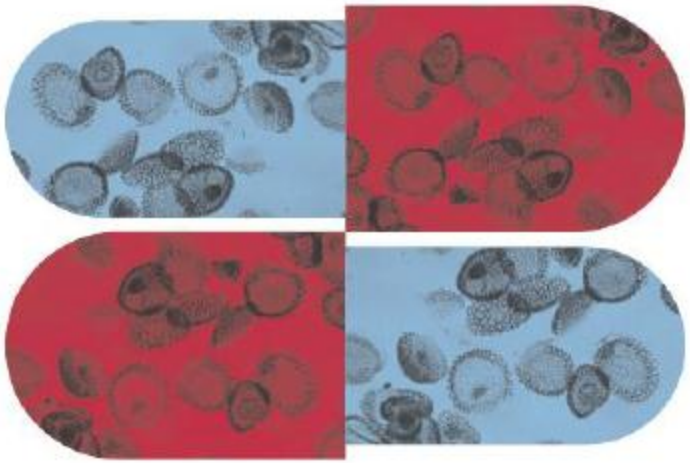
PubMed

"Bad Bugs"

- Bad bugs need drugs: an update on the development pipeline from the Antimicrobial Availability Task Force of the Infectious Diseases Society of America. (2006)
- Drugs for bad bugs: confronting the challenges of antibacterial discovery. (2007)
- The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. (2008)
- Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America. (2009)
- Bad bugs, no drugs: no ESCAPE revisited. (2009)
- Challenges in anti-infective development in the era of bad bugs, no drugs: a regulatory perspective using the example of bloodstream infection as an indication. (2010)

What Every Health Care Executive Should Know:

The Cost of Antibiotic Resistance



CHAPTER 1 Antibiotic Resistance: Patients and Hospitals in Peril

Why is the issue of antibiotic resistance important to you and your organization?
Stephen Weber, M.D., M.S.
Barbara M. Soule, R.N., M.P.A., C.I.C.

CHAPTER 2 The Clinical Consequences of Antibiotic Resistance

How many patients at your institution died last year as a result of infection with multidrug-resistant organisms?
Thomas R. Talbot, M.D., M.P.H.

CHAPTER 3 The Financial Impact of Antibiotic Resistance

How much did it cost your hospital last year to prevent and manage infections caused by multidrug-resistant organisms?
Keith Kaye, M.D., M.S.

CHAPTER 4 Transmission Control to Prevent the Spread of MDROs in Health Care Facilities

How frequently do clinicians at your organization clean their hands before and after seeing a patient?
Christopher J. Crnich, M.D., M.S.
Stephen Weber, M.D., M.S.
Barbara M. Soule, R.N., M.P.A., C.I.C.

CHAPTER 5 Antibiotic Stewardship

Is antibiotic misuse promoting the spread of MDROs and unnecessarily increasing costs at your institution?
Paul Cook, M.D.

CHAPTER 6 Challenges on the Path to Higher Performance

Is your organization ready to implement the changes needed to control MDROs?
David M. Boan, Ph.D.
Deborah Hadzim, R.N., Ph.D.

CHAPTER 7 Call to Action

Why you? Why now?
Stephen Weber, M.D., M.S.
Barbara M. Soule, R.N., M.P.A., C.I.C.

APPENDIX Additional Readings

The Joint Commission
HELPING HEALTH CARE ORGANIZATIONS HELP PATIENTS

http://www.jcrinc.com/MDRO-Toolkit/

How do we control MDROs ?

So ----- What is the answer?

1. Hand Hygiene – WHO

Barriers

- Compliance often sub optimal
- Measurement and monitoring systems inadequate
- Technology can be a barrier
- Complexity of Healthcare

Successful Strategies

Education

Reinforcement

Team work

Culture

Multimodal Approach

Infection Control and Hospital Epidemiology
Published for The Society for Healthcare Epidemiology of America

- **Effectiveness of Multifaceted Hand Hygiene Interventions in Long-Term Care Facilities in Hong Kong: A Cluster-Randomized Controlled Trial**

Mei-lin Ho, MBBS, MPH, FHKCCM, FHKAM, FFPH;
Wing-hong Seto, MBBS, MRCP, FRCPath, FHKCPath,
FHKAM; Lai-chin Wong, BSc, MSc; Tin-yau Wong,
MBBS, MPH, MSc, FHKCP, FRCP, FHKAM

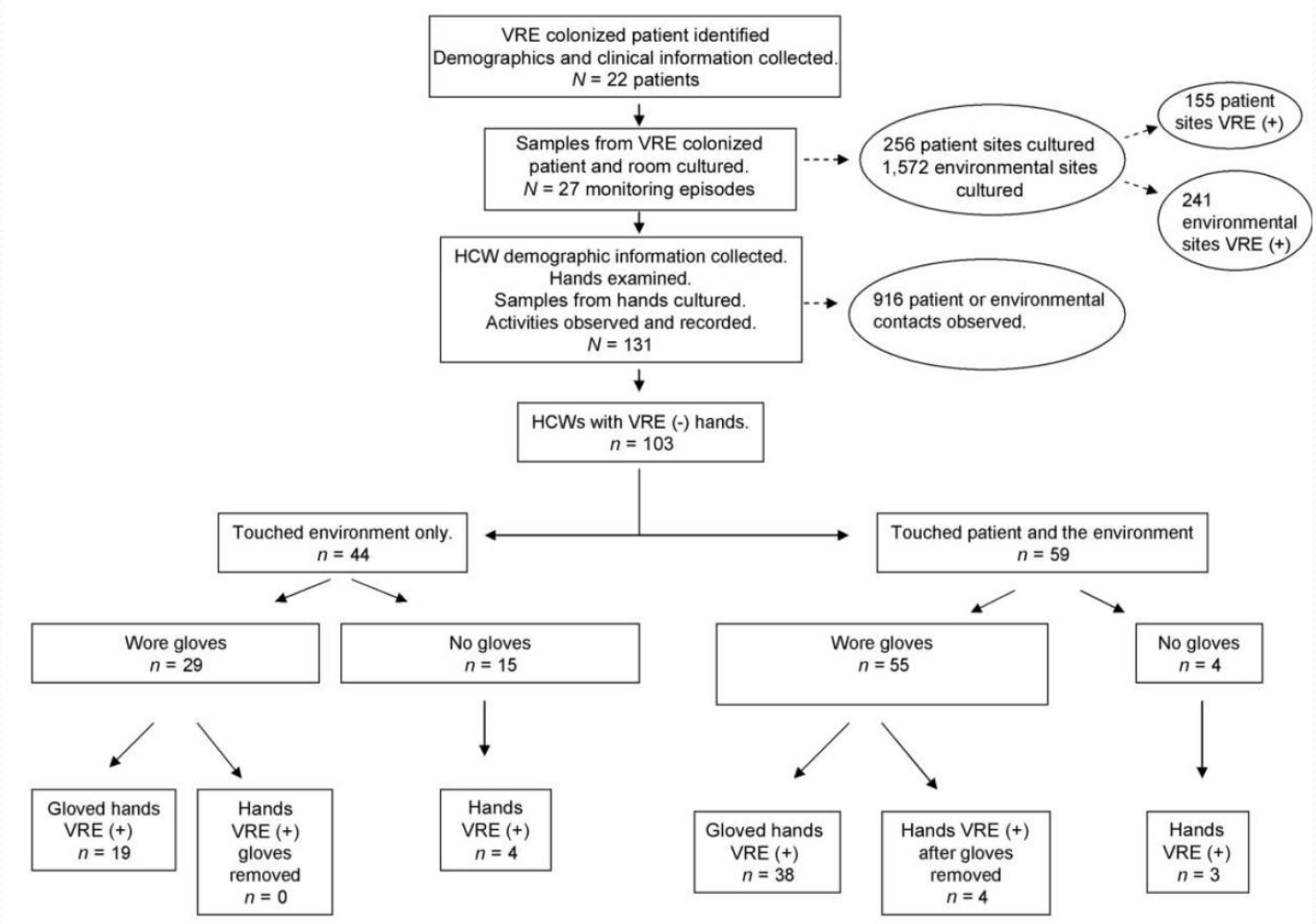
Infection Control and Hospital Epidemiology
Vol. 33, No. 8 (August 2012), pp. 761-767

Contact Precautions

- High level of evidence – use of gloves
- General Agreement on need for gowns and gloves

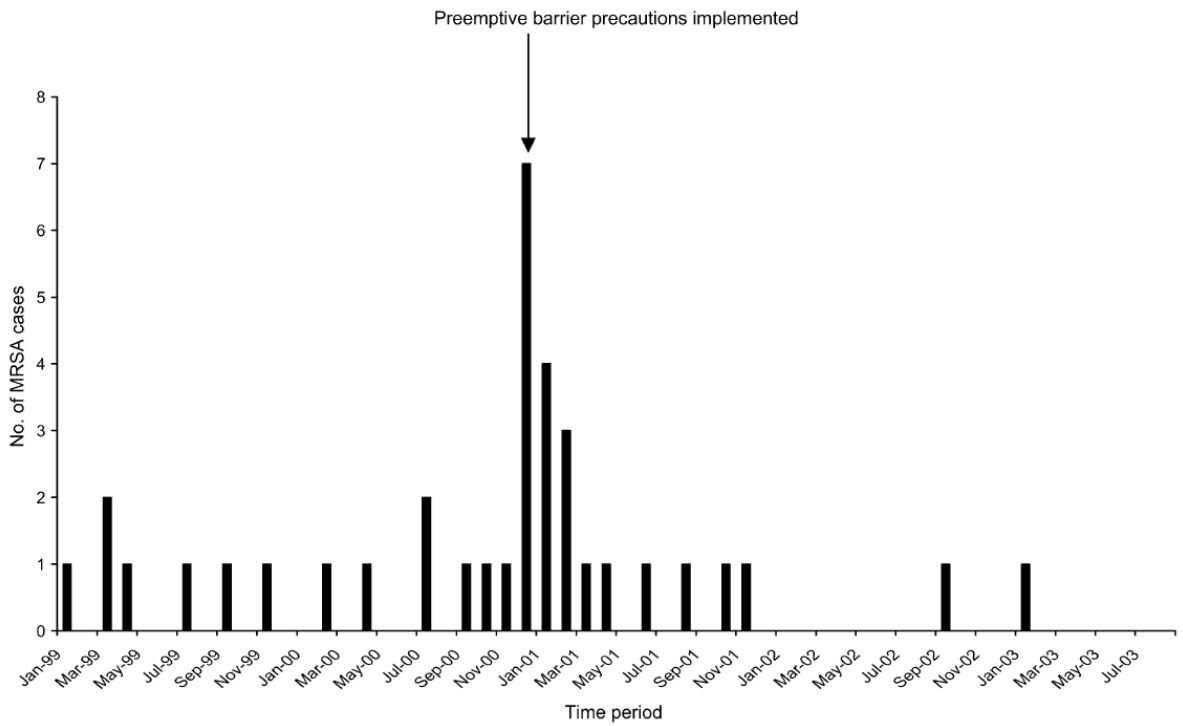
The Daily and the Mundane

Is it Effective?



Hayden et al, ICHE 2008

Is it Effective?



Outbreak of MRSA on a burn unit terminated upon initiation of universal contact precautions for all patients on the unit

Rates 0.22, 0.72, 0.11 per 1000 patient day before, during, and after the outbreak, respectively

Safdar et al AJIC 2006

Is it Effective?

Am J Med. 1990 Feb;88(2):137-40.

Prospective, controlled study of vinyl glove use to interrupt Clostridium difficile nosocomial transmission.

Johnson S, Gerding DN, Olson MM, Weiler MD, Hughes RA, Clabots CR, Peterson LR.
Department of Medicine, Veterans Administration Medical Center, Minneapolis, Minnesota 55417.

Prior to Universal or Standard Precautions

Standard of Care versus Intervention

- intensive education about glove use when handling stool and other bodily substances
- placement of a box of gloves at every bedside

RESULTS

- CDI rate decreased from 7.7 cases/1,000 patient discharges to 1.5/1,000 following intervention ($p = 0.015$)
- Control wards remained the same (5.7/1,000 versus 4.2/1,000)

Is it Effective?

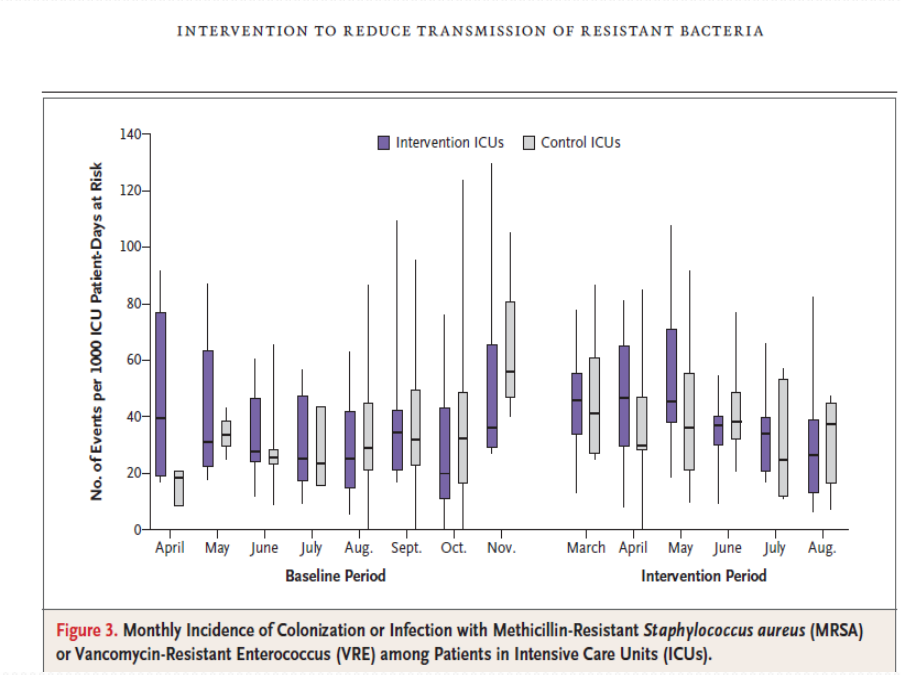


Figure 3. Monthly Incidence of Colonization or Infection with Methicillin-Resistant *Staphylococcus aureus* (MRSA) or Vancomycin-Resistant Enterococcus (VRE) among Patients in Intensive Care Units (ICUs).

STAR* ICU
Cluster-randomized trial

- Universal gloving, universal screening, and contact isolation for MRSA/VRE known infections and newly diagnosed carriage VS
- Traditional infection control procedures of isolating only known carriers

- No difference in MRSA/ VRE rates, incident cases
- Suboptimal compliance with contact precautions in both arms (~70%)

Huskins C NEJM 2011

Least restrictive alternative?

TABLE 3
PROPORTIONAL HAZARDS MODEL OF RISK FACTORS FOR ACQUISITION OF VANCOMYCIN-RESISTANT ENTEROCOCCI ACROSS THE STUDY PERIOD

Factor	Hazard Ratio (N = 68)	*P*	CI_{95}
Male	0.74	.442	0.34 to 1.60
Caucasian	0.62	.234	0.28 to 1.36
Antibiotic treatment			
Vancomycin	1.41	.403	0.63 to 3.14
Third-generation cephalosporin	0.46	.071	0.20 to 1.07
Anti-anaerobic agent	1.35	.444	0.63 to 2.91
Being hospitalized during gloves only period	2.47	.02	1.15 to 5.30

CI_{95} = 95% confidence interval.

Srinivasan A et al ICHE 2002

Least restrictive alternative?

Table 4. Change in Acquisition Rates of Organisms After Privatization in the ICU

Organism	Rate Ratio (95% CI)[a]
Likely exogenous	
C difficile+MRSA+VRE	0.46 (0.30-0.71)
C difficile	0.57 (0.35-0.93)
MRSA	0.53 (0.29-0.99)
VRE	NA
Acinetobacter species	0.47 (0.24-0.92)
Stenotrophomonas maltophilia	0.48 (0.21-1.07)
Fungi-molds	1.23 (0.75-2.03)
Exogenous/endogenous	
Yeast	0.49 (0.36-0.66)
Enterococcus species	0.77 (0.56-1.06)
Enterobacter species	0.62 (0.42-0.93)
Escherichia species	0.89 (0.55-1.44)
Staphylococcus aureus	1.02 (0.67-1.54)
Pseudomonas species	1.00 (0.63-1.57)
Klebsiella species	0.62 (0.38-0.99)
Serratia species	0.77 (0.41-1.43)
Citrobacter species	1.36 (0.74-2.50)
Proteus mirabilis	0.69 (0.38-1.24)
Morganella species	0.57 (0.30-1.06)
Likely endogenous	
Coagulase-negative *Staphylococcus* species	0.96 (0.76-1.20)
Haemophilus species	0.53 (0.30-0.95)
Streptococcus viridans	1.03 (0.56-1.90)

Table 1. Patient Populations in the ICUs Before and After Room Privatization[a]

Period Relative to March 2, 2002	Hospital Intervention		Hospital Comparison	
	Before	After	Before	After
Hospital admissions with ICU stay, No.	2732	5468	4167	6976
Mean age, y	59.6	59.4	60.1	60.9
Female sex, No. (%)	973 (35.6)	1874 (34.3)	1624 (39.0)	2690 (38.6)

5 year Canadian observational study

Intervention –all private rooms with dedicated sinks (prior 2 large 12 bed rooms, one inner private room in each, 4 total sinks)

Control – standard of care with rooms with 2, 5, or 6 beds and 8 single rooms

Telsch TY Arch Int Med 2011

Negative impact of isolation

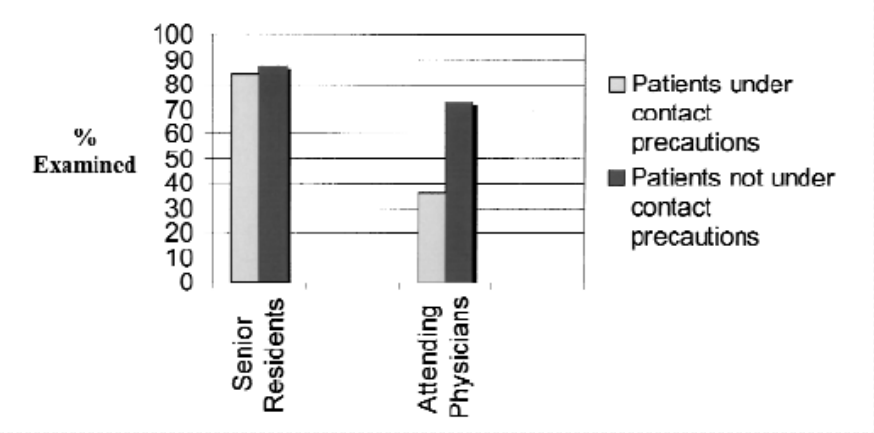
Table 1 Principle adverse effects of contact precautions [1••, 2••]

- Increased anxiety and depression
- Decreased patient satisfaction
- Less patient–health care worker interaction
- Changes in care leading to care delays and increased noninfectious adverse events

4.2 vs 2.1 contacts / hr
50% difference, p 0.03

Bearman Curr Inf Dis Rep 2012

Negative impact of isolation



Observation of rounds for 139 patients
31 on contact precautions
Blinded to actual purpose of observation

General Medicine and CHF: matched retrospective cohort studies

CP patients
8% complaints
31 adverse events /1000 pt days
20 preventable events /1000 pt days

Non CP Patients
1% complaints
15 adverse events /1,000 pt days
3/1,000 preventable events pt days

Saint S et al AJIC 2003
Kirkland et al Lancet 1999
Stelfox et al JAMA 2003

Alternate Approach

Red Box

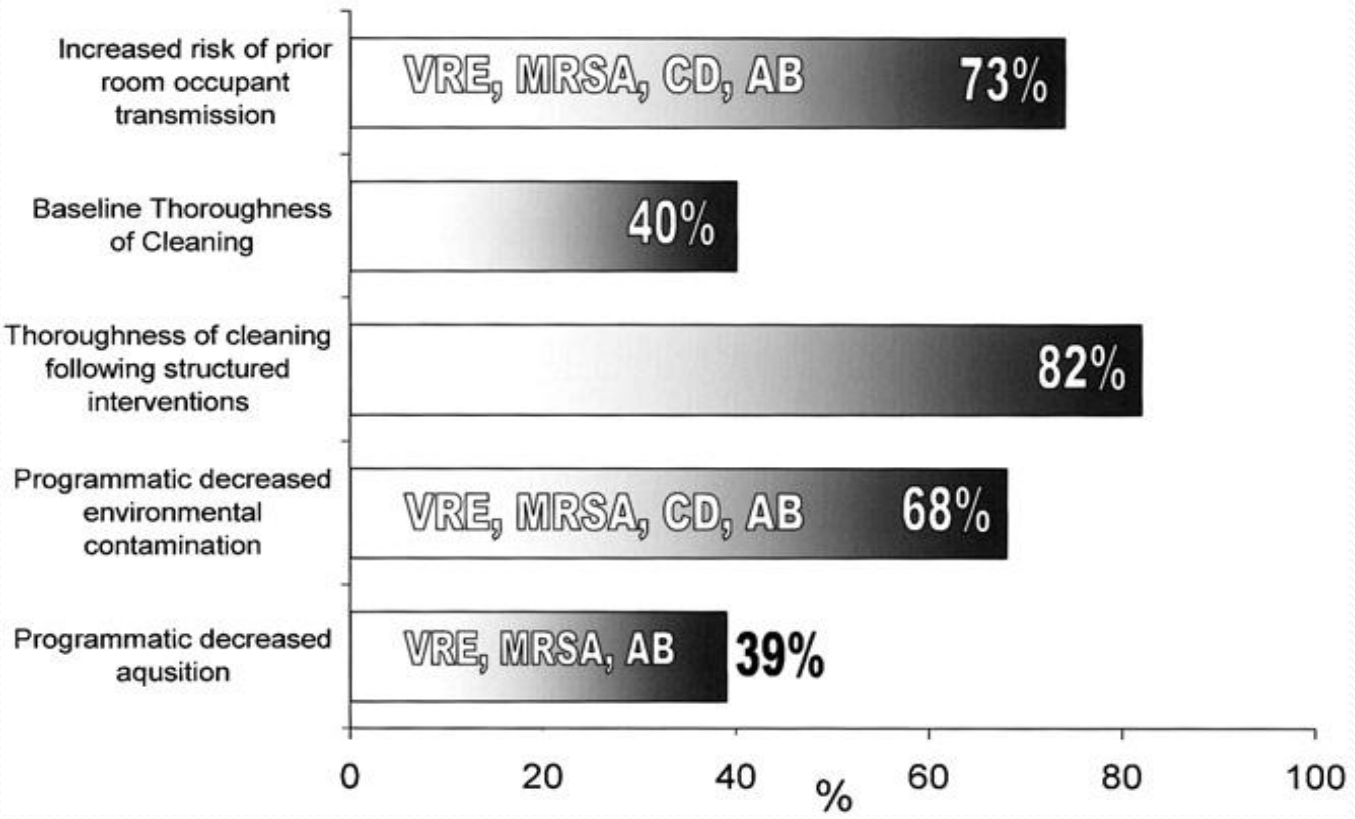
Photo by Trinity Medical Center, Quad Cities

How do we control MDROs ?

Antibiotic Control

Increasing evidence that Antimicrobial programs are cost effective and can lead to decreased incidence and prevalence of MDROs

Need for Improved Healthcare Environmental Cleaning: Literature Support



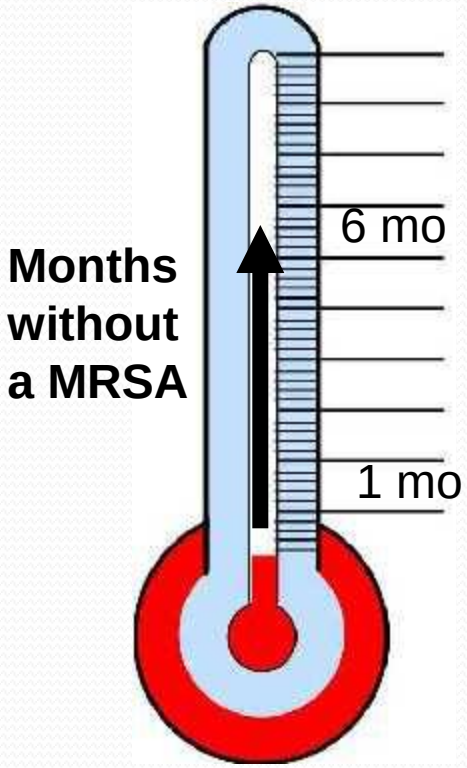
Carling P, Bartley J. *Am J Infect Control.* 2010;38:S41-S50.

Challenges in Improving Environmental Cleaning

- Enviornmental Services (EVS) has not traditionally been an integral part of the Infection Prevention team
- Many healthcare institutions run at or near 100% capacity. Room turnover, quick discharge and admission of new patients is a priority
- We have not shared outcome data with EVS staff and helped them to understand the important role they play in infection prevention

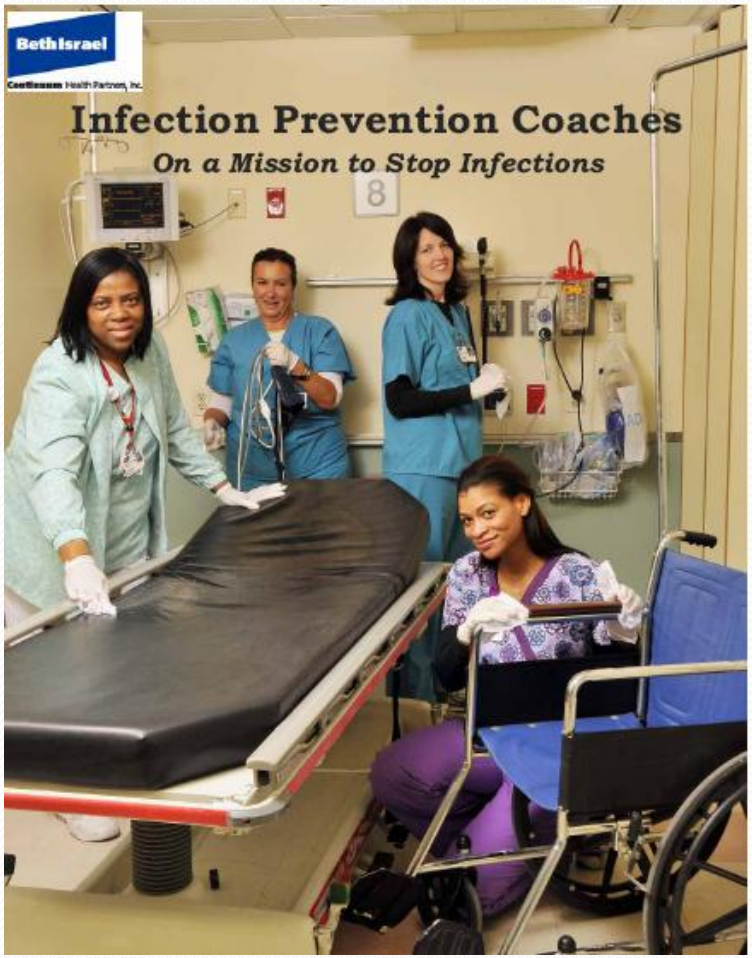
Strategies: “Connect the Dots”

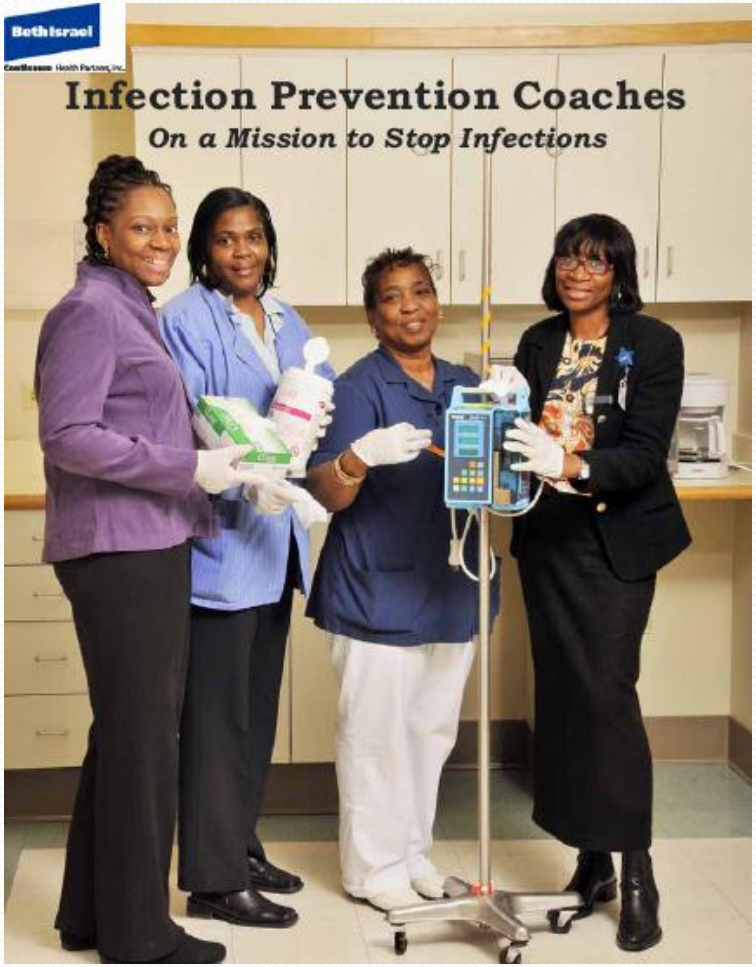
- Help EVS understand their role in patient care
- Safety through optimizing their practices



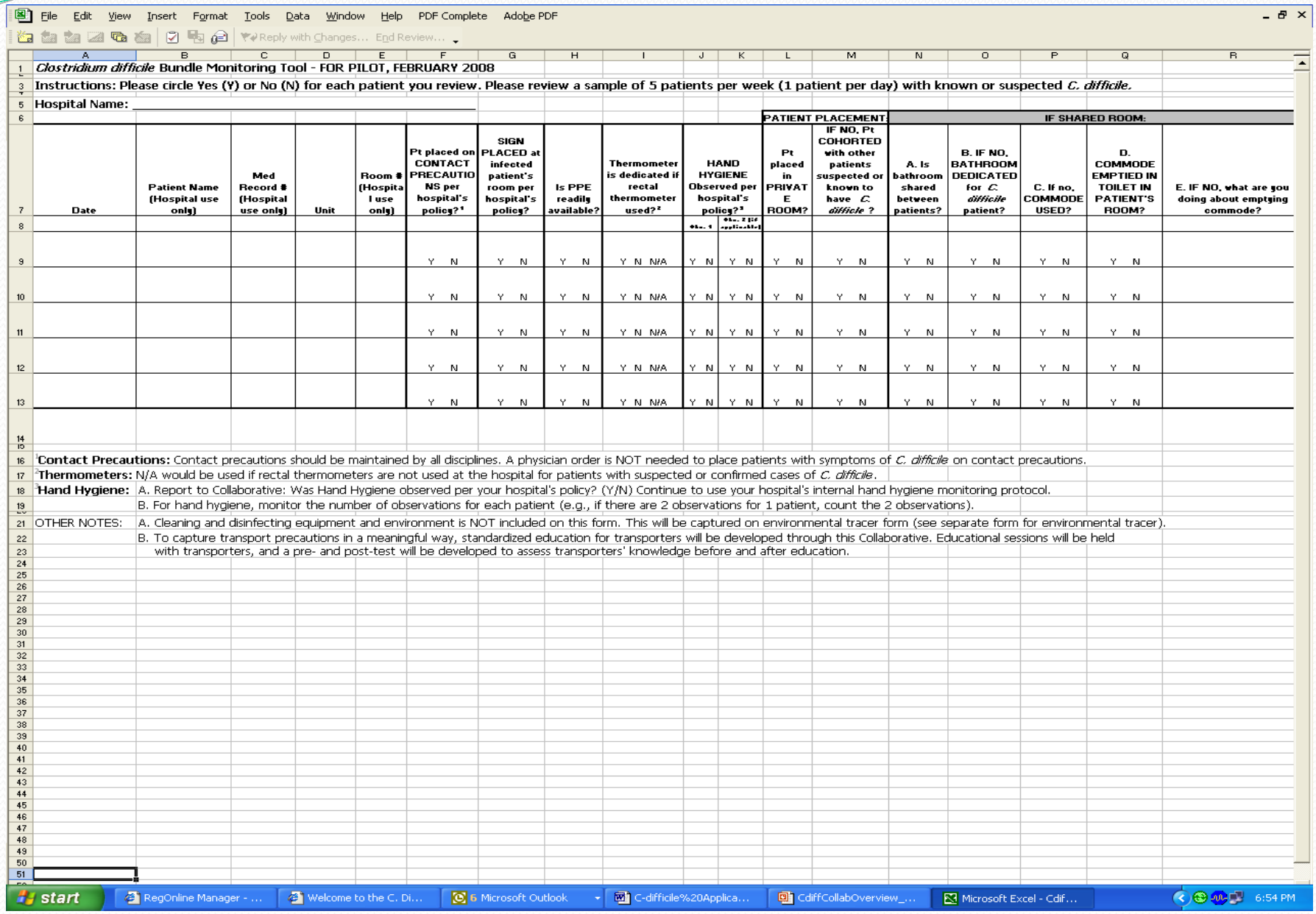
Story Telling – Names and Faces

Infection Prevention Bundles





Bundle Monitoring Tool



Clostridium difficile Bundle Monitoring Tool - FOR PILOT, FEBRUARY 2008

Instructions: Please circle Yes (Y) or No (N) for each patient you review. Please review a sample of 5 patients per week (1 patient per day) with known or suspected *C. difficile.*

Hospital Name: _____

											PATIENT PLACEMENT:		IF SHARED ROOM:				
Date	Patient Name (Hospital use only)	Med Record # (Hospital use only)	Unit	Room # (Hospital use only)	Pt placed on CONTACT PRECAUTIONS per hospital's policy?[1]	SIGN PLACED at infected patient's room per hospital's policy?	Is PPE readily available?	Thermometer is dedicated if rectal thermometer used?[2]	HAND HYGIENE Observed per hospital's policy?[3]		Pt placed in PRIVATE ROOM?	IF NO, Pt COHORTED with other patients suspected or known to have *C. difficile* ?	A. Is bathroom shared between patients?	B. IF NO, BATHROOM DEDICATED for *C. difficile* patient?	C. If no, COMMODE USED?	D. COMMODE EMPTIED IN TOILET IN PATIENT'S ROOM?	E. IF NO, what are you doing about emptying commode?
									#hr. 1	#hr. 1 (if applicable)							
					Y N	Y N	Y N	Y N N/A	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	
					Y N	Y N	Y N	Y N N/A	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	
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					Y N	Y N	Y N	Y N N/A	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	

[1] **Contact Precautions:** Contact precautions should be maintained by all disciplines. A physician order is NOT needed to place patients with symptoms of *C. difficile* on contact precautions.

[2] **Thermometers:** N/A would be used if rectal thermometers are not used at the hospital for patients with suspected or confirmed cases of *C. difficile*.

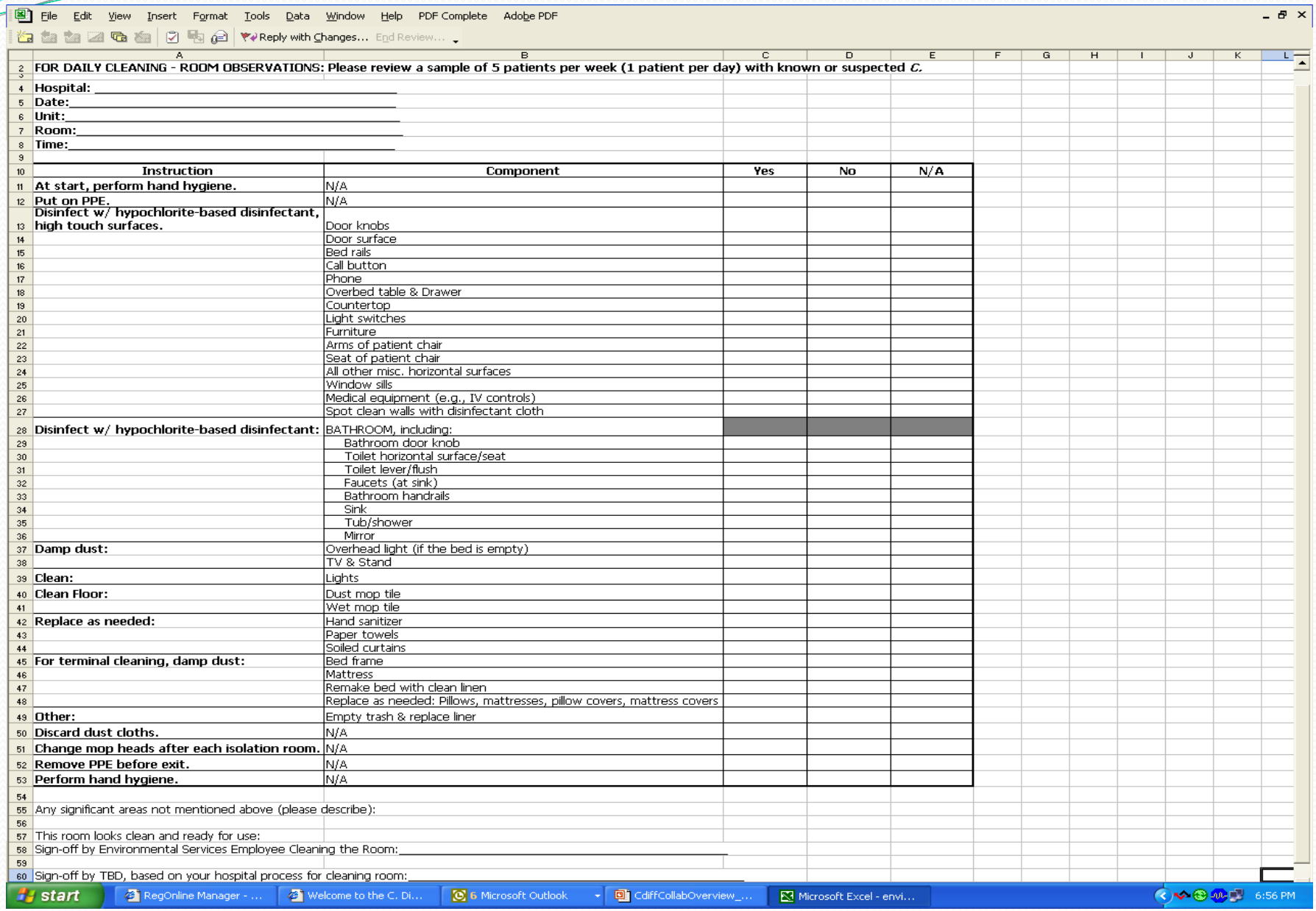
[3] **Hand Hygiene:** A. Report to Collaborative: Was Hand Hygiene observed per your hospital's policy? (Y/N) Continue to use your hospital's internal hand hygiene monitoring protocol.

B. For hand hygiene, monitor the number of observations for each patient (e.g., if there are 2 observations for 1 patient, count the 2 observations).

OTHER NOTES: A. Cleaning and disinfecting equipment and environment is NOT included on this form. This will be captured on environmental tracer form (see separate form for environmental tracer).

B. To capture transport precautions in a meaningful way, standardized education for transporters will be developed through this Collaborative. Educational sessions will be held with transporters, and a pre- and post-test will be developed to assess transporters' knowledge before and after education.

Environmental Checklist



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Reply with Changes... End Review...

FOR DAILY CLEANING - ROOM OBSERVATIONS: Please review a sample of 5 patients per week (1 patient per day) with known or suspected *C.*

Hospital: _____

Date: _____

Unit: _____

Room: _____

Time: _____

Instruction	Component	Yes	No	N/A
At start, perform hand hygiene.	N/A			
Put on PPE.	N/A			
Disinfect w/ hypochlorite-based disinfectant, high touch surfaces.	Door knobs			
	Door surface			
	Bed rails			
	Call button			
	Phone			
	Overbed table & Drawer			
	Countertop			
	Light switches			
	Furniture			
	Arms of patient chair			
	Seat of patient chair			
	All other misc. horizontal surfaces			
	Window sills			
	Medical equipment (e.g., IV controls)			
	Spot clean walls with disinfectant cloth			
Disinfect w/ hypochlorite-based disinfectant:	BATHROOM, including:			
	Bathroom door knob			
	Toilet horizontal surface/seat			
	Toilet lever/flush			
	Faucets (at sink)			
	Bathroom handrails			
	Sink			
	Tub/shower			
	Mirror			
Damp dust:	Overhead light (if the bed is empty)			
	TV & Stand			
Clean:	Lights			
Clean Floor:	Dust mop tile			
	Wet mop tile			
Replace as needed:	Hand sanitizer			
	Paper towels			
	Soiled curtains			
For terminal cleaning, damp dust:	Bed frame			
	Mattress			
	Remake bed with clean linen			
	Replace as needed: Pillows, mattresses, pillow covers, mattress covers			
Other:	Empty trash & replace liner			
Discard dust cloths.	N/A			
Change mop heads after each isolation room.	N/A			
Remove PPE before exit.	N/A			
Perform hand hygiene.	N/A			

Any significant areas not mentioned above (please describe):

This room looks clean and ready for use:

Sign-off by Environmental Services Employee Cleaning the Room: _____

Sign-off by TBD, based on your hospital process for cleaning room: _____

start | RegOnline Manager - ... | Welcome to the C. Di... | 6 Microsoft Outlook | CdiffCollabOverview_... | Microsoft Excel - envi... | 6:56 PM

The Answer-It is not just a simple checklist though

ANNALS OF MEDICINE

THE CHECKLIST

If something so simple can transform intensive care, what else can it do?

BY ATUL GAWANDE

The damage that the human body can survive these days is as awesome as it is horrible: crushing, burning, bombing, a burst blood vessel in the brain, a ruptured colon, a massive heart attack, rampaging infection. These conditions had once been uniformly fatal. Now survival is commonplace, and a large part of the credit goes to the irreplaceable component of medicine known as intensive care.

It's an opaque term. Specialists in the field prefer to call what they do "critical care," but that doesn't exactly clarify matters. The non-medical term "life support" gets us closer. Intensive-care units take artificial control of failing bodies. Typically, this involves a panoply of technology—a mechanical ventilator and perhaps a tracheostomy tube if the lungs have failed, an aortic balloon pump if the heart has given out, a dialysis machine if the kidneys don't work. When you are unconscious and can't eat, silicone tubing can be surgically inserted into the stomach or intestines for formula feeding. If the intestines are too damaged, solutions of amino acids, fatty acids, and glucose can be infused directly into the bloodstream.

The difficulties of life support are considerable. Reviving a drowning victim

sician on the phone, they began cardiopulmonary resuscitation. A rescue team arrived eight minutes later. The girl had a body temperature of sixty-six degrees, and no pulse. Her pupils were dilated and did not react to light, indicating that her brain was no longer working.

But the emergency technicians continued CPR anyway. A helicopter took her to a nearby hospital, where she was wheeled directly to an operating room. A surgical team put her on a heart-lung bypass machine. Between the transport time and the time it took to plug the inflow and outflow lines into the femoral vessels of her right leg, she had been lifeless for an hour and a half. By the two-hour mark, however, her body temperature had risen almost ten degrees, and her heart began to beat. It was her first organ to come back.

After six hours, her core temperature reached 98.6 degrees. The team tried to put her on a breathing machine, but the pond water had damaged her lungs too severely for oxygen to reach her blood. So they switched her to an artificial-lung system known as ECMO—extracorporeal membrane oxygenation. The surgeons opened her chest down the middle with a power saw and sewed lines to and from the ECMO unit into her aorta

Perspectives

The art of medicine
Reality check for checklists

Catheter-related bloodstream infections in the intensive care unit (ICU) are common, costly, and potentially lethal. The December 28, 2006 issue of *The New England Journal of Medicine* reported that an evidence-based intervention in 103 intensive care units in the Michigan Keystone ICU programme had resulted in a large sustained reduction in rates of these infections. The study was widely reported in the popular media and elsewhere as a triumph of the "simple checklist" as a solution to patients' safety problems. Yet the widespread interest of the study is a dual-edged sword.

It was a great story. Science often needs to be simplified for the lay public. The problem is that the story may well have been oversimplified. The emphasis on checklists is a Hitchcockian "McGuffan", a distraction from the plot that diverts attention from how safer care is really achieved.

a checklist for a clinical problem is a nonetheless achievable ambition: there are well-defined processes for identifying and synthesising research evidence. For the Keystone programme, interventions with a potential to improve outcomes were identified, and the five procedures that had the strongest evidence and the lowest barriers to implementation were selected and converted into a standardised checklist.

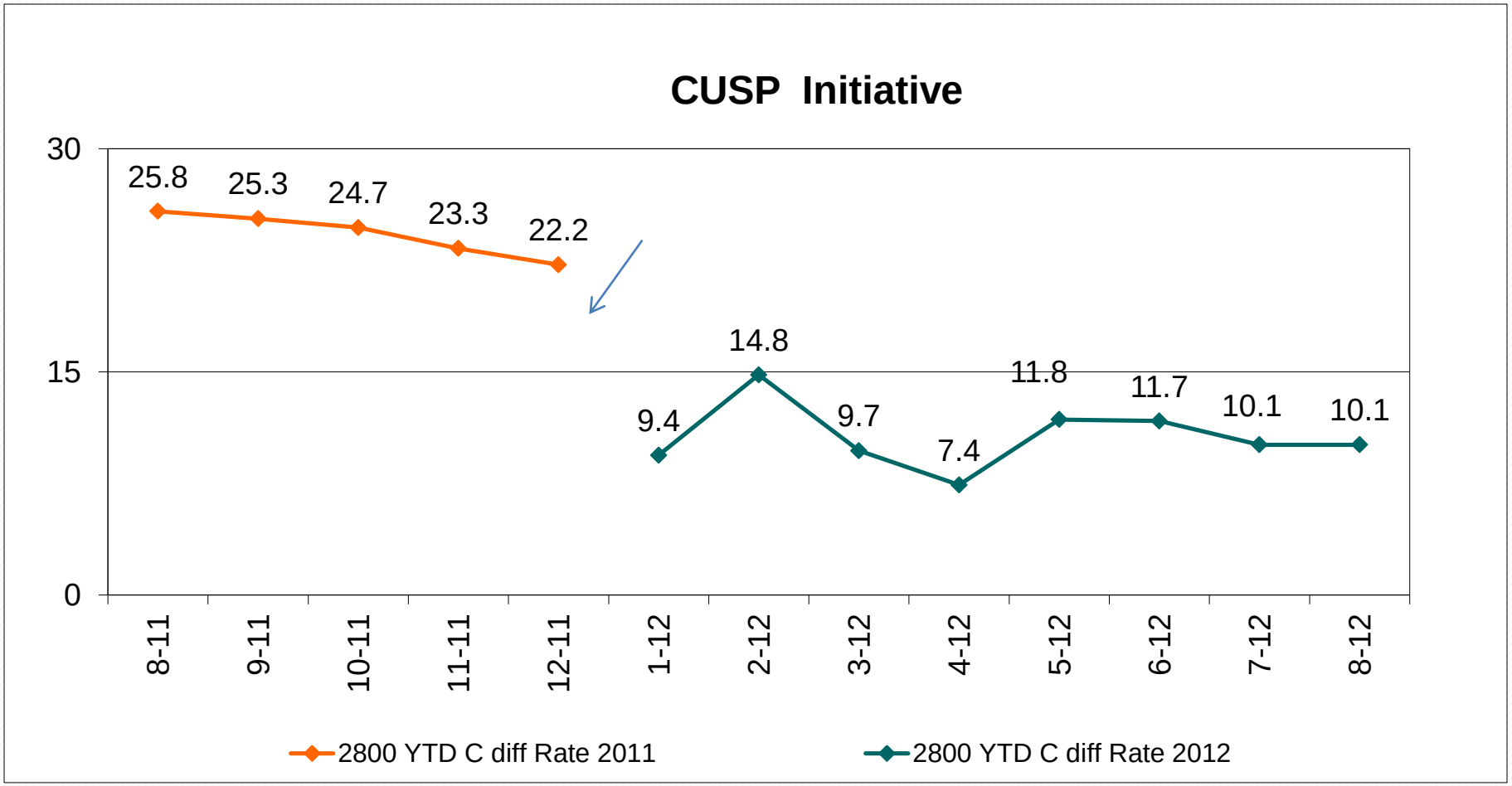
But checklists, even if based on rigorous evidence, have never penetrated medicine in the way they perhaps ought to have. The reasons for this are primarily social and cultural. In part, the way that physicians are socialised creates resistances and interferences to the use of checklists. Some come to feel that checklists undermine their claims to expertise, are infantilising, and an unnecessary impediment to the swift decision-making and action required for effective care. How

Ideas for Ensuring Patients Receive the Interventions: the 4Es

- Engage: stories, show baseline data
- Educate staff on evidence
- Execute
  - Standardize Processes
  - Create independent checks: Create checklist
  - Empower caregivers to stop each other if there are breeches in protocol
  - Learn from mistakes
- Evaluate
  - Feed back performance
  - View infections as defects

Rochester General Experience with Behavioral Intervention and C *difficile*

RGH 2800 *C. difficile* Infections and Rates



The Purpose of Our Work

"The names of the patients whose lives we save can never be known. Our contribution will be what did not happen to them.

And, though they are unknown, we will know that mothers and fathers are at graduations and weddings they would have missed, grandchildren will know grandparents they might never have known, holidays will be taken, work completed, books read, symphonies heard, and gardens tended that, without our work, would never have been."

Donald M. Berwick, MD,MPP

Conclusion

- MDROs are a world wide problem
- The answer is not a single approach
- We must blend technical knowledge with socio-adaptive skills
- We must create a vision where prevention of harm, quality and safety is everyone's responsibility