Updated 20180412 1245!

The Scoop on Poop: 21st Century Look at an 18th Century Problem

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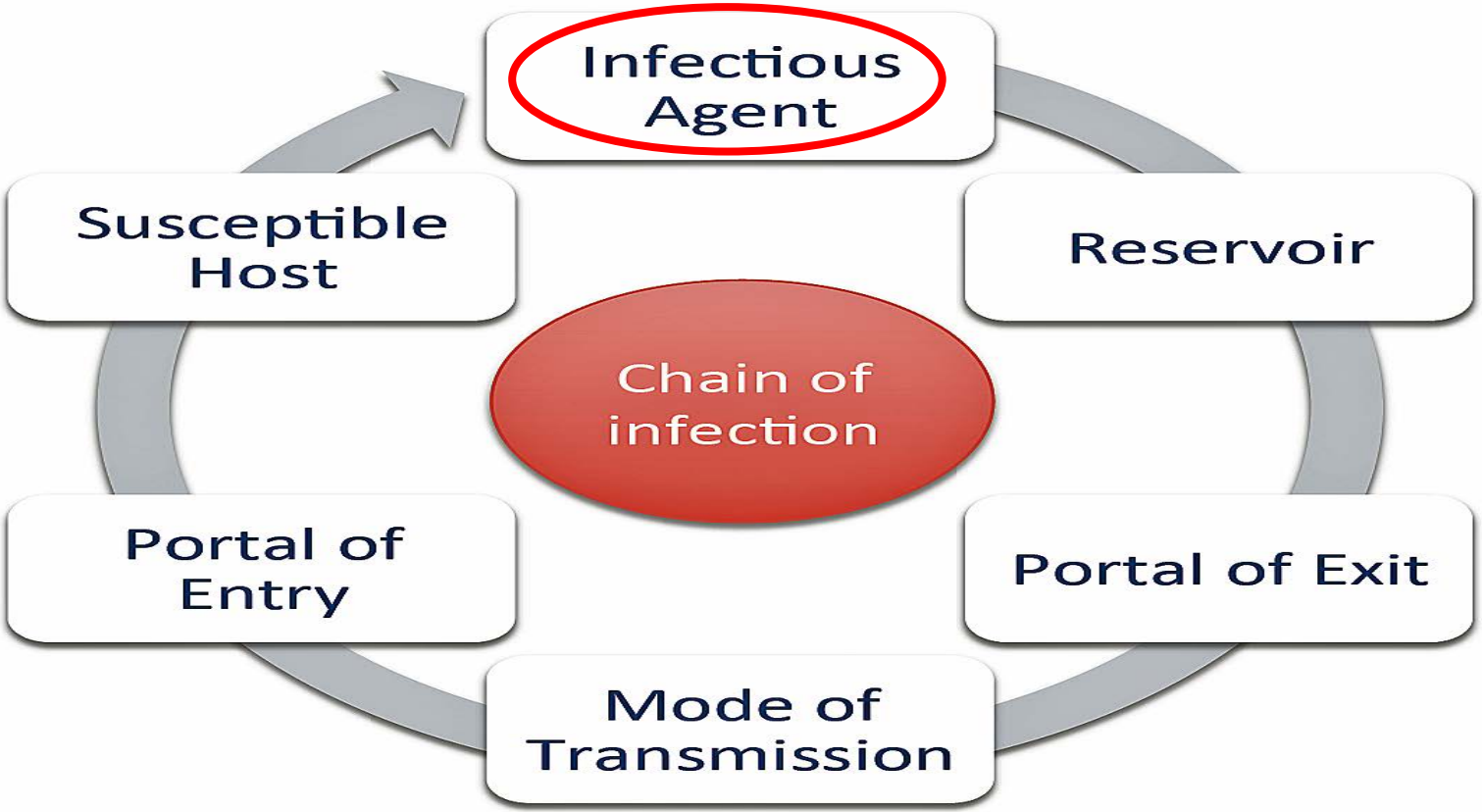
Disclaimer

Jim is employed by Diversey. His expenses to attend this meeting (travel, accommodation, and salary) are paid by this company.

Objectives

- Review mode of transmission and portal of entry related to multi-drug resistant organisms (MDRO)
- Discuss areas in healthcare that need more attention
- Propose ideas for discussion

Chain of Transmission



http://diseasedetectives.wikia.com/wiki/Chain_of_Transmission

Infectious Agent

Vancomycin Resistant Enterococci (VRE)

Extended Spectrum Beta Lactamase (ESBL)

Carbapenemase-producing Enterobacteriaceae (CPE)

Carbapenemase-producing Organisms (CPO)

Clostridium difficile (CD)

- Not truly an MDRO

Infectious Agent

Methicillin Resistant *Staphylococcus aureus*

- Yes, that bug… (Boyce 2007)

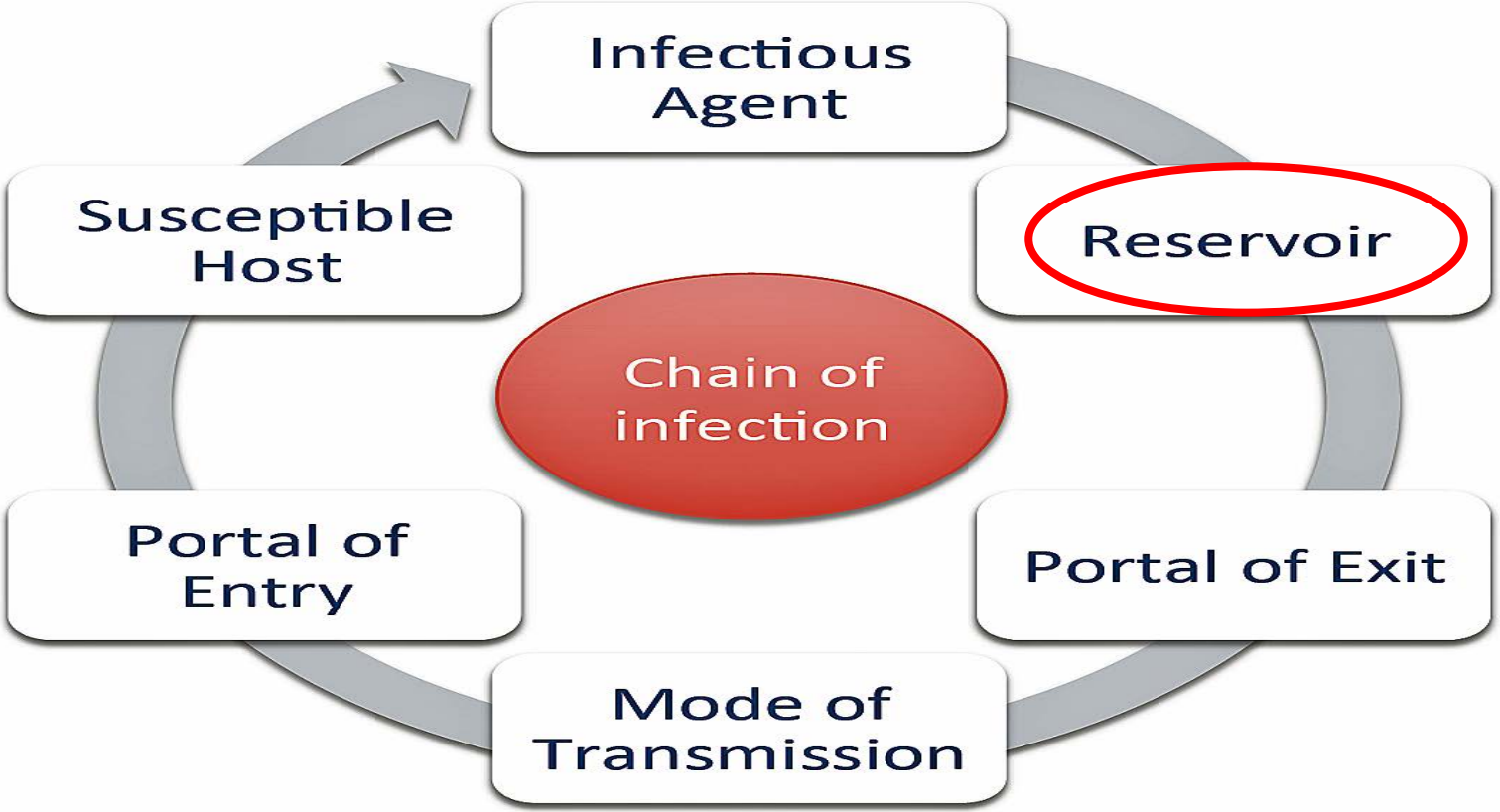
Ebola

- Yes, I know it is not an MDRO by definition

Norovirus

Rotavirus

Chain of Transmission



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Reservoir

Feces

fe·ces fi siz/ [**fee**-seez] –noun (used with a plural verb)

- 1. Waste matter discharged from the intestines through the anus; excrement.
- 2. Also, especially British, faeces.
  - Origin 1425-75; late middle English from Latin faecēs – grounds, dregs, sediment

*www.dictionary.com Dictionary.com unabridged V1.0.1

Reservoir

Urine

- Colonization common
- Especially elderly patients
- Catheterized patients

Reservoir

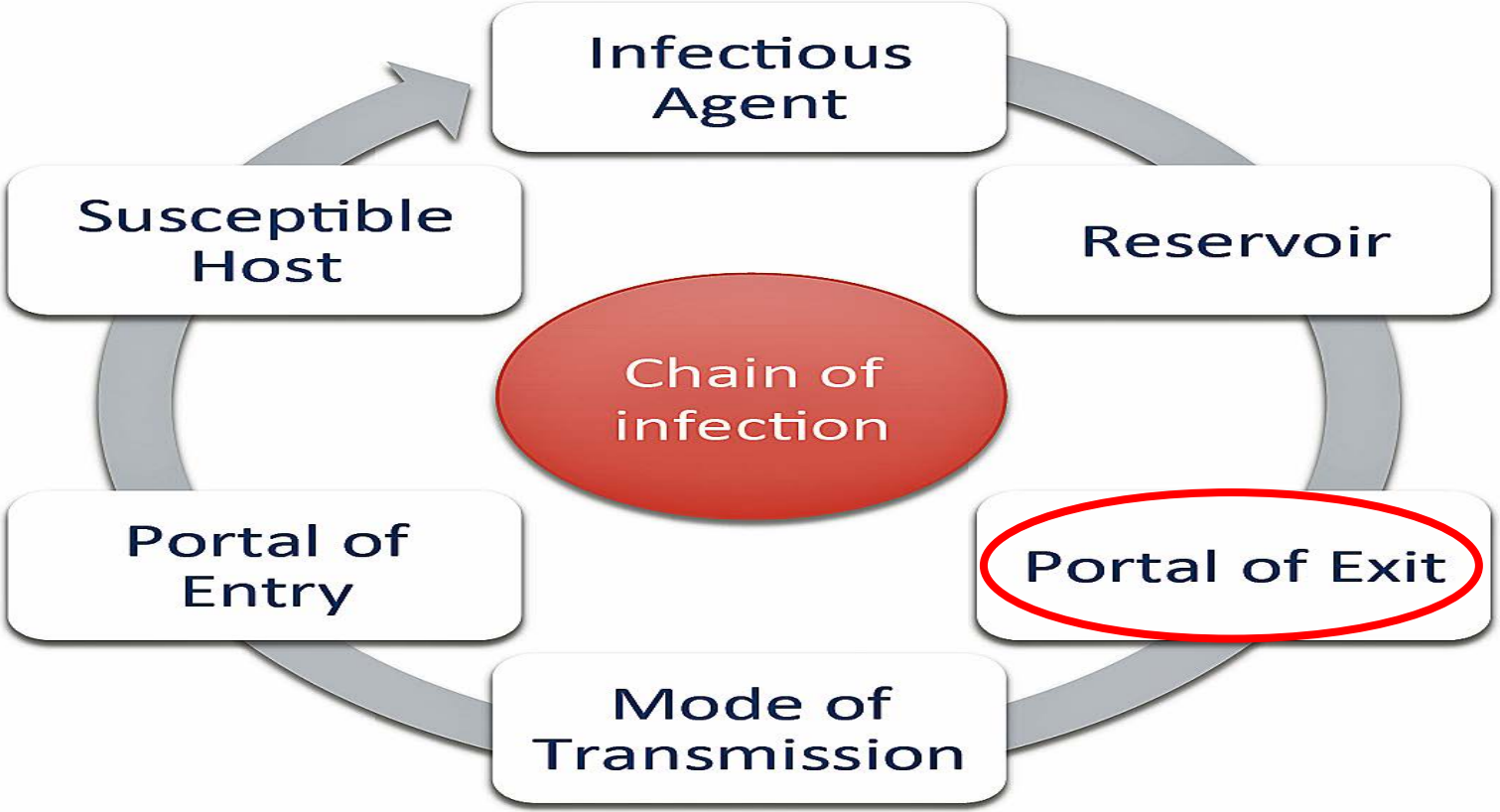
Sputum

- Common in elderly, intubated (Garcia 2005)
- Not applicable to this presentation

Sink Drains

- Beyond this presentation

Chain of Transmission



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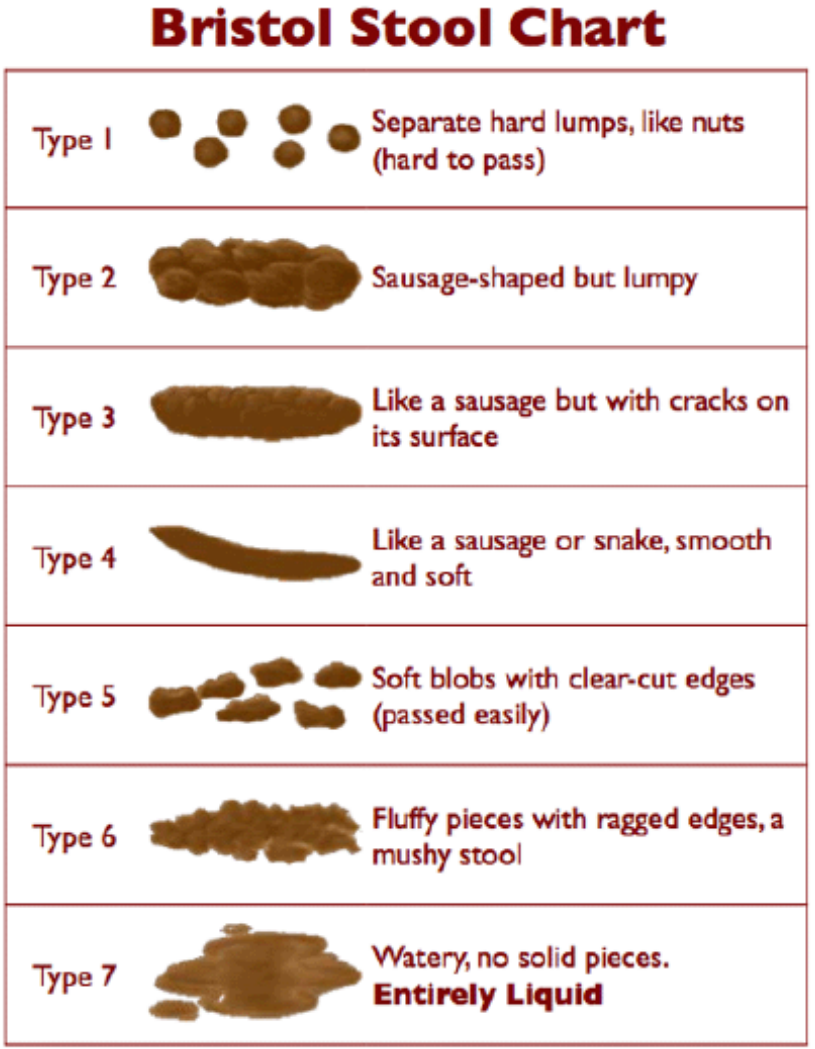
Portal of Exit

Defecation

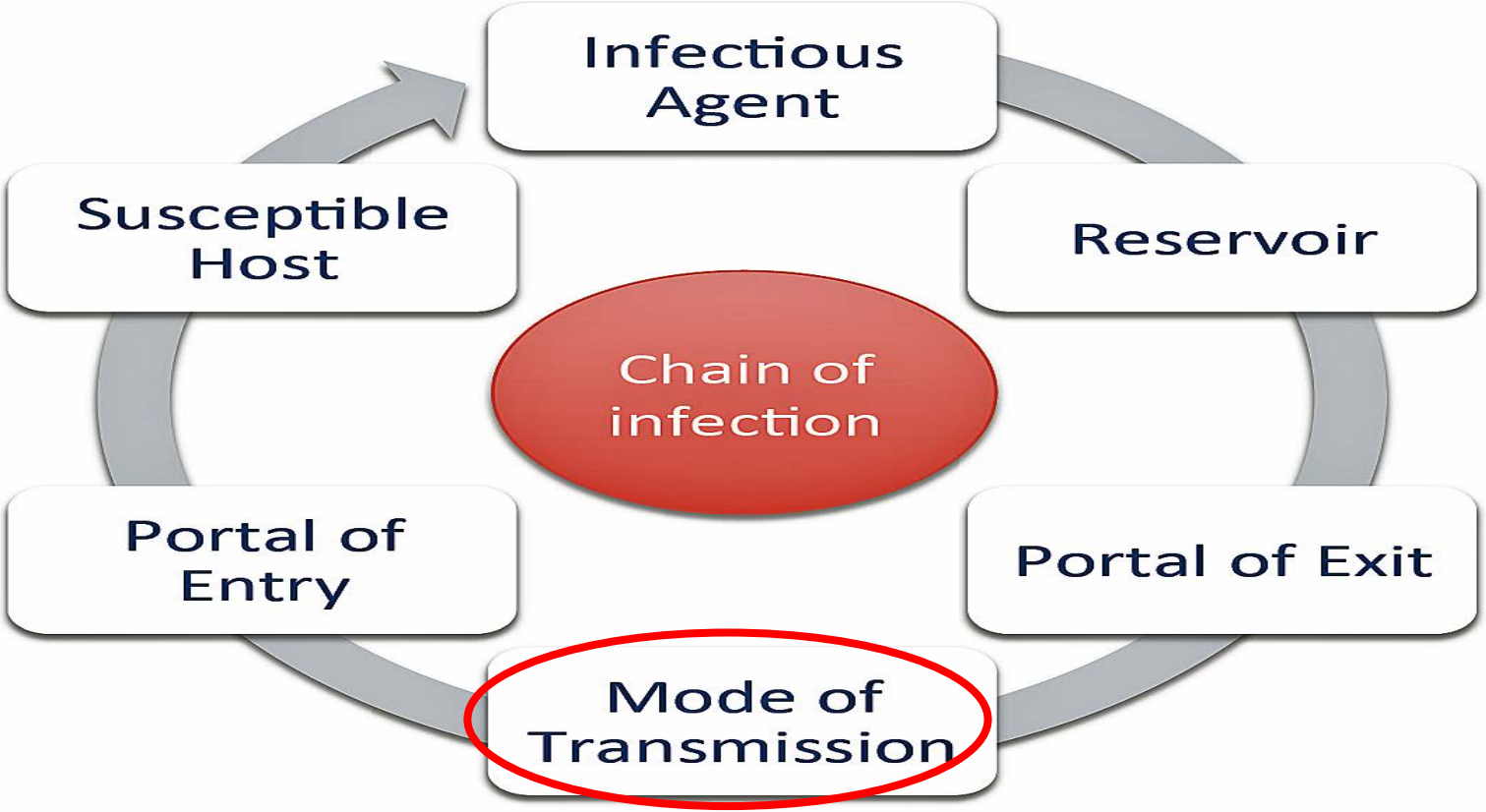
- Formed, soft, loose
- www.continence.org.au

(O'Donnell 1990)

Urination



Chain of Transmission



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Mode of Transmission

Equipment

- Bedpans, commode buckets, urinals, High Touch surfaces (Overbed tables, bed rails), toilet high touch surfaces

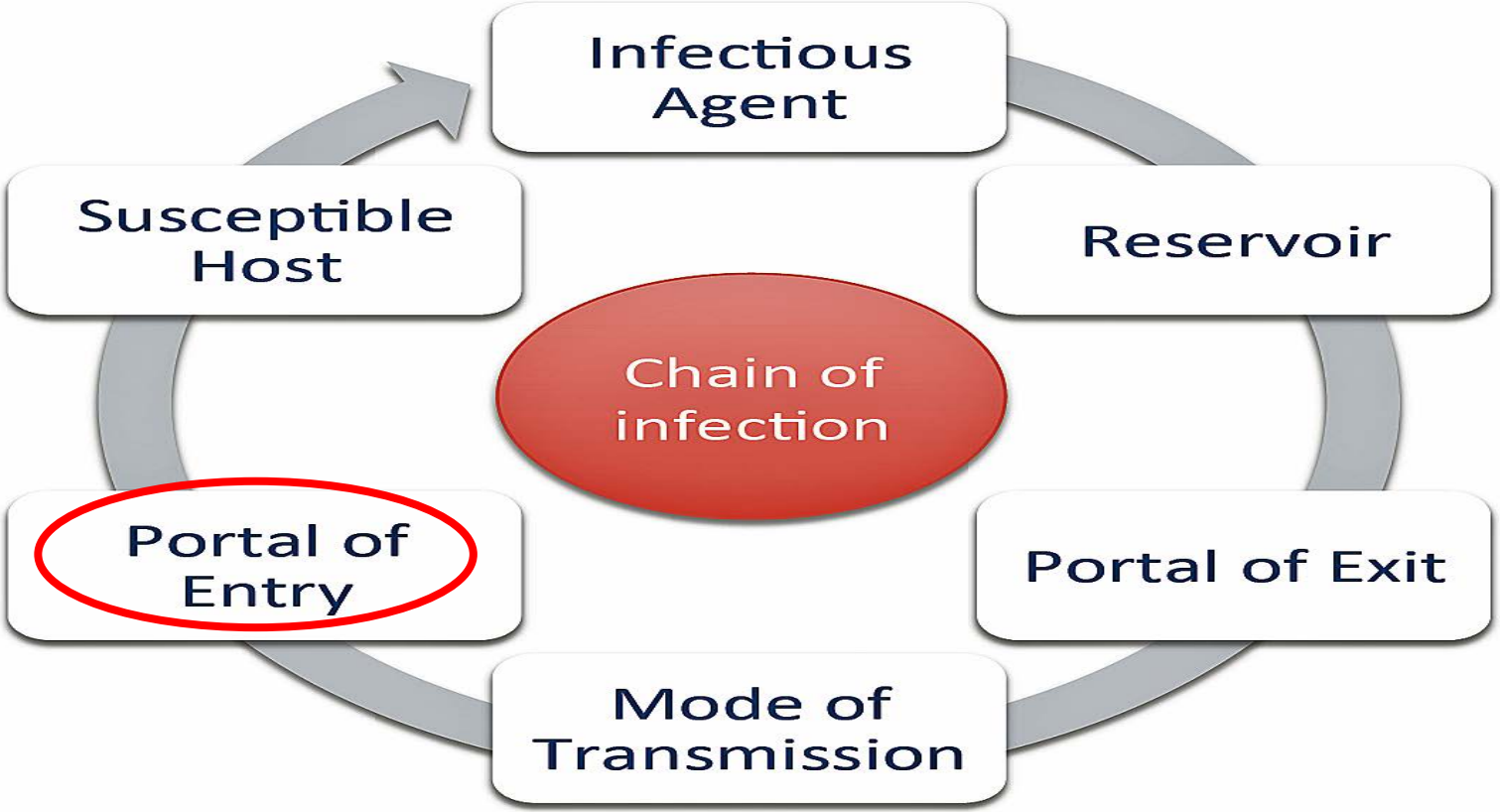
Hands

- Staff
- Patients

Sink Drains

Aerosols

Chain of Transmission



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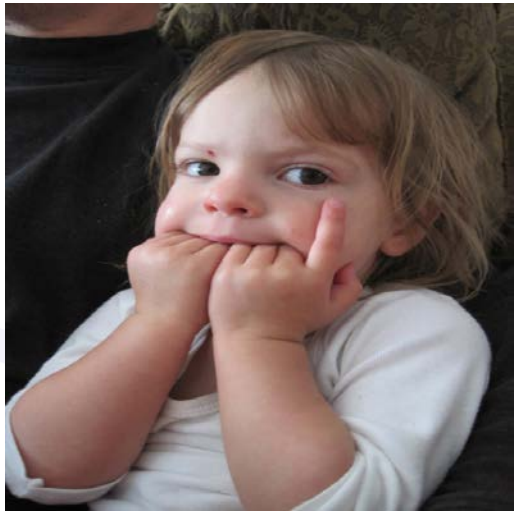
Portal of Entry



Rectum, mouth, non-intact skin

Fecal – oral

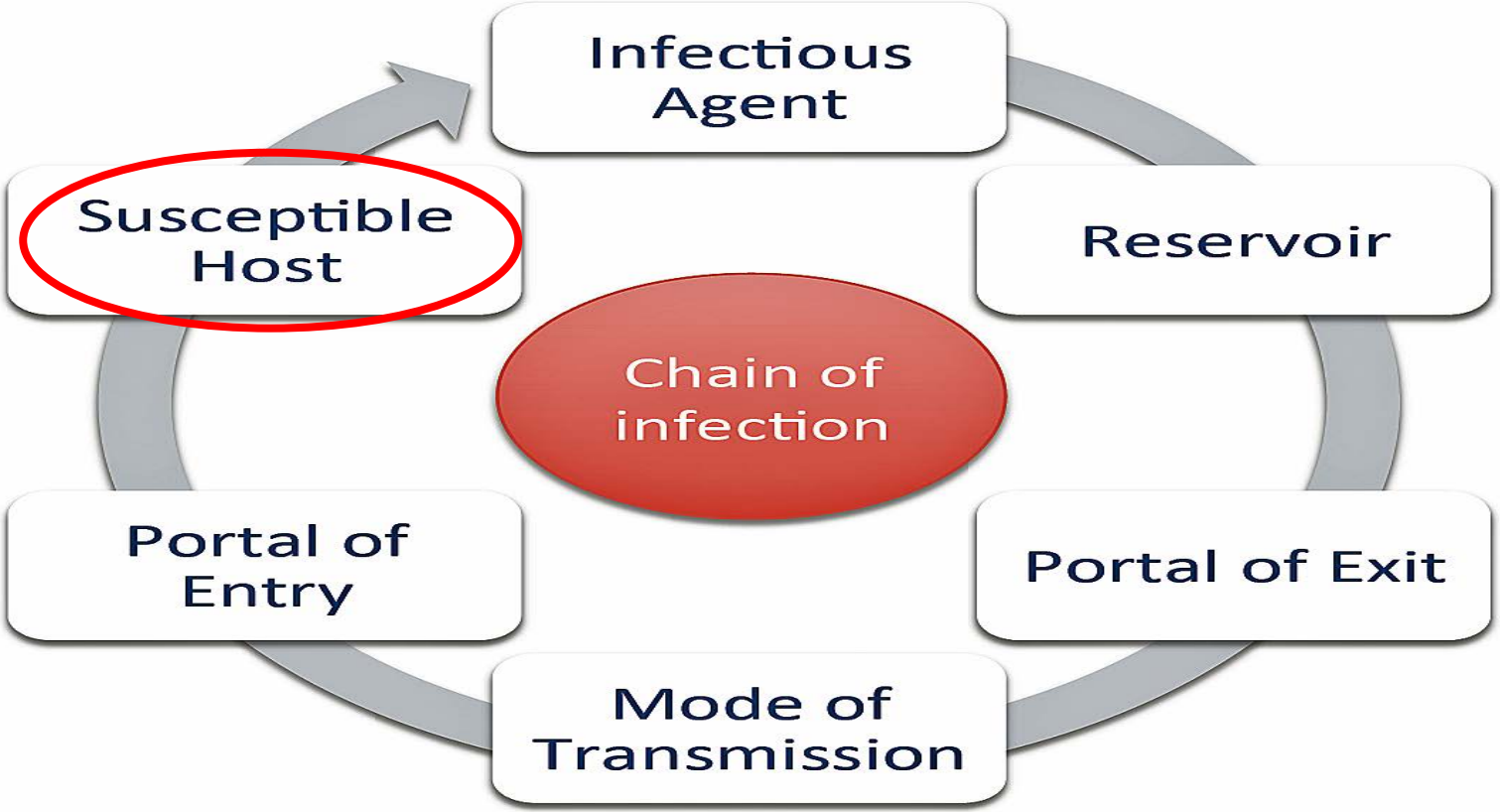
- Who puts feces into the patient’s mouth or rectum?
- Rectum – endoscopes, gloved hands
- Mouth – endoscopes, hands

Portal of Entry

“Hepatitis A is usually spread through having oral contact with items contaminated with hepatitis A, for example, through ingesting food or drinks contaminated by infected feces”

ProMed 20180112

Chain of Transmission



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Susceptible Host

Our patients

CDI

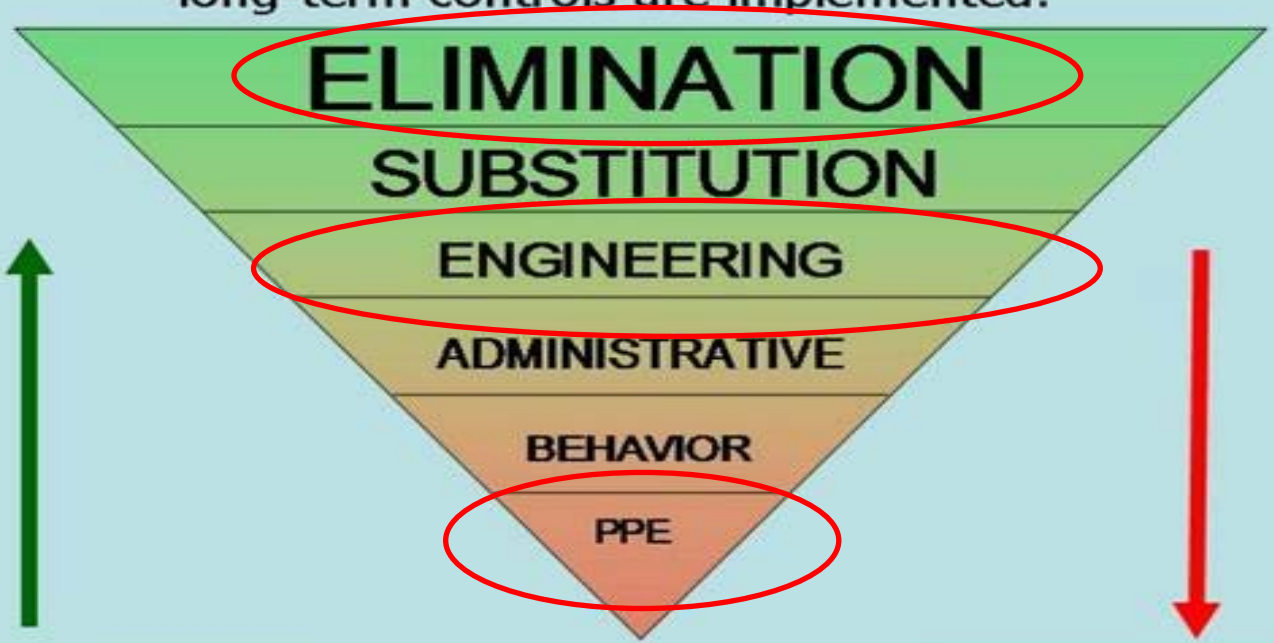
- Proton pump inhibitors, antibiotics, hemodialysis, HIV, numerous hospital admissions (Bengualid 2011)

CRE

- International travel (Tängdén 2010)
- Unrecognized colonized patient (Borgia 2012)

Hierarchy of Control

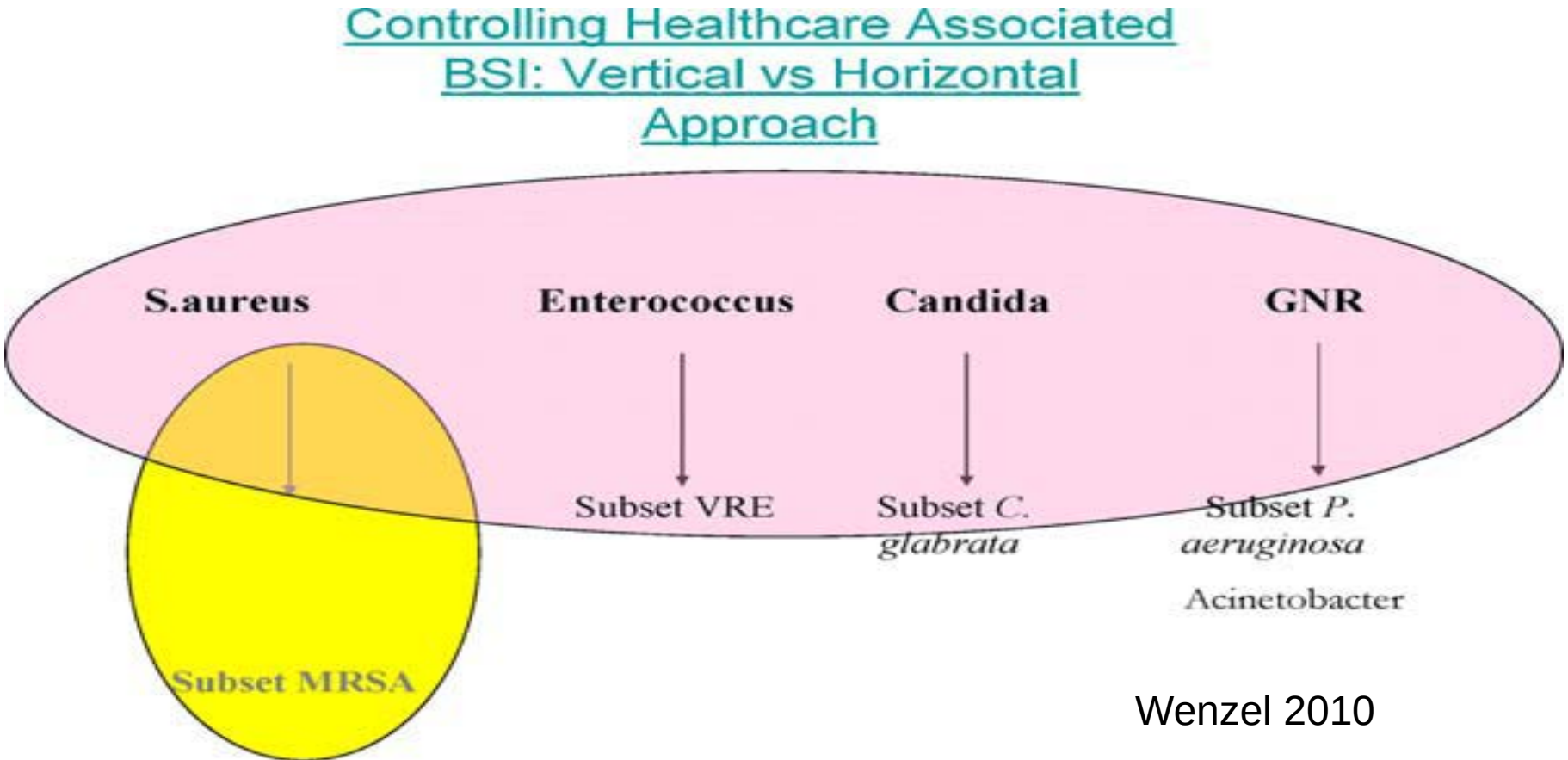
Apply the highest level of control commensurate with the risk level– lower value controls may be used in the interim until long-term controls are implemented.



Increasing effectiveness and sustainability

Increasing participation and supervision needed

Horizontal vs Vertical Infection Control



Wenzel 2010

Horizontal

Reduce rates of all infections for all pathogens

Hand hygiene program

Decolonization therapies (Chlorhexidine bathing)

Board to ward (Nat Audit Office 2009)

Antibiotic Stewardship Programs

Cleaning and disinfection

Vertical

Focus on a single pathogen or anatomic site

Pathogen specific

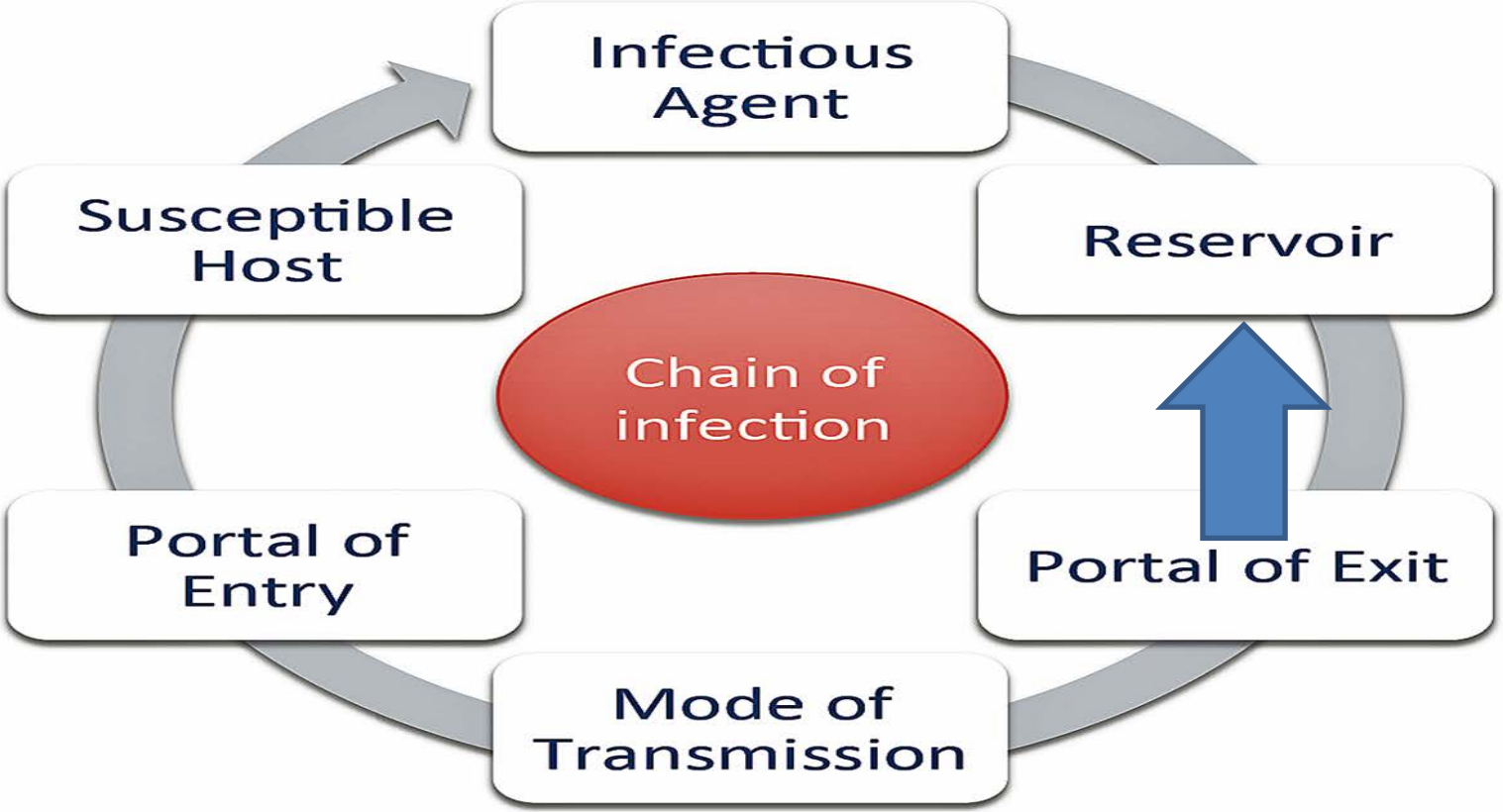
- MRSA
- VRE
- ESBL
- CRE
- *C. difficile*
- Acinetobacter
- *Candida auris*

Semmelweis

Death by Group A Streptococcal puerperal sepsis

- Screen for Group A only?
- Only use an agent effective against gram positive cocci?
- Only wash hands if in morgue?

Chain of Transmission



WARNING!!

This patient has:

Skin!

Feces!

Mucous Membranes!

PERFORM HAND HYGIENE AFTER CONTACT WITH THIS PATIENT OR THEIR ENVIRONMENT!

VRE in the Environment

Grabsch 2006

Colonized and past colonized VRE patients

Structured exam, hemodialysis sessions

Chairs positive in 36% outpatient, 58% hemodialysis

Couch positive 48% OP, 42% radiology,

VRE – How Much?

Ray (2002) - 12 of 13 had greater than 4log VRE per gram (mean 7.5 log)

Mayer (2003) - The mean density of these specimens was 7.5 log10 cfu/g of stool (range: 3.7-9.2 log) for the patients who were continent and 6.2 log10 cfu/g of stool (range: 3.4-8.9 log) for those who were incontinent

NDM-1 Environment

Walsh 2011- New Delhi

12 of 171 seepage samples grew

2 of 50 water samples grew

11 species in which NDM-1 not previously reported

Some resistance to meropenem seen in isolates

Survival - CRE

Havill 2014

Looked at *K. pneumoniae* and *C. freundii*

	Water	Trypticase Soy Broth
K. pneumoniae	19 days	40 days
C. freundii	12 days	40 days

- Can be shed into the environment and survive
- Because in GI tract, could be shed with high inoculum

C. difficile Colonization

Alasmari 2014 14% on admission

- Toxigenic, no relation to previous admission

Galdys 2014 Review article

- Strong evidence suggests that CD-colonized individuals are a reservoir for CD infection

Donskey 2015 Review article

- As above
- Sporicidal in all rooms has potential to reduce transmission

C. difficile Colonization

Longtin 2016 4.8% of admission were carriers. Isolation of carriers reduced overall HAI with CD

MRSA diarrhea

Stools for CD testing cultured for MRSA

- Case: Diarrhea and MRSA colonization of stool (pure to heavy growth)
- Control: MRSA + patients, negative stool colonization with MRSA

10 surfaces in patient’s room cultured

MRSA diarrhea

59% of case surfaces contaminated

23% of control surfaces contaminated

Most commonly bedside rails, blood pressure cuffs, television remote controls, and toilet seats

Specimens were found to contain approximately 10^7-10^9 colony-forming units (cfu) per gram of stool

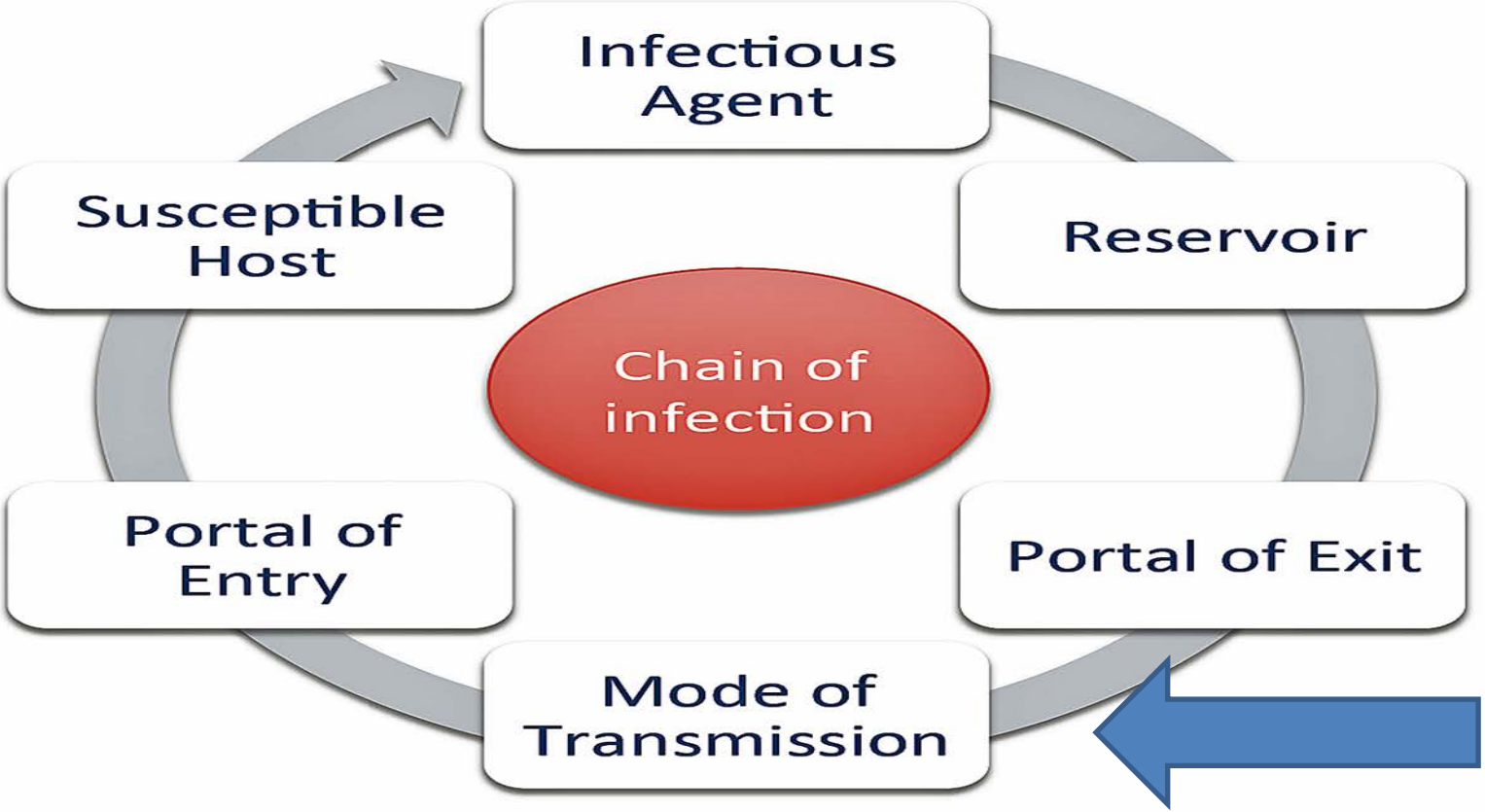
- Boyce 2007

Ebola

2-4 litres of liquid stool per day

- Lyon 2014

Chain of Transmission



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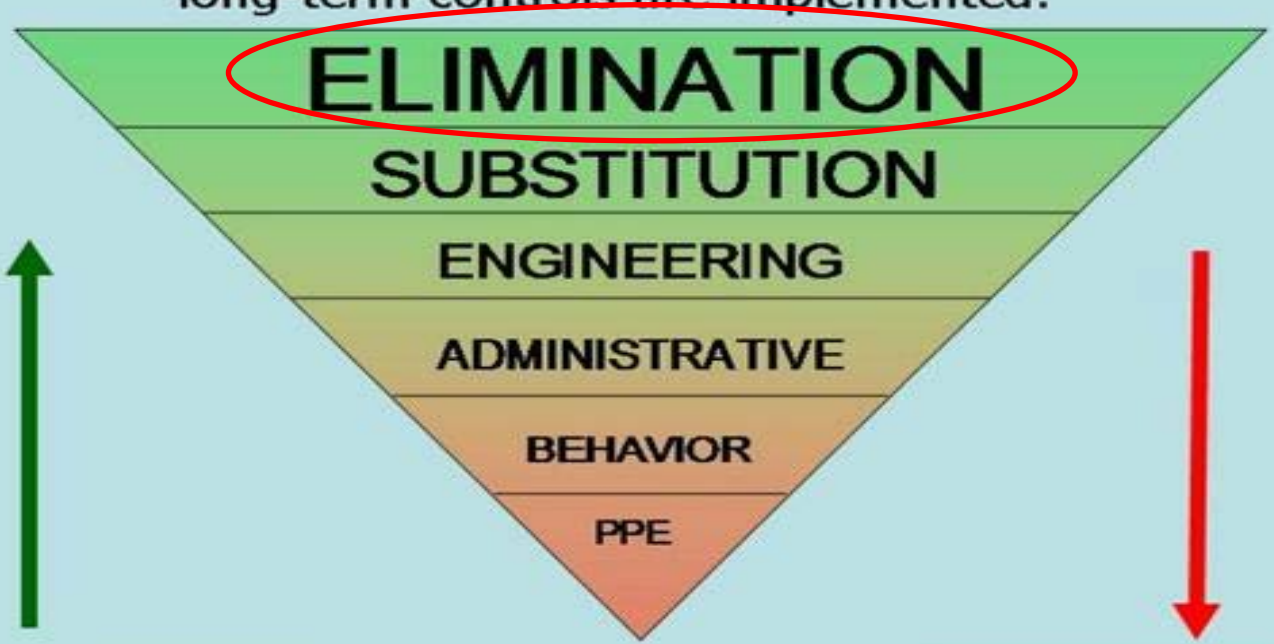

Suggestions – Clean!

Nseir 2011

- Acquisition if in bed from previous patient

Siani 2011

- Wipes moved spores around
- Issue with “sporicidal” claims

Sattar 2013

- Need better control of wipe use and testing

Loo 2015

- Clean environment and patient’s hands

Suggestions – Clean!

Zoutman 2013

- 40% of ICP's felt hospital was NOT clean enough
- Frequent consultation between IPAC and Environmental Services before cleaning changes – lower CDI rates

Suggestions – Clean!

Zoutman 2014

Less than 50% of EVS managers felt they had enough staff

Over 1/3 did no auditing

The Patient's Environment

EVS Cleans 1x per day…
What happens the other 23.5 hrs?

Patient Room Entries

Between 5 AM and 8 PM, (ICU and Med/Surg Unit)

- Number of room entries = 5.5/hour (28 max)
- Number of different staff entering room = 3.5/hour (18 max)
- Number of people in room during waking hours

= 15 hrs * 5.5 /hr = 82.5 people

Table 1. Entries into Patients' Rooms by Patient Population, Isolation Status, and Unit Type

	Patient Population		Isolation Status		Unit Type		Total
	Adults	Children	Any Isolation	No Isolation	Intensive Care	General Medical/Surgical	
Total patient hours observed	120.4	371.0	223.9	267.5	200.6	290.8	491.4
Total number of room entries per hour*	5.0 (0–26.4)	8.5 (1.0–28.0)	5.0 (0–28.0)	6.0 (0–26.4)	6.0 (0–28.0)	6.0 (0–20.6)	5.5 (0–28.0)
Number of different people entering room per hour*	3.0 (0–18.0)	3.5 (0.5–9.0)	3.0 (0–11.0)	4.0 (0–18.0)	3.5 (0–18.0)	3.5 (0–11.3)	3.5 (0–18.0)
Minutes spent in room by each individual*	3.0 (1.0–124.0)	3.0 (1.0–120.0)	3.0 (1–124.0)	3.0 (1–120.0)	3.0 (1–120.0)	3.0 (1–124.0)	3.0 (1–124.0)

* Data presented are median (range).

Cohen 2012

Surface Contact

Huslage and Rutala (2010) studied HTS in an ICU and a general med-surg unit.

In the ICU (contacts per interaction):

- Bedrails = 7.8
- Bed surface = 6
- Supply cart = 4

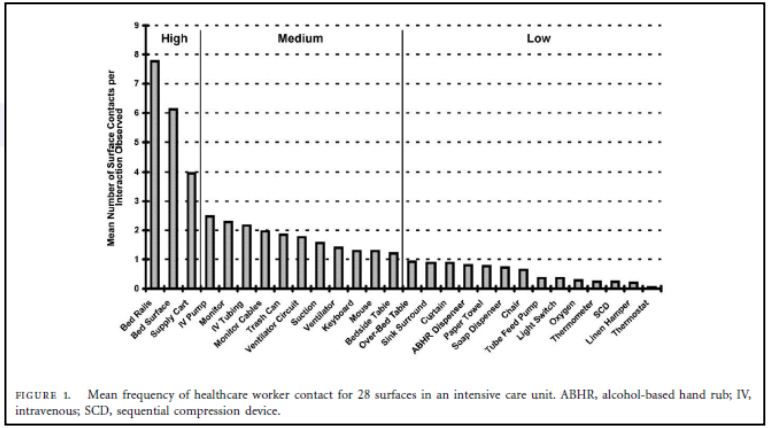

FIGURE 1. Mean frequency of healthcare worker contact for 28 surfaces in an intensive care unit. ABHR, alcohol-based hand rub; IV, intravenous; SCD, sequential compression device.

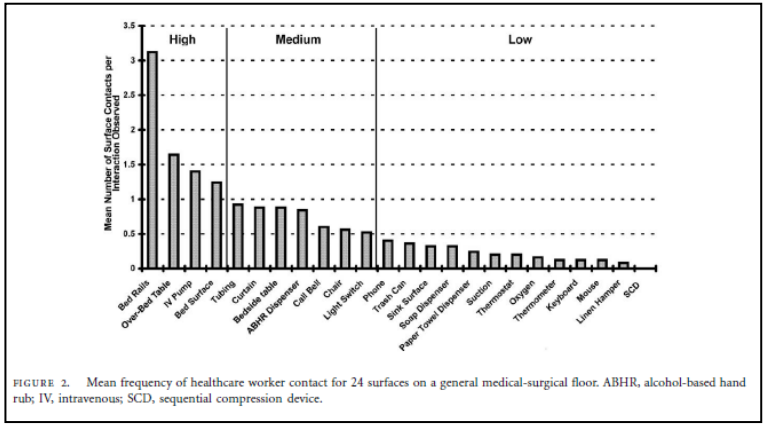

FIGURE 2. Mean frequency of healthcare worker contact for 24 surfaces on a general medical-surgical floor. ABHR, alcohol-based hand rub; IV, intravenous; SCD, sequential compression device.

Surface Contact

In the Med-Surg unit (contact per interaction)

- Bedrails = 3.1
- Over-bed table = 1.6
- IV pump = 1.4
- Bed surface = 1.3

Average surfaces per interaction:

- ICU = 44, Med-Surg = 15

More Math!

Room entries per hour = 5.5

Bedrail contacts per hour = 17.1 (5.5 x 3.1)

Bedrail contacts per 15 hour patient ‘awake’ day = 256

Number of times per day bedrail is disinfected by EVS = 1

- Probability of EVS disinfecting the bedrail = ~50%

?255?

ICT Feb 2018 – 24 Hour ICU

1. Patient (850)
2. WOW (634)
3. Bedrail (375)
4. IV pump (326)
5. Bed Surface (302)
6. Overbed Table (223)
7. Vitals Machines (213)
8. Wall Shelf (110)
9. Door (90)
10. In room Computer (78)

Jinadatha BMC Infect Dis 2017

Math!

Number of times per day bedrail is disinfected by the clinical staff = ? (probably zero)

- Probability of Clinical staff performing hand hygiene = 40%

6 Moments of Environmental Disinfection (6MED)

1. Before placing a food tray on an over-bed table
2. After any procedure involving feces or respiratory secretions within the patient bed space
3. Before/after any aseptic practice (wounds, lines, etc.)
4. After patient bathing (within bed space)
5. After assistance with productive cough or vomiting
6. Any time surfaces are visibly soiled

It is everyone’s job to disinfect, but it is *not* everyone’s job to disinfect everything

every time!

Why do We Need to do This?

Bed Rail as HTS

Bhalla (VRE), Boyce 1994 (VRE), Bonten (VRE), Ray (VRE), Duckro (VRE), Hayden (VRE), Mayer (VRE), Hota (VRE), Sehulster (HTS), Rock (KPC), Rosa (CR-Ab), Calfee (MRSA), Anderson (Bioburden), Sample (VRE), Hess (MDRO), Thom (MDR-Ab), Boyce 2007 (MRSA), Adams (Bio), Attaway (Bio), Choi (CR-Ab), Yui (CDI)

Why do We Need to do This?

Overbed table as HTS:

Bhalla (VRE, *St. aureus*, Gm neg bacilli, CD), Boyce 1994 (VRE), Boyce 2007 (MRSA), Hota (VRE) , Enfield (*A. baumannii*), Calfee (MRSA), Hess (MRSA, MDR-Ab), Dancer 2008 (bioburden) , Dancer 2009 (MSSA, MRSA), Adams (bioburden), Yui (CDI)

Why do We Need to do This?

Two body substances that are predominately organisms

- Feces – $1x10^{12}$ per gram dry weight (Kelly)
- Saliva – $1x10^{8}$ per mL (Lamont)

Moment 1 – Food Tray

Overbed table listed as HTS or contaminated (see previous slide!)

We all know what goes on an overbed table

None of us eat in our bathrooms!

Moment 2 – Feces/Suctioning

Mayer 2003 - VRE

Continent – average *3.2X10^{7}* colony-forming unit/g of stool (*5x10^{3}-1.6x10^{9})*

1,600,000,000!

Incontinent 1.6x10^{6} colony-forming unit/g of stool (range: *2.3x10^{3}-7.9x10^{8})*

790,000,000!

Moment 2 – Feces/Suctioning

Ray 2002 - VRE

- 13 patients (8 NH,5 Hosp) – 12 had >4log VRE per g stool
- Mean of 7.5 log or ~32,000,000 per g stool!

Boyce 2007 - MRSA

- If present in 4+ -> 10^7-10^9 Colony-Forming Units (cfu) per gram of stool

Moment 2 – Feces/Suctioning

Site	Known + CD Patient		No Known + CD Patient	
	After Routine	After Terminal	After Routine	After Terminal
Bedrails	50%	11.8%	7.4%	4.1%
Bedside Table	57.1%	22.2%	7.5%	5.9%
Bed Controls	42.9%	17.6%	3.7%	4.1%

Yui 2017

Moment 2 – Feces/Suctioning

Rock: CRE – spread linked to caring for a patient with trach or ET

Morgan (2010): MDR-Ab: “…care or use of endotracheal tube or tracheostomy site…”

Morgan (2012): “… the respiratory tract is often heavily colonized with MDR bacteria and contact with respiratory equipment may pose a particular risk…”

Moment 3 – Wounds

Rock – CRE: “…factors associated with HCW contamination … providing wound care (4 of 11 contacts resulted in contamination; *P* = .05)…”

Morgan- MDR-Ab: “ …wound dressing…”

Sergent – bioburden: “…contamination in the hospital environment is frequent during the dressing of colonized wounds with tissue loss…”

Moment 4 – Basin Bathing

Johnson – basin mean aerobic colony count of 91657, median 1150. Reference (Shannon – not available) that showed bath water had >10^5 cfu/mL

Rose - “Standard plate count bacteria ranged from 10^5 to 10^{10} (cfu) per 100 ml for shower and bath water, and an average of 10^4 to 10^6 cfu per 100 ml for total coliforms.”

Moment 5&6 - Visible

In actuality – Routine Practices!

Is This a New Idea?

Choi (2010) – *A. baumanii*

- "Similarly, other HCWs such as medical technologists, radiological technologists, or physical therapists who care for patients in both ICUs could have been a source of transmission."

Attaway (2012) – Bioburden

- "…to keep the bacterial population in check on the bed rails likely would require bihourly cleaning…"

Ali (2012) – Staph

- Regular wiping with antibacterial wipes could be a cost-effective means of maintaining low numbers of bacteria near to the patient

Suggestion

Family and Visitors

Feel free to use our disinfectant wipe on hard surfaces around the patient

(not a “baby wipe”)

Dispose in the regular garbage

Please do not flush!

Hierarchy of Control

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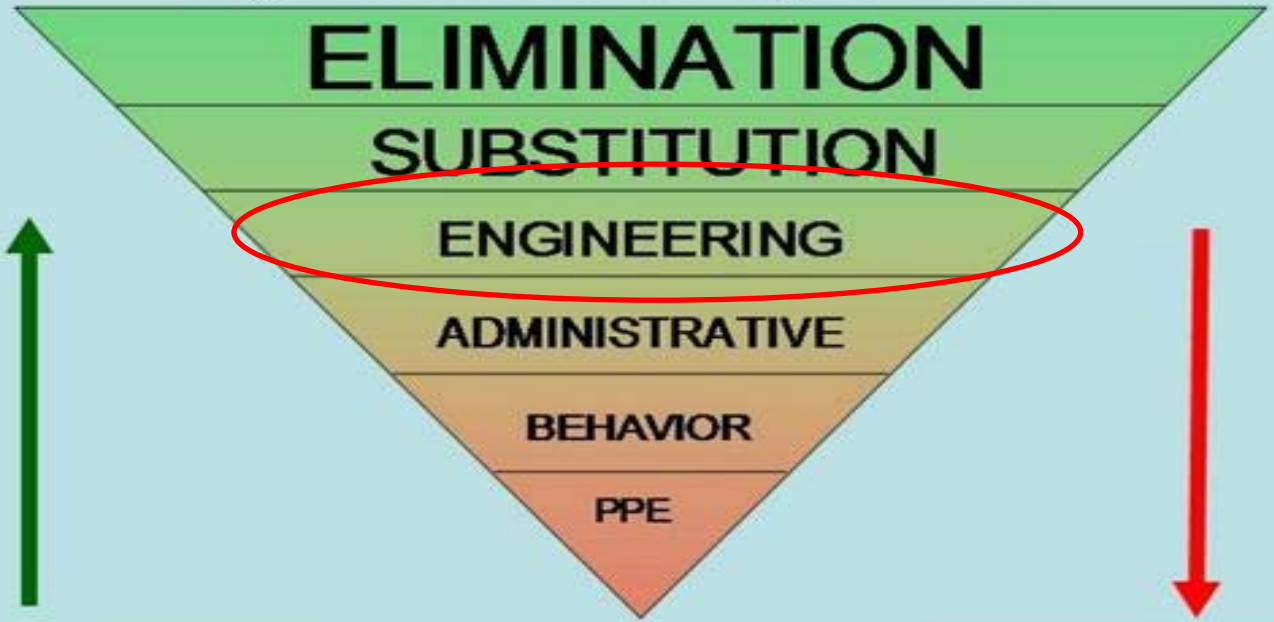

Increasing effectiveness and sustainability

Increasing participation and supervision needed

Feces Receptacles

No manual cleaning

No emptying within patient area

Use a machine to do the pan…

Liners

Patient Hand Hygiene

Savage 2011

36 hour observation session

Patients: 151 opportunities

- Zero used soap or ABHR

Visitors: 121 opportunities

- 4% soap or ABHR

Journal of Hospital Infection 75 (2010) 269–272

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Systematic patients' hand disinfection: impact on meticillin-resistant *Staphylococcus aureus* infection rates in a community hospital

D. Gagné, G. Bédard, P.J. Maziade*

Centre Hospitalier Pierre Legardeur, Terrebonne, Québec, Canada

Does it Work?

Could not get MRSA rates down

4 full time and 4 part time attendants hired

Met patients and visiting relatives at door

Verbal and pamphlet

Encourage to clean hands at least twice per day

Used 70% with 0.5% Chlorhexidine

Results Impressive

	2002-3	2003-4	Reduction
MRSA Infections per 1000 Admissions	10.6	5.2	51%
MRSA BSI	1.3	0.2	85%
MRSA Resp	4.9	1.5	69%
Ratio MRSA BSI / MSSA BSI	59% (13/22)	14% (2/14)	76%
MRSA Mortality	0.7	0.2	71%

Projected Savings

$688,843!

May have prevented 51 infections

- MRSA infection ~ $14,360
- MRSA BSI ~ $27,083
- Staffing was $170,000

MRSA Infections per 1000 Patient Admissions

04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13
2.3	1.0	0.6	0.6	0.7	0.5	0.3	0.2	0

Personal Communication 2013

Patient Hand Hygiene

Assessment on admission for capability of performing hand hygiene

- Do you know what this is?
- Show me how to use it
- Signage if not able to do own HH

Help Wanted

With Hand Hygiene!

Hand Sanitizer Bottle Label

FOR PATIENT USE

Keep on overbed table

If necessary, please ask for assistance to use this product

Patient Moments

Landers 2012 (review)

1. After using the toilet, bedpan, or commode

3. Before eating, drinking, taking medicine, or putting anything in your mouth

Patient Moments

4. When visibly dirty

5. Before touching any breaks in the skin (wounds, dressing, tubes) or any care procedure (dialysis, IV drug administration, injections)

7. After coughing, sneezing, or touching nose or mouth

Jim’s Additional Moments

1. Leaving a wheelchair
   - New pamphlet for patients
2. After pet therapy (Lefebvre 2006)

Hierarchy of Control

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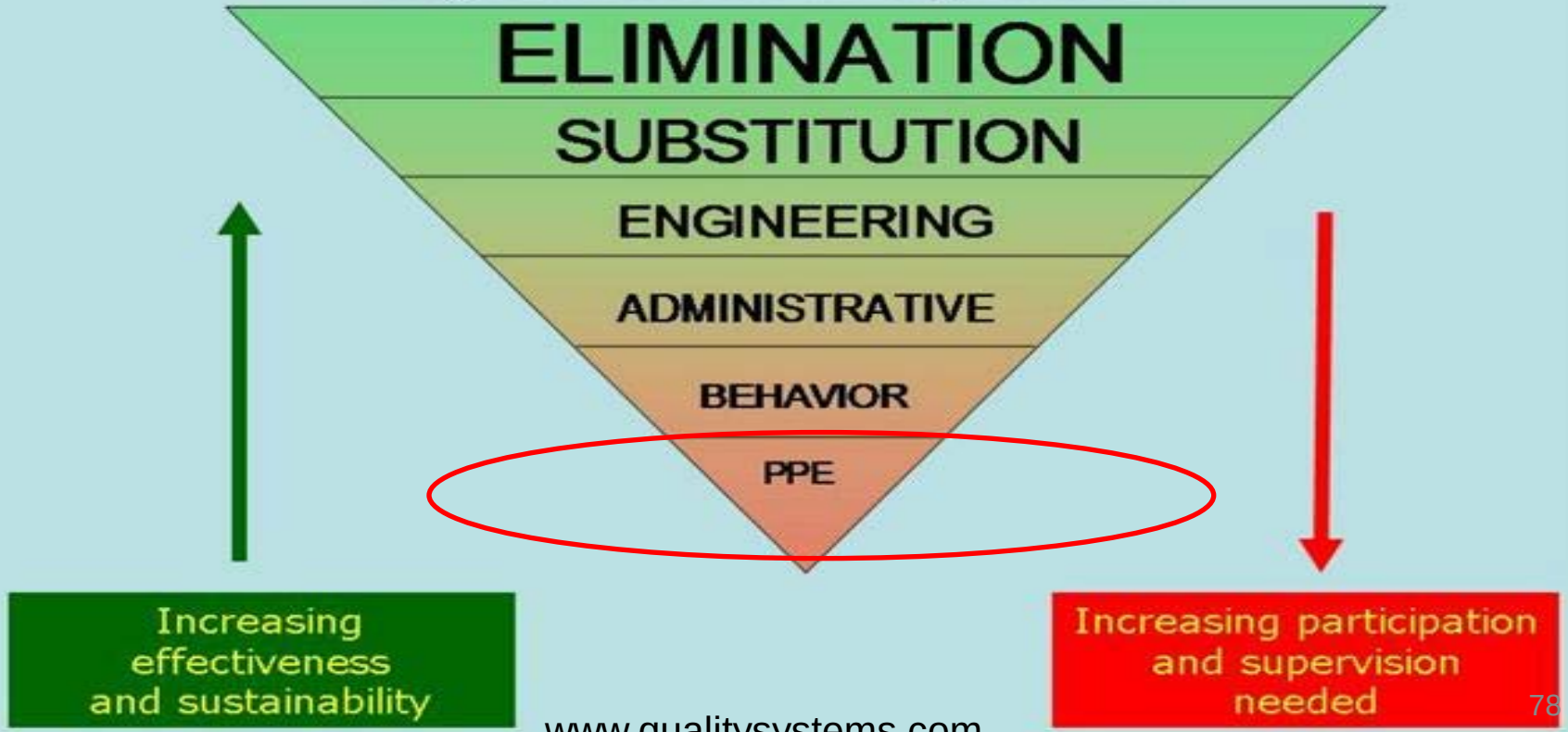


Preventative Measures

Palmore 2013 - CRE

Patients use gloves and gowns

Double clean

Hand hygiene (staff)

Chlorhexidine baths (ICU)

Adherence monitoring

Guidelines

ECDC TECHNICAL REPORT

Risk assessment on the spread of carbapenemase-producing Enterobacteriaceae (CPE)

through patient transfer between healthcare facilities, with special emphasis on cross-border transfer

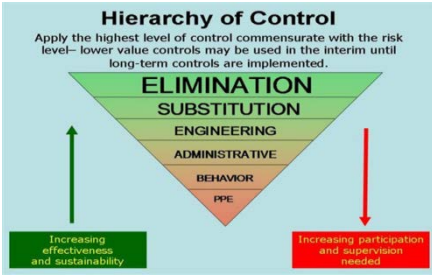
ECDC 2011

ECDC – Low Grade Evidence

…consistently supports the effectiveness of early, active surveillance for CPE carriage by rectal screening

Additional precautions for the care of CPE-positive patients,

- wearing disposable gloves and gown
- cohort nursing by a separate, dedicated team



ECDC – Other Measures

Long Term Healthcare Facilities

- Israel uses contact precautions if:
  - Patient incontinent
  - On antimicrobials

Public Health England

Acute trust toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae

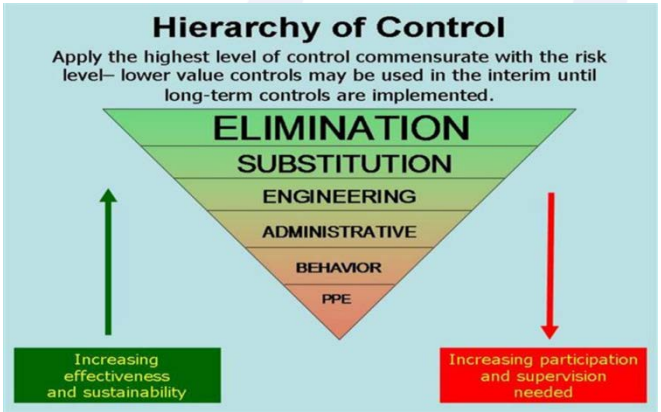
2013

PHE

Early Screening

Early Isolation

Reinforce Strict Standard Precautions



PHE

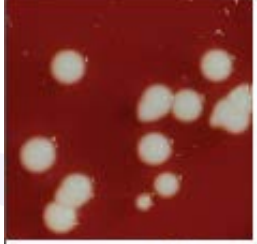
No words such as

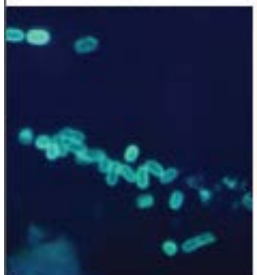
- Bedpan

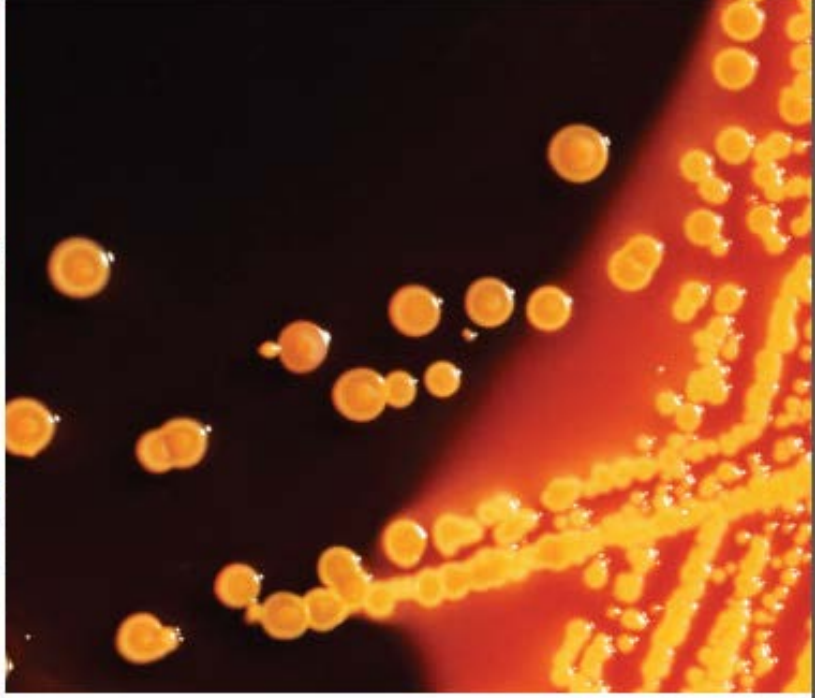
Does have language for

- Diarrhoea (around hand hygiene)
- Toilet (that patient will have a private en suite)
- Environment (cleaning)
- Commode (if no toilet)
- Disinfection (high touch, mattresses, endoscope, etc.)

Diversey™







Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

2012 CRE Toolkit

CDC

Hand Hygiene

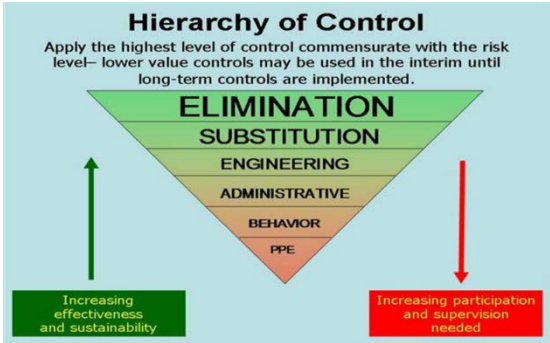
Contact Precautions (colonized or infected)

Patient and staff cohorting

Minimize use of invasive devices

Antimicrobial Stewardship

Screening



CDC

LTC settings high risk residents

- totally dependent upon healthcare personnel for activities of daily living
- ventilator-dependent
- incontinent of stool
- wounds whose drainage is difficult to control
- high-risk settings (e.g., ventilator unit)

CRE Guidelines

Curran 2014

Confusion on terms like Standard Precautions

Ensure guidelines writers understand the front line

Curran 2014

5 Fronts:

- SP for all and additional transmission based precautions for CRE
- Hand washing basins free of CRE
- Safe injection and endoscopy practices
- Prepare for outbreaks
- Antimicrobial stewardship

Ebola

Feces and vomit have virus

- (Shieffelin 2014, Chertow 2014)
- Dallas family
  - No illness
- Dallas hospital
  - 2 infected

Wet Phase

2-4 litres of liquid stool per day

So, What do I Suggest?

Monitor, or know, how many patients are incontinent

- Or using briefs, diapers, assistive devices

Cochard 2014 – ESBL carriage nursing homes

Significantly associated with

- Malignancy
- Urinary AND fecal incontinence

Suggestions

When we publish, list how feces and urine is managed and by what percentage

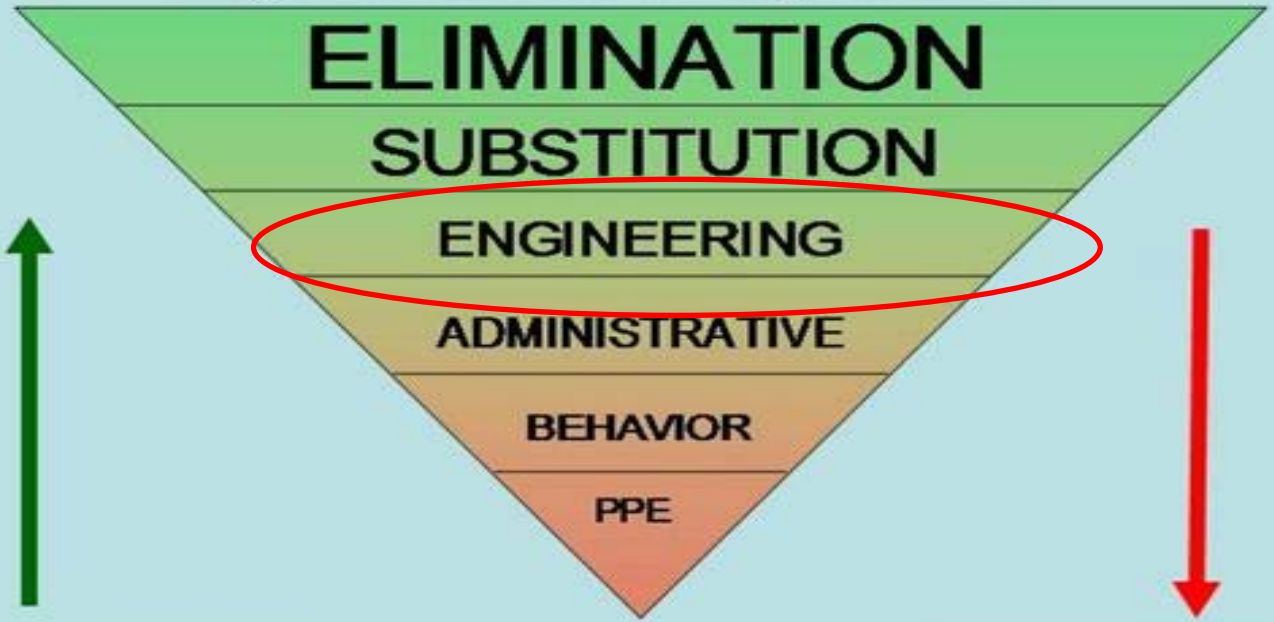
- Brief/Incontinent product
- Toilet
- Commode

AND

- Thermal disinfection
- Macerator
- Liner

Hierarchy of Control

Apply the highest level of control commensurate with the risk level– lower value controls may be used in the interim until long-term controls are implemented.



Increasing effectiveness and sustainability

Increasing participation and supervision needed

Suggestions

Manage feces and urine better than our great grandfathers

Mandate NO manual cleaning

- Thermal disinfection
- Macerators
- Liners
- Disposable

Suggestions

Mandatory gown use for any contact or potential contact with feces

- All the time
- Horizontal program

- Sporicidal agent for all terminal cleans of washrooms (Bengualid 2011, Galdys 2014)
- Use of UV for terminal clean of contact precaution room (Rutala, AHE conference 2016)

Suggestions

Isolate patients with diarrhea

- Benjamin 2014

Any soiling of the environment with feces is an issue!

- Spill clean up should include sporicide!?!

Suggestions

Lids on toilets/hoppers

- Aerosols around toilets from flushing has been studied (Gerba 1975, Barker 2005, Johnson 2013)
- *C. difficile* was in droplets around toilets with no lids (Best 2012, Roberts 2008)
- *C. difficile* detected on 31.6% of air vents (Wei 2017)
- Viral spread (Verani 2014)

Summary

It’s all about the poop…

Let’s talk about this!!

Comments? Questions?

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