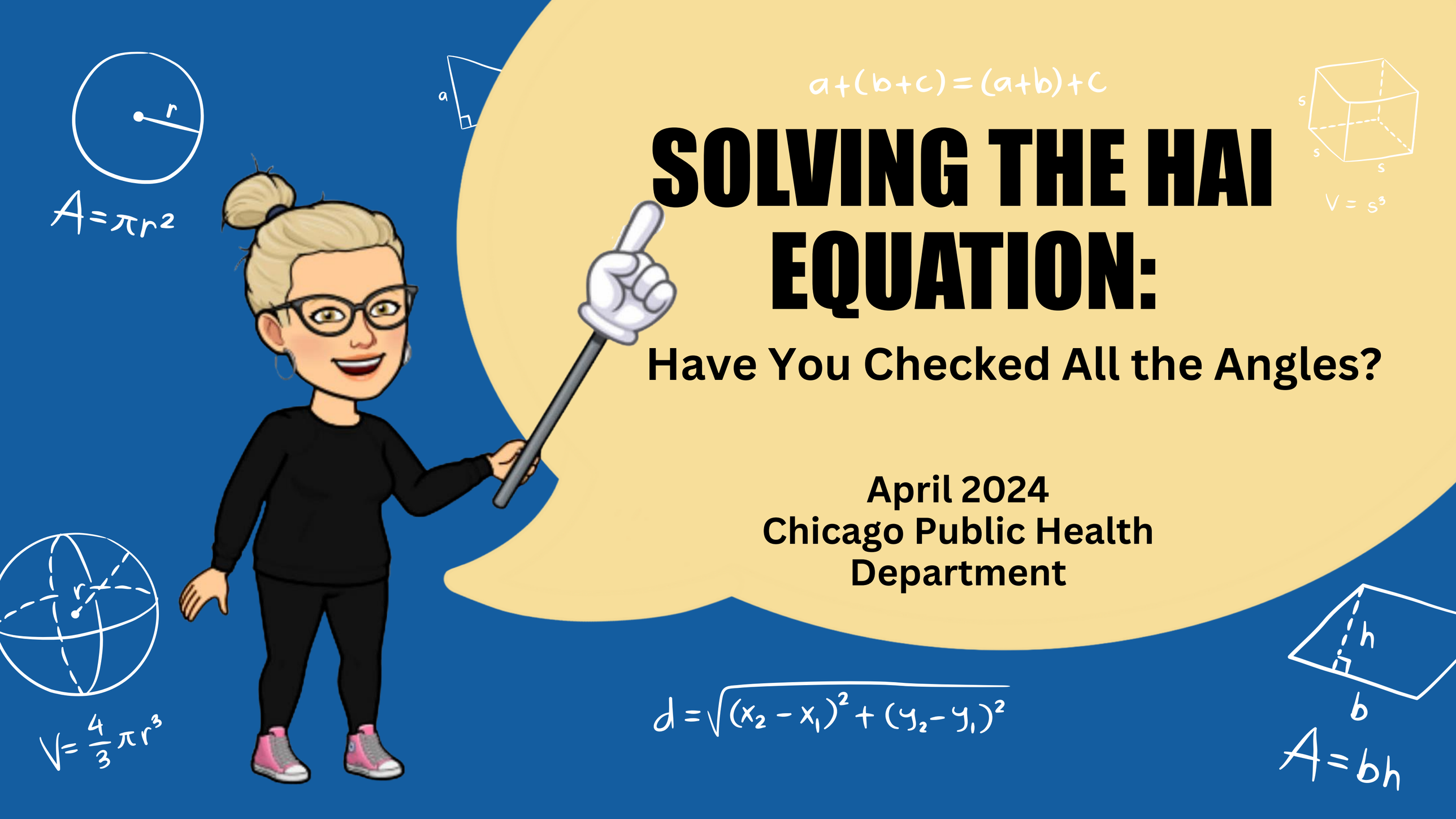


SOLVING THE HAI EQUATION:

Have You Checked All the Angles?

April 2024
Chicago Public Health Department

Rebecca Battjes, MPH, CIC, FAPIC

DISCLOSURE

Rebecca is employed by Diversey—A Solenis Company. The company pays her expenses to attend this meeting & create educational content (salary). Diversey has had no input into this presentation from a commercial interest.

OBJECTIVES

1. Understand the multiple factors that can impact healthcare-associated infection (HAI) risk.

2. Evaluate if current practices are robust enough to address the risk of HAI transmission.

3. Understand basic and multi-modal practices to address the risk in the healthcare environment.

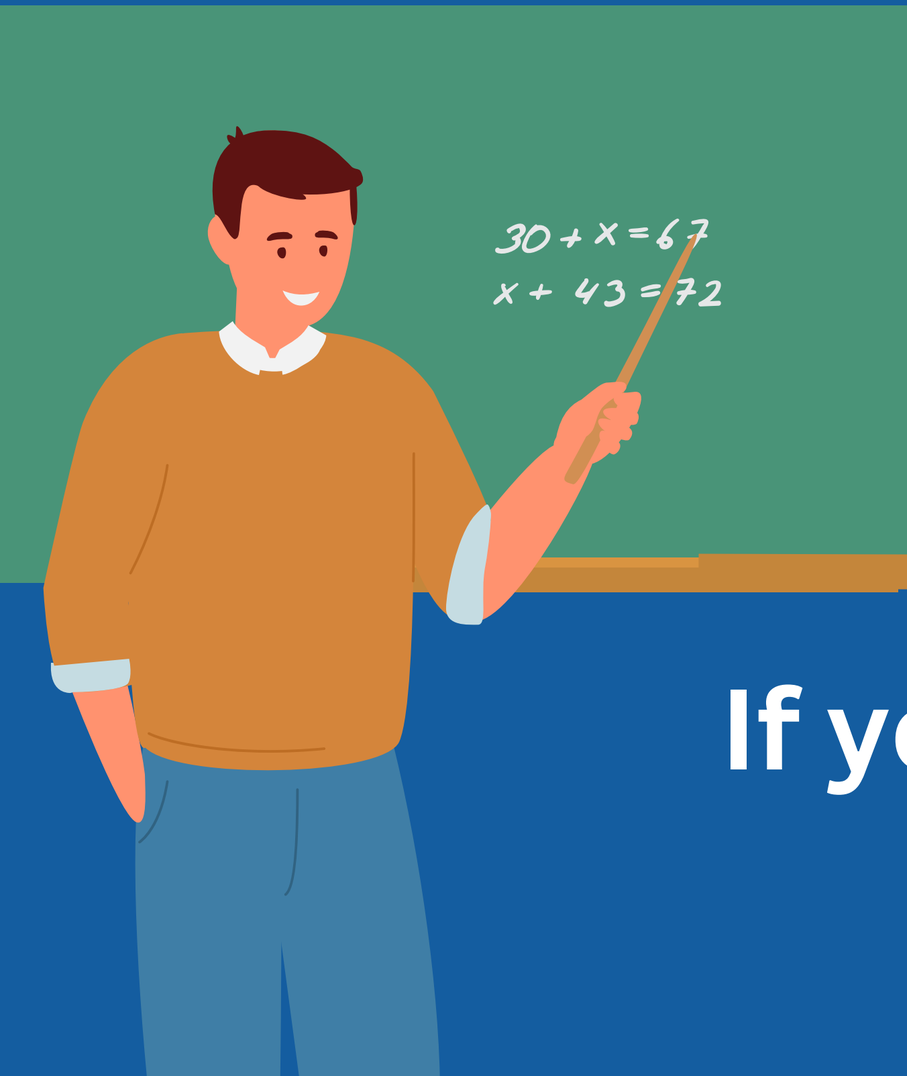
4. Create solutions to improve compliance and reduce risk.

HAI CONSTANTS*

*Constant = a fixed value; a situation or state of affairs that does not change

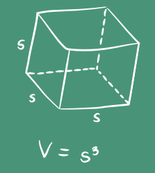
- Multifactorial problem!
  - Be wary of anyone trying to sell you a magic bullet solution!
- Hand hygiene reduces infections. (WHO 2009, Table 1.22.1)
- The environment plays a role in transmission. (Otter 2011, 2013; Wu 2019)

REMEMBER ALGEBRA?



$$x = f(1) + f(2) + f(3) + \ldots + f(n)$$

Where x is the problem AND f are the components making up the problem.



If you can't solve for a variable, you must control for it!

HEALTHCARE-ASSOCIATED INFECTIONS

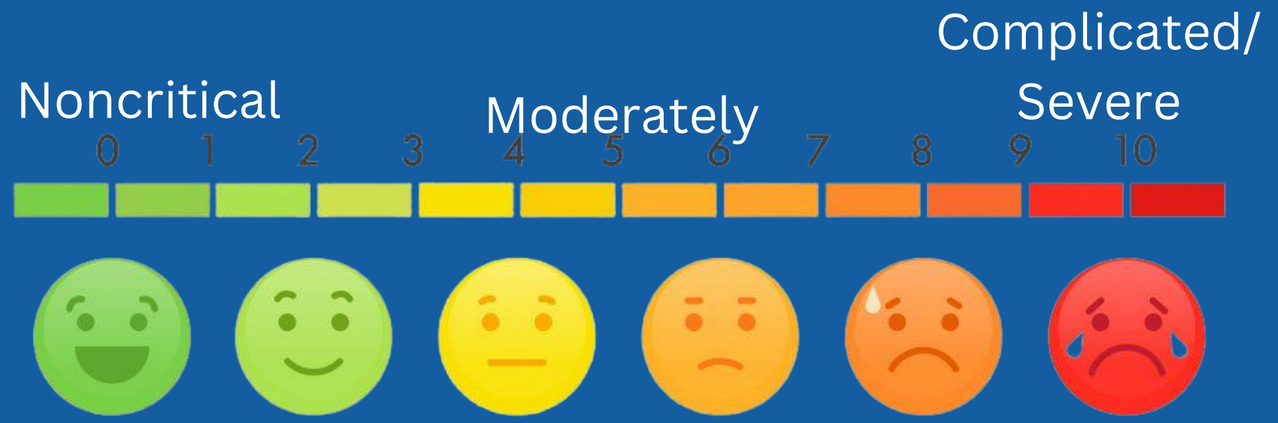
$$HAI(p) = PA + HH + ASP + CP + FWM + ED$$

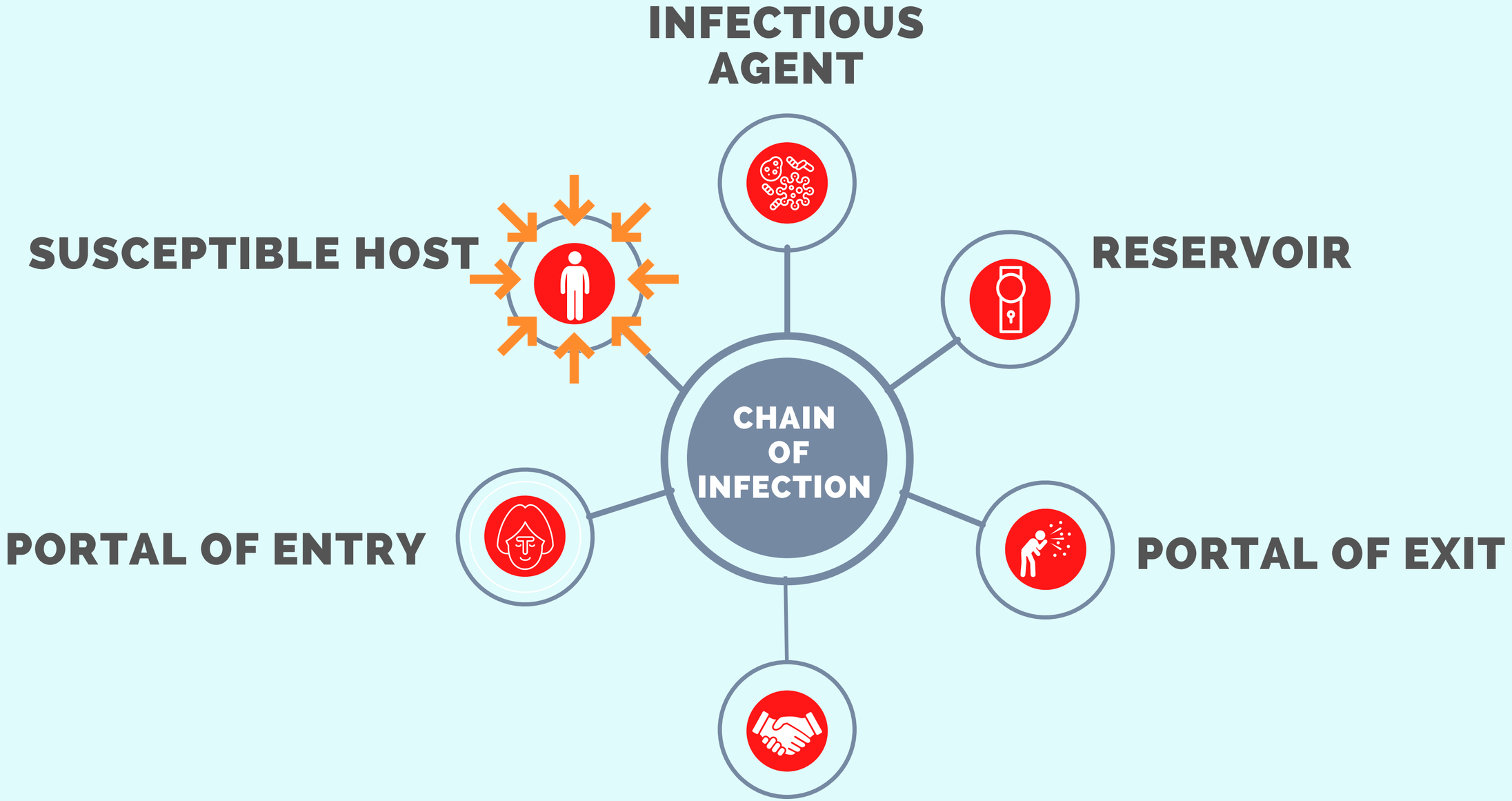
Where:

- PA = Patient Acuity
- HH = Hand Hygiene
- ASP = Antimicrobial Stewardship Program
- CP = Clinical Practices
- FWM = Fecal Waste Management
- ED = Environmental Disinfection

PATIENT ACUITY (PA)

- The sicker a patient is, the more prone a patient will be to acquiring an HAI
- Each added co-morbidity makes the patient more of a susceptible host




INFECTIOUS AGENT
SUSCEPTIBLE HOST
RESERVOIR
CHAIN OF INFECTION
PORTAL OF ENTRY
PORTAL OF EXIT
MODE OF TRANSMISSION

PATIENT ACUITY

VENTILATION

Increased risk of pneumonia (Papazian 2020)

PORTALS OF ENTRY

Vascular catheters, urinary catheters, surgical incisions, any open skin areas

AGE

Elderly: Immune senescence, thinning skin, GI, resp & GU changes, malnutrition, meds

Neonates: Birthweight, gestational age, immature immune systems (Milstone 2020)

ANTIBIOTICS

Alter microbiome

C. diff precipitation

Fungal overgrowth

CO-MORBIDITIES

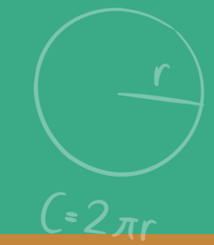
Additional pressure on all defense systems (CHF, diabetes, obesity, immunocomp'd) (Eleazu 2019, Sidorenkov 2011, Linden 2009)

PATIENT ACUITY: THE VARIABLES

- On a vent → (vent)
- Portal of entry → (poe)
- Elderly/neonate → (age)
- Antibiotics → (abtic)
- Co-morbidities → (co-m)

HEALTHCARE-ASSOCIATED INFECTIONS

$$HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co\text{-}m)$$



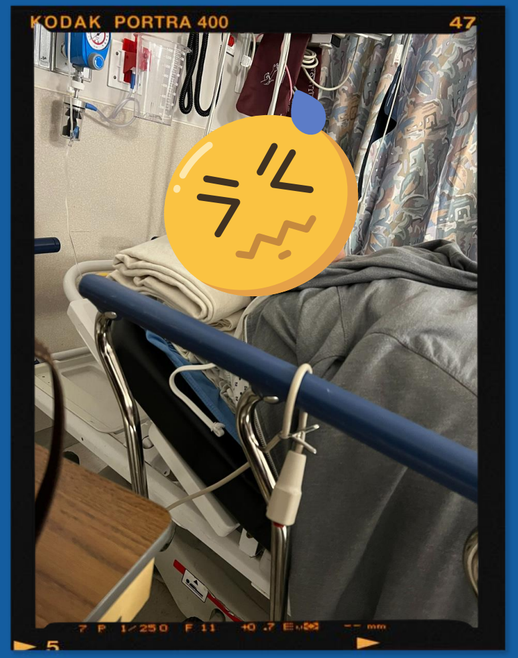
HAND HYGIENE

- Get compliance with the 5 moments (still TBD for "ideal")
  - Leapfrog set **# of observations** required w/o strong evidence to support (updated in 2022 d/t APIC/IP rebuttals). (TLG 2022)
- Auditing
  - Observation, "secret shoppers," electronic via sensors, ultrasound (Fisher 2013), etc.
  - Thermal imaging? (Boyce 2022)

Fig 2. Thermal images of a volunteer's hand before, immediately after hand hygiene, and 1 and 2 minutes later.

HAND HYGIENE PROGRAM COMPONENTS: TRADITIONAL

- Need to have product (ABHR, soap & water) at **point-of-care (POC)**
  - POC: The place where three elements come together: the patient, the HCW, and care or treatment involving contact with the patient or his/her surroundings (within the patient zone) (Sax 2007)
- Product that staff will use
  - Trials, skin care programs with lotions
  - Otherwise, they'll bring in their own lotion.
  - Don’t do trials in winter!



My father, in a 20+ bed ER bay with on two ABHR dispensers and blocked sink access

HAND HYGIENE PROGRAM COMPONENTS: TRADITIONAL

- Education to staff on your facility's **moments for use**
  - Need the "whys" to go with the moments
  - Incorporate moments into any presentation
- Educate on **contact time** & **quantity** for ABHR
  - Hand size can affect efficacy (Wilkinson 2017)
- Unit/Site Champions and Support of C-Suite
  - Frontline ownership (Gardam 2017)

HAND HYGIENE COMPONENTS: 2.0/NEXT LEVEL?

Patient Hand Hygiene!

- Often missed in traditional compliance measures
- Not (yet) required by regulatory agencies
- Does the patient know that the product is there and what it is and when to use it?

- **Can the patient perform their own hand hygiene?**
  - Assessment on admission
  - Identification/recognition of patients who require assistance

HAND HYGIENE COMPONENTS: 2.0/NEXT LEVEL?

Family & Visitors

- Is compliance captured in your observations?
- Does the family/visitor know that the product is there & when to use it?
  - Lee et al (2021): patient, family & visitor HH compliance = 10.3%!
  - Survey found that visitors preferred soap & water over ABHR (contributed to poor rates?)
- Can the family/visitor assist the patient with hand hygiene?
- Partner with **Patient & Family Engagement Committees**!

HOT OF THE PRESS: PATIENT HAND HYGIENE RESOURCE!

This toolkit was researched and written by members of the APIC Practice Guidance Committee

https://apic.org/patient-hand-hygiene-toolkit/

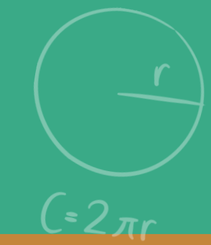
HAND HYGIENE: THE VARIABLES

- Product that staff will use → (prod)
- POC placement → (place)
- Feedback/auditing of use → (audit)
- Staff education on moments → (mom)
- Champions/C-Suite support → (champ)
- Patient HH → (pat)
- Family & visitor HH, involvement → (fam/vis)

HEALTHCARE-ASSOCIATED INFECTIONS

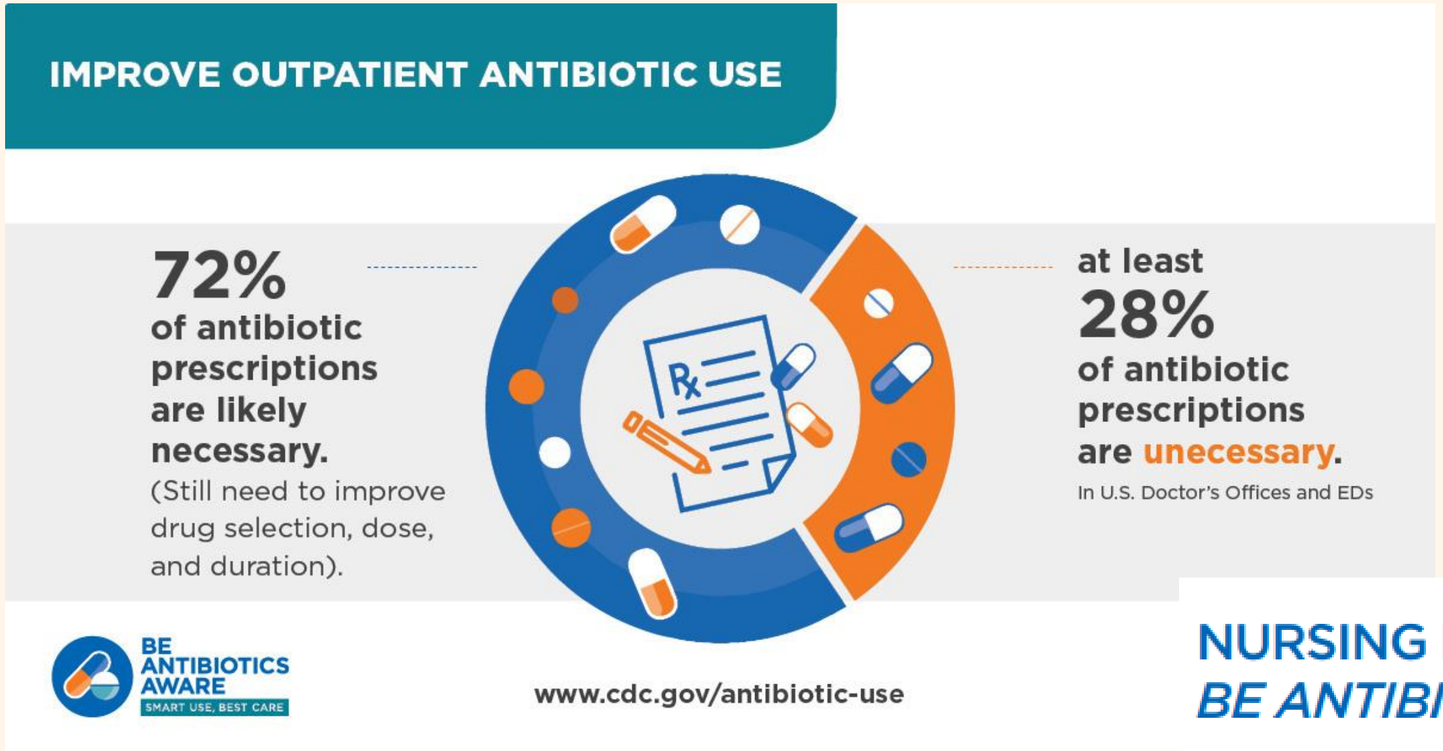
HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(audit) + HH(mom) + HH(champ) + HH(pat) + HH(fam/vis)

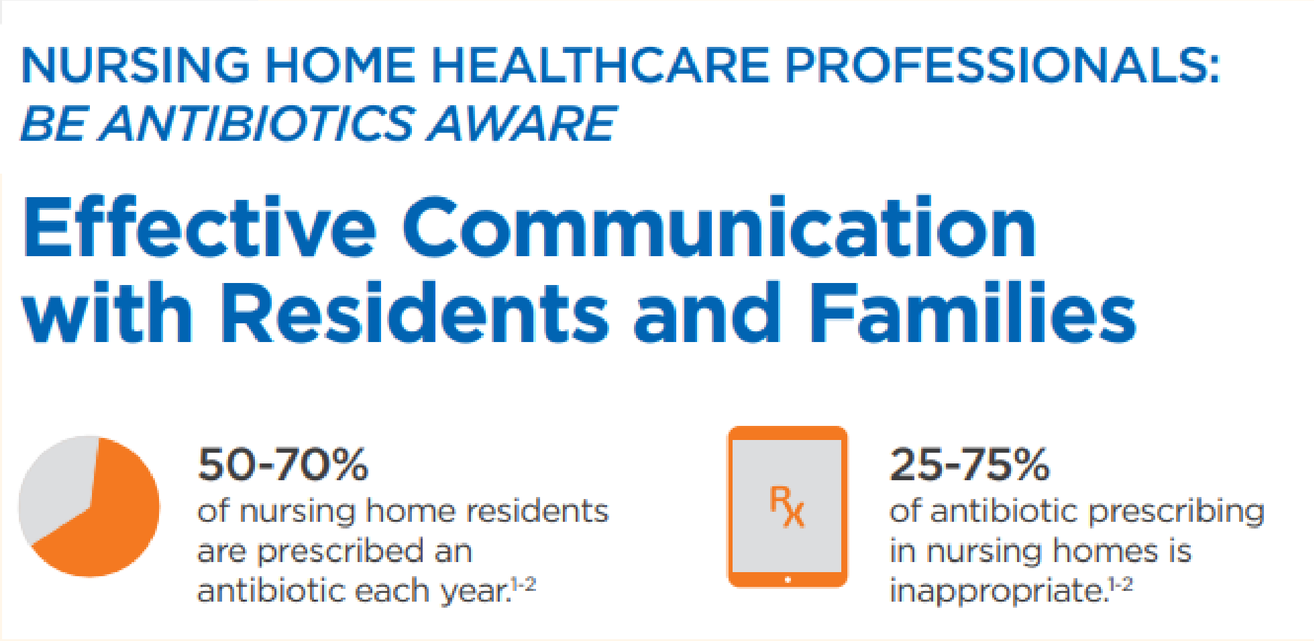


ANTIMICROBIAL STEWARDSHIP

- **Coordinated interventions designed to improve and measure the appropriate use of antimicrobials (IDSA 2023)**
- Core elements developed for hospitals, nursing homes, outpatient & limited resource environments
  - https://www.cdc.gov/antibiotic-use/core-elements/index.html
- CMS requirement for hospitals & long-term care
  - Hospitals = Tag A-0749
    - TJC MM09.01.01
  - Nursing homes = F881



https://www.cdc.gov/antibiotic-use/week/images/Improve-Outpatient-Antibiotic-Use.jpg



https://www.cdc.gov/antibiotic-use/pdfs/NursingHome-Toolkit-508.pdf

NEW AS RESOURCE!

ANTIBIOTIC RESISTANCE & PATIENT SAFETY PORTAL

https://arpsp.cdc.gov/profile/geography/texas

ANTIMICROBIAL STEWARDSHIP PROGRAMS

- In a 5-year study on cardiac surgical infections, an effective program reduced combined infection rates by 66% (Frenette 2016)
- By examining organisms isolated from infected hip arthroplasty patients & modifying pre-surgical antibiotics, infections were reduced from 1.19% to 0.55% (p=0.05) (Bosco 2016)
- Review of ASP and CDI (McDonald 2018)

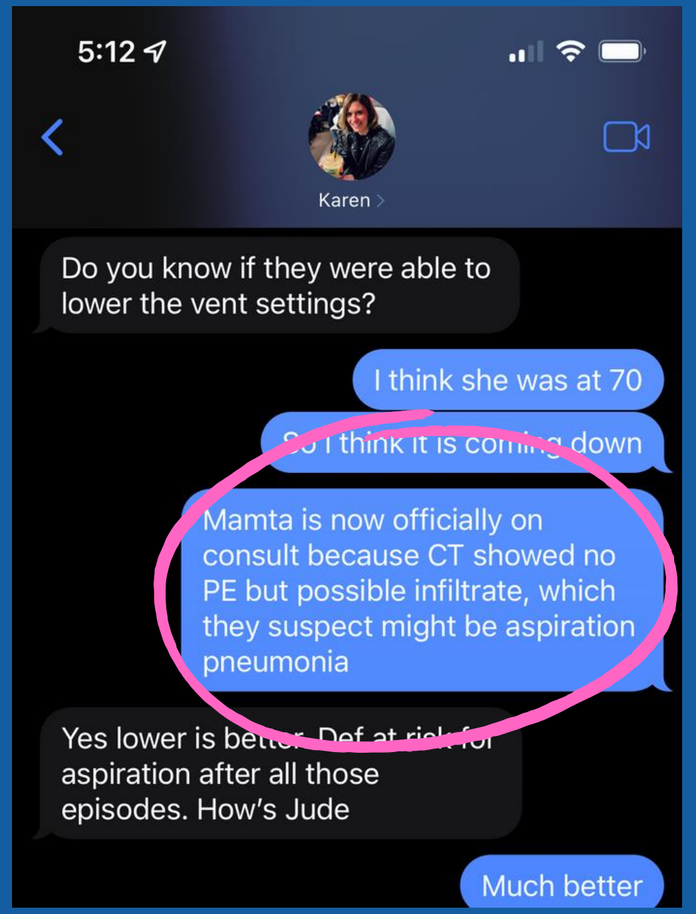
ANTIMICROBIAL STEWARDSHIP PROGRAMS

- **Formulary restrictions** on overused or “no brainer” antibiotics (kills everything!)
  - Fluoroquinolones and other broad spectrum (Talpaert 2011)
  - Fluoroquinolone restriction reduced CDI rates (fluoroquinolone resistant strains of CD had been detected (Dingle 2021))

ASP

- Right drug
- Right route (intravenous, oral, inhaled)
- Right duration (number of days or doses)
- Right dose - Step down to narrow spectrum
    - Important when organism is confirmed and tested

https://www.publichealthontario.ca/en/Health-Topics/Antimicrobial-Stewardship

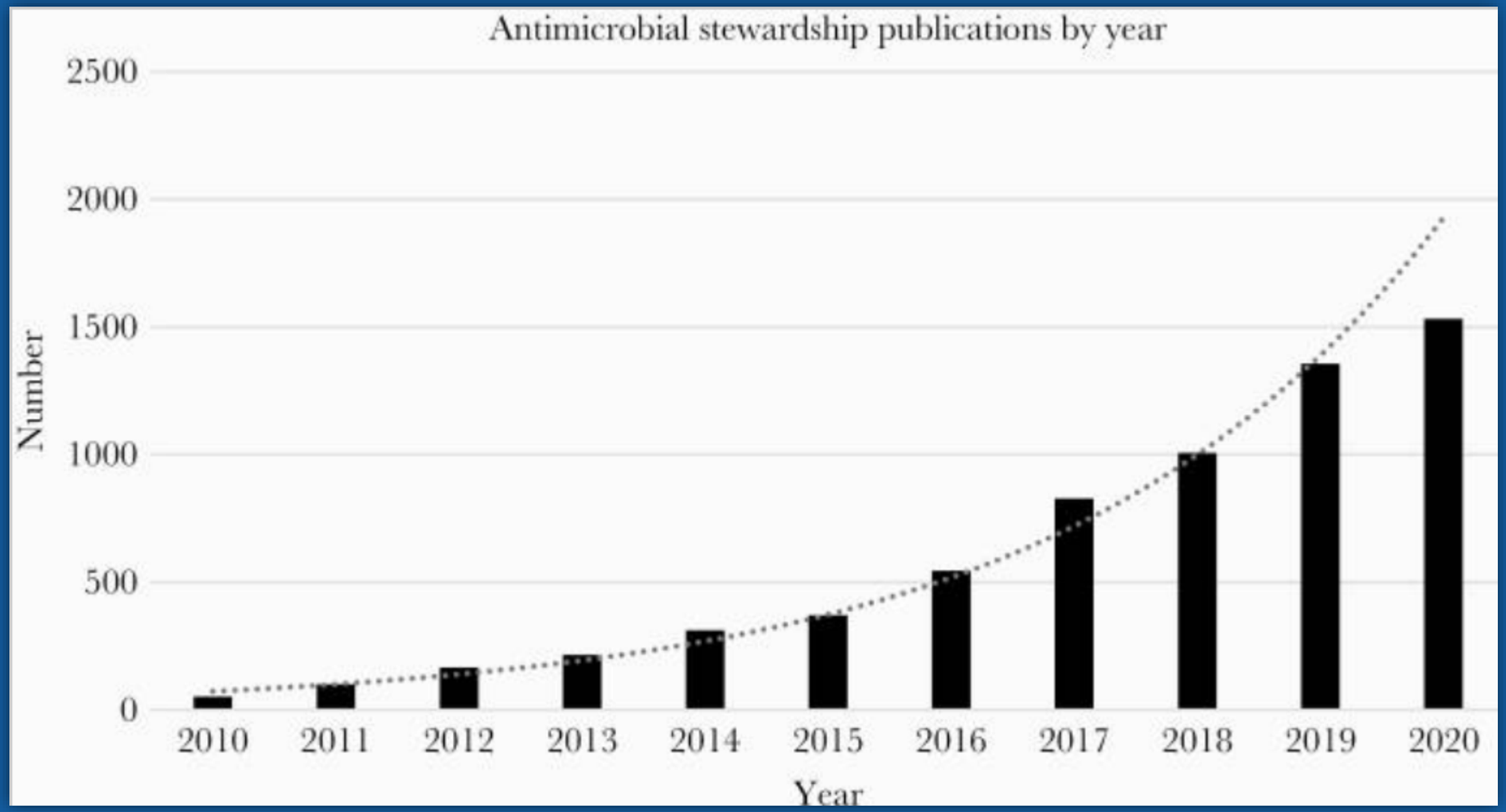


ANTIMICROBIAL STEWARDSHIP = DIAGNOSTIC STEWARDSHIP

- Dx stewardship is **ordering** the **right tests** for the **right patient** at the **right time** to inform & optimize care.
  - Includes culture-based & non-culture-based diagnostics (UA, procalcitonin, PCR panels & beyond).
  - Avoid “pan-culturing” (Vaughn et al 2019)
  - Integration of the electronic health records (EHRs) to "force function" evidence-based guidelines.

CDC 2022, Curren et al 2022.

AS & DS LITERATURE HAS EXPLODED IN THE LAST DECADE!



A Baker's Dozen of Top Antimicrobial Stewardship Intervention Publications in 2020

Green et al 2021

ASP: VARIABLES

- Right drug → (drug)
- Right route (IV, oral, inhaled, etc) → (route)
- Right duration (# days or doses) → (duration)
- Right dose → (dose)
- Formulary restrictions → (restrict)
- Diagnostic stewardship → (dxstwdsp)

HEALTHCARE-ASSOCIATED INFECTIONS

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(audit) + HH(mom) + HH(champ) + HH(pat) + HH(fam/vis)

ASP(drug) + ASP(route) + ASP(dur) + ASP(dose) + ASP(restrict) + ASP(dxstwdsp)

CLINICAL PRACTICES

- Skin preparation (for devices, surgeries)
  - Chlorhexidine vs. iodine (Lee 2010, Uppal 2017)
  - Review article (Boyce 2019)
- Decolonization therapies
  - Nasal (mupirocin, alcohol, iodine) & CHG bathing (Campbell 2014, Boyce 2019)
- Prophylactic antibiotics *if clinically indicated* (Bratzler et al 2013)

CLINICAL PRACTICES

- Bundles (checklists, standardized kits/trays)
  - Central line insertion (full barrier, sterile site) (Pronovost 2006)
- Ventilator care (oral care, head of bed) (Munro 2014, Papazian 2020)
- Oral care for prevention of hospital onset pneumonia (Munro 2018)

CLINICAL PRACTICES: VARIABLES

- Skin prep (devices, procedures) → (prep)
- Decolonization → (decol)
- Prophy ABX pre-procedure → (prophy)
- Bundles/checklists → (bundle)

HEALTHCARE-ASSOCIATED INFECTIONS

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CP(prep) + CP(decol) + CP(prophy) + CP(bundle)

FECAL WASTE MANAGEMENT

How do we dispose of waste from those who cannot self toilet?

Single-use disposable plastic, commode buckets & bedpans

Liner bags w/ absorbent pads (Lepainteur 2015, Macdonald 2016, PHO)

Thermal disinfection equipment

Single-use macerated
(crushed paper--*might require frame to hold weight of patient*)

Presenter has not seen commonly used in US

FECAL WASTE MANAGEMENT

- **Discourage rinsing in patient room/bathroom?**
  - Despite the device *on the toilet* designed for this purpose!
  - Risk of splash/contamination to HCP vs risk of spillage in hallway?
- **Main source of VRE, ESBL, CRE, *C. difficile* (*and* MRSA -** Boyce 2007**)**

FECAL WASTE MANAGEMENT

- **Personal protective equipment (PPE) at point of care for *<u>any</u>* feces (not just Contact Precautions!)**
  - Brief/diaper/pad change protocol
  - When to change gloves
  - Where to place soiled articles
  - What to disinfect after change
- **CDC Project Firstline**
  - https://www.cdc.gov/infectioncontrol/projectfirstline/healthcare/interactive-Diarrhea-Dilemma.html

FECAL WASTE MANAGEMENT: VARIABLES

- Bedpan/commode buckets → (container)
- No rinsing in patient room/bathroom → (no rinse)
- PPE at POC for any feces → (ppe)
- Brief/diaper/pad change protocol → (protocol)

HEALTHCARE-ASSOCIATED INFECTIONS

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +
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CP(prep) + CP(decol) + CP(prophy) + CP(bundle) +
FWM(cont) + FWM(ppe) + FWM(no rinse) + FWM(protocol)

ENVIRONMENTAL DISINFECTION

- CDC (2010) provides options for evaluating environmental cleaning
  - Note date of publication.
- Is there an audit system in place to see if it was cleaned?
  - ATP
  - Fluorescent
  - Visual

ENVIRONMENTAL DISINFECTION: PROGRAM VALIDATION





Method	Pros	Cons
Visual audits	Easy to perform, cost effective, engages staff. IPs can learn A LOT!	Difficult to standardize, may be seen as punitive w/o team engagement, Hawthorne effect, IP resources
Satisfaction surveys	Encourages resident participation, including family & visitors, quantitative measurement	Subjectivity, **emphasizes visible cleanliness only, not true disinfection**, no benchmarking
Culturing/ PCR/ Surface swab	May be useful during an outbreak or research project, quantitative	Not recommended by CDC as routine measure, **high cost**, long turn around times, results may not correspond to the outbreak
ATP	Easy to use & train others, immediate feedback, can be helpful when evaluating new/novel cleaning methods	Detection of organic matter (bioburden) is **not reliable predictor** of infection risk, **high cost of equipment & supplies**, storage of swabs. Variable results create confusion.
Fluorescent marking	Very inexpensive, easy to perform, immediate results	Does not identify pathogens, only detects cleaned/not cleaned, may be seen as punitive w/o team engagement

Modified from Infection Prevention Guide to LTC 2nd ed, APIC, 2017

ENVIRONMENTAL DISINFECTION

WHO DISINFECTS WHAT & WHEN & with WHAT WIPE?

Nurses?

Patient Care Techs/CNAs?

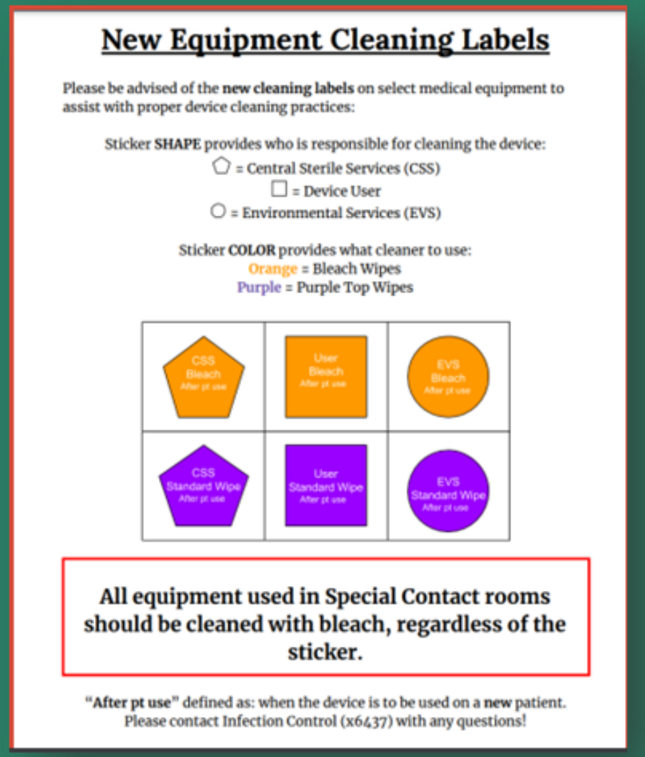
No laughter please . . . Physicians?

ENVIRONMENTAL DISINFECTION
WHO DISINFECTS WHAT & WHEN?

#APIC2022

Selected Equipment for Labeling

Equipment or Item	Group Responsible	Manufacturer Recommended
IV pump	CSS	Bleach
SCD Pump	EVS	Bleach
Vital Sign Machines	User	Bleach
Wall Mounted Vital Sign Machines	EVS	Bleach
EKG Machine	User	Bleach
PCA	CSS	Bleach
Feeding Pump	EVS	Bleach
Defibrillator on Code Cart	CSS	Quaternary Ammonium
Wall Mounted Patient Monitor/Leads/Pulse Ox/Cuff	EVS	Quaternary Ammonium
Bladder Scanner	User	Quaternary Ammonium
Telemetry Pack	User	Quaternary Ammonium



New Equipment Cleaning Labels

Please be advised of the **new cleaning labels** on select medical equipment to assist with proper device cleaning practices:

Sticker **SHAPE** provides who is responsible for cleaning the device:
⬠ = Central Sterile Services (CSS)
☐ = Device User
○ = Environmental Services (EVS)

Sticker **COLOR** provides what cleaner to use:
Orange = Bleach Wipes
Purple = Purple Top Wipes

All equipment used in Special Contact rooms should be cleaned with bleach, regardless of the sticker.

"After pt use" defined as: when the device is to be used on a **new** patient.
Please contact Infection Control (x6437) with any questions!

Dabkowski M. 2022. **Improving Cleaning Compliance of Noncritical Equipment with Labels and Auditing**. APIC 2022 oral abstract. Accessed securely online as conference attendee at https://c53ac34983397363b9e2-fa85729df59db74d0fed9dc21ffea231.ssl.cf1.rackcdn.com//1884872-1491675-004.pdf.

ENVIRONMENTAL DISINFECTION

- What can **family/visitors** clean and when?
  - Can we engage them, as we've done with hand hygiene?
  - Does the disinfectant have an acceptable **safety rating**?
  - Do they know the key opportunities?
  - What do YOU disinfect when you’re visiting family & friends?

ENVIRONMENTAL DISINFECTION

- What product can be used in room?
  - What product can be used near patient?
  - Are staff comfortable using product near patient? (Mahmutoglu 2016)
  - Diversey in-progress study saw virtually no daily disinfection of bedrails.
- What PPE is required to use product?
- Contact time
  - Regulatory/accreditation measuring evaporation rate & querying staff on contact time

ENVIRONMENTAL DISINFECTION (ED)

- Dilution control (Boyce 2016)
  - Does dilution control system deliver proper concentration?
  - How do you test end-use solutions?
  - Do staff members become chemists?
- Compatibility of chemistry
  - Cleaning equipment (quat binding) (Boyce 2016)
  - Surfaces/fabrics

ED: VARIABLES

- EVS C&D → (evs)
- Are surfaces being cleaned? → (audit)
- Nursing C&D → (nurse)
- Add'l clinical HCP C&D → (other)
- Family/visitor C&D → (family)

*C&D = cleaned & disinfected

ED: VARIABLES

- Product use near patient? → (prod)
- PPE required for product? → (ppe)
- Contact/wet time → (contact)
- Dilution control → (dil)
- Compatibility w/cloths → (compat)
- Adequate resources? → (resource)

HEALTHCARE-ASSOCIATED INFECTIONS

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ASP(drug) + ASP(route) + ASP(dur) + ASP(dose) + ASP(restrict) + ASP(dxstwdsp)

CP(prep) + CP(decol) + CP(prophy) + CP(bundle) +

FWM(cont) + FWM(ppe) + FWM(no rinse) + FWM(protocol) +

ED(evs) + ED(audit) + ED(nurse) + ED(other) + ED(family) + ED(prod) + ED(ppe) +
ED(contact) + ED(dil) + ED(compat) + ED(resource)

PATIENT ROOM ENTRY

Between 5am & 8pm (ICU & Med/Surg units)

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

15 hrs* 5.5/hr = 82.5 entries into the room!

Cohen 2012

PATIENT ROOM ENTRY

Who came into the room?

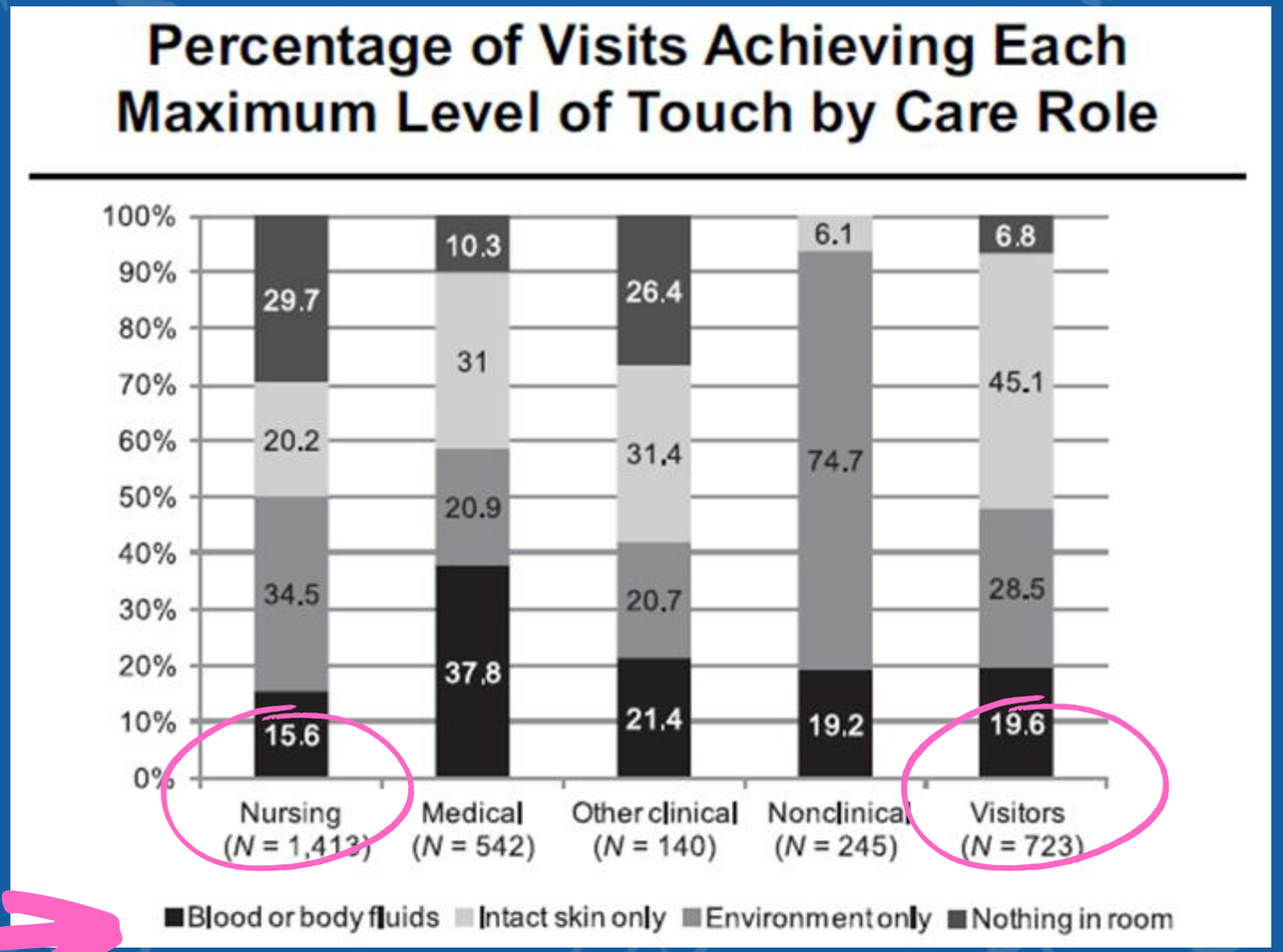
45% = Nursing staff
23% = Personal visitors
17% = Medical staff
8% = Nonclinical staff
4% = Other clinical staff

Cohen 2012

WHAT ARE THEY TOUCHING?

- 33.5% = contact with the environment only
  - Most common
- 27.1% = patient's intact skin
- 17.8% = blood or body fluids
- 16.0% = the person touched nothing in the room

And don't forget Lee found visitor HH compliance = 10.3%

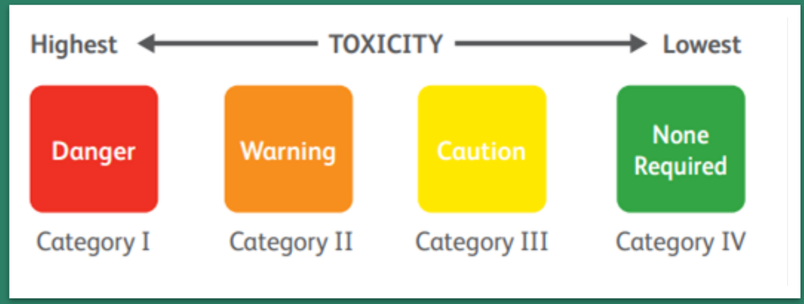


Cohen 2012

POINT OF CARE DISINFECTION

- Disinfectant at point of care!
  - Mount brackets!
- Staff will NOT search for wipes

- EPA Category IV (no signal words!)
  - Nonflammable, cannot pose risk to eyes, skin or respiratory tract, no PPE
- Fast contact time

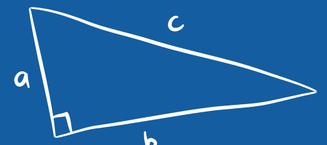


TARGETED MOMENTS OF ENVIRONMENTAL DISINFECTION

- Before placing food/drink on an overbed table
- Before and after any aseptic procedure
- After any procedure involving feces, vomit or respiratory secretions within the patient bed space
- After any patient bathing within the bed space
- After anything used on/by a patient touches the floor

Gauthier 2020

$A = \pi r^2$



$a^2 + b^2 = c^2$

SIMPLY PUT

$a + (b + c) = (a + b) + c$

$V = s^3$

If, during care, you have touched it or used it: DISINFECT IT!

$V = \frac{4}{3}\pi r^3$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$A = bh$

STRATEGIES FOR TMED IMPLEMENTATION

Start small, don't overwhelm yourself!

- Review C&D roles & responsibilities--are expectations clearly outlined?
- Perform environmental cleaning & disinfection audits.
- Integrate TMED into new hire & annual education modules.
- Highlight audit findings at your leadership safety huddles.

HAI EQUATION: IP STRONGEST INFLUENCES?

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(audit) + HH(mom) + HH(champ) + HH(pat) + HH(fam/vis) +

ASP(drug) + ASP(route) + ASP(dur) + ASP(dose) + ASP(restrict) + ASP(dxstwdsp)

CP(prep) + CP(decol) + CP(prophy) + CP(bundle) +

FWM(cont) + FWM(ppe) + FWM(no rinse) + FWM(protocol) +

ED(evs) + ED(audit) + ED(nurse) + ED(other) + ED(family) + ED(prod) + ED(ppe) +

ED(contact) + ED(dil) + ED(compat) + ED(resource)

HAI EQUATION: IP STRONGEST INFLUENCES?

HAI(p) = PA(vent) + PA(poe)

HH(prod) + HH(place) + HH(audit) + HH(mom) +

ASP(dxstwdsp)

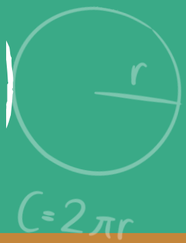
14?

CP(prep) + CP(decol) +

+ ED(audit) + ED(nurse) + ED(other)

CP(bundle) +

+ ED(prod)



HAI EQUATION: EVS STRONGEST INFLUENCES?

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(audit) + HH(mom) + HH(champ) + HH(pat) + HH(fam/vis) +

ASP(drug) + ASP(route) + ASP(dur) + ASP(dose) + ASP(restrict) + ASP(dxstwdsp)

CP(prep) + CP(decol) + CP(prophy) + CP(bundle) +

FWM(cont) + FWM(ppe) + FWM(no rinse) + FWM(protocol) +

ED(evs) + ED(audit) + ED(nurse) + ED(other) + ED(family) + ED(prod) + ED(ppe) +

ED(contact) + ED(dil) + ED(compat) + ED(resource)

HAI EQUATION: EVS STRONGEST INFLUENCES?

HH(mom) +

9

ED(evs) + ED(audit) + ED(prod) + ED(ppe) +

ED(contact) + ED(dil) + ED(compat) + ED(resource)

HEALTHCARE-ASSOCIATED INFECTIONS

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(audit) + HH(mom) + HH(champ) + HH(pat) + HH(fam/vis) +

ASP(drug) + ASP(route) + ASP(dur) + ASP(dose) + ASP(restrict) + ASP(dxstwdsp)

CP(prep) + CP(decol) + CP(prophy) + CP(bundle) +

FWM(cont) + FWM(ppe) + FWM(no rinse) + FWM(protocol) +

ED(evs) + ED(audit) + ED(nurse) + ED(other) + ED(family) + ED(prod) + ED(ppe) +

ED(contact) + ED(dil) + ED(compat) + ED(resource)

HEALTHCARE-ASSOCIATED INFECTIONS

HAI(p) = PA(vent) + PA(poe) + PA(age) + PA(abtic) + PA(co-m) +

HH(prod) + HH(place) + HH(au mom) mp) + HH(pat) + HH(fam/vis) +

ASP(drug) + ASP(route) + AS e) + ASP(restrict) + ASP(dxstwdsp)

CP(prep) + CP( ) + C oh P(bundle) +

FWM(cont) + FW WM(FWM(protocol) +

ED(evs) + ED(audit) + ED(nurse) + ED(other) + ED(family) + ED(prod) + ED(ppe) +

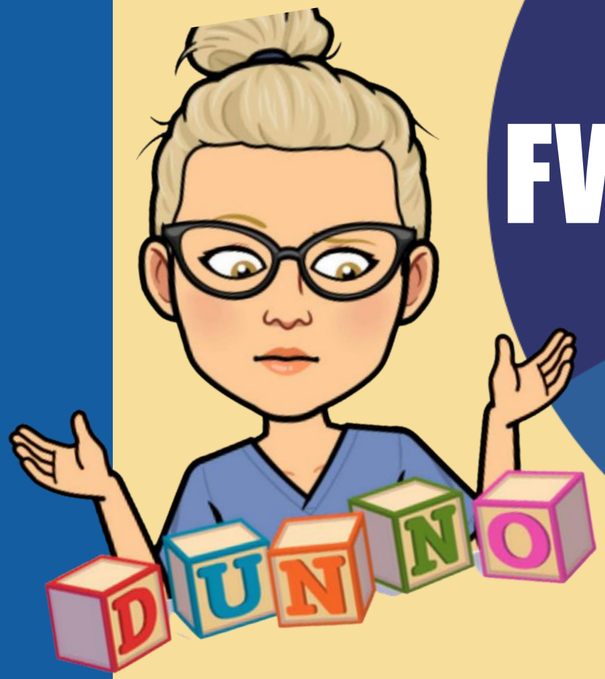
ED(contact) + ED(dil) + ED(compat) + ED(resource)

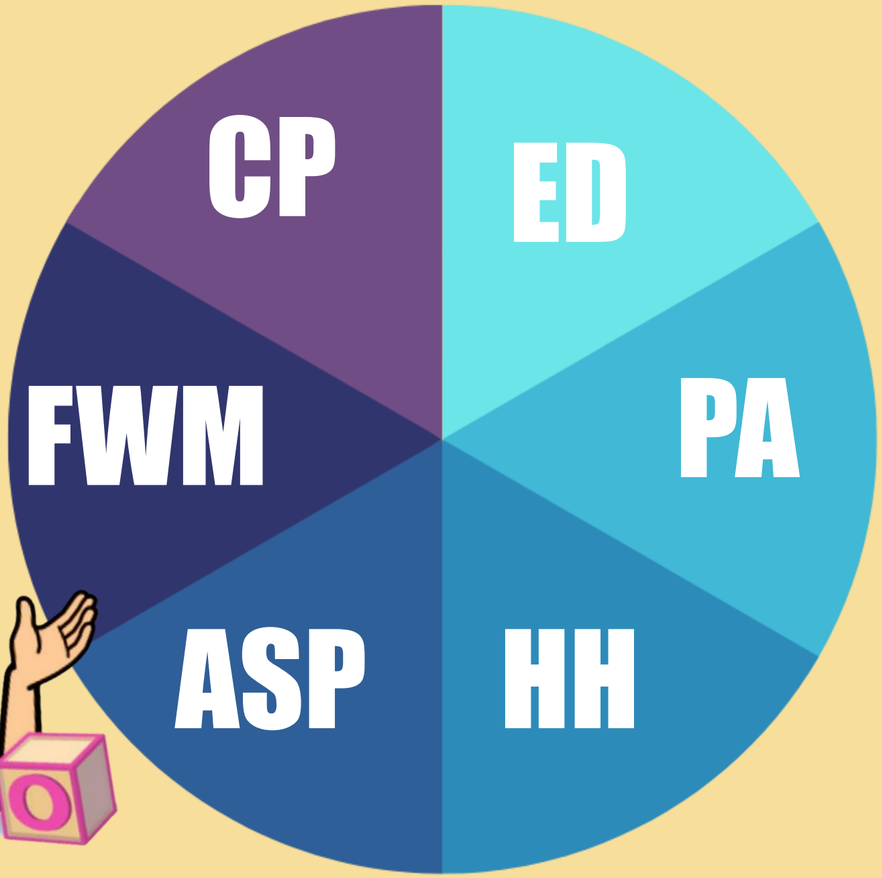
26

In summary:

- We cannot be mathematically certain how greatly each category impacts HAI risk.
- Many variables contribute to HAIs.
- Identify the variables over which you (IP) have influence.

% CONTRIBUTION TO HAIS?





INTRODUCING OUR NEW IP RESOURCE!

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THANKS! QUESTIONS?

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