Contemporary trend in infection prevention and control, surveillance and management of MDROs

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Advanced Training for Infection Control Nurses (ICNs)
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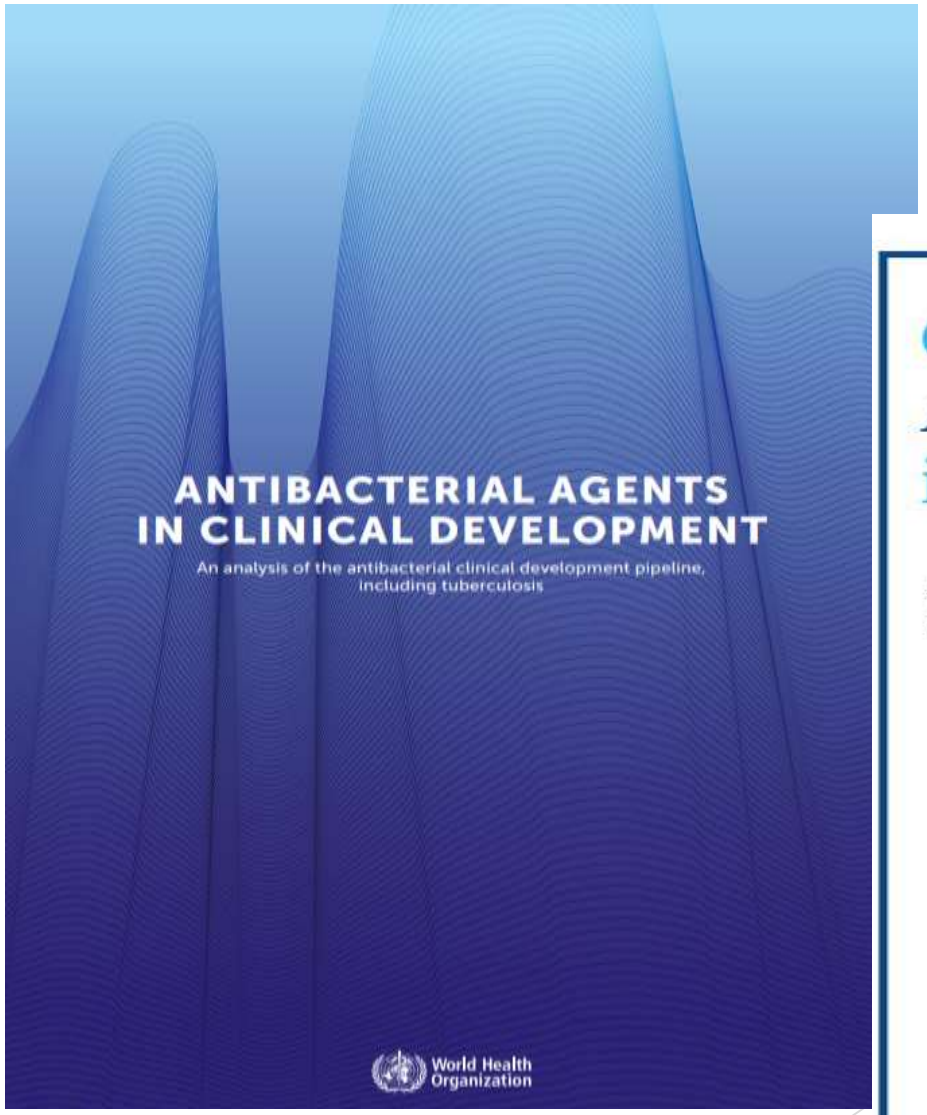
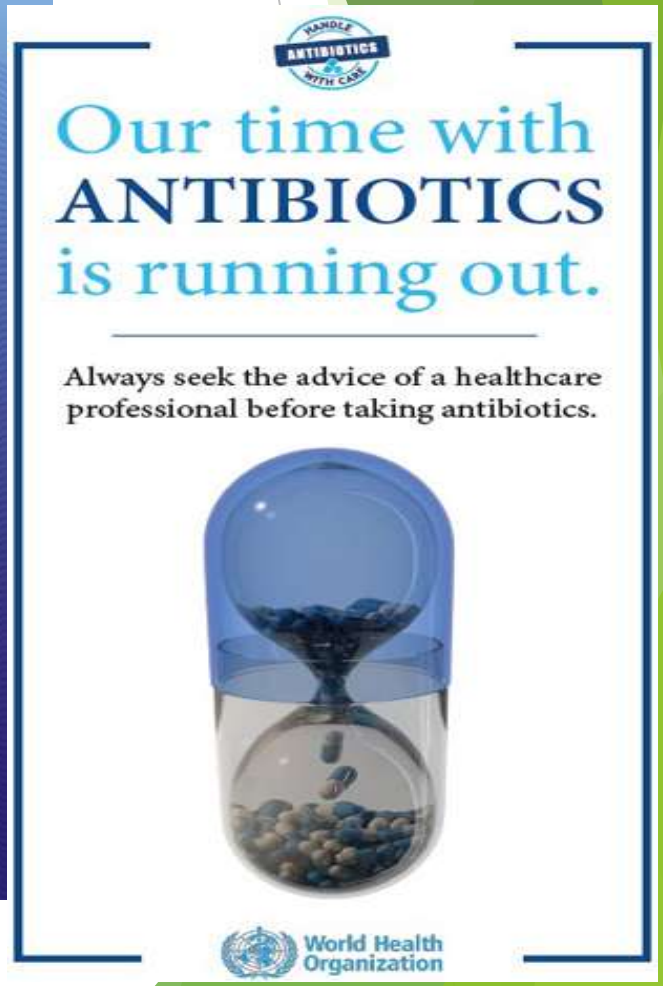
What is antimicrobial resistance?

- **What is antimicrobial resistance?**
  - **Antimicrobial resistance happens when microorganisms**
    - Bacteria
    - Fungi
    - Viruses
    - Parasites
  - **Change when they are exposed to antimicrobial drugs**
    - Antibiotics
    - Antifungals
    - Antivirals
    - Antimalarial
  - **Antimicrobial drugs become ineffective**
    - Infections persist in the body
    - Increasing the risk of spread to others

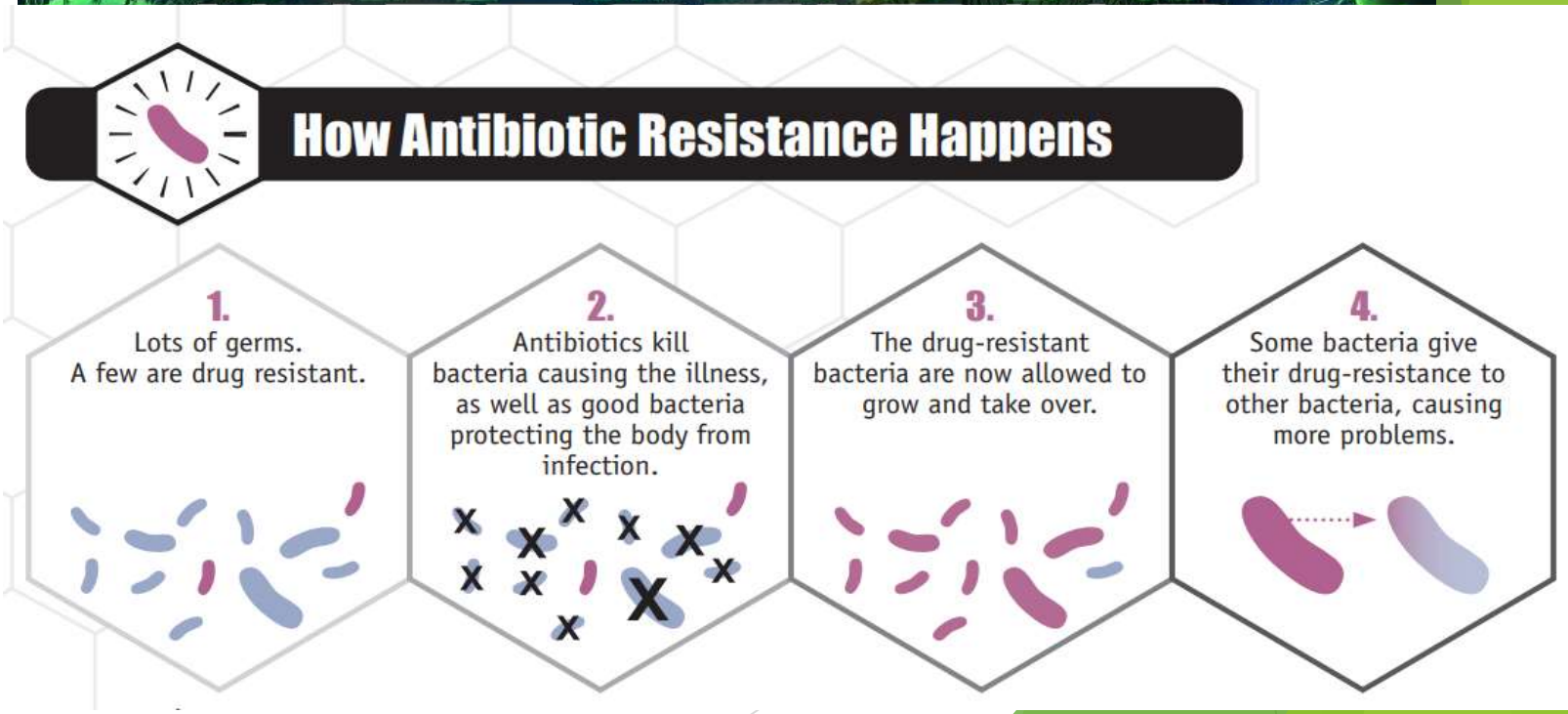




WHO - Antibiotic resistance
http://www.who.int/mediacentre/factsheets/antibiotic-resistance/en/

What is antimicrobial resistance?

- **Survival of the fittest**
  - Antimicrobial resistance occurs by genetic mutation or
  - From accepting antimicrobial resistant genes from other bacteria
- **The misuse and overuse of antimicrobials accelerates this process**
  - **Relatively harmless bacteria can develop resistance to multiple antibiotics and cause life threating infections**



FDA_Animation of Antimicrobial Resistance
https://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/ucm134359.htm
https://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf

Resistant gene transfer

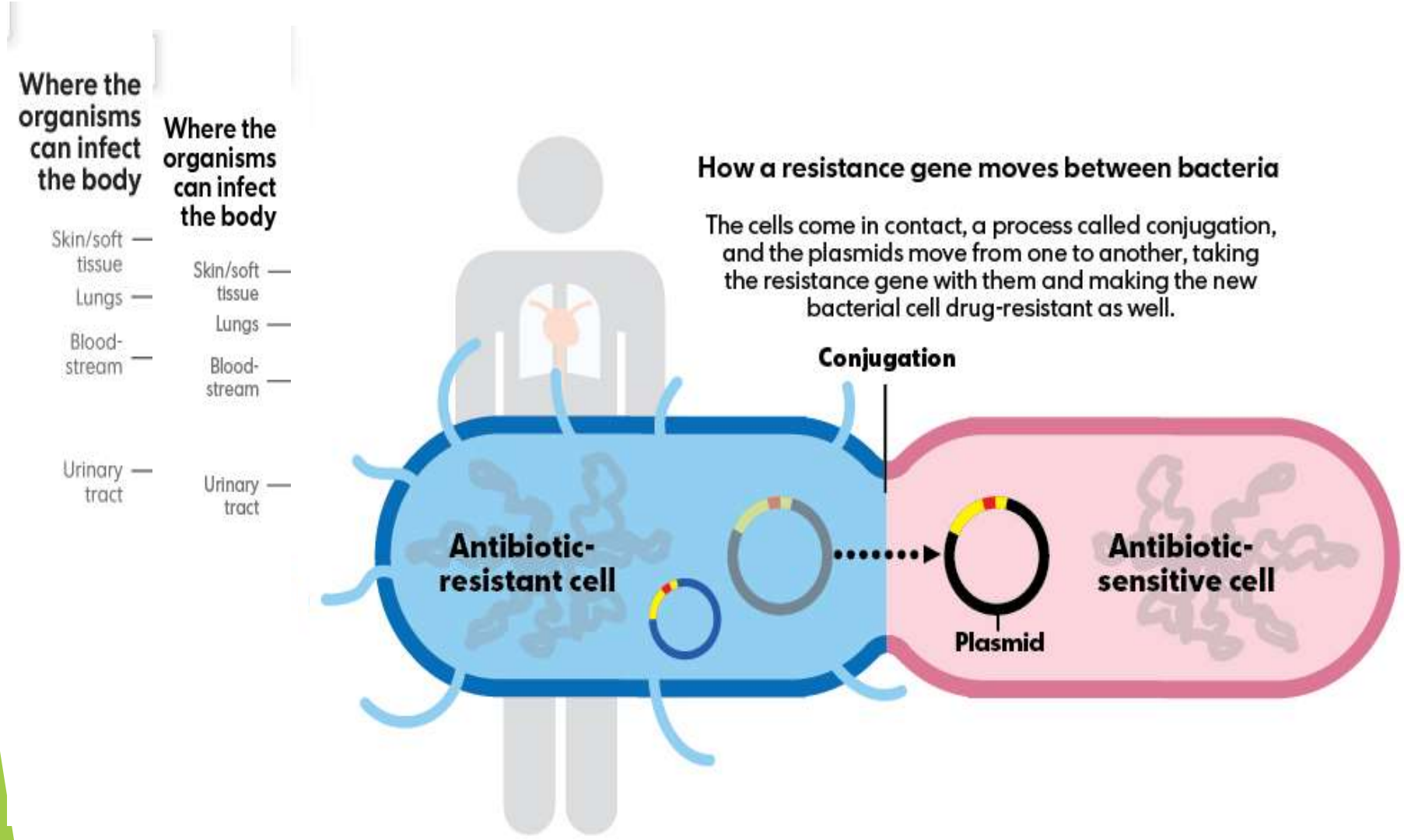


Photo credit:
http://www.usatoday.com/story/news/nation/2012/11/29/bacteria-deadly-hospital-infection/1727667/

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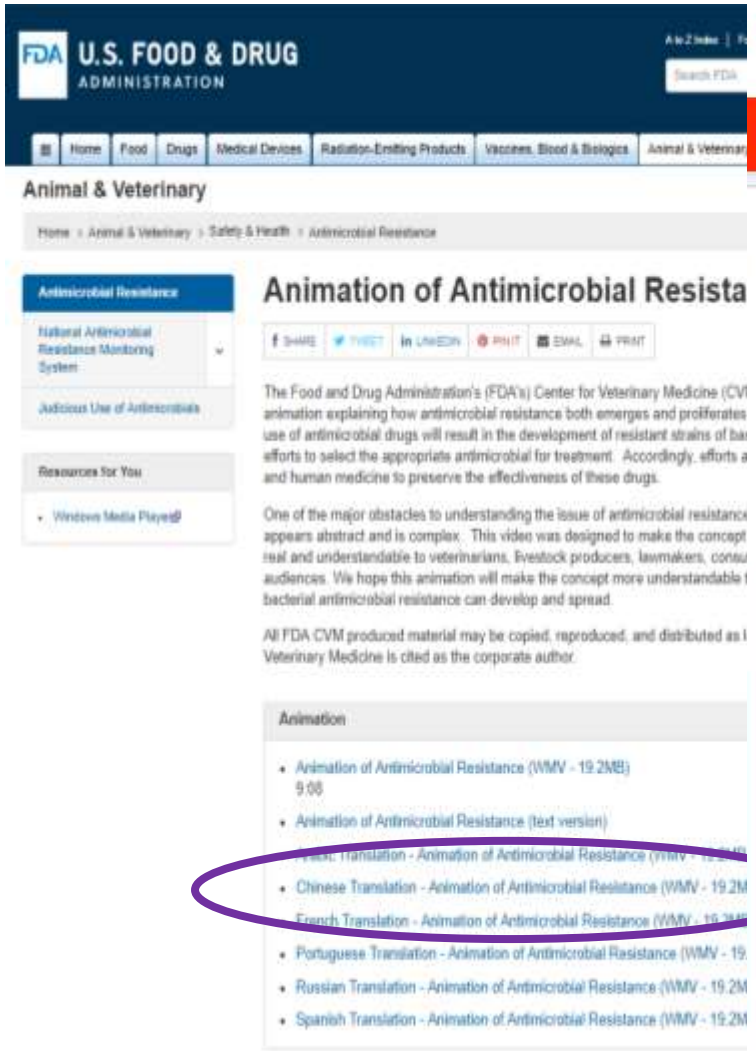


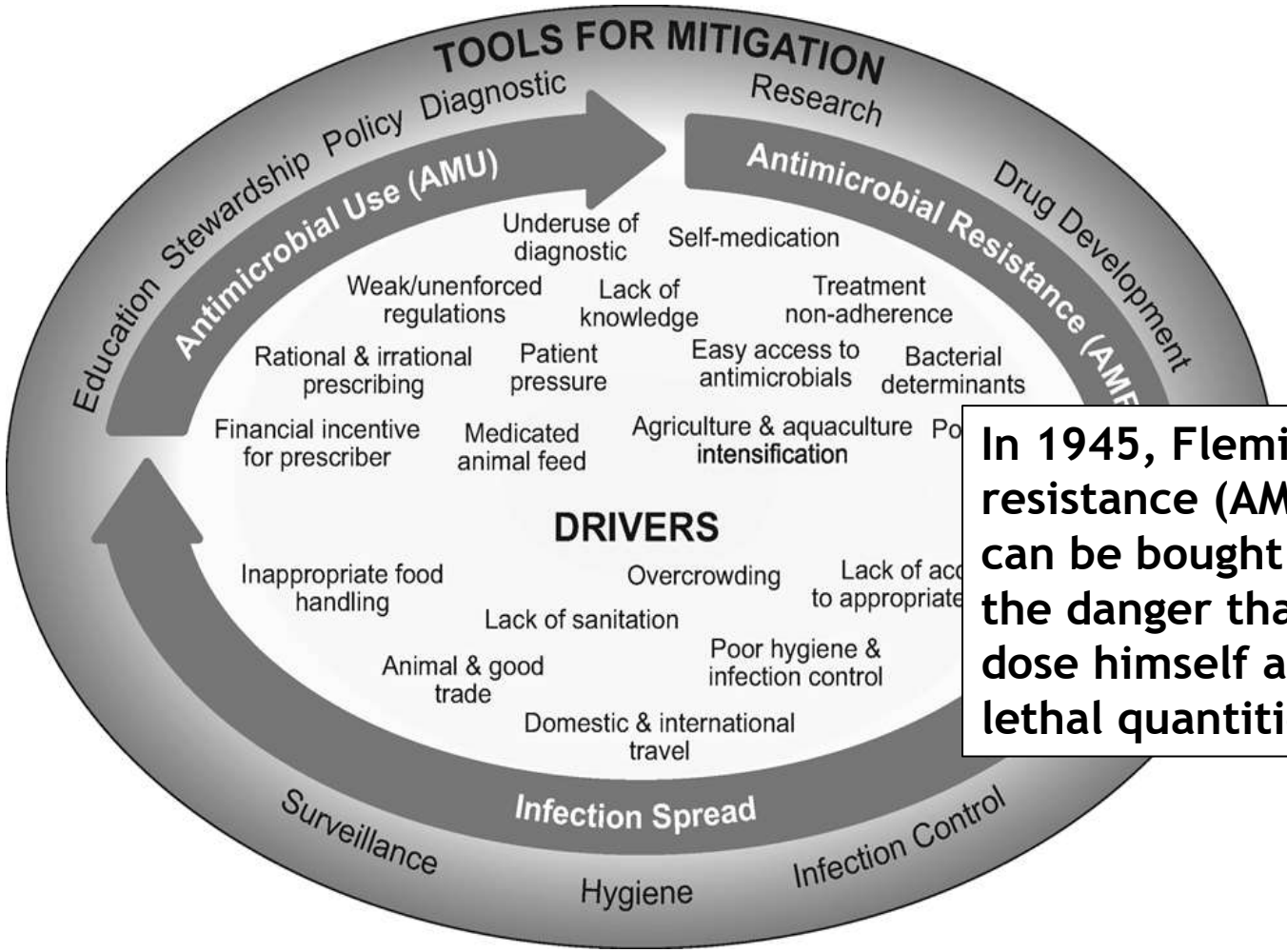
FDA - Animation of Antimicrobial Resistance
https://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/ucm134359.htm
TED Talk - What causes resistance
https://ed.ted.com/lessons/how-antibiotics-become-resistant-over-time-kevin
Futurism - Natural Selection *https://futurism.com/?post_type=glossary&p=53989?post_type=glossary&p=53989*

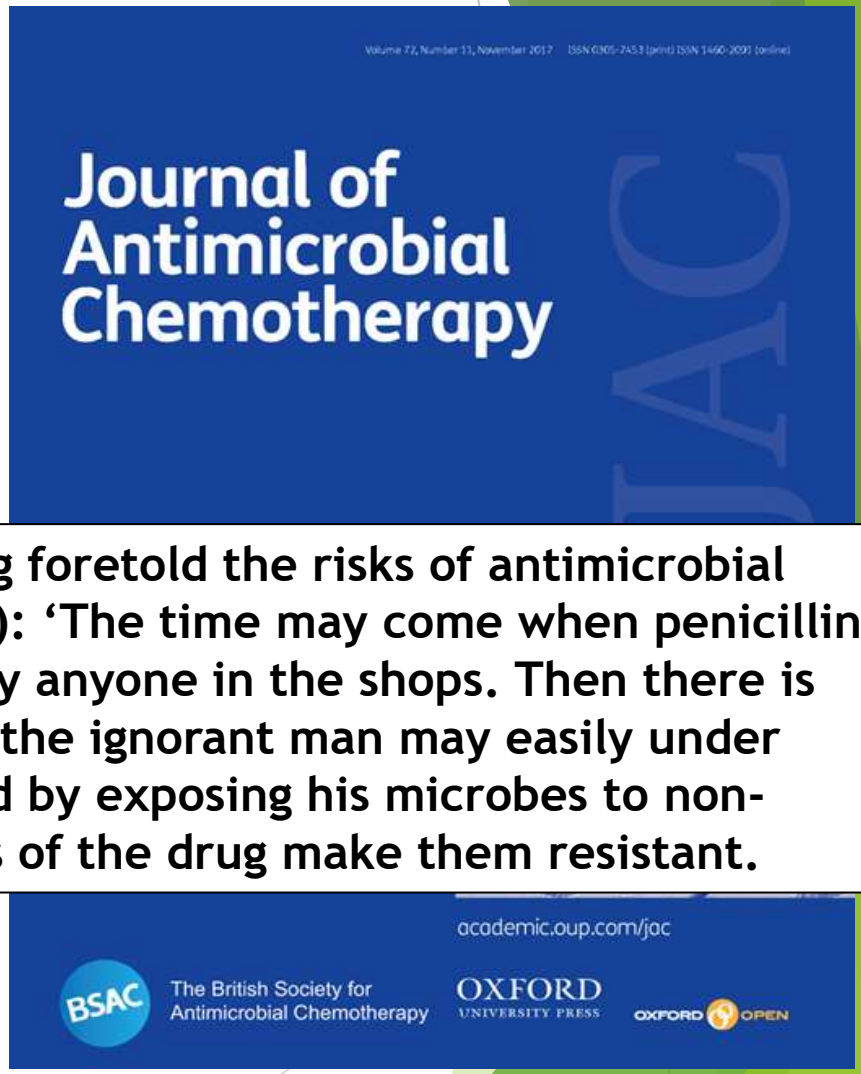
Antimicrobial resistance - A current perspective on antimicrobial resistance in Southeast Asia

- AMU and AMR are increasing in Southeast Asia
  - Driven by:
    - Rapid intensification of food-production systems
    - Loosely regulated access to antimicrobials
    - Poor awareness with respect to antimicrobials
      - Public
      - Health professionals
      - Farmers
    - Widespread irrational prescribing and self-medication
    - An abundance of low-quality or counterfeit drugs
  - Setting
    - High prevalence of infectious disease
    - Weak diagnostic capacity
      - Particularly in primary healthcare settings
    - Bacteria being readily transported to other parts of the world by international travellers, and by international trade of animals and goods

M. Zellweger RM et al. A current perspective on antimicrobial resistance in Southeast Asia. Antimicrob Chemother 2017; 72: 2963-2972

Schematic of the development, spread, drivers and tools for the mitigation of Antimicrobial resistance



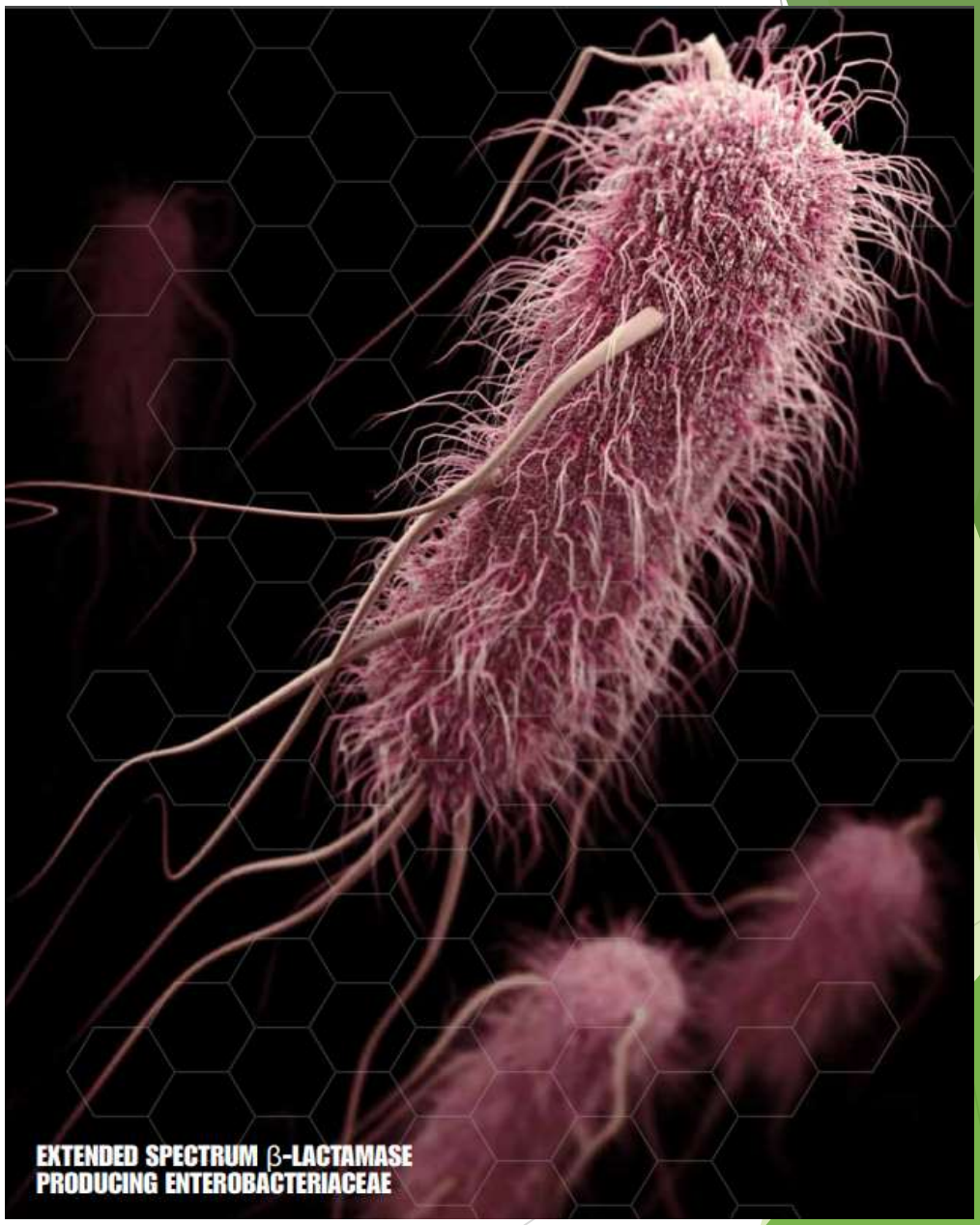


In 1945, Fleming foretold the risks of antimicrobial resistance (AMR): 'The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily under dose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant.

M. Zellweger RM et al. A current perspective on antimicrobial resistance in Southeast Asia. Antimicrob Chemother 2017; 72: 2963-2972
Fleming A. Nobel lecture, December 11, 1945. http://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/fleming-lecture.pdf.

Problem organisms

- **MRSA** **M**ethicillin **r**esistant ***S**taphyloccous **a**ureus*
- **VRE** **V**ancomycin **r**esistant ***E**nterococci* spp.
- *Clostridium difficile*
- **E**xtended **s**pectrum **β-l**actamase producing Enterobacteriaceae (**ESBLs**)
  - i.e. Klebsiella pneumoniae
- Carbapenem-resistant **E**nterobacteriaceae (**CRE**)
- **MRAB** **M**ulti-**r**esistant ***A**cinetobacter **b**aumannii*
- Multidrug-resistant *Pseudomonas aeruginosa*



Methicillin-resistant *Staphylococcus aureus* (MRSA)

MRSA - In a healthcare setting, such as a hospital or nursing home can cause severe problems such as bloodstream infections, pneumonia and surgical site infections

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- SKIN & SOFT TISSUE DISEASES
- ZOONOTIC & VECTOR-BORNE DISEASES

ARTICLE

UC Irvine Medical Center Reveals Ongoing MRSA Outbreak

APR 21, 2017 | EINAV KEET

*Updated April 24, 2017 at 2:05 EST

The University of California Irvine Medical Center recently announced that 10 infants were infected with the methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria since last summer. This is the first time the ongoing outbreak is made known to the public.

Antibiotic-resistant staph infections in hospitals and healthcare settings are dangerous, as these superbug infections can defy treatment and lead to life threatening illness. MRSA can be spread by direct contact, typically by healthcare workers, or patients with open wounds—such as from a recent surgical incision—are often most at risk of these skin infections. According to the Centers for Disease Control and Prevention (CDC), 1 in 3 (33%) people are carriers of staph bacteria in their nose, usually without any illness, while about 2 in 100 people carry MRSA. However, the CDC notes that a study in the *Journal of the American Medical Association Internal Medicine* found that life-threatening hospital-associated MRSA infections declined by 54% in the United States from 2005 to 2011, resulting in 30,800 fewer severe infections and about 9,000 fewer deaths.

The recent news from UC Irvine involves a MRSA outbreak that has affected 10 infants receiving care in the hospital's neonatal intensive care unit (NICU). The Los Angeles Times first reported the news of the outbreak on April 13. "Orange County Healthcare Agency has been involved since August," explained UC Irvine spokesperson, John Murray, in a recent interview with *Contagion*®. "In December, the county laboratory confirmed 5 clonal strains between August and November 2016." Murray says that a total of 10 infants at the hospital tested positive for MRSA between August 2016 and March 2017– 9 of them had infections and 1 was colonized. All infected infants were successfully treated with antibiotics and no infant deaths have been linked to the outbreak.

The Telegraph

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Six intensive care babies infected in MRSA superbug outbreak

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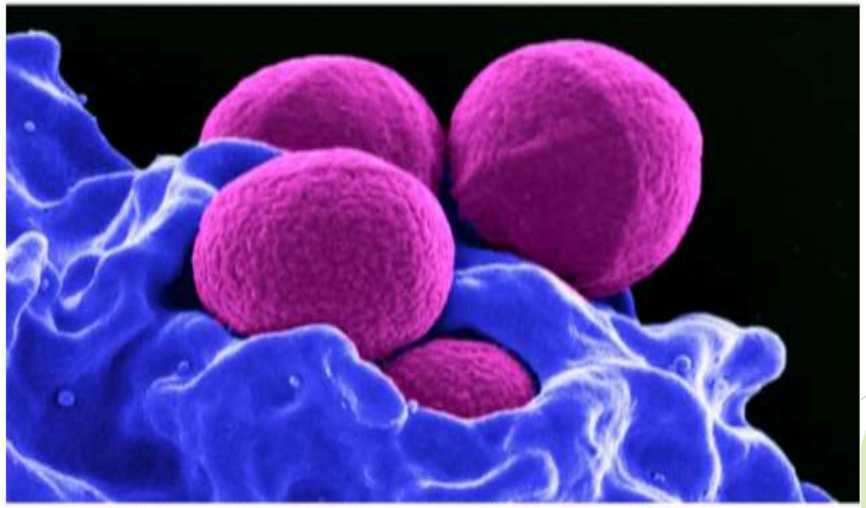

MRSA bacteria, shown in magenta, being destroyed by a white blood cell CREDIT: REUTERS

By Telegraph Reporters

2 OCTOBER 2016 • 12:27PM

Methicillin-resistant *Staphylococcus aureus* (MRSA)

- **Community acquired MRSA (CaMRSA)**
- Often quite different to MRSA strains assoc with hospitals
- CaMRSA infections
  - Infections of the surface of the skin such as boils and impetigo (school sores)
  - Infections under the skin that can be tender and increase in size (abscesses and cellulitis)
  - Infections of the bone, blood, lungs and other parts of the body
- **How is it spread?**
  - CaMRSA can get into the body through broken skin or sores, resulting in redness, pimples, swelling, tenderness or boils
- **Can be spread by:**
  - Touching or squeezing an infected body area, such as a boil or open wound
  - Using towels, clothes or bed sheets that have been used by a person with a MRSA infection
  - Using grooming items that have been used by a person with a MRSA infection
  - Not washing your hands carefully
- **Outbreaks tend to happen in schools, dormitories, military barracks, households, jails, and childcare centres**

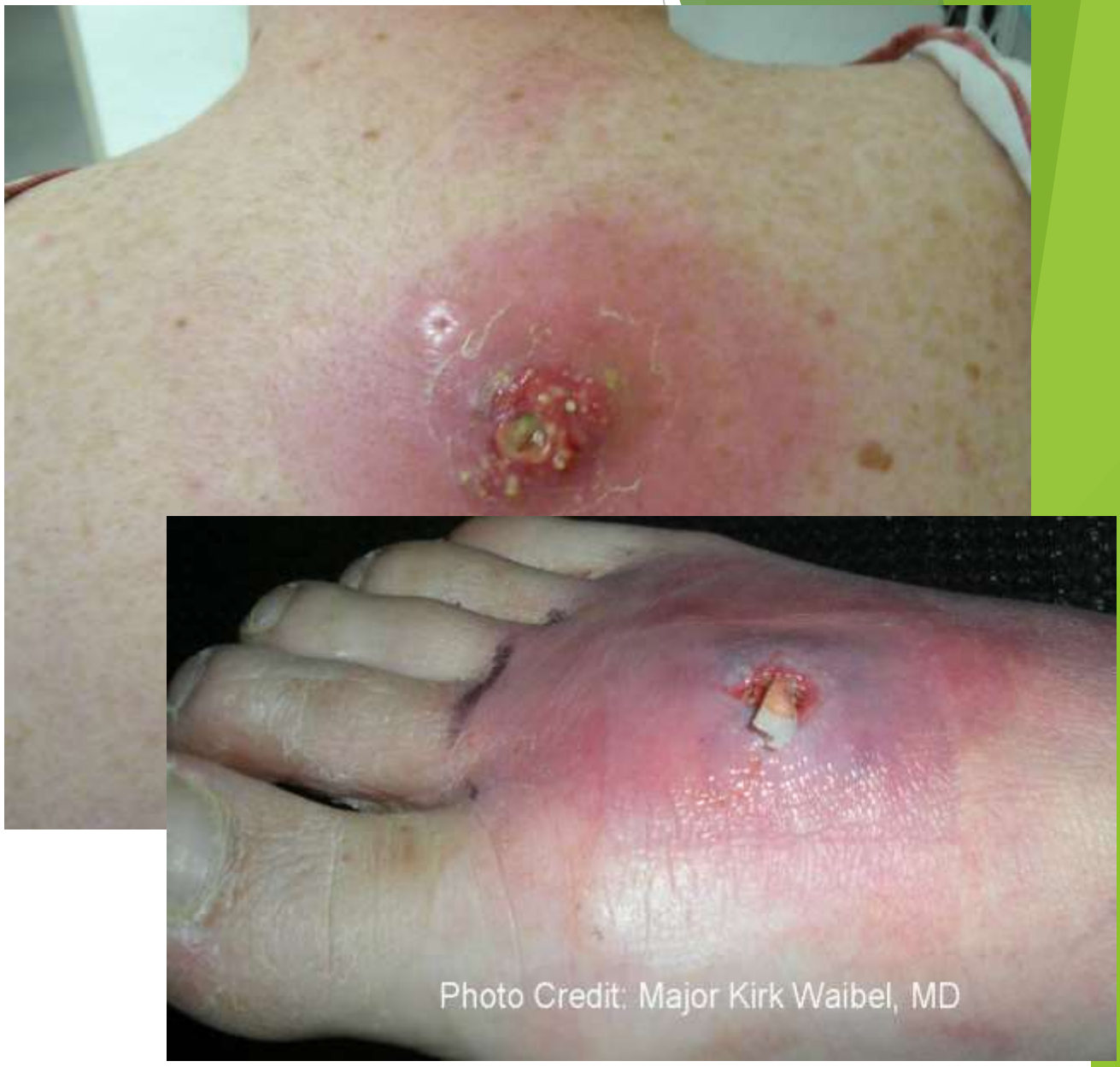

Photo credit: Gregory Moran, M.D. https://www.cdc.gov/mrsa/community/photos/photo-mrsa-10.html

Disease Burden, Characteristics, and Outcomes of Methicillin-Resistant Staphylococcus aureus Bloodstream Infection in Hong Kong

- **A retrospective, observational study was conducted in 26 Hong Kong public hospitals**
- January 2010 and December 2012
- The primary outcome measures were 30-day mortality rate and infection-related hospital cost
- 1133 patients records
  - 727 (64.17%) were male
  - 1075 (94.88%) had health care–associated community-onset
  - 44 (3.88%) had hospital-onset MRSA infection
  - Mean age of patients was 76 (SD = 15) years
  - 172 (15.18%) aged 20 to 59 years
  - 961 (84.8%) aged ≥60 years

Asia Pacific Journal of Public Health

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Disease Burden, Characteristics, and Outcomes of Methicillin-Resistant *Staphylococcus aureus* Bloodstream Infection in Hong Kong

Joyce H. S. You, DPharm, BCPS-AQ ID, Kin-wing Choi, MBChB, FRCP (Edin), Tin-yau Wong, MBBS, MPH, more... Show all authors

First Published July 18, 2017 | Research Article

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Abstract

We aimed to describe disease burden, characteristics, and outcomes of methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infection (BSI) in Hong Kong. A retrospective, observational study was conducted in 26 Hong Kong public hospitals between January 2010 and December 2012. The primary outcome measures were 30-day mortality rate and infection-related hospital cost. Of 1133 patients reviewed, 727 (64.17%) were male, 1075 (94.88%) had health care–associated community-onset and 44 (3.88%) had hospital-onset MRSA infection. The mean age of patients was 76 (SD = 15) years, including 172 (15.18%) aged 20 to 59 years and 961 (84.8%) aged ≥60 years. The annual incidence rates in age groups of 20 to 59 years and ≥60 years were 0.96 to 1.148 per 100 000 and 22.7 to 24.8 per 100 000, respectively. The 30-day mortality was 367 (32.39%). Older patients (>79 years), chronic lung disease, and prior hospitalization were associated with increased mortality. The mean cost was US$10 565 (SD =

Joyce H S You et al.Disease Burden, Characteristics, and Outcomes of Methicillin-Resistant Staphylococcus aureus Bloodstream Infection in Hong Kong. Asia-Pacific Journal of Public Health 29(5):451-461,July 2017

Disease Burden, Characteristics, and Outcomes of Methicillin-Resistant Staphylococcus aureus Bloodstream Infection in Hong Kong

- **Results**
  - Annual incidence rates
    - 20 to 59 age groups was 0.96 to 1.148 per 100 000
    - ≥60 age groups was 22.7 to 24.8 per 100 000
    - The 30-day mortality was 367 (32.39%)
    - Older patients (>79 years), chronic lung disease, and prior hospitalization were associated with increased mortality
    - The mean cost was US$10 565 (SD = 11 649; US$1 = HK$7.8)
- **MRSA BSI was a significant burden in Hong Kong**

Asia Pacific Journal of Public Health

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Vancomycin-resistant Enterococcus (VRE)

South China Morning Post EDITION: INTERNATIONAL

HONG KONG

PUBLISHED: Thursday, 01 August, 2013

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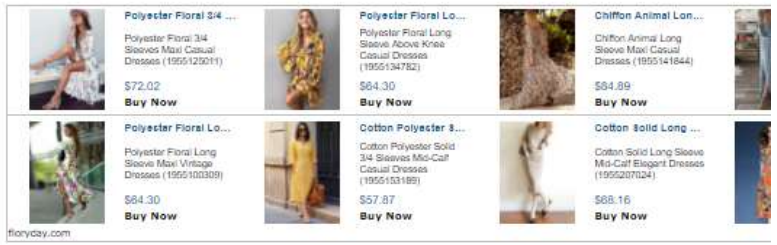
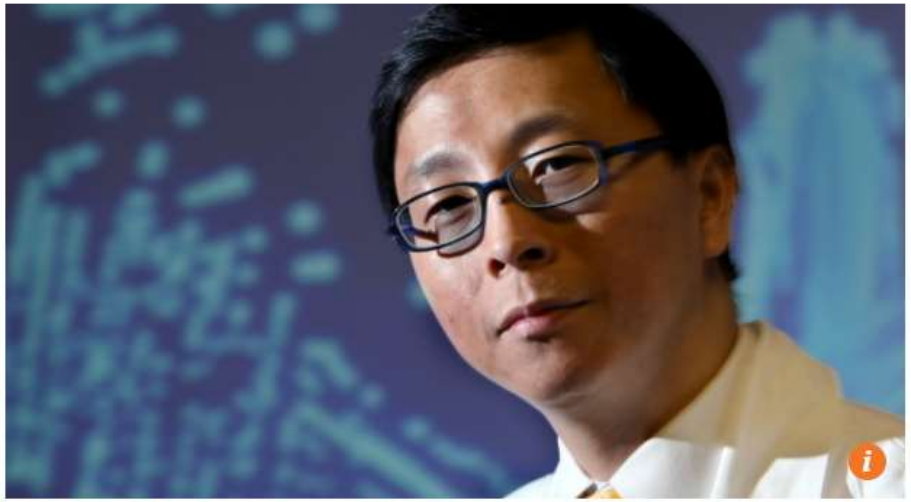


News / Hong Kong / MEDICINE

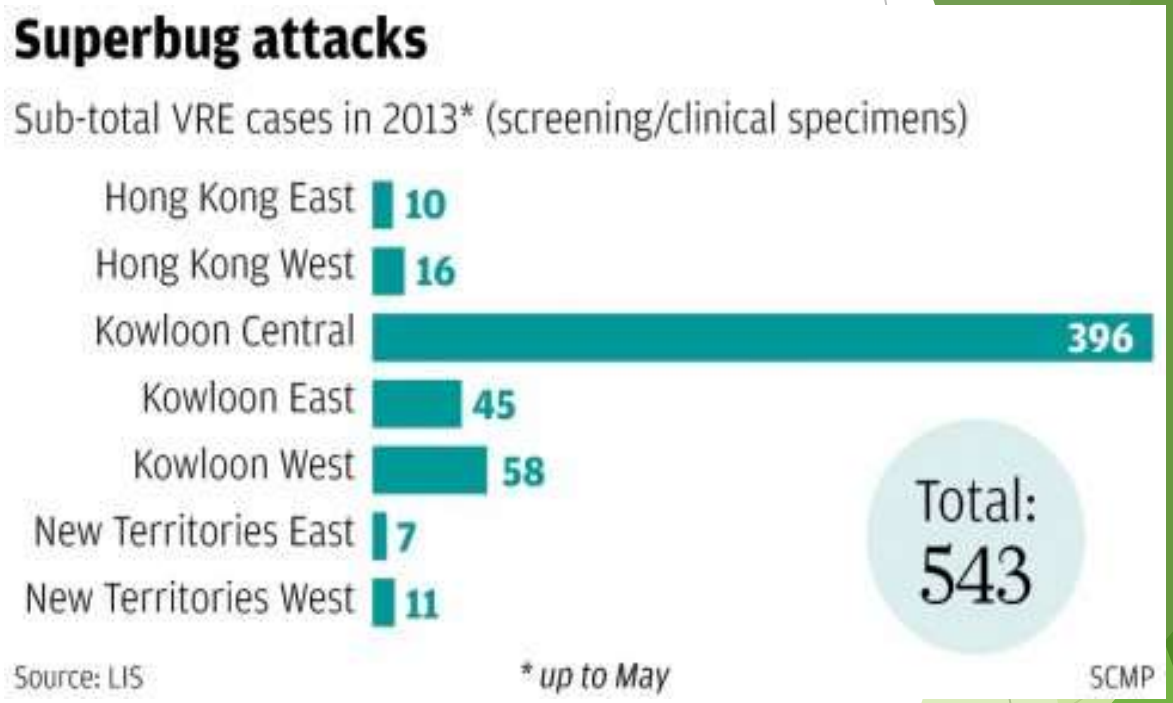
Screening shows VRE superbug cases doubled in Hong Kong

Increased screening reveals rise in number of patients hit by drug-resistant bacteria, with almost 400 cases appearing in one hospital

PUBLISHED : Thursday, 01 August, 2013, 12:00am
UPDATED : Thursday, 01 August, 2013, 8:37am



The detection of a drug-resistant bug has surged at public hospitals this year as authorities intensify their clinical screening efforts, the latest data shows.



Prevalence and risk factors for VRE colonisation in a tertiary hospital in Melbourne, Australia

- **Alfred hospital, Melbourne, Victoria**
  - Vancomycin-resistant Enterococcus (VRE) first isolation in Australia in 1994
  - 2008 - hospital-wide point prevalence survey
  - Prevalence of VRE colonisation on the day of screening was 17.5% (95% CI, 13.7 to 21.9)
  - VRE was detected from patients in each ward
    - Prevalence ranging from 3% to 29%
- **Univariate analysis**
  - Use of any antibiotic, meropenem, ciprofloxacin, diarrhoea and longer length of hospital stay were associated with increased risk of VRE colonisation ($p<0.05$)

Karki *et al. Antimicrobial Resistance and Infection Control* 2012, **1**:31
http://www.aricjournal.com/content/1/1/31

ANTIMICROBIAL RESISTANCE & INFECTION CONTROL

RESEARCH **Open Access**

Prevalence and risk factors for VRE colonisation in a tertiary hospital in Melbourne, Australia: a cross sectional study

Surendra Karki[1], Leanne Houston[2], Gillian Land[3], Pauline Bass[3], Rosaleen Kehoe[3], Sue Borrell[3], Kerrie Watson[3], Denis Spelman[4], Jacqueline Kennon[3], Glenys Harrington[4] and Allen C Cheng[1,3*]

Abstract

Background: Vancomycin-resistant *Enterococcus* (VRE) has been established as a significant health-care associated problem since its first isolation in Australia in 1994. In this study, we measured the point prevalence and identified risk factors associated with *vanB* VRE colonisation in a tertiary care hospital in Melbourne, Australia where VRE has been endemic for 15 years.

Methods: A hospital-wide point prevalence survey was conducted on October 13, 2008 with colonisation detected using rectal swab culture. Patient's demographic and medical information was collected through a review of medical records. Factors associated with VRE colonisation in univariate analysis were included in multivariate logistic regression model to adjust for confounding.

Results: The prevalence of VRE colonisation on the day of screening was 17.5% (95% CI, 13.7 to 21.9). VRE was detected from patients in each ward with the prevalence ranging from 3% to 29%. Univariate analysis showed the use of any antibiotic, meropenem, ciprofloxacin, diarrhoea and longer length of hospital stay were associated with increased risk of VRE colonisation ($p<0.05$). However, age, sex, proximity to VRE positive cases, use of other antibiotics including cephalosporins, vancomycin were not associated with increased risk ($P>0.05$). Multivariate analysis showed the exposure to meropenem ($p=0.004$), age (≥65 years) ($p=0.036$) and length of stay ≥7 days

Karki S, et al. Prevalence and risk factors for VRE colonisation in a tertiary hospital in Melbourne, Australia: a cross sectional study. Antimicrob Resist Infect Control. 2012 Oct 8;1(1):31.

Prevalence and risk factors for VRE colonisation in a tertiary hospital in Melbourne, Australia

- Age, sex, proximity to VRE positive cases, use of other antibiotics including cephalosporins, vancomycin were not associated with increased risk (P>0.05)
- **Multivariate analysis**
  - Exposure to meropenem (p=0.004), age (≥65 years) (p=0.036) and length of stay ≥7 days (p<0.001) as independent predictors of VRE colonisation
- Study suggested that **exposure to antibiotics may have been more important** than recent cross transmission for a high prevalence of **vanB VRE** colonisation

Perspectives

Should we continue to isolate patients with vancomycin-resistant enterococci in hospitals?

The routine use of contact precautions for patients with vancomycin-resistant enterococci cannot be justified once colonisation with this multidrug-resistant bacterium becomes endemic

Infections with vancomycin-resistant enterococci (VRE), which have become more common in Australian hospitals since the late 1990s, are associated with poor patient outcomes. Patients with gastrointestinal colonisation of VRE are at greater risk of infection, and patients infected with VRE are at higher risk of all-cause mortality.[1]

During outbreaks, VRE is assumed to spread between patients mainly via the hands of health care workers or in the hospital environment. Widely recommended strategies for minimising the risk of VRE transmission include screening to identify colonised patients, and subsequent contact precautions to minimise cross-transmission. Many hospitals use contact precautions for patients colonised or infected with VRE on current and each subsequent hospital admission, assuming VRE colonisation is lifelong. These recommendations for contact precautions are based on observational studies conducted primarily during outbreaks, inductive reasoning based on the known transmission potential, and expert opinion. However, dissent has been expressed against the routine use of contact precautions, particularly in hospitals where VRE is endemic.[2]

"Universal interventions ... are likely to be more effective in preventing transmission in high-risk settings"

VRE is endemic in many Australian hospitals.[3] We have recently changed our policy requiring the routine use of contact precautions for patients found to be colonised with VRE, to a risk-based policy applied to all patients at Alfred Health. By outlining the rationale for this change, we hope that it will inform VRE control policies at other Australian

Surendra Karki MSc, MScIH, PhD[1,2]
Karin Leder FRACP, PhD, MPH[1,3]
Allen C Cheng FRACP, MPH, PhD[1]
1 Monash University, Melbourne, VIC

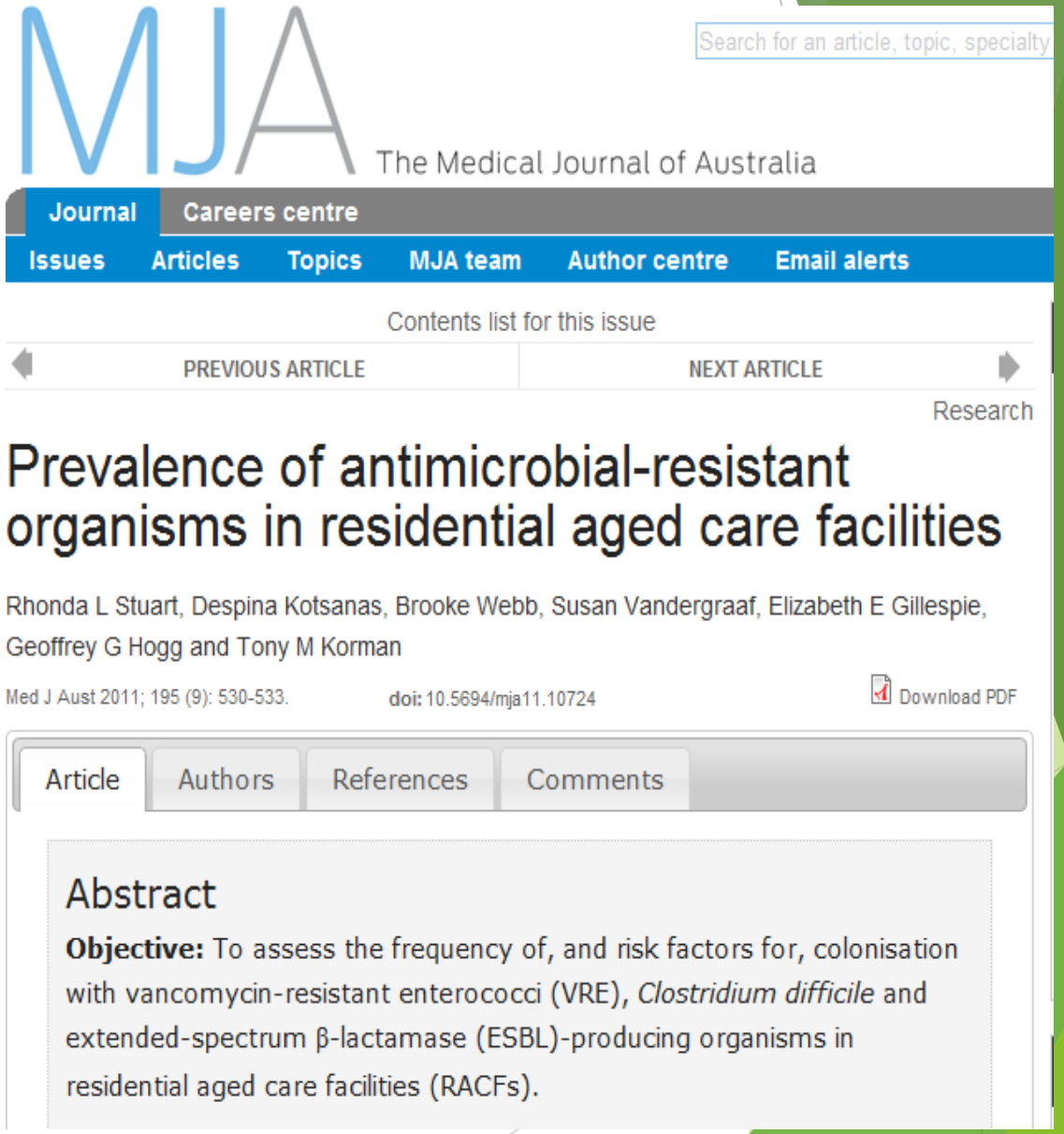
we have recently shown that antibiotic exposure, particularly to meropenem, is an important risk factor for VRE colonisation among patients.[4] Although the magnitude of the effect of re-exposure to antibiotics on detectability and transmissibility of VRE has not been definitively established, we note that no patients who had colonisation detected more than 4 years prior were found to have VRE, despite 40% being exposed to antibiotics within the previous 3 months.[5]

In an earlier study where VRE transmission through contacts was documented, exposure to broad-spectrum antibiotics was an important risk factor among incident cases.[6] Therefore, these studies suggest that during cross-transmission of VRE in hospital, antibiotics are the major facilitator and predictor of new VRE acquisition. Similarly, a recent study based on phylogenetic analysis and mapping of the *vanB* gene suggested that about half of hospital-acquired vancomycin-resistant *Enterococcus faecium* had recently acquired a transposon coding for vancomycin resistance.[7] This sequence was the same as a *Tn*1549 sequence present in anaerobic bacteria, but was inserted in different sites in the *E. faecium*

Karki S, et al. Prevalence and risk factors for VRE colonisation in a tertiary hospital in Melbourne, Australia: a cross sectional study. Antimicrob Resist Infect Control. 2012 Oct 8;1(1):31.

Antimicrobial-resistant - MDRO in residential aged care facilities (RACF)

- **Point prevalence survey - October - November 2010**
  - Frequency of, and risk factors for, colonisation with VRE, *Clostridium difficile* and extended-spectrum ß-lactamase (ESBL)-producing organisms
  - 3 RACFs associated with a health service
  - A single faecal sample was collected
  - Presence of risk factors for antibiotic-resistant organisms was identified using a questionnaire
- **Results:**
  - Of 164 residents in the three facilities
  - 119 (73%) were screened
  - Mean age of screened residents was 79.2 years
  - 61% were women
  - 74% had resided in the RACF for > 12 months
  - 21% had been given antibiotics within the past month
  - 12% had been in an acute care centre within the past 3 months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Prevalence of antimicrobial-resistant organisms in residential aged care facilities

Rhonda L Stuart, Despina Kotsanas, Brooke Webb, Susan Vandergraaf, Elizabeth E Gillespie, Geoffrey G Hogg and Tony M Korman

Med J Aust 2011; 195 (9): 530-533. doi: 10.5694/mja11.10724 Download PDF

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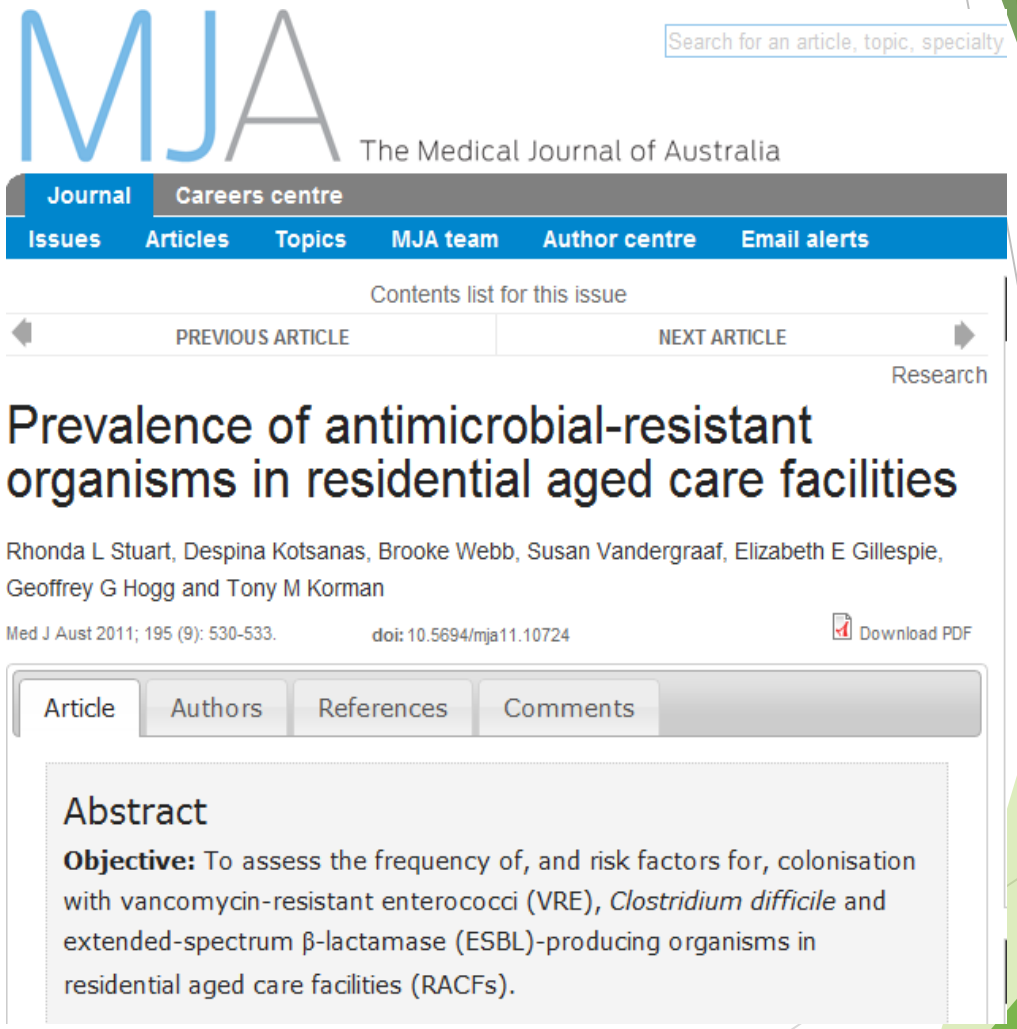
Abstract

Objective: To assess the frequency of, and risk factors for, colonisation with vancomycin-resistant enterococci (VRE), *Clostridium difficile* and extended-spectrum β-lactamase (ESBL)-producing organisms in residential aged care facilities (RACFs).

Infect Control Hosp Epidemiol 2001;22:576-578. Med J Aust 2011; 195 (9): 530-533.

Prevalence of antimicrobial-resistant organisms in residential aged care facilities

- Overall rates of VRE (2%) and *C. difficile* (1%) colonisation were low
- ESBL-producing *Escherichia coli* was detected in 14 residents (12%)
  - 1/2 resided in one wing of an RACF
    - 27% of wing residents tested
  - 10/14 ESBL-producing isolates had identical molecular typing patterns and belonged to genotye CTX-M-9
  - 8/13 residents had persistent colonisation on repeat testing 3 months later
- **Conclusion**
  - High prevalence of ESBL-producing *E. coli* in RACF residents
  - A clonal relatedness suggesting possible transmission within the facility
  - RACFs should have programs emphasising:
    - Good hand hygiene compliance
    - Enhanced environmental cleaning and
    - Dedicated antimicrobial stewardship programs



Infect Control Hosp Epidemiol 2001;22:576-578. Med J Aust 2011; 195 (9): 530-533.

Antimicrobial prescribing and infections in Australian residential aged care facilities

- **RACFs with high antimicrobial use**
  - Increased risk for all residents
  - Potential for cross-transmission among residents
- **Survey**
  - 186 RACFs - June and August 2015
  - Individual facilities conducted a single-day (point prevalence) survey
  - 69.9% were in Victoria
  - Surveyors
    - Infection control practitioners (57.5%), nurses (35.5%) and pharmacists (11.0%)
  - All residents were assessed for signs or symptoms of a suspected or confirmed infection, and/or a current prescription for antimicrobial therapy

Antimicrobial prescribing and infections in Australian residential aged care facilities
Results of the 2015 Aged Care National Antimicrobial Prescribing Survey pilot, May 2016

Antimicrobial prescribing and infections in Australian residential aged care facilities

- **Summary findings**
  - 4.5% of RACF residents had signs and symptoms of infection
- **Antibiotic prescribing**
  - In total, 975 antimicrobials were prescribed for 824 residents
  - 11.3% of residents were prescribed one or more antimicrobials
  - The 5 most commonly prescribed antimicrobials - cephalexin (16.7%), clotrimazole (16.5%), amoxicillin–clavulanate (6.5%), trimethoprim (6.5%) and chloramphenicol (6.4%)
  - 37.1% of prescribing was for topical antimicrobials
- **Five most common indications for antimicrobial prescribing documented were:**
  - 17.5% - Skin, soft tissue or mucosal infections
  - 16.7% - Urinary tract infections
  - 11.8% - Lower respiratory tract infections
  - 8.4% - Tinea
  - 5.2% - Conjunctivitis

Antimicrobial prescribing and infections in Australian residential aged care facilities
Results of the 2015 Aged Care National Antimicrobial Prescribing Survey pilot, May 2016

Antimicrobial prescribing and infections in Australian residential aged care facilities

- Results identified three key areas for targeted quality improvement interventions:
  - **Inadequate documentation**
    - 31.6% of prescriptions did not have an indication documented justifying their use
    - 65.0% of prescriptions did not have a review or stop date documented
  - **Use of antimicrobials for unspecified infections**
    - 17.5% of antimicrobials were being used for unspecified skin infections
  - **Prolonged duration of prescriptions**
    - 31.4% of prescriptions had been prescribed for longer than six months; of these
      - Only 51.0% had an indication documented
      - Only 2.0% had a review or stop date recorded

Antimicrobial prescribing and infections in Australian residential aged care facilities
Results of the 2015 Aged Care National Antimicrobial Prescribing Survey pilot, May 2016

Clostridium difficile

- **A spore-forming, gram-positive anaerobic bacillus**
  - Produces two exotoxins
    - toxin A and toxin B
  - A common cause of antibiotic-associated diarrhoea
  - Accounts for 15-25% of all episodes antibiotic-associated diarrhoea
- **Virulent strain of *Clostridium difficile***
  - Associated with more severe disease
  - Higher relapse rates
  - Increased mortality up to 19%
  - Greater resistance to antibiotics
    - Penicillins, Cephalosporins, Clindamcyin, Fluoroquinolones
- **Outbreaks are common**

ARTICLE IN PRESS

Clinical Microbiology and Infection xxx (2017) 1.e1–1.e4

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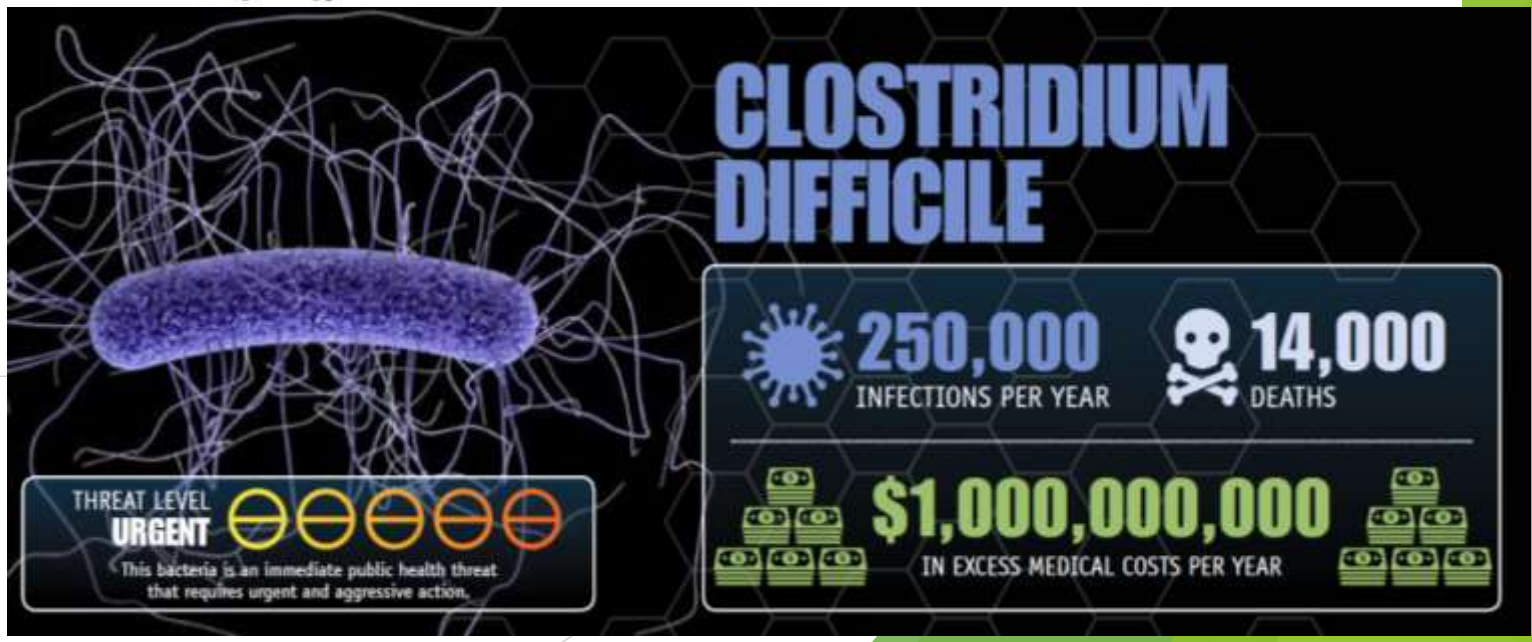
journal homepage: www.clinicalmicrobiologyandinfection.com

Research note

An outbreak of *Clostridium difficile* infections due to new PCR ribotype 826: epidemiologic and microbiologic analyses☆

M.J.T. Crobach [1,†], A.F. Voor in 't holt [2,†], C.W. Knetsch [1], S.M. van Dorp [1], W. Bras [2], C. Harmanus [1], E.J. Kuijper [1], M.C. Vos [2,*]



Clostridium difficile surveillance in Australian is undertaking on a national level

2011 – 2012 Clostridium difficile

Objectives

- Prospective surveillance
  - Quarterly incidence of hospital-identified *Clostridium difficile* infection (HI-CDI) in Australia
    - Hospital-associated (HA) infections
    - Community-associated(CA) infections

Results

- The annual incidence of HI-CDI increased from **3.25/10,000 patient days in 2011** to **4.03/10,000 patient days in 2012**
- Poisson regression modelling demonstrated a 29% increase (95% CI, 25% to 34%) per quarter between April and December 2011, with a peak of 4.49/10 000 PD in the October–December quarter

Research

Increasing incidence of *Clostridium difficile* infection, Australia, 2011–2012

Claudia Slimings BSc, PGDipHlthSci, PhD, Associate Professor[1]
Paul Armstrong BE(Min), MB BS, MApplEpid, Director, Communicable Disease Control Directorate[2]
Wendy D Beckingham BHSc(Nurs), GradCertInfectControl, MClinNurs, Clinical Nurse Consultant[3]
Ann L Bull BSc(Hons), MAppEpid, PhD, Operations Director[4]
Lisa Hall BTech(Hons), PhD, Epidemiologist[3,4]
Karina J Kennedy MB BS, FRACP, FRCPA, Infectious Diseases Physician and Microbiologist[3]
John Marquess BSc, MPH, Manager of Epidemiology and Research[3]
Rebecca McCann RN, BSc(Nurs), Program Manager, Healthcare Associated Infection Unit[3]
Andrea Menzies

Abstract

Objectives: To report the quarterly incidence of hospital-identified *Clostridium difficile* infection (HI-CDI) in Australia, and to estimate the burden ascribed to hospital-associated (HA) and community-associated (CA) infections.

Design, setting and patients: Prospective surveillance of all cases of CDI diagnosed in hospital patients from 1 January 2011 to 31 December 2012 in 450 public hospitals in all Australian states and the Australian Capital Territory. All patients admitted to inpatient wards or units in acute public hospitals, including psychiatry, rehabilitation and aged care, were included, as well as those attending emergency departments and outpatient clinics.

Main outcome measures: Incidence of HI-CDI (primary outcome); proportion and incidence of HA-CDI and CA-CDI (secondary outcomes).

Results: The annual incidence of HI-CDI increased from 3.25/10 000 patient-days (PD) in 2011 to 4.03/10 000 PD in 2012. Poisson regression modelling demonstrated a 29% increase (95% CI, 25% to 34%) per quarter between April and December 2011, with a peak of 4.49/10 000 PD in the October–December quarter. The incidence plateaued in January–March 2012 and then declined by 8% (95% CI, −11% to −5%) per quarter to 3.76/10 000 PD in July–September 2012, after which the rate rose again by 11% (95% CI, 4% to 19%) per quarter to 4.09/10 000 PD in October–December 2012. Trends were similar for HA-CDI and CA-CDI. A subgroup analysis determined that 26% of cases were CA-CDI.

Conclusions: A significant increase in both HA-CDI and CA-CDI identified through hospital surveillance occurred in Australia during 2011–2012. Studies are required to further characterise the epidemiology of CDI in Australia.

Global rates of hospital-associated *Clostridium difficile* infection (HA-CDI) have increased dramatically over the past 10 years. The emergence of fluoroquinolone-resistant *C. difficile* polymerase chain reaction (PCR) ribotype (RT) 027 in North America in 2003 and in Europe in 2005 has been associated with increased morbidity and mortality.[1,2] The appearance of RT027 in Australia was delayed, with the first reported case occurring in Western Australia in 2009 in a patient who apparently acquired the infection overseas.[3] The first case of locally acquired infection did not occur until 2010 in Melbourne, Victoria.[4] The reasons for this delay are unclear but could be due to Australia's geography, which may impede the introduction of new strains into the country, and slow their spread due to the distances between major cities.[5] Aus-

Increasing incidence of Clostridium difficile infection, Australia, 2011-2012. MJA 2014; 200: 272-276

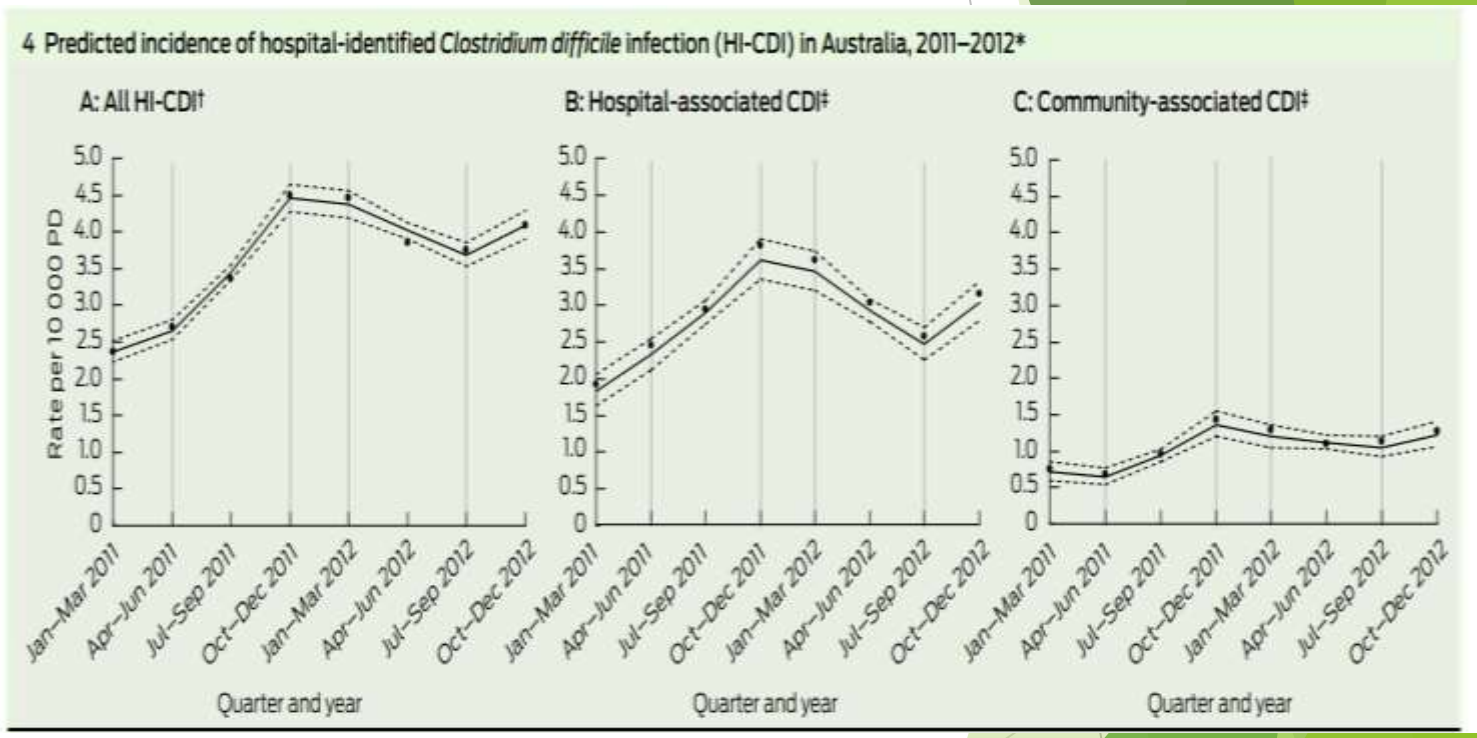
Clostridium difficile surveillance in Australian is undertaking on a national level

Results:

- The incidence plateaued in January–March 2012 and then declined by 8% (95% CI, ▫ 11% to ▫ 5%) per quarter to 3.76/10 000 PD in July–September 2012
- After which the rate rose again by 11% (95% CI, 4% to 19%) per quarter to 4.09/10 000 PD in October–December 2012
- Trends were similar for HA-CDI and CA-CDI. A subgroup analysis determined that **26% of case were CA-CDI**

Conclusions

- "A significant increase in both HA-CDI and CA-CDI identified through hospital surveillance occurred in Australia during 2011–2012



Increasing incidence of Clostridium difficile infection, Australia, 2011-2012. MJA 2014; 200: 272-276

Clostridium difficile outbreaks in Hong Kong

- **Report outbreaks of acute gastroenteritis (AGE) including those related to C. difficile**
- 2004 to 2013
- Total of 1,746 AGE outbreaks
- 829 occurred in residential care homes for elderly
- 163 hospitals
- **C. difficile**
  - 16 outbreaks affecting 93 persons
    - All occurred in hospitals
  - The first C. difficile was in May 2006
    - Affected 10 persons
  - There was no further case recorded until June 2011
    - Four to six outbreaks recorded annually

衞生防護中心
Centre for Health Protection

Scientific Committee on Enteric Infections and Foodborne Diseases

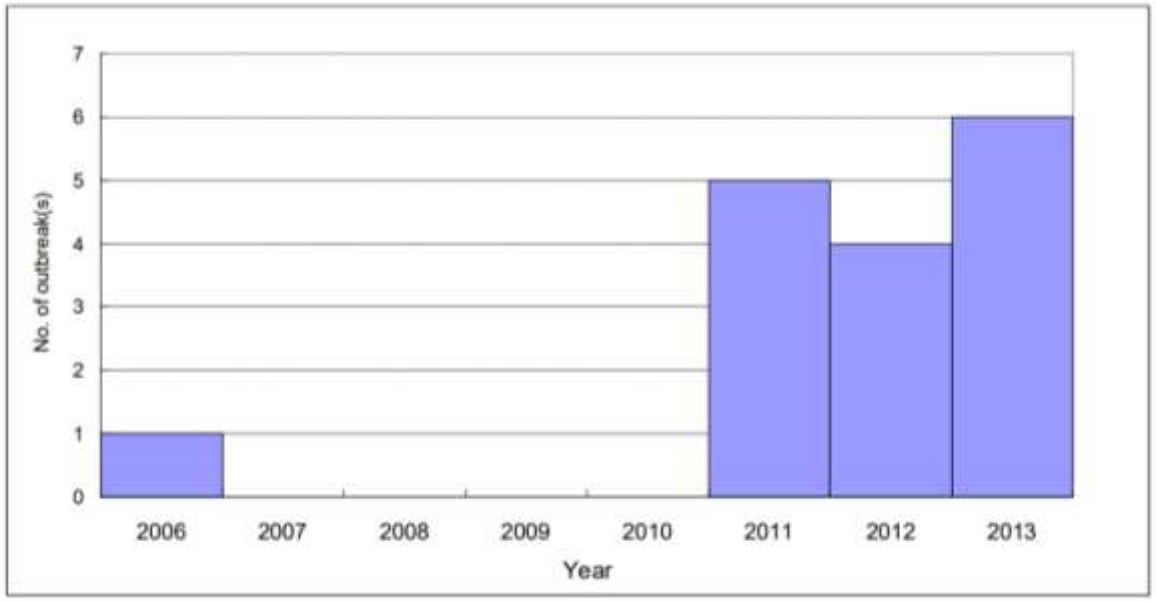


Figure 1 Number of AGE outbreaks associated with *C. difficile*, 2006 to 2013

Scientific Committee on Enteric Infections and Foodborne Diseases Epidemiology, Prevention and control of Clostridium difficile associated outbreaks in Hong Kong. Centre for Health Protection August 2014

Acinetobacter

- **Outbreaks**
  - Intensive care units and healthcare settings housing very ill patients
  - Pneumonia
  - serious blood or wound infections
  - Can “colonise” tracheostomy sites or open wounds
- **Those at risk**
  - very ill patients on a ventilator
  - those with a prolonged hospital stay
  - those who have open wounds
  - person with invasive devices like urinary
- *Acinetobacter* can be spread to susceptible persons by person-to-person contact or contact with contaminated surfaces
- **High rate of antibiotic resistance**
  - Up to **70% mortality rate** from infections caused by XDR strains in some case series

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Clinical and Pathophysiological Overview of *Acinetobacter* Infections: a Century of Challenges

Darren Wong[a], Travis B. Nielsen[a,b], Robert A. Bonomo[c], Paul Pantapalangkoor[b], Brian Luna[a,b] and Brad Spellberg[a,b,d]

Author Affiliations

SUMMARY

Acinetobacter is a complex genus, and historically, there has been confusion about the existence of multiple species. The species commonly cause nosocomial infections, predominantly aspiration pneumonia and catheter-associated bacteremia, but can also cause soft tissue and urinary tract infections. Community-acquired infections by *Acinetobacter* spp. are increasingly reported. Transmission of *Acinetobacter* and subsequent disease is facilitated by the organism's environmental tenacity, resistance to desiccation, and evasion of host immunity. The virulence properties demonstrated by *Acinetobacter* spp. primarily

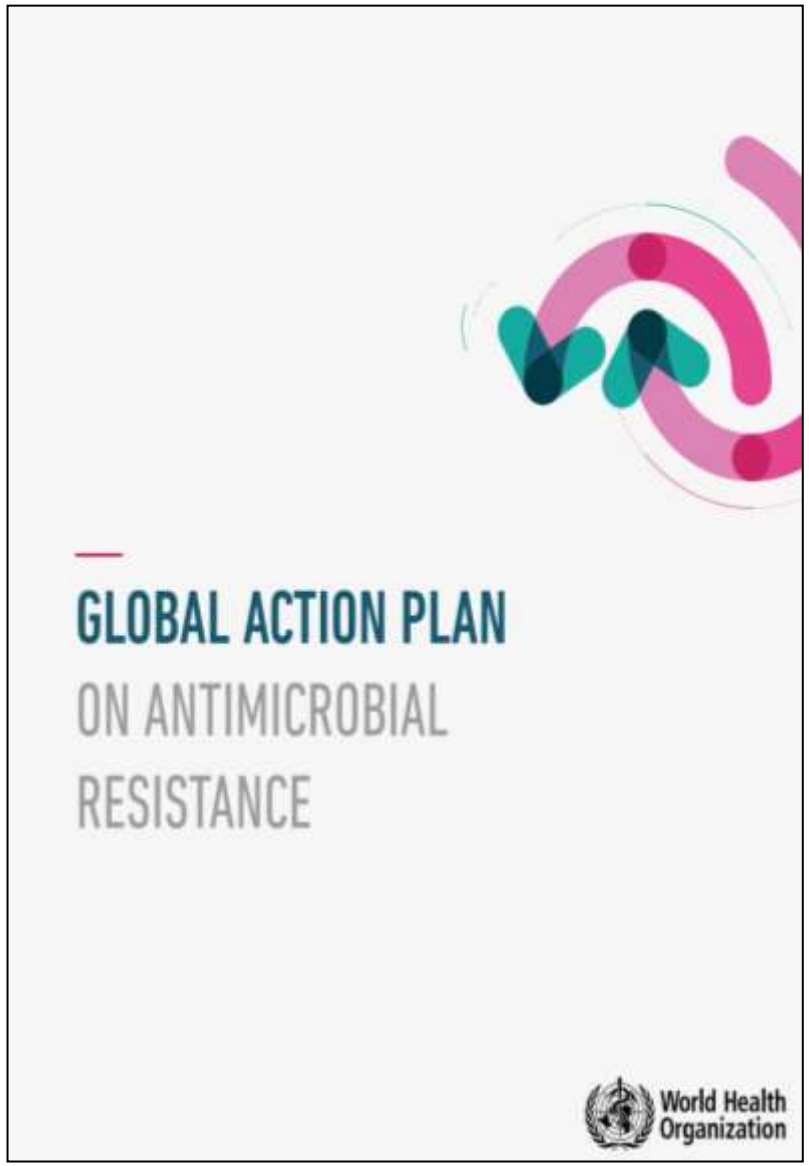
Clin. Microbiol. Rev. January 2017 vol. 30 no. 1 409-447

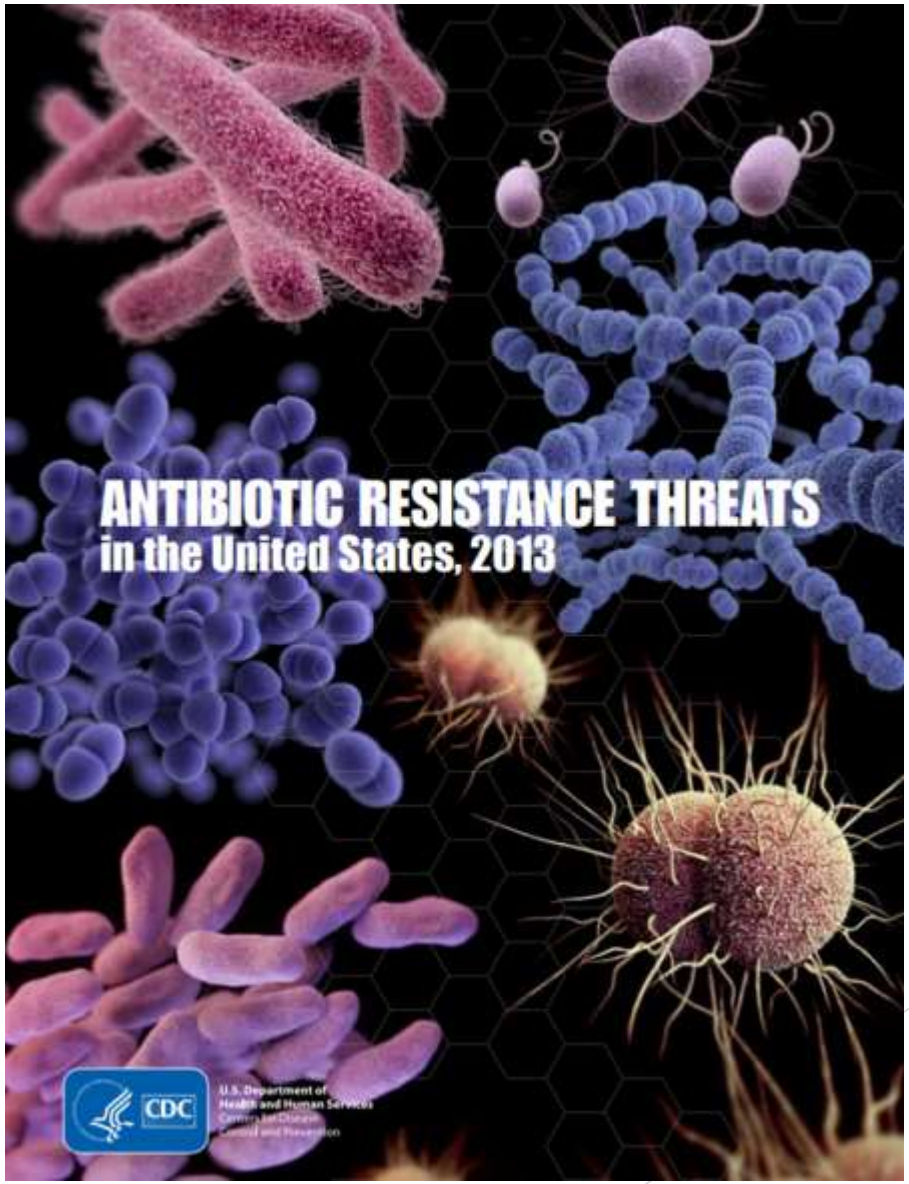
Multidrug-resistant *Pseudomonas*

- **Serious *Pseudomonas* infections usually occur in people in hospital and/or with weakened immune systems**
  - Infections of the blood, pneumonia, and infections following surgery can lead to severe illness and death in these people
  - Patients in hospitals, especially those on breathing machines, those with devices such as catheters, and patients with wounds from surgery or from burns are potentially at risk for serious, life-threatening infections
  - ***Multidrug-resistant Pseudomonas* can be deadly for patients in critical care**
  - An estimated 51,000 healthcare-associated *P. aeruginosa* infections occur in the United States each year
  - More than 6,000 (13%) of these are multidrug-resistant, with roughly 400 deaths per year attributed to these infections
  - ***Multidrug-resistant Pseudomonas* was given a threat level of serious threat in the CDC Antibiotic Resistance Threats Report**

https://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf

MDRO control strategies - International and National strategies





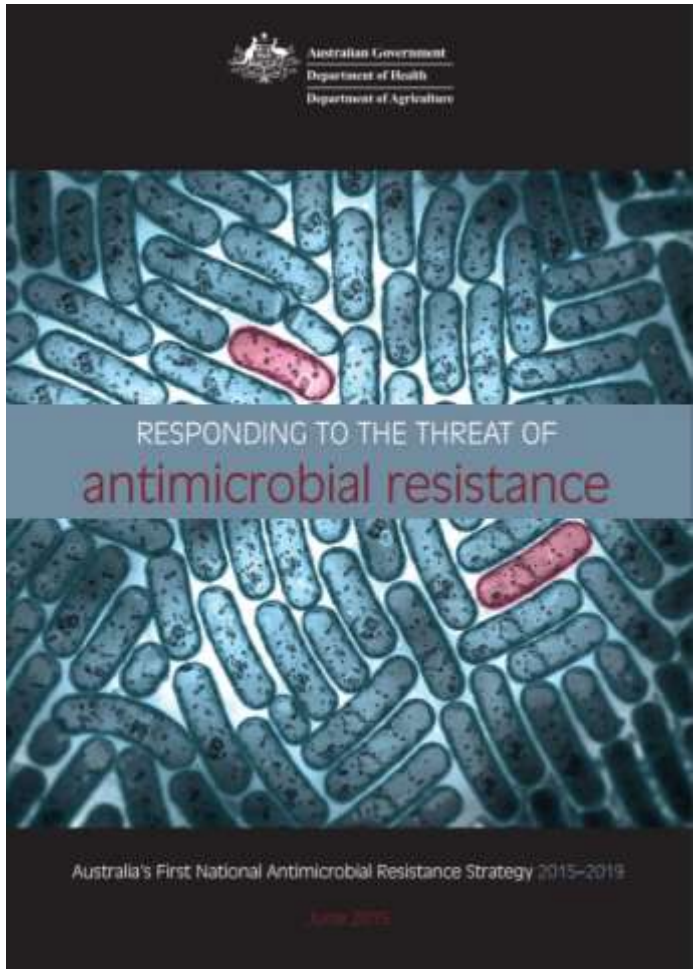
MDRO control strategies - Gaps

- Limited national, state, and federal **capacity** to detect and respond to urgent and emerging antibiotic resistance threats
- Currently, there is **no systematic international surveillance** of antibiotic resistance threats
- Data on **antibiotic use** in **human healthcare** and in **agriculture** are **not systematically collected**
- **Programs to improve antibiotic prescribing** are **not widely used** in the United States
- **Advanced technologies** can identify threats much faster than current practice are **not being used as widely as necessary**

CDC antibiotic Resistance threatshttps://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf

Australia's First National Antimicrobial Resistance Strategy 2015-2019

RESPONSE TO THE THREAT

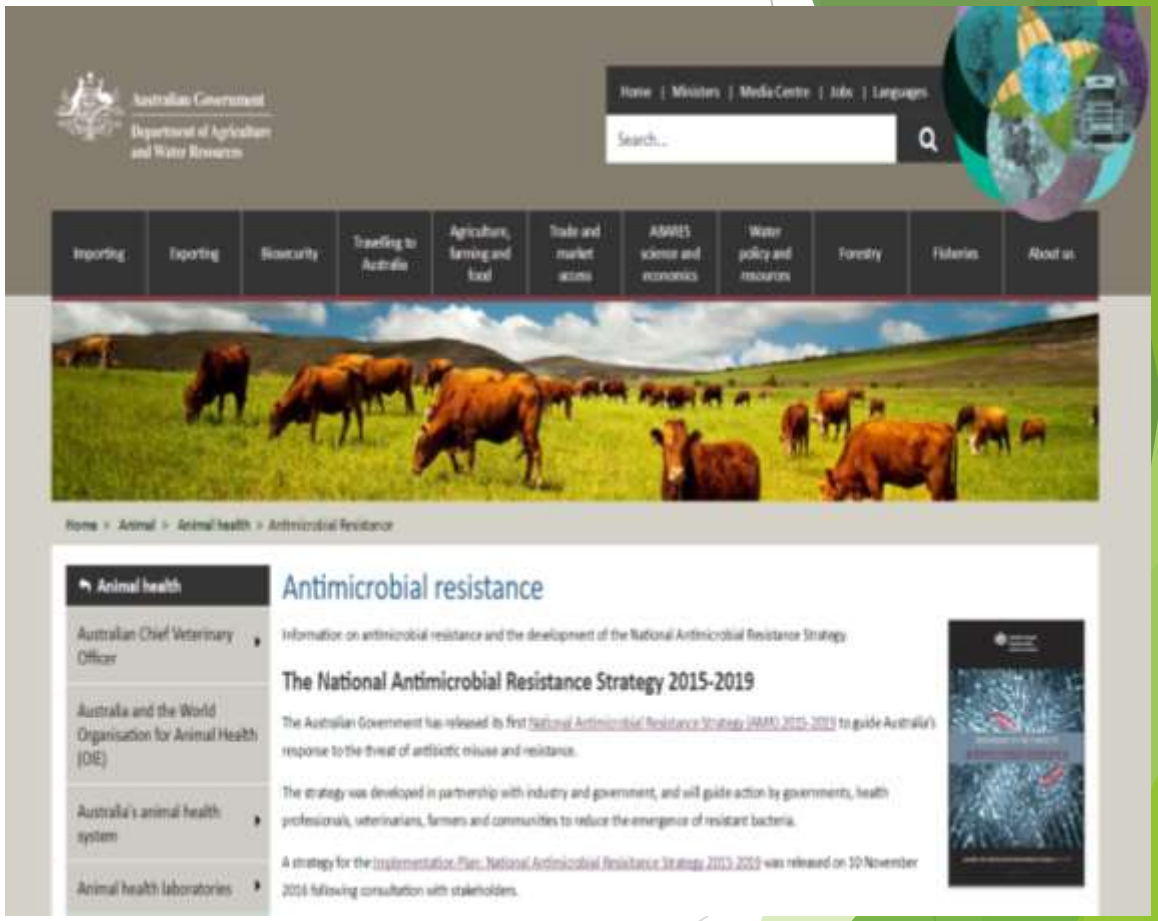


IMPLEMENTATION PLAN

Responding to the threat of antimicrobial resistance & Implementation plan
Australia's First National Antimicrobial Resistance Strategy 2015-2019
June 2015 http://www.health.gov.au

Australia's First National Antimicrobial Resistance Strategy 2015-2019

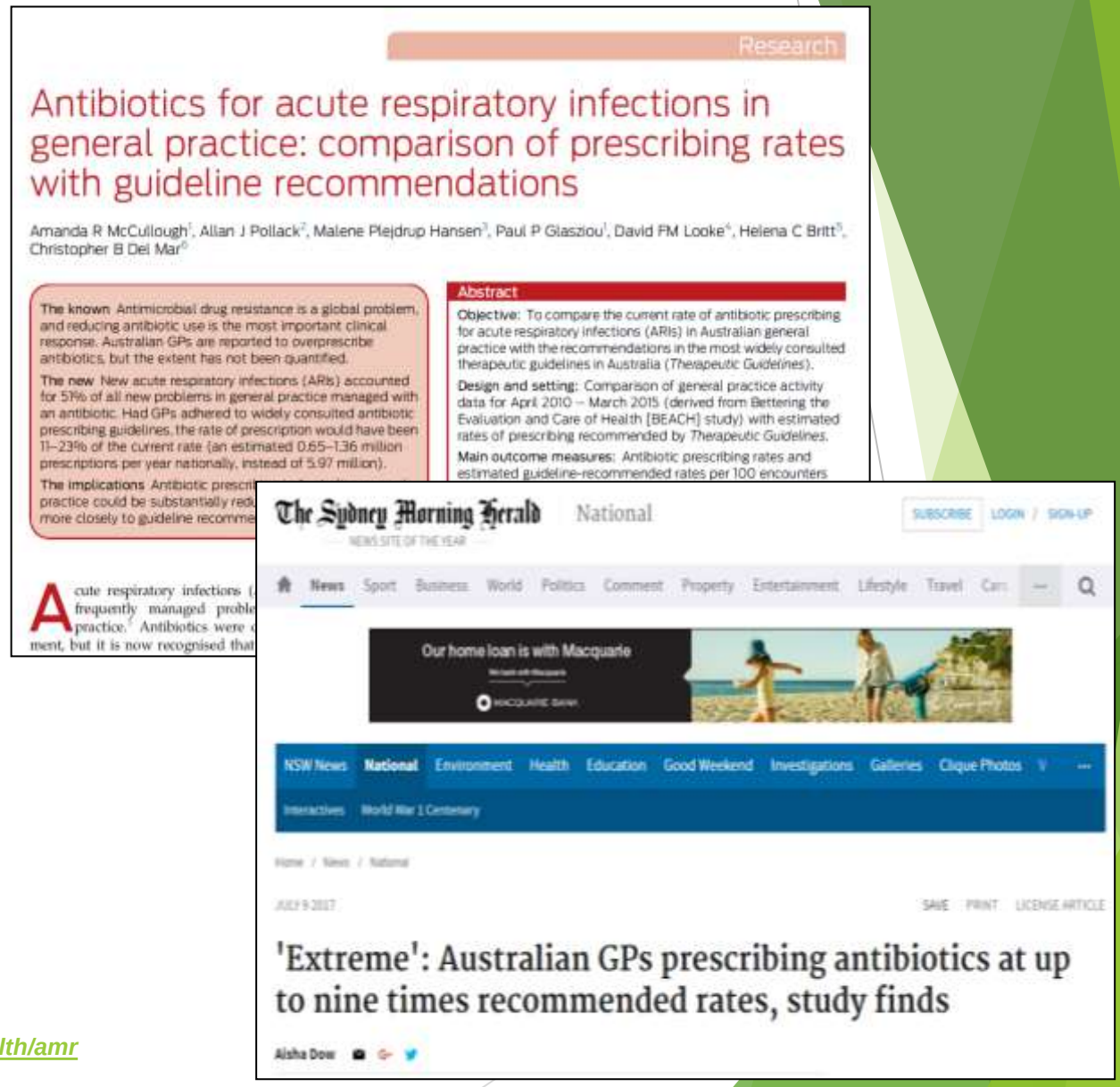
- **Seven objectives**
- **Objective 1:** Increase awareness and understanding of AMR, its implications, and actions to combat it through effective communication, education and training
- **Objective 2:** Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials
- **Objective 3:** Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage
- **Objective 4:** **Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of AMR**



Responding to the threat of antimicrobial resistance & Implementation plan
Australia's First National Antimicrobial Resistance Strategy 2015-2019
June 2015 http://www.health.gov.au http://www.agriculture.gov.au/animal/health/amr

Australia's First National Antimicrobial Resistance Strategy 2015-2019

- **Seven objectives…….**
- **Objective 5:** Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain AMR
- **Objective 6:** Strengthen international partnerships and collaboration on regional and global efforts to respond to AMR
- **Objective 7:** Establish and support clear governance arrangements at the local, jurisdictional, national and international levels to ensure leadership, engagement and accountability for actions to combat AMR



Research

Antibiotics for acute respiratory infections in general practice: comparison of prescribing rates with guideline recommendations

Amanda R McCullough, Allan J Pollack, Malene Plejdrup Hansen, Paul P Glasziou, David FM Looke, Helena C Britt, Christopher B Del Mar

The known Antimicrobial drug resistance is a global problem, and reducing antibiotic use is the most important clinical response. Australian GPs are reported to overprescribe antibiotics, but the extent has not been quantified.

The new New acute respiratory infections (ARIs) accounted for 51% of all new problems in general practice managed with an antibiotic. Had GPs adhered to widely consulted antibiotic prescribing guidelines, the rate of prescription would have been 11–23% of the current rate (an estimated 0.65–1.36 million prescriptions per year nationally, instead of 5.97 million).

The implications Antibiotic prescri… practice could be substantially red… more closely to guideline recomme…

Abstract

Objective: To compare the current rate of antibiotic prescribing for acute respiratory infections (ARIs) in Australian general practice with the recommendations in the most widely consulted therapeutic guidelines in Australia (*Therapeutic Guidelines*).

Design and setting: Comparison of general practice activity data for April 2010 – March 2015 (derived from Bettering the Evaluation and Care of Health [BEACH] study) with estimated rates of prescribing recommended by *Therapeutic Guidelines*.

Main outcome measures: Antibiotic prescribing rates and estimated guideline-recommended rates per 100 encounters

Acute respiratory infections … frequently managed proble… practice.[7] Antibiotics were … ment, but it is now recognised that …

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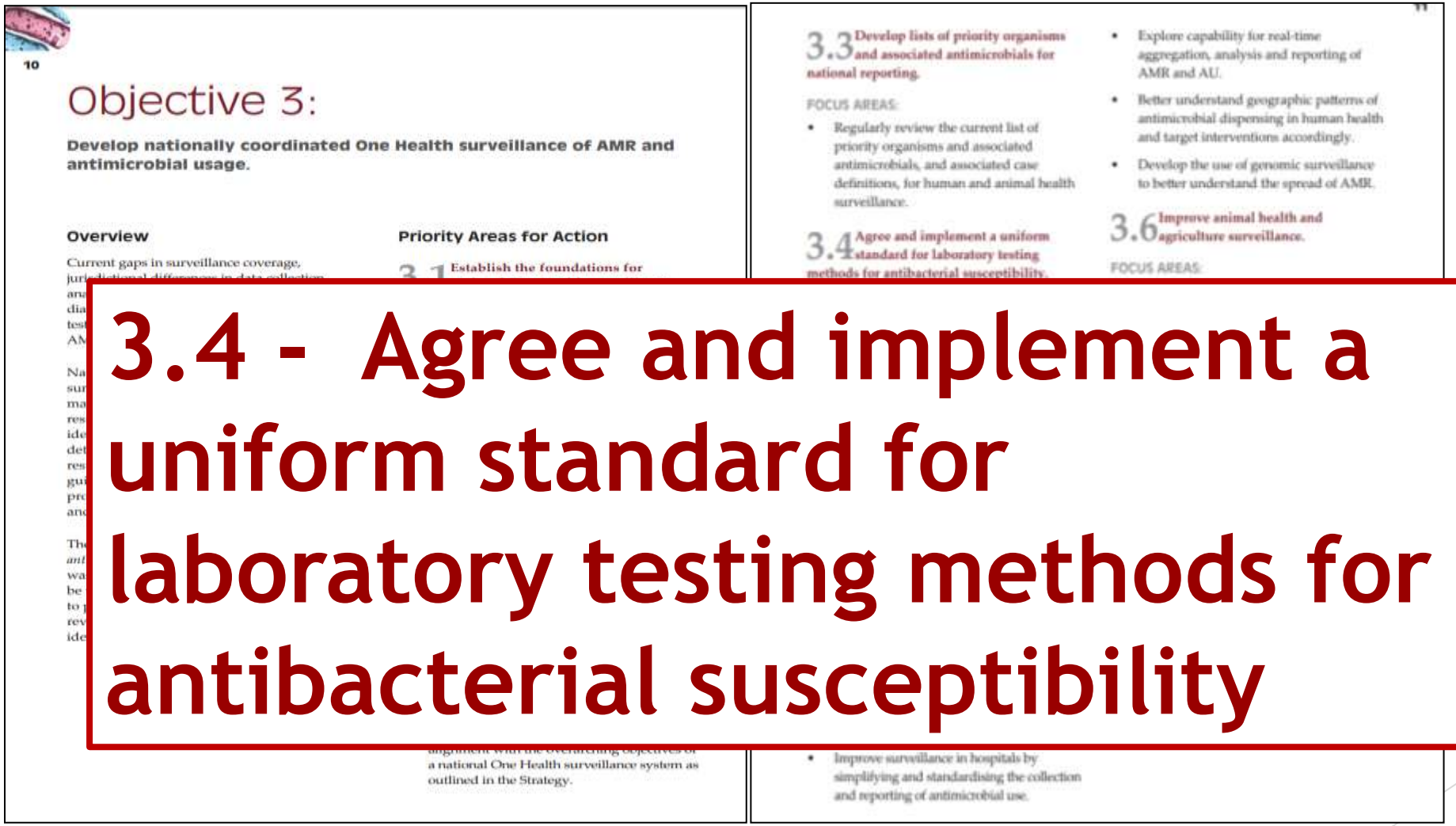
'Extreme': Australian GPs prescribing antibiotics at up to nine times recommended rates, study finds

Aisha Dow

Responding to the threat of antimicrobial resistance & Implementation plan
Australia's First National Antimicrobial Resistance Strategy 2015-2019
June 2015 http://www.health.gov.au http://www.agriculture.gov.au/animal/health/amr
MJA 207 (2) j 17 July 2017

Objective 3: Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage



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Objective 3:

Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage.

Overview

Current gaps in surveillance coverage,

Priority Areas for Action

3.1 Establish the foundations for

a national One Health surveillance system as outlined in the Strategy.

11

3.3 Develop lists of priority organisms and associated antimicrobials for national reporting.

FOCUS AREAS:

- Regularly review the current list of priority organisms and associated antimicrobials, and associated case definitions, for human and animal health surveillance.

3.4 Agree and implement a uniform standard for laboratory testing methods for antibacterial susceptibility.

- Explore capability for real-time aggregation, analysis and reporting of AMR and AU.
- Better understand geographic patterns of antimicrobial dispensing in human health and target interventions accordingly.
- Develop the use of genomic surveillance to better understand the spread of AMR.

3.6 Improve animal health and agriculture surveillance.

FOCUS AREAS:

- Improve surveillance in hospitals by simplifying and standardising the collection and reporting of antimicrobial use.

3.4 - Agree and implement a uniform standard for laboratory testing methods for antibacterial susceptibility

Responding to the threat of antimicrobial resistance & Implementation plan
Australia's First National Antimicrobial Resistance Strategy 2015-2019
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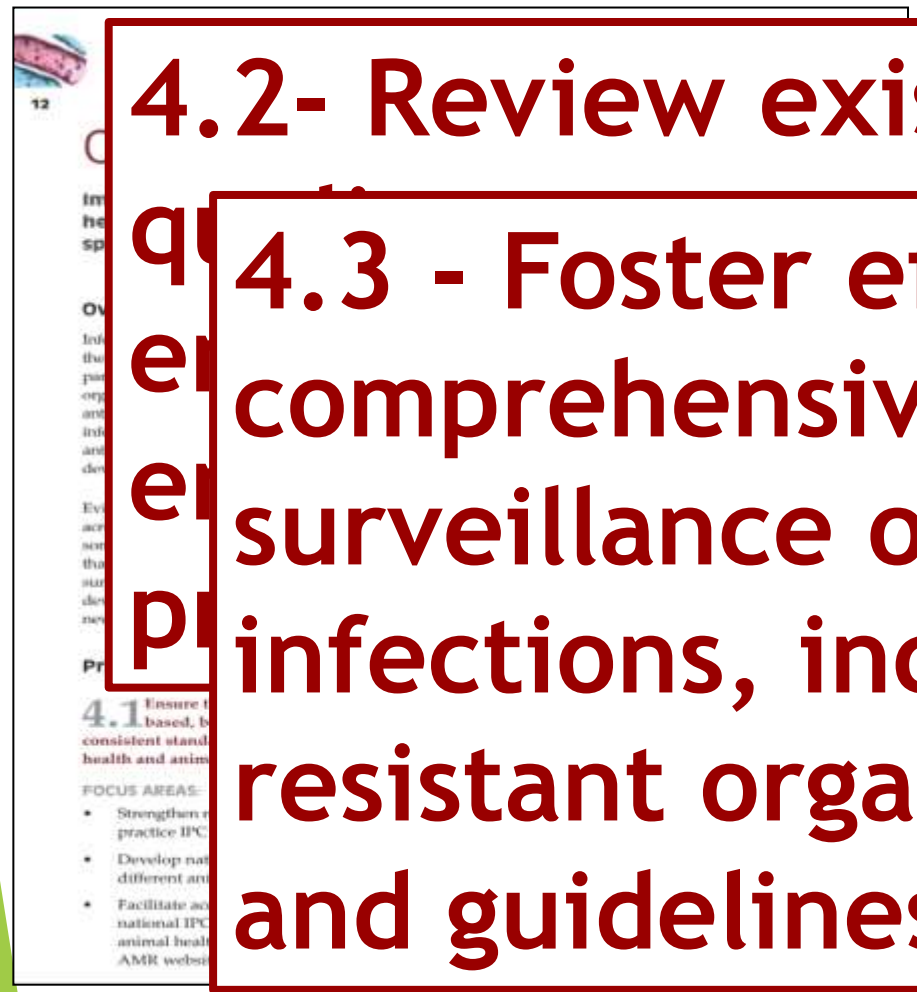
Objective 4: Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of AMR



4.2- Review existing accreditation and q… e… e… p…

4.3 - Foster efforts to establish comprehensive and integrated national surveillance of healthcare-associated infections, including for resistant and non-resistant organisms, to inform IPC policy and guidelines

Responding to the threat of antimicrobial resistance & Implementation plan
Australia's First National Antimicrobial Resistance Strategy 2015-2019
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General approaches to healthcare-associated infection (HAI) prevention

- **Vertical Approaches**
  - Aim to reduce colonization, infection, and transmission of specific pathogens, largely through use of active surveillance testing, followed by implementation of measures aimed at preventing transmission
- **Horizontal Approaches**
  - Aim to reduce the risk of infections due to a broad array of pathogens through implementation of standardized practices that do not depend on patient-specific conditions
  - Examples include:
    - Minimizing the unnecessary use of invasive medical devices
    - Enhancing hand hygiene
    - Improving environmental cleaning
    - Promoting antimicrobial stewardship
- **Vertical and horizontal approaches are not mutually exclusive and are often intermixed**
- **Some experts believe that the horizontal approach offer the best overall value given the constrained resources available for infection prevention efforts**

General approaches to healthcare-associated infection (HAI) prevention

- **Horizontal Approaches**
  - Focus on approaches that target all rather than selected organisms in the absence of an organism-specific epidemic (outbreaks)
    - Local knowledge of microbial epidemiology and ecology
    - Supported by a robust quality improvement program
  - Some experts believe that the horizontal approach offer the best overall value given the constrained resources available for infection prevention efforts
- **Screening**
  - Understand the relative benefits and costs of pathogen-specific screening and intervention strategies compared to reliable application of more general methods to mitigate transmission and infection
- **Reliable implementation is critical for either vertical or horizontal strategies**

International Journal of Infectious Diseases 14S4 (2010) S3–S5

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Infection control: the case for horizontal rather than vertical interventional programs

Richard P. Wenzel*, Michael B. Edmond

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SUMMARY

The authors define two types of infection control interventions: *horizontal*, in which all infections at any site are reduced; and *vertical*, in which only specific organisms are targeted. We suggest that horizontal programs should form the platform of all infection control programs and the key question should be, what is the incremental value of a new vertical program?

1. Introduction

In developed countries, 5–10% of hospitalized patients encounter an infection that was not present or incubating on admission. In the USA, with 35 million admissions annually to acute care institutions, that percentage translates to 1.75–3.5 million infections, of which 10% each (175 000–350 000) involve both the bloodstream and the lung.[1–5] The crude mortality of both nosocomial bloodstream infections and pneumonias is approximately 25–30% (43 750–105 000 deaths in each category). The proportion of the deaths directly linked to the infection after accounting for the mortality of the underlying diseases is called the attributable mortality.[6] With bloodstream infections, approximately one half of the deaths are directly attributable to the infection (21 875–52 500 deaths).[3,4] With nosocomial pneumo-

all infections due to all pathogens; and (2) narrow programs focusing on a single pathogen or single anatomic site. The former are referred to as 'horizontal' programs and the latter as 'vertical'.[7,8] There is strong debate in the infection control arena about which is the more beneficial approach. An example of the focus of controversy is the strong advocacy by some infection control experts for methicillin-resistant *Staphylococcus aureus* (MRSA) nasal screening of inpatients (vertical program)[9] vs. a more broad-based horizontal program.[7,8]

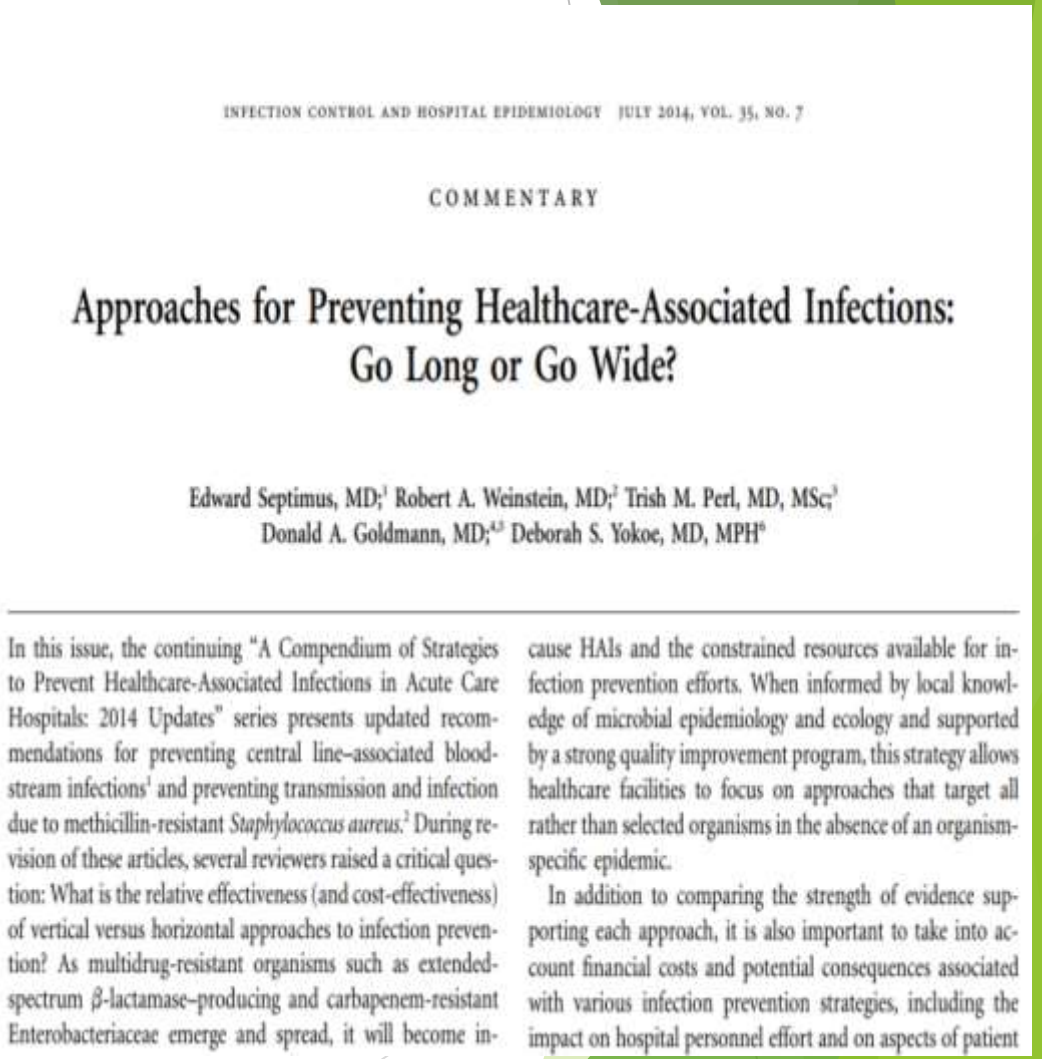
This paper will summarize the current level of evidence for programs advocated in infection control and explore the relative merits of horizontal and vertical programs.

2.1. Grading evidence

Wenzel RP and Edmond MB. Infection control: the case for horizontal rather than vertical interventional programs. International Journal of Infectious Diseases 14S4 (2010) S3-S5

General approaches to healthcare-associated infection (HAI) prevention

- **Summary**
  - Use **robust quality improvement methods to ensure reliable performance of basic infection prevention practices** known to mitigate transmission of MDROs and the infections they cause
  - Ensure **adherence to evidence-based universally applied HAI prevention strategies** including:
    - Hand hygiene
    - Antimicrobial stewardship and
    - Adequate environmental cleaning
  - **Apply other evidence-based, horizontal strategies such as universal decolonization in settings where benefits are likely to outweigh risks and costs**
  - Use active surveillance screening and other vertical approaches selectively **when epidemiologically important pathogens are newly emerging and rare to a given institution or region or to control outbreaks of specific pathogens**



INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JULY 2014, VOL. 35, NO. 7

COMMENTARY

Approaches for Preventing Healthcare-Associated Infections: Go Long or Go Wide?

Edward Septimus, MD;[1] Robert A. Weinstein, MD;[2] Trish M. Perl, MD, MSc;[3] Donald A. Goldmann, MD;[4,5] Deborah S. Yokoe, MD, MPH[6]

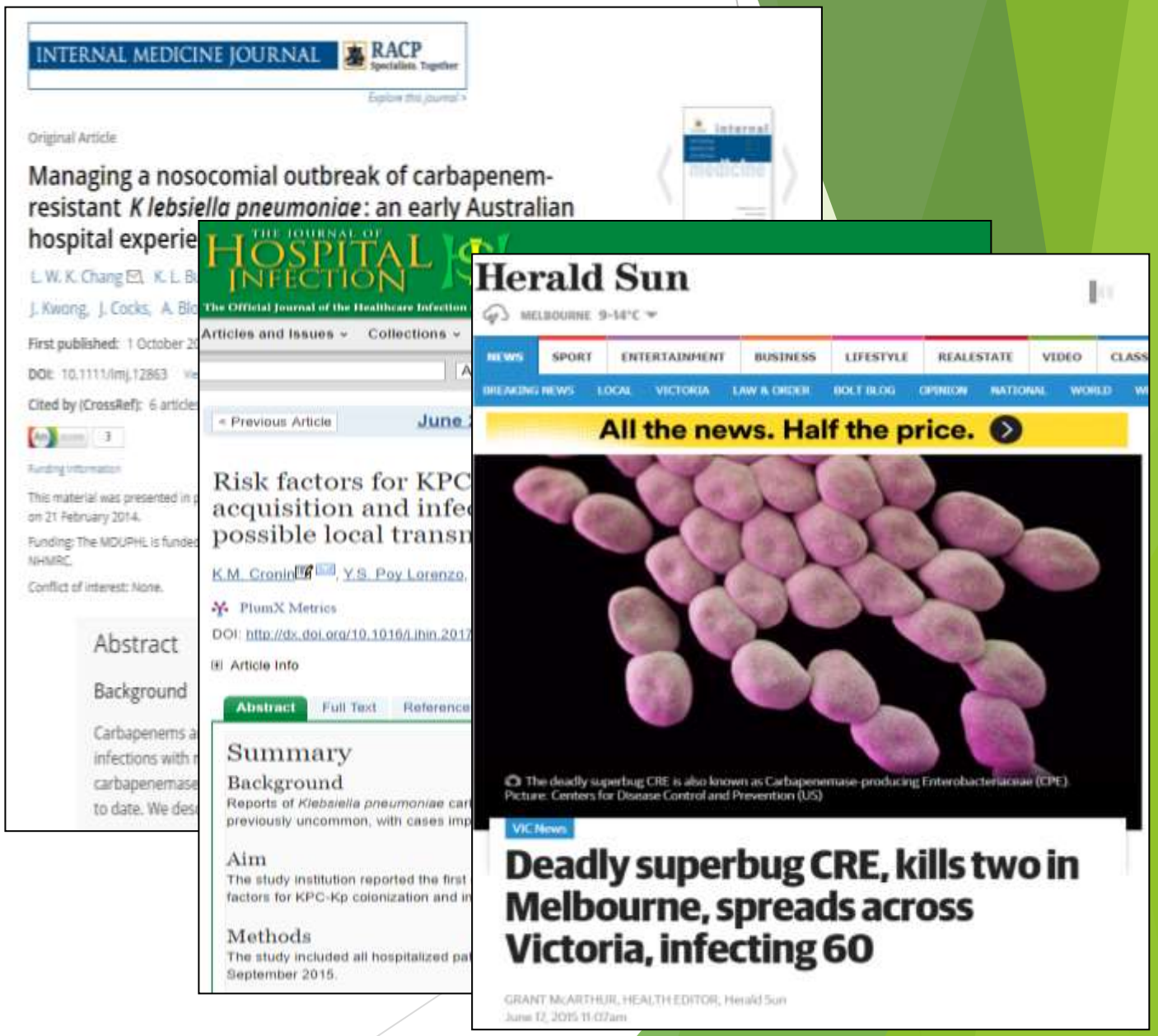
In this issue, the continuing "A Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals: 2014 Updates" series presents updated recommendations for preventing central line–associated bloodstream infections[1] and preventing transmission and infection due to methicillin-resistant *Staphylococcus aureus*.[2] During revision of these articles, several reviewers raised a critical question: What is the relative effectiveness (and cost-effectiveness) of vertical versus horizontal approaches to infection prevention? As multidrug-resistant organisms such as extended-spectrum β-lactamase–producing and carbapenem-resistant Enterobacteriaceae emerge and spread, it will become increase HAIs and the constrained resources available for infection prevention efforts. When informed by local knowledge of microbial epidemiology and ecology and supported by a strong quality improvement program, this strategy allows healthcare facilities to focus on approaches that target all rather than selected organisms in the absence of an organism-specific epidemic.

In addition to comparing the strength of evidence supporting each approach, it is also important to take into account financial costs and potential consequences associated with various infection prevention strategies, including the impact on hospital personnel effort and on aspects of patient

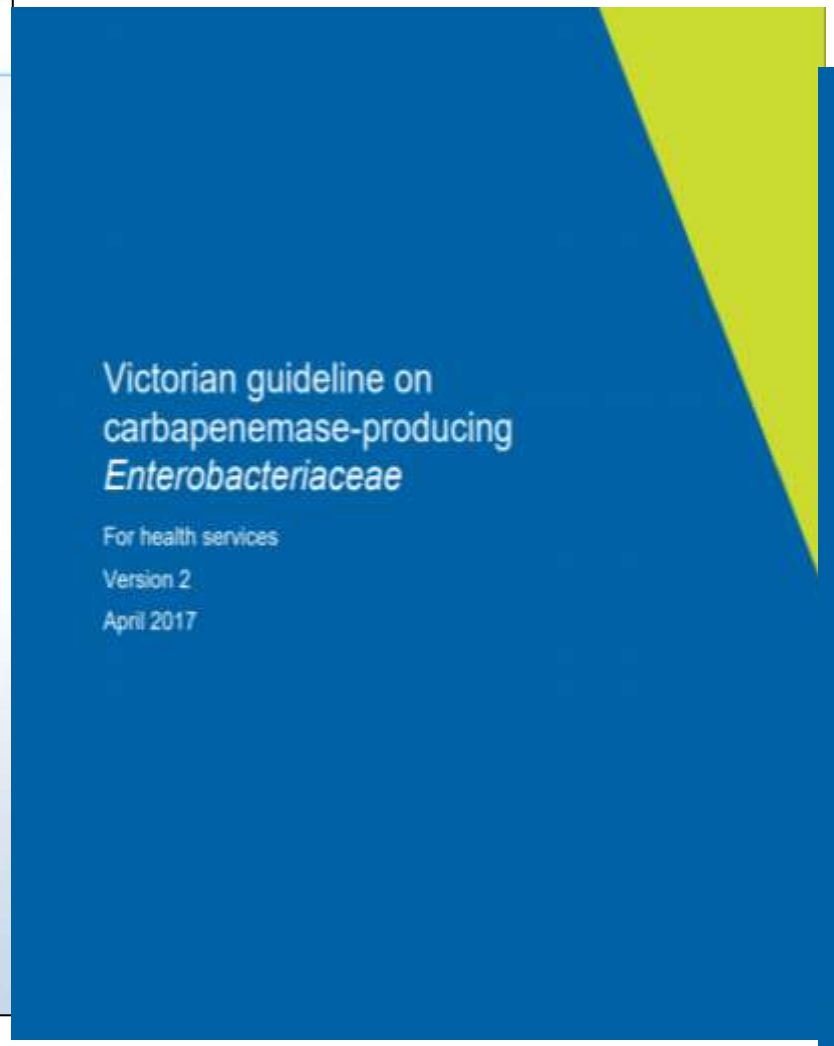
Septimus E, MD, Weinstein RA, Perl TM, Goldmann DA and Yokoe DS. Commentary: Approaches for Preventing Healthcare-Associated Infections: Go Long or Go Wide? Infection Control and Hospital Epidemiol. Vol. 35, No. 7, July 2014.

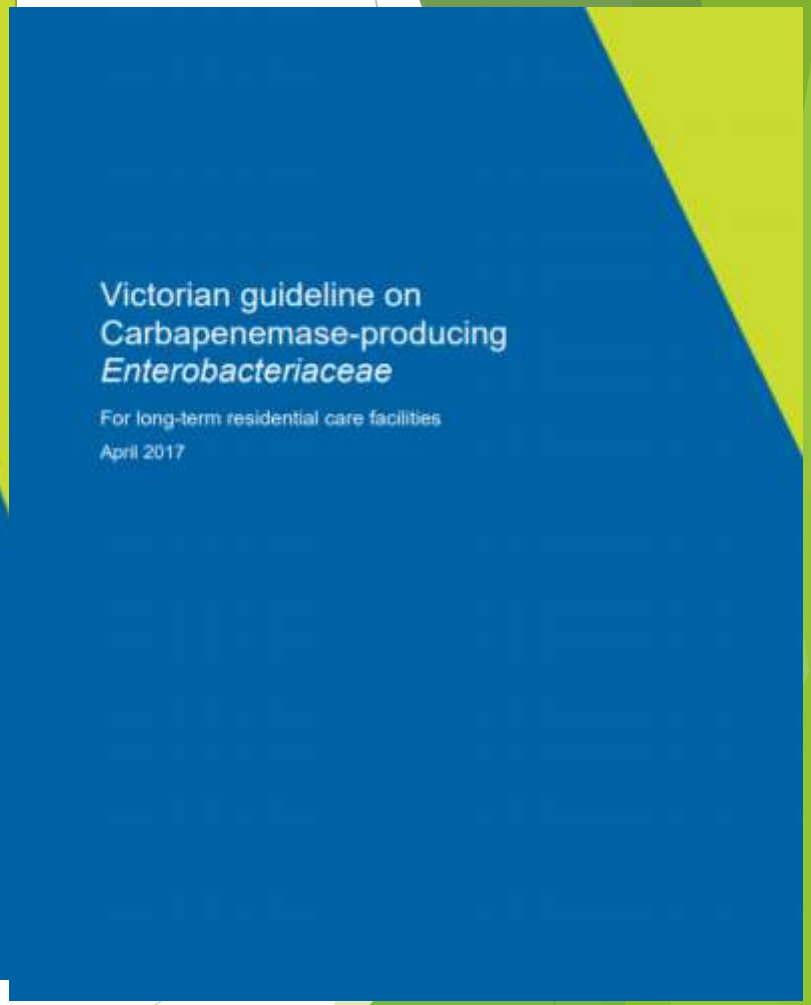
Surveillance screening and other vertical approaches
Carbapenemase-producing Enterobacteriaceae

- **CPE in Australia**
  - Lower than that observed in some areas of Europe, North America, the Middle East and Asia
  - Prior to 2012, identification of CPE in Victoria was limited to patients with recent overseas hospitalisation in high burden countries
- **2012 and 2015**
  - An increase in one particular carbapenemase, KPC throughout Victoria
  - An investigation concluded that KPC transmission in Victoria was driven by discrete healthcare associated outbreaks in a number of healthcare facilities
  - A state-wide epidemiological and laboratory surveillance system was commenced



Surveillance screening and other vertical approaches
Carbapenemase-producing Enterobacteriaceae





ACSQHC. Recommendations for the control of carbapenemase-producing Enterobacteriaceae (CPE). A guide for acute care health facilities 2017 https://www.safetyandquality.gov.au
Carbapenemase-producing Enterobacteriaceae - management guidelines
https://www2.health.vic.gov.au

Surveillance screening and other vertical approaches
Carbapenemase-producing Enterobacteriaceae

- Management Plans for CPE
- CPE Surveillance and Response Unit (VCSRU)
- Victorian CPE Incident Management Team (VCIMT)
- Health Service Incident Management Team (HSIMT)
- Data collection for a case of CPE
  - Part A: Confirmed CPE event
    - 5 pages
  - Part B: Outbreak case risk history
    - 4 pages

Confidential
Surveillance of Carbapenemase producing Enterobacteriaceae (CPE)

VICTORIA State Government | Health and Human Services

Please return completed form within 24 hours of CPE confirmation to the VICNISS Coordinating Centre **by faxing 03 9342 9355.**
For enquiries telephone 03 9342 9333.

Office use only 320

Part A: Confirmed CPE event

Case details – please answer all questions

Last name

First name(s)

Date of birth

Sex: Male, Female, Other, specify

Residential address

Suburb/town

Postcode

Tel home

Tel mobile

Parent/guardian/next of kin name and contact number

CPE specimen details

Specimen collection date

Specimen ID (local lab)

Location of case at time of specimen collection
- Acute hospital – admitted
- Acute hospital – emergency
- General practice
- Residential aged care
- Sub-acute (e.g. rehabilitation)
- Unknown
- Other, specify below

Facility name

Patient identifier (UR number)

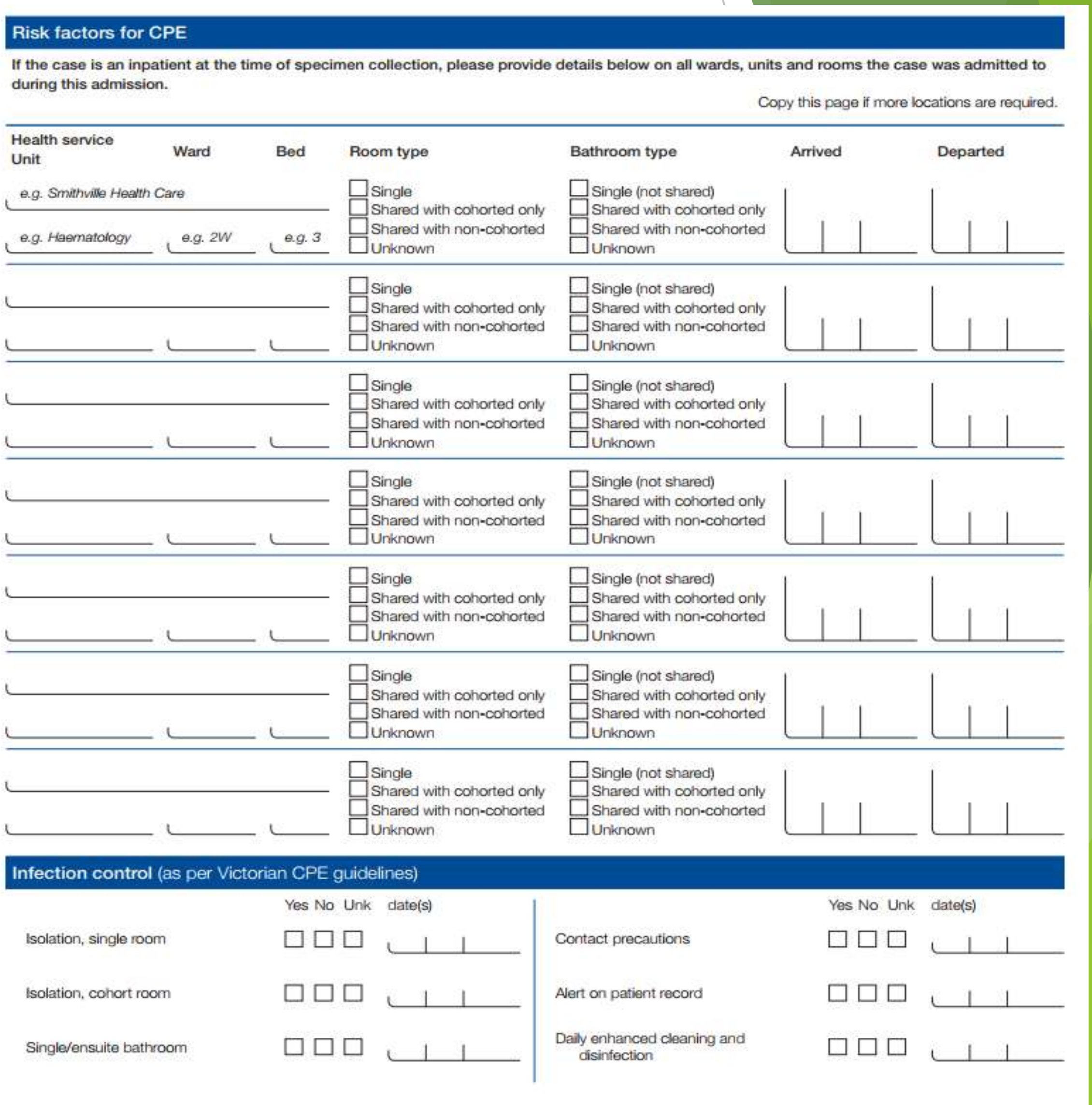
Treating unit/ward

Case presented to this location from
- Acute hospital within Australia

Carbapenemase-producing Enterobacteriaceae - management guidelines
https://www2.health.vic.gov.au

Surveillance screening and other vertical approaches Victoria - CPE containment strategies

- Contact tracing and screening
- Transmission based precautions
  - Contact precautions
- Declaration as a Transmission Risk Area (TRA)
  - Two or more confirmed cases of genetically related CPE as determined by the public health laboratory and
  - At least one case is a locally acquired case and
  - There is a plausible epidemiological connection between the two cases
- TRAs notified to other unaffected public and private health services
- Enhanced Environmental cleaning
- Education and communication
- Audits of infection control practices



Risk factors for CPE

If the case is an inpatient at the time of specimen collection, please provide details below on all wards, units and rooms the case was admitted to during this admission.

Copy this page if more locations are required.

Health service Unit	Ward	Bed	Room type	Bathroom type	Arrived	Departed
e.g. Smithville Health Care e.g. Haematology	e.g. 2W	e.g. 3	☐ Single ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown	☐ Single (not shared) ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown		
			☐ Single ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown	☐ Single (not shared) ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown		
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			☐ Single ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown	☐ Single (not shared) ☐ Shared with cohorted only ☐ Shared with non-cohorted ☐ Unknown		

Infection control (as per Victorian CPE guidelines)

	Yes	No	Unk	date(s)		Yes	No	Unk	date(s)
Isolation, single room	☐	☐	☐		Contact precautions	☐	☐	☐	
Isolation, cohort room	☐	☐	☐		Alert on patient record	☐	☐	☐	
Single/ensuite bathroom	☐	☐	☐		Daily enhanced cleaning and disinfection	☐	☐	☐	

Carbapenemase-producing Enterobacteriaceae - management guidelines https://www2.health.vic.gov.au

MDROs and the environmental - what we know

- **Contaminated of environmental surfaces in hospital rooms plays an important role in the transmission of several healthcare associated pathogens** including;
  - Methicillin-resistant *Staphylococcus aureus* (MRSA)
  - Vancomycin-resistant *Enterococcus spp* (VRE)
  - *Clostridium difficile*
  - *Acinetobacter spp*
  - Norovirus and
  - *Possibly Candida auris*
    - Recovered from the hospital environment
      - Suggesting contaminated surfaces may be a source of transmission
      - CDC recommend daily and post-discharge disinfection of surfaces in rooms of patients with C. auris infection

UK Independent Tuesday 15 August 2017

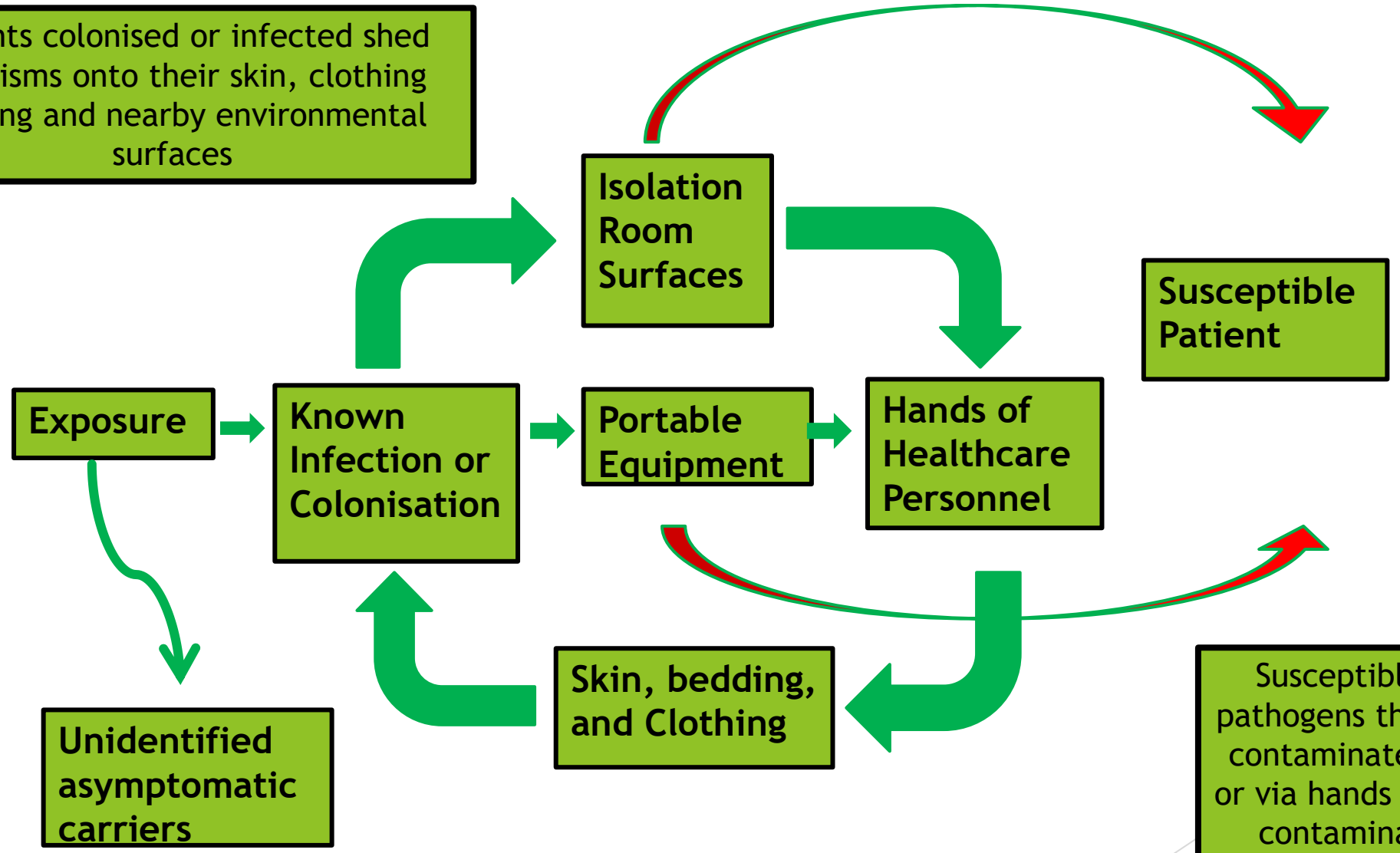
MDROs and the environmental - what we know

Organism	Duration of persistence on dry inanimate surfaces (range)
Clostridium difficile (spores)	5months
Acinetobacter spp.	3 days - 5 months
Enterococcus spp. including VRE	5 days – 4 months
Klebsiella spp.	2 hours - > 30 months
Pseudomonas aeruginosa	6 hours – 16 months
Serratia marcescens	3 days – 2 months
Staphylococcus aureus, inc MRSA	7 days – 7 months
Candida albicans	1 – 120 days
SARS Coronavirus	72hrs - >28 days
Influenza	Hours to several days

Kramer et al. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. BMC Infect Dis 2006;6:130.

MDROs and the environmental- what we know
Routes of transmission

Patients colonised or infected shed organisms onto their skin, clothing bedding and nearby environmental surfaces



Susceptible patients may acquire pathogens through direct contact with contaminated surfaces or equipment or via hands of staff that have become contaminated after contact with patients or environmental surfaces

Donskey et al. Does improving surface cleaning and disinfection reduce healthcare-associated infections? AJIC 41(2013) S12-S19

MDROs and the environmental - Rooms are not adequately cleaned

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY NOVEMBER 2008, VOL. 29, NO. 11

ORIGINAL ARTICLE

Improving Cleaning of the Environment Surrounding Patients in 36 Acute Care Hospitals

Philip C. Carling, MD; Michael M. Parry, MD; Mark E. Rupp, MD; John L. Po, MD, PhD; Brian Dick, MS, CIC; Sandra Von Beheren, RN, BSN, MS, CIC; for the Healthcare Environmental Hygiene Study Group

OBJECTIVE. The prevalence of serious infections caused by multidrug-resistant pathogens transmitted in the hospital setting has reached alarming levels, despite intensified interventions. In the context of mandates that hospitals ensure compliance with disinfection procedures of surfaces in the environment surrounding the patient, we implemented a multihospital project to both evaluate and improve current cleaning practices.

DESIGN. Prospective quasi-experimental, before-after, study.

SETTING. Thirty-six acute care hospitals in the United States ranging in size from 25 to 721 beds.

METHODS. We used a fluorescent targeting method to objectively evaluate the thoroughness of terminal room disinfection cleaning before and after structured educational and procedural interventions.

- 36 acute care hospitals
  - Fluorescent marker
  - **Baseline data**
    - **Thoroughness of cleaning score = mean 48.5%**

Carling PC et al. Infect Control Hosp Epidemiol 2008; 29:1035-1041

MDROs and the environmental - Rooms are not adequately cleaned

Table 1

Results of UVM compared with visual auditing for November 2014

Site	UVM compliance for terminal cleaning and daily cleaning, %	Internal visual audit results, %
Hospital A	Terminal: 58 Daily: 20	97.5
Hospital B	Terminal: 65 Daily: 58	85.9
Hospital C	Terminal: 70 Daily: 38	97.4
Hospital D	Terminal: no discharges Daily: 65	95.2
Hospital E	Terminal: 90 Daily: no discharges	98

American Journal of Infection Control 43 (2015) 1347-9

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Practice forum

The role of ultraviolet marker assessments in demonstrating cleaning efficacy

Elizabeth Gillespie BN, SIC, MPubHlth(Melb)*, P. Louise Wright BN, SIC, Kylie Snook BN, IC cert, Susan Ryan BApp Sci(Nsg), IC cert, MNsg, Susan Vandergraaf BN, SIC, Grad Dip Crit Care, Mardi Abernethy BN, SIC, Grad Dip ED(Nsg), Anita Lovegrove BN, SIC, MNsg

Infection Control and Epidemiology Unit, Monash Health, Clayton, Victoria, Australia

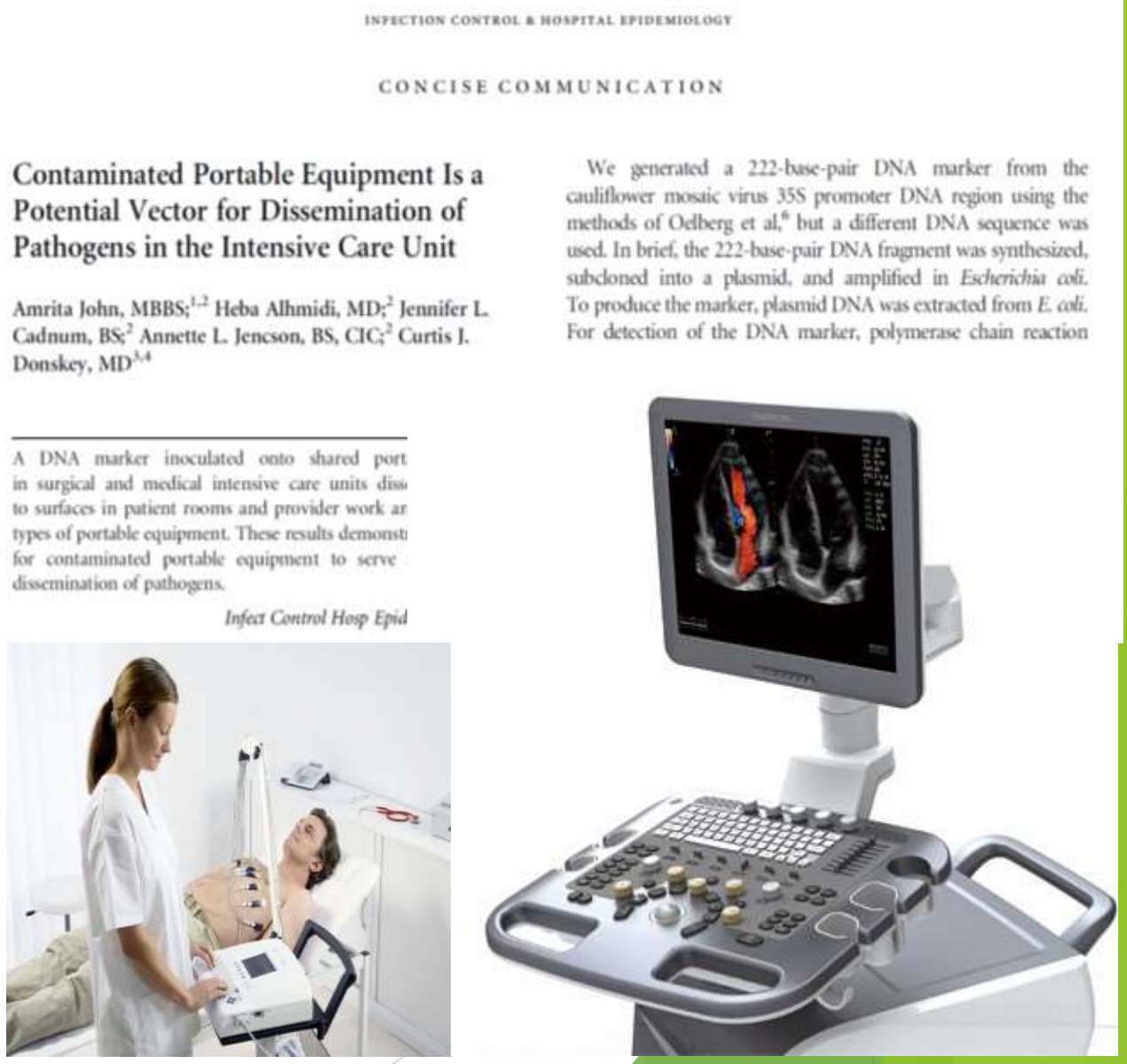
Key Words:
Cleaning
Environmental cleaning
Ultraviolet marker assessment

Cleaning standards measuring compliance using visual auditing alone can be misleading, because visually clean surfaces might not be cleaned of pathogens. An evidence-based system using both visual auditing and ultraviolet marker (UVM) assessments is recommended. Using a UVM system has enabled our health service to measure infection risk and implement actions to improve results. We recommend adopting a combined monitoring process using visual auditing with UVM audits to enhance cleaning and reduce the risk of health care–associated infection.

Gillespie E et al. The role of ultraviolet marker assessments in demonstrating cleaning efficacy. American Journal of Infection Control 43 (2015) 1347-9

MDROs and the environmental - Contaminated portable equipment

- **The Louis Stokes Veterans Affairs Medical Center**
  - 215-bed acute-care hospital
  - 10-bed surgical intensive care unit (SICU)
  - 16-bed medical intensive care unit(MICU)
- Generated a 222-base-pair DNA marker from the cauliflower mosaic virus 35S promoter DNA region
- **DNA marker was inoculated onto portable equipment in each ICU**
  - 13 Doppler ultrasound machines
  - 3 electrocardiogram machines
- On days 1, 2, and 6 after inoculation of the DNA marker, swabs were used to sample high-touch surfaces within patient rooms, common work areas and other portable equipment
- Florescent markers were used to measure if the machines were cleaned daily



INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY

CONCISE COMMUNICATION

Contaminated Portable Equipment Is a Potential Vector for Dissemination of Pathogens in the Intensive Care Unit

Amrita John, MBBS;[1,2] Heba Alhmidi, MD;[2] Jennifer L. Cadnum, BS;[2] Annette L. Jencson, BS, CIC;[2] Curtis J. Donskey, MD[3,4]

We generated a 222-base-pair DNA marker from the cauliflower mosaic virus 35S promoter DNA region using the methods of Oelberg et al,[6] but a different DNA sequence was used. In brief, the 222-base-pair DNA fragment was synthesized, subcloned into a plasmid, and amplified in *Escherichia coli*. To produce the marker, plasmid DNA was extracted from *E. coli*. For detection of the DNA marker, polymerase chain reaction

A DNA marker inoculated onto shared port
in surgical and medical intensive care units diss
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types of portable equipment. These results demonst
for contaminated portable equipment to serve
dissemination of pathogens.

Infect Control Hosp Epid

Infect Control Hosp Epidemiol 2017;1-3

MDROs and the environmental - Contaminated portable equipment

Results

- The overall percentage of sites positive for DNA marker was similar for each ICU units
  - SICU: 14 of 100, 14%
  - MICU: 11 of 128, 9%
- On days 1 and 2, there was no evidence that the inoculated portable equipment had been cleaned
  - Presence of fluorescent marks on the inoculated devices

Summary

- There is a need for effective strategies for routine disinfection of portable equipment shared among patients

Infect Control Hosp Epidemiol 2017;1-3

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY

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A DNA marker inoculated onto shared portable equip in surgical and medical intensive care units disseminated w to surfaces in patient rooms and provider work areas and to types of portable equipment. These results demonstrate the pot for contaminated portable equipment to serve as a vecto dissemination of pathogens.

Infect Control Hosp Epidemiol 2017

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MDROs and the environmental – what we know
Daily disinfection reduces hospital acquired infections

- **538-bed acute care tertiary hospital in Canada**
  - Prospective interrupted time series study design with a control group
    - 52 week period
  - UV-visible marker monitoring system in place (weekly feedback)
    - Cleaning considered acceptable if >80% of UV visible marks partially or completely removed
  - **Intervention**
    - Disinfection cleaning wipe
      - 1-step surface disinfectant with 1 minute contact time
      - Accelerated hydrogen peroxide
    - Hospital wide – all patient care areas
    - All high touch sites/surfaces
    - Standard cleaning agent used for floor and non clinical areas

American Journal of Infection Control 43 (2015) 141-6

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates

Michelle J. Alfa PhD[a,b,*], Evelyn Lo MD[b,c], Nancy Olson BSc[a], Michelle MacRae[c], Louise Buelow-Smith RN[c]

[a] St Boniface Research Centre, Winnipeg, MB, Canada
[b] Department of Medical Microbiology, University of Manitoba, Winnipeg, MB, Canada
[c] St Boniface Hospital, Winnipeg, MB, Canada

Key Words:
Methicillin-resistant Staphylococcus aureus
Vancomycin-resistant enterococci
Clostridium difficile
Housekeeping
Environmental cleaning

Background: Documenting effective approaches to eliminate environmental reservoirs and reduce the spread of hospital-acquired infections (HAIs) has been difficult. This was a prospective study to determine if hospital-wide implementation of a disinfectant cleaner in a disposable wipe system to replace a cleaner alone could reduce HAIs over 1 year when housekeeping compliance was ≥80%.
Methods: In this interrupted time series study, a ready-to-use accelerated hydrogen peroxide disinfectant cleaner in a disposable wipe container system (DCW) was used once per day for all high-touch surfaces in patient care rooms (including isolation rooms) to replace a cleaner only. The HAI rates for methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and *Clostridium difficile* were stratified by housekeeping cleaning compliance (assessed using ultraviolet-visible marker monitoring).
Results: When cleaning compliance was ≥80%, there was a significant reduction in cases/10,000 patient days for MRSA ($P = .0071$), VRE ($P < .0001$), and *C difficile* ($P = .0005$). For any cleaning compliance level there was still a significant reduction in the cases/10,000 patient days for VRE ($P = .0358$).
Conclusion: Our study data showed that daily use of the DCW applied to patient care high-touch environmental surfaces with a minimum of 80% cleaning compliance was superior to a cleaner alone because it resulted in significantly reduced rates of HAIs caused by *C difficile*, MRSA, and VRE.

Alfa MJ et al. Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates. American Journal of Infection Control 43 (2015) 141-6

MDROs and the environmental – what we know
Daily disinfection reduces hospital acquired infections

- **Results**
  - When the cleaning compliance was ≥80% there was a significant reduction in cases/10,000 patient days for:
    - **MRSA**
      - ***P* = .0071**
    - **VRE**
      - ***P* ≤ .0001**
    - **C difficile**
      - ***P* = .0005**
  - For any cleaning compliance level there was still a significant reduction cases/10,000 patient days for VRE
    - VRE *P*=.0358


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Major article

Use of a daily disinfectant cleaner instead
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Michelle J. Alfa PhD[a,b,*], Evelyn Lo MD[b,c], Nancy Olso
Louise Buelow-Smith RN[c]

[a] St Boniface Research Centre, Winnipeg, MB, Canada
[b] Department of Medical Microbiology, University of Manitoba, Winnipeg, MB, Canada
[c] St Boniface Hospital, Winnipeg, MB, Canada

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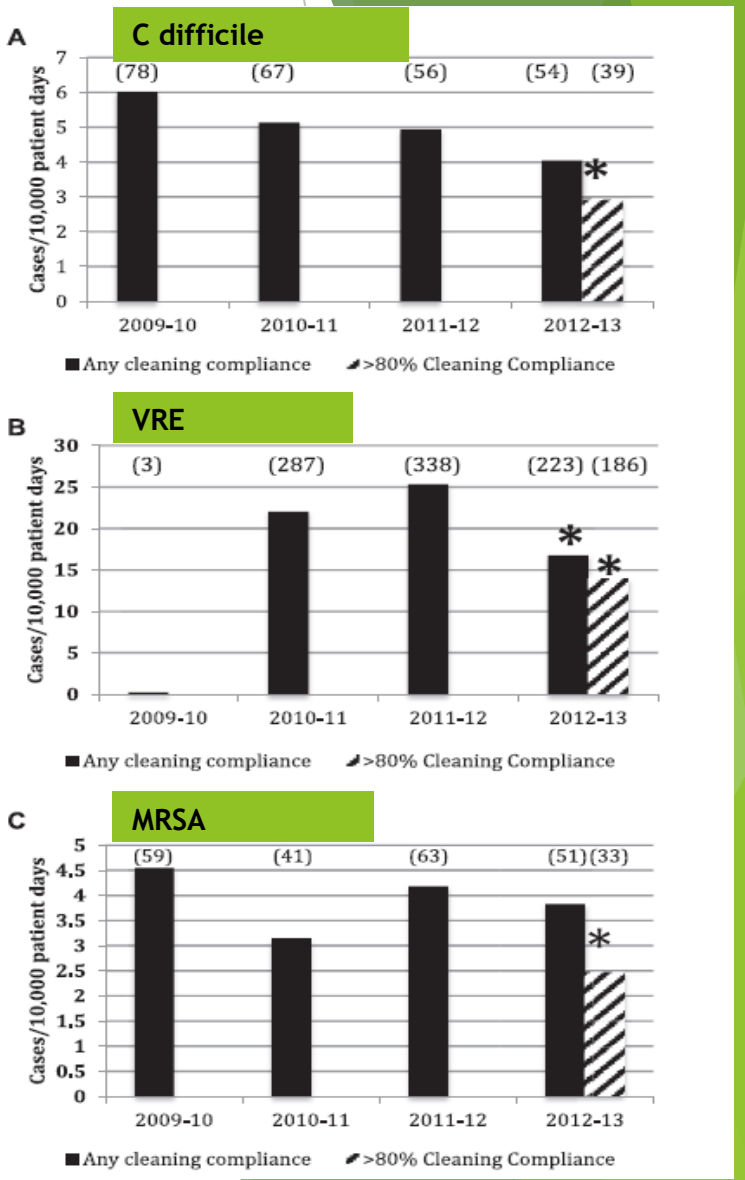


Michelle J. Alfa PhD et al. Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates. American Journal of Infection Control 43 (2015) 141-6

The use of cleaning and disinfectant agents

American Journal of Infection Control 43 (2015) 141-6

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

HAI Rates with Cleaner only → **HAI Rates with Disinfectant-Cleaner in 2012-13**

CONCLUSION:

…….daily use of a ready-to-use accelerated hydrogen peroxide disinfectant cleaner ……applied to patient care high-touch environmental surfaces with a minimum of 80% cleaning compliance was superior to a cleaner alone because it resulted in significantly reduced rates of HAIs caused by C difficile, MRSA, and VRE.

Alfa MJ et al. Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates. Am J Infect Control. 2015 Feb;43(2):141-6

MDROs and the environmental - Organism acquisition from prior room occupant

Journal of Hospital Infection 91 (2015) 211–217

Available online at www.sciencedirect.com

Journal of Hospital Infection

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

Review

Risk of organism acquisition from prior room occupants: a systematic review and meta-analysis

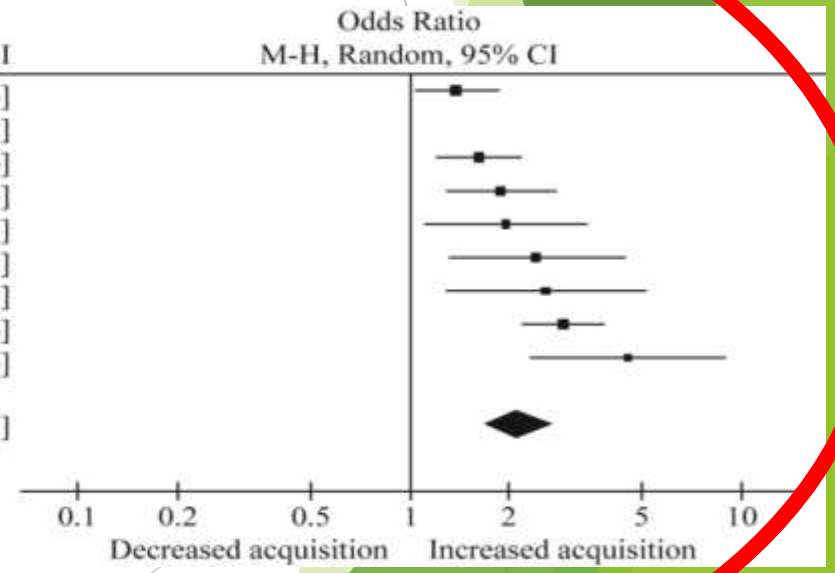
B.G. Mitchell [a,b,*], S.J. Dancer [c], M. Anderson [a], E. Dehn [a]

[a] Avondale College of Higher Education, Faculty of Arts, Nursing and Theology, Wahroonga, NSW, Australia

Study or Subgroup	Decreased acquisition Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Huang (MRSA)	57	1454	248	8697	16.2%	1.39 [1.04, 1.86]
Nseir (ESBL producing Gram neg)	8	50	50	461	0.0%	1.57 [0.70, 3.52]
Huang (VRE)	58	1291	256	9058	16.2%	1.62 [1.21, 2.16]
Ajao (Klebsiella sp. or Escherichia coli)	32	648	235	8723	14.2%	1.88 [1.29, 2.74]
Nseir (Pseudomonas)	21	85	61	426	10.4%	1.96 [1.12, 3.45]
Drees (VRE)	19	138	31	500	7.7%	2.42 [1.32, 4.43]
Shaughnessy (Clostridium difficile)	10	91	77	1679	3.3%	2.57 [1.28, 5.15]
Mitchell (MRSA)	74	884	163	5344	14.4%	2.90 [2.18, 3.86]
Nseir (Acinetobacter)	16	52	41	459	8.6%	4.53 [2.32, 8.86]
Total (95% CI)		4643		34886	100.0%	2.14 [1.65, 2.77]
Total events	287		1112			

Heterogeneity: $Tau^2 = 0.09$; $Chi^2 = 21.32$, df = 7 (P = 0.003); $I^2 = 67\%$

Test for overall effect: Z = 5.74 (P < 0.00001)



Mitchell BG et al. Risk of organism acquisition from prior room occupants: a systematic review and meta-analysis. Journal of Hospital Infection 91 (2015) 211-217.

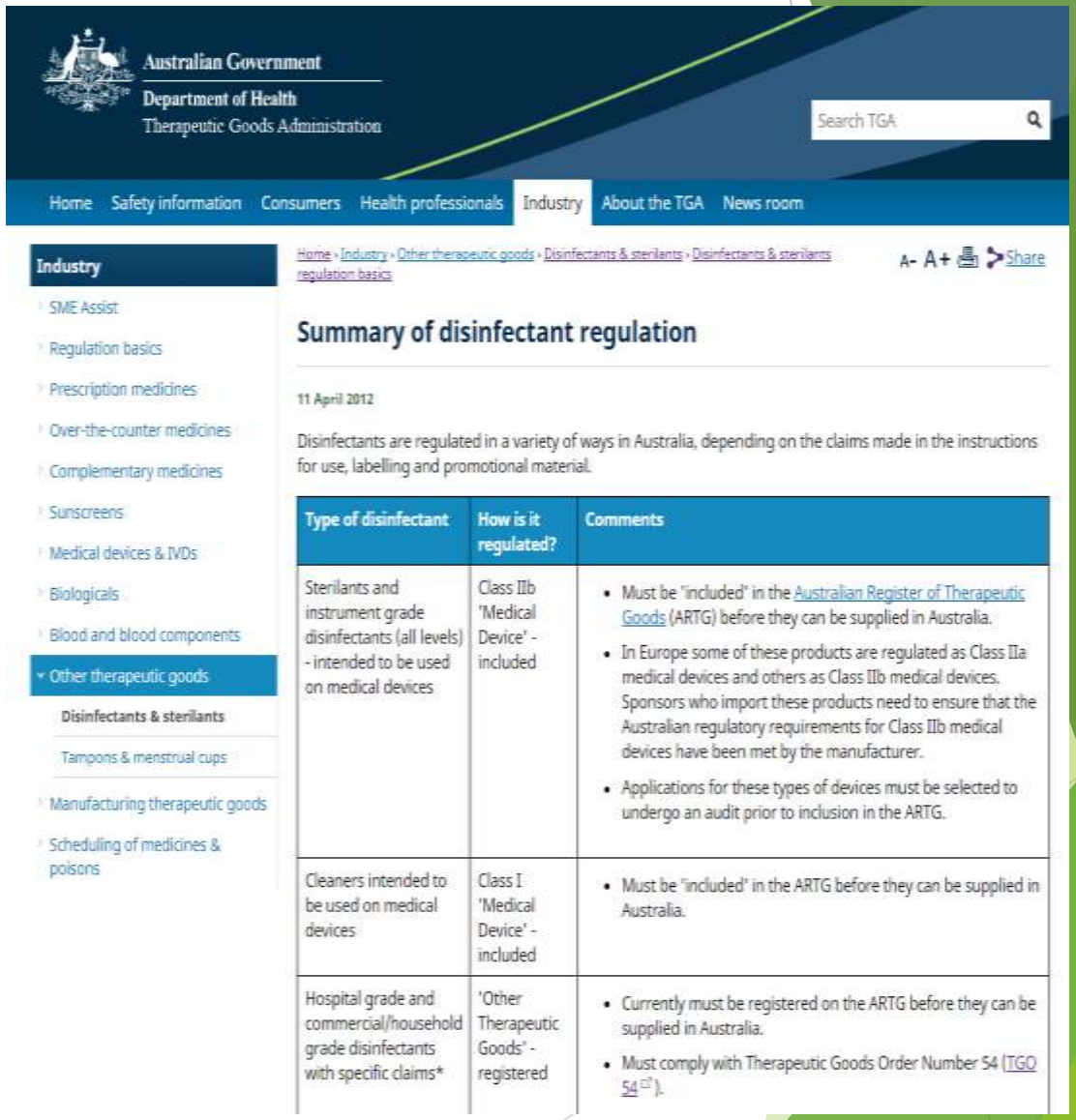
MDROs and the environmental - Strategies to reduce transmission

- **What is important?**
  - Thoroughness of cleaning (compliance)
  - Disinfection - not just cleaning
  - Frequency of cleaning and disinfection
  - Monitoring the effectiveness of cleaning and disinfection
  - Evidence support the use of “No-touch” technologies as an adjunct to cleaning/disinfection for terminal room disinfection
    - Rooms of patients colonised/infected with epidemiological important organisms
    - Ultraviolet C/Vaporised Hydrogen Peroxide

INTERGRATE EVIDENCE INTO PRACTICE

MDROs and the environmental - Selecting disinfectants

- **Follow the manufacturers instructions**
- Not all products target the same pathogens or require the same contact times
  - Long contact times <u>not practical</u>
    - Contact times of 10 minutes requires:
      - Reapplying the disinfectant 5-6 times to keep it wet
      - Drying time for a water-based disinfectant is 1.5-2 minutes
  - Contact time is affected by drying time
- Disinfectants should be selected on a healthcare facilities current needs and situation
- Concentrations <u>should not</u> be mixed by hand
- Dispensing systems need to be validated



https://www.tga.gov.au/summary-disinfectant-regulation

MDROs and the environmental - Disinfectant dilution control dispensers

- **Dispensers - Quat concentrations of ≥800 ppm in dispensed solutions**
  - Disinfectant solutions obtained from the 33 dispensing stations audited:
    - 7 stations - Quat concentrations of <200 ppm
    - 17 stations - 200–400 ppm
    - 6 stations - from 400–600 ppm
    - 2 stations contained no concentrated disinfectant and
    - 1 station was inoperative
  - **Investigations by the disinfectant vendor:**
    - Variations in water pressure at dispensing stations and certain design issues in the dispensing system were responsible for the variations
    - Installation of water-pressure regulators on each dispensing station and modifications of the flow-control devices in jugs resulted in Quat concentrations of ≥800 ppm

Boyce JM, Sullivan L, Booker A, Baker J. Quaternary Ammonium Disinfectant Issues Encountered in an Environmental Services Department. Infect Control Hosp Epidemiol 2016;37(3):340-342

MDROs and the environmental - Monitoring the effectiveness of cleaning and disinfection

- Visual assessment-not a reliable indicator of surface cleanliness
- Microbiological swabbing is costly, microorganism specific and time consuming
- ATP bioluminescence-measures organic debris
  - Not all APT machines perform equally
- Fluorescent markers
  - Mimics microbiological data better than APT
  - Transparent, easily cleaned, environmentally stable
  - solution fluoresces when exposed to an ultraviolet light
    - Applied prior to cleaning and assessed after cleaning with a black light

MDROs and the environmental - Monitoring the effectiveness of cleaning and disinfection

ROOM CLEANING CHECKLISTS

DISCHARGE/TERMINAL ROOM, BEDSPACE OR CUBICLE CLEANING AND DISINFECTION CHECKLIST

DISCHARGE/TERMINAL CLEANING AND DISINFECTION - CHECKLIST (ROOM, BED SPACE OR CUBICLE AREA)
DATE:
WARD/UNIT - ROOM OR BED NUMBER:
TICK THE BOX DISCHARGE/TERMINAL CLEAN

	CLEANING AND DISINFECTING PROCEDURE	TICK √ OR N/A
	REMOVE:	
1	Curtain from around the bed and dust the top of the curtain rail	
	CLEAN AND DISINFECT THE FOLLOWING SURFACES:	
1	Empty rubbish bins in the room and spot clean and disinfect ONLY	
2	Over bed examination light including the arm	
3	Monkey bar - the handle and the bar	
4	Mattress and bed base – front and back of mattress and the bed base	
5	Patient control handset	
6	Bed head	
7	Bed rails	
8	Bed frame	
9	IV poles attached to the bed – all surfaces	
10	Patient chart holder	
11	Equipment stored under the bed	
12	Bedside locker – all surfaces inside and outside	
13	Over bed table - all surfaces including the knob to adjust the height and the frame	
14	Wardrobe - all surfaces inside and out	
15	Chairs – all surfaces including the arms and frame	
16	Telephone - all surfaces	
17	TV remote - all surfaces and the cord	
18	Patient call button - all surfaces and the cord	
19	Service panel behind the head of the bed - including the emergency button, oxygen flow metre, the suction on/off tap, the blood pressure machine and the panel surface	
20	Monitors – outer surfaces only. DO NOT wipe the front screen – check with manufacturer's instructions	
21	Suction bottle/s and the suction tubing - outer surfaces	
22	Free standing IV poles and IV pumps – all surfaces including the base of the poles	
23	Patient care equipment or devices in the room - all surfaces. Use clean disposable cloths/wipes for each piece of equipment or device	
24	Room light switches – all surfaces	
25	Room sinks - all surfaces of the basin, taps, tap handles and the backsplash	
26	Hand soap pump (dispenser) –all outer surfaces	
27	Paper towel dispenser – all outer surfaces	
28	Glove dispenser frame – all surfaces	
29	Room mounted sharps containers – outer surface of container ONLY. DO NO PLACE YOUR HAND NEAR OR IN THE OPENING OF THE CONTAINER	
30	Door handles – all surfaces	
31	Floor – mop	
32	Room walls – spot clean and disinfect ONLY	

PLEASE PRINT

PERSON WHO CLEANED AND COMPLETED THE CHECKLIST:

NAME:.....

TITLE:.....

MDROs and the environmental - Florescent (invisible marker/pen) monitoring

QUALITY IMPROVEMENT PROJECT
ENVIRONMENTAL CLEANING AND MONITORING FOR INFECTION PREVENTION

WARD – CLEANING AND DISINFECTION CHECKLIST

DATE:

ROOM OR BED NUMBER:

TICK THE BOX

ROUTINE CLEAN ☐

ISOLATION CLEAN ☐

TERMINAL CLEAN ☐

	HIGH TOUCH ROOM SURFACES	WHERE TO MARK WITH INVISIBLE PEN	TICK WHEN MARKED √ OR N/A	WAS THE INVISIBLE PEN MARK REMOVED? Y OR N OR N/A
1	BED SIDE RAIL	LEFT SIDE WHERE NURSE AND PATIENT TOUCH		
2	BED SIDE RAIL	RIGHT SIDE WHERE NURSE AND PATIENT TOUCH		
3	OVERBED TABLE	KNOB TO RAISE OR LOWER THE TABLE		
4	WALL SUCTION	ON/OFF LEVER		
5	BACK OF BED PANEL	ABOVE THE TV REMOTE PLUG		
6	NURSE CALL BUZZER	WHERE THE NURSE OR PATIENT TOUCH		
7	TELEPHONE	PHONE HANDLE		
8	PATIENT CHAIR	LEFT ARM OF THE CHAIR		
9	PATIENT CHAIR	RIGHT ARM OF THE CHAIR		
10	BEDSIDE LOCKER	HANDLE OF THE TOP DRAWER		
11	ROOM SINK	TAP HANDLES		
11	DOOR HANDLE	INSIDE THE ROOM		
12	BATHROOM DOOR HANDLE	INSIDE THE BATHROOM		
13	BATHROOM TOILET HAND RAIL	HAND RAIL		
14	TOILET FLUSH BUTTON	BUTTON WHERE THE PATIENT OR NURSE TOUCHES		
15	TOILET PAPER DISPENSER	NEAR WHERE THE TOILET PAPER COMES OUT		
16	BED REMOTE	ON THE TOP SURFACE OF THE BED REMOTE		
17	PUMP	ON THE TOP SURFACE OF THE PUMP		
			NUMBER OF PEN MARKS	NUMBER OF MARKS REMOVED
			% RESULT	

QUALITY IMPROVEMENT PROJECT
ENVIRONMENTAL CLEANING MONITORING FOR INFECTION PREVENTION

BATHROOM/ENSUITE – CLEANING AND DISINFECTION CHECKLIST NUMBER 1

DATE:

ROOM OR BED NUMBER:

TICK THE BOX

ROUTINE CLEAN ☐

ISOLATION CLEAN ☐

DISCHARGE CLEAN ☐

	HIGH TOUCH ROOM SURFACES	WHERE TO MARK WITH INVISIBLE PEN	TICK WHEN MARKED √ OR N/A	WAS THE INVISIBLE PEN MARK REMOVED? Y OR N OR N/A
1	LIGHT SWITCHES	WHERE NURSE OR PATIENT WILL TOUCH		
	DOOR HANDLE	INSIDE THE BATHROOM/ENSUITE DOOR		
2	HAND PAPER TOWEL DISPENSER	WHERE NURSE OR PATIENT WILL TOUCH		
3	HAND SOAP DISPENSER	ON THE OUTSIDE COVER		
4	TOILET PAPER DISPENSER	WHERE NURSE OR PATIENT WILL TOUCH		
5	SINK	ON THE FRONT EDGE OF THE SINK		
6	SINK TAPS	ON BOTH TAPS WHERE THE NURSE OR PATIENT WILL GRIP THE TAPS		
7	SINK SPLASHBACK	WHERE THE SINK IS JOINED TO THE SPLASHBACK AT THE REAR		
8	TOILET SEAT	WHERE THE NURSE OR PATIENT WILL TOUCH		
9	TOILET FLUSH BUTTION/HANDLE	BUTTON WHERE THE PATIENT OR NURSE WILL TOUCH		
10	UNDER TOILET SEAT-TOILET BOWEL	UNDER THE TOILET SEAT ON THE OUTER EDGE OF THE TOILET BOWL		
			NUMBER OF PEN MARKS	NUMBER OF MARKS REMOVED
			% PERCENTAGE RESULT	

MDROs and the environmental - Cleaning and disinfecting wipes

- **Cleaning and disinfecting wipes**
  - Detergent/ disinfectant surface wipes
  - Can improve timeliness and thoroughness of room cleaning
  - Makes spot cleaning of equipment and surfaces easy
  - Improves consistency and delivery of correct concentrations of cleaning and disinfecting agents and
  - Decrease usage of water and chemical agents
  - Cleaning and disinfecting is one-step with disinfectant-detergent
  - No pre-cleaning necessary unless spill or gross contamination
  - **Wipe should have sufficient wetness to achieve the disinfectant contact time (e.g. >1 minute)**

No-touch room disinfection (NTD) systems

'Given the choice of improving technology or improving human behaviour, technology is the better choice'.

Dr Bob Weinstein

No-touch room disinfection (NTD) systems
Used to supplement standard cleaning protocols

Weinstein RA. *Emerg Infect Dis* 1998;4:416-420.

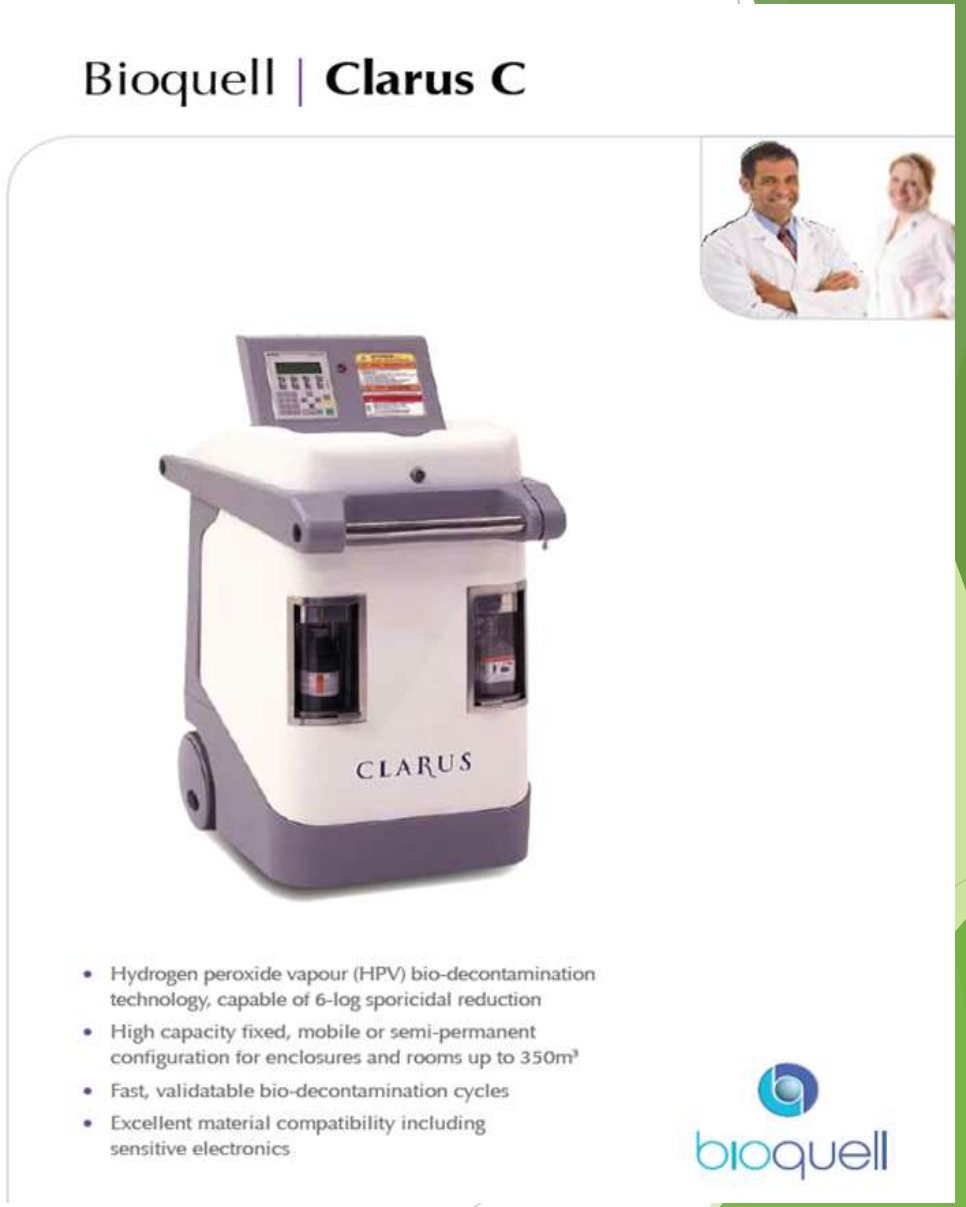
Reducing the risk of organism acquisition from prior room occupant

- **Hydrogen peroxide vapor (HPV)** decontamination reduced environmental contamination and the risk of acquiring MDROs compared with standard cleaning protocols
- Patients admitted to rooms decontaminated using HPV were:
  - 64% less likely to acquire any MDRO (incidence rate ratio [IRR], 0.36; 95% confidence interval [CI], .19-.70; P < .001) and
  - 80% less likely to acquire VRE (IRR, 0.20; 95% CI, .08-.52; P < .001)

Passaretti CL et al. An evaluation of environmental decontamination with hydrogen peroxide vapor for reducing the risk of patient acquisition of multidrug-resistant organisms. Clin Infect Dis. 2013 Jan;56(1):27-35

Vapor-Based Hydrogen Peroxide Systems

- **Micro-condensation process (Bioquell)**
  - Hydrogen peroxide “dry mist” (vaporized)
  - 35% hydrogen peroxide
- **Advantages**
  - Reliable biocidal activity against a wide range of pathogens
  - Surfaces and equipment decontaminated
  - Demonstrated to decrease disease incidence (C. difficile)
  - Residual free and does not give rise to health and safety concerns (aeration units convert HPV into oxygen and water)
  - Useful for disinfecting complex equipment and furniture
  - Cost-effective



Vapor-Based Hydrogen Peroxide Systems

- **Disadvantages**
  - Can only be done for terminal disinfection (i.e., not daily cleaning)
  - All patients and staff must be removed from room
  - Decontamination takes approximately 3-5 hours
  - HVAC system must be disabled and the room sealed with tape
  - Substantial capital equipment costs
  - Does not remove dust and stains which are important to patients/visitors
  - Sensitive use parameters (e.g., HP concentration)

Vapor-Based Hydrogen Peroxide Systems

- **Micro-condensation process (Bioquell)**
  - Bioquell BQ-50
  - Uniformly exposed to hydrogen peroxide vapour
  - 35% hydrogen peroxide
  - Total cycle time of 60 – 80min
    - Room needs aeration time

Ultra violet-C (UV-C) irradiation

- **Ultra violet C (UV-C) irradiation**
  - Kills a variety of bacterial species including spores
  - On exposure to UV-C the DNA and RNA of the microorganisms are deactivated by the absorption of protons
  - Stops the organism reproducing
  - Cost-effective

Tru-D Smart UV-C System™ (robot)

Pulsed Xenon UV (PX-UV)

Ultra violet-C (UV-C) irradiation

- **Advantages**
  - Reliable biocidal activity against a wide range of pathogens
  - Surfaces and equipment decontaminate
  - Room decontamination is rapid (~15-20 min) for vegetative bacteria
  - HVAC system does not need to be disabled and room does not need to be sealed
  - UV is residual free and does not give rise to health and safety concerns
  - No consumable products so operating costs are low (key cost = acquisition)

Infect Control Hosp Epidemiol 2010; 31(10):1025-1029

Ultra violet-C (UV-C) irradiation

- **Disadvantages**
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Infect Control Hosp Epidemiol 2010; 31(10):1025-1029

Enhanced Disinfection Leading to Reduction of Microbial Contamination and a Decrease in Patient Col/Infection

- **A cluster randomised multi-centred crossover study**
  - 9 hospitals
  - 28 Month Study Period
  - 4 arms
    - Standard - Quat
    - Quat and UV
    - Bleach
    - Bleach and UV
  - Outcome measure -infections/colonisation with epidemiological important pathogens – MRSA, VRE, *C. difficile* & MDR *Acinetobacter*
- **UVC system**
  - Tru-D SmartUVC system™ (robot)

Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and *Clostridium difficile* (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study

Deverick J Anderson, Luke F Chen, David J Weber, Rebekah W Moehring, Sarah S Lewis, Patricia F Triplett, Michael Blocker, Paul Becherer, J Conrad Schwab, Lauren P Knelson, Yuliya Lokhnygina, William A Rutala, Hajime Kanamori, Maria F Gergen, Daniel J Sexton, for the CDC Prevention Epicenters Program

Summary

Background Patients admitted to hospital can acquire multidrug-resistant organisms and *Clostridium difficile* from inadequately disinfected environmental surfaces. We determined the effect of three enhanced strategies for terminal room disinfection (disinfection of a room between occupying patients) on acquisition and infection due to meticillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, *C difficile*, and multidrug-resistant *Acinetobacter*.

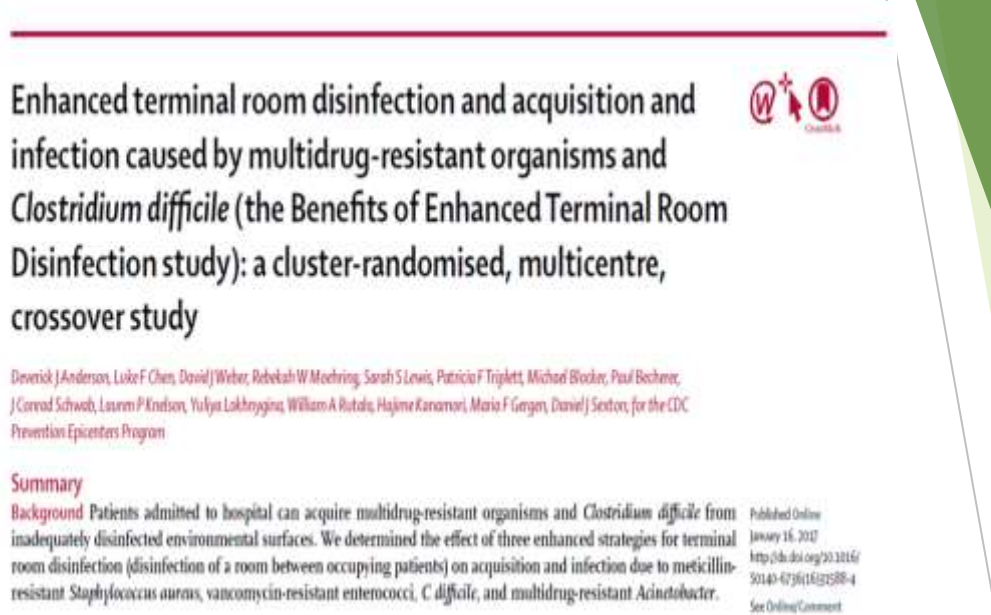
Published Online January 16, 2017 http://dx.doi.org/10.1016/S0140-6736(16)32588-4

See Online/Comment

Dr Deverick J Anderson et al. The Lancet Volume 389, No.10071, p805-814, 25 February 2017

Enhanced Disinfection Leading to Reduction of Microbial Contamination and a Decrease in Patient Col/Infection

- **Results**
  - Best strategy -Quat/UV
  - Worst strategy – Quat
  - Comparing the best strategy with the worst strategy
    - Epidemiological important pathogens
      - Mean CFU per room 60.8 vs 3.4 - **94% reduction**
      - Colonisation infection rate 2.3% vs **1.5%**
      - **35% decrease in colonization/infection**
      - ⇩ in room contamination was assoc with a ⇩ in patient colonization/infection



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First study which quantitatively described the entire pathway whereby improved disinfection decreases microbial contamination which in-turn reduced patient colonization/infection

Dr Deverick J Anderson et al. The Lancet Volume 389, No.10071, p805-814, 25 February 2017

Reducing the risk of organism acquisition from prior room occupant

Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and *Clostridium difficile* (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study

Adding UVC to current cleaning and disinfecting practices reduces the risk of organism acquisition from prior room occupant

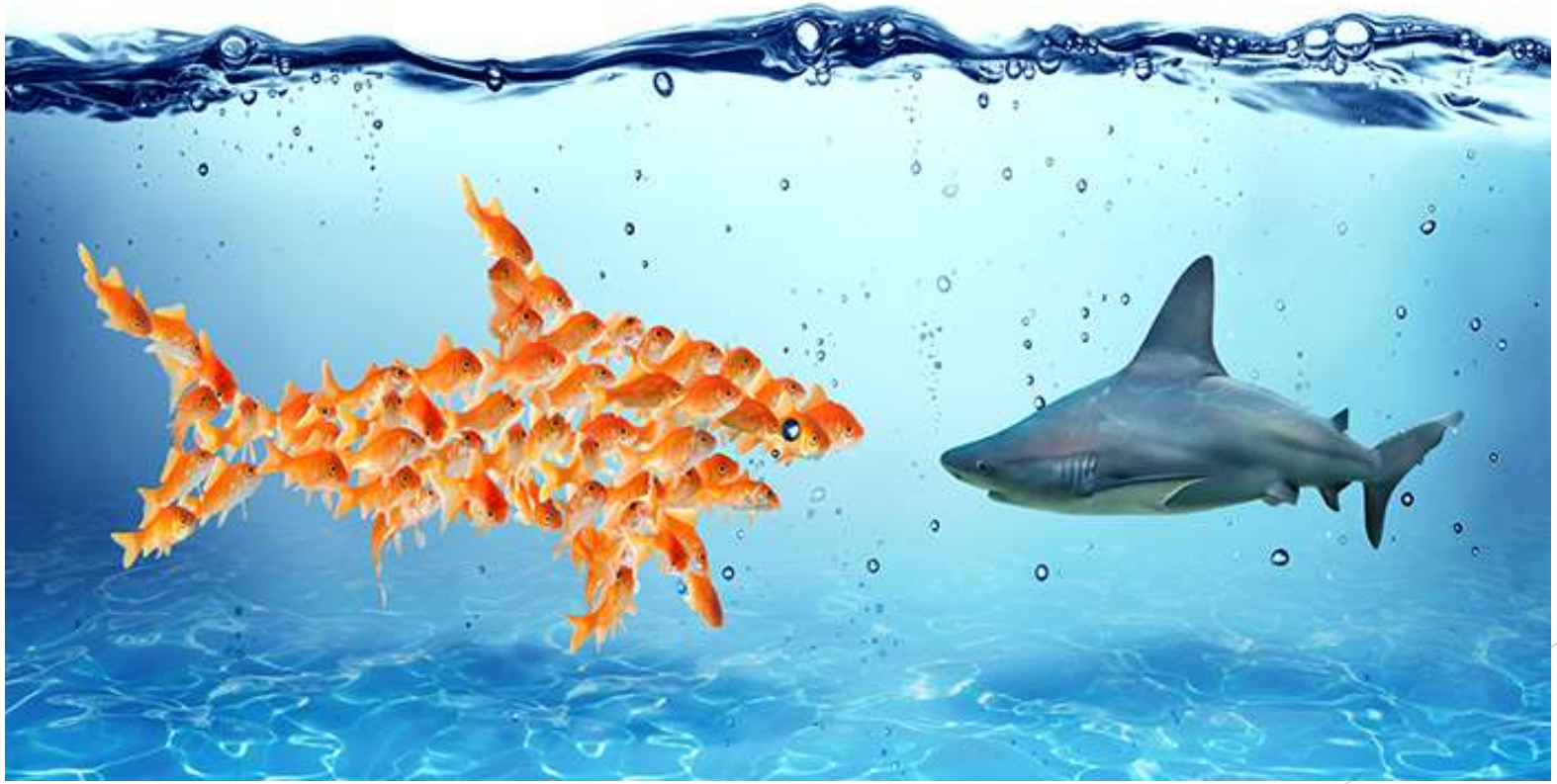
Anderson DJ et al. Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and Clostridium difficile (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study. Lancet. 2017 Jan 16. Published online January 16, 2017.

Selection of “no touch” room disinfection systems

- **Systems vary considerably**
  - Review the peer-reviewed literature
  - Choose only devices with demonstrated bactericidal capability
    - Carrier tests and/or the ability to disinfect actual patient rooms
  - Select a device that has demonstrated bactericidal capability and ideally the ability to reduce healthcare associated infections

In summary……

Managing MDROs requires on **organisation wide strategy, a robust quality improvement program, adherence to evidence-based universally applied HAI prevention strategies** and collaborative **teamwork**



Thank you

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