Getting to grips with healthcare-associated Gram-negative bloodstream infection?

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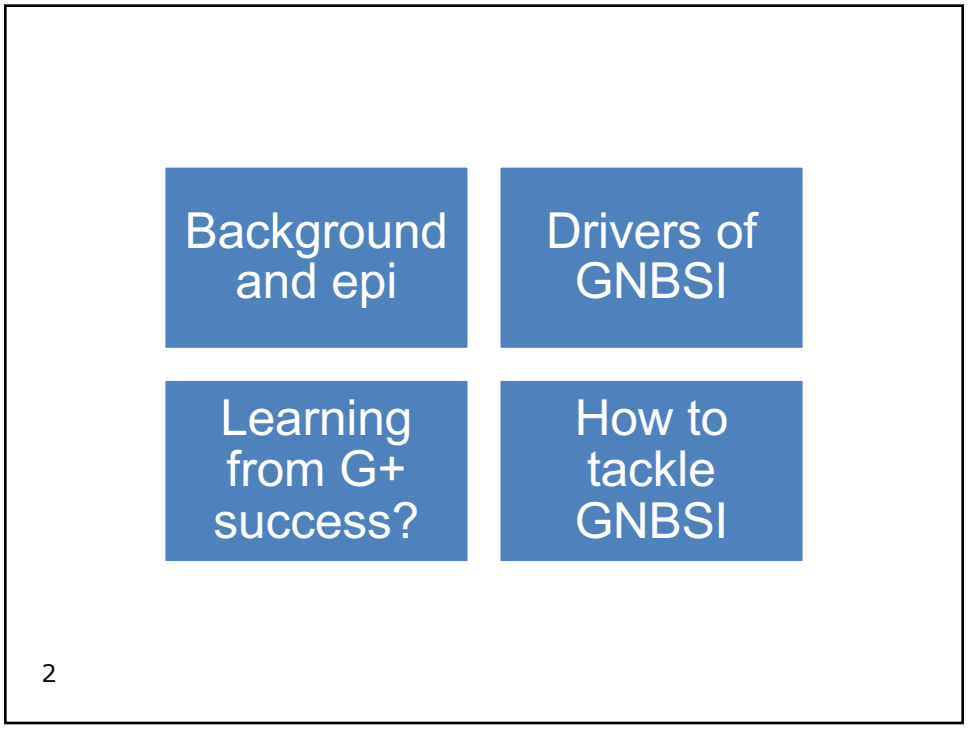
www.webbertraining.com June 25, 2019



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Background and epi

Drivers of GNBSI

Learning from G+ success?

How to tackle GNBSI

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Source: DMAP.

Point prevalence

Around 0.5 (2016 UK PPS) to 1% (2012 European PPS) of hospital inpatients will have a BSI at any one time.

	All types of infection	Pneumonia or other lower respiratory tract infection	Surgical site infection	Urinary tract infection	Bloodstream infection	Gastrointestinal infection
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
HAIs and microorganisms						
HAIs, total	1,531 (100)	394 (25.7)	290 (18.9)	264 (17.2)	200 (13.1)	119 (7.8)
HAIs with microorganisms	905 (59.1)	191 (48.5)	172 (59.3)	187 (70.8)	188 (94.0)	48 (40.3)
Microorganisms, total	1,165 (100)	249 (100)	247 (100)	210 (100)	228 (100)	65 (100)
Major groups of microorganisms						
Gram-positive cocci	410 (35.2)	46 (18.5)	134 (54.3)	39 (18.6)	95 (41.7)	21 (32.3)
Enterobacteriaceae	404 (34.7)	80 (32.1)	58 (23.5)	134 (63.8)	79 (34.7)	18 (27.7)
Gram-negative bacteria, non-*Enterobacteriaceae*	226 (19.4)	91 (36.5)	36 (14.6)	29 (13.8)	30 (13.2)	7 (10.8)
Fungi	69 (5.9)	23 (9.2)	5 (2.0)	7 (3.3)	17 (7.5)	4 (6.2)
Top 15 microorganisms (accounting for (92.4% of total number microorganisms)						
Escherichia coli	177 (15.2)	24 (9.6)	29 (11.7)	78 (37.1)	29 (12.7)	10 (15.4)
Staphylococcus aureus	141 (12.1)	26 (10.4)	53 (21.5)	2 (1.0)	26 (11.4)	5 (7.7)
Pseudomonas aeruginosa	131 (11.2)	44 (17.7)	24 (9.7)	21 (10.0)	17 (7.5)	6 (9.2)
Enterococcus spp.	114 (9.8)	4 (1.6)	33 (13.4)	32 (15.2)	21 (9.2)	11 (16.9)
Coagulase-negative staphylococci	97 (8.3)	3 (1.2)	33 (13.4)	3 (1.4)	38 (16.7)	1 (1.5)
Klebsiella spp.	94 (8.1)	22 (8.8)	7 (2.8)	30 (14.3)	25 (11.0)	3 (4.6)

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Zarb et al. Eurosurvellance 2012. European Point Prevalence Survey of HCAI.

Rising threat from AMR-GNR

% of all HAI caused by GNRs.

% of ICU HAI caused by GNRs.

Non-fermenters	***Acinetobacter baumannii*** ***Pseudomonas aeruginosa*** ***Stenotrophomonas maltophilia***	**CPO**
Enterobacteriaceae	*Klebsiella pneumoniae* *Escherichia coli* *Enterobacter cloacae*	**CPE**

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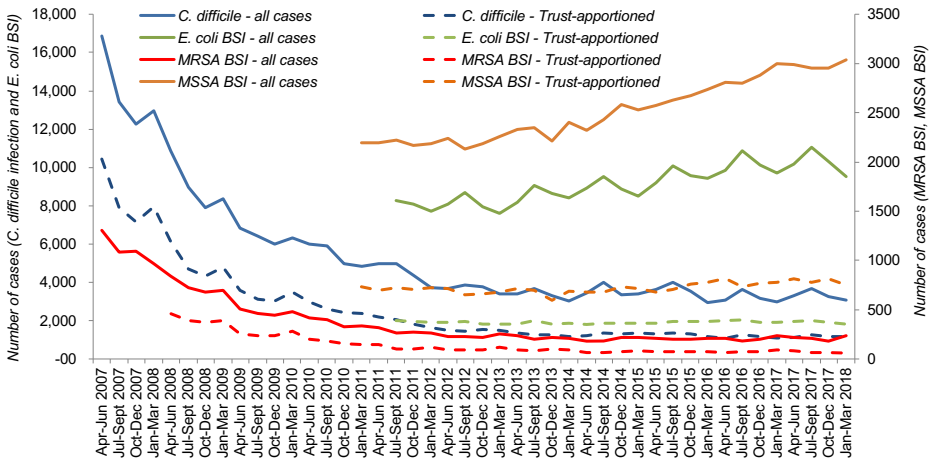
Hidron et al. *Infect Control Hosp Epidemiol* 2008;29:966-1011.
Peleg & Hooper. *N Engl J Med* 2010;362:1804-1813.

Gram-negative BSIs are getting more common



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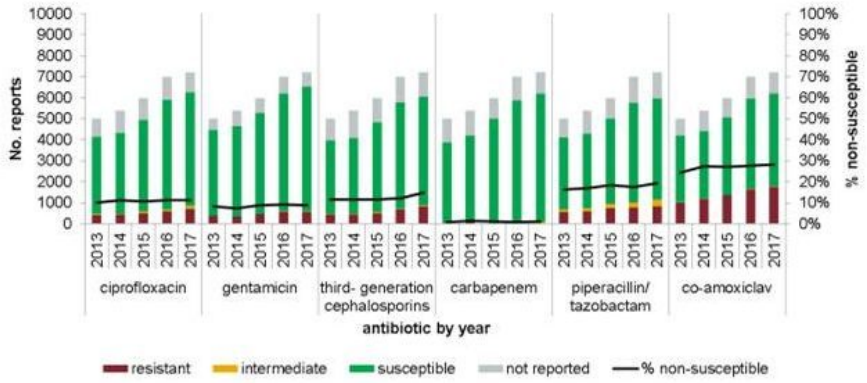
Data: Public Health England.

Gram-negative BSIs are getting harder to treat



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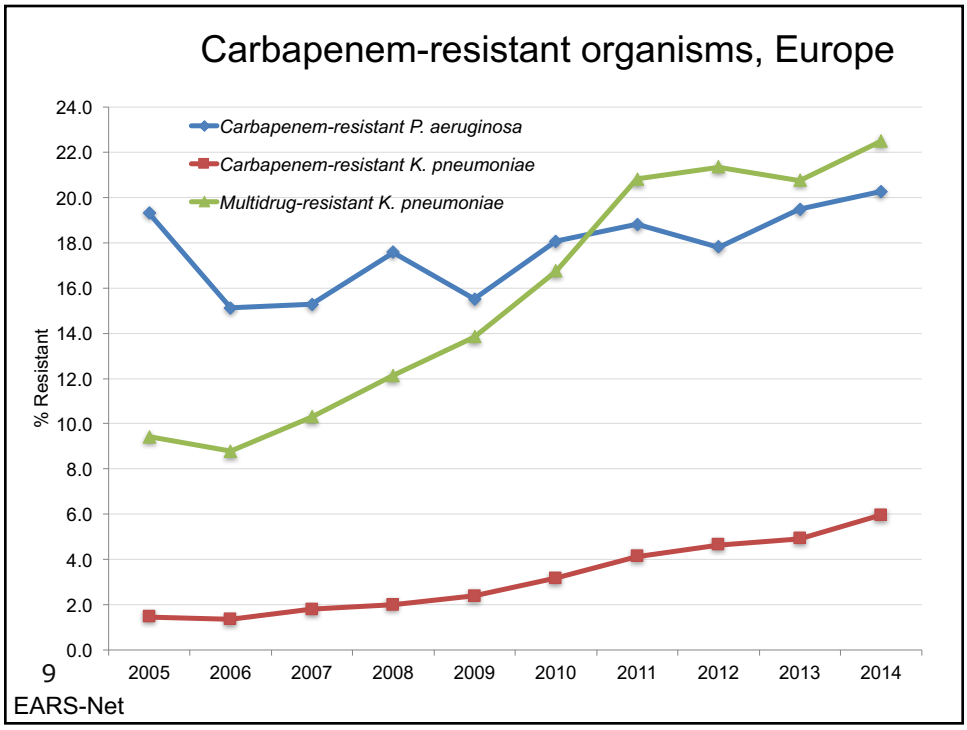
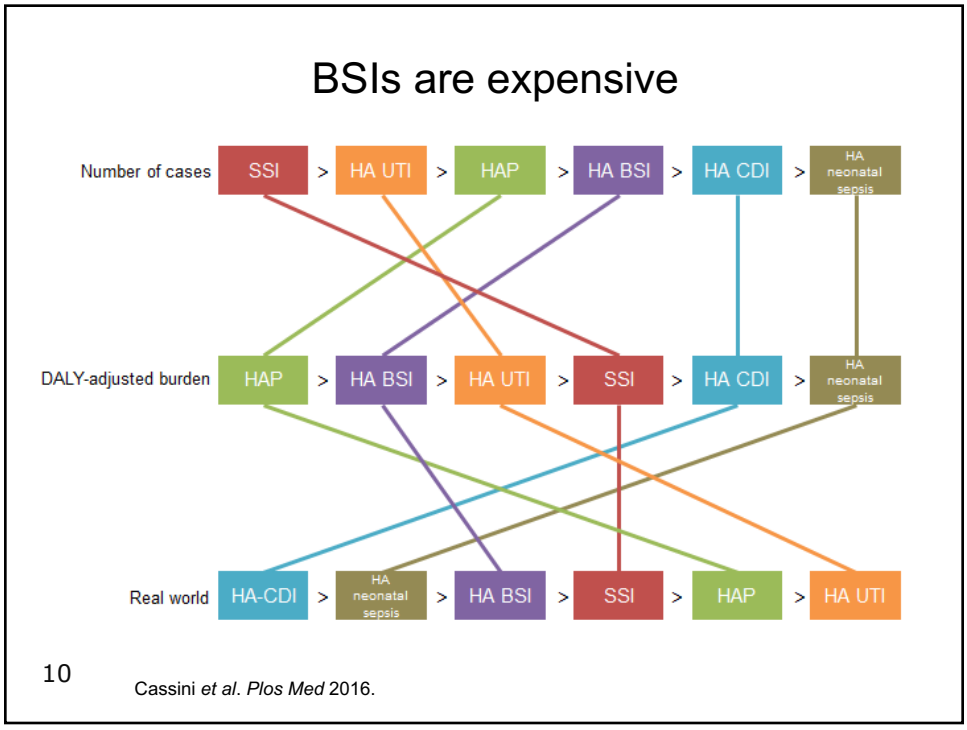
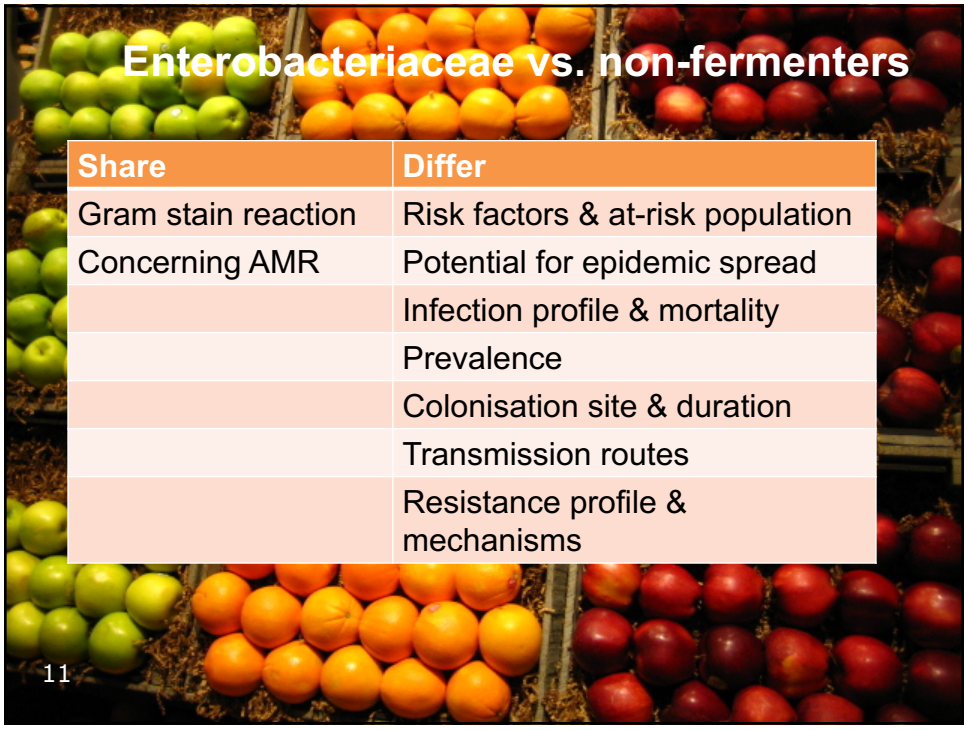
Data: ESPAUR 2018.


Carbapenem-resistant organisms, Europe
Carbapenem-resistant P. aeruginosa
Carbapenem-resistant K. pneumoniae
Multidrug-resistant K. pneumoniae
% Resistant
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
9
EARS-Net


BSIs are expensive
Number of cases
SSI
HA UTI
HAP
HA BSI
HA CDI
HA neonatal sepsis
DALY-adjusted burden
HAP
HA BSI
HA UTI
SSI
HA CDI
HA neonatal sepsis
Real world
HA-CDI
HA neonatal sepsis
HA BSI
SSI
HAP
HA UTI
10
Cassini *et al*. *Plos Med* 2016.



What's the problem? Poor clinical outcome

	Enterobacteriaceae		Non fermenters
Organism	AmpC / ESBL	CPE	*A. baumannii*
Attributable mortality	Moderate	Massive (>50%)	Minimal

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Shorr *et al. Crit Care Med* 2009;37:1463-1469.
Patel *et al. Iinfect Control Hosp Epidemiol* 2008;29:1099-1106.

The emerging threat of AMR GNR!

Pathogen	GNR	MRSA	VRE	*C. difficile*
Resistance	+++	+	+	+/-
Resistance genes	Multiple	Single	Single	n/a
Species	Multiple	Single	Single	Single
HA vs CA	HA & CA	HA	HA	HA
At-risk pts	All	Unwell	Unwell	Old
Virulence	+++	++	+/-	+
Environment	+/-	+	++	+++

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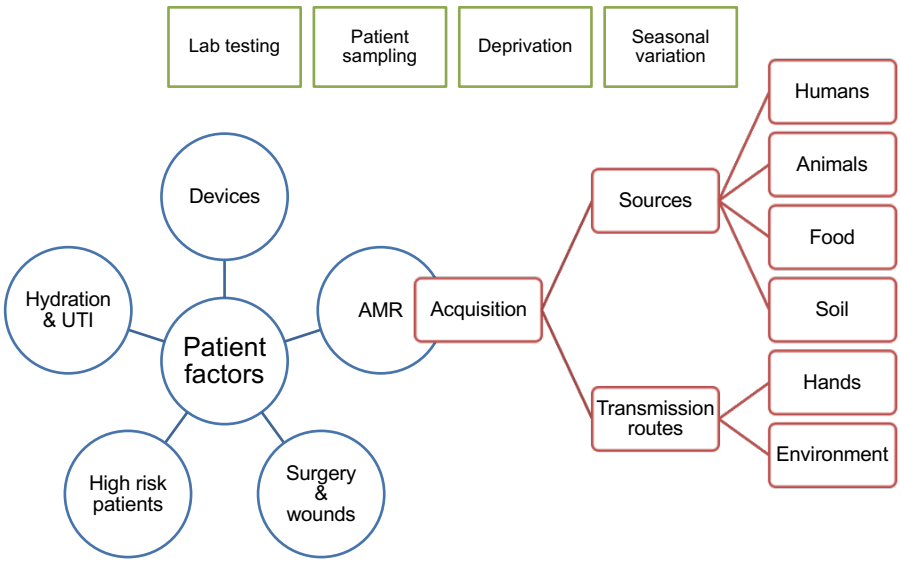
Drivers of Gram-negative BSI



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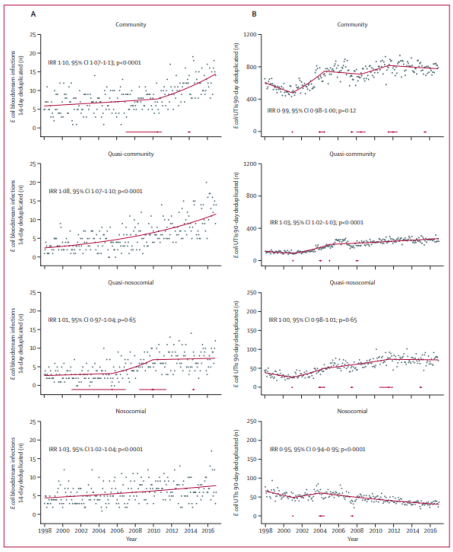
Trends in classification of *E. coli* BSIs

Classification and trends of *E. coli* BSIs in Oxfordshire, England.



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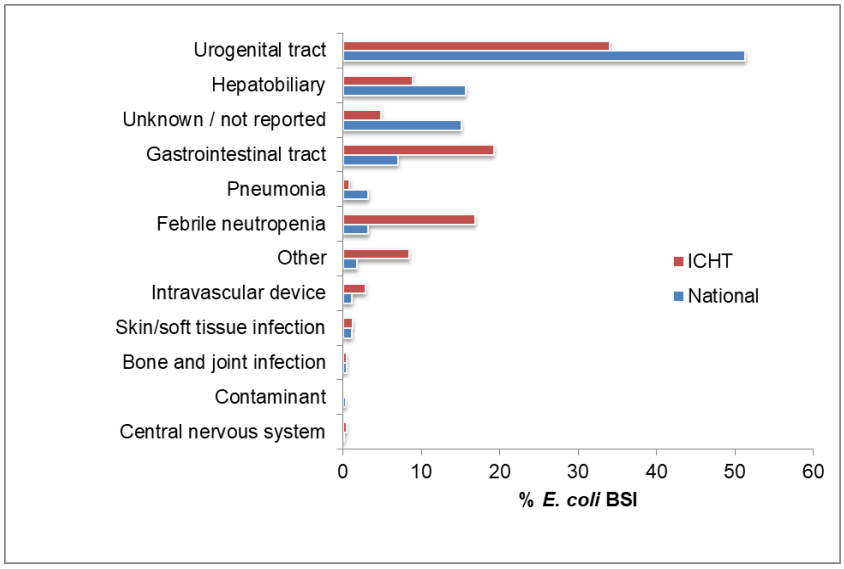
Vihta et al. Lancet Infectious Dis 2018.

Getting to grips with the source of *E. coli* BSIs

Comparing the source of 250 healthcare-associated *E. coli* BSIs with the national picture, 2015-2017.



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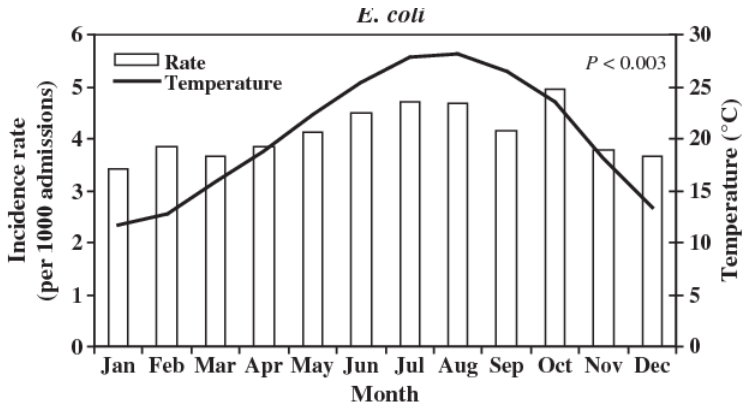
Otter et al. J Hosp Infect 2018.

Seasonal variation in *E. coli* BSIs

The monthly rate of 2810 *E. coli* BSIs in a region of Israel plotted against ambient temperature.



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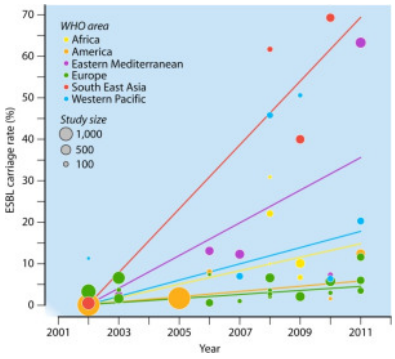
Chazan et al. Clinical Microbiol Infect 2011.

Social and material deprivation



The global prevalence of ESBL in the community, from Woerther et al.

- We performed a risk factor analysis, which included both individual-level variables (such as overseas travel, antibiotic exposure, and age) and were also able to include community-level variables (such as markers of household overcrowding, deprivation, immigration, and ethnicity).
- We found that risk factors for ESBL were travel to Asia (OR 4.4, CI 2.5-7.6), or Africa (OR 2.4, CI 1.2-4.8) in the 12 months prior to admission, two or more courses of antibiotics in the 6 months prior to admission (OR 2.0, CI 1.3-3.0), and residence in a district with a higher than average prevalence of overcrowded households (OR 1.5, CI 1.05-2.2).

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Otter et al. Clinical Microbiol Infect 2019.

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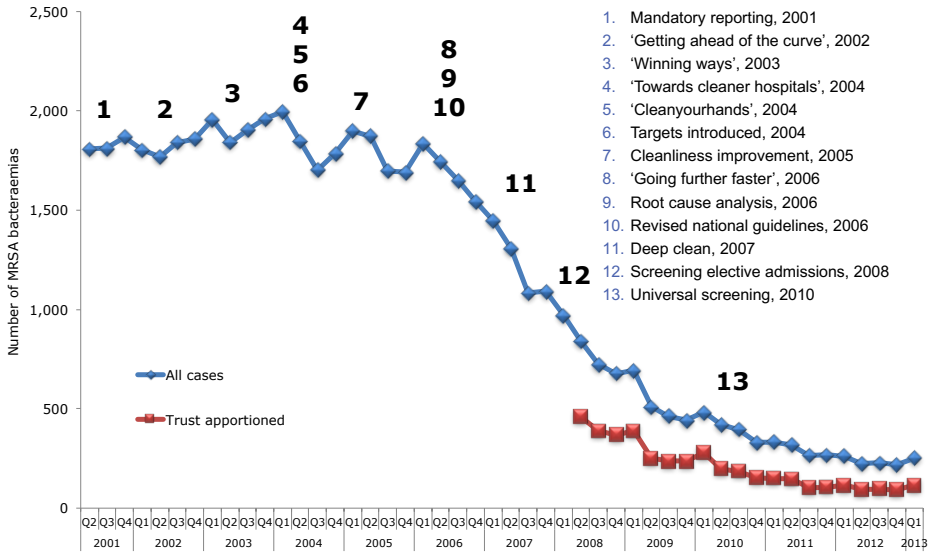
MRSA bacteraemia, England 2001-2013



1. Mandatory reporting, 2001
2. 'Getting ahead of the curve', 2002
3. 'Winning ways', 2003
4. 'Towards cleaner hospitals', 2004
5. 'Cleanyourhands', 2004
6. Targets introduced, 2004
7. Cleanliness improvement, 2005
8. 'Going further faster', 2006
9. Root cause analysis, 2006
10. Revised national guidelines, 2006
11. Deep clean, 2007
12. Screening elective admissions, 2008
13. Universal screening, 2010

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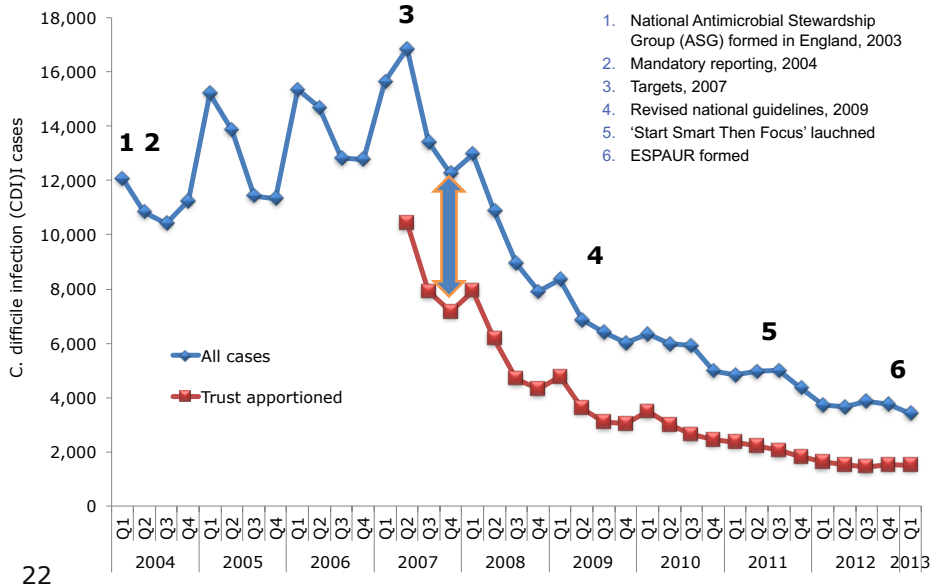
C. difficile infection (CDI), England 2004-2013



1. National Antimicrobial Stewardship Group (ASG) formed in England, 2003
2. Mandatory reporting, 2004
3. Targets, 2007
4. Revised national guidelines, 2009
5. 'Start Smart Then Focus' lauchned
6. ESPAUR formed

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Does hand hygiene explain the reductions?

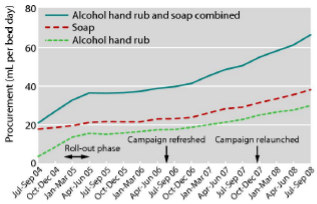

Fig 1 Estimated use of hand hygiene consumables, by quarter

'The Cleanyourhands campaign was associated with sustained increases in hospital procurement of alcohol rub and soap, which the results suggest has an important role in reducing rates of some healthcare associated infections.'

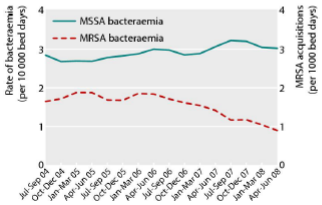

Fig 2 Estimated quarterly rate of bacteraemia (per 10 000 bed days)

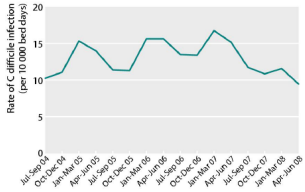

Fig 3 Estimated quarterly rate of *C difficile* infection (per 10 000 bed days)

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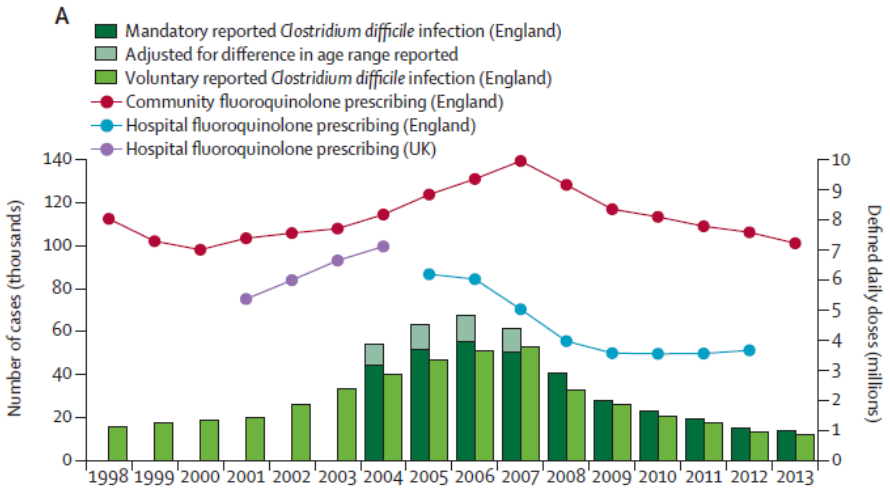
Stone *et al. BMJ* 2012;344:e3005.

Does antimicrobial stewardship explain the reduction?



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Dingle *et al. Lancet Infect Dis* 2017 in press.

Spurious correlation?

Correlation between national chocolate consumption and rate of Nobel prize winners.

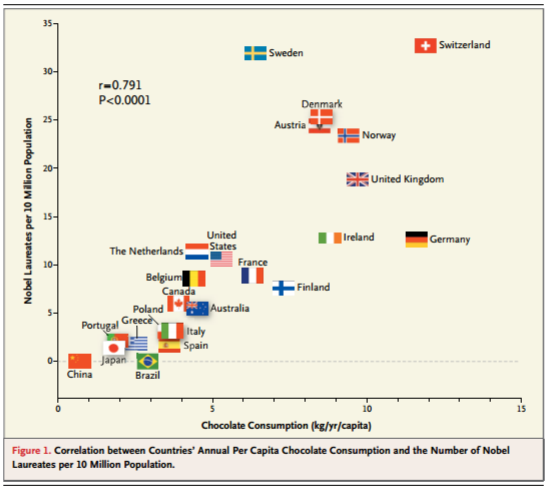

Figure 1. Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.

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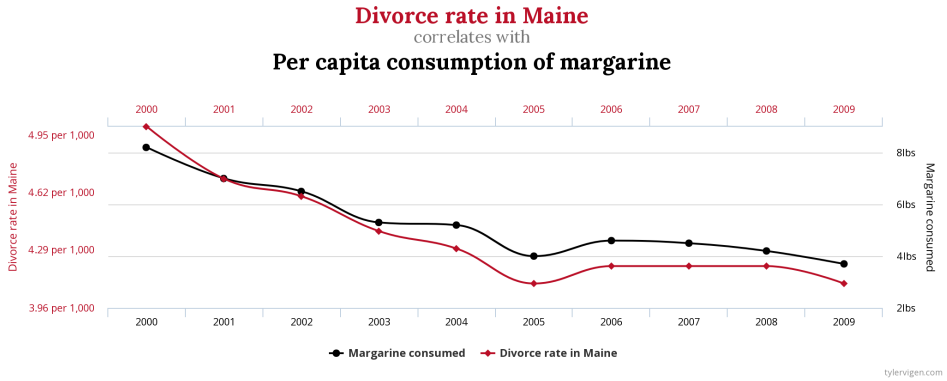
Messerli FH. *New Engl J Med* 2012;367:1562-4.

Spurious correlations



http://www.tylervigen.com/spurious-correlations

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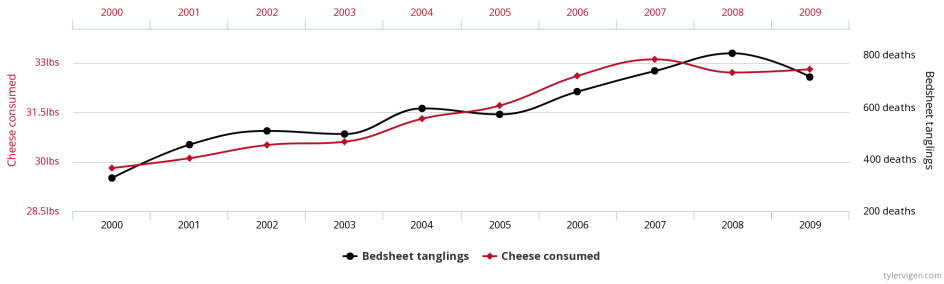
Spurious correlations

Per capita cheese consumption
correlates with
Number of people who died by becoming tangled in their bedsheets



http://www.tylervigen.com/spurious-correlations

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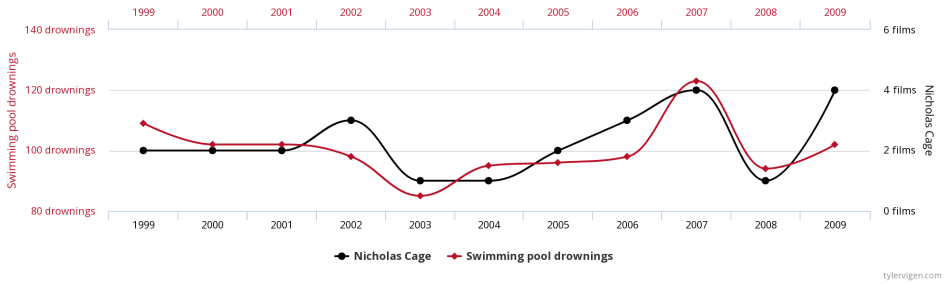
Spurious correlations

Number of people who drowned by falling into a pool
correlates with
Films Nicolas Cage appeared in



http://www.tylervigen.com/spurious-correlations

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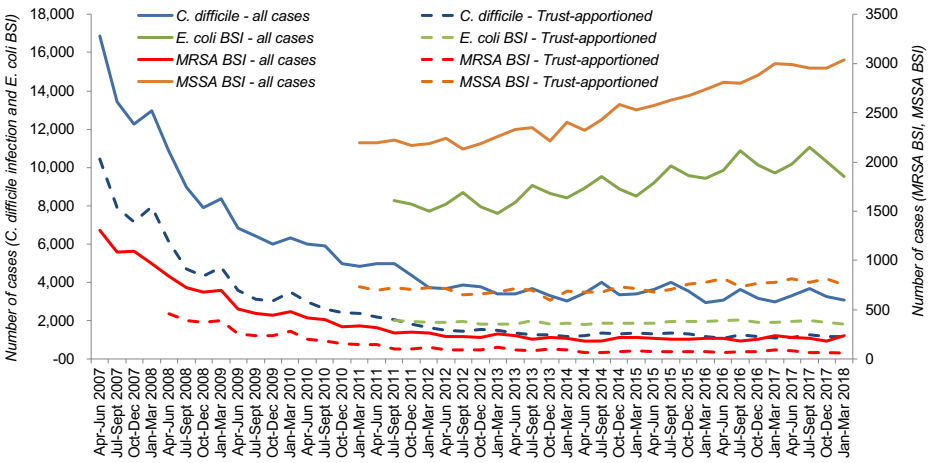
What's driving increases in MSSA and *E. coli* BSI?



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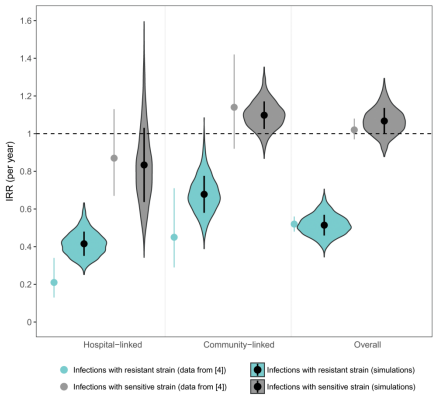
Why antibiotic susceptible bacteria are resistant to hospital-based IPC intervention



- Mathematical model to investigate transmission in hospitals and their surrounding catchment area.
- Included a competitive advantage for resistant bacteria in hospitals and sensitive bacteria in the community.
- Modelling the impact of improving hand hygiene by 10%.
- Antibiotic-resistant bacteria were disproportionately affected in hospitals!

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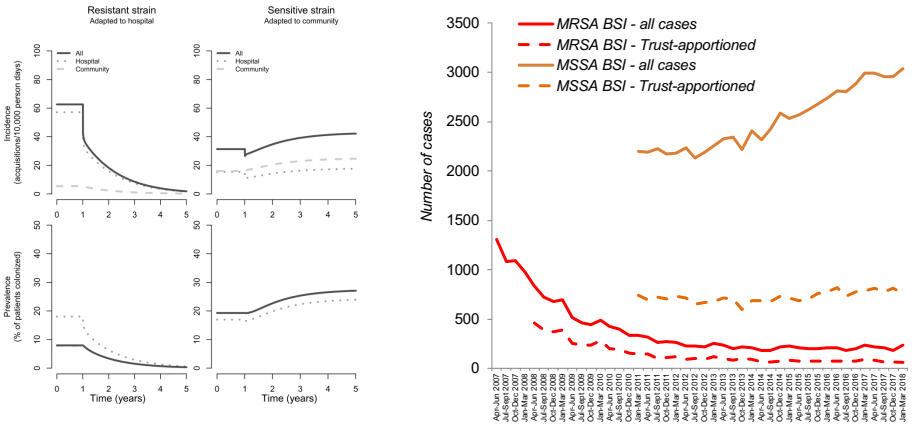
van Kleef et al. BMC Infect Dis 2013;13:294.

Why antibiotic susceptible bacteria are resistant to hospital-based IPC intervention



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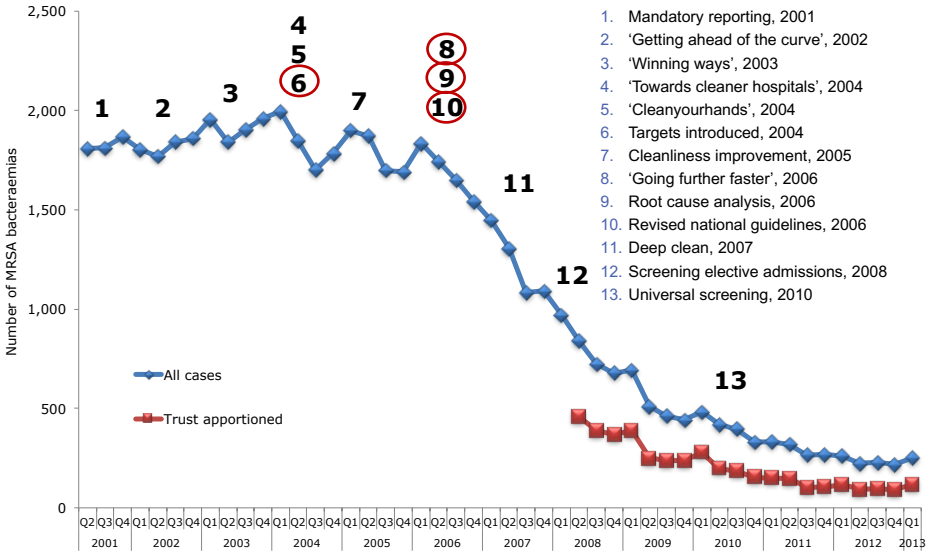
van Kleef et al. BMC Infect Dis 2013;13:294.

MRSA bacteraemia, England 2001-2013



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Targeted approach to MRSA infection prevention

- Reduction targets introduced in 2004 and reinforced in 2006
- High impact interventions launched in 2006
- Root cause analysis launched in 2006
- Revised national guidelines launched in 2006 (including screening, isolation, and suppression for carriers)

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'Going further faster' (2006)

Key challenge	Specific Focus
Challenge 1	Engage the board and use performance management at every level
Challenge 2	Ensure clinical ownership across organisation
Challenge 3	Screen and/or decontaminate according to risk assessment
Challenge 4	Use HIIs* to monitor and increase compliance
Challenge 5	Integrate with risk and clinical governance framework
Challenge 6	Ensure infection control is part of induction and ongoing training
Challenge 7	Effectively coordinate bed management with infection control input
Challenge 8	Clean and decontaminate
Challenge 9	Proactively manage your reputation, engage all staff and local community

* HII = high impact interventions: Central venous catheter care bundle; Peripheral intravenous cannula care bundle; Renal catheter care bundle; Care bundle to prevent surgical site infection; Care bundle for ventilated patients; Urinary catheter care bundle; Care bundle to reduce the risk from *Clostridium difficile*.

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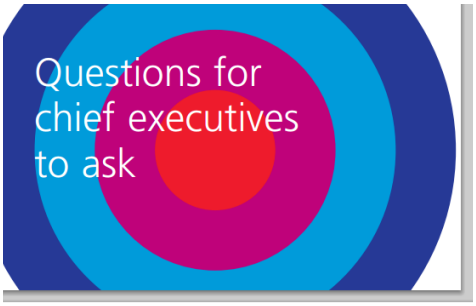
From 'Going further faster'



- Where are MRSA bacteraemias occurring and how often?
- How do you ensure that your data is accurate?
- Does the Trust board understand this agenda and are they engaged in reducing MRSA?
- Who is responsible for leading this work and what resources are needed?
- How are you embedding this in your performance management framework?
- Do you have a non-executive champion for this?
- Is this integrated into your risk management and clinical governance framework?
- How are you engaging patients and the public to increase public confidence in your trust?

Questions for chief executives to ask

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From 'Going further faster', 2006

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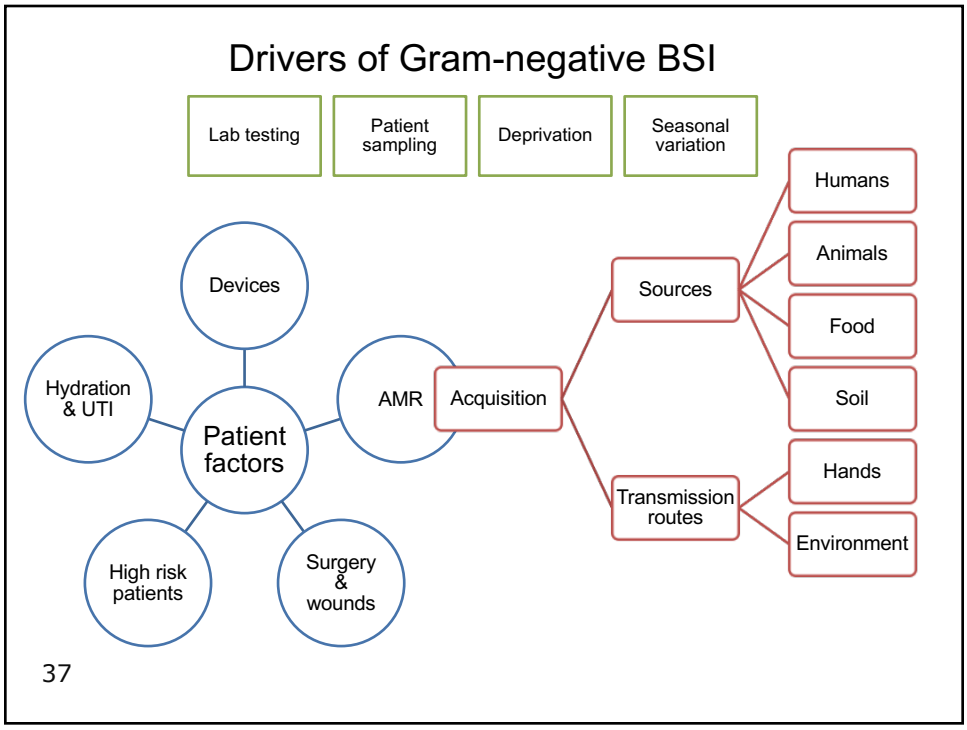
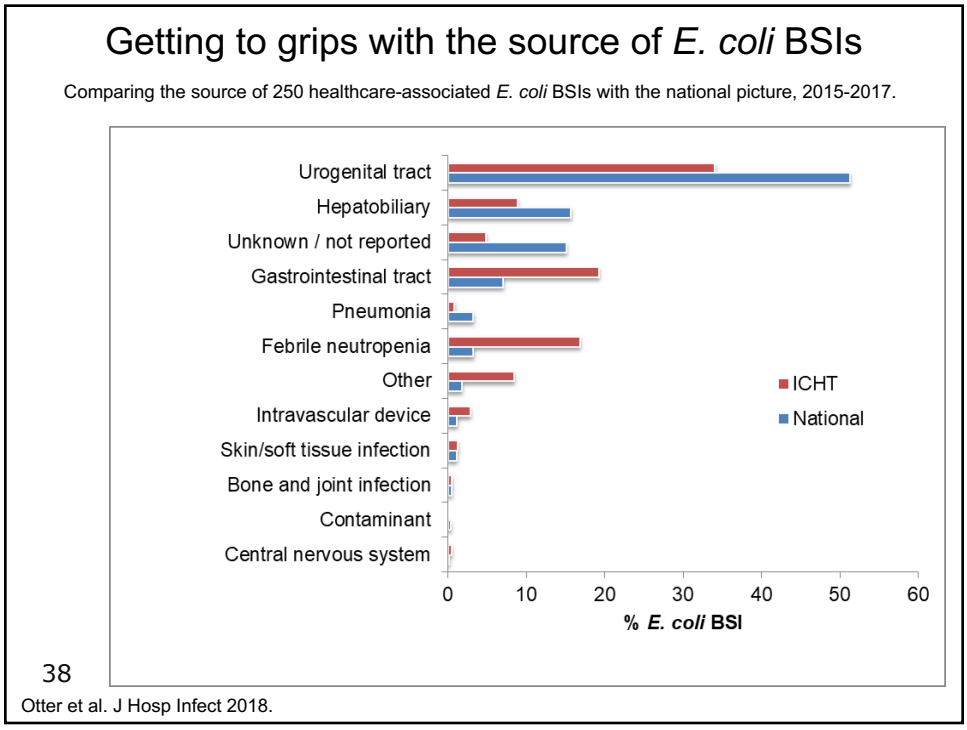
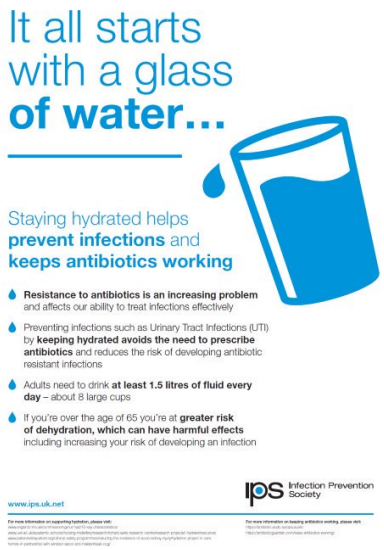




Otter et al. J Hosp Infect 2018.

You're givin' me good hydration



Simple interventions (e.g. offering people a drink and giving them a choice of fluids) made a big impact on hydration levels (Wilson, Clin Nutr, 2019)

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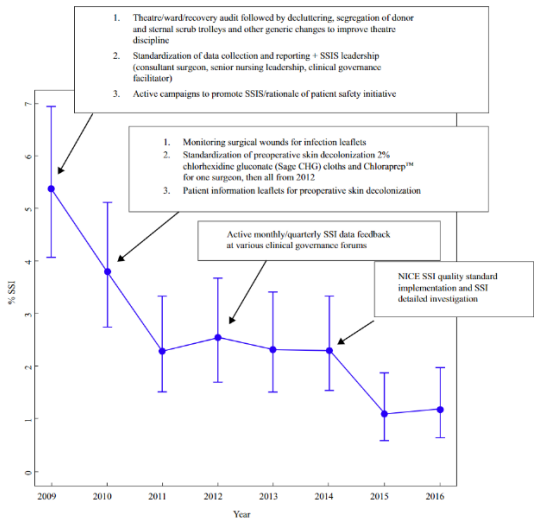
Prevent preventable SSIs

% patients with SSI following cardiothoracic surgery.



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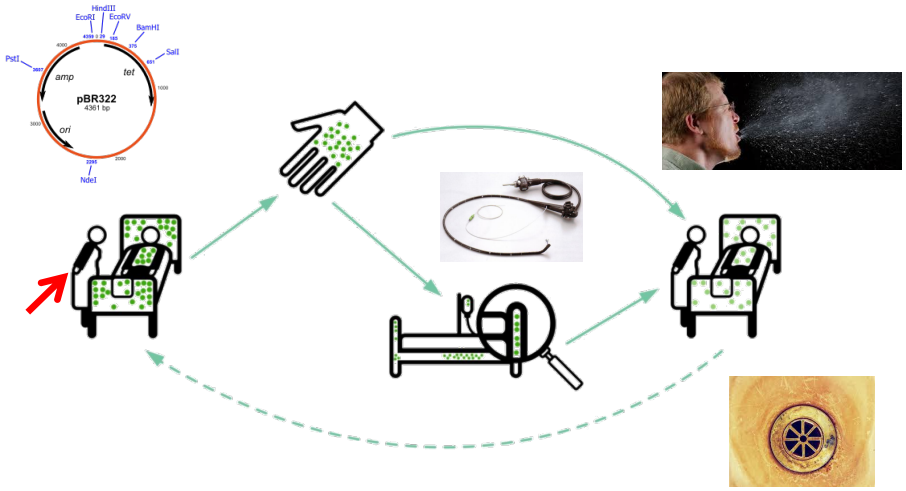
Chiwera et al. J Hosp Infect 2018.

Transmission modes of Gram-negative bacteria



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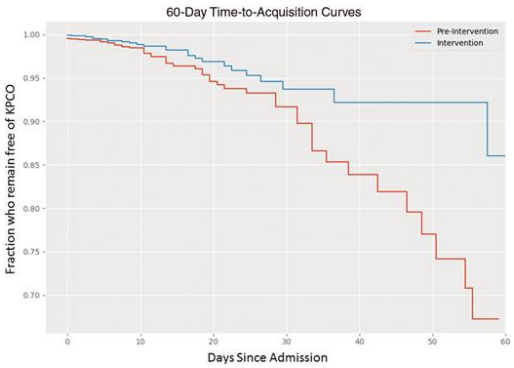
Otter *et al. Infect Control Hosp Epidemiol* 2011;32:687-699.

Contaminated sinks / drains

- CPE (*K. pneumoniae*) acquisition and clinical infection halved through improved management of sinks (OR = 0.51 for acquisions, and 0.29 for clinical cultures) (n=~7,500 pts).



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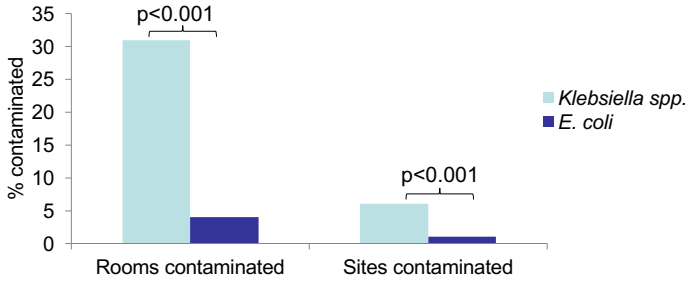
Mathers *et al. Clin Infect Dis* 2018 in press.

Transmissibility / fitness

- *Klebsiella* species **3.7x** more transmissible than *E. coli* in the ICU.[1]
- *K. pneumoniae* seems to be more environmental than *E. coli.*[2,3]

Surface contamination on five standardized sites surrounding patients infected or colonized with ESBL-producing *Klebsiella* spp. (n=48) or ESBL-producing *E. coli* (n=46).[2]



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1. Gurieva *et al. Clin Infect Dis* 2018;66:489-93. 2. Guet-Revillet *et al. Am J Infect Control* 2012;40:845-8.
3. Gbaguidi-Haore. *Am J Infect Cont* 2013;41:664-5.

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Getting to grips with healthcare-associated Gram-negative bloodstream infection?

Jon Otter, PhD FRCPath
Imperial College London

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@jonotter
Blog: www.ReflectionsIPC.com

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Imperial College London

Getting to grips with healthcare-associated Gram-negative bloodstream infection?
Dr. Jon Otter, Imperial College, London
A Webber Training Teleclass

www.webbertraining.com/schedulep1.php	
July 9, 2019	*(European Teleclass)* SUPERBUGS - THE CENTRALITY OF HUMAN BEHAVIOUR: A FOCUS ON FILOVIRUS OUTBREAKS Speaker: **Prof. Adriano Duse**, University of the Witwatersrand, Johannesburg, South Africa
July 16, 2019	INFECTION CONTROL IN PEDIATRICS Speaker: **Dr. Shahnaz Armin**, Shahid Beheshti University of Medical Sciences, Iran
July 25, 2019	DIAGNOSTIC STEWARDSHIP: MODIFIED CULTURE TESTING TO ENHANCE ANTIBIOTIC STEWARDSHIP Speaker: **Robert Garcia**, Stony Brook University Medical Center, New York City
August 15, 2019	*(FREE Teleclass)* BED BUG PREVENTION IN THE HEALTHCARE SETTING Speaker: **Dr. Marcia Anderson**, Environmental Protection Agency, United States
August 22, 2019	HOW TO ENGAGE AND EDUCATE NURSES IN EVIDENCE-BASED PRACTICE Speaker: **Eileen J. Carter**, Columbia University School of Nursing
September 5, 2019	MEASURES TO PREVENT AND CONTROL VRE: DO THEY REALLY MATTER? Speaker: **Dr. Hilary Humphreys**, The Royal College of Surgeons in Ireland
	(FREE Teleclass) MEAT, MONKEYS, AND MOSQUITOES: A ONE HEALTH PERSPECTIVE ON

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