

Surveillance by Objectives? Using Measurement in the Prevention of HCAI  
 Prof. Jennie Wilson, Richard Wells Research Centre, University of West London  
 Broadcast live from the 2019 conference of the Infection Prevention Society



# Surveillance by objectives? Using measurement in the prevention of HCAI

Professor Jennie Wilson  
 Richard Wells Research Centre



www.webbertraining.com

September 30, 2018

## In the beginning there was no infection control.....

- Organized IPC began in response to epidemics of Staphylococcal infections in hospitals in 1950s
- Wider problems of HCAI not recognised
- 1<sup>st</sup> ICU opened in Copenhagen in 1953
  - Risks associated with medical interventions & Immunosuppression



- Even by 1980s many UK hospitals had no ICP and most had small numbers

*First full-time infection control sister* appointed at Torbay hospital by Brendan Moore (CIO), 1959

- Collection & preparation of records
- Prompt recognition & disposal of infected patients
- Liaison between matron & ward sisters
- Check performance of ward techniques
- Monitor Staphylococcal carriage rate in operating theatre staff; keep records of infected staff

**THE INFECTION CONTROL SISTER**  
 A New Member of the Control of Infection Teams  
 in General Hospitals  
 A. M. N. GARDNER  
 B.M. Oxon., F.R.C.S.  
 CONSULTANT SURGEON AND CONTROL-OF-INFECTION OFFICER  
 M. STAMP  
 S.R.N., S.C.M.  
 MATRON  
 TORBAY HOSPITAL, TORQUAY, DEVON  
 I. A. BOWGEN  
 A.H.A., A.C.C.S.  
 GROUP SECRETARY  
 B. MOORE  
 M.D., B.Sc. N.U.I.  
 DIRECTOR, PUBLIC HEALTH LABORATORY, EXETER; HONORARY  
 CONSULTANT BACTERIOLOGIST, DEVON AND EXETER CLINICAL AREA

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## Trajectory to becoming an HCAI surveillance nerd?

### Royal Liverpool Hospital

BSc Microbiology & Nursing (1977 to 1982)



Research assistant

Nursing Practice Research Unit

Indwelling catheterization and related nursing practice  
 Rosemary Crow, Anne Mulhall,  
 Robert Chapman. J. Adv Nurs 1988

Charing Cross Hospital  
 Senior nurse infection control



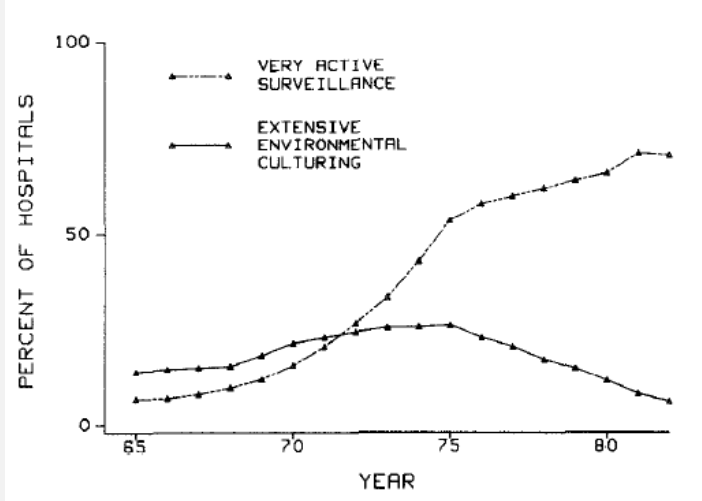
## IPC in UK during the 1980s

- Focused on control measures
  - 1<sup>st</sup> epidemic MRSA strains
  - HIV & hepatitis B
- Focus on policies for infection control
- Surveillance only of alert organisms
  - No computers!

Early HCAI surveillance:  
 ➤ The Infection control  
 Alert organism Board!



## Trends in practice of surveillance in US hospitals – 1965 to 1983 (Haley 1985)



1970s – ‘Band wagon’ phase  
1980s – concerns about costs vs benefits



## What is surveillance?

- 1 • Ongoing, systematic collection, analysis, and interpretation of health data
- 2 • Closely integrated with the timely dissemination to those who need to know
- 3 • Application of the data to preventing and controlling disease

Thacker SB, Berkelman RL. Epidemiol Rev 1998

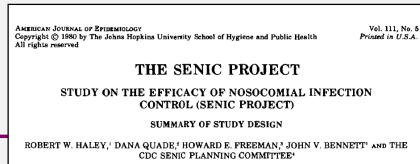


## Study of the Efficacy of Nosocomial Infection Control (SENIC project)

- Survey of 6500 hospitals to establish **surveillance** and **control** indices
- Random stratified sample of 338 hospitals
- Estimated HAI rate in 1970 and 1976 from case note review of 500 patients (random selection)
- Adjusted for case mix and changes in hospital characteristics



Robert Haley, Epidemiologist  
Southwestern Medical Center, Dallas, USA



## Main findings from SENIC

- Overall HCAI reduced by 6%
- Best infection control programmes
  - reduced rate by 32%
- No infection control programme
  - rate increased by 18%

Haley *et al* 1985, Am J  
Epidemiol 121: 182



## Surveillance and control activities associated with reduction in rates by type of HCAI

Type of HCAI	Effective programme	% reduction in rate
SSI	Intensive control <b>Surveillance &amp; reporting rates</b> Hospital epidemiologist	Low risk : 41% High risk: 35%
UTI	<b>High intensity surveillance</b> High intensity control ICN/250 beds	Low risk: 44% High risk: 31%
Pneumonia (post-op)	<b>High intensity surveillance</b> Regardless of control ICN/250beds	27%
Bacteraemia	High intensity control <b>Moderate surveillance</b> ICN/250 beds	35%



## Conclusions

- Different strategies required to tackle different HCAI but surveillance an essential component for all HCAI
- Without an organized surveillance programme the most active infection control efforts probably have little impact on the infection rate:
 

*'infection control problems and the need for prevention efforts were not apparent to physicians, nurses or administrators until they were given quantitative measures of the problem derived from surveillance data'*
- This is an important factor in 1 ICNs per 250 beds being associated with the most effective programmes!

Haley et al 1985



## Effective surveillance programmes.....

- ICN employed to find HAI
- Analysed rates of infection
- Used basic epidemiological techniques
- **Used the data in decision making**

Haley *et al* 1985, Am J Epidemiol 121: 182



## HCAI surveillance 30 years on.....?

### What surveillance is...

- Determined by national requirement
- Not linked to specific objective
- Time consuming
- Not related to local priorities

### What surveillance should be...

- Define objectives to be achieved
  - E.g. Reduce SSI after bowel surgery by 30%
- Design programme of activity directed at objective
- Measure results
- Provide feedback on performance



Process objective



Outcome objective



# Outcome vs process objectives

## Process objectives

Compliance with standards:

- Hand hygiene
- Urine catheter care
- IV device insertion
- Reporting BSI data to national Centre
- Safety Thermometer data

## Outcome objectives

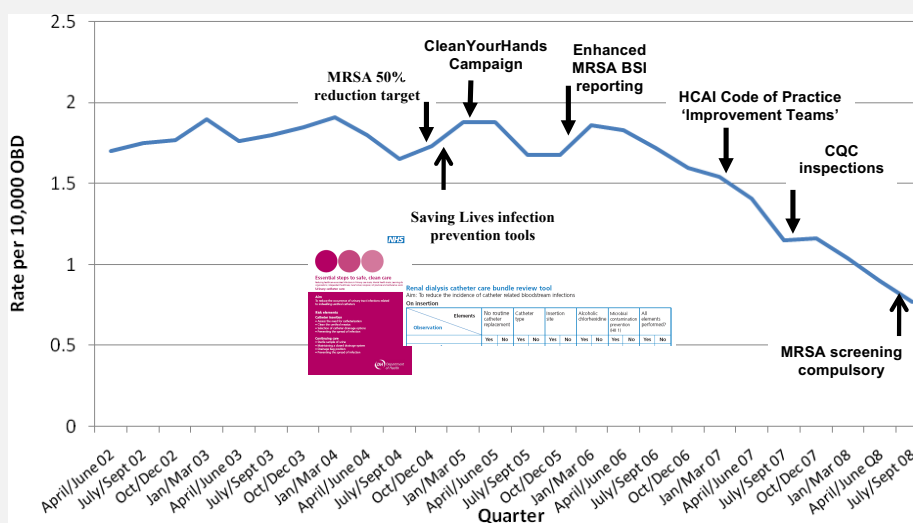
Reduce number of patients affected by (Explicit target for reduction):

- Surgical site infection
- Urinary tract infection
- Pneumonia
- Bloodstream infection

Specific prevention strategies informed by epidemiology



## Department of Health 'Delivery programme' to reduce MRSA & trend in rate of MRSA bacteraemia



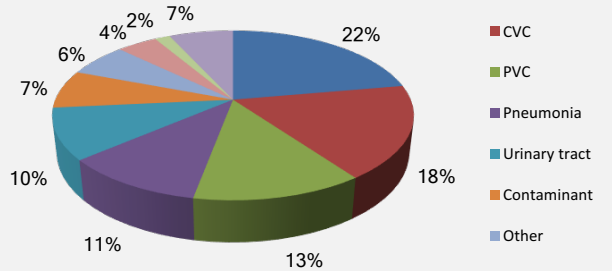
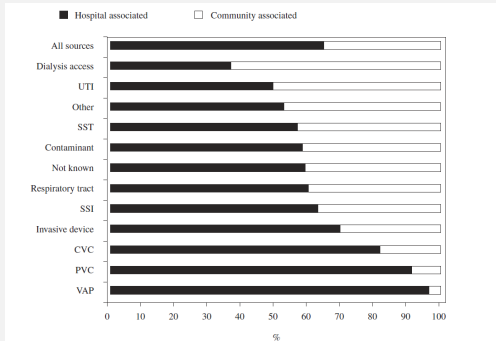
MRSA bacteraemia per occupied bed days



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# MRSA prevention strategies targeted at epidemiology

Wilson et al (2011)  
Trends in Sources of  
MRSA bacteraemia

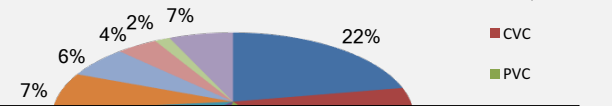
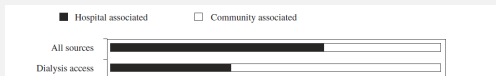


- Skin/soft tissue
- CVC
- PVC
- Pneumonia
- Urinary tract
- Contaminant
- Other



# MRSA prevention strategies targeted at epidemiology

Wilson et al (2011)  
Trends in Sources of  
MRSA bacteraemia

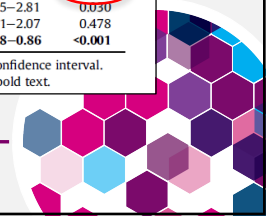


- Skin/soft tissue
- CVC
- PVC

Relative change in the number of episodes of methicillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia in England between two years using rolling two-year comparisons<sup>a</sup> by reported source adjusted for age and sex

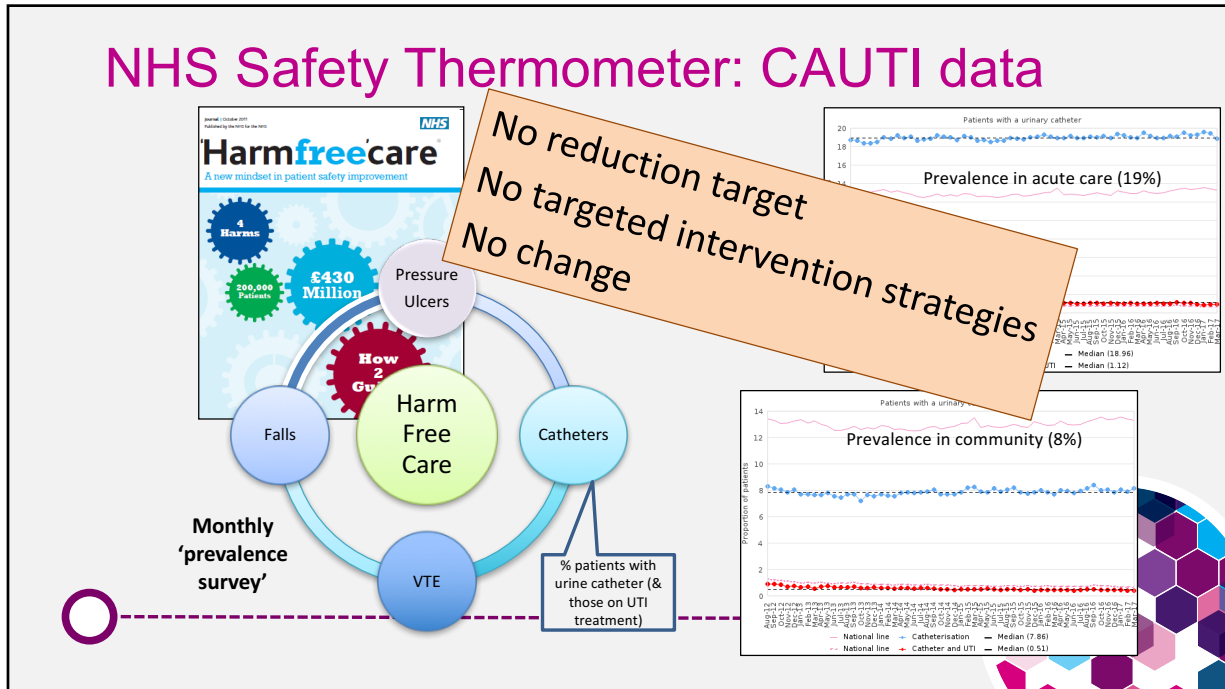
	2007 vs 2006 (baseline)			2008 vs 2007 (baseline)			2009 vs 2008 (baseline)			2009 vs 2006 (baseline)		
	IRR	95% CI	P-value	IRR	95% CI	P-value	IRR	95% CI	P-value	IRR	95% CI	P-value
CVC	0.75	0.59–0.95	0.018	0.79	0.61–1.03	0.078	0.71	0.48–1.05	0.083	<b>0.42</b>	<b>0.29–0.61</b>	<b>&lt;0.001</b>
PVC	1.21	0.94–1.56	0.148	0.69	0.54–0.88	0.003	0.83	0.58–1.18	0.302	<b>0.69</b>	<b>0.48–0.99</b>	<b>0.042</b>
UTI	0.97	0.72–1.29	0.817	1.08	0.83–1.41	0.558	1.28	0.94–1.74	0.111	1.34	0.97–1.86	0.079
Dialysis	0.72	0.43–1.21	0.211	1.48	0.92–2.39	0.104	0.68	0.36–1.26	0.218	0.72	0.37–1.39	0.327
Skin/soft tissue	1.08	0.88–1.32	0.482	1.20	1.01–1.43	0.043	1.03	0.84–1.27	0.772	<b>1.33</b>	<b>1.05–1.69</b>	<b>0.017</b>
SSI	0.77	0.55–1.08	0.135	1.03	0.73–1.44	0.867	0.53	0.31–0.90	0.019	<b>0.42</b>	<b>0.25–0.72</b>	<b>0.001</b>
Respiratory tract	1.00	0.75–1.34	0.989	0.94	0.71–1.23	0.637	1.20	0.87–1.66	0.275	1.13	0.80–1.59	0.495
Invasive device	0.57	0.31–1.08	0.084	1.19	0.62–2.27	0.598	1.20	0.57–2.52	0.624	0.82	0.40–1.70	0.596
Contaminant	1.74	1.17–2.59	0.006	0.96	0.71–1.30	0.798	1.17	0.81–1.69	0.400	<b>1.96</b>	<b>1.25–3.06</b>	<b>0.003</b>
Other	1.23	0.79–1.91	0.369	1.22	0.85–1.76	0.274	1.15	0.76–1.74	0.517	1.72	1.05–2.81	0.030
Unknown	1.00	0.63–1.59	0.997	1.09	0.72–1.65	0.672	1.11	0.68–1.82	0.683	1.21	0.71–2.07	0.478
All sources	1.83	1.66–2.01	<0.001	0.71	0.66–0.78	<0.001	0.59	0.53–0.65	<0.001	<b>0.77</b>	<b>0.68–0.86</b>	<b>&lt;0.001</b>

CVC, central vascular catheter; PVC, peripheral vascular catheter; SSI, surgical site infection; UTI, urinary tract infection; IRR, incident rate ratio; CI, confidence interval.  
<sup>a</sup> IRRs from a generalized linear model with a log link function for Poisson distribution to estimate the relative risk; significant values denoted by bold text.



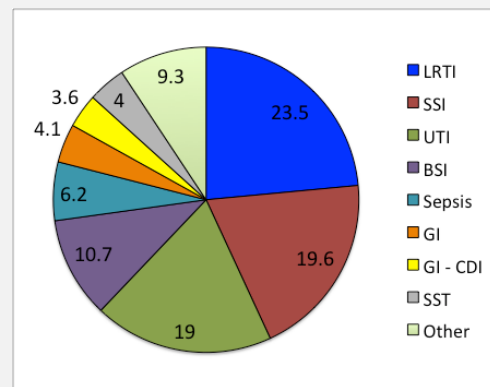


## NHS Safety Thermometer: CAUTI data



## What does your IPC programme look like?

- What HCAI do your patients acquire?
- Is activity prioritized to maximize impact on prevention of HCAI?
  - Pneumonia?
  - UTI?
  - SSI?
- Specific outcome objectives defined?
- Surveillance objectives defined annually?
  - Process or outcome?



Proportion of HCAI by type: ECDC PPS (2012)

## How to use surveillance effectively

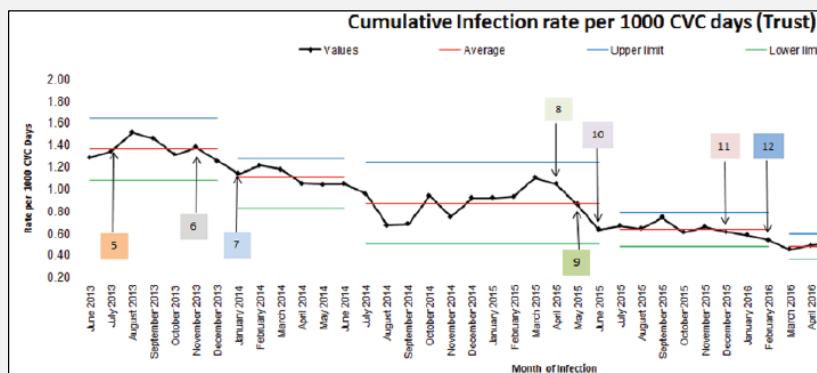
1. Define specific outcome objectives
2. Assign priorities
  - burden; cost of health services; impact
3. Allocate time and resources
4. Design surveillance and control strategies
  - Aim at factors which contribute to the infections
  - May include process objectives (but designed to achieve outcome)
5. Evaluate and revise



## Using BSI surveillance to drive improvement

- CVAD steering group – clinical staff from ICU, NICU, OPAT
- Case definition agree
- Data captured – denominator/numerator
- Root cause analysis of all cases – led by clinical teams
- Rate ↓ from 5/1000 CD (2011) to 0.23/1000 CD (2017)

Hallam et al JIP 2018



1.	Standard CVAD pathway	Apr-11
2.	Adapted neonatal pathway	Apr-12
3.	CVAD pathway audit	Aug-12
4.	Standardised training	Oct-12
5.	Competency Matrix	Jul-13
6.	Change of dressing in ICU	Nov-13
7.	CVAD RCA standard	Jan-14
8.	OPAT data	Apr-15
9.	Community data	May-15
10.	MSSA screening	Jun-15
11.	Daily CHX washes	Dec-15
12.	Standardised dressings	Feb-16
13.	Patient information checklist	Dec-16



# VAP prevention bundle

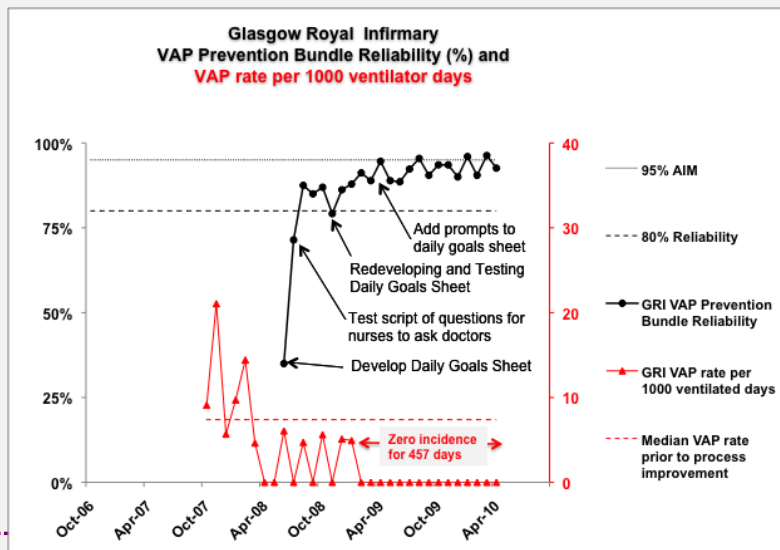
Scottish Intensive Care Society Audit Group.

Four bundle elements (all had to be delivered to meet standard):

1. Sedation reviewed daily, stopped if appropriate
  2. Patients assessed daily for weaning, identify plan
  3. Avoid the supine position, aim for head at least 30°
  4. Chlorhexidine antiseptics for daily mouth care.
- Bundle **criteria** recorded on patient daily goals sheet
  - Compliance **measured** by reviewing 1 day/week (selected at random)
  - Monthly bundle compliance **displayed** on run chart in ICU
  - Weekly 'huddle' at run chart **to review progress**
  - VAP identified by active surveillance (**linked to outcome**)

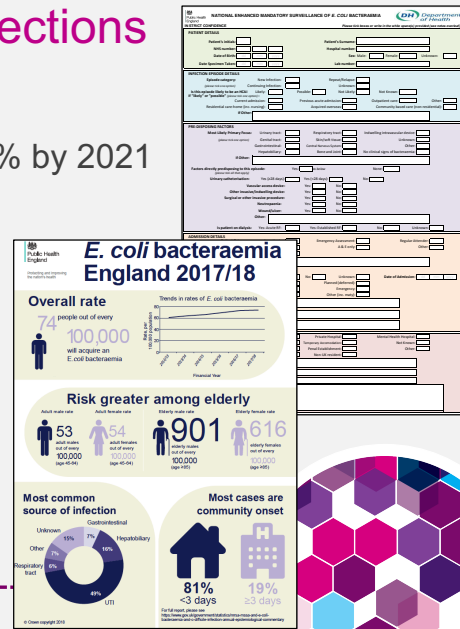


## Surveillance & feedback used to drive improvement



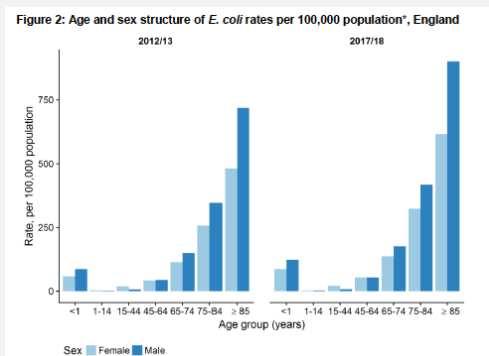
## Reducing *E. coli* bloodstream infections What surveillance data tells us?

- Target: Reduce Gram negative BSI by 50% by 2021
  - *E. coli* accounts for 75%
  - Rates very high (MRSA only 9/100,000 at peak)
- Large routine dataset
  - Reliability of source data?
- Descriptive reporting of surveillance data
  - Describe trends (but not seasonal variation)
  - Age/gender
  - Regional differences
    - needs age/deprivation standardization?



## What do we know about the epidemiology of *E. coli* blood stream infections?

- 70% community onset
- 70% in >65 years
- 70% UTI source (if unknowns excluded)
  - 15% hepatobiliary; 7%GI
- 20% with urinary catheter in last 7 days
  - 30% for retention
- 60% treated for UTI in last month
  - aOR 5.4 for BSI
  - Previous UTI aOR 10.7
- Inadequate UTI treatment?
  - Coamoxiclav resistance 43%
  - Trimethoprim resistance 40%

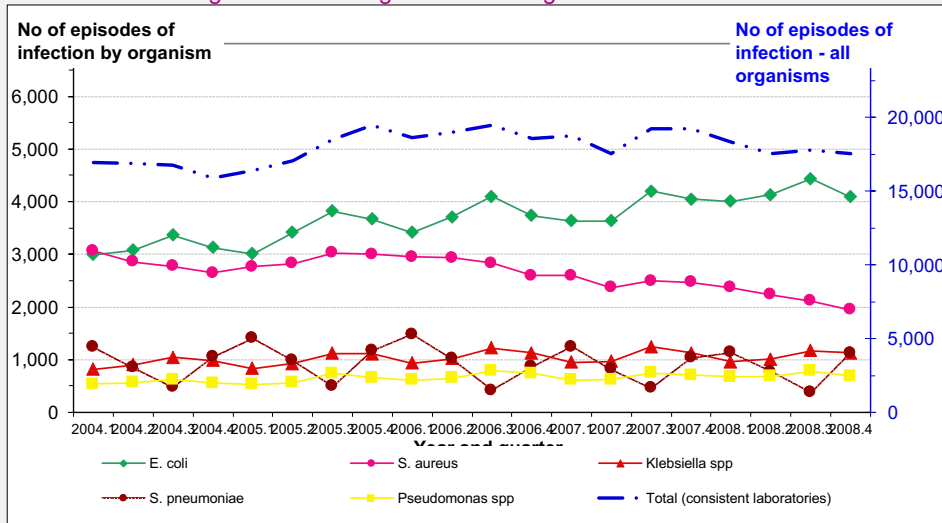


**Epidemiology of *Escherichia coli* bacteraemia in England: results of an enhanced sentinel surveillance programme**

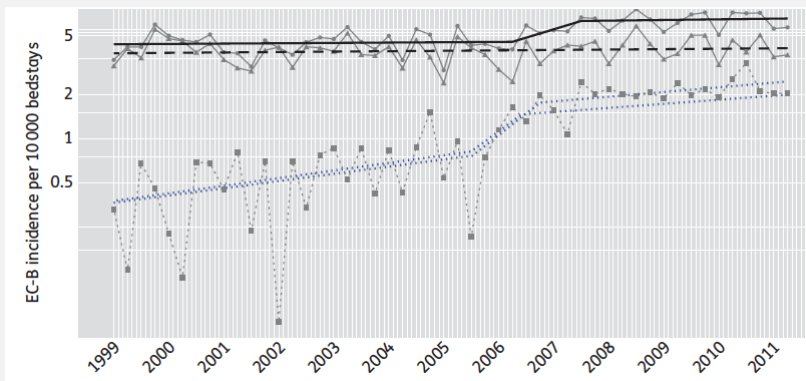
J. Abernethy<sup>a,b</sup>, R. Guy<sup>a</sup>, E.A. Sheridan<sup>b,c</sup>, S. Hopkins<sup>d,e</sup>, M. Kiernan<sup>f</sup>, M.H. Wilcox<sup>g</sup>, A.P. Johnson<sup>h</sup>, R. Hope<sup>h</sup>, on behalf of the *E. coli* bacteraemia sentinel surveillance group

## Seasonal variation in incidence of E. coli BSI

Trends in England of microorganisms causing bacteraemia



## Other evidence of seasonal trends



“an increase in mean weekly air temperature of 5°C was associated with a 5% increase in EC-B incidence (IRR=1.05; 95%CI 1.01-1.09, p = 0.03)”



### Methods

- Data extracted from surveillance database 1999 -2011
  - Severity & outcome
- Temperature & rainfall data from UK Met Office

*J Antimicrob Chemother* 2012; 67: 1514-1516  
 doi:10.1093/ac/ckr162 Advance Access publication 9 March 2012

Increasing incidence of *Escherichia coli* bacteraemia is driven by an increase in antibiotic-resistant isolates: electronic database study in Oxfordshire 1999–2011

Iryna Schlieckow<sup>1</sup>, Nicole Staessen<sup>1,2</sup>, A. Sarah Walker<sup>1,3</sup>, Derrick W. Cook<sup>1</sup>, Tim E. A. Peat<sup>1</sup> and David H. Wyllie<sup>1,4\*</sup> on behalf of the Infections in Oxfordshire Research Database (IOR-D) team

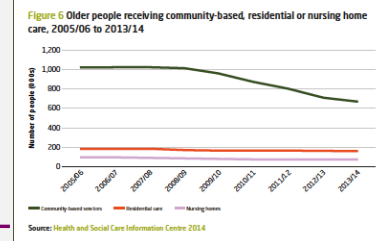
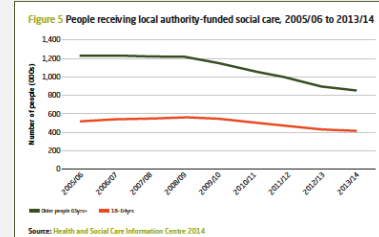
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TheKingsFund nuffieldtrust  
**Social care for older people**  
 Home truths

## Supporting hydration in frail elderly

### Impact of changes in social care provision?

- 26% fewer people get help because of cuts in LA budgets (2000-16)
- Social care providers under huge pressure – reduced fees from LAs, staff shortages, National Living Wage
- Access to social care increasingly depends on what the person can afford rather than their need.
- Threadbare LA service only provided for those with greatest need
- LAs in poorer regions have to make a smaller budget spread further as fewer eligible to/able to self pay
- Pressure on LAs to keep elderly out of residential care
  - more expensive

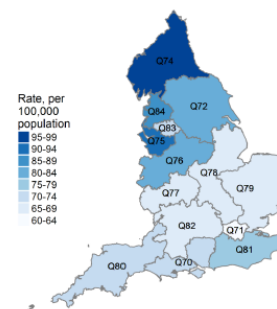


## What might explain regional variations?

- All three highest rates in north England (also high in Wales)
- These rates are >30% higher than in London/South
- Population of > 75 years increased by 8% (2012 -18)
- E.coli BSI cases increased by **27%** (2012-18)



**Figure 6:** Geographic distribution of *E. coli* rates per 100,000 population, England 2017/18\*



## Impact of social care support on E.coli bloodstream infections?

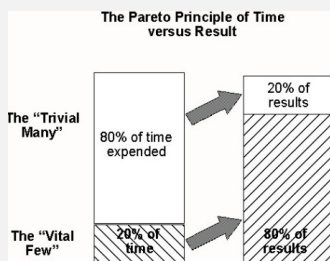
Region	E.coli BSI cases*	% population aged 75-84	Older people supported by social care throughout year*	Over 65yrs receiving attendance allowance or DLA per 1000
England	74	5.7	9,781	230
North-west	89	5.8	12,297	293
North-east	97	6.2	11,358	287
East of England	70	6.1	8,738	201
South-east	72	5.9	8,506	180

\* Per 100,000 population

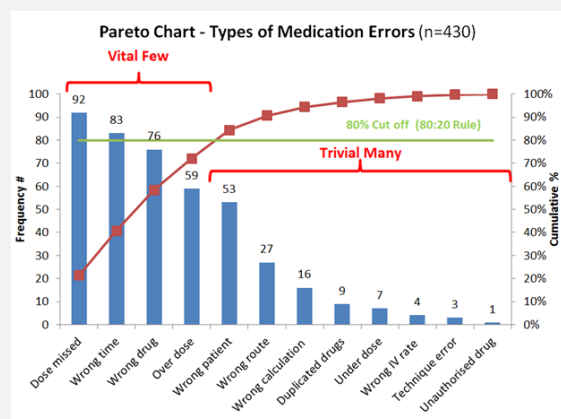
Source: Public Health Profiles (Fingertips) & PHE 2018

## The Pareto principle: the Law of the Vital Few

- Don't sweat the small stuff
- 80% of events due to 20% of causes



- Law of Diminishing Returns
  - Point at which additional units of input (time, effort, money) will yield negligible outputs



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**Using data to inform strategy**  
**E. coli BSI prevention strategies: 'The Vital Few'**

1. Implement strategies to prevent UTI in >75 years
  - Hydration (public awareness)
  - Remove urinary catheters
    - high proportion for undiagnosed 'retention'
2. Improve (accurate) diagnosis of UTI in elderly
  - Avoid over treatment
    - confusion in elderly often due to dehydration not infection!
  - Treat with antibiotic to which the bug is susceptible
3. Social care support critical:
  - Access to fluid/drink - Meals-on-wheels; shopping
  - Carer time to support drinking
  - Plan to manage fear of incontinence
4. Strengthen community-based IPC services
  - Establish systems for sharing microbiology data with community services
  - Use data to identify and target prevention strategies

**Tackling dehydration top tips**

Dehydration in winter weather can cause a significant increase in the incidence of urinary tract infections (UTIs) and other serious infections associated with it.

Here are some key facts to help prevent your patients becoming dehydrated:

- Keep drinking**
  - Drink and a minimum of 1.5 litres of fluid every day.
  - This is essential to avoid symptoms of dehydration.
- Any fluid is good fluid**
  - The most important thing to ensure sufficient fluids is to not restrict what you can drink when. Coffee and tea are a good source of fluids for most people and they have shown to have a beneficial effect on UTIs.
  - Fluids from other sources like soups, smoothies, juices, and soft drinks are also good.
- Look out for signs of dehydration**
  - The signs of dehydration include: thirst, headache, confusion and dizziness can all be signs of dehydration.
- Older people and young children are particularly vulnerable**
  - They are more likely to not drink enough. Check that all family members are drinking enough to avoid dehydration. It is important to get them to drink more water with difficulty remembering. It is important to check if they are unwell and encourage them to drink more fluids. Encourage them to drink more fluids when they are unwell and increase the risk of infection.

Source: NHS.uk



**Meals on wheels under threat as more councils drop service due to cuts**

Fewer than half of councils now provide a hot meal each day for vulnerable older people, and campaigners say their health and independence are suffering

**David Brindle**  
 16 Nov 2018 11:44 am

Fewer than half of councils are still providing a meals on wheels service after six years of spending cuts, new figures have revealed.

Just two years ago, two thirds of councils were offering a daily hot meal to help support older and disabled people in their own homes - an idea first put into practice more than 70 years ago.

The service is not protected by law, however, and is being dropped by growing numbers of authorities forced to focus only on their statutory responsibilities. Advocates for meals on wheels, however, say the trend is a false economy because it runs counter to the aim of keeping people living independently and out of hospital or costly residential care.



**Using surveillance effectively...**

1. Surveillance by objectives
  - Target at specific HCAI problems & goals
2. Use data in decision making
  - Analyse and respond to triggers
3. Use to support improvement
  - Data alone is not enough
4. Understand the epidemiology – be curious!
5. Target prevention measures (and resources)

**Surveillance by objective: A new priority-directed approach to the control of nosocomial infections**

**The National Foundation for Infectious Diseases Lecture**

**Robert W. Haley, M.D.**  
 Dallas, Texas





*“measurement alone does not hold the key to improvement. Measuring could be an asset in improvement if, and only if, it were connected to **curiosity** - part of a culture primarily of learning and enquiry not primarily of judgement and contingency”*

Don Berwick 2001



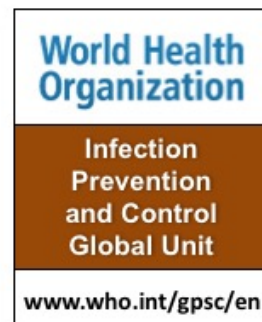
The screenshot shows the homepage of the Infection Prevention Society (IPS). At the top left is the IPS logo and the text "Infection Prevention Society". To the right is the website URL "www.ips.uk.net". Below the logo is a navigation menu with buttons for "Home", "Education & Events", "Professional Practice", "News & Media", "Membership", "About IPS", "Public / Patients", and "Contact Us". The main banner features a stack of "Journal of Infection Prevention" magazines and the text "FREE Access to the Journal of Infection Prevention". Below this, it states "All IPS members get free online access to the JIP, a bi-monthly peer-reviewed publication containing a wide range of articles." and includes a button "Access Journal ...". At the bottom, there is a section titled "Join IPS and Enjoy Access To ..." with five circular icons representing different benefits: "Conference and Seminar Programmes", "FREE Access to the Journal of Infection Prevention", "Influencing IPS has responded to the EPIC3", "IPS Twitter and Infection News Updates", and "Infection Prevention Best Practice".

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<a href="http://www.webbertraining.com/schedule1.php">www.webbertraining.com/schedule1.php</a>	
October 2, 2018	<p><i>(FREE European Teleclass - Broadcast live from the 2018 IPS conference)</i> <b><u>Ayliffe Lecture ...THE IMPACT OF DISINFECTANTS ON ANTIMICROBIAL RESISTANCE - AN AYLIFFE PREDICTION</u></b> Speaker: <b>Prof. Shaheen Mehtar</b>, Stellenbosch University, Cape Town, South Africa</p>
October 11, 2018	<p><i>(FREE CBIC Teleclass)</i> <b><u>INFECTION CONTROL CHAMPIONS ARE MADE, NOT BORN</u></b> Speaker: <b>To be announced</b></p>
October 17, 2018	<p><i>(South Pacific Teleclass)</i> <b><u>BIOFILMS IN THE HOSPITAL ENVIRONMENT - INFECTION CONTROL IMPLICATIONS</u></b> Speaker: <b>Prof. Karen Vickery</b>, Macquarie University, Australia</p>
October 18, 2018	<p><b><u>INFECTION PREVENTION CORE PRACTICES: RESETTING THE BAR FOR SAFE PATIENT CARE</u></b> Speaker: <b>Prof. Ruth Carrico</b>, University of Louisville</p>

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