HEALTHCARE ASSOCIATED INFECTION SURVEILLANCE IN THE ERA OF ELECTRONIC HEALTH DATA

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Objectives

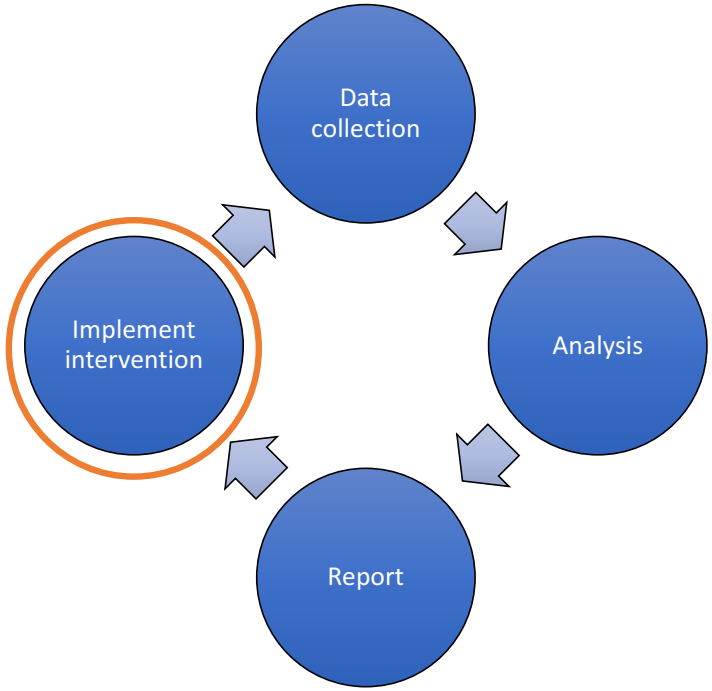
- Provide brief historical background to HAI surveillance
- Discuss current surveillance issues, including findings of a systematic review the impact of electronic HAI surveillance software on IP's
- Explore future surveillance options in the era of electronic medical records

Background

Healthcare associated infection (HAI) is an infection that occurs as a result of a healthcare intervention and may occur within, or after leaving, a healthcare facility. [1]

Surveillance

"*ongoing* and *systematic* collection, *analysis* and *interpretation* of outcome specific data essential to the *planning, implementation*, and *evaluation* of public health practice, closely integrated with the *timely dissemination* of these data to those who *need to know*"[2]

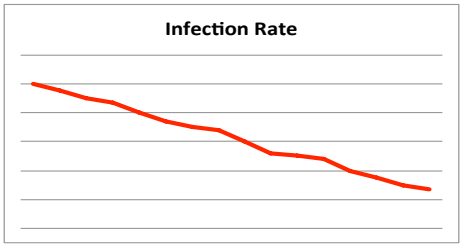


1. NHMRC 2010
2. Thacker 1996

Why do HAI surveillance?

SENIC [7]

- a structured surveillance program
- one infection prevention nurse per 250 beds
- an infection prevention physician
- a system for reporting infection rates to surgeons



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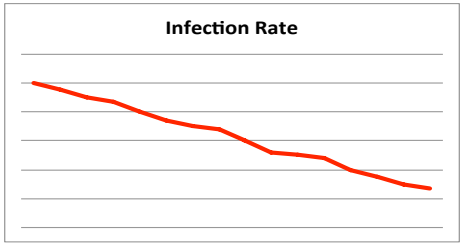

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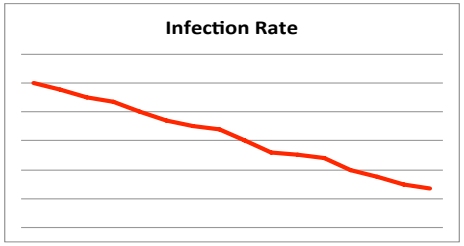

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Objectives [8,9]

- Establish baseline/endemic rates
- Detect clustering/potential outbreaks
- Assess effectiveness of interventions
- Generate hypotheses/research
- Quality improvement
- Guide treatment and prevention strategies
- Meet regulatory requirements
- Benchmark
- **Reduce the incidence of preventable infections**

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Data for Action

Infection prevention activities

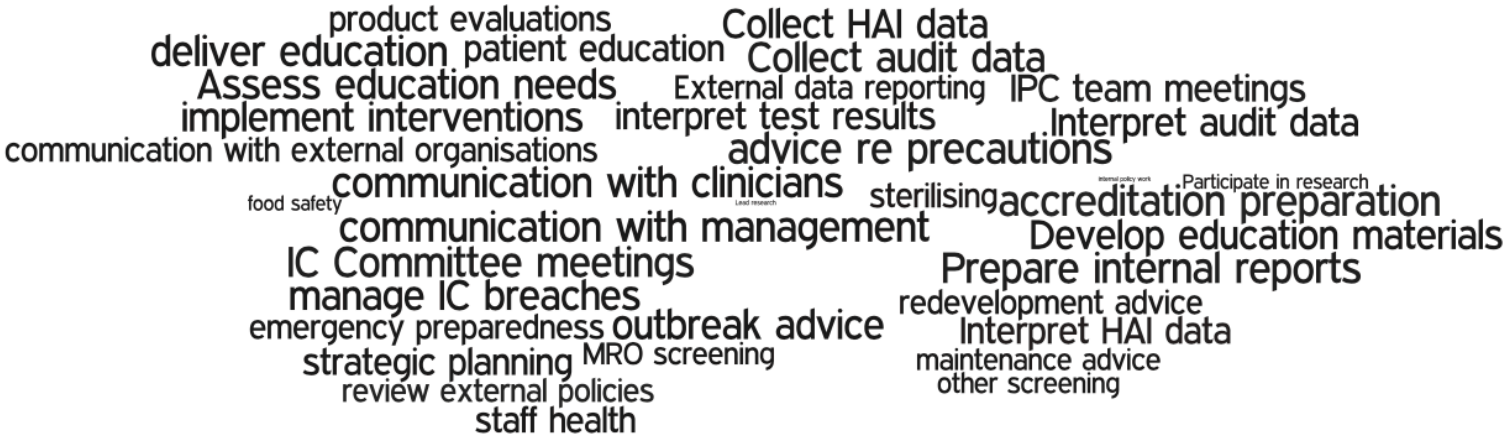
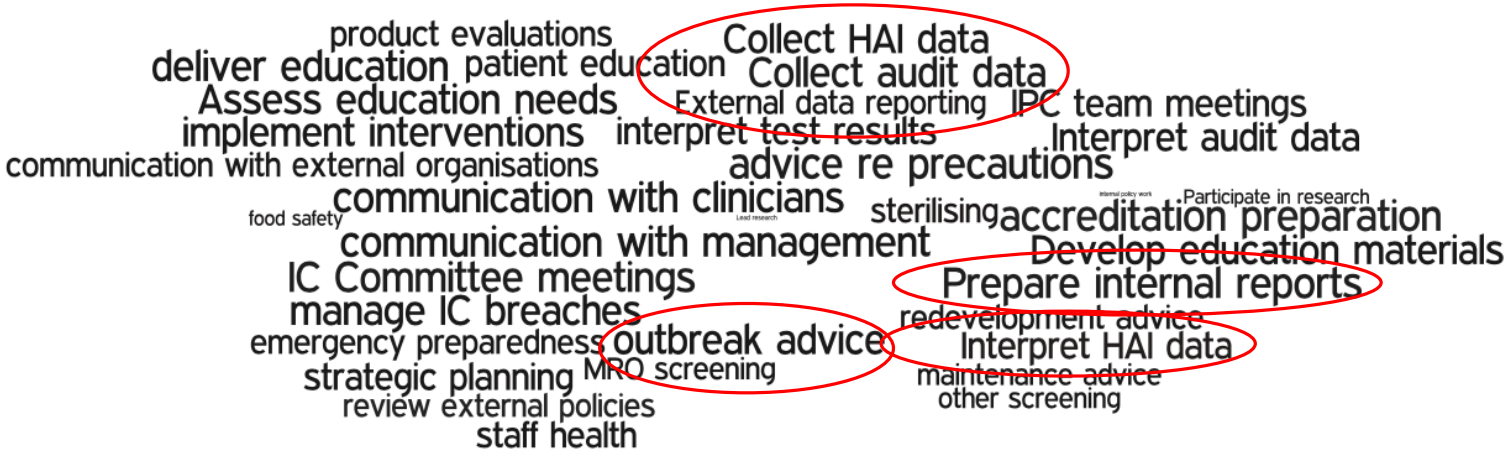


Fig. 1. Word Cloud of ICP activities. The size of the word is representative of the number of ICPs undertaking each activity.

Hall et al. *IDH* 2015

Infection prevention activities



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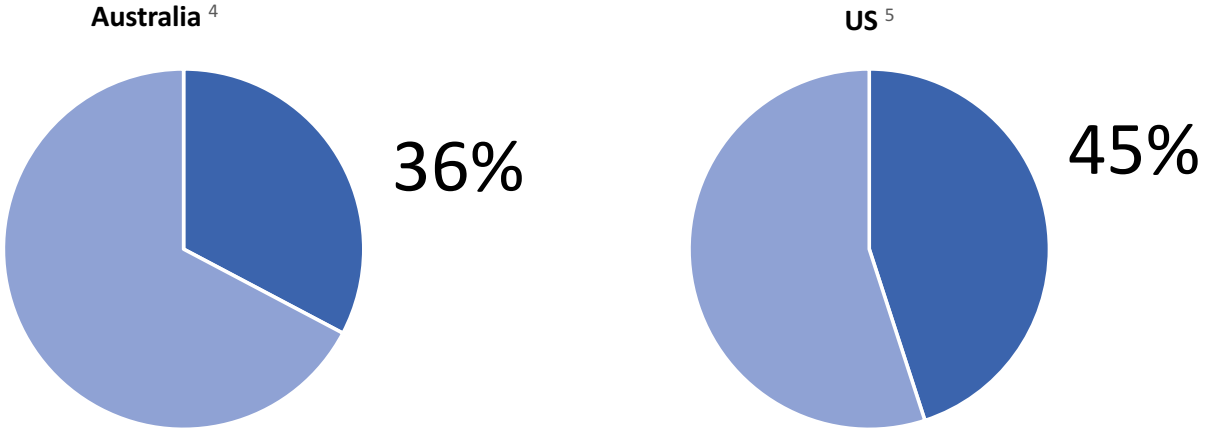
ICP time spent on surveillance



23-38% use dedicated surveillance software [6-8]

4. Mitchell et al IDH 2016
5. Stone et al AJIC 2009
6. Grota et al AJIC 2010
7. Halpin et al AJIC 2011
8. Masnick ICHE 2014

Common practices…

- HAI surveillance, manual data collection, medical record review, pathology, radiology, patient review
- Double data entry, error prone, slow turnaround
- National study of 92 IP nurses, agreement levels of HAI identification varied between 53-75%

Russo et al. *AJIC* 2015

Leading to HAI Data Quality issues…

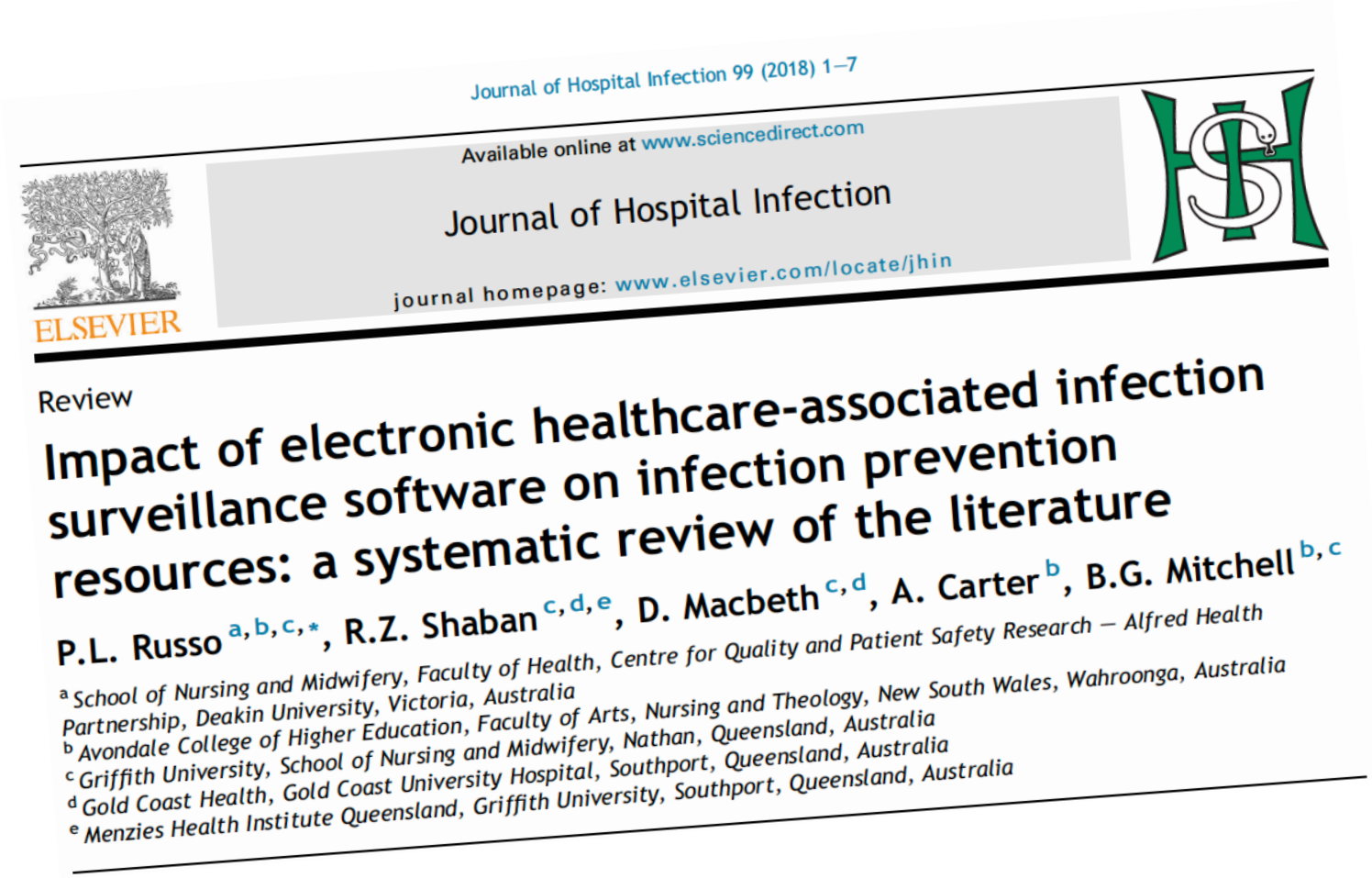
- Misclassification of HAIs
  - misinterpretation of definitions
  - inconsistent methods
- Subjective elements = natural variation
- Influenced by surveillance intensity, available resources, skill and knowledge, use of electronic tools
- Performance measurement
  - Potential to manipulate data

Rich et al *AJIC* 2013

Hello Publicly reported HAI data

- Robust, captured consistently over time and validated [11]
- An association exists with increased quality improvement measures in hospitals [12]
- Implementation in Australia of financial penalties linked to HAI outcomes as an incentive to improve quality of care [13]

11. Talbot et al. *Ann Intern Med* 2013
12. Humphreys et al. *Clin Micro Inf* 2008
13. Magid et al. *Infection, Disease and Health* 2017



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Review

Impact of electronic healthcare-associated infection surveillance software on infection prevention resources: a systematic review of the literature

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[a] School of Nursing and Midwifery, Faculty of Health, Centre for Quality and Patient Safety Research — Alfred Health Partnership, Deakin University, Victoria, Australia
[b] Avondale College of Higher Education, Faculty of Arts, Nursing and Theology, New South Wales, Wahroonga, Australia
[c] Griffith University, School of Nursing and Midwifery, Nathan, Queensland, Australia
[d] Gold Coast Health, Gold Coast University Hospital, Southport, Queensland, Australia
[e] Menzies Health Institute Queensland, Griffith University, Southport, Queensland, Australia

Aim

- Describe the findings of a systematic review on the impact of electronic surveillance software (ESS) on infection prevention resources

Method

- Medline & CINAHL
- 1 January 2006 and 31 December 2016

Inclusion / Exclusion

- cohort studies, case–control studies, cross-sectional studies, observational studies, randomised controlled trials or case reports of HAI
- refer to the impact of electronic surveillance software post implementation on infection control resources in a hospital

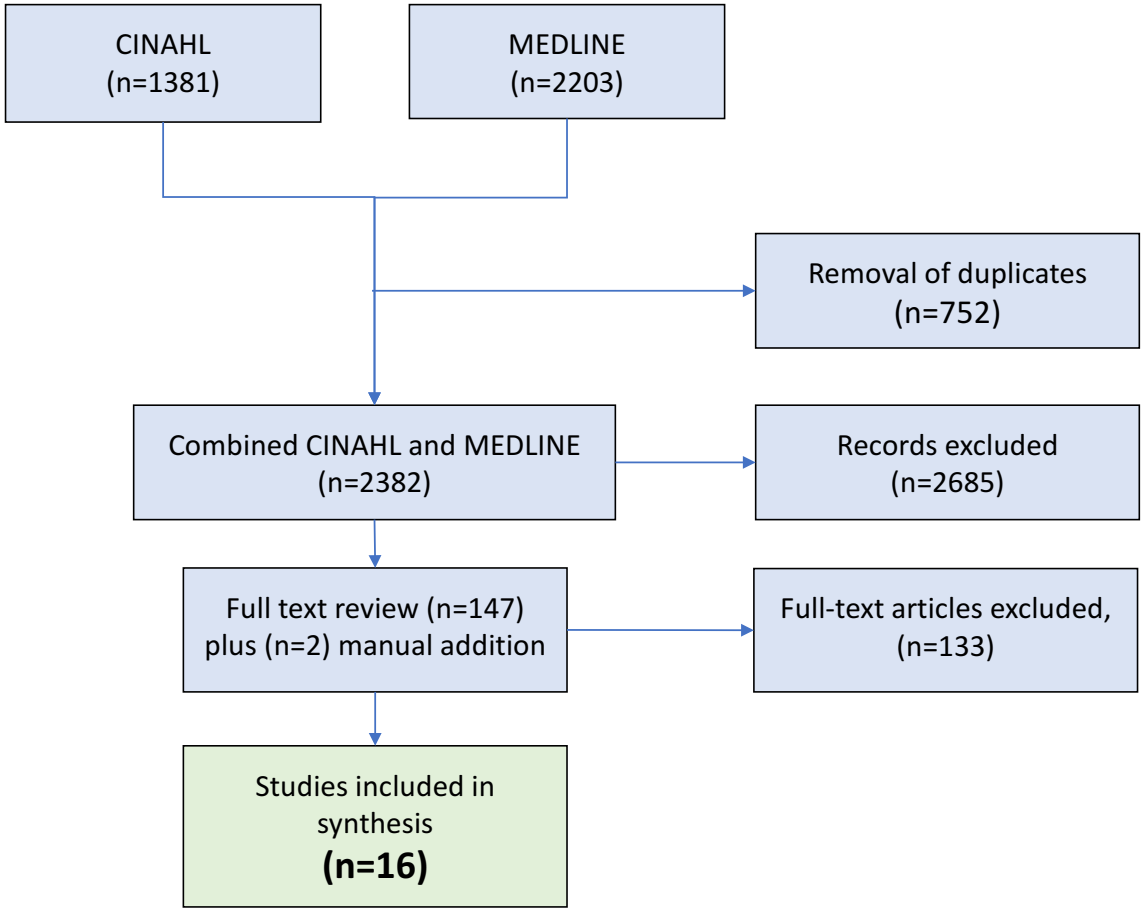
- all grey literature
- non-peer reviewed
- conference abstracts
- papers written in languages other than English
- reviews, editorials, commentaries or policy statements

Definitions

- Electronic surveillance software
  - a system that performs electronic healthcare associated infection surveillance or
  - an automated process that identifies healthcare associated infections
- Healthcare-associated infection
  - any infection as defined or accepted by the authors as being healthcare associated, hospital acquired or nosocomial
- Resources
  - staffing, models of staffing, infrastructure or delivery of infection control services

PRISMA

- 3584 articles identified
- Duplicate removal, reviewed 2832 abstracts
- 149 suitable for full text review
- 16 met the eligibility criteria



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Data collection
Case ascertainment

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Wright *et al.* [26], USA	3	Prospective cohort					40	97.3 ($P < 0.01$)	99	99	6
Brossette *et al.* [27], USA	3	Prospective cohort					20	96.7	86	98	5
Nuckchady *et al.* [28], USA	1	Retrospective cohort					60	94.0	95	99	5
Streefkerk *et al.* [29], Netherlands	1	Retrospective cohort					200	90.0	NR	NR	5
Blacky *et al.* [30], Austria	1	Retrosepctive cohort					50	84.8	90	100	5
Knepper *et al.* [31], USA	1	Retrospective cohort					148	84.2 ($P < 0.01$)	93	88	5
Peterson *et al.* [32], USA	3	Prospective cohort	disease?	wide			20	75.0	NR	NR	6
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All reported reduction in time

12.5% - 98.4%

(mean 73.9%)

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Knepper *et al.* [31], USA	1	Retrospective cohort	SSI (colon FX)	Hospital-wide	In-house	26,418	4148	84.2 ($P < 0.01$)	93	88	5
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3 other studies

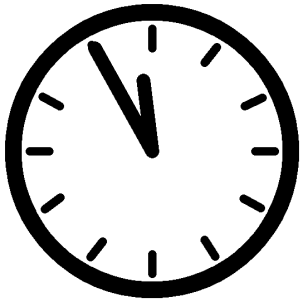
- “Workload reduction of 90%”
- “Reduction of 10 weeks of ICP time per year”
- “< 3 minutes per device day”

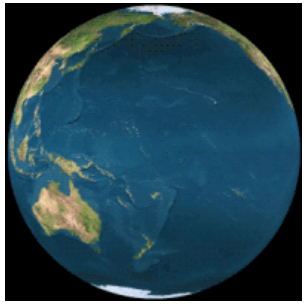
Limitations

- Post 2006
- Inability to identify roles of IC team (US - Hosp Epidemiologist)
- Impact on resources limited to time
- Variation in study design limits comparability
- No studies where effect was primary outcome

In summary…Surveillance software / automation…

Significantly reduces time

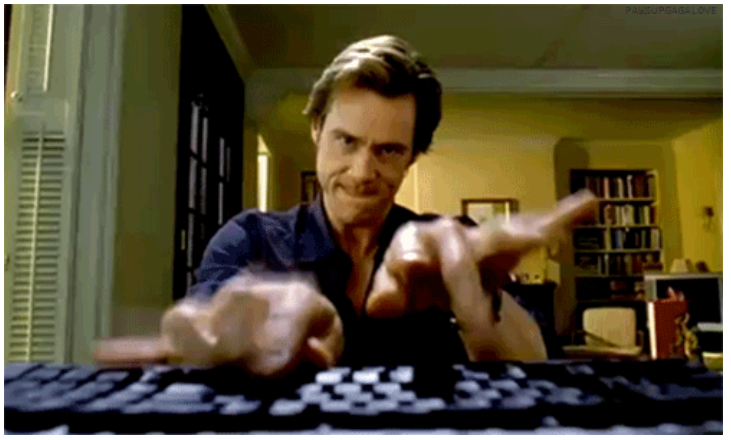




Appropriate for public reporting

Accurate and consistent

More research



Where is it all going?

What is the purpose of surveillance?

What is the purpose of surveillance?

What we measure depends on ***how*** we measure,

which should depend on ***why we measure***

Simon Sineks' "Golden Circle"

Surveillance

One system?

Image credits
Copyright:© JCorbettcartoon - http://www.redbubble.com/people/jcorbettcartoo

Purpose vs characteristics

	Research	Hospital infection prevention/ drive improvement	National Surveillance	Public reporting & financial penalty
Clinical relevance				
Actionable				
Large scale standardisation (robust)				
Reliable over time				
Robust to financial incentives				
Timely				
Risk Adjustment				

Modified from van Mourik ECCMID 2016

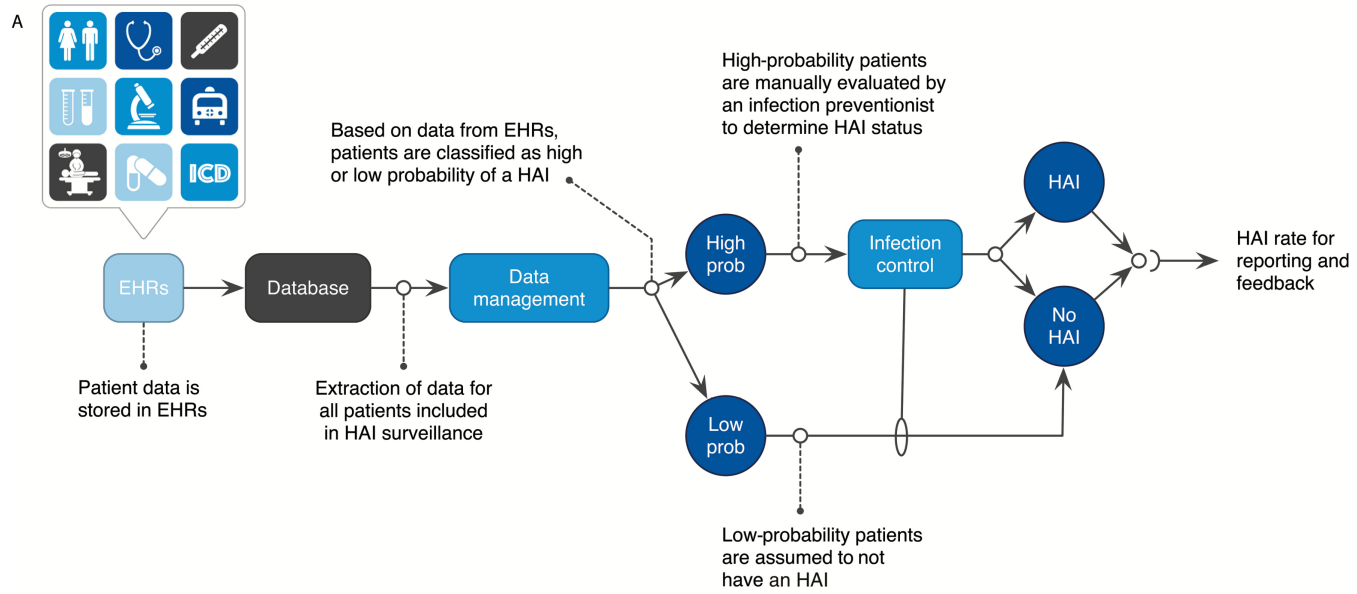
Electronic and Automated surveillance

- Ensure consistent application of definitions
  - Eliminate subjectiveness
- Reduce burden of data collection
  - Significantly reduce time spent on surveillance
- Improved sensitivity
- Automated, tailored and dissemination reporting

Trends *de Bruin JAMIA 2014*

- Combining data sources improves accuracy (micro, pharmacy A&D)
- Pharmacy data in combination with other data sources show excellent sensitivity (reasonable specificity)
- Antimicrobial data improves sensitivity
  - subject to prescribing habits
- Diagnostic codes are weak indicators for HAI
- Billing codes demonstrate high variability and inaccuracy for HAIs
- Recent studies - bias towards higher sensitivity at expense of specificity
  - i.e finding true infections, but also investigating false positives

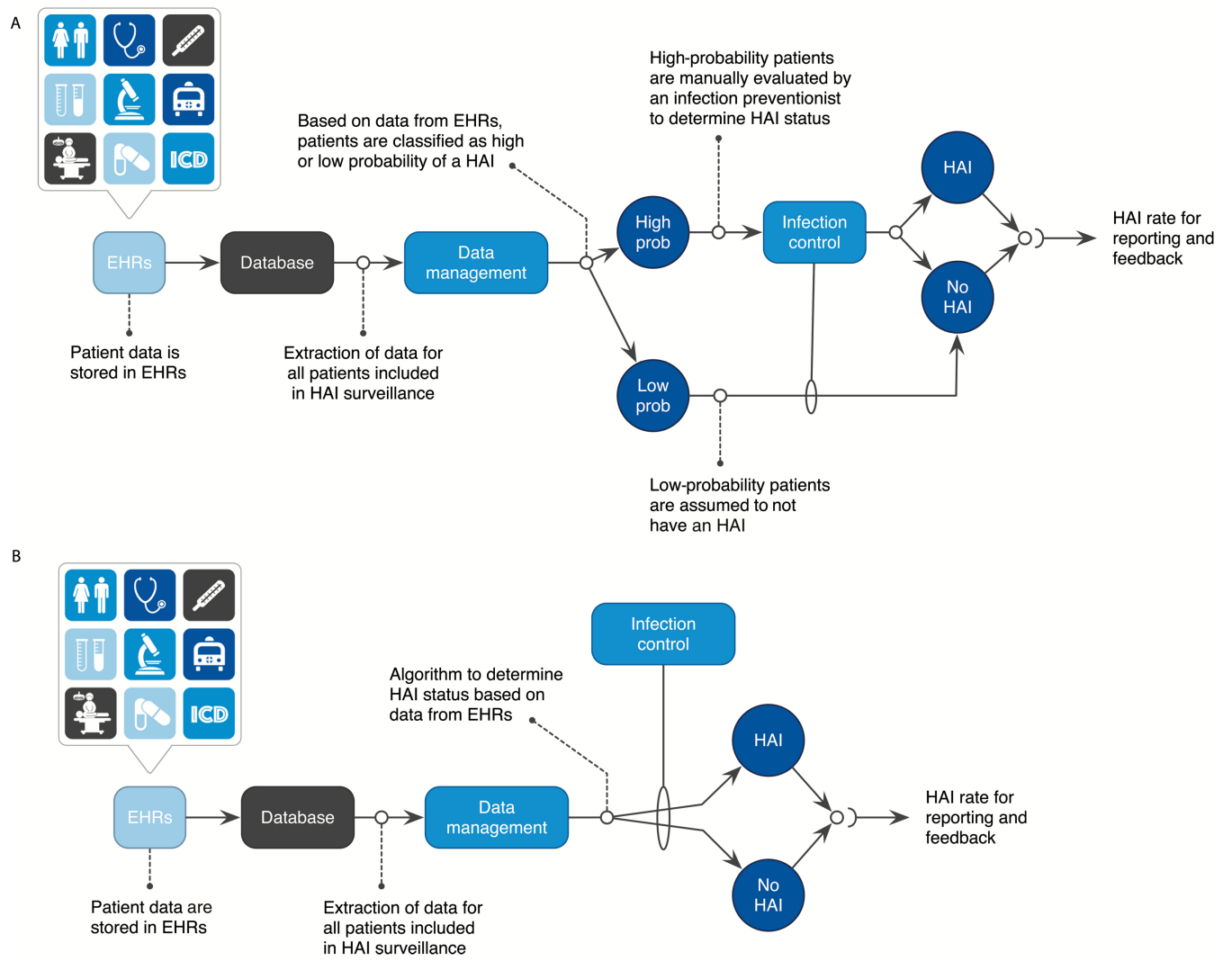
Semi automated surveillance



From: Designing Surveillance of Healthcare-Associated Infections in the Era of Automation and Reporting Mandates Clin Infect Dis. 2017;66(6):970-976. doi:10.1093/cid/cix835

Semi automated surveillance

Fully automated surveillance



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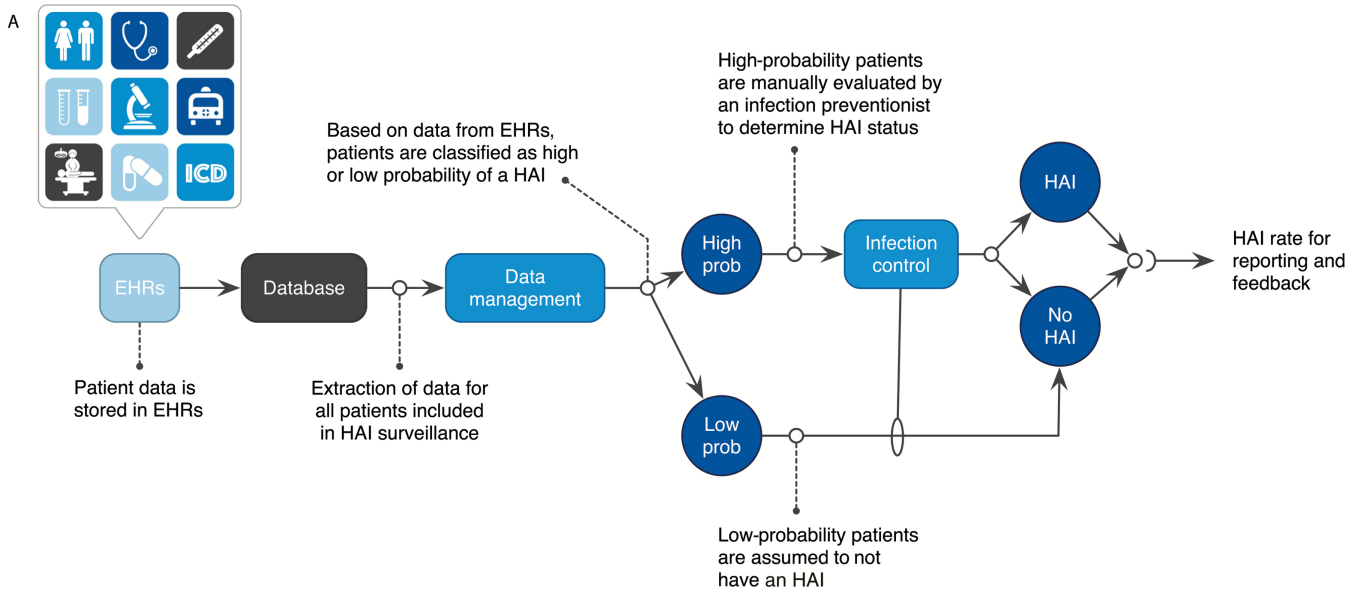

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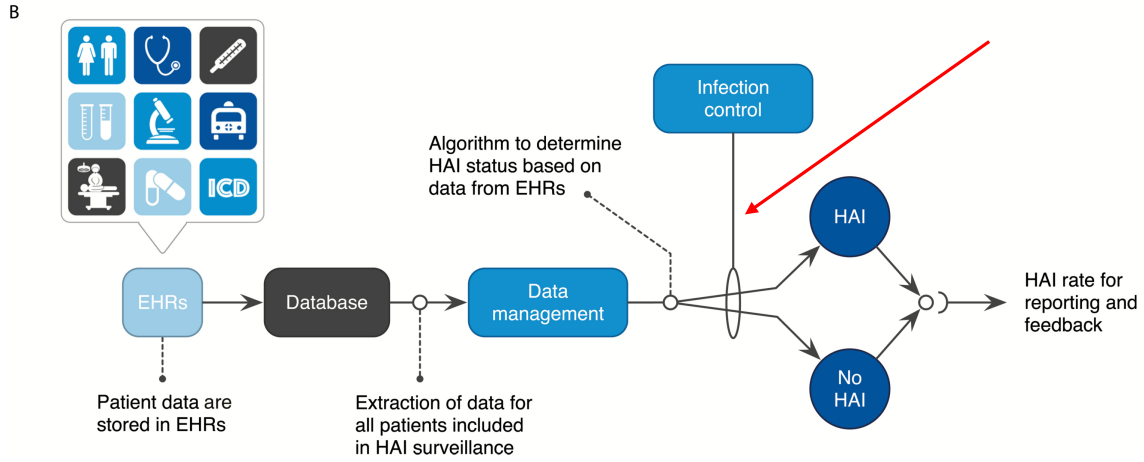

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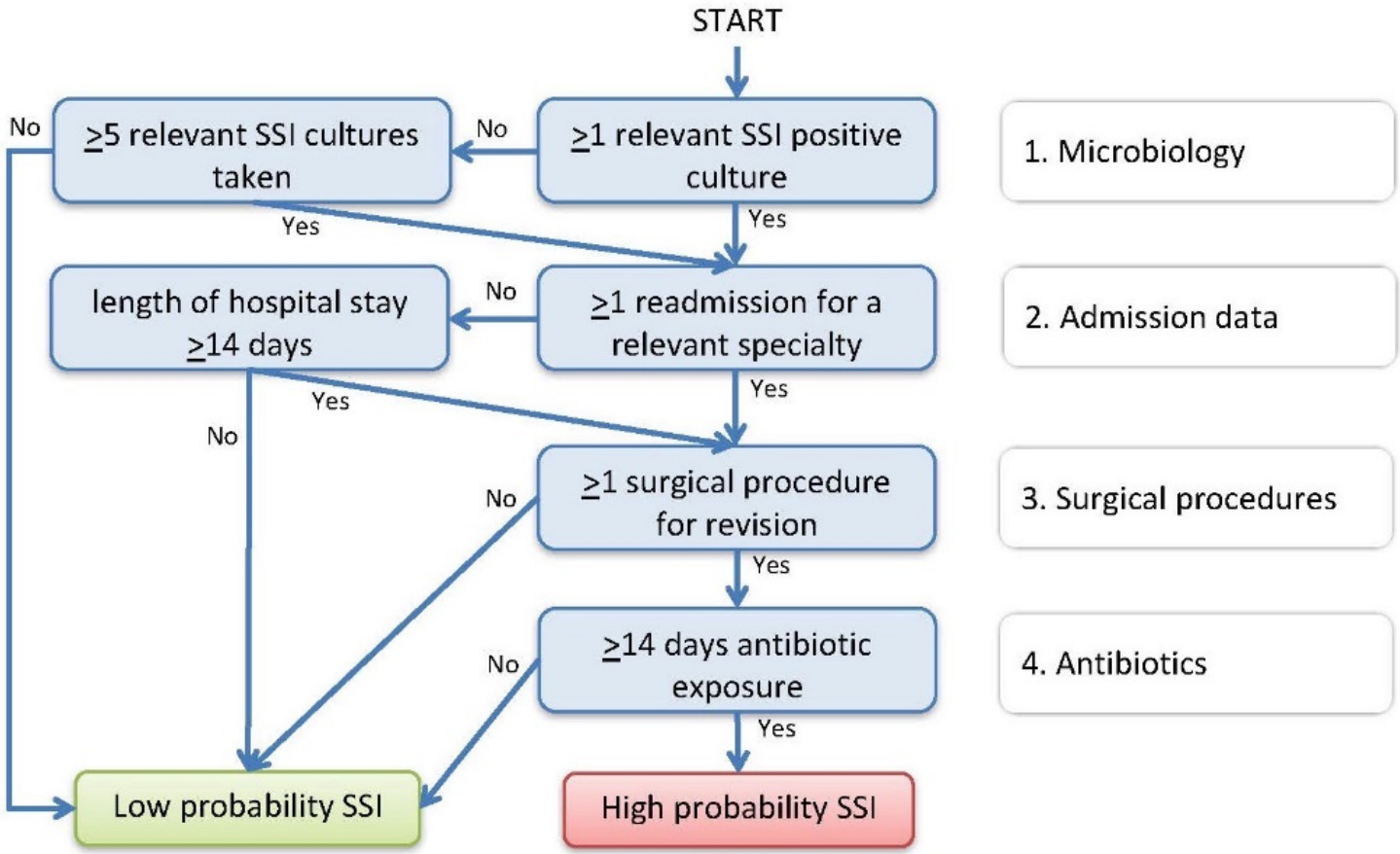
Semi automated Surveillance of Deep Surgical Site Infections after Primary total Hip or Knee Arthroplasty

- Traditional surveillance
  - Infection control team
  - review every procedure

- Algorithm
  - Microbiology
  - Procedure
  - Admissions and Discharge
  - Pharmacy

Sips et al. *Infect Control Hosp Epidemiol* 2017

Semi automated Surveillance of Deep Surgical Site Infections after Primary total Hip or Knee Arthroplasty



van Mourik, Sips et al ECCMID 2016

Semi automated Surveillance of Deep Surgical Site Infections after Primary total Hip or Knee Arthroplasty

- Number of cases reviewed
  - Traditional surveillance – 1637
    - Identified 30 deep SSI

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- Number of cases reviewed
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97% reduction in medical records reviewed

Sips et al. *Infect Control Hosp Epidemiol* 2017

Infection Control & Hospital Epidemiology (2019), 1–5
doi:10.1017/ice.2019.36

Original Article

A diagnostic algorithm for the surveillance of deep surgical site infections after colorectal surgery

Tessa Mulder MD[1], Marjolein F.Q. Kluytmans-van den Bergh MD[1,2,3], Maaike S.M. van Mourik MD, PhD[4], Jannie Romme[3], Rogier M.P.H. Crolla MD[5], Marc J.M. Bonten MD, PhD[1,4] and Jan A.J.W. Kluytmans MD, PhD[1,3]

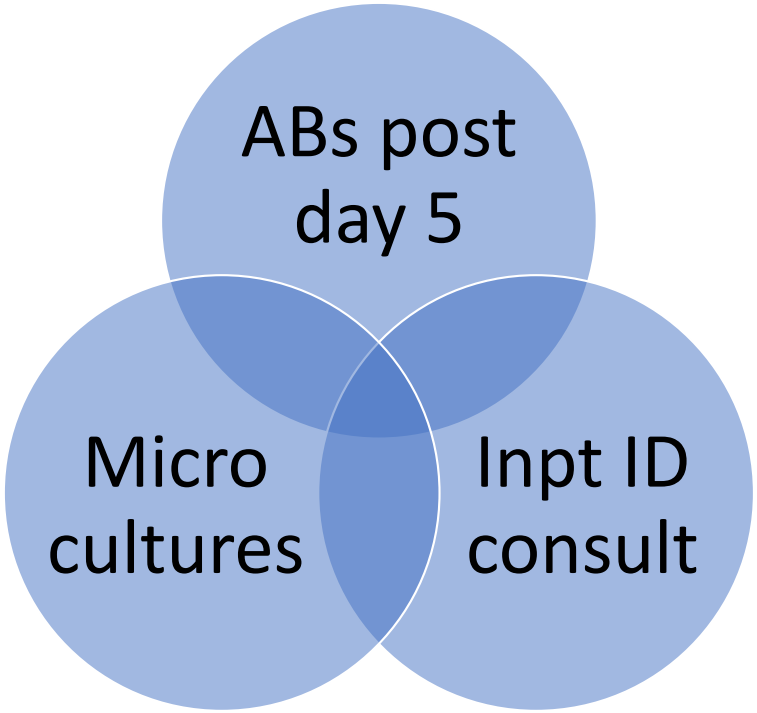
1. Post op length of stay
2. Wound class
3. Readmission
4. Reoperation
5. 30 day mortality

- Reduced number of medical records to be reviewed by 63% (miss 2 deep SSI)

Semi automated Surveillance - SSI

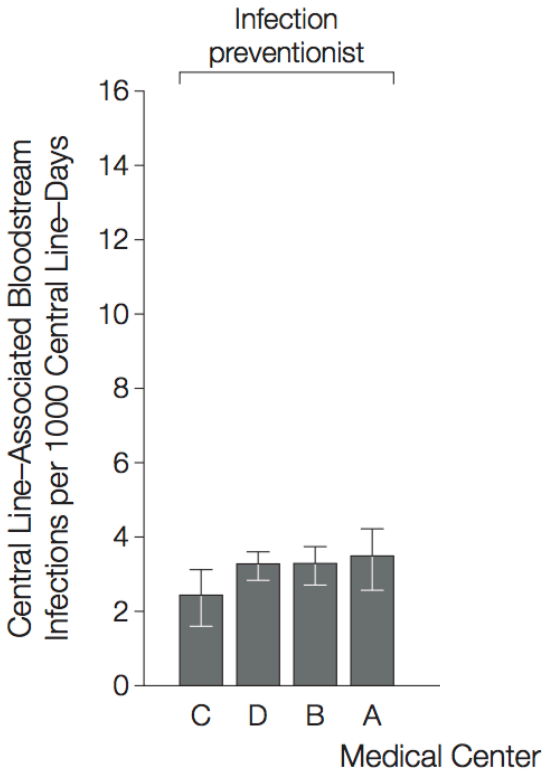
Cho 2018 ICHE Korea

- >40,000 procedures, 38 surgical categories
- Se 96.7% | PPV 4.1%
- >60% decrease in time
- Procedure specific algorithms?



Fully automated Surveillance - BSI

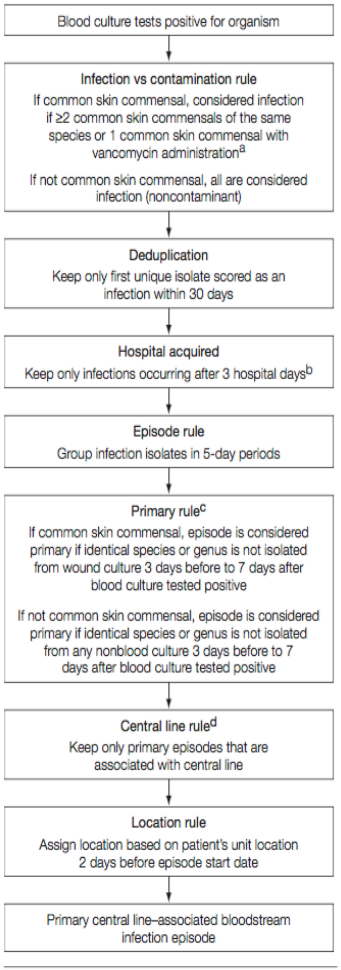
Figure 4. Relative Ranking of 4 Medical Centers



Lin JAMA 2010

Fully automated Surveillance - BSI

Figure 1. Schematic of Computer Algorithm for Central Line–Associated Bloodstream Infection Surveillance



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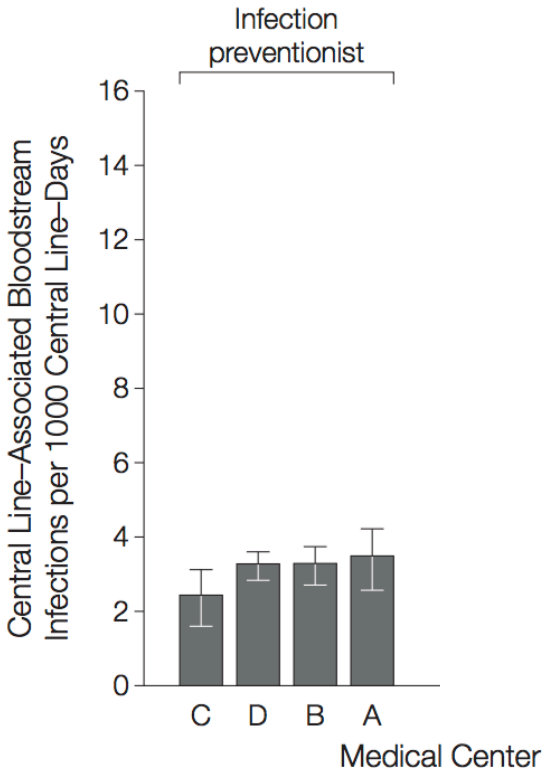

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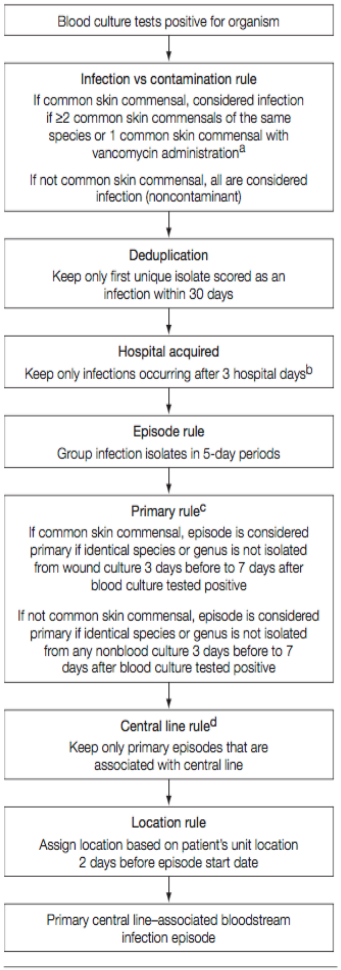

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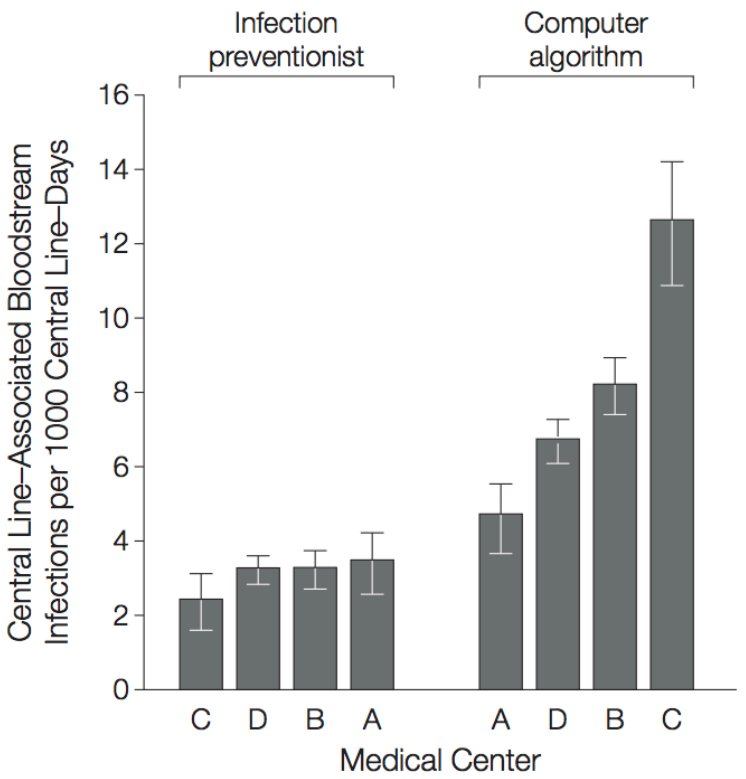

Lin JAMA 2010

Data quality - Administrative coding data

Why use ACDs?

- ✓convenient
- ✓widespread
- ✓electronic availability
- ✓ease of use

Why Not?

- Xnot developed for surveillance
- Xdo not take into account clinical context
- Xpoor discrimination between on admission Vs HA
- Xtimeliness of coding
- Xvariation in coding habit

Marra 2017 reported **Se 2%** using ICD 10 codes for CAUTI
BUT may supplement other strategy

Surveillance driving improvement

- Hallam 2018
  - Adopted Matching Michigan program
  - Reduce CRBSI across Trust
  - Clinician engagement and collaboration
  - Monthly CVAD data “Dashboard”
    - Raw data, rates, days between infections
  - Root cause analysis
  - Continuous review, feedback and improvement
  - Significant reduction CRBSI over 5 years: 5/1000 CDs V 0.23/1000 CDs

Hallam 2018 JIP

Surveillance driving improvement

- Standardisation - care plans and pathways
- Clinician involvement
- Don’t wait for the mandate!

Hard work

Hallam 2018 JIP

Public reporting at surgeon level

- 4 years colorectal surgery 90 day mortality (DM)
- Pre and post public reporting of surgeon data
  - ✓ No difference in type of pts receiving surgery
  - ✓ No evidence of change in care
  - ✓ Significant decrease in 90 DM for elective procedures
  - ✓ No change in 90 DM for emergent procedures

Vallance 2018 BMJ

Public reporting at surgeon level

- No risk averse behaviour
- No gaming of data
- Suggest improvement in elective pts resulted from improved pre-operative processes
- Surgeon specific?
- Teams?
- Hospitals?

Vallance 2018 BMJ

Public reporting HAI data

What do consumers want to know?

- Semi structured interviews
- 20 electively admitted surgical inpatients
- Large acute hospital

Poor awareness of HAI, little or no pre op information

Russo 2019 AJIC

Public reporting HAI data

More focussed on their current illness

“I’m not really worried about a bloody infection, I’m just hoping they can start me heart up again”

Russo 2019 AJIC

Public reporting HAI data

Does not influence choice, loyalty more important

"I came here because they've got all my records here. I've been dealing with them for over 20 years and they're very, very good to me"

Russo 2019 AJIC

Purpose vs characteristics

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Clinical relevance	✓			
Actionable	✓			
Large scale standardisation (robust)				
Reliable over time				
Robust to financial incentives				
Timely				
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Modified from van Mourik ECCMID 2016

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Robust to financial incentives				✓
Timely		✓		
Risk Adjustment	✓		✓	✓

Fully automated surveillance

Modified from van Mourik ECCMID 2016

Concluding thoughts

- What is the role of the Infection Preventionist?
  - Semi automated – make a final determination
  - Fully automated – no involvement
- Is HAI data without some clinician determination acceptable?

Concluding thoughts

- Semi automated
  - local quality improvement / measure effect of interventions
- Fully automated
  - Large scale, mandated, public reporting

Questions?

www.webbertraining.com/schedulep1.php

April 9, 2019	*(FREE European Teleclass … Denver Russell Memorial Teleclass Lecture)* **MODERN TOOLS FOR BACTERIAL IDENTIFICATION AND ANTIBIOTIC SUSCEPTIBILITY TESTING** Speaker: **Prof. Vincent Cattoir**, Université de Caen Basse-Normandie, France
April 18, 2019	**INFECTION CONTROL ISSUES IN HEALTHCARE CONSTRUCTION, PART 1 - RENOVATION** Speaker: **Andrew Streifel**, University of Minnesota
May 2, 2019	*(FREE Teleclass)* **MEAT, MONKEYS, AN… …ONE HEALTH PERSPECTIVE ON EMERGING DISEASES** POSTPONED TO LATER IN THE YEAR Speaker: **Prof. Laura Kahn**, Woodrow Wilson School of Public and International Affairs, Princeton University
May 3, 2019	*(FREE … WHO Teleclass - Europe)* **SPECIAL LECTURE FOR 5 MAY** Speaker: **Prof. Didier Pittet**, World Health Organization, Geneva

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