

The Problem with Evidence - The Thorny Relationship of Infection Control and Evidence Based Practice
Frank Bowden, ANU Medical School, Australia
Broadcast live from the 2017 conference of the Australasian College of Infection Control

Broadcast live from

6th INTERNATIONAL

Australasian College for Infection Prevention and Control
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National Convention Centre, Canberra
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The Problem with Evidence -
The Thorny Relationship of
Infection Control and Evidence
Based Practice

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November 20, 2017



“Evidence based medicine is the integration of the *best* research evidence with clinical expertise and patient values...’

David Sackett

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Pyramid of evidence



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Essay

Why Most Published Research Findings Are False

John P.A. Ioannidis

Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; when there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance. Simulations show that for most study designs and settings, it is more likely for a research claim to be false than true. Moreover, for many current scientific

factors that influence this problem and some corollaries thereof.

Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9-11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the convenient, yet ill-founded strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a p -value less than 0.05. Research is not most appropriately represented and summarized by p -values, but, unfortunately, there is a widespread notion that medical research articles

is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is $R/(R+1)$. The probability of a study finding a true relationship reflects the power $1 - \beta$ (one minus the Type II error rate). The probability of claiming a relationship when none truly exists reflects the Type I error rate, α . Assuming that r relationships are being probed in the field, the expected values of the 2×2 table are given in Table 1. After a research finding has been claimed based on achieving formal statistical significance, the post-study probability that it is true

It can be proven that most claimed research findings are false.

should be interpreted based only on p -values. Research findings are defined

Infection Control and Evidence Based Medicine

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The screenshot shows a search interface for MeSH (Medical Subject Headings). The search term 'Infection Control' is entered in the top left. The interface is divided into several sections:

- Definition:** Infection Control - Programs of disease surveillance, generally within health care facilities, designed to investigate, prevent, and control the spread of infections and their causative microorganisms.
- Thesaurus matches:** Under 'Exact Term Match', 'Infection Control' is highlighted with a red box. Other matches include 'Infection Control Practitioners', 'Infection Control, Dental', and 'Infection Control Practitioners'.
- MeSH trees:** A tree structure is shown with 'Tree Number 1' checked. The tree includes: Environment and Public Health [+3], Public Health [+25], Public Health Practice [+8], Communicable Disease Control [+10], Fumigation, Immunization [+1], Pest Control [+5], Sanitation [+2], Contact Tracing, Universal Precautions, Infection Control [+6], Antisepsis [+1], Patient Isolation, and Quarantine.
- Search results:** A table on the right shows 1376 results. The top result is 'Cochrane Reviews' with 14 results, highlighted with a red box. Other results include 'Other Reviews' (100), 'Trials' (1056), 'Methods Studies' (0), 'Technology Assessments' (87), 'Economic Evaluations' (119), and 'Cochrane Groups' (0).

‘EBM’ is easy to say but hard to do...


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Cochrane Database of Systematic Reviews

Clinically-indicated replacement versus routine replacement of peripheral venous catheters

[New search](#) [Review](#) [Intervention](#)

Joan Webster , Sonya Osborne, Claire M Rickard, Karen New

First published: 14 August 2015

Editorial Group: [Cochrane Vascular Group](#)

DOI: 10.1002/14651858.CD007798.pub4 [View/save citation](#)

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Main results

Seven trials with a total of 4895 patients were included in the review. The quality of the evidence was high for most outcomes but was downgraded to moderate for the outcome catheter-related bloodstream infection (CRBSI). The downgrade was due to wide confidence intervals, which created a high level of uncertainty around the effect estimate. CRBSI was assessed in five trials (4806 patients). There was no significant between group difference in the CRBSI rate (clinically-indicated 1/2365; routine change 2/2441). The risk ratio (RR) was 0.61 (95% CI 0.08 to 4.68; $P = 0.64$). No difference in phlebitis rates was found whether catheters were changed according to clinical indications or routinely (clinically-indicated 186/2365; 3-day change 166/2441; RR 1.14, 95% CI 0.93 to 1.39). This result was unaffected by whether infusion through the catheter was continuous or intermittent. We also analysed the data by number of device days and again no differences between groups were observed (RR 1.03, 95% CI 0.84 to 1.27; $P = 0.75$). One trial assessed all-cause bloodstream infection. There was no difference in this outcome between the two groups (clinically-indicated 4/1593 (0.02%); routine change 9/1690 (0.05%); $P = 0.21$). Cannulation costs were lower by approximately AUD 7.00 in the clinically-indicated group (mean difference (MD) -6.96, 95% CI -9.05 to -4.86; $P \leq 0.00001$).

Authors' conclusions

The review found no evidence to support changing catheters every 72 to 96 hours. Consequently, healthcare organisations may consider changing to a policy whereby catheters are changed only if clinically indicated. This would provide significant cost savings and would spare patients the unnecessary pain of routine re-sites in the absence of clinical indications. To minimise peripheral catheter-related complications, the insertion site should be inspected at each shift change and the catheter removed if signs of inflammation, infiltration, or blockage are present.

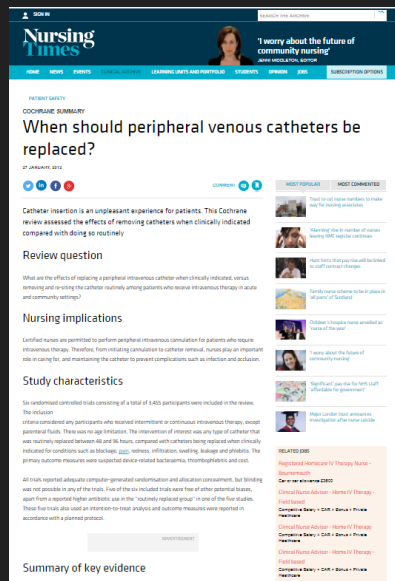
7 studies INCLUDED in the Cochrane review

1. Barker P, Anderson ADG, Macfie J. (2004). Randomised clinical trial of elective re-siting of intravenous cannulae. *Annals of the Royal College of Surgeons of England*, 86(4):281-3.
- Barker 2004 unpublished data
2. Nishaath S, Sivaram G, Kalavarasan R, Kate V, Ananthakrishnan N. (2009). Does elective re-siting of intravenous cannulae decrease peripheral thrombophlebitis? A randomized controlled study. *The International Medical Journal of India*, 22(2):60-2.
3. Rickard CM, McCann D, Munnings J, McGill M. (2010). Routine re-site of peripheral intravenous devices every 3 days did not reduce complications compared with clinically indicated re-site: a randomised controlled trial. *BMC Medicine*, 8:53.
- Rickard 2010 unpublished data
4. Rickard CM, Webster J, Wallis MC, Marsh N, McGill MR, French V, et al. (2012). Routine versus clinically indicated replacement of peripheral intravenous catheters: A randomised equivalence trial. *Lancet*, 380(9847): 1066-74.
- Rickard 2012 unpublished data
5. Rickard CM. (2013). Clinically indicated and routine replacement of peripheral IV catheters did not differ for phlebitis. *Annals of Internal Medicine*, 158:JCB. Ref ID:81
6. Juffa H, Rickard CM, Webster J, Marsh N, Gordon L, Wallis M, et al. (2014). Cost-effectiveness analysis of clinically indicated versus routine replacement of peripheral intravenous catheters. *Applied Economics and Health Policy*, 12:51-8.
7. Van Donk P, Rickard CM, McGill MR, Doolan G. (2009). Routine replacement versus clinical monitoring of peripheral intravenous catheters in a regional hospital in the home program: A randomized controlled trial. *Infection Control and Hospital Epidemiology*, 30(9):915-7.
- Van Donk 2009 unpublished data
8. Webster J, Lloyd S, Hopkins T, Osborne S, Yaxley M. (2007). Developing a research base for intravenous peripheral cannula re-sites (DRIP trial). A randomised controlled trial of hospital in-patients. *International Journal of Nursing Studies*, 44(5):664-71.
- Webster 2007 unpublished data
9. Webster J, Clarke S, Paterson D, Hutton A, van Dyke S, Gale C, et al. (2008). Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial. *BMJ*, 337:a339.
- Webster 2008 unpublished data

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Best practice recommendations

The results from this review suggest that peripheral venous catheters should be replaced when clinically indicated for those patients who receive intravenous therapy in acute and community settings. The evidence recommends discouraging the routine change of catheters every 72-96 hours.

The full review report, including references, can be accessed [here](#).

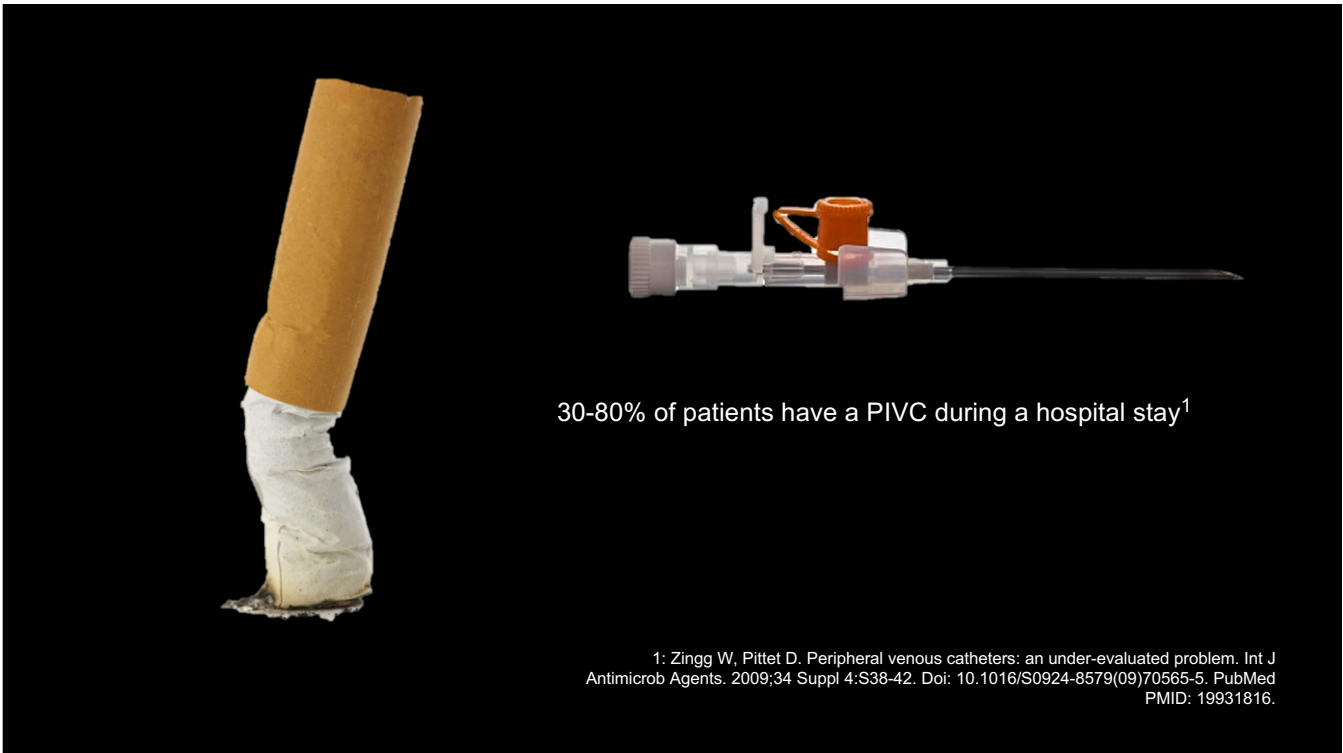
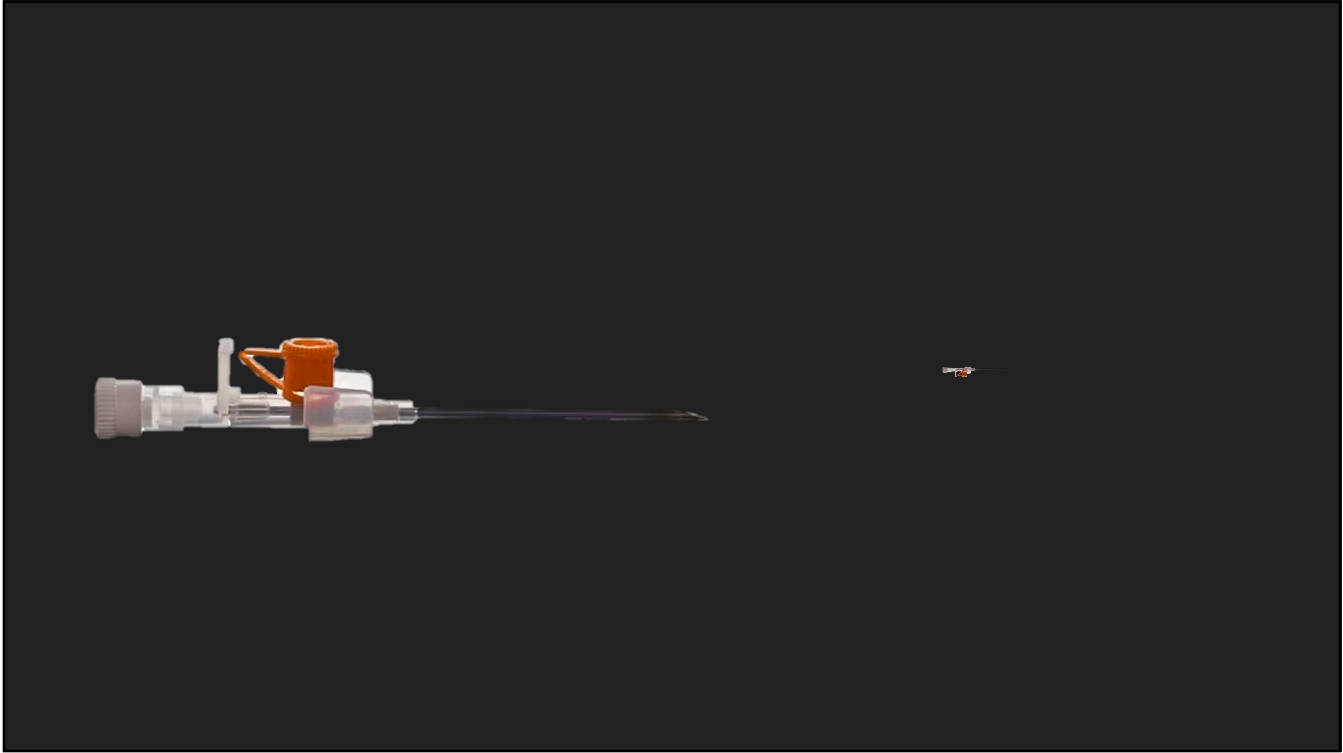
Dora Lang is a group member of the National Cancer Institute Singapore, National University Health System, and a member of the Cochrane Nursing Care Field

Risk of catheter-related bacteraemia ¹	0.03% - 0.18%
Number of patients in meta-analysis ²	4806
Expected number of bacteraemias	1 - 4
Observed number of bacteraemias in meta-analysis	3



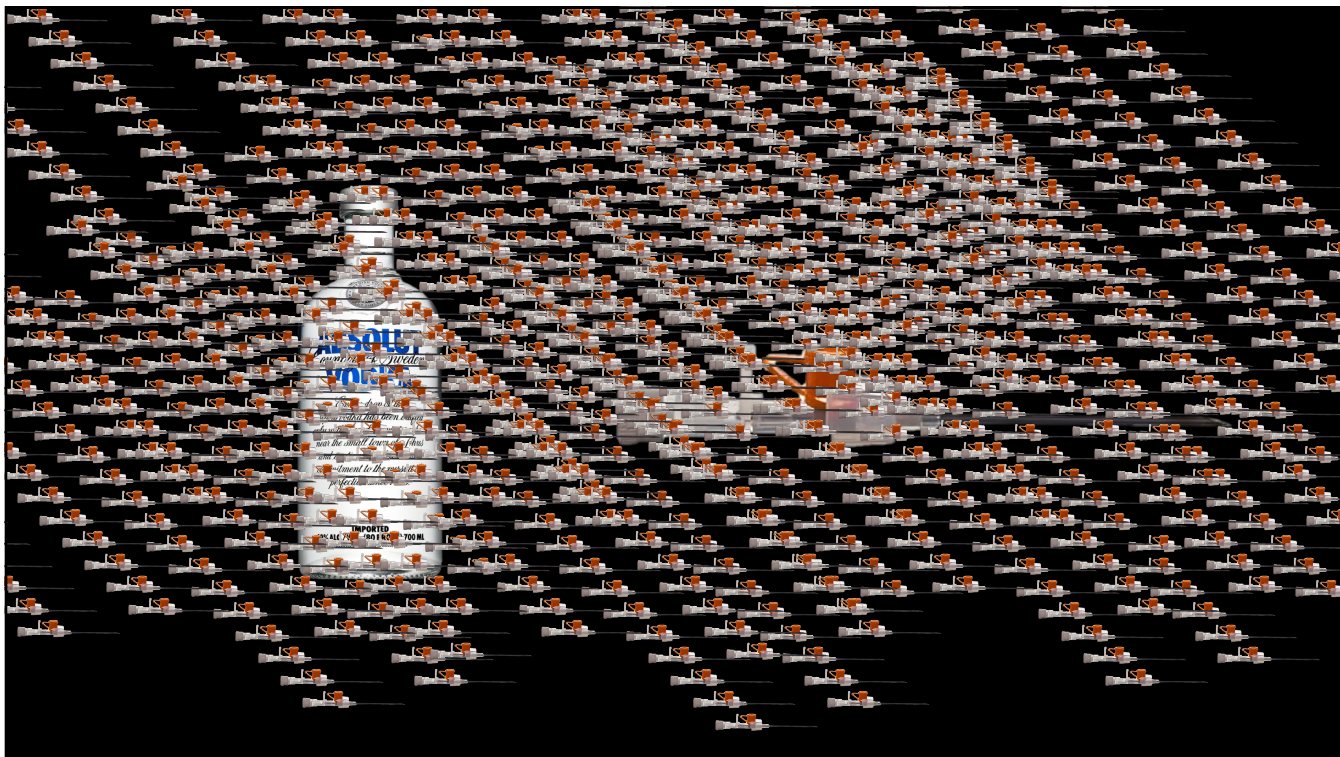
1: Mermel LA. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. CID 2017;65(10):1757-62
 2: Webster J, Osborne S, Rickard CM, New K. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Cochrane Database of Systematic Reviews 2015, Issue 8. Art. No.: CD007798. DOI: 10.1002/14651858.CD007798.pub4

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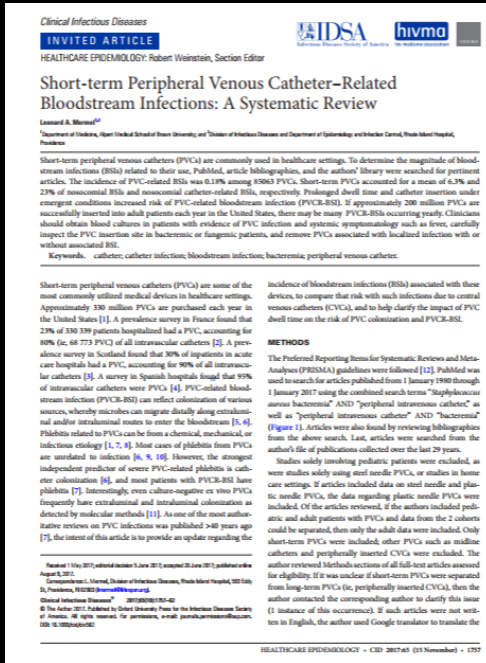


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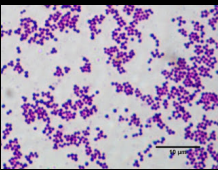
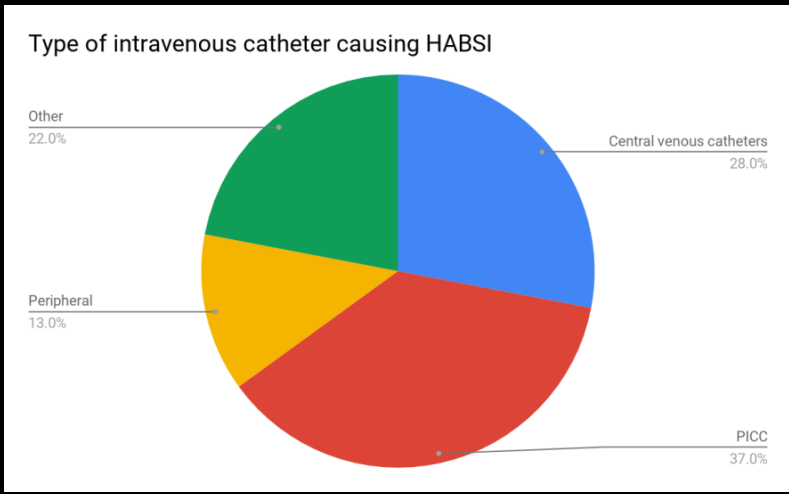
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Abstract

Short-term peripheral venous catheters (PVCs) are commonly used in healthcare settings. To determine the magnitude of bloodstream infections (BSIs) related to their use, PubMed, article bibliographies, and the authors' library were searched for pertinent articles. The incidence of PVC-related BSIs was 0.18% among 85063 PVCs. Short-term PVCs accounted for a mean of 6.3% and 23% of nosocomial BSIs and nosocomial catheter-related BSIs, respectively. Prolonged dwell time and catheter insertion under emergent conditions increased risk of PVC-related bloodstream infection (PVCR-BSI). If approximately 200 million PVCs are successfully inserted into adult patients each year in the United States, there may be many PVCR-BSIs occurring yearly. Clinicians should obtain blood cultures in patients with evidence of PVC infection and systemic symptomatology such as fever, carefully inspect the PVC insertion site in bacteremic or fungemic patients, and remove PVCs associated with localized infection with or without associated BSI.



'...1 in 3 healthcare-associated S.aureus CR-BSIs are due to PVCs...'^{1,2}

1. Si, Damir, Runnegar, Naomi, Marquess, John, Rajmohan, Mohana and Playford, Elliott G. (2016) Characterising health care-associated bloodstream infections in public hospitals in Queensland, 2008-2012. Medical Journal of Australia, 204 7: 276.e1-276.e7. doi:10.5694/mja15.00957
 2. Mermel LA. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. CID 2017;65(10):1757-62

Peripheral cannula-related BSI in the ACT 2016

Total ACT public hospital separations ¹	68,000
Estimated number of patients with IVC (@30%)	20,400
Expected number PIVC-related bloodstream infections/year (@0.05 - 0.1%)	10 - 20
Observed number PIVC-related BSI/year	~ 8

1. Represents TCH and Calvary Hospital; data on PIVC BSI only available from TCH

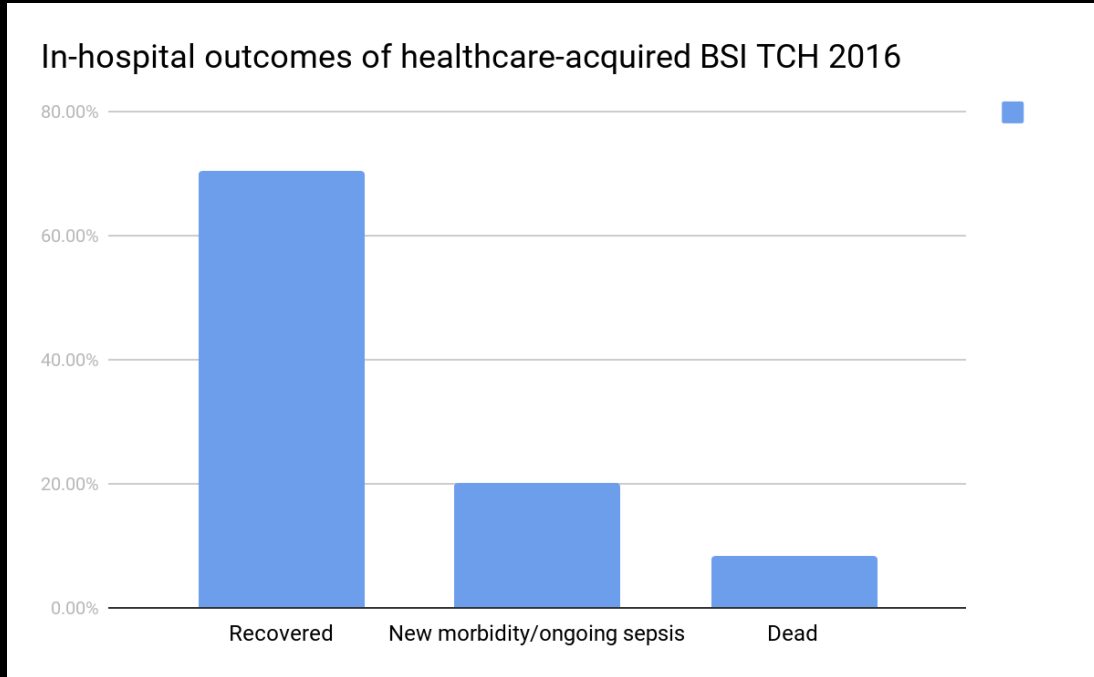
Estimate of PIVC used annually in Australia

Total hospital separations ¹	10,599,768
Estimated number of patients with IVC (@30%)	~ 3,000,000
Expected number PIVC-related bloodstream infections/year (@0.05 - 0.1%)	1,500 - 3,000



1. AIHW data - public and private hospitals 2015-16

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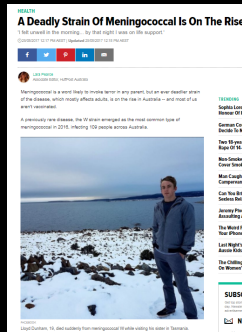
Expected number PIVC-related bloodstream infections/year (@0.05 - 0.1%)	1,500 - 3,000
Expected deaths in hospital (8% mortality)	120 - 240

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Meningococcal infection in Australia 2016

Number of cases	254
Deaths	~ 25
PBS vaccination costs	~ \$15 million



How do you reduce the infection-related mortality of PIVCs?



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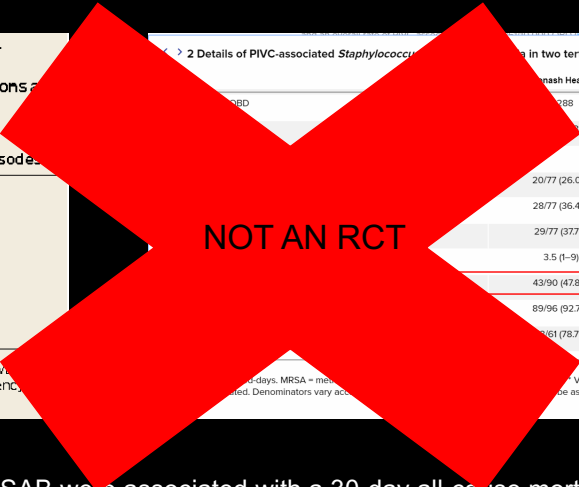
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Peripheral intravenous catheter (PIVC) dwell times for PIVC-associated bloodstream infections at Canberra Hospital since 2002*

No. of days PIVC in place	No. of episodes	Monash Health	Austin Health	Total
1	1	20/77 (26.0%)	3/34 (8.8%)	23/111 (20.8%)
2	6	28/77 (36.4%)	16/34 (47.1%)	44/111 (39.6%)
3	12	29/77 (37.7%)	15/34 (44.1%)	44/111 (39.6%)
4	13	3.5 (1-9)	3.5 (0.25-9)	3.5 (0.25-9)
5	6	43/90 (47.8%)	13/34 (38.2%)	56/124 (45.2%)
≥ 6	3	89/96 (92.7%)	38/41 (92.7%)	127/137 (92.7%)
Unknown	6	1/61 (1.6%)	27/41 (65.9%)	28/102 (27.5%)

* There were 5 episodes where PIVC was inserted in hospital transfer or emergency department and was in place for > 1 day.

† Values are no. of episodes/total PIVC-associated SAB episodes (%) unless otherwise specified. Denominators vary according to the variable. ‡ Values are no. of episodes/total PIVC-associated SAB episodes (%) unless otherwise specified.



'...PIVC-associated SAB were associated with a 30-day all-cause mortality rate of 26.5%...' ²

1. Collignon PJ, Kimber FJ, Beckingham WD, Roberts JL. Prevention of peripheral intravenous catheter-related bloodstream infections: the need for routine replacement [letter]. *Med J Aust* 2013; 199: 750-751.
2. Rhonda L Stuart, Donna R M Cameron, Carmel Scott, Despina Kotsanas, M Lindsay Grayson, Tony M Korman, Elizabeth E Gillespie and Paul D R Johnson. Peripheral intravenous catheter-associated *Staphylococcus aureus* bacteraemia: more than 5 years of prospective data from two tertiary health services *Med J Aust* 2013; 198 (10): 551-553. || doi: 10.5694/mja12.11699

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- The gold standard is a systematic review of a number of RCTs
- RCTs are expensive
- RCTs may lack the power to demonstrate a small reduction in risk
- In the absence of adequate RCTs we must rely on 'lower levels' of evidence



Voltaire (1694 - 1778)

*'...Can't stop the memory that goes
climbing through my brain
I get no answers
So the question still remains...'*

From the 1976 song 'Am I ever gonna see your face again?' by The Angels



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Summary

- EBM offers powerful tools to help us practice Infection control safely, effectively and efficiently
- Must choose the right tool and use it properly



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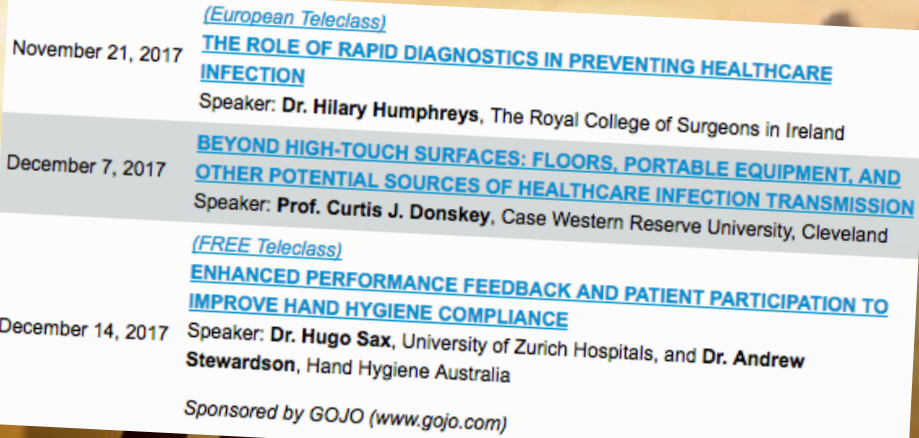
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- 
- (European Teleclass)*
November 21, 2017 **THE ROLE OF RAPID DIAGNOSTICS IN PREVENTING HEALTHCARE INFECTION**
Speaker: **Dr. Hilary Humphreys**, The Royal College of Surgeons in Ireland
- December 7, 2017 **BEYOND HIGH-TOUCH SURFACES: FLOORS, PORTABLE EQUIPMENT, AND OTHER POTENTIAL SOURCES OF HEALTHCARE INFECTION TRANSMISSION**
Speaker: **Prof. Curtis J. Donskey**, Case Western Reserve University, Cleveland
- (FREE Teleclass)*
December 14, 2017 **ENHANCED PERFORMANCE FEEDBACK AND PATIENT PARTICIPATION TO IMPROVE HAND HYGIENE COMPLIANCE**
Speaker: **Dr. Hugo Sax**, University of Zurich Hospitals, and **Dr. Andrew Stewardson**, Hand Hygiene Australia
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