Universal MRSA Screening – Is it Worthwhile, and For Whom
Dr. Barry Cookson, University College of London
A Webber Training Teleclass

Universal MRSA Screening

Is it worthwhile and for whom?

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Hosted by Paul Webber
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IT REALLY DOES DEPEND !!!!

"CONTEXT" is EVERYTHING

EXAMINE THE QUALITY OF THE EVIDENCE

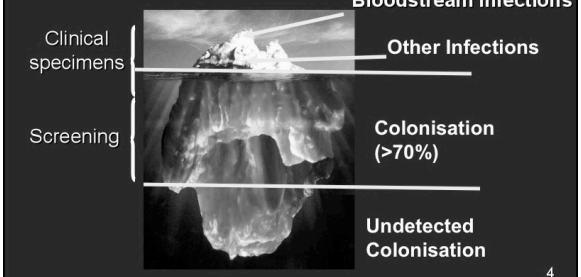
DECIDE HOW APPLICABLE THE STUDY IS TO YOUR COUNTRY AND YOUR HOSPITAL

ENGAGE WITH ALL RELEVANT STAKEHOLDERS ENSURING OWNERSHIP OF THE DECISIONS

Outline

1. Types of Screening:
   Focus on Admission Screening
2. Effectiveness of measures it informs?
3. Who are the Stakeholders?
4. Review of studies
5. Conclusions

MRSA a typical Healthcare Associated Infection Pathogen
The Iceburg Phenomenon



MRSA Screening Categorisation

Adapted from Brown D, Cookson B. MRSA – laboratory aspects of detection in *MRSA Current Perspectives*, Fluit D and F-J Schmitz (Eds), Caister Academic Press, Wymondham, UK 2003: 11-29

Five MRSA Screening Categories	Effects of improved sensitivity and speed of detection method.
1: Patient admissions from other Hospitals, Re-admissions, Long Term Care Facilities (Primary to ICU RARE: screen all!)	Control of spread (e.g. isolation? and decontamination?) and bed management improved.
2: Outbreaks: patient & staff carriage	
3: Detection of acquisition to inform success of interventions e.g. improved hand hygiene	PLUS Greater confidence in results
4: Clearance from treated subjects	PLUS informs establishment of clearance
5: Clinical "screening" i.e. routine specimens examined for MRSA	Earlier correct treatment: fewer "reserve" antimicrobials used & less selection pressure for resistance.

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Modelling an Issue?

- George Box
  "Essentially all models are wrong but some are useful"

- Anderson and May 1991
  "mathematical models are no more and no less tools for thinking clearly about something."
- ***Our Modelling group (BMJ discussion)***
  "Use of models, combined with the empirical assessment of their findings, is the most realistic and viable approach"

1) can help understand how different factors interact and affect success or failure of combinations of interventions
2) especially where it is not feasible to use clinical studies alone.

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Context is EVERYTHING!

Modelling SENSITIVITY analyses show huge influences of :

- •MRSA occurrence (prevalence/incidence)
- •MRSA "challenges" to the system e.g. re-admissions, Long Term Care Facility dynamics, CA-MRSA, LA-MRSA….
- •Case mix, hospital type, transfer patterns inter ward/ICU ("carousel")
- •Healthcare system e.g. private/public funded, patient advocates
- •Other infection control interventions and effectiveness e.g. hand hygiene, decolonisation/suppression, isolation (ward/ cohorts/ single-bed rooms) AND
- •When done e.g. before results, after risk assessment?.....

(Study Design: EQUATOR www site for STROBE and CONSORT tools also ORION tools [Google "IDRN ORION"])

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HTA MRSA Isolation: Systematic Review

Cooper et al, Health Technol Assess 2003; 7(39) &
Proc Nat Acad Sciences 2004: **6:** 10223-10228

Modelling introductions of MRSA to a hospital

- Increasing the detection rate reduces the endemic prevalence
- Effectiveness of intervention can depend critically on timing (the earlier the better)
- Isolation policies scale with MRSA reservoir or may fail
- Ability of MRSA strain to persist in, and transfer between, patients can be key factors in the long-term dynamics

Community acquired MRSA would have a MAJOR effect on the dynamics

Seven non RCT Studies where antiseptic use could be related to reductions in ICU MRSA

Edgeworth J, J Ant Chemother 2011:66;Suppl 2:ii41-ii47

Reference	Setting	Population	Measures pre-intervention	Intervention	Outcomes
46	13 bed general ICU	2200 adm., 16.5% MRSA carriers	not stated	ASC (nose); CHX bathing and nasal mupirocin for colonized patients	trend reduction in MRSA infection (year 1 versus year 5: 8.2% versus 2.8%; $P=0.001$)
44	10 bed general ICU	667 adm. before, 1995 adm. after	no specific interventions	ASC (nose); contact precautions, CHX bathing and nasal mupirocin for colonized patients	MRSA infection rate (before versus after: 3.5 versus 1.7/1000 patient days; $P=0.0023$)
		4 used for Colonised			
49	16 bed coronary medical ICU	845 adm. before, 736 adm. after	ASC (nose)	CHX bathing and nasal mupirocin for colonized patients	MRSA incidence density (before versus after: 8.5 versus 4.1/1000 patient days; $P=0.048$)
51	8 bed medical and 14 bed surgical ICU	653 adm. with length of stay >24 h	not stated	ASC[a] (nose); contact isolation and topical betaine polyhexamide for colonized patients[b]	MRSA infection incidence rate (before versus after: in surgical ICU, 3.8 versus 3.0/1000 patient days; $P=0.057$; in medical ICU, 1.4 versus 1.7/ 1000 patient days)
8	30 bed general ICU	2480 adm. before, 2090 adm. after	ASC (nose, axilla, groin), contact precautions, isolation or cohorting	CHX bathing[c] plus CHX applied to nose, tracheostomy and skin creases for all patients	incident rate ratio (95% CI) for CHX-susceptible strains before versus after: 0.3 (0.19–0.47)
50	16 bed general ICU	1232 adm. before, 1421 adm. after	contact precautions for clinically identified cases	ASC (nose, throat, axilla, groin); CHX bathing and nasal anti-MRSA preparations for all patients	MRSA cases (before versus after: 16% versus 6%) time series analysis showed immediate effect—reduction of 11.38% (95% CI: 19.2%–3.54%; $P<0.001$)
		3 used for All			
34	2 medical, 2 surgical and 2 mixed ICUs from 4 centres	2670 adm. before, 2650 adm. after	ASC (nose)	CHX bathing for all patients	MRSA acquisitions (before versus after: 5.04 versus 3.44/1000 patient days; $P=0.046$)

Adm., admissions; ASC, active surveillance testing; CHX, chlorhexidine.
[a]Detected by PCR.
[b]Topical treatment for all patients implemented midway through study.
[c]Non-MRSA colonized patients received triclosan to skin instead of CHX.

ICU MRSA
Prevention and Control Strategies

Robotham et al, BMJ 2011; doi: 10.1136/bmj.d5694

- 12 strategies for Screening + Isolation
- 9 strategies for Screening + Decolonisation
- Sensitivity analyses for cost effectiveness (i.e. reality checks)
- Decolonisation key component of cost effective control strategies
- Warned about viability risks e.g. issues with resistance
- Further research needed e.g. no ICU RCTs

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Targeted versus Universal Decolonization to Prevent ICU Infection

Huang et al, N Engl J Med 2013. DOI: 10.1056/NEJMoa1207290

- Cluster RCT in 43 mainly community hospitals in 16 USA States with ICUs with SINGLE BEDDED ROOMS to one of 3 arms

❑ ARM 1: Active detection (nasal only) + ISOLATION if MRSA positive

❑ ARM 2 : "1" + DECOLONISATION
(5d nas. b.d. Mupirocin & Chlorhex baths)

❑ ARM 3: Universal DECOLONISATION with no screening

- 3">"2">"1" significant reductions in clinical MRSA and other pathogen BSIs but not MRSA BSIs
- CNS comprised significant proportion of BSIs and mainly in ARM 3 as had ¾ Bone Marrow and Solid Organ Transplant. ICUs

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Points of interest: Huang et al, 2013 Study

- ARM 3 had far fewer patients with no history of MRSA: might explain the lack of MRSA BSI effects?
- "Failed to look for antiseptic resistance": lengths of stay were short (~3 days) but emphasised a risk and need surveillance
- No information on turnaround times/how screened/cost evaluations
- Only contact isolation when knew MRSA positive

BUT

All in single rooms so less prone to cross infection…..so impact of this was less?

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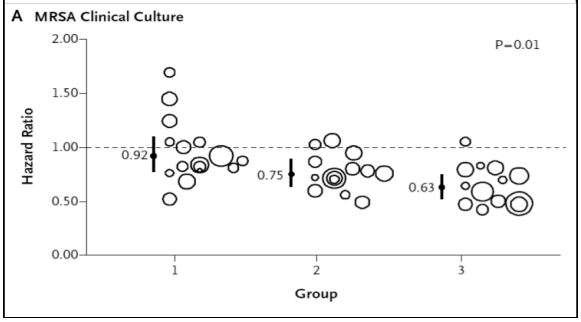
Huang et al, N Engl J Med 2013. DOI: 10.1056/NEJMoa1207290



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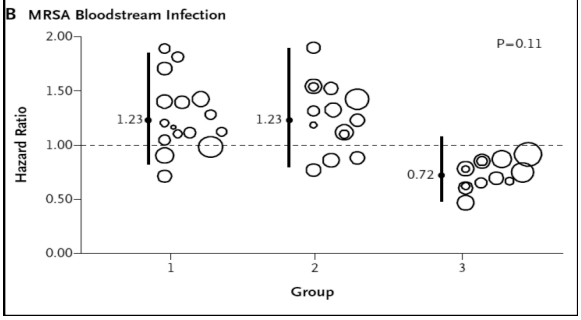

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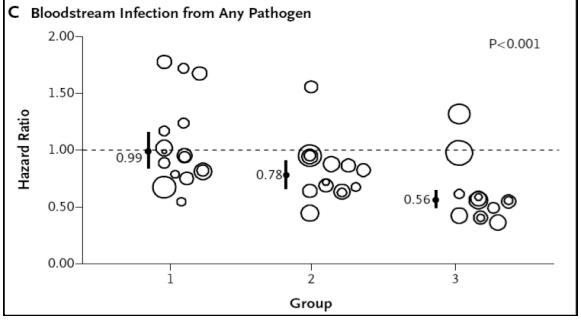

General Wards: isolation and decolonisation are effective: Worby et al, 2013

- General London Teaching Hospital wards 2006–2007
- Prospective MRSA surveillance 14,035 patient episodes and data informed stochastic modelling
- Undetected MRSA-positive patients source of 75% (67- 86) of transmission events.
- 64% (95% CI 37-79) reduction by Isolation + Decolonization
- Relative importance of each unclear

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Who are the Stakeholders?

- Managers and other Healthcare workers
  - Public and Private Sector
  - Infection Control
  - Others
- Patients, Families and their Advocates
- Innovation Landscape: Industry, Rapid Review Panel….
- Politicians, Policy Makers, DH
  - Electorate: difficult to review decisions especially before an election: can be seen as weakness
  - Treasury: all decisions need in depth review
    - Do criteria exist for cost effectiveness? England range of "£20K to £30K/ QUALY"

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Patient Experience
Healthcare Associated Infection (HAI)

- Insufficient or incorrect understanding of the transmission, treatment and outcomes of HAI
- Exaggerated sense of HAI risk (Gould et al, 2009)
- and of MRSA (Brady et al., 2009, Easton et al., 2007, MORI POLL, 2010).
- Provided verbally no written information (Burnett et al., 2010, MORI Pol, 2010).

Scottish Pathfinder 2011:
Staff & Patient Views on Universal MRSA Screening

- ~700 individuals: few patients with direct experience
- Highly acceptable to patients, visitors & wider community
- Staff : "significant minority" more negative attitudes
  - Unacceptable; isolation facilities lacking, increased workload, screening/decolonisation protocol variation
- All wanted staff screening: to be examined more fully.
- All wanted MRSA infected patients nursed in isolation not with other colonised patients.
- English studies should be published soon (Loveday & Pellowe….)

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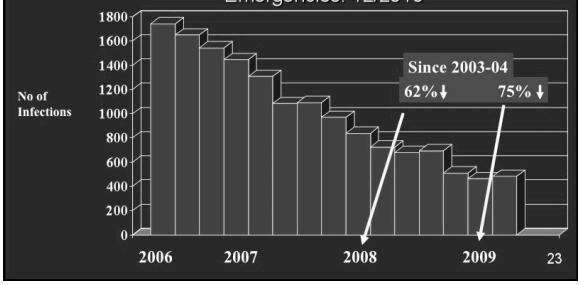
English Quarterly Mandatory MRSA Bloodstream Infection Data

Mandatory Screening based on ~2007 data:
Electives: 4/2009
Emergencies: 12/2010



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Implications for low prevalence on MRSA Screening Otter et al, J. Hosp. Infect 2013;83: 114-121

London Teaching hospitals

- 2004-05: emergency admissions: 8.6%
- 2006-07: medical and surgical patients 6.7%
- 2008-09: London teaching hosp. : 28,892 admissions 1200 beds
  - Overall typical MRSA 2% rates
  - Previously unknown MRSA: 1.4% (were i.e. VERY LOW)

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Implications for low prevalence & CAMRSA on MRSA Screening Otter et al, 2013

2008-09: 2% MRSA

- Most were HAI MRSA (EMRSA-15 and –16)
- 18% of all isolates were community acquired MRSA (CA-MRSA)
  - 37.5% from accident and emergency
  - 23.1% from surgery
  - Significantly different risk factors used e.g. antibiotics, international travel, overcrowding e.g. prisons, sport…

Concluded

1)Low rate HA-MRSA 2) increasing proportion of CA-MRSA so HAI risk-factor-based screening strategies may be less effective?

3) Universal MRSA admission screening costings need to take account of this changing local epidemiology.

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Possible Strategies for Admission Screening

- Clinical Risk Based
- "Universal" (Mandatory or Otherwise)

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Clinical Risk Based Assessment (Yellow Pathfinder Method)

- Informed by National Evidence Based Guidelines
- Adapted for Local Use e.g.
- o Age; Previous colonisation; Antibiotics in previous year;
- o Diabetes; Chronic Lung Disease
- o Specialty admitted to e.g. Intensive Care Units
- o Previous Hospital Admission
- o Breaks in integument e.g. Pressure Sores or other Wounds
- o Presence of devices e.g. Venous, Intubation, Urinary
- o Admission not from home e.g. Long Term Care Facility
- o Healthcare Worker or Family member of patient
- o Contact with pigs e.g. Denmark, Netherlands

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Universal Screening

- Patients with risk factors might otherwise be missed?
- Patients with MRSA do not have risk factors
- "KISS": staff can follow it more easily so don't forget
- It is argued that it is cost effective (at 6% rate!)

- Danger false sense of security in healthcare workers
  - Might assume patients are screened and not check notes or take a history!
  - In "NOW" study 19% of admissions were missed

Targeted versus universal screening and decolonization to reduce healthcare-associated meticillin-resistant *Staphylococcus aureus* infection

S.R. Deeny [a,*], B.S. Cooper [b], B. Cookson [a], S. Hopkins [a,c,d], J.V. Robotham [a]

J Hosp Infect 2013; 33-44

- Stochastic, individual-based model of MRSA transmission
- First one to include detailed patient movements between general medical and intensive care unit (ICU) wards, and between the hospital and community
- 18 months of individual patient data from a 900-bed London tertiary care hospital

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Universal versus Targeted MRSA Screening?

Deeny et al, JHI 2013

- Compared universal screening and decolonisation with targeted screening of elderly care, ICU and re-admitted MRSA patients (All <1% MRSA colonisation) and decolonisation of positives
- Reduced screening and decolonization by ~95%
- Only 12% less reduction in infections than universal screening
- More efficient use of resources
- Less potential for resistance to antiseptics

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Evaluation of screening risk and non risk patients for methicillin-resistant Staphylococcus aureus on admission in an acute care hospital.
Creamer et al, AJIC 2012;40:411e415

- Eire tertiary referral hospital (incl neurosurgery and renal/ pancreas transplantation) non randomised prospective study
- Multi-faceted prospective intervention including patient and environmental sampling and assess for risk factors (RF) e.g. previous MRSA, chronic wounds
- Initial MRSA screening: 48 of 892 (5%: "endemic") but declined over 3years of study.
- MRSA patients positive: 4/340 (1%) no recognized RF
  44/552 (8%) with RF
- Best strategy: Selective screening of RF positives: 2-4 cheaper

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Jeyaratnam et al, 2008	London, UK	General Wards; Cross Over	Commercial PCR admission & discharge	NSD in acquisitions
Hardie et al, 2010	Birmingham UK	Surgical Wards; Cross Over	Commercial PCR admission & discharge	Less MRSA acquired
Robicsek et al, 2008	Chicago, USA	ICU & Whole Hospital: Sequential ITS	Commercial PCR admission	Reduced MRSA infections. Acquisition ?
Harbarth et al, 2008	Geneva, Switzerland	Surgical Wards; Cross Over	In-House PCR admission	NSD in MRSA infections. Acquisition ? Delays: see next slide!

PCR Testing: Additional Points

Harbarth et al, JAMA 2008;299: 1149-1157:

- Pragmatic study using an in-house PCR
- Median time from PCR-based admission screening to notification of test results was long (22.5 hours)
- Emergencies and laboratory delays: 120/386 (31%) MRSA carriers identified only after surgical intervention

Read other papers carefully

- What was the role of funded staff or the study design: include ensuring specimens were taken and results sent to ward and interventions implemented?
  Can you implement PCR effectively in the "real world" ... and at what cost?

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Cost-effectiveness of universal MRSA screening on admission to surgery

Murthy et al, CMI, 2011:16; 1747-1753

Modelled Harbarth et al, JAMA 2008;299: 1149-1157 study data and found:

- PCR is cost effective at their MRSA endemic admission rate
- If rate falls less effective than risk based isolation and culture screening
- Ineffectiveness perhaps due to on-going transmissions whilst awaiting results?

- Bedside testing may be a way forward?
- Local analysis and decision making is required

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BMJ open **Comparison of strategies to reduce meticillin-resistant *Staphylococcus aureus* rates in surgical patients: a controlled multicentre intervention trial**

Lee et al, 2013 doi 10.11.36/ bmjopen-2013-003126

- Pragmatic ITS Cohort Study: 33 Surgical wards; 10 hospitals in 9 EU countries plus Israel
- All low incidence MRSA hospitals (0.8 to 1.1%)
- ARM 1: multi-modal hand hygiene (HH) intervention: no reductions in MRSA but compliance already ~50%. No attempt to change isolation/decolonisation practices.
- ARM 2: Universal MRSA screening (without pre-emptive isolation) and decolonisation if +; reduced MRSA cultures (15%/month) & infections (17%/m) on clean surgery wards

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Surgical MRSA Study
Lee et al, 2013 doi 10.11.36/bmjopen-2013-003126

- ARM 3: 2 countries used targeted risk factor screening (as mandated) and WHO HH:
  reduced MRSA cultures (12% /m: 95% CI 0.79 to 0.98 and 15%/m in clean surgery).
- No attempt was made to explore cost effectiveness of the interventions

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NHS Scotland Pathfinder Results: February 2011

http://www.documents.hps.scot.nhs.uk/hai/mrsa-screening/pathfinder-programme/mrsa-pathfinder-update-2011-02-23.pdf *

- 6 acute hospitals : 81,438 admissions (30% elective& **70% emergency**). About same no. as a London Teaching hospital
- MRSA colonisation prevalence fell: 5.5% to 3.5% in year
- Emergency rate 4.5% and elective admissions 2.1%
- 7.5 Infections per 1,000 patient days: reduced in the year

* Google search names: "Scotland MRSA Pathfinder"

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Modelling: most clinically & cost effective strategy for a national MRSA screening policy

- Needs further work before recommending implemented
- Option "1": Universal screening
- **Option "2": Clinical Risk assessment (see previous slide) & targeted MRSA laboratory testing of at risk patients**
- Option "3": "2" Plus "universal" testing of selected specialties.
- Option 2 & 3: Similar Clinical Effectiveness
- Option "1" four times the cost of "2" and twice cost of "3"
- Option "2" had greatest clinical impact with lowest cost

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Pathfinder: Summary of Recommendations

- No point screening unless informs interventions quickly and effectively: look at bed management
- Side rooms were few but did not consider cohorting
- Median 3d stay so cannot Decolonise/Suppress/ Isolate!
- Clinical risk assessment realistic alternative to universal screening (as effective and cheaper)
- Faster PCR testing may help; more costly and limited evidence of added benefit: alludes to false positives
- **Consider bed-side or nearer point of care testing**: recommends more work is done

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DoH Audit of Universal MRSA Screening the "NOW" Study: 2010

Aims: Review implementation, impact on patient management, admission prevalence and extra yield of Universal MRSA Screening compared to

•"high-risk" specialty (HRS) cardiothoracic, vascular, orthopaedic .... or .....

•"Checklist-Activated" MRSA risk factor Screening (CLAS)

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NOW Results*

1) Audit: Fuller et, al PLoS ONE 8(9): e74219

•Implementation of universal screening was poor
Admission Screening performed on:

- Emergency admissions 61% (median 67.3%),
- Electives 81% (median 59.4%;)

•Very low MRSA admission prevalence:

- Emergencies 1%: Electives 0.6%
- Inpatient. MRSA prevalence 3.3%

2) Modelling http://idrn.org/audit.php
Preliminary results further analyses underway.

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NOW Modelling: Conclusions (for England)

- High Risk Specialty, not Universal, screening is more cost effective BECAUSE it reduces MOST infections and deaths (rather than transmissions)
- Robust to prevalence: e.g. the same if doubled, transmission rates and no of death assumptions
- Uncertainties: mainly on isolation and decolonisation effectiveness: need more data !
- Current resources better spent: on improving intervention compliance e.g. faster results, ensuring ward interventions implemented e.g. isolation and, perhaps, decolonisation, sustaining improved infection prevention/control compliance e.g. hand hygiene, RF screening, isolation?

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Conclusions

- Literature supports universal screening is not likely to be cost effective (little detailed costings data)
- Policy decisions need to be fully discussed with all stakeholders
- Bedside testing may alter the rubric depending on cost evaluations (caution ref "DNA" testing future-proofing)
- Isolation and Bed Management need to be considered
- Decolonisation: there are now better studies supporting its role BUT antiseptic resistance surveillance needed
- Consider national and local context ref applicability of previous and current study results
- Modelling can inform decision making: needs good data!
- More work needed on cost effectiveness: essential for policy makers: need to show investment saves money!

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February 6 **HAND HYGIENE - IS IT THE 100% SOLUTION?**
Dr. Yves Longtin, Infectious Disease Research Centre, Quebec City

February 12 *(South Pacific Teleclass)*
PREVENTING CATHETER ASSOCIATED URINARY TRACT INFECTIONS: WHAT'S NEW
Prof. Paul A. Tambyah, National University of Singapore

February 13 *(Free Teleclass)*
ELIMINATING PREVENTABLE HARM THROUGH BUILDING A RELIABLE CULTURE OF SAFETY
Dr. Denise M. Murphy, Main Line Health System, Pennsylvania

February 27 **RAPID BACTERIAL DIAGNOSTICS – IMPACT ON PATIENT AND INFECTION CONTROL**
Dr. Stephen M. Brecher, VA Boston Health Care System

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