



# The role of microbiological diagnosis in antimicrobial stewardship: A systems approach

Symposium on Advanced Infection Control 2020  
Antimicrobial Stewardship  
19-20 November 2020

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No disclosures

# Antimicrobial Stewardship in Australian Hospitals\*

Antimicrobial stewardship is a requirement of hospital accreditation

- National safety and quality health care standards
- Specified requirements and assessment process

Programs:

1. **AURA** Antimicrobial Use and Resistance in Australia
2. **NAPS** National Antimicrobial Prescribing Surveillance
3. **NAUSP** National Antimicrobial Utilisation Surveillance Program

\*The focus of this presentation is on hospitals in particular  
Australian AMS/AMR also include aged care and surgical  
specific programs

[www.safetyandquality.gov.au](http://www.safetyandquality.gov.au)  
[www.ncas-Australia.org](http://www.ncas-Australia.org)



3  
Preventing and Controlling  
Healthcare-Associated  
Infection Standard



**AUSTRALIAN COMMISSION**  
**ON SAFETY AND QUALITY IN HEALTH CARE**



## Antimicrobial Stewardship in Australian Health Care

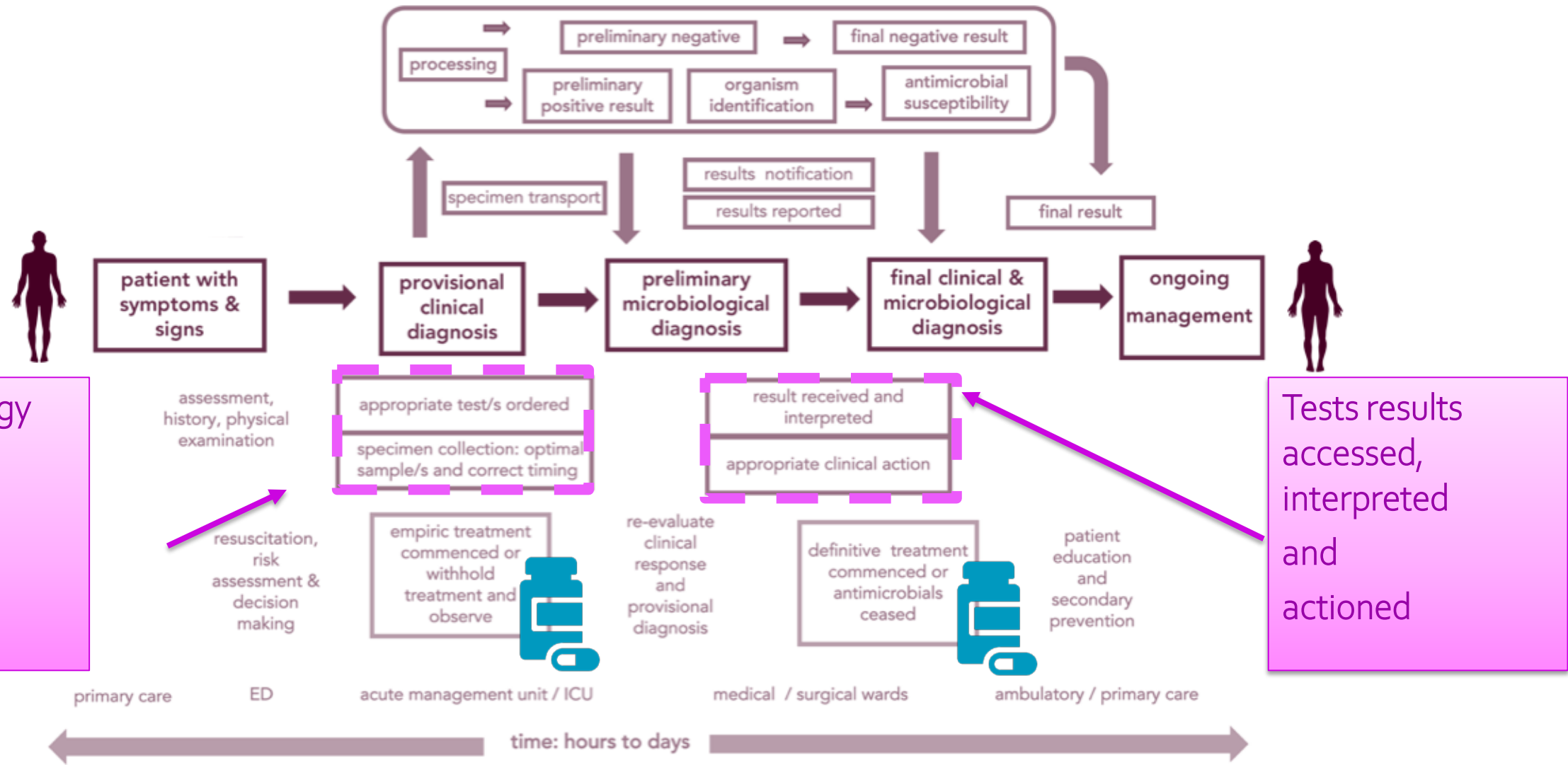
2018

# 9

## Role of the clinical microbiology service in antimicrobial stewardship

- 9.1 Introduction \_\_\_\_\_
- 9.2 Overview of the diagnostic testing process \_\_\_\_\_
- 9.3 Pre-analytical phase: microbiology process \_\_\_\_\_
  - 9.3.1 Selecting diagnostic tests \_\_\_\_\_
  - 9.3.2 Collecting and transporting samples \_\_\_\_\_
  - 9.3.3 Commenting on specimen quality \_\_\_\_\_
- 9.4 Analytical phase: microbiological analytical practice \_\_\_\_\_
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  - 9.6.5 Linking microbiology results with electronic prescribing \_\_\_\_\_
  - 9.6.6 Measuring performance of the clinical microbiology service as part of the antimicrobial stewardship program \_\_\_\_\_
- 9.7 Role in education \_\_\_\_\_

# SMART Sepsis: Integrated Management



Microbiology tests ordered & collected

Tests results accessed, interpreted and actioned



# Antimicrobial Stewardship 2020



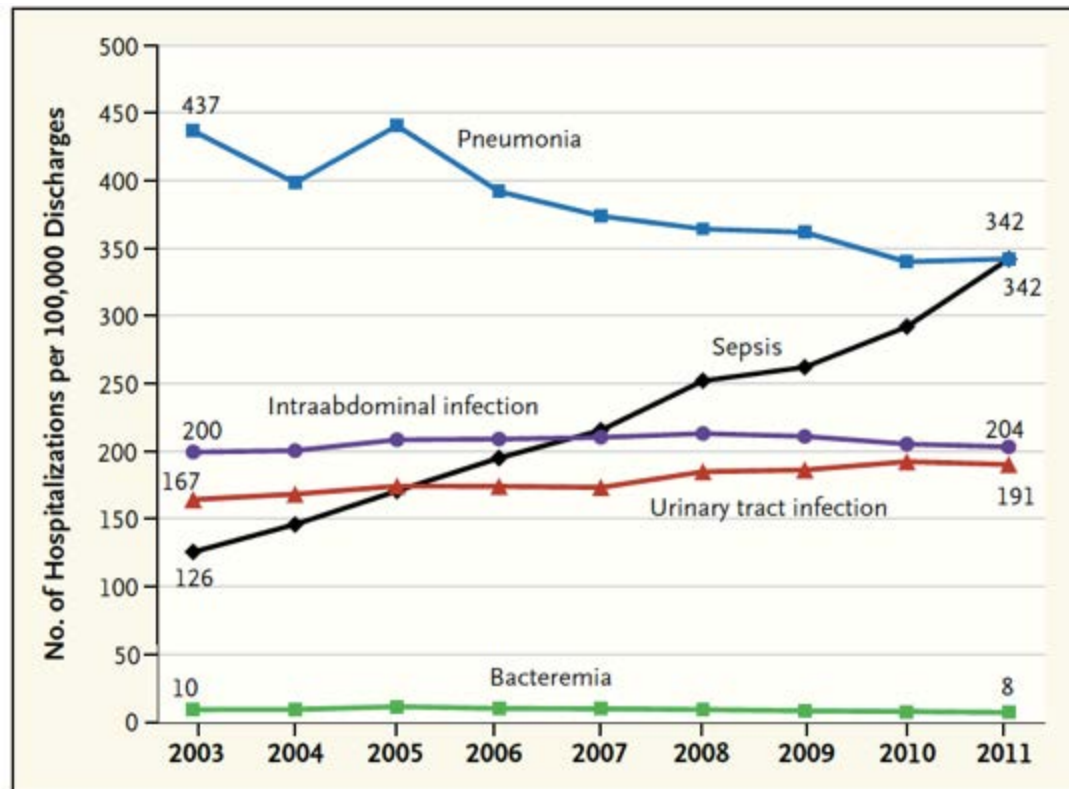
## Hospital National Antimicrobial Prescribing Survey

- 2013-2018 annual surveys
- 2018 26,714 prescriptions, 324 Australian hospitals
- Detailed information
- Antimicrobial use remains problematic
  - total usage is high with small improvements
  - appropriateness of prescribing 77.7 %
- AMS programs
  - routinely implemented
  - some improvements in process measures
  - improvement in outcomes difficult to achieve

# Sepsis as a “diagnosis” increasing but specific diagnosis decreasing

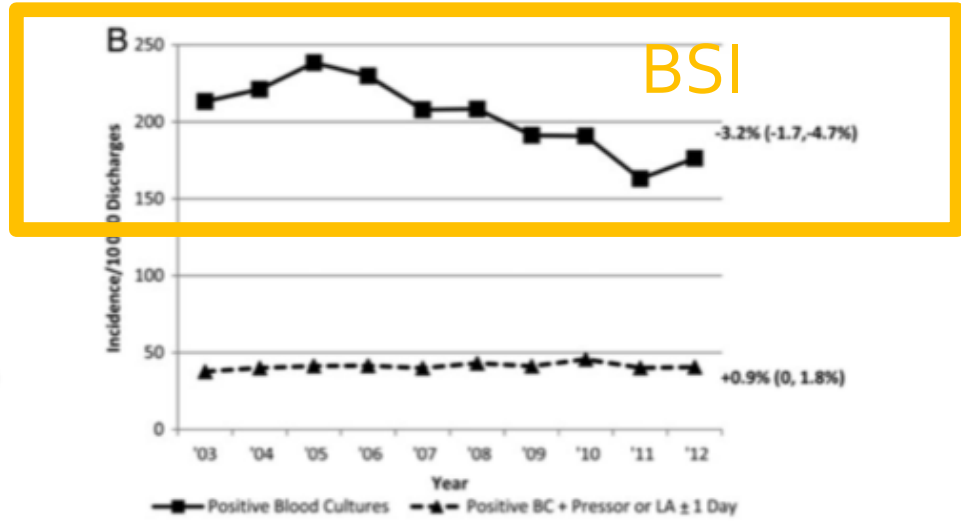
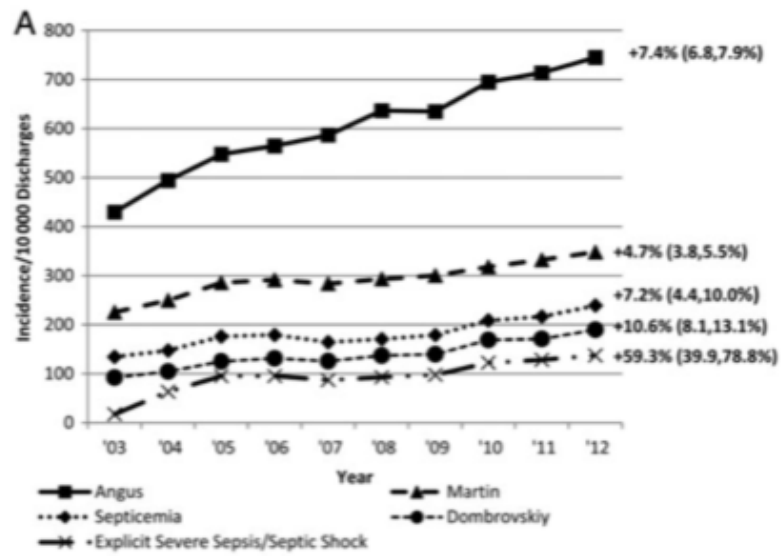
## Regulatory Mandates for Sepsis Care — Reasons for Caution

Chanu Rhee, M.D., Shruti Gohil, M.D., M.P.H., and Michael Klompas, M.D., M.P.H.



Hospitalizations for Which Certain Infection Codes Were Listed as a Primary Diagnosis, 2003–2011.

# Comparison of Trends in Sepsis Incidence and Coding Using Administrative Claims Versus Objective Clinical Data



incidence of hospitalisations for sepsis increased by 54-706%

incidence of hospitalisations with positive blood cultures decreased by 17%



# Diagnostic Errors that Lead to Inappropriate Antimicrobial Use

Filice 2015

- **CDS effectiveness depends on accuracy of original diagnosis**
- 500 patients, retrospective review
  - 55% diagnosis correct
  - 31% diagnosis incorrect
  - 6% diagnosis sign or symptom only
- Appropriateness of antimicrobial strongly correlated with diagnostic accuracy
- 33% antibiotic therapy not indicated
- **Diagnostic error rate x2 higher than general inpatient diagnostic error rates**



# Antimicrobial prescribing practice in Australian hospitals

Results of the 2018 Hospital National Antimicrobial Prescribing Survey



## Directed Therapy 13.6%

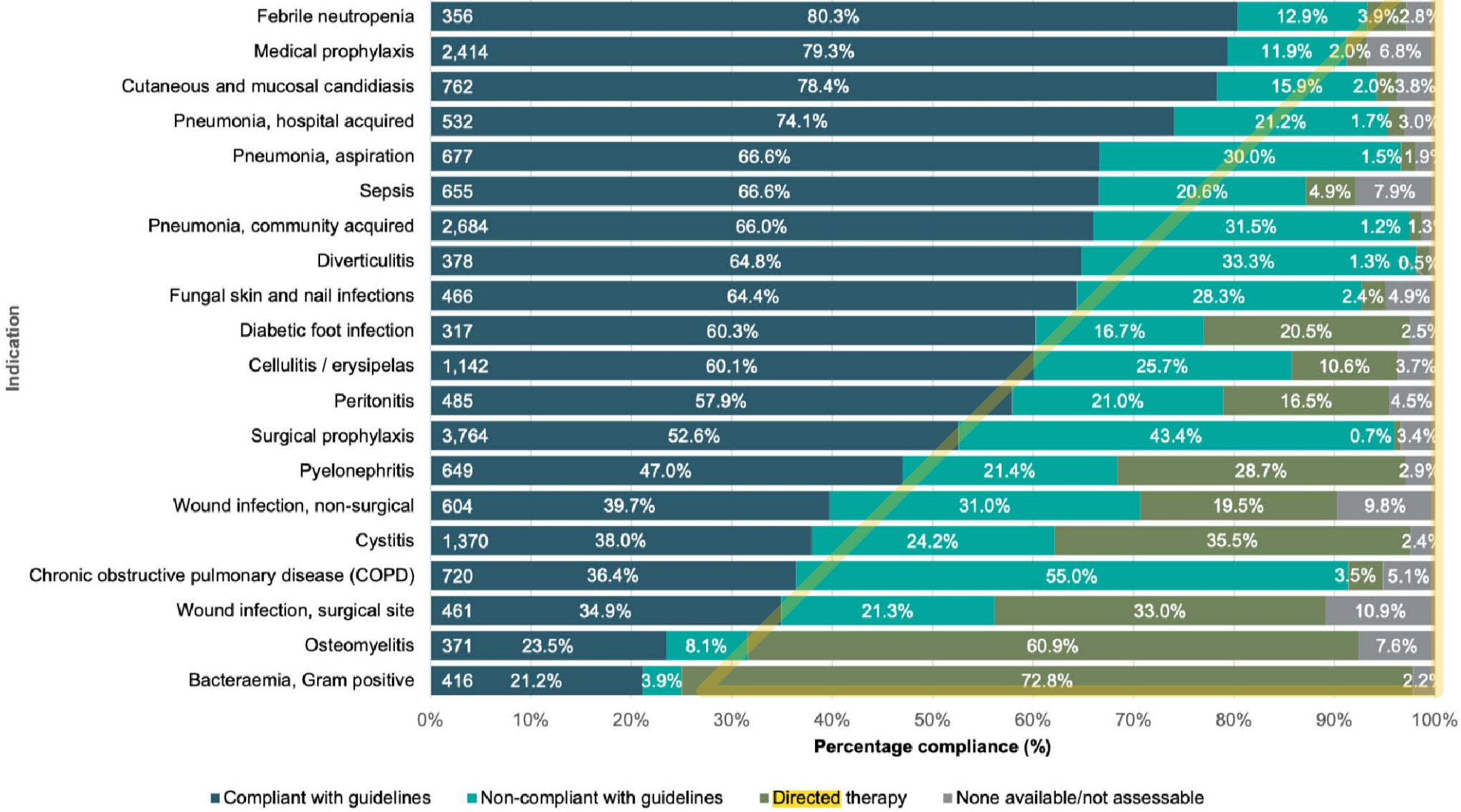
Proportion of antimicrobials prescribed based on microbiology results 13.6%  
 >> 86% of patients empirical therapy

**Table 5: Hospital NAPS compliance with guidelines and prescription appropriateness, for all prescriptions 2013–2018**

		Percentage of total prescriptions (%)					
		2013	2014	2015	2016	2017	2018
<b>Compliance with guidelines</b>	Compliant with <i>Therapeutic Guidelines</i> <sup>1</sup>	44.5	44.3	45.3	42.4	44.8	44.2
	Compliant with local guidelines	14.1	12.6	10.4	9.7	9.3	9.4
	Non compliant	22.7	23.8	23.8	26.9	26.2	25.7
	Directed therapy	na	9.5	12.0	12.7	12.5	13.6
	No guideline available	12.0	5.3	3.7	4.0	3.3	3.7
	Not assessable	6.6	4.5	5.0	4.4	3.8	3.4
<b>Appropriateness</b>	Optimal	54.0	55.2	54.5	56.6	58.1	59.9
	Adequate	16.9	16.9	17.8	15.6	14.9	14.9
	Suboptimal	15.0	12.7	12.3	11.3	12.1	11.9
	Inadequate	7.7	10.5	10.0	11.2	10.2	9.5
	Not assessable	6.6	4.7	5.4	5.3	4.7	3.8

## Compliance with guidelines for the 20 indications most commonly requiring antimicrobials in Hospital NAPS contributors, 2018

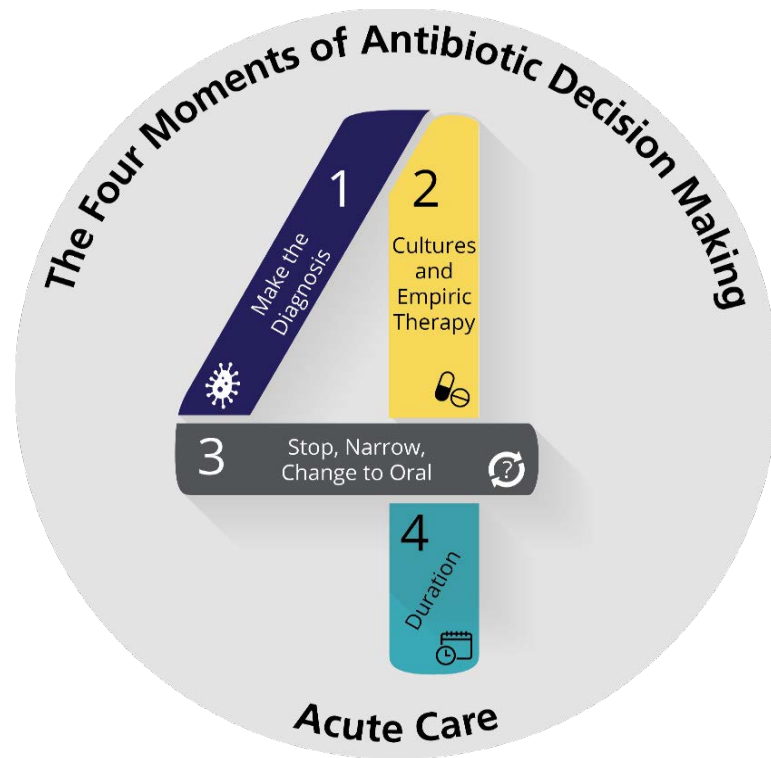
Australian Prescribing Survey (NAPS) 2018



# The importance of diagnosis in AMS

- Antibiotic guideline compliance and computer decision support is a central pillar to AMS
- Effectiveness is lost and even harmful if the diagnosis is incorrect
- Poor use of microbiology diagnostic tests can contribute to diagnostic error

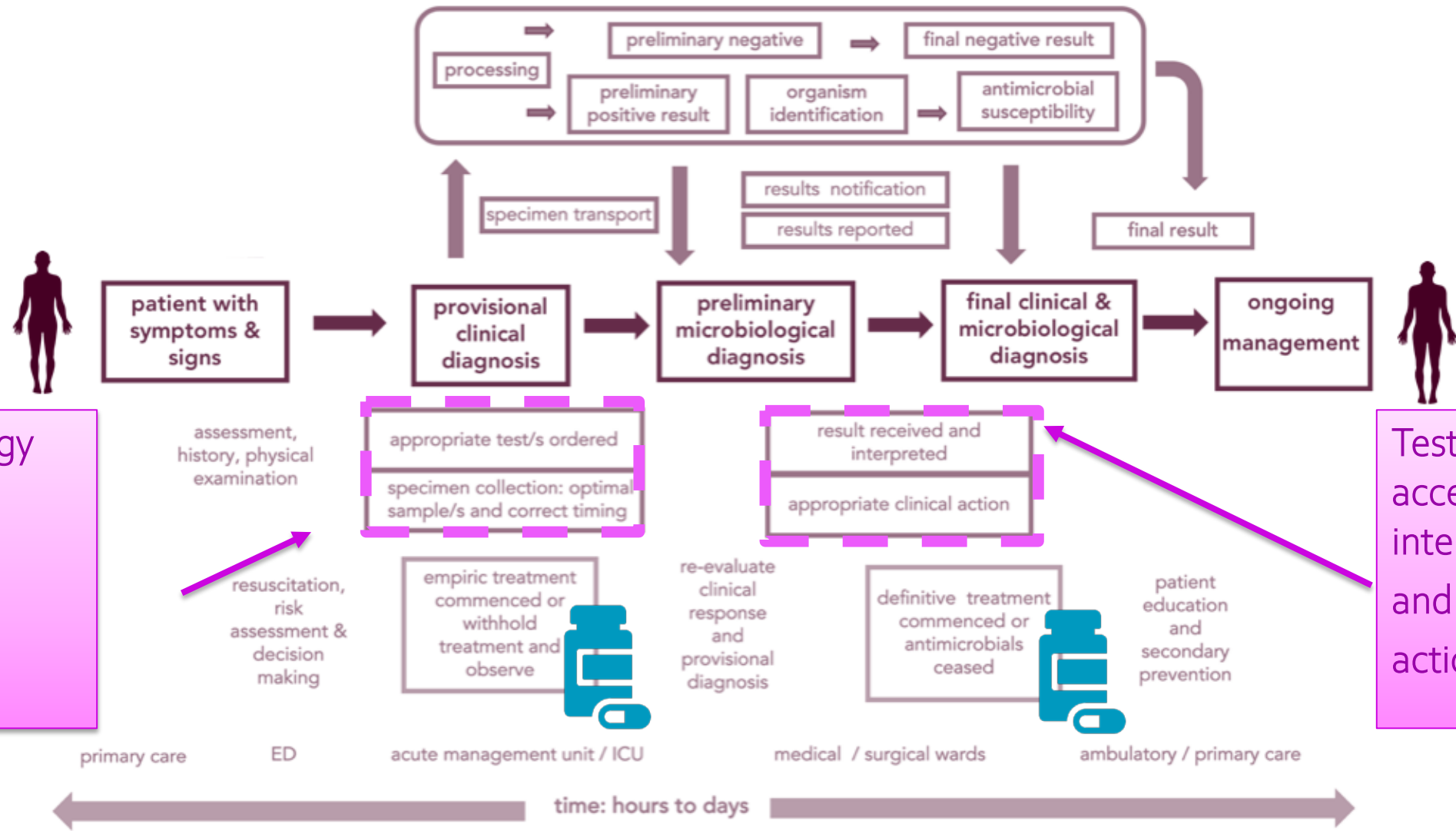
# The Four Moments of Antibiotic Decision Making



1. Does my patient have an infection that requires antibiotics?
2. Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?
3. A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy?
4. What duration of antibiotic therapy is needed for my patient's diagnosis?



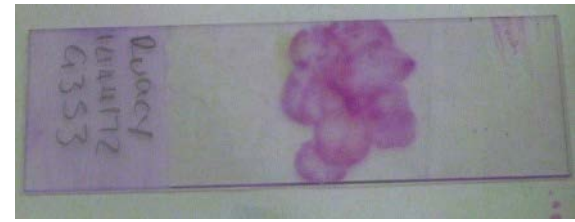
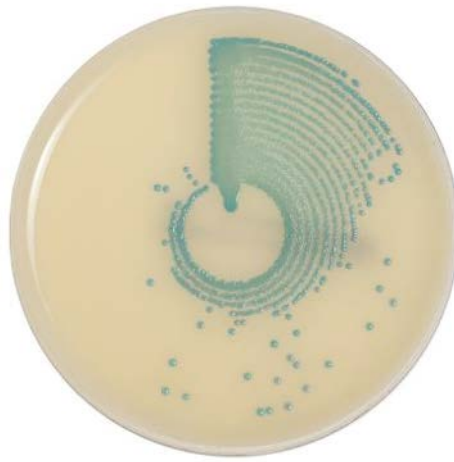
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# Microbiology Test Use:

## Diagnostic

Purpose: to direct patient management

- Rule in or rule out provisional diagnosis
- Guide patient treatment not only antibiotic selection

Diagnosis has multiple elements

- Condition
- Organism
- Susceptibility

Testing restricted to symptomatic patients only

Accurate interpretation of the test result is critical

Impact of suboptimal use of tests:

- Under-diagnosis
- Mis-diagnosis
- Over-diagnosis

## Infection Control

Purpose: to direct infection control interventions

Management of risk

- Healthcare facility
- Other patients

Focus on specific organisms / antibiotic resistances

Test results: organism detected or not detected

Testing involves:

- Symptomatic and asymptomatic patients ie screening
- Environment

Impact of suboptimal use of tests

- Under-detection

# WA Health SMART Sepsis: Summary 2018 FYI

age, blood and wound tests by age and sex

age (bin)

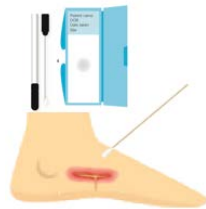
urine  
blood  
wound swab



170,000  
Patients



\$6.2 m  
Test  
Fees



30,000  
Wound Cultures



80,000  
Blood Cultures



115,000  
Urine Cultures

IMPROVEMENT  
TARGETS

Specific  
Measurable  
Achievable  
Relevant  
Time-based

# Midstream Urine Culture FY2017



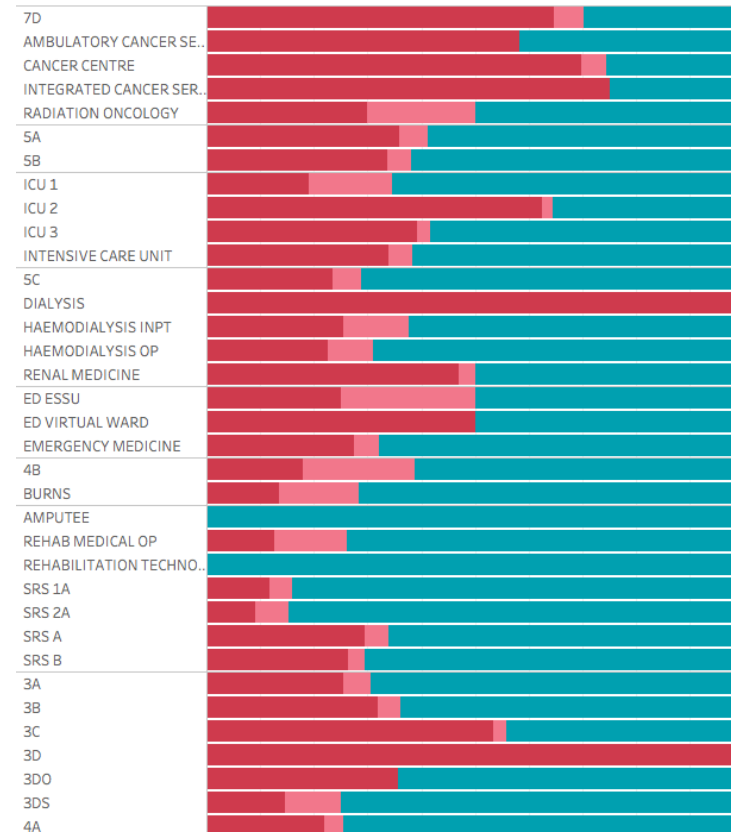
- Use the data tool to identifying top performing and lowest performing units
- Why the variation? Learn from others to drive improvement

# Wound Swab Cultures FY 2017



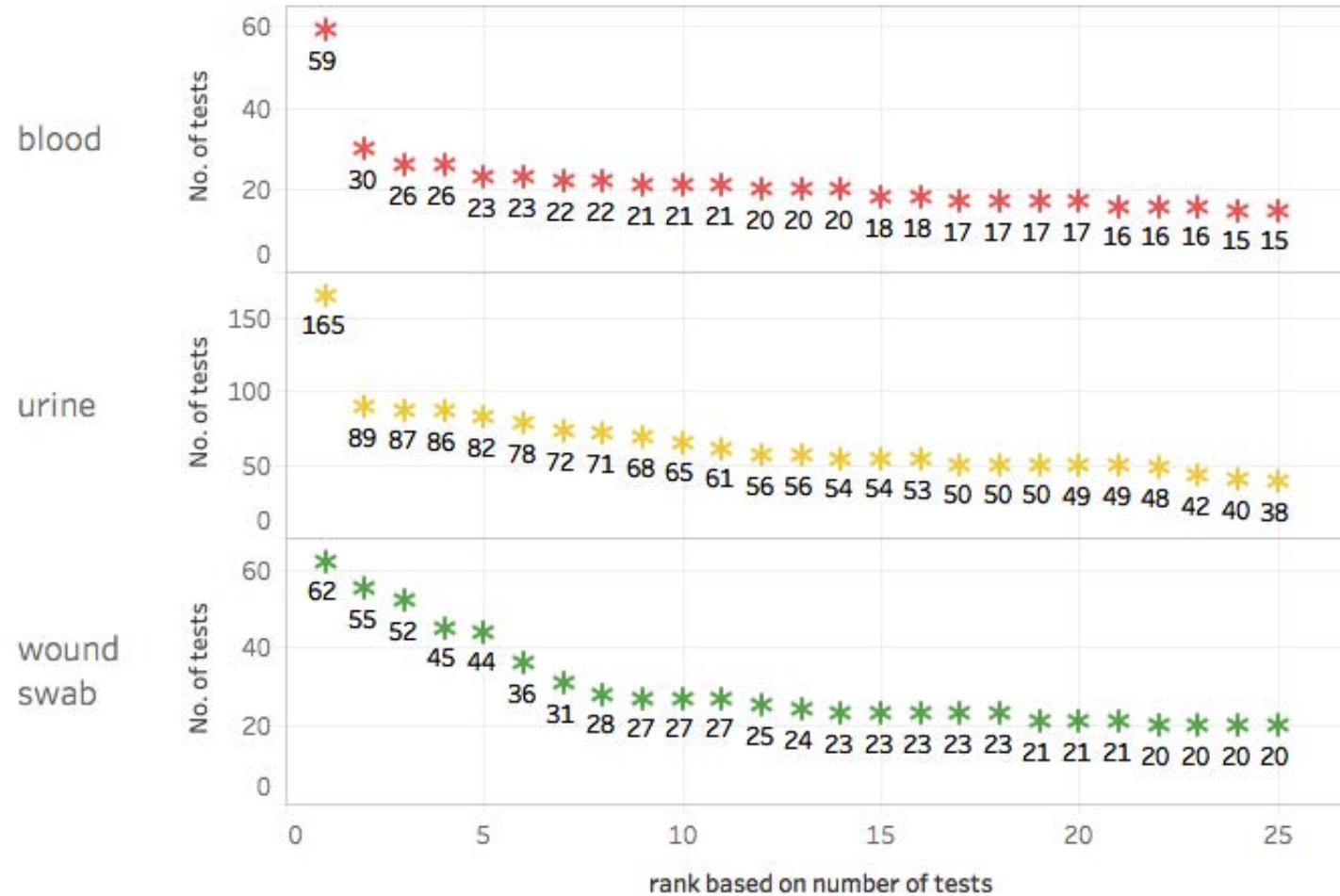
- 24% collections do not follow guidelines (2000tests on 725patients) \$71,000/yr.
- Implement standardised processes to eliminate incorrect practice >> \$70,000/year
- Other issues for wound swabs:
  - Inappropriate testing – ulcers, dirty sites, dry wounds
  - Specimen site labelling 10% do not have site specified – patient safety (1500 tests, 1400 patients)

Wide variation across the hospital



# Repeat testing

Top 25 patients based on number of tests per episode of care

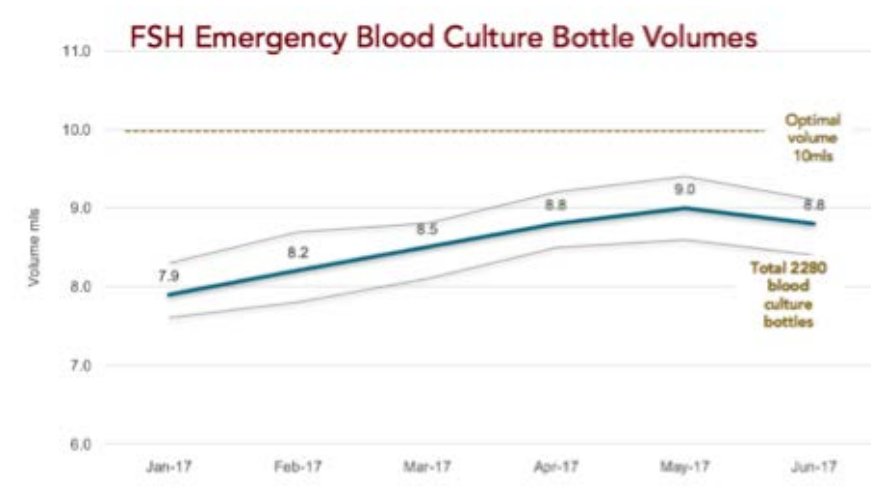


# Indicators of over-use of tests

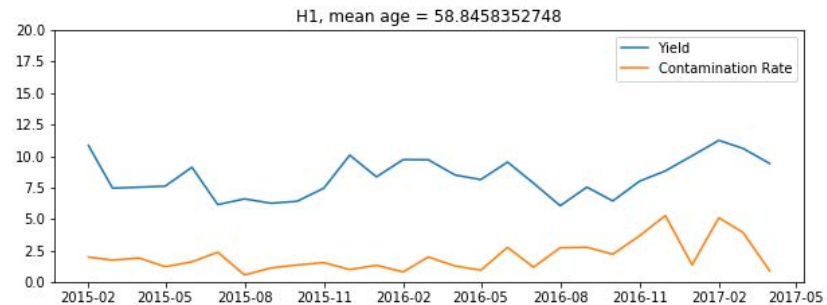
	Tests per visit > 3 (group)			
	1	2	3	> 3
blood	49% 5,194 \$143,770	29% 3,054 \$107,398	11% 1,183 \$58,958	11% 1,164 \$115,730
urine	72% 15,202 \$281,237	16% 3,286 \$79,661	6% 1,218 \$32,320	6% 1,275 \$74,037

- 22 % of episodes of care that had a blood culture had more than 2 (max: 26)
- 28% had more than 1 urine (max: 154 MSU in a single admission)
- Reduce by 30% - \$150,000/year

# Blood Cultures ED

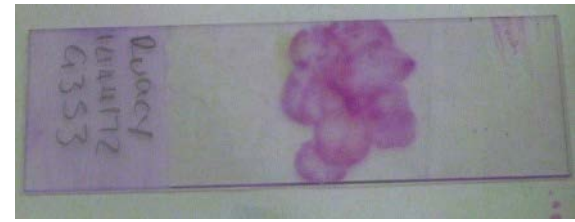
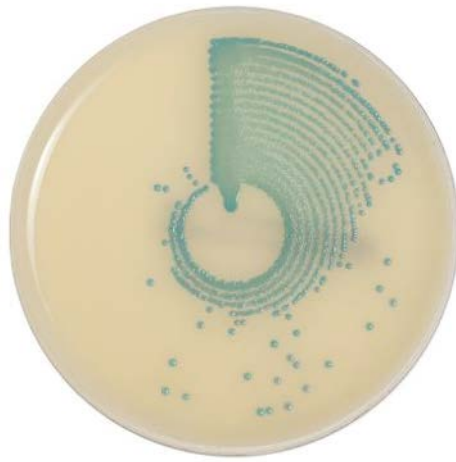


> 1 set collected per day	Department
	FSH
	RPH
	SCGH
	AHS
	RGH



- Rate of collection of more than 1 set: 40% ED (achievable best practice is > 90%) to increase detection of septicaemia by 28%
- Mean blood culture volume: 7.9-8.8 mls (best practice 10 mls) increase yield from blood culture testing by 15-20%
- Contamination rates: 2-5% (best practice 0.6-3%). Reduce to benchmark >> projected savings \$ 100,00 – 500,000 / year





# Microbiology User's Survey: Knowledge Indication for urine culture



Indicate how frequently you recommend a urine culture for each fo the following clinical scenarios

Routine practice on admission to hospital

Pre-operative screening

Patient with urinary catheter

Patient with a fever

Patient with confusion

# Microbiology User's Survey: Knowledge Indication for wound swab



Cellulitis without discharge

60%

Non-healing wound

Cellulitis with purulent ooze

Abscess fluid at time of drainage

# Microbiology User's Survey: Knowledge: Collection of Blood Cultures



If you are collecting a blood culture, please rate the importance of the different variables listed below:

Collection of blood cultures before antibiotics

Number of sets of blood cultures

Blood samples for multiple sets should be taken with separate stabs

Timing of collection in relation to fever spike\*

The ideal volume of blood for each blood culture bottle (i.e. aerobic and anaerobic ..

## Blood cultures:

1. **Before antibiotics** 50 % reduced yield
2. **At least 2 sets from separate collections** 28 % reduced yield
3. **10ml/bottle** 3-5 % reduced yield per ml <10ml
4. **Aseptic technique**

# Microbiology User's Survey:

## Previous formal education / training about microbiology culture test use

Medical

Nursing

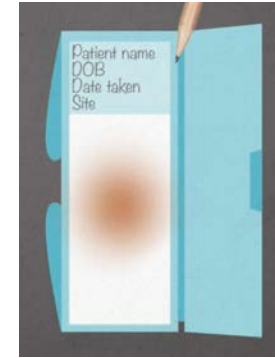


# SMART Sepsis Education Videos

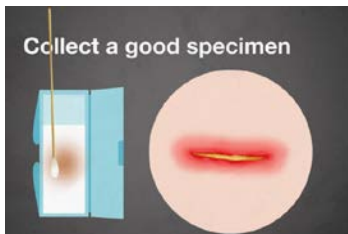
**If we are going to do the test,  
we need to do it right.**

Patient selection  
Aseptic technique  
2 sets, 2 sites  
Fill to 10 mL  
Before antibiotics

**If the wound  
doesn't look infected,  
don't swab it.**



**This is how we take  
wound swabs at  
Fiona Stanley Hospital**



## Choose your wound

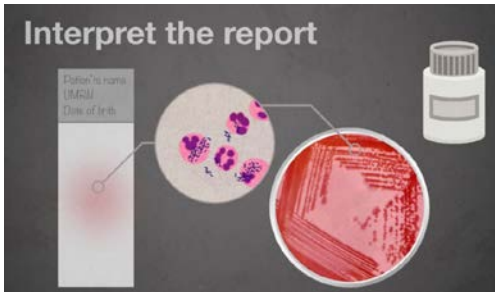
Sites that **SHOULDN'T** be routinely tested include:

- Pressure sores
- Chronic ulcers
- Wounds without discharge

1. Choose the right wound
2. Collect a good specimen
3. Provide lab with information
4. Be smart when reading the report



## Interpret the report



**Do it right!**




# SMART Sepsis Project

## Key targets

- Urine
  - Reduce unnecessary testing
  - Reduce contaminated samples
  - Stop catheter bag samples
- Blood cultures
  - Better target which patients to tests
  - 2 sets from different sits before antibiotics
  - 10mls blood per bottle
  - Aseptic technique
  - Reduce inappropriate repeat testing
- Wound swabs
  - Better target which sites to tests
  - Clean before collection
  - Collect adequate smear
  - Specifically identify the collection site


### SPECIMEN COLLECTION FOR MICROBIOLOGY DIAGNOSTIC TESTS

Appropriate indication and sample quality is critical.  
If we are going to do the test - do it right

Blood Culture	Urine - Midstream for Microscopy and Culture	Wound Swab for Microscopy and Culture
 <ol style="list-style-type: none"> <li>Appropriate indication: <b>Suspected septicemia</b></li> <li>Equipment: Minimum 2 sets of bottles (i.e. 4 bottles), gloves, tourniquet, skin antiseptic</li> <li><b>Site</b>: before antibiotics where ever possible. <b>No need to wait for temperature.</b></li> <li><b>Collect minimum of 2 sets</b> (i.e. 4 bottles) suspected; samples can be taken immediately after each other but must be collected from <b>2 separate venipuncture sites</b></li> <li><b>Aseptic technique</b> is critical</li> <li><b>Volume of blood:</b> 10ml/bottle in blue 20mls to 1 set</li> <li>Alcohol swab top of bottles and inoculate aseptic. Ebat first, then aseptic (purple) if sufficient blood</li> </ol>	 <ol style="list-style-type: none"> <li>Appropriate indication: Don't use as "screening test" or "test of cure". Test in septicemic patients without other direct reason.</li> <li><b>Collect before antibiotics</b> have started</li> <li>Quality of the sample is critical: <b>patients will need instructions on how to collect</b></li> <li>Avoid contamination by cleaning area below</li> <li><b>Sample required is a "midstream urine"</b>: pass the first 20 ml; stop and collect the next 20mls in container.</li> <li>If the patient is cognitively or physically impaired - may need assistance of carer or staff</li> <li>Patients with indwelling catheters: remove including catheter, and collect fresh sample when new catheter is inserted. The sample is labelled as an MSU sample.</li> <li>Send to laboratory without delay (within 1 hour). Refrigerate if necessary.</li> </ol>	 <ol style="list-style-type: none"> <li>Appropriate indication: <b>Only test if clinical suspicion of infection. Don't test sites that just need cleaning. Don't wash dry sites.</b></li> <li>Equipment: swab with gel container, dry swab on wooden stick, glass slide and container, w/ dressing pack and saline.</li> <li>If needed: <b>clean the surface of the site with normal saline</b> prior to collection to remove contaminating colonising organisms.</li> <li><b>Collect the purulent material with sterile swab and insert in the plastic carrier tube with gel.</b></li> <li>Use the wooden swab to collect again: use the material on the swab to <b>prepare a smear on the glass slide</b> (use the side which has the frosted end up). Rub the swab to create a thin smear <b>1 cm diameter, in the centre of the clear glass section</b> of the slide. Place in slide container.</li> <li><b>Ensure swab, slide container and request form identifies the specific anatomical site the sample was taken from and the form has relevant clinical history</b> ("wound", "burn" or "abrasion" is sufficient).</li> </ol>
<p><b>Note:</b> These are diagnostic tests and not infection control screening</p>		

Extracted by: Infection Prevention and Management Department and PathNet (copy) | Infection Prevention and Management Department | Date of Issue: 06 Aug 2017 | Revision Due: 06 Aug 2019 | Ver: 1.0

### Collecting Mid Stream Urine (MSU) sample to diagnose bladder or urinary tract infection (not for STDs)



1. Wash your hands.
2. Open the container. Do not touch the inside.
3. Wipe or wash before passing urine.
4. Pass urine into toilet for 3 seconds, then stop.
5. Collect the next 10-20ml, then pass the rest into toilet.
6. Replace the lid.
7. Wash your hands.
8. Take the sample back to your doctor or nurse.

If you are collecting the sample at home - return the labelled specimen to the hospital or specimen collection centre within 4 hours and keep in the refrigerator in the meantime.

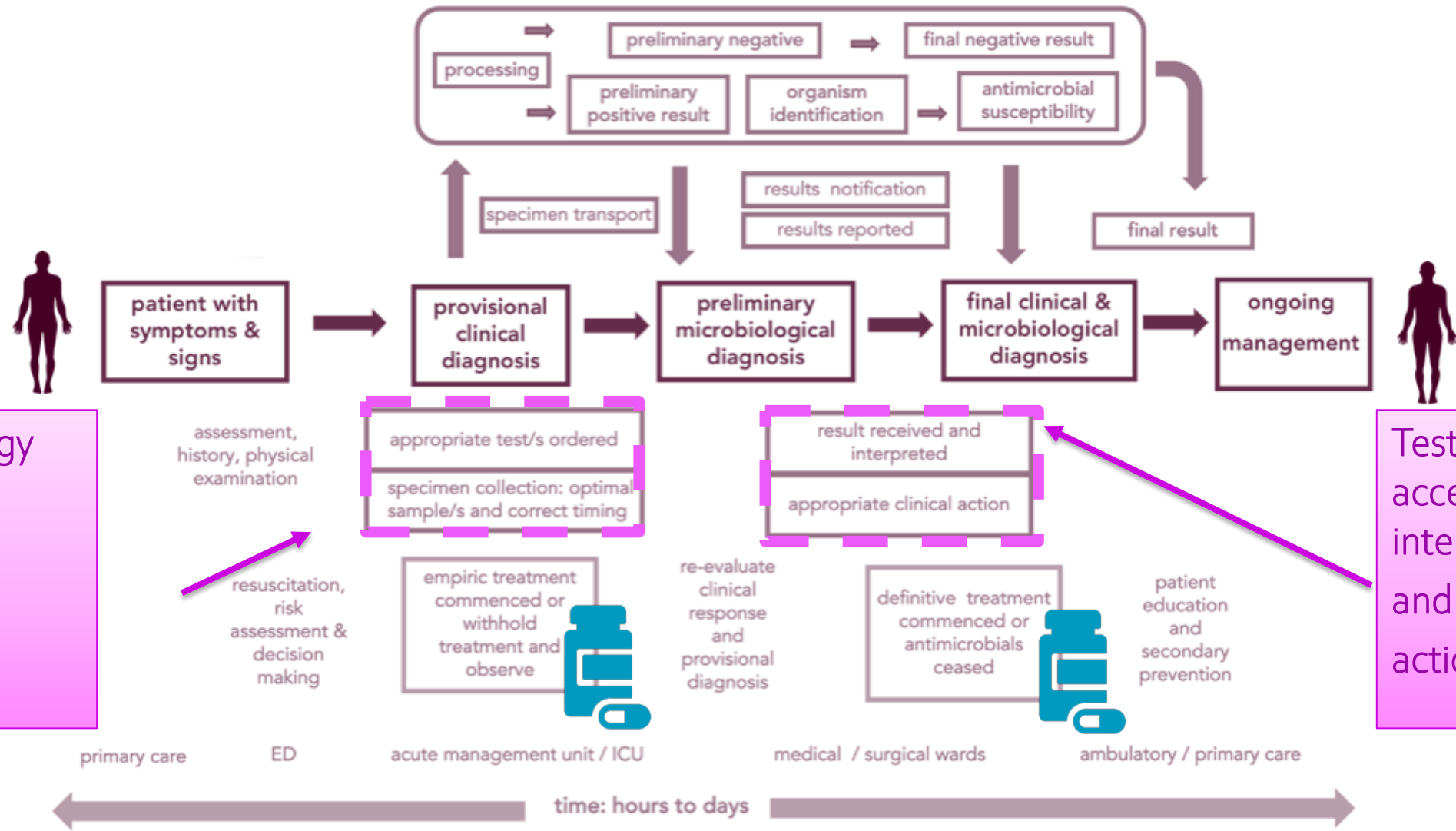
Endorsed by: Medical Advisory Group | Date Revised: 09 Aug 2017 | Compiled by: SMART Sepsis PCG | Revision Due: 09 Aug 2018 | Date of Issue: 09 Aug 2017 | Version: 1.0



# A Baker's Dozen of Top Antimicrobial Stewardship Intervention Publications in 2018

Musgrove et al. 2018 [17]	Multicenter, single pre- and postintervention, quasi-experimental study	Clinical microbiology laboratory changed wording in reports on non-pathogen-containing respiratory cultures to emphasize no <i>Staphylococcus aureus</i> , MRSA, or <i>Pseudomonas aeruginosa</i> .	<ul style="list-style-type: none"> <li>• Mortality: historical 7 (2.3) vs intervention 3 (1); <math>P = .233</math></li> </ul> Primary outcome <ul style="list-style-type: none"> <li>• De-escalation: 39% vs 73%; <math>P &lt; .001</math></li> </ul> Secondary outcomes <ul style="list-style-type: none"> <li>• Discontinuation of anti-MRSA therapy: 37% vs 71%; <math>P &lt; .001</math></li> <li>• Discontinuation of antipseudomonal therapy: 32% vs 70%; <math>P &lt; .001</math></li> <li>• Acute kidney injury: 31% vs 14%; <math>P = .003</math></li> <li>• In-hospital, all-cause mortality: 30% vs 18%; <math>P = .52</math></li> </ul>
Keller et al. 2018 [22]	Single-center, prospective time series analysis	To reduce the ordering of urinalyses and urine cultures in patients without symptoms of a UTI, a series of interventions including the distribution of educational materials and implementation of CDS alerts in the EMR was implemented. CDS alerts were placed on all orders for urinalyses, urine cultures, and for antibiotics commonly used for treating UTIs (nitrofurantoin, trimethoprim-sulfamethoxazole, ciprofloxacin, cefazolin, cephalexin, and ceftriaxone).	Primary outcome: Urinalysis orders did not significantly decrease <ul style="list-style-type: none"> <li>• <math>-10.2\%</math>; <math>P = .24</math></li> </ul> Secondary outcome: Orders for urine cultures did significantly decrease <ul style="list-style-type: none"> <li>• <math>-6.3\%</math>; <math>P &lt; .001</math></li> </ul> Other results <ul style="list-style-type: none"> <li>• Decrease in simultaneously ordering urinalyses and urine cultures (<math>-5.8\%</math>; <math>P &lt; .001</math>)</li> <li>• Decrease in urinalysis orders followed by antibiotic orders within 1–24 hours (<math>-0.56\%</math>; <math>P = .021</math>)</li> <li>• Decrease in urine culture results followed by an antibiotic order within 24 hours (<math>-0.24\%</math>; <math>P = .036</math>)</li> </ul>

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