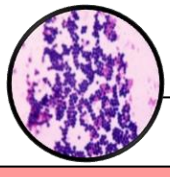
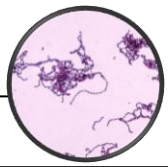
DIAMS
(DAILY INTEGRATION OF ANTIMICROBIAL STEWARDSHIP)

MICROBIOLOGY QUICK GUIDE



Gram Positive Cocci (GPC)



GPC in clusters

Staphylococci

- Coagulase (+) ***(Staph aureus)***
  - **MSSA** *(Methicillin-sensitive Staphylococcus aureus*
  - **MRSA** *(Methicillin-resistant Staphylococcus aureus*
- Coagulase (-) **(CONS)**
  - *S. lugdunensis**
  - *S. haemolyticus*
  - *S. epidermidis*
  - *S. capitis*
  - *Others*

**Staph lugdunensis* can be a significant culture as it behaves like *Staph aureus*

GPC in chain

Streptococci/ Enterococci

- α-hemolytic
  - **Viridans Strep.**
  - ***Strep. pneumoniae***
- β-hemolytic
  - **Group A: *S. pyogenes***
  - **Group B: *S. agalactiae***
  - Groups C, F, G
- γ-hemolytic
  - **Group D: Enterococci**
    - ***Enterococcus faecalis***
    - ***Enterococcus faecium***

Gram Negative Rods (GNR)

Enterobacterales

Escherichia coli
Klebsiella sp.
Enterobacter sp.
Serratia sp.
Proteus sp.

Non-lactose Fermenters

Pseudomonas aeruginosa
Acinetobacter baumannii
Burkholderia cepacia
Stenotrophomonas maltophilia

Others

Haemophilus influenzae
Moraxella catarrhalis
Neisseria meningitidis

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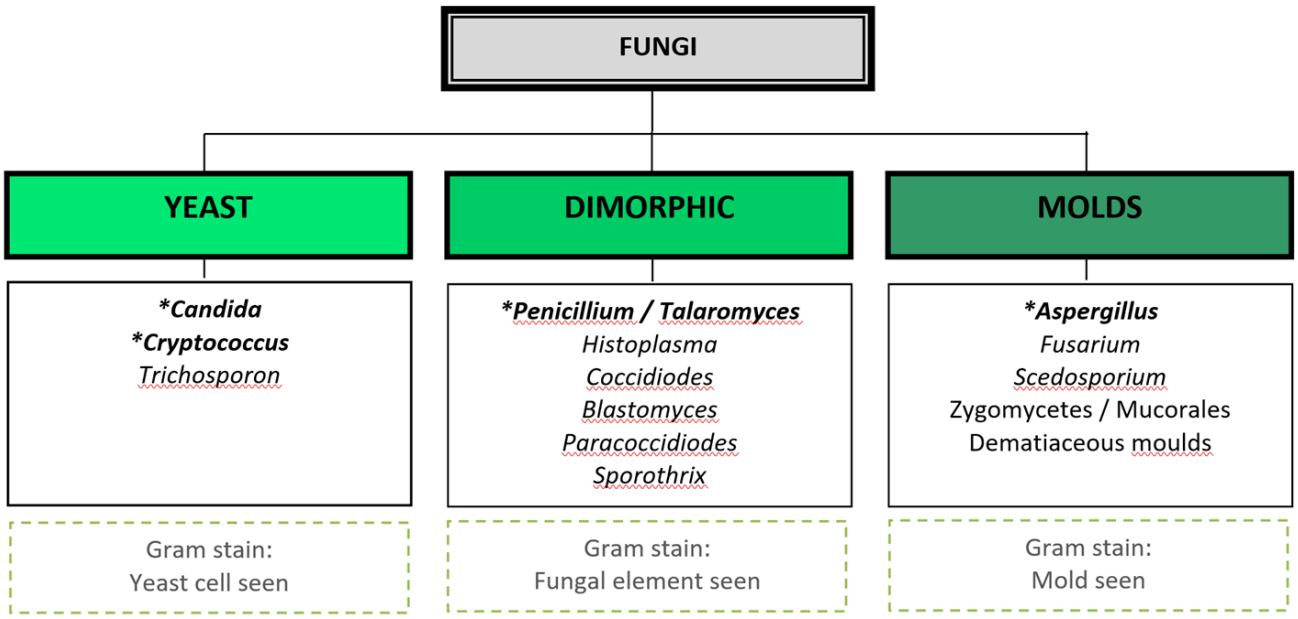

** More commonly seen in HSgB*

ANTIFUNGAL SPECTRUM

Daily Integration of AMS (DIAMS)
Hospital Sungai Buloh
Antifungal Activity Spectra

Revised: October 2021

Prepared by:
AMS (Izyana & Hannah), PRIC (Abby), Clinical (Arthur) & Microbiologist (Dr Hanani)

Disclaimer:
All information in this guide is merely for educational and informational purposes. It is not intended as a substitute for professional advice. Kindly seek consultation from the patient's physician for further management. We reserve the right to update this guide at any given time.

		YEAST								MOLD							DIMORPHIC		
		Candida species							Others	Aspergillus species				Others			Miscellaneous		
		Candida albicans	*Candida parapsilosis*	*Candida tropicalis*	*Candida lusitaniae*	*Candida glabrata*	*Candida auris*	*Candida krusei*	*Cryptococcus neoformans* (Cryptococcosis / Cryptococcal meningitis)	*Aspergillus fumigatus* (Most common)	*Aspergillus flavus*	*Aspergillus niger*	*Aspergillus tereus*	*Mucorales* (Mucormycosis)	*Fusarium spp*	*Scedosporium spp*	*Talaromyces marneffei* (Penicillosis)	*Histoplasma capsulatum* (Histoplasmosis)	*Sporothrix schenckii* (Sporotrichosis)
Polyenes	Amphotericin B (AMB)	++	++	++	±	++	±	++	++	++	+	++	x	++	±	x	++	++	++
Azoles	Fluconazole (FLU)	++	++	++	++	C	x	x	++	x	x	x	x	x	x	x	+	±	±
	Itraconazole (ITR)	+	+	+	+	±	±	±	+	±	±	±	±	x	±	x	++	++	++
	Voriconazole (VOR)	+	+	+	+	±	±	+	+	++	++	++	++	x	++	+	++	+	+
	Posaconazole (POS)	+	+	+	+	±	±	+	+	+	+	+	+	++	++	±	x	+	+
	Isavuconazole (ISA) [N/A]	+	+	+	+	±	±	+	+	++	++	++	++	++	++	±	x	+	+
Enchinocandins	Micafungin (MICA)	++	+	++	++	++	++	++	x	±	±	±	±	x	x	x	x	x	x
	Andulafugin (ANI)	++	+	++	++	++	++	++	x	±	±	±	±	x	x	x	x	x	x
	Caspofungin (CAS) [N/A]	++	+	++	++	++	++	++	x	±	±	±	±	x	x	x	x	x	x
Fluoropyrimidines	Flucytosine (SFC)	+	+	+	+	+	+	+	++	x	x	x	x	x	x	x	x	x	x

Guide:

++	Active (Recommended)	:	Drug is recommended due to reliable in-vitro activity, clinically effective & recommended in guidelines.
+	Active (Alternative)	:	Drug may be used as alternative therapy. It has in-vitro activity & likely to be clinically effective but not used as 1st line due to overly broad spectrum/ toxicity profile / limited clinical evidence or experience).
±	Variable coverage	:	Variable sensitivity.
C	Conditional Use	:	Can only be used in specific condition (i.e; only as part of combination therapy /sensitivity-dose-dependent (SDD) (May be sensitive in higher doses).
x	Not Recommended	:	Agent is not recommended (likely to be resistant due poor penetration/unfavourable toxicity profile/insufficient data/inherent resistance).
[N/A]	Not Available	:	Registered in Malaysia but not available in HSgB

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CONTAMINANT VS COLONISER VS PATHOGEN

CONTAMINANT

- Introduced into sample due to poor sampling technique.
- Do not require treatment, unless repeated C&S isolate the same microorganism(s) despite proper technique & patient demonstrates clinical infection.

Common contaminants:
- Coagulase-negative species (CONS)
- *Bacillus* spp.
- *Corynebacterium* spp.
- *Propionibacterium acnes*
- *Micrococcus* spp.

COLONISER

- Grow in or on non-sterile body sites/prosthetic devices without causing infection.
- Does not normally harm the patient nor require antibiotic treatment.
- Colonisation may become infectious when there is:
  - Weakened immune systems (opportunistic pathogen)
  - Access to a normally sterile site through invasive procedures

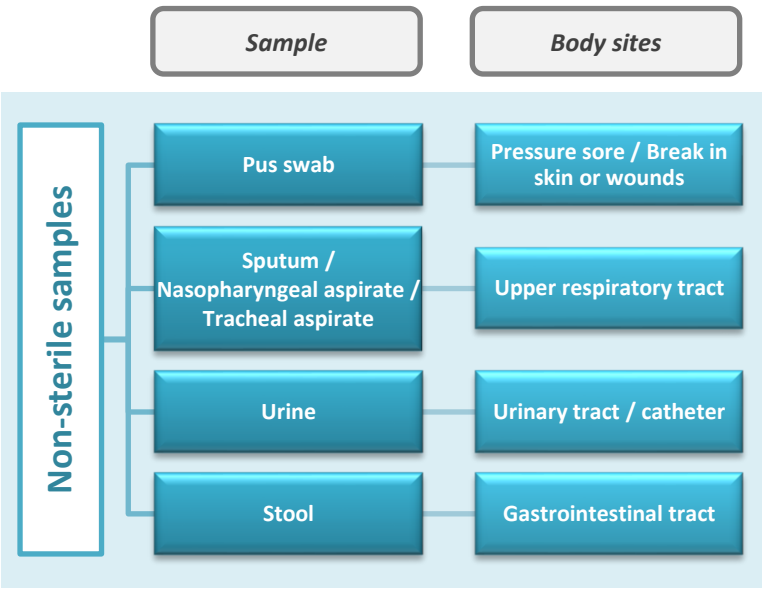
Common colonisers:
- Skin flora (eg: *Staphylococci*)
- Enteric flora (eg: *E. coli*, *Enterococci*, anaerobes)
- Oral/urogenital flora (eg: *Candida albicans*)

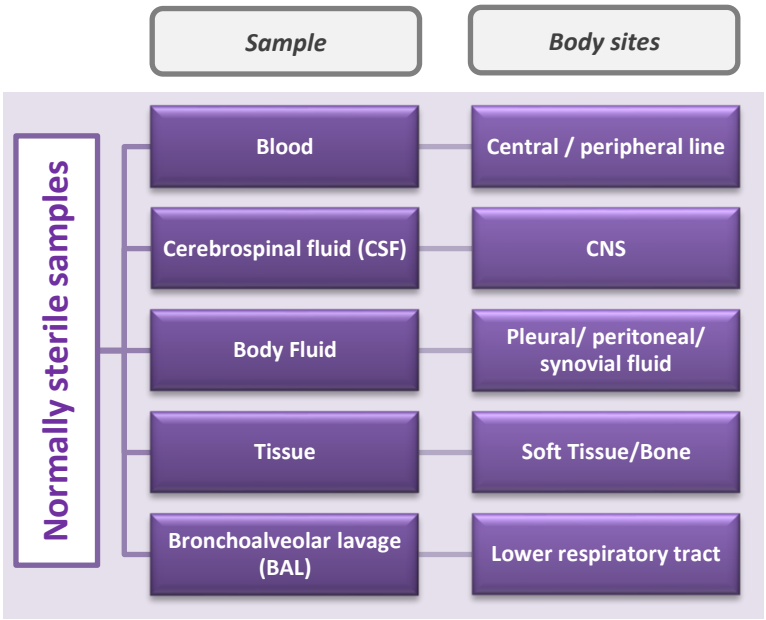
PATHOGEN

- Infectious agents that cause disease or illness to its host.
- Microorganisms isolated from a normally sterile site that may cause infection.
- Signs & symptoms of true infection:
  - Generalised: Fever, malaise
  - Localised: Swelling due to inflammation, heat, pain, erythema

Common pathogens:
- *Staphylococcus aureus*
- *Streptococcus pneumoniae/pyogenes/agalactiae*
- *Enterobacteriaceae*
- *Pseudomonas aeruginosa*
- Fungus (yeast i.e. *Candida albicans*)

NON-STERILE & STERILE CULTURE SAMPLES FROM BODY SITES/ DEVICES





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COMMON RESISTANCE IN HOSPITAL ACQUIRED INFECTIONS

<table>
<tr><th>Microorganism</th><th>Description</th></tr>
<tr><td>Methicillin-resistant S. aureus (MRSA)</td><td>Resistance conferred by MecA gene, leading to resistance to Methicillin, Oxacillin & Cephalosporins.</td></tr>
<tr><td>Vancomycin-intermediate S. aureus (VISA)
Vancomycin-resistant S. aureus (VRSA)</td><td>Rare resistance, seen mostly in patients with long-term Vancomycin therapy (MIC creep).</td></tr>
<tr><td>Vancomycin-resistant Enterococcus (VRE)</td><td>Resistance conferred by plasmid-mediated VanA and VanB gene complexes.</td></tr>
<tr><td>AmpC β-Lactamase-Producing Enterobacterales**

**Enterobacterales previously known as Enterobacteriaceae</td><td>• Mutations which confers resistance to penicillins & 3rd generation cephalosporins. Exists in 3 forms:
○ On chromosome + inducible
○ On chromosome + de-repressed
○ On plasmid + constitutive
• May be inducible by certain antibiotics. Refer table below [click here].</td></tr>
<tr><td>Extended Spectrum Beta-Lactamase-producing Enterobacterales** (ESBL-E)

**Enterobacterales previously known as Enterobacteriaceae</td><td>• TEM-/SHV-/CTX-M enzyme-producing organisms under Ambler Class A.
• Carbapenem is the first line treatment for ESBL-E infection outside urinary tract based on data from a large clinical trial (MERINO trial) which showed 30-d mortality difference of 12% vs 4% when meropenem was used as compared to piperacillin/tazobactam.</td></tr>
<tr><td>Carbapenem-resistant Enterobacterales** (CRE)

**Enterobacterales previously known as Enterobacteriaceae</td><td>Heterogenous group of pathogens with multiple potential mechanism of resistance. It can be broadly divided into 2 groups:
a) Carbapenemase-producing (CP-CRE)
b) Non-carbapenemase producing (Non CP-CRE)

<table>
<tr><th colspan="2">CRE Mechanism of Resistance</th></tr>
<tr><th>CP-CRE</th><th>Non CP-CRE</th></tr>
<tr><td>1. Serine (Ambler Class A)
Eg: KPC
2. Metallo-β-lactamases (Ambler Class B)
Eg: NDM, VIM, IMP
3. Serine (Ambler Class D)
Eg: OXA-48</td><td>1. Efflux pump
2. Porin Mutations
3. Other β-lactam hydrolyzing enzymes Eg: ESBLs, AmpC</td></tr>
</table>
</td></tr>
</table>

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Carbapenem-resistant Acinetobacter baumannii (CRAB) *#Pan-sensitive A. baumannii are sensitive to sulbactams, meropenem, pip/tazo, cefepime, AMG & FQs.*	Once Acinetobacter baumannii exhibits carbapenem resistance, it generally acquired resistance against most other antibiotics expected to be active against pan-sensitive# (wild-type) A. baumannii. • Presence of carbapenemases such as OXA-24/40-like, OXA-23-like, metallo-β-lactamases and additional serine carbapenemases causes carbapenem resistance. • Mutation to the PBP & β-lactamases production confers additional resistance towards sulbactam. • Presence of Aminoglycoside modifying enzyme (AME) causes additional resistance towards aminoglycosides. • Upregulation of efflux pumps mediates resistance to FQs.
Difficult-to-treat resistant (DTR) Pseudomonas aeruginosa	• Exhibit resistance against antibiotic that commonly used to treat Pseudomonas (pip/tazo, ceftazidime, cefepime, aztreonam, meropenem, imipenem, ciprofloxacin & levofloxacin). • Multiple complex resistance mechanisms can exist simultaneously including reduced porin expression (OprD), efflux pump upregulation (MexAB-OprM), PBP mutations, AmpC & carbapenemase productions.

Significant AmpC β-Lactamase-Producing Enterobacterales (CEK)

C	*Citrobacter freundii*
E	*Enterobacter cloacae complex*
K	*Klebsiella aerogenes (previously known as Enterobacter aerogenes)*

- **CEK:** Treat with Cefepime or Meropenem for initial treatment even when C&S shows susceptibility to Ceftazidime/Tazocin.
- Antibiotic(s) capacity for inducing AmpC production and their efficacy against AmpC-producing organism as listed below:

	Weak AmpC Inducer Antibiotics	Strong AmpC Inducer Antibiotics
Effective against AmpC producing pathogens	**Cefepime** *(subjected to inoculum effect)*	**Carbapenems**
Not effective against AmpC producing pathogens	Piperacillin±Tazobactam 2nd & 3rd gen Cephalosporins Aztreonam	Ampicillin±Sulbactam Amoxycillin±Clavulanate 1st gen Cephalosporins

* **Inoculum effect:** Efficacy of antibiotic reduced due to significant increase in Abx MIC because of high bacterial load.

Lower risk for significant AmpC β-Lactamase-Producing Enterobacterales (SPM)

S	*Serrata marcescens*
P	*Providencia spp.*
M	*Morganella morganii*

- **SPM:** Treat as per susceptibility testing. In severe infection & high bacterial burden* conditions, there is a risk of treatment failure.
- ➔ refer to ID if indicated. *(*High bacterial burden eg: undrained abscesses, infective endocarditis, ventriculitis, etc)*

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ESKAPE

- ESKAPE pathogens are leading causes of nosocomial infections with rapidly growing multidrug resistance (MDR) and virulence

E	*Enterococcus faecium*
S	*Staphylococcus aureus*
K	*Klebsiella pneumoniae*
A	*Acinetobacter baumannii*
P	*Pseudomonas aeruginosa*
E	*Enterobacter spp.*

HACEK

- Fastidious GNR organisms commonly colonize the human oropharynx as normal flora with propensity to cause infective endocarditis (IE)
- May appear as "culture negative endocarditis" as HACEK grows slowly in blood culture media

H	*Haemophilus parainfluenzae/ aphrophilus*
A	*Actinomycete comitans (Aggregatibacter spp.)*
C	*Cardiobacterium hominis*
E	*Eikenella corrodens*
K	*Kingella kingae*
**Culture negative endocarditis organisms:*	*Brucella spp.*
	Coxiella burnetii (agent of Q fever)
	Bartonella spp.

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