ANTIMICROBIAL STEWARDSHIP WORKSHOP

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of
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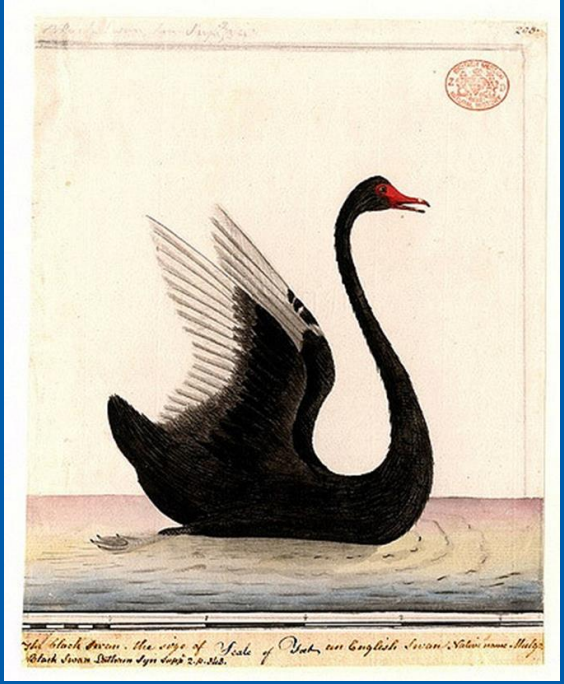
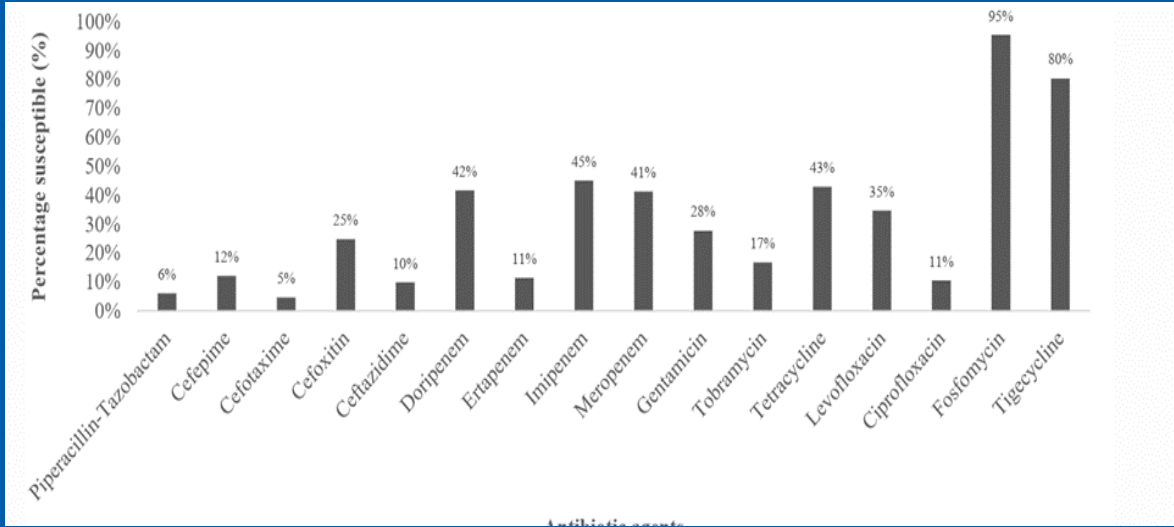
30/05/2023

Make today matter

Can we foretell the future?

Mechanisms of resistance as confounder in antibiotic stewardship – Black Swans?



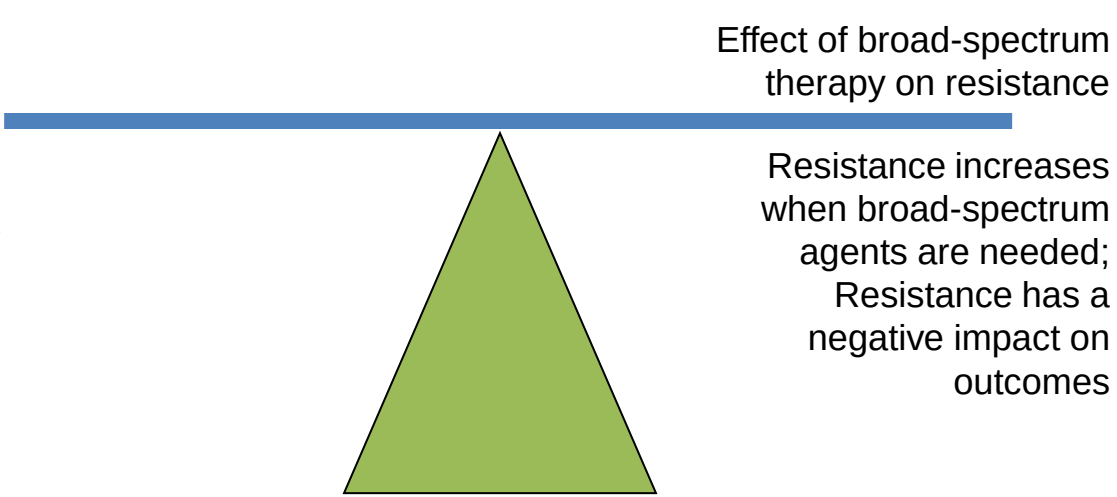


CRE prevalence in the public sector –colistin drug resistance was reported in 18.6% (201/1079) of the isolates

The Critical Balance

Importance of appropriate empiric therapy

Mortality increases when initial therapy is inappropriate



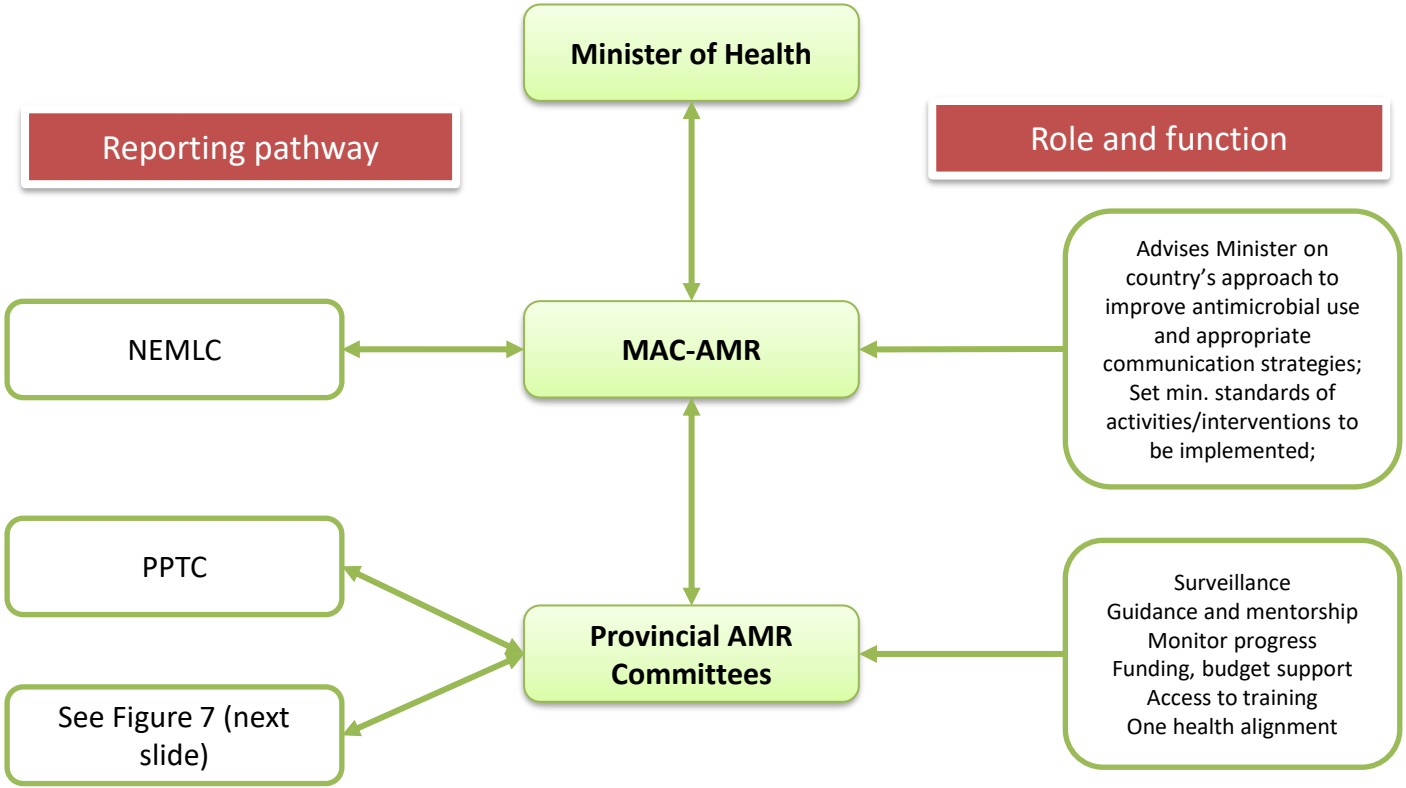
Effect of broad-spectrum therapy on resistance

Resistance increases when broad-spectrum agents are needed; Resistance has a negative impact on outcomes

Collateral damage

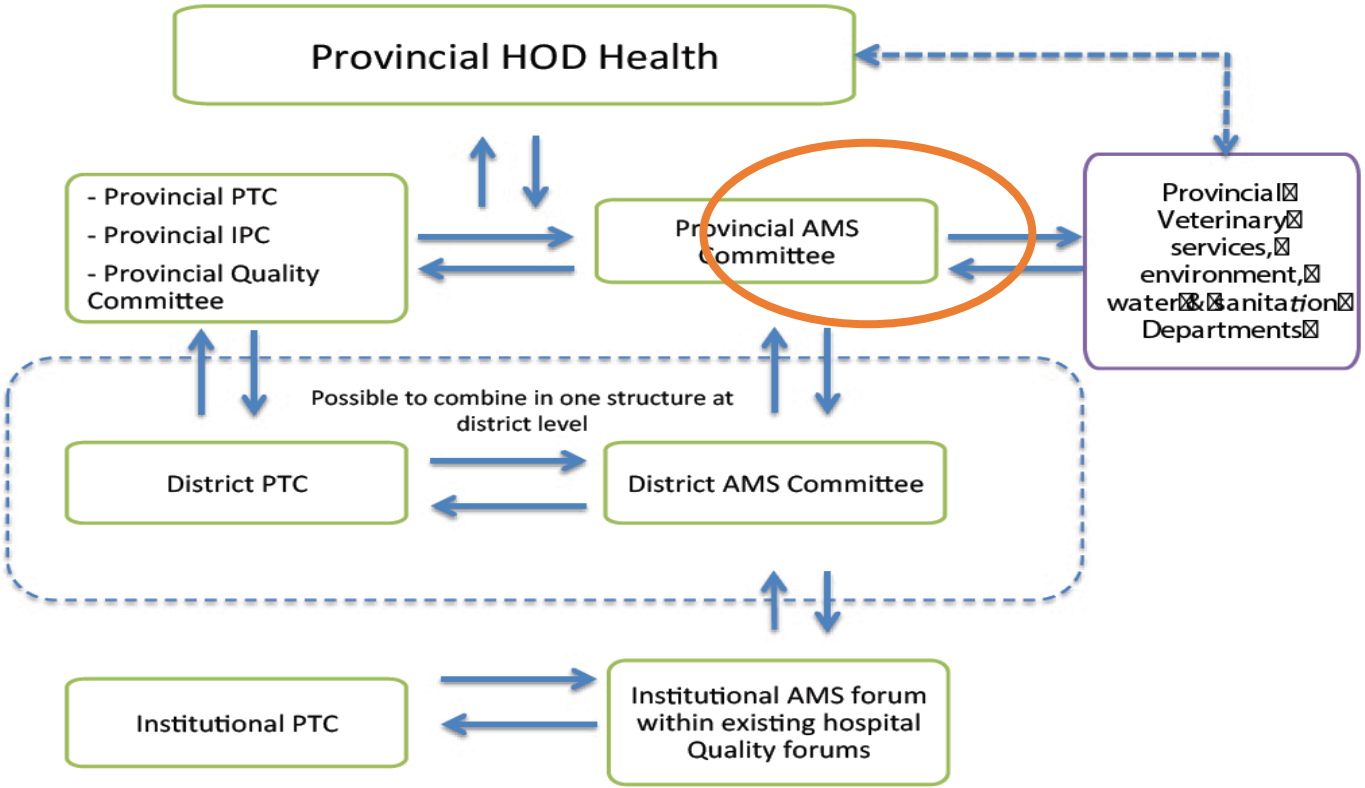
AMR Policy Building Blocks

Governance and Communication Pathways



Governance and Communication Pathways

Figure 7 – Communication and reporting lines for PAMSC



Antimicrobial Resistance National Strategy Framework; One Health Approach, 2018-2024 five strategic objectives:

1	2	3	4	5
Strengthen, coordinate and institutionalise interdisciplinary and intersectoral efforts through national and provincial One Health governance structures which encompasses human, animal, and environmental health experts	Diagnostic Stewardship to improve the appropriate use of diagnostic investigations to identify pathogens and guide patient and animal treatment and antimicrobial management whilst strengthening quality laboratory systems for the detection of	Optimise surveillance and early detection of AMR and antimicrobial use to enable reporting of local, regional, and national resistance patterns to optimise empiric and targeted antibiotic choice	Enhance IPC and biosecurity to prevent the spread of resistant microbes to patients in healthcare settings and between animals, farms and countries. Reduced use of antimicrobials by disease prevention and community measures include wide-reaching vaccination programmes, improvements in water and sanitation, and improved biosafety	Promote appropriate use of antimicrobials in human and animal health through AMS practices and controlled access to antimicrobials to ensure availability.

The AMR National Strategy Framework provides a structure for managing AMR among humans and animals to limit further increases in resistant microbial infections, and improve the health of the population

Strategic objectives (cont.)

Under Sub-objective 5.2: Institutionalise antimicrobial stewardship in human health, Antimicrobial Stewardship (AMS) is highlighted as a key method to help correct inappropriate use through protocols, structures and interventions. AMS Includes:

- AMS is a key function of PTCs - can either be a subcommittee of the PTC or other relevant standing Committee, at the discretion of the Provincial Head of Health.
- PTC should develop and maintain a mechanism for regular interaction with and feedback from the AMS committee.
- AMS should be a standing item on the agenda of PTC meetings and should form an essential part of the RMU cycle

AMS Committee or structure to function in every Health Establishment and district aligned within the overarching clinical leadership functions

AMS Teams in every institution to actively oversee appropriate prescribing and optimise antimicrobial use. Outreach and support by experts may be sought to advise and train teams

Provision, use and monitoring of protocols such as formulary restrictions, pre-authorisation of antimicrobials, monitoring the use of national prescribing guidelines such as the STGs and EML, and development of local treatment guidelines based on health establishment resistance data

Expenditure on antimicrobials

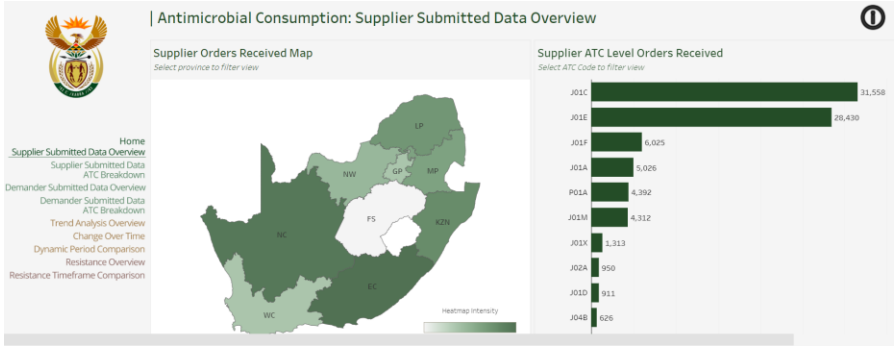
Coming Soon – NSC Antimicrobial Stewardship Dashboard

Purpose

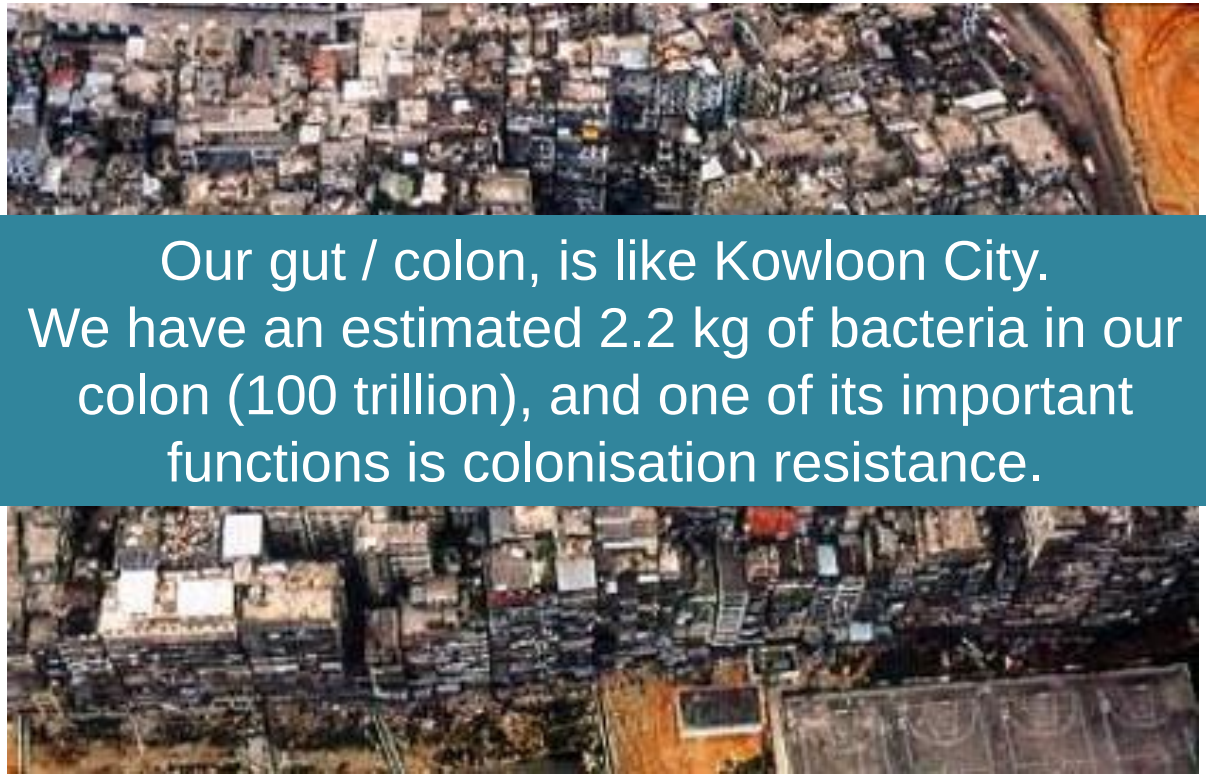
- To provide an overview of antimicrobial use across South Africa's public health sector over time, enabling an indication of possible irrational use of antimicrobials to trigger appropriate interventions.

Scope

- Antimicrobial consumption data (demand planning and supplier data) - NDoH
- Antimicrobial resistance data – publicly available from NICD
- Trends over time per province
- Disaggregation per ATC code

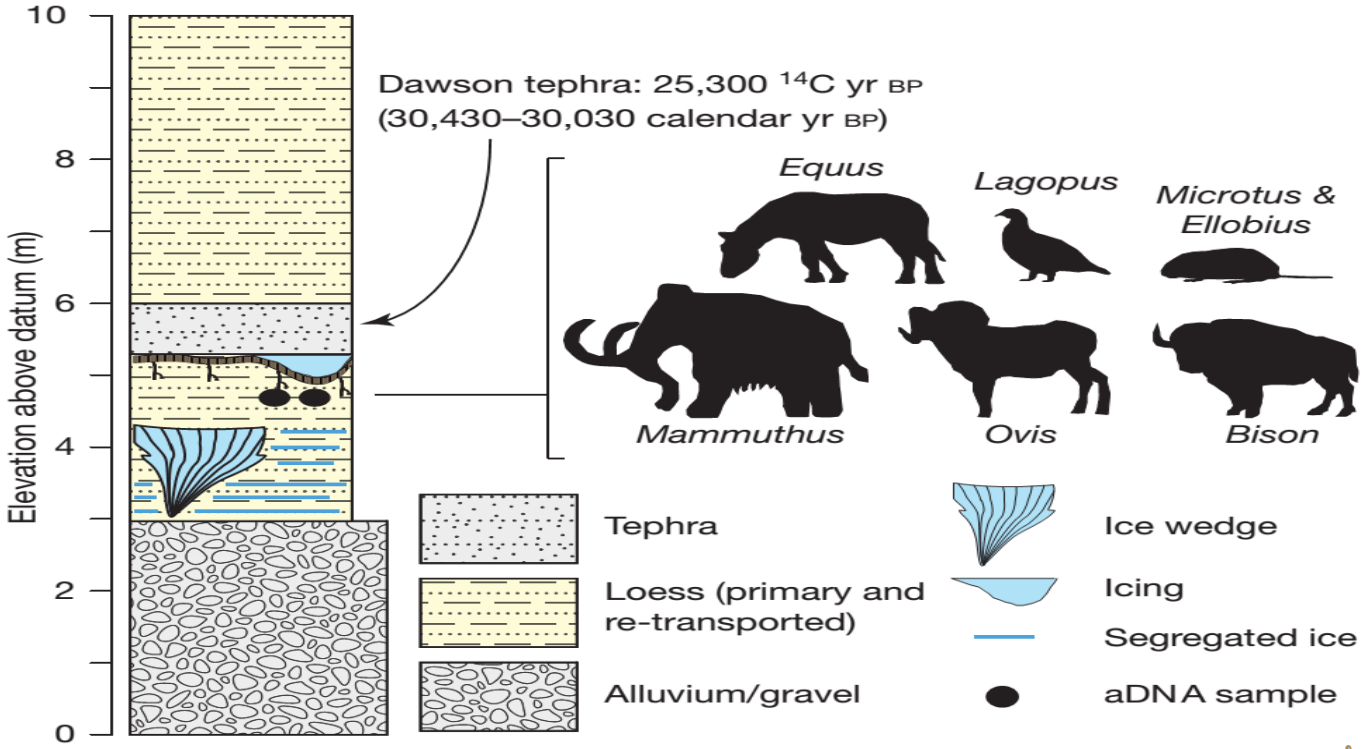


The concept of colonisation resistance



Our gut / colon, is like Kowloon City.
We have an estimated 2.2 kg of bacteria in our colon (100 trillion), and one of its important functions is colonisation resistance.

Where does bacterial resistance come from?



D 'Costa, *Nature* 2011; 477:457 - 61

Where does bacterial resistance come from?

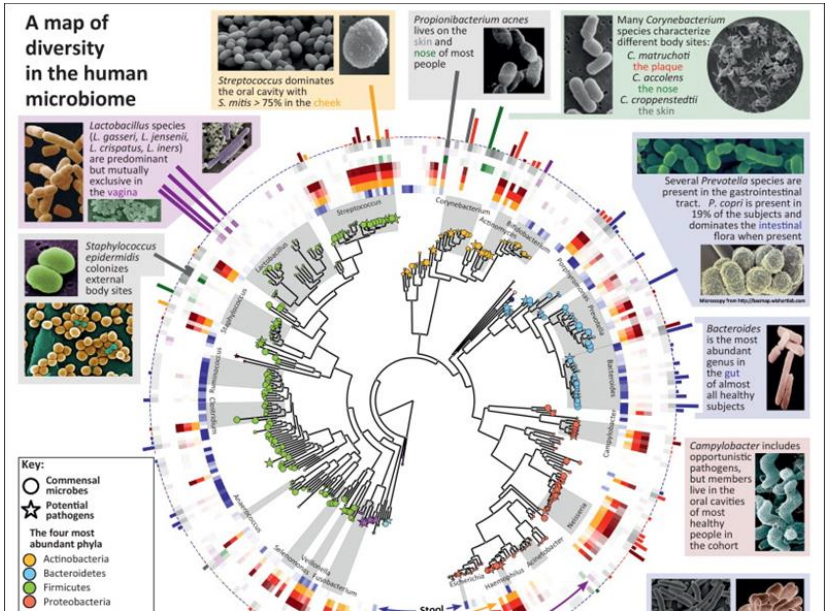
- Bacteria for 4 billion years in existence
- In 30 000 yr old permafrost samples, the following detected in this metagenomic analysis study:
  - The β-lactamase bla_{TEM} found in 30,000 year old permafrost samples
  - Ribosomal protection protein *TetM*, which confers resistance to tetracycline

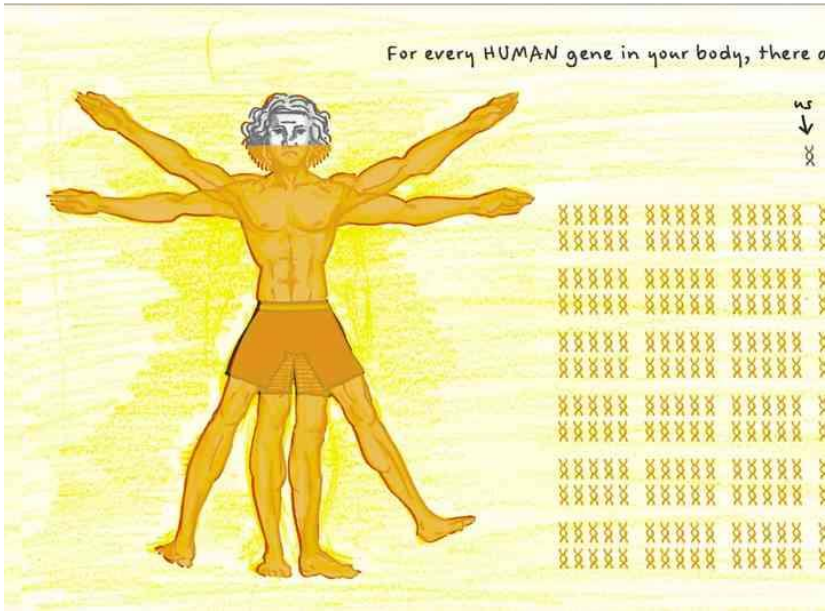
"These results show conclusively that antibiotic resistance is a natural phenomenon that predates the modern selective pressure of agricultural or clinical antibiotic use"

methyltransferase

  - *Erm*, which blocks the binding of macrolide, lincosamide and type B streptogramin antibiotics.

D 'Costa, *Nature* 2011; 477:457 - 61





The Human Microbiome

Effects of antibiotics on microbiome in gut

There is without a doubt going to be a lot of attention paid to antimicrobial stewardship!

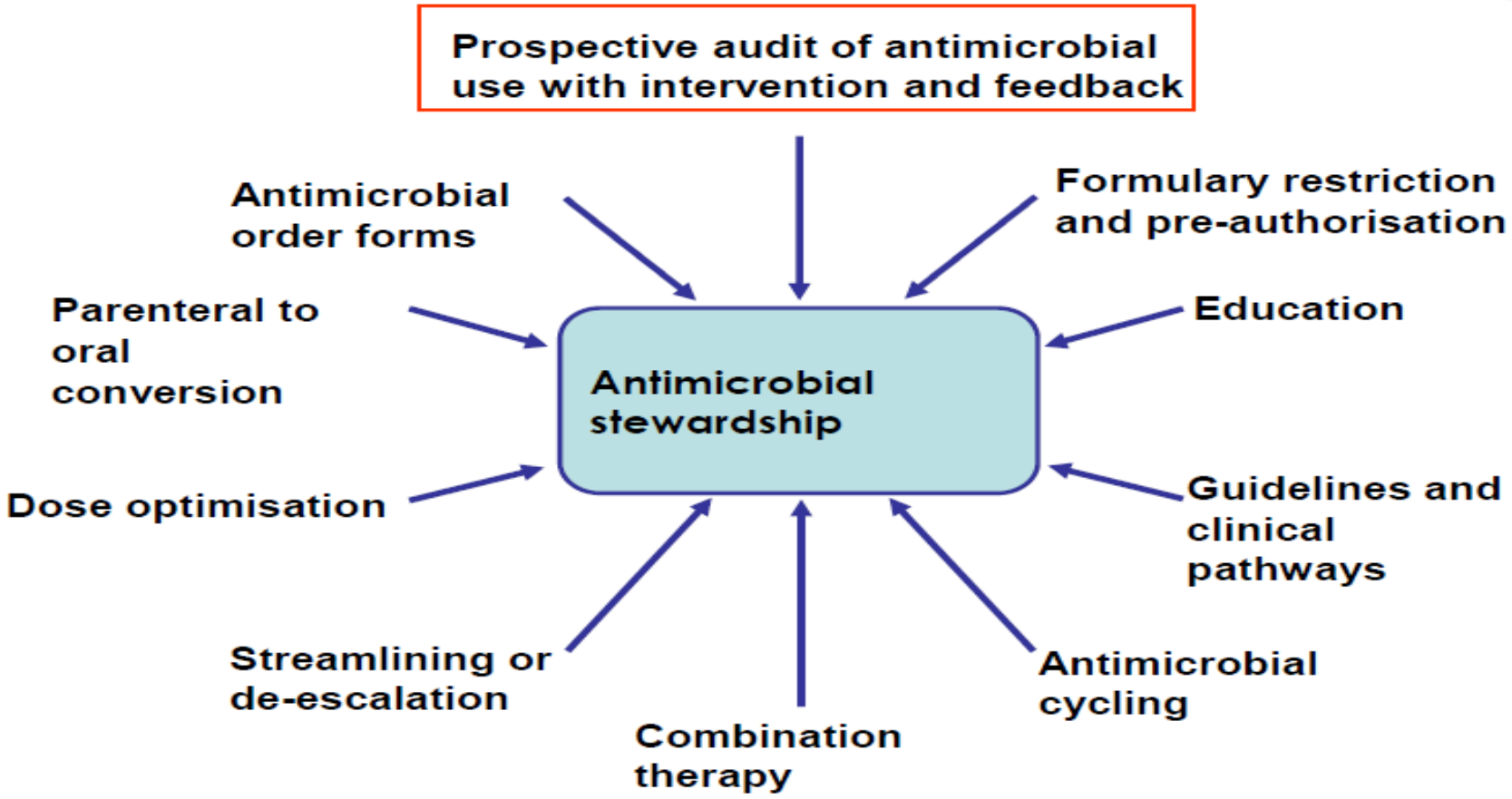
Definition: Antimicrobial Stewardship

- Infection control plus antimicrobial management
- Appropriate antimicrobial selection, dosing, route, and duration
- Systematic selection of antimicrobials that cause the least collateral damage
  - MRSA
  - ESBLs
  - *Clostridium difficille*
  - Stable depression
  - Metallo-beta-lactamases and other carbapenemases
  - VRE

Goals of Antimicrobial Stewardship

- Primary goal
  - Optimize clinical outcome/minimize unintended consequences of antimicrobial use
  - Unintended consequences:
    - Toxicity
    - Selection of pathogenic organisms
    - Emergence of resistant pathogens
- Secondary goal
  - Reduce healthcare costs without adversely impacting quality of care

Strategies for Antimicrobial Stewardship



Core Members of the Team

- Infectious disease physician
- Clinical pharmacist with infectious disease training
- Other members of the team
  - Microbiologist
  - Information system specialist
  - Infection control professional

Role of Infection Control

- Infection control trumps everything else
  - Hand hygiene – must have hand washing policies
  - Barrier precautions
- Devotion to all aspects of strict infection control
  - Nursing staff
  - Medical staff
  - Medical staff leadership

Recommended Components of an Antimicrobial Stewardship Program

- Foundation = *2 core, proactive strategies*

- Formulary restriction and preauthorization
- Prospective audit with intervention and feedback

Other Recommended Components of an Antimicrobial Stewardship Program

- Standardized order sets and clinical pathways (foster evidence-based prescribing)
- Antimicrobial order forms
- De-escalation of therapy (Review C&S results; on-going review of therapy)
- Dose optimization (right dose for site of infection; renal dose adjustment)
- IV to oral dose conversion


Antibiotic stewardship
Enhancing infection prevention and control
Controlling the source of infection
Prescribing antibiotics when they are truly needed
Prescribing appropriate antibiotic(s) with adequate dosages
Using the shortest duration of antibiotics based on evidence
Reassessing treatment when culture results are available
Supporting surveillance of AMR and HAIs and monitoring of antibiotic consumption
Educating staff
Supporting an interdisciplinary approach

New drugs approved or in clinical development with activity against multi-drug resistant Gram-negatives

	ESBL	KPC	OXA-48	MBL	CRPA	CRAB	Phase
β-lactam/β-lactamase inhibitors							
Meropenem/vaborbactam	✓	✓	–	–	–	–	Postmarket
Meropenem/nacubactam	✓	✓	✓	–	–	–	Phase I
Meropenem/QPX7728	✓	✓	✓	✓	±	✓	Preclinical
Imipenem/relebactam	✓	✓	–	–	✓	–	Postmarket
Ceftazidime/avibactam	✓	✓	✓	–	✓	–	Postmarket
Ceftolozane/tazobactam	✓	–	–	–	✓	–	Postmarket
Cefepime/tazobactam (2 g/2 g)	✓	–	✓	–	–	–	Phase III[a]
Cefepime/enmetazobactam	✓	–	–	–	–	–	Phase III
Cefepime/zidebactam	✓	✓	✓	✓	±	±	Phase I
Cefepime/VNRX5133	✓	✓	✓	±	±	–	Phase III
Cefepime/QPX7728	✓	✓	✓	✓	±	–	Preclinical
Ceftibuten/VNRX-7145	✓	–	–	–	–	–	Phase I
Ceftibuten/QPX7728	✓	✓	✓	–	–	–	Preclinical
Cefpodoxime/ETX-0282	✓	–	–	–	–	–	Phase I
Aztreonam/avibactam	✓	✓	✓	✓	–	–	Phase III[b]
Sulbactam/durlobactam	✓	✓	✓	✓	–	✓	Phase III
β-lactams							
Cefiderocol	✓	✓	✓	±	✓	±	Phase III
Tebipenem	✓	–	–	–	–	–	Phase III
Sulopenem	✓	–	–	–	–	–	Phase III
Aminoglycosides							
Plazomicin	✓	✓	✓	±	–	–	Postmarket
Tetracyclines							
Eravacycline	✓	✓	✓	✓	–	±	Postmarket
Polymyxins							
SPR741 plus beta-lactams	✓	±[c]	±[c]	–	–	✓	Phase I
SPR206	✓	✓	✓	✓	✓	✓	Phase I
QPX9003	✓	✓	✓	✓	✓	✓	Preclinical

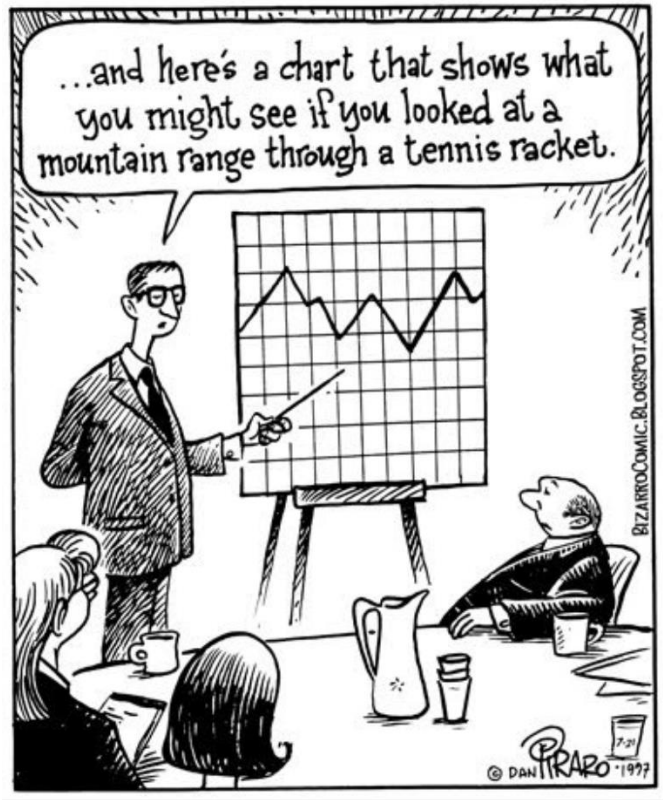
[a]Not yet recruiting.
[b]Suspended because of a delay in drug availability.
[c]Active against *Escherichia coli*, inactive against *Klebsiella pneumoniae*.

Paterson et al. Curr Opin Infect Dis 2020;33:214-223.


Enhancing infection prevention and control
Supporting an interdisciplinary approach
Controlling the source of infection
Educating staff
Antibiotic stewardship
Prescribing antibiotics when they are truly needed
Supporting surveillance of AMR and HAIs and monitoring of antibiotic consumption
Prescribing appropriate antibiotic(s) with adequate dosages
Reassessing treatment when culture results are available
Using the shortest duration of antibiotics based on evidence

Measurement and antimicrobial stewardship programs

- Why we should measure
- What should we measure
  - Structural measures
  - Process measures
  - Outcome measures
- How do we drive action with the data



Why measure?

To assess the effectiveness of any implemented strategies to determine:

- That they achieved what we wanted (led to improvement)
- That there are no unintended ***adverse consequences***

To prove our worth…

- ***To executives***
- ***To our prescribers and clinicians and patients***

What to measure?

- Hospitals are struggling to identify appropriate measures of success
- The relevant methods and measures for different hospitals will vary
- Access to meaningful data is a challenge
  - Unstructured/structured data
  - Lack of interoperability
  - Lack of definitions
  - Beware of adminstritative data
- EHRs are not necessarily a solution (rubbish in/rubbish out)

Types of measures

STRUCTURE

The context in which healthcare is provided

Organisational structure and available resources (people, tools)

What we need to have in place

PROCESS

The method by which health care is provided

Quantity and quality of prescribing

What we are doing

OUTCOME

The consequence of the health care provided

Eg; morbidity and mortality from infection

What we are achieving

Quantity - Antibiotic consumption

- Cost of antibiotics consumed (budget)
- Volume/ Amount of antibiotics consumed
  - Defined daily dose (**DDD**) – WHO
    - Not useful for paediatrics, affected by dose used (eg 1g vs 2g cetriaxone)
    - Can be done from pharmacy dispensing/ purchasing
  - Days of therapy (**DOT**) – IDSA
    - Can be used for paediatric, not affected by dose
    - Can be done if electronic prescribing, otherwise too hard
  - Must be adjusted for population (beware case-mix)
    - Usually /1000 occupied bed days for inpatients (per 1000 inhabitants for outpatients)
    - Beware confusion if use of per 1000 admissions in the denominator

Fatima Suleman

Professor, and the Prince Claus Chair of Development and Equity for the theme Affordable (Bio)Therapeutics for Public Health (September 2016 to September 2018), Faculty of Science, Utrecht University, Utrecht, The Netherlands

AND

Associate Professor:

Global Drug Utilization Review: What's happening in Africa?

Africa - Challenges

- Multiple types of health care system mixes (public, private, UHC, informal)
- Inappropriate and poor quality medicine prescribing, and usage are common both in HIC and LMIC countries worldwide.
- Formal studies on the prescribing and usage patterns of medicine in Africa are very limited.
- Medicines continue to be an important contributor of health care and health costs in Africa.
- Burden of health care costs – out-of-pocket payments and increasing prevalence of chronic diseases .
- Not only the number of chronic diseases - but also the co-morbidity.
- The popularity of traditional medicine exists today – some sources

Global Drug Utilization Review: What's happening in Africa?

Medicines Utilization Research in Africa (MURIA) Group

- A pro-active group in Africa stimulating cross-national research to enhance the rational use of medicines.
  - Active membership is from SA, Namibia, Botswana and Nigeria
  - First meeting in Port Elizabeth, South Africa in January 2015
  - Followed by a workshop in Botswana the same year (July 2015)
  - Second Meeting in July 2016 in Botswana
  - Third training workshop and Symposium in Namibia in June 2017
- A multidisciplinary network of healthcare professionals striving to promote sustainable, rational medicine use in Africa
- Achieved through training, collaborative research, information sharing and facilitation of access to data across Africa.

ENAABLERS Study

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Professor, and the Prince Claus Chair of Development and Equity for the theme Affordable (Bio)Therapeutics for Public Health (September 2016 to September 2018), Faculty of Science, Utrecht University, Utrecht, The Netherlands

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Associate Professor: Discipline of Pharmaceutical Sciences, School of Health Sciences, College of Health Sciences, Westville Campus, University of KwaZulu-Natal

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Global Drug Utilization Review: What's happening in Africa?

In Conclusion

- Still a long way to go, but much progress has been made thus far
- Issue of data availability and access
  - Clinical data - confidential issues develop
  - Informed consent
  - Legislation regarding privacy of data
  - Medical record – not computerized
  - Lack of diagnoses or indication for drug treatment
- Challenges for cross-national studies include using standard utilization methods, the same protocol, robust datasets, working with health authorities to accurately document country measures and ensuring a good mix of countries and interventions to enhance future learnings

We need to work together!!

SOUTH AFRICA

"The overwhelming majority of South Africans rely on the public health sector…"

"Despite the issues facing the private sector and regardless of the proposal for a unified, single-payer health system…"

"The public sector still requires the greatest amount of resources"
- Michael Edmonton

South African Health Care

- Only 17 in 100 South Africans have medical insurance, the essential key that opens the door to private healthcare. As many as 45 million, or 82 out of every 100 South Africans, fall outside the medical aid net, and as a result are laregely dependent on public health care.

- The lack of medical cover is expressed in the decisions that families make. When asked, seven in every ten households choose to go to a public clinic or public hospital as their first point of access if a household member becomes ill. Only a quarter of households opted to go to a private institution.

- It's no wonder then that healthcare is a high priority for public-sector spending. For every rand that the South African government spent in 2014/15, 11 cents went to healthcare, totalling R157 billion.2 This makes healthcare the fourth largest item of government expenditure, superseded by education (19 cents), social protection (13 cents), and executive and legislative organs (13 cents).

- Who spends this money? The bulk, 86% in fact, was spent by provincial government, which is tasked to manage the nation's public healthcare system, comprising 422 hospitals and 3 841 clinics and health centres.

8 Stats SA, *General Household Survey, 2016*. Table 7 (download here). The 82 in 100 South Africans without medical aid excludes those who indicated that they don't know if they have medical aid, and those classified as 'unspecified'.

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

South Africa's Antimicrobial Resistance National Strategy Framework

IMPLEMENTATION PLAN FOR THE ANTIMICROBIAL RESISTANCE STRATEGY FRAMEWORK IN SOUTH AFRICA: 2014–2019

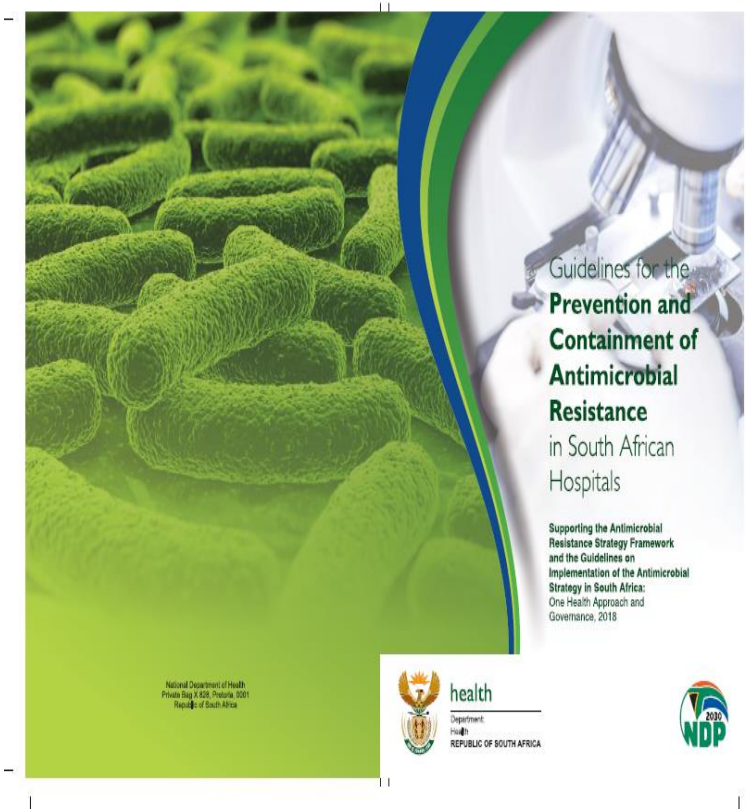
September 2015

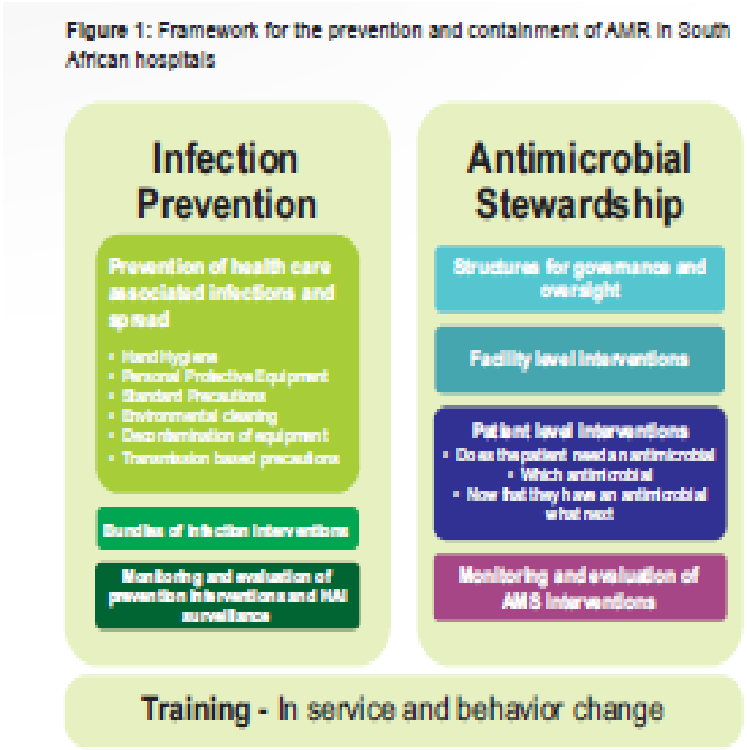
- SAASP's advocacy coupled with increasing global drivers of change[2-3] and momentum generated within **the National Department of Health (NDoH)** culminated in the publication of **South Africa's Antimicrobial Resistance National Strategy Framework 2014–24** in October 2014, at a Ministerial AMR Summit.[4]

2. Leung E, Weil DE, Raviglione M, Nakatani H on behalf of the World Health Organization World Health Day Antimicrobial Resistance Technical Working Group. The WHO policy package to combat antimicrobial resistance. Bulletin of the World Health Organization 2011; 89: 390–392. doi: 10.2471/BLT.11.088435.
3. WHO. Antimicrobial resistance: global report on surveillance 2014. World Health Organization, Geneva; 2014. http://www.who.int/drugresistance/documents/surveillancereport/en/ (accessed Aug 15, 2021).

   WHO. Global Worldwide country situation analysis: response to antimicrobial resistance. April 2015. World Health Organization, Geneva; 2015. http://apps.who.int/iris/bitstream/10665/163468/1/9789241564946_eng.pdf (accessed Aug 15, 2021).
4. Antimicrobial resistance. National Strategy Framework 2014-2024. 2015. http://www.health.gov.za/index.php/antimicrobial-resistance (accessed Aug 15, 2021).

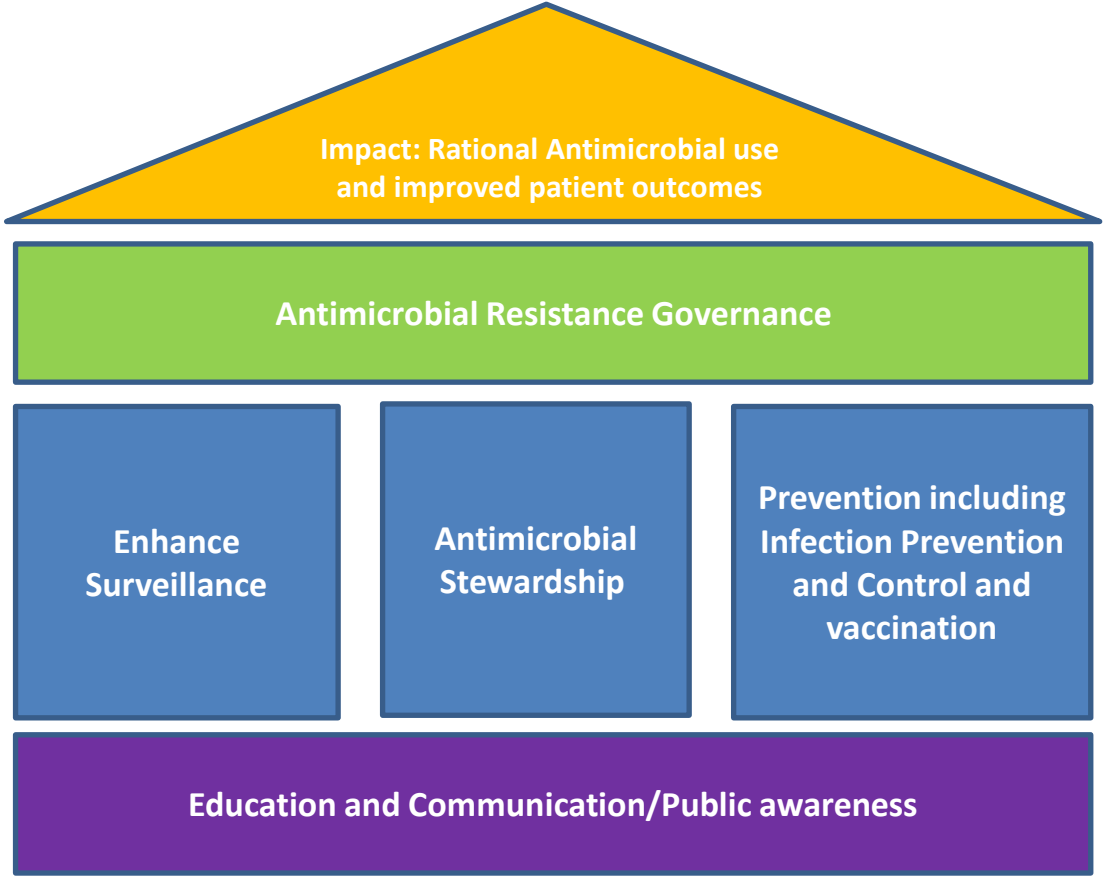
Prevention and Containment of AMR





Guidelines on the implementation of AMR

Intervention options	
IPC	**AMS**
1. Hand hygiene compliance 2. Improved environmental cleaning practice in public areas and clinical areas 3. Isolation room terminal cleaning practices 4. Screening of patients at high risk 5. Isolation of infected patients 6. Decolonisation 7. Functioning bedpan washer disinfector in clinical areas 8. Single patient use ventilator tubing in intensive care areas 9. Appropriate decontamination and sterilisation reprocessing of medical devices. *(WHO: Decontamination and Reprocessing of Medical Devices for Healthcare Facilities, Sept 2016)*	1. Formulary restrictions based on AMR and antimicrobial use 2. Pre-authorisation 3. Multidisciplinary stewardship teams and rounds 4. Prospective audits with feedback to prescribers, study, act on the following indicators: • Culture taking prior to commencement of antibiotics; • Empiric treatment against STG's • Documented indication for antibiotics; • Review of antibiotic with culture results; • Change in antibiotic – stopping / de-escalation / substitution / addition of agents; • IV to oral switch; • Batching of intravenous antimicrobials; • Duration of therapy monitoring and intervention; • Hang time; • Surgical prophylaxis choice and duration of therapy.
	Administration of antibiotics • Correct dose • Correct duration • Correct frequency • Correctly documented



[5]National Department of Health, South Africa. Antimicrobial resistance. National Strategy Framework 2014-2024. 2015. http://www.health.gov.za/index.php/antimicrobial-resistance (accessed Feb 15, 2017).

EXPERT REVIEW OF ANTI-INFECTIVE THERAPY
https://doi.org/10.1080/14787210.2021.1898946

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ORIGINAL RESEARCH

A point prevalence survey of antimicrobial utilisation patterns and quality indices amongst hospitals in South Africa; findings and implications

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[a] School of Pharmacy, Sefako Makgatho Health Sciences University, Ga-Rankuwa, Gauteng, South Africa; [b] Department of Pharmacoepidemiology, Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow, UK; [c]Division of Clinical Pharmacology, Department of Laboratory Medicine, Karolinska Institutet Karolinska University Hospital Huddinge, Stockholm, Sweden; [d]Department of Pharmacology, College of Pharmacy, Hawler Medical University, Erbil, Iraq

ABSTRACT

Objectives: Antimicrobial use is growing, driven mainly by rising demands in developing countries. Knowing how antimicrobials are prescribed is important. Consequently, we undertook a point prevalence survey (PPS) quantifying antimicrobial consumption among 18 public sector hospitals across South Africa.

Method: A purpose-built web-based application was used to collect PPS data.

Results: Out of 4407 adult patients surveyed, 33.6% were treated with an antimicrobial. The most frequently prescribed groups were a combination of penicillins including β-lactamase inhibitors. Amoxicillin combined with an enzyme inhibitor accounted for 21.4% total DDDs. In the medical and surgical wards, Access antimicrobials (54.1%) were mostly used, while in the ICU, Watch antimicrobials (51.5%) were mostly used. Compliance with the South African Standard Treatment Guidelines and Essential Medicines List was 90.2%; however, concerns with extended use of antimicrobials for surgical prophylaxis (73.2% of patients).

Conclusion: The web-based PPS tool was easy to use and successful in capturing PPS data since the results were comparable to other PPS studies across Africa. High use of amoxicillin combined with an enzyme inhibitor, possibly because it was among the broad-spectrum antimicrobials in the Access group. The findings will assist with future targets to improve antimicrobial prescribing among public sector hospitals in South Africa.

ARTICLE HISTORY
Received 7 December 2020
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KEYWORDS
Antimicrobial consumption; point prevalent surveys; aware list of antimicrobials; South Africa; public hospitals; quality indicators; rational medicine use; standard Treatment Guidelines; surgical prophylaxis

PPS of Antimicrobial Utilisation in SA

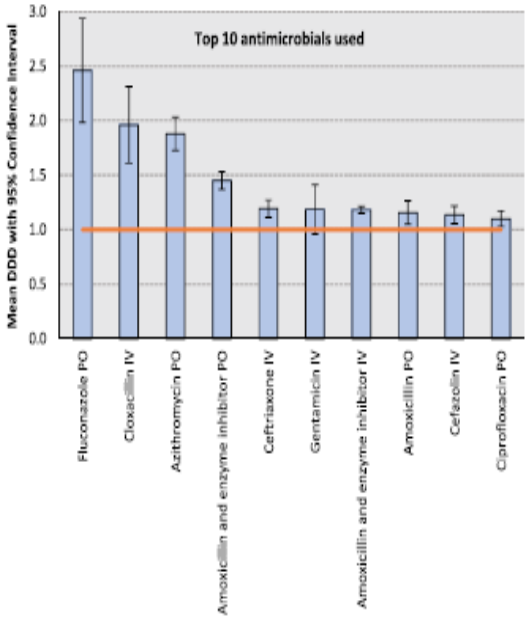

Figure 1. Mean DDD for the 10 most-used antimicrobials compared to the standard DDD = 1 from ATC Index 2019. IV = Intravenous; PO = oral.

Table 3. Top 16 antimicrobials prescribed with their route of administration and frequency.

ATC level 3 classes	Antimicrobial	ATC code	Route	Number of times AM prescribed	Percentage (based on total DDDs) %
J01C: Beta-lactam antibacterials, penicillins	Cloxacillin	J01CF02	IV	32	1.6
	Amoxicillin and enzyme inhibitor	J01CR02	PO	90	4.1
	Amoxicillin and enzyme inhibitor	J01CR02	IV	420	19.1
	Amoxicillin	J01CA04	PO	33	1.5
	Piperacillin and enzyme inhibitor	J01CR05	IV	89	4.0
	Ampicillin	J01CA01	IV	69	3.1
J01D: Other beta-lactam antibacterials	Ceftriaxone	J01DD04	IV	236	10.7
	Cefazolin	J01DB04	IV	112	5.1
	Meropenem	J01DH02	IV	32	1.5
J01E: Sulfonamides and trimethoprim	Sulfamethoxazole and trimethoprim	J01EE01	PO	90	4.1
	Sulfamethoxazole and trimethoprim	J01EE01	IV	12	0.5
J01F: Macrolides, lincosamides and streptogramins	Azithromycin	J01FA10	PO	75	3.4
	Azithromycin	J01FA10	IV	14	0.6
J01G: Aminoglycoside antibacterials	Gentamicin	J01 GB03	IV	35	1.6
J01M: Quinolone antibacterials	Ciprofloxacin	J01 MA02	PO	63	2.9
	Ciprofloxacin	J01 MA02	IV	19	0.9
J01X: Other antibacterials	Vancomycin (parenteral)	J01XA01	IV	40	1.8
	Metronidazole (oral/rectal)	J01XD01	IV	119	5.4
J02A: Antimycotics for systemic use	Fluconazole	J02AC01	PO	50	2.3
	Fluconazole		IV	26	1.2
J04A: Drugs for treatment of tuberculosis	Rifafour	J04AM06	PO	103	4.7
P01A: Agents against amoebiasis and other protozoal diseases	Metronidazole (oral/rectal)	P01AB01	PO	87	3.9

NB: IV = Intravenous; PO = oral


Antibiotic stewardship
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Educating staff
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Supporting surveillance of AMR and HAIs and monitoring of antibiotic consumption
Prescribing appropriate antibiotic(s) with adequate dosages
Reassessing treatment when culture results are available
Using the shortest duration of antibiotics based on evidence

Call to Action

health
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ANTIMICROBIAL RESISTANCE BACKGROUND DOCUMENT

ANTIMICROBIAL RESISTANCE
NATIONAL STRATEGY FRAMEWORK

2014-2024

health
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IMPLEMENTATION PLAN FOR THE ANTIMICROBIAL RESISTANCE STRATEGY FRAMEWORK IN SOUTH AFRICA: 2014–2019

September 2015

RSA AMR plan

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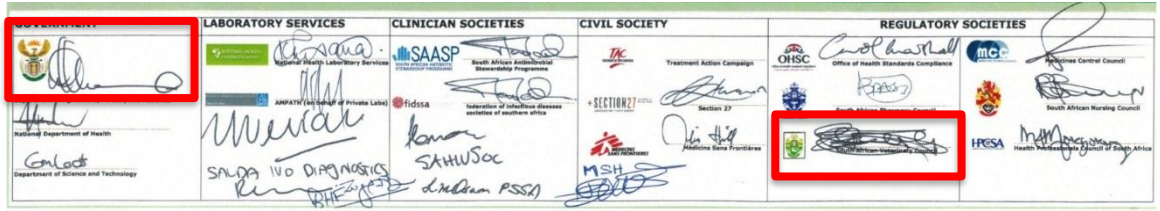
Antimicrobial Resistance National Strategy Framework Commitments

The purpose of the Antimicrobial Resistance National Strategy framework is to provide a framework for managing Antimicrobial Resistance (AMR), to limit further increases in resistant microbial infections, and improve patient outcomes.

Strategic objectives	**Governance Structures** **Strengthen, coordinate and institutionalise interdisciplinary efforts through national and health establishment level governance structures**		
	Surveillance Optimise surveillance and early detection of antimicrobial resistances to enable reporting of local, regional, and national resistance patterns to optimise empiric and targeted antibiotic choice	**Infection Prevention & Control** Enhance infection prevention and control of the spread of resistant microbes to patients in healthcare settings, focusing on improvement in hand hygiene and the identification and isolation of patients with resistant organisms. Community measures include preventing infection through wide-reaching vaccination programmes and improvements in water and sanitation.	**Antimicrobial Stewardship** Promote appropriate use of antimicrobials in human and animal health through antimicrobial stewardship including: • Effective policies and protocols • Stewardship at point-of-care • National prescribing guidelines • Appropriate antibiotic choice
Strategic enablers	**Legislative and policy reform for health systems strengthening** to support the quality of antimicrobials in the country and to enable control over prescribing of antimicrobials in the animal health sector.		
	Education of all levels of health providers in human health and agriculture in the critical concepts of antimicrobial stewardship, infection control, infectious diseases, microbiology and pharmacology.		
	Communication to educate the public, create awareness of the dangers of inappropriate antimicrobial use and enhance patient advocacy to combat antimicrobial resistance.		
	Research into novel diagnostics, such as point of care testing, new antimicrobials and implementation of treatment guidelines (treatment duration, antimicrobial consumption).		

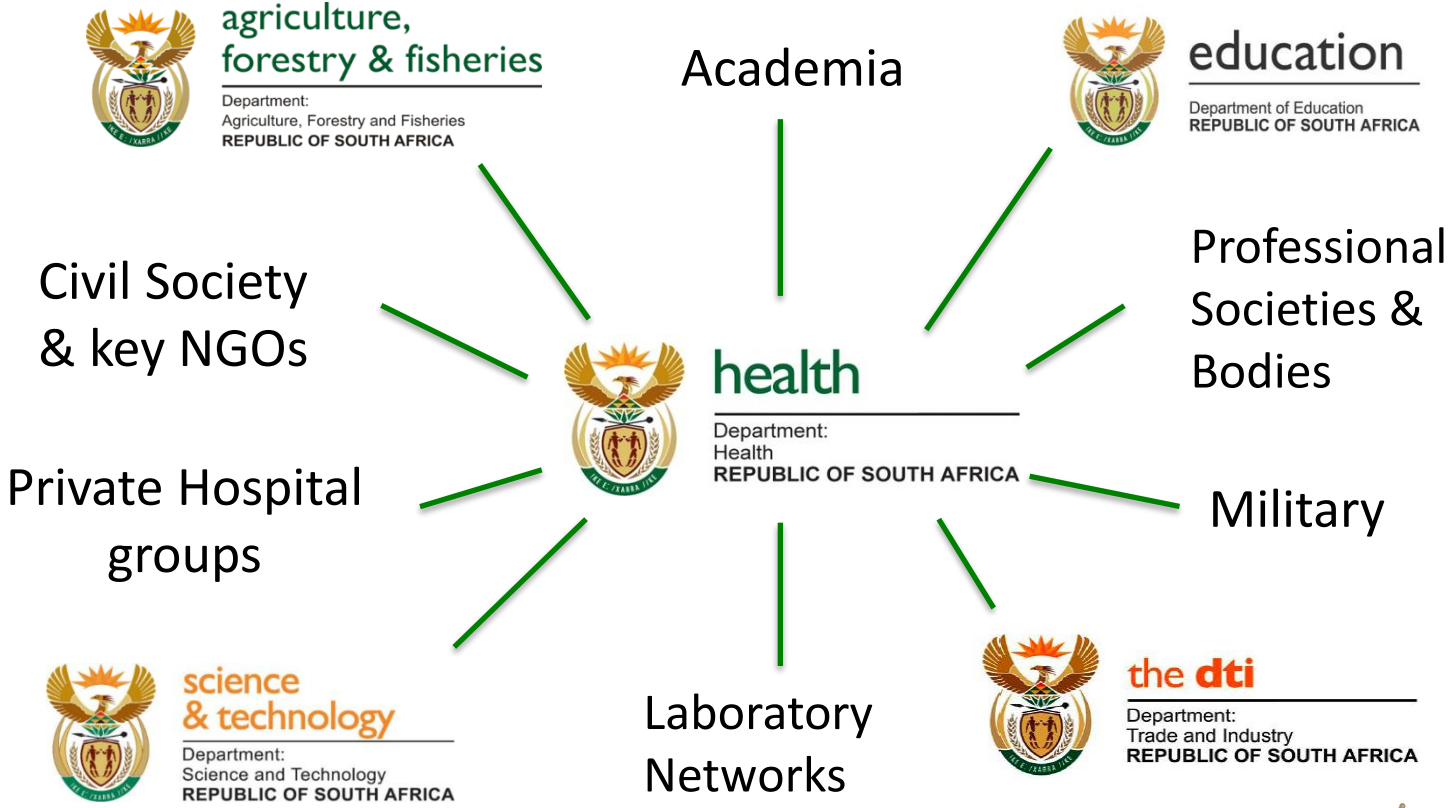
	Commitments	Time Frames & Actions
1.	To **collaborate** as intersectoral, interdisciplinary organisations and departments to strengthen, co-ordinate and institutionalise efforts to address Antimicrobial Resistance	Short term – March 2015: Establishment and initial meeting of National Ministerial Advisory Committee Short to medium term 2015 - 2019: Strengthen governance at Health Establishment levels
2.	To establish a **national surveillance system** to track and report resistant organisms and Antimicrobial use in agriculture and human health	Short term 2015 - Develop an Antimicrobial Resistance map for South Africa through data sharing between the private and public sector laboratory services
3.	To **enhance** the processes, structures, resources and supplies needed for effective Infection Prevention & Control	Short term 2015 - Ensure the equipment and Infection Prevention & Control resources required to practice effective hand hygiene are available at all times in all Health Establishments Medium term 2016 – 2019 – All Health Establishments meeting compliance of the National Core Standards relating to Antimicrobial Stewardship and Infection Prevention & Control
4.	To promote the appropriate use of Antimicrobials in human and animal health through antimicrobial stewardship in facilities and suitable enabling **legislation and regulations**	Short term 2015 – Ensure availability of Antimicrobials according to Essential Medicines List in all Health Establishments Medium term 2016 – 2019 – Review of antimicrobials use in feed additives
5.	To build the expertise and strengthen the competency of health and veterinary professionals and improve the staffing levels of the **workforce** in Antimicrobial Resistance and Infection Prevention & Control	Medium term 2016 – 2019 - Development of strategy and operational plan for the integration and implementation of Antimicrobial Resistance and Infection Prevention & Control training into the undergraduate and post graduate medical curriculums of health care professionals in South Africa
6.	To increase the **community awareness** of Antimicrobial Resistance	Short term 2014 – 2015 – Design of an awareness campaign relating to Antimicrobial Resistance based on past successful campaigns
7.	To promote **research** into novel diagnostics and clinical trials in Infection Prevention & Control and Antimicrobial Resistance	Long term 2019 – 2024 – Defined research opportunities

National Department of Health of the Republic of South Africa
and
Participating Stakeholders from Various Sectors, each Company represented herein as follows:

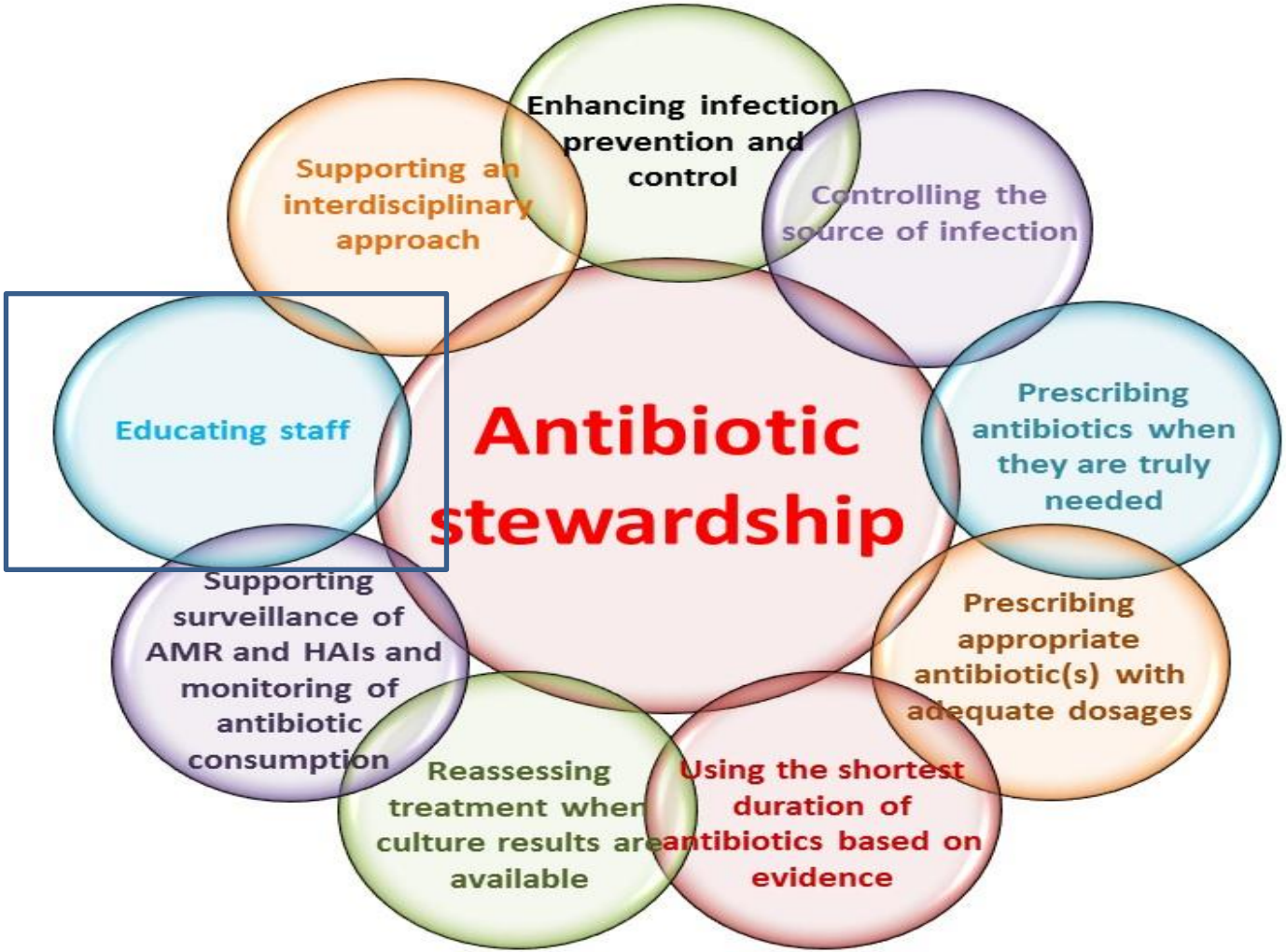


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Intersectoral Ministerial Advisory Committee



Which way to go for new frontiers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Using the shortest duration of antibiotics based on evidence

Antimicrobial Original Research Paper

Compliance with South Africa's Antimicrobial Resistance National Strategy Framework: are we there yet?

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Antimicrobial resistance (AMR) is a growing problem worldwide. South Africa has recently released its Antimicrobial Resistance National Strategy Framework (referred to as the Framework) to instigate antimicrobial stewardship programmes (ASPs). Consequently, there is a need to assess compliance with the Framework. Methods: Descriptive study design, collecting quantitative data, among pre-selected public healthcare facilities. One healthcare professional from each participating facility, involved in ASPs, was invited to participate. Results: Overall 26 facilities from 8 provinces participated. Average compliance to the Framework was 59.5% for the 26 facilities, with 38.0% for community health centres, 66.9% for referral hospitals and 73.5% for national central hospitals. For 7 facilities compliance was <50% while 5 facilities were >80% compliant. Conclusion: Although some facilities complied well with the Framework, overall compliance was sub-optimal. With the introduction of universal healthcare in South Africa, coupled with growing AMR rates, ongoing initiatives to actively implement the Framework should be targeted at non-compliant facilities.

Keywords: antimicrobial resistance; framework; compliance; antimicrobial stewardship; hospitals; healthcare centres; South Africa

5. Conclusion and recommendations

This study observed a sub-optimal compliance to the Framework among public sector healthcare facilities in South Africa. It is evident that implementation of the AMR National Strategy Framework Guidelines should be actively promoted throughout all public sector healthcare facilities in the country and not merely disseminated amongst the various facilities to achieve government goals. Such activities can build on encouraging signs, including the majority of participants' consciousness of the Framework. There is already typically active multidisciplinary collaboration within the facilities studied. Improved adherence to the Framework could be achieved by appointing a designated HCP at each facility to take responsibility for its implementation and subsequent compliance monitoring. This person should act as the liaison between the various antimicrobial governance structures, including the IPC, PTC and AMS groups. Ideally, a situational analysis should then be conducted at each facility to serve as baseline data for current antimicrobial usage. Monitoring of compliance to the Framework at regular intervals can be part of ongoing quality improvement programmes aimed at decreasing AMR trends. Facilities can subsequently be graded within provinces depending on their performance pertaining to ASPs and curbing of AMR to drive further improvements. A qualitative study has subsequently been carried out to gain a more in-depth understanding of these results.

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South Afr J Infect Dis
ISSN 2312-0053 EISSN 2313-1810

RESEARCH

Knowledge and perceptions of antimicrobial stewardship concepts among final year pharmacy students in pharmacy schools across South Africa

Marisa Burger[a], Jaco Fourie[a], Devin Loots[a], Tercia Mnisi[a], Natalie Schellack[a]*, Selente Bezuidenhout[a] and Johanna C Meyer[a]

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Background: Antimicrobial stewardship is currently not mandatory as part of the undergraduate training of pharmacists. Identifying gaps in knowledge and a better understanding of pharmacy students' perceptions about antimicrobial stewardship could assist in recommendations for appropriate changes to the pharmacy degree curricula that may lead to more appropriate use of antimicrobials, within the multi-disciplinary team.
Methods: A descriptive quantitative study with a survey design was conducted at the eight universities offering the pharmacy degree in South Africa. An electronic questionnaire with four main categories on antimicrobial stewardship was administered to final (fourth) year pharmacy students (June–August 2015).
Results: An overall response rate of 26.6% (n = 260) was obtained from 978 students, despite a weekly reminder. Most of the respondents were familiar with antimicrobial stewardship programmes in South Africa (71.9%), and claimed to know what antimicrobial stewardship is (83.5%) with significant differences between the universities ($p < 0.001$). Only 37.7% of the respondents recalled having had formal training on antimicrobial stewardship, with responses from the eight universities differing significantly ($p < 0.001$). However, almost all respondents (98.5%) felt that a strong knowledge of antimicrobials was important for their future career, with 90.0% indicating that they would like more training on antimicrobial stewardship at undergraduate level.
Conclusion: There were significant differences between the eight universities with regards to undergraduate education on antimicrobial stewardship. In order to help prevent antimicrobial resistance, efforts should be made to introduce concepts of antimicrobial stewardship into the undergraduate pharmacy curricula to promote better use of antimicrobials and prevent antimicrobial resistance.

Keywords: antimicrobial resistance, antimicrobial stewardship, education, pharmacy students

South African medical students' perceptions and knowledge about antibiotic resistance and appropriate prescribing: Are we providing adequate training to future prescribers?

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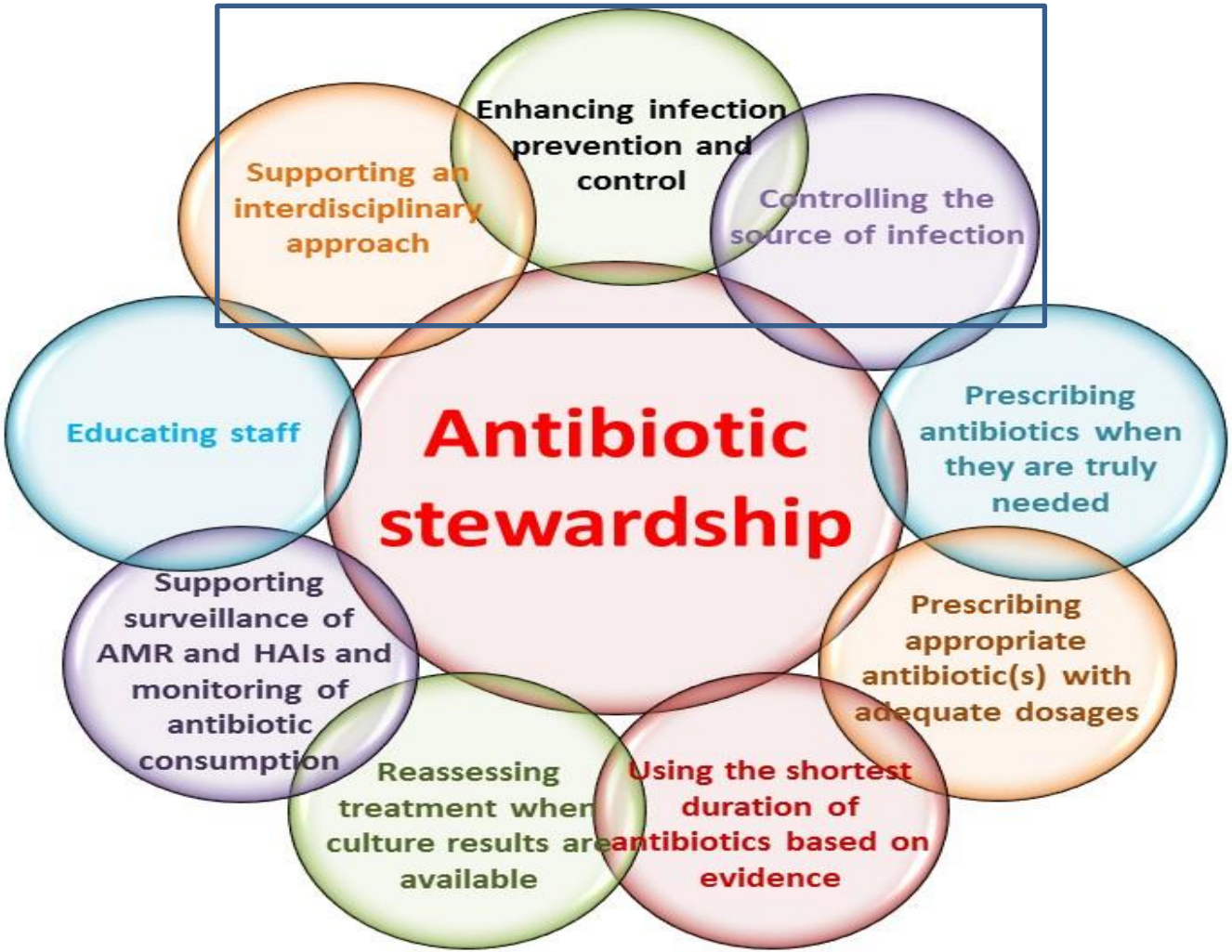
Background. Education of medical students has been identified by the World Health Organization as an important aspect of antibiotic resistance (ABR) containment. Surveys from high-income countries consistently reveal that medical students recognise the importance of antibiotic prescribing knowledge, but feel inadequately prepared and require more education on how to make antibiotic choices. The attitudes and knowledge of South African (SA) medical students regarding ABR and antibiotic prescribing have never been evaluated.
Objective. To evaluate SA medical students' perceptions, attitudes and knowledge about antibiotic use and resistance, and the perceived quality of education relating to antibiotics and infection.
Methods. This was a cross-sectional survey of final-year students at three medical schools, using a 26-item self-administered questionnaire. The questionnaires recorded basic demographic information, perceptions about antibiotic use and ABR, sources, quality, and usefulness of current education about antibiotic use, and questions to evaluate knowledge. Hard-copy surveys were administered during whole-class lectures.
Results. A total of 289 of 567 (51%) students completed the survey. Ninety-two percent agreed that antibiotics are overused and 87% agreed that resistance is a significant problem in SA – higher proportions than those who thought that antibiotic overuse (63%) and resistance (61%) are problems in the hospitals where they had worked ($p<0.001$). Most reported that they would appreciate more education on appropriate use of antibiotics (95%). Only 33% felt confident to prescribe antibiotics, with similar proportions across institutions. Overall, prescribing confidence was associated with the use of antibiotic prescribing guidelines ($p=0.003$), familiarity with antibiotic stewardship ($p=0.012$), and more frequent contact with infectious diseases specialists ($p<0.001$). There was an overall mean correct score of 50% on the knowledge questionnaire, with significant differences between institutions. Students who used antibiotic prescribing guidelines and found their education more useful scored higher on knowledge questionnaires.
Conclusion. There are low levels of confidence with regard to antibiotic prescribing among final-year medical students in SA, and most students would like more education in this area. Perceptions that ABR is less of a problem in their local setting may contribute to inappropriate prescribing behaviours. Differences exist between medical schools in knowledge about antibiotic use, with suboptimal scores across institutions. The introduction and use of antibiotic prescribing guidelines and greater contact with specialists in antibiotic prescribing may improve prescribing behaviours.

S Afr Med J 2017;107(5):405–410. DOI:10.7196/SAMJ.2017.v107i5.12370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South African Journal of Infectious Disease 2018;33(1):28-35

South Afr J Infect Dis
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GUIDELINES

SASOCP position statement on the pharmacist's role in antibiotic stewardship 2018

Schellack N,[1] Bronkhorst E,[2] Coetzee R,[3] Godman B,[4] Gous AGS,[5] Kolman S,[6] Labuschagne Q,[2] Malan L,[2] Messina AP,[7,8] Naested C,[9] Schellack G,[10] Skosana P,[2] Van Jaarsveld A[11]

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[9] Pharmacist, Netcare Greenacres Hospital
[10] Pharmaceutical Industry, South Africa
[11] Clinical Pharmacy Specialist Mediclinic Southern Africa.

SASOCP
Pharmacists care no matter where

The Team..

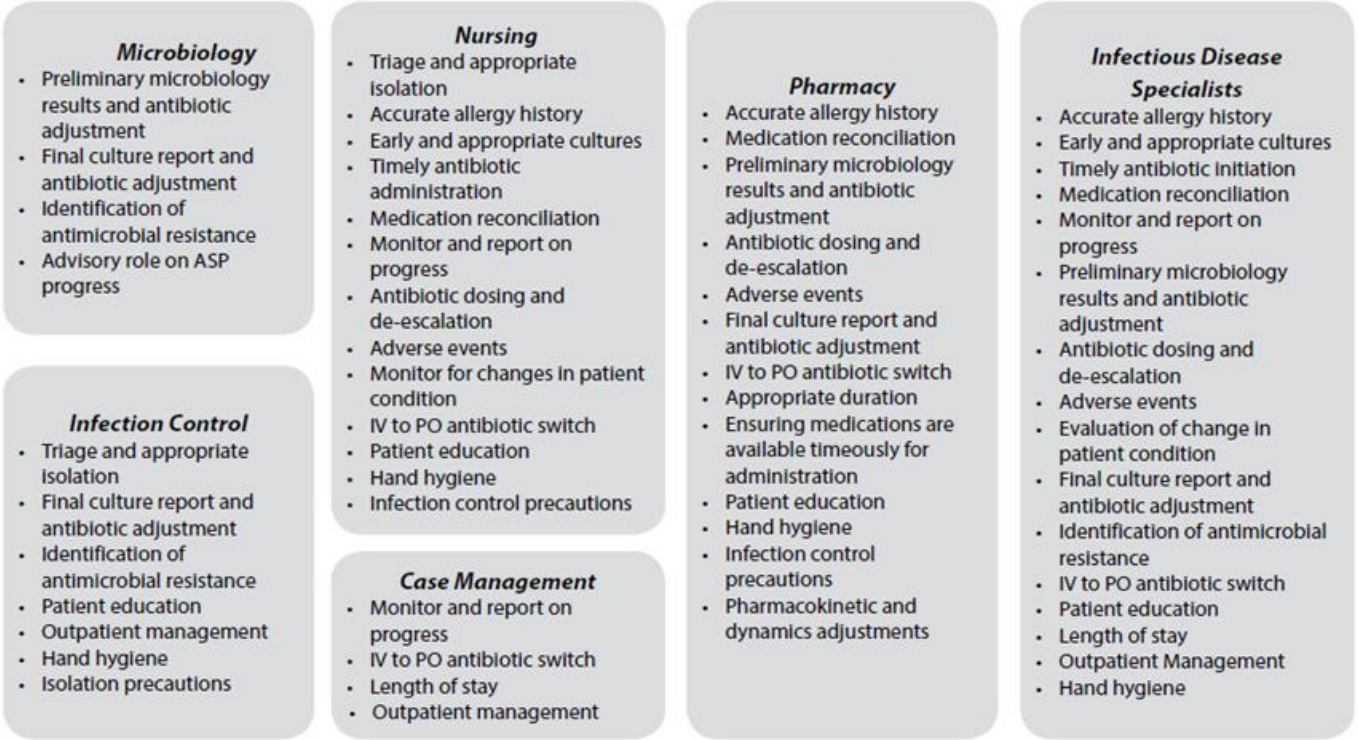

Figure 1. The attributes of function within current antimicrobial stewardship models[18]

SAMJ GUEST EDITORIAL

Passing the baton to pharmacists and nurses: New models of antibiotic stewardship for South Africa?

Brink et al. *J Antimicrob Chemother* 2016;106:947-948

The Nurse

CLINICAL UPDATE

'*Esprit de corps*': Towards collaborative integration of pharmacists and nurses into antimicrobial stewardship programmes in South Africa

N Schellack,[1] BCur, BPharm, PhD; **R Pretorius**,[2] BCur, MCur, PhD; **A P Messina**,[3] BPharm

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With the global threat of antimicrobial resistance now more emergent than ever, there should be wider collaboration between members of the multidisciplinary healthcare team. This article proposes possible ways of engagement between the pharmacist, nurse and doctor. The pharmacist and nurse are placed in an ideal position through united efforts (camaraderie) to redirect healthcare towards improved patient outcomes while also reducing antimicrobial resistance.

S Afr Med J 2016;106(10):xx-xx. DOI:10.7196/SAMJ.2016.v106i10.xxxxx


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AMS in the community

JAC Antimicrob Resist
doi:10.1093/jacamr/dlab106

JAC-Antimicrobial Resistance

Driving antibiotic stewardship awareness through the minibus-taxi community across the Tshwane District, South Africa—a baseline evaluation

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[1]Division of Clinical Pharmacy, School of Pharmacy, Sefako Makgatho Health Sciences University, Molotlegi Street, Ga-Rankuwa, Gauteng, South Africa; [2]Department of Pharmacology, Faculty of Health Sciences, University of Pretoria, Pretoria, Gauteng, South Africa; [3]Division of Medical Microbiology, Faculty of Health Sciences, University of Cape Town and National Laboratory Sciences, Cape Town, South Africa

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Background: The minibus-taxi community plays an integral role within society, and for years this community has been neglected. Of late, studies on minibus-taxi operators' health and their perceptions of HIV have emerged. Antibiotic resistance is a global problem and to help curb its spread studies have looked into the knowledge, attitude and perceptions amongst students and healthcare professionals, and yet little to nothing is known about the minibus-taxi community.

Objectives: To assess the knowledge and understanding of the minibus-taxi community on antibiotics and antibiotic resistance, and document indigenous antibiotic terminology used across the Tshwane District in Gauteng, South Africa.

Methods: A semi-structured questionnaire was adopted from WHO, translated into commonly spoken languages and administered to 83 minibus-taxi community members: 27 minibus-taxi operators and 56 commuters. A convenience sampling method was utilized in selecting the minibus-taxi ranks and routes. The questionnaire was later adapted to the minibus-taxi community's busy lifestyle and a section added to document antibiotic terms.

Results: Seventy-one percent ($n = 59$) of the participants knew the importance of taking antibiotics as directed, while 64% ($n = 53$) believed it's correct to share antibiotics. Seventy-five percent ($n = 62$) thought antibiotic resistance occurred in the human body. One misconception noted was that the minibus-taxi community thought antibiotics treated cold/flu and fever. Over 80% of the community were unfamiliar with antibiotic terminology.

Conclusions: Several misconceptions were documented amongst the minibus-taxi community and, whilst highlighting the linguistic barriers for the term antibiotic resistance, we identified several enablers for public awareness and empowerment. Further studies are required to define appropriate indigenous terms for future educational antibiotic campaigns.

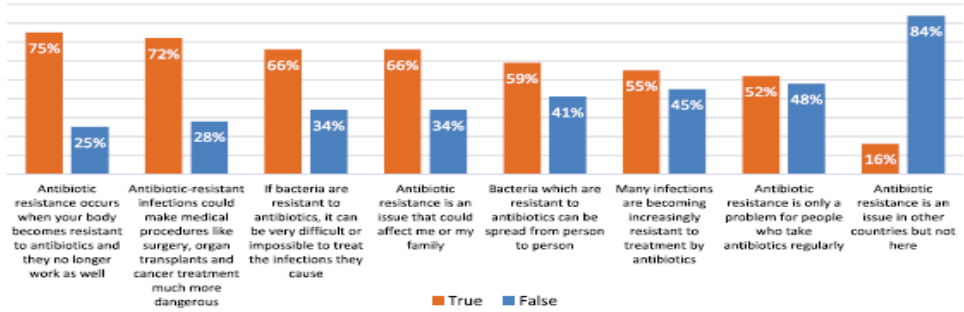

Figure 1. Taxi community's understanding of antibiotic resistance statements.

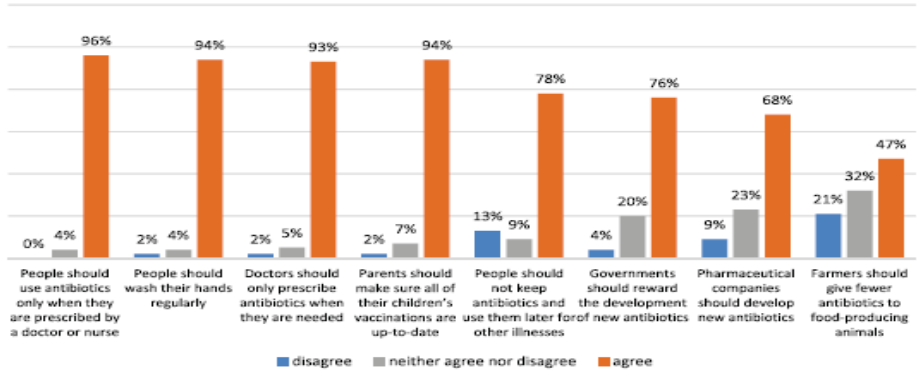

Figure 2. Participants' level of awareness of ways to address antibiotic resistance.

	Antibiotics	Antibiotic resistance	Antibiotic stewardship	Infection	Infection prevention	Bacteria	Microorganisms	Superbugs
IsiZulu	Amapilisi			uguli		Amagerms	amagerms	mbungulu
	Amacqiwane	Cwecwa	Umkhambathi	Ukuqula	Imvikelo yukugula	Ukuncola		ukuncola
	Amaphilisi			iciwane	amaphilisi wokuvikela iciwane	Emajemisi		
	Umjovo	Ukungasebenzi komjovo ongamaphilisi	ukukundisa ngomjovo wama phili si	Amagciwane	ukuvikela amagciwane	Amagciwane	Amagciwane	Amagciwane amakhulu
	Amaphilisi			Isifo		Igciwane		Imbungulu
	Amaphilisi			Imikuhlane				
Sepedi	Depilisi							
	Thibela bolwetsi			Phetelo	Thibela petelo	kokwana thloko		
	Phili si			Bolwetsi		Kokwana thloko		
	Dihlare			Pheteletso	go thibela malwetsi			
	Di ukubatsi				Thibela bolwetsi			
				Bolwetsi	Thibela malwetsi			
	Dihlare			go fetelwa	go thibela go fetelwa	Ditshila		
				Fitelello	Ditlamorago	Twatsi	Tlakatlakano ya di lelo	
				Kokwane	tibela malwetsi			
				Tshwaetso ya malwetsi	Thibela malwetsi	Mogare wa bolwetse		
Sesotho	Dipilisi			bolwetsi		Dichila		
				Tshwaetso	Thibela tshwaetso	Kokwana		
	Dipilisi					kokwana thloko		
				Tshiwahetsano	Ho thibela tshwanetsano	Kokwana hloko		
	Anti-biotics			Infection		Bacteria		
isiNdebele	Mshoga	ukungabheregi kwe shlahla		Indruga	Isivhikhela bolwlao	Ndonga		
	kwemithi elwa nama gciwane	ukumelana namagciwane	ubuphathi bama antibiotic		Ukuvikela ukutheleleka	Amagciwane	Silwanyana	
isiXhosa	Amapilisi wokhugeza igazi							
SiSwati	Ukumelana nemithi elwa namagciwane	Ukwangamela ama-antibiotic	Ukutheleleka	ukuvimbela ukutheleleka	amagciwane	ama micro organisms	ama-superbug	Ukumelana nemithi elwa namagciwane

JAC Antimicrob Resist
https://doi.org/10.1093/jacamr/dlab196

Antimicrobial Resistance

Using mystery shoppers to determine practices pertaining to antibiotic dispensing without a prescription among community pharmacies in South Africa—a pilot survey

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Received 2 November 2021; accepted 14 December 2021

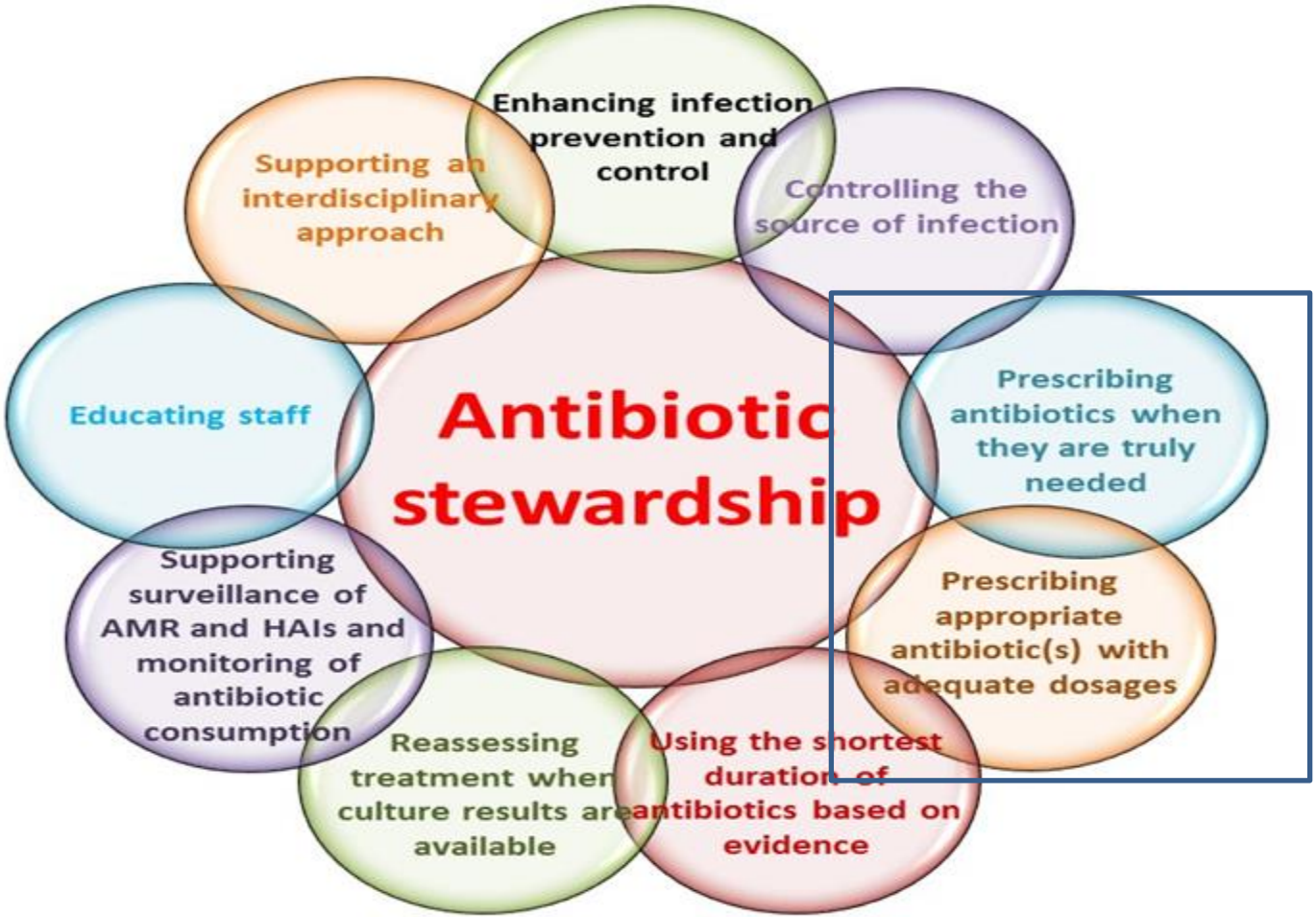
Background: Inappropriate use of antimicrobials is a key factor increasing antimicrobial resistance, a major global public health problem including in South Africa. Key drivers include antibiotics being dispensed without a prescription.

Objectives: To determine the accessibility of antibiotics without a prescription in community pharmacies in urban areas in South Africa and determine whether counselling was provided when antibiotics were dispensed.

Patients and methods: Prospective, observational study, employing simulated patients (SPs), presenting with upper respiratory tract infections (URTIs) and urinary tract infections (UTIs), undertaken to establish whether antibiotics can be obtained without a valid prescription in South Africa. This pilot study was conducted in privately owned ($n = 20$) and corporate (franchised, $n = 14$) community pharmacies in three regions in Gauteng Province.

Results: Antibiotics were sold in privately owned pharmacies without a prescription in 80% (16/20) of cases while no antibiotics were dispensed in corporate (franchised) pharmacies. Of the 16 pharmacies selling antibiotics without a prescription, pharmacist assistants were involved in 37.5% ($n = 6$) and counselling was not provided to 19% of SPs. Ciprofloxacin (42.9%) and metronidazole (28.6%) were the most common antibiotics dispensed. No antibiotics were dispensed for URTIs, only UTIs.

Conclusions: Dispensing antibiotics without prescriptions can be common among privately owned pharmacies in urban areas in South Africa. Corporate pharmacies, which probably have a greater income, appear to follow current legislation banning such activities. To limit selling with no prescription, community pharmacists and assistants especially in urban areas should be educated on appropriate patient care and legal requirements, with dispensing electronically monitored.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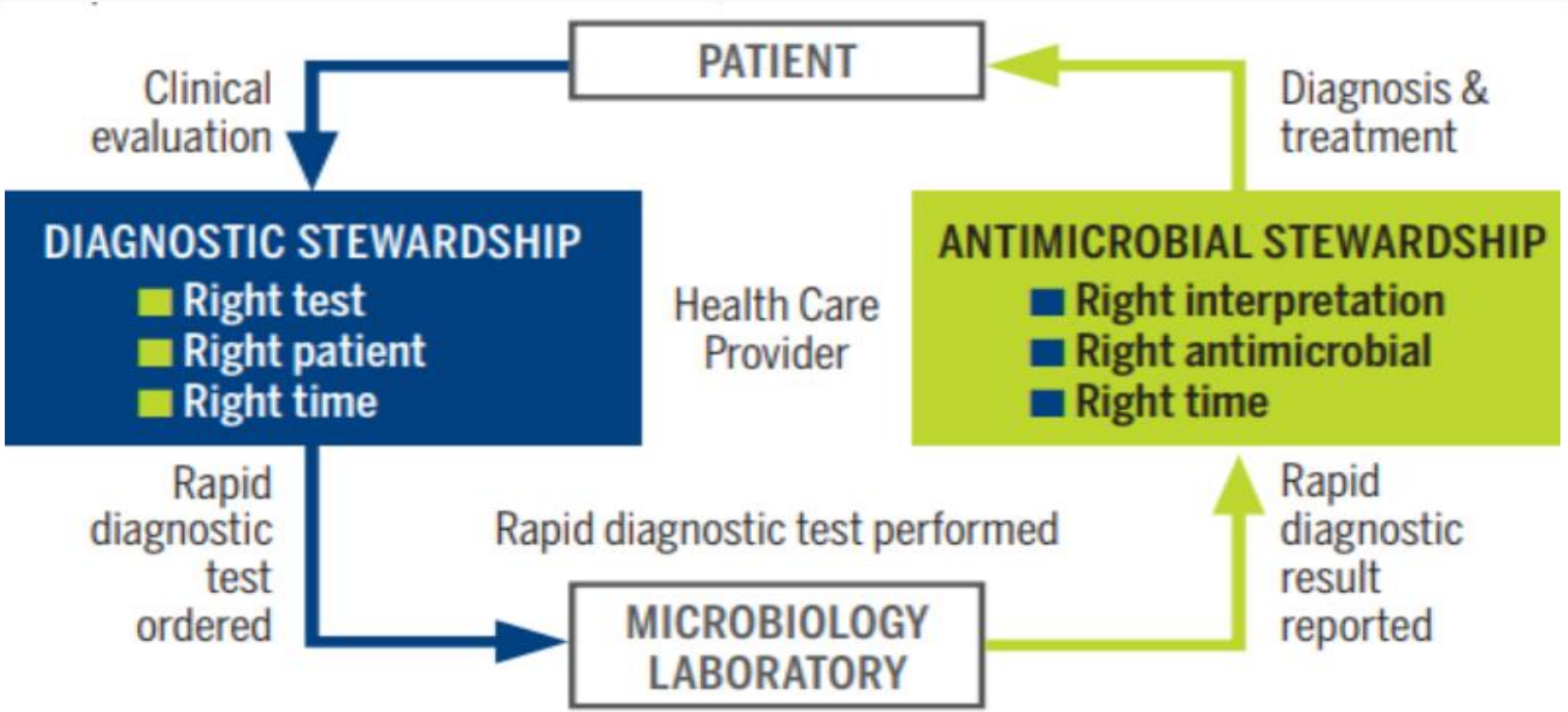
Supporting surveillance of AMR and HAIs and monitoring of antibiotic consumption
Prescribing appropriate antibiotic(s) with adequate dosages
Reassessing treatment when culture results are available
Using the shortest duration of antibiotics based on evidence

Roles of diagnostic and antimicrobial stewardship in the implementation of rapid molecular tests



Messacar et al. *J Clin Microbiol* 55:715–723

Key diagnostic stewardship considerations for implementation of rapid molecular tests

Goal	Key question	Key considerations and potential strategies
Right test	Is the test appropriate for the clinical setting?	Sensitivity and specificity Predictive values Testing volumes Diagnostic yield Laboratory feasibility Cost Clinical impact
Right patient	Will the clinical care of the patient be affected by the test result?	Laboratory test utilization committee Automatic laboratory reflex CPOE decision support Appropriate use criteria Indication selection Prior authorization Benchmarking Specimen rejection
Right time	Will the result be available in time to optimally affect care?	Time to specimen receipt Centralized vs point-of-care testing On-demand vs batched testing Specimen preparation time Run time Result reporting time

Messacar et al. *J Clin Microbiol* 2017;55:715–723

Key antimicrobial stewardship considerations for implementation of rapid molecular tests

Goal	Key question	Key considerations and potential strategies[a]
Right interpretation	Will the clinician understand the test result?	Result report language Selective reporting of relevant results AS prospective audit and feedback AS real-time decision support
Right antimicrobial	Will the clinician appropriately modify antimicrobials based on the test result?	Clinical practice guidelines EMR-based decision support with result reporting AS prospective audit and feedback AS real-time decision support
Right time	Will the clinician act upon the test result promptly?	EMR reporting Results called with readback reporting AS prospective audit and feedback AS real-time decision support

Messacar et al. *J Clin Microbiol* 55:715–723

Trends for improved dosing

Principal trends for optimised dosing from *in vitro* and animal *in vivo* data to define PK/PD relationships

THEN from PK/PD modelling and simulation papers to describe the dosing that best achieves those indices

Understanding altered PK is key

Knowledge of bacterial susceptibility (PD) key

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Southern African Journal of Infectious Diseases

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ojid20

A pilot study on the use of amikacin in neonates: Who should be monitored for ototoxicity?

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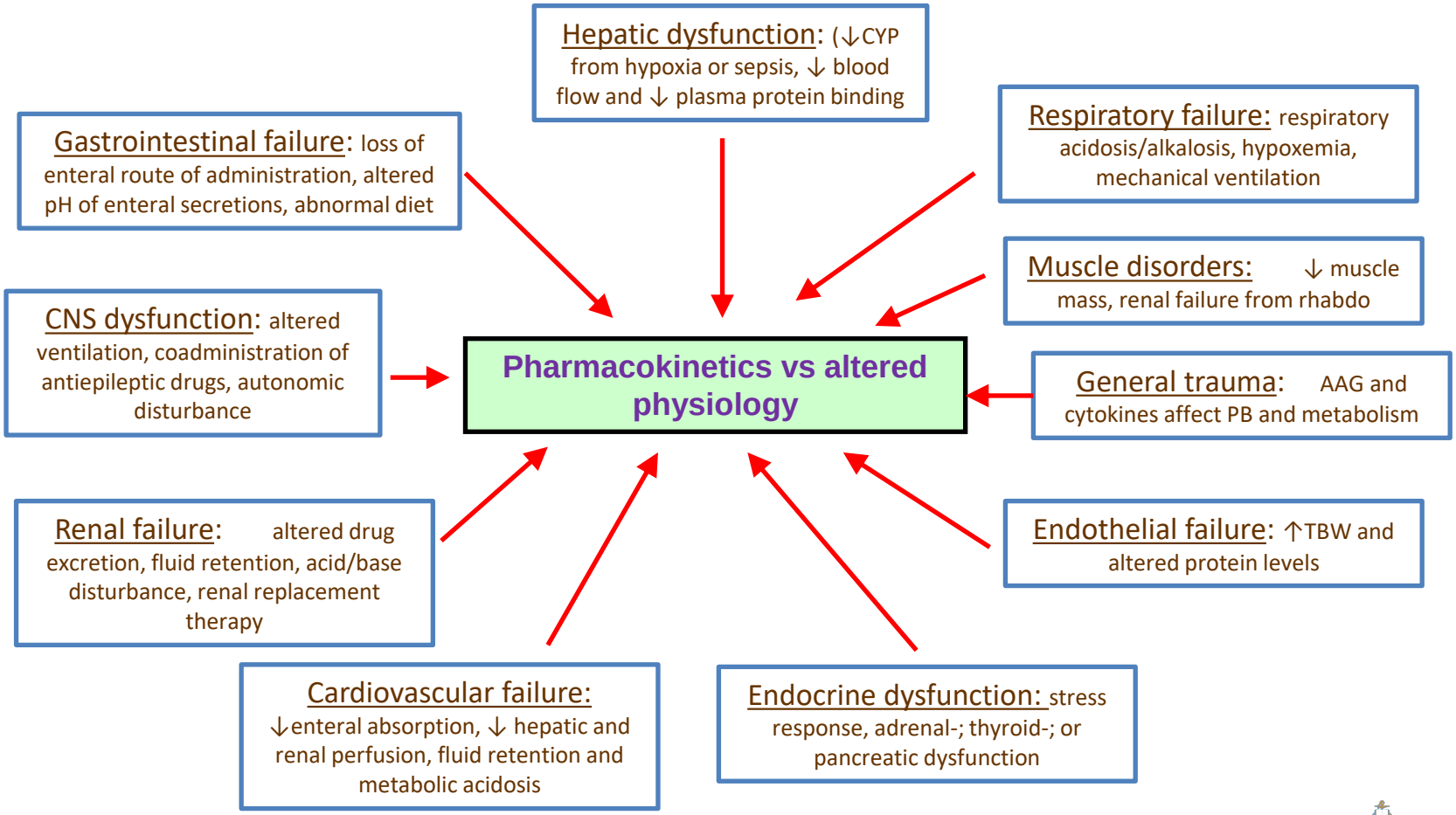
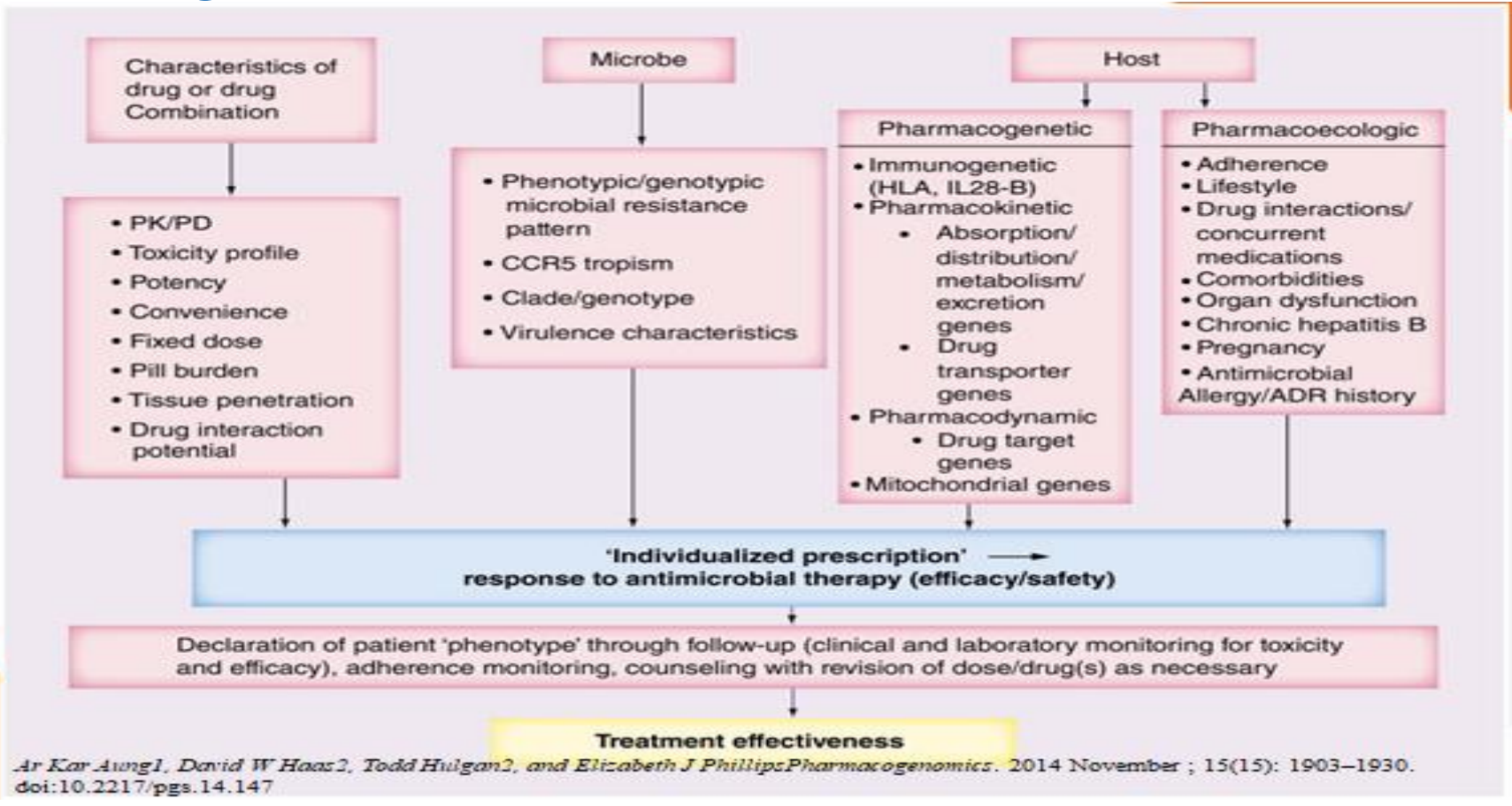
ID	GA (weeks)	Gender	Weight (kg)	Dose (mg/kg)	Peak (mcg/mL)	Trough (mcg/mL)	t½ (hours)	Vd (L/kg)	DP_Dif_2kHz	DP_Dif_4kHz	DP_Dif_6kHz	DP_Dif_8kHz
78	27	F	1.20	20.83	33.54	9.73	13.35	0.860	-0.45	0.70	0	1.15
83	28	M	1.60	20.00	62.40	5.36	6.75	0.329	5.7	7.20	4.05	13.05
42	29	M	1.20	20.00	51.79	3.95	6.43	0.421	12	10.7	4.7	5.7
49	29	F	1.10	20.00	52.35	11.54	10.98	0.485	21.3	19.9	16.8	19.6
82	29	F	0.90	22.22	54.48	5.97	7.49	0.477	2.1	3.55	-2.6	22.05
73	30	M	1.46	20.55	50.81	1.70	4.88	0.426	-0.1	-1.25	-4.45	-1.5
74	30	M	1.35	22.22	69.82	14.30	10.50	0.365	-4.85	-3.95	-15.45	20.6
75	30	M	1.10	20.00	41.78	10.77	12.22	0.685	2.65	-2.05	-1.45	-2.55
80	30	M	1.40	21.43	15.42	8.82	30.26	3.400	1.3	1.2	-12.2	21.05
40	31	M	1.35	20.00	43.47	0.77	4.10	0.467	-2.4	-3.2	-3.85	2.35
41	32	F	1.40	20.00	65.38	7.25	7.55	0.361	13	24.7	18	19.3
69	32	M	1.35	20.00	77.47	2.08	4.59	0.254	-9.2	-11.5	-5.55	8.85
14	33	F	2.70	18.52	54.51	0.01	3.95	0.337	-3.6	9.4	7.1	2.4
79	33	M	2.20	20.45	61.03	1.39	4.39	0.340	-11.15	-12.85	-7.6	-7.2
6	36	M	2.80	20.00	53.61	10.62	10.24	0.464	-3.7	-5.8	0.3	-2
21	36	M	1.55	20.00	54.69	0.76	3.88	0.365	1.65	1.2	2.95	0.35
5	38	M	2.85	19.30	48.34	2.87	5.85	0.421	5.85	0.8	-1.3	-2
76	38	M	4.60	20.00	45.90	1.16	4.50	0.444	0.35	-0.2	-4.7	-0.45
38	39	M	2.80	19.64	52.40	2.83	5.68	0.430	-6	-9	-8.6	-9.2
81	39	M	3.45	17.39	28.51	3.15	7.52	0.717	-0.3	-1.75	-4.7	-6.65
12	40	F	3.00	20.00	51.87	4.43	6.74	0.419	-0.5	-0.15	-0.5	-0.85
22	40	F	2.70	20.00	33.26	0.62	4.31	0.610	4.65	5.2	5.95	0.2


Hepatic dysfunction: (↓CYP from hypoxia or sepsis, ↓ blood flow and ↓ plasma protein binding
Gastrointestinal failure: loss of enteral route of administration, altered pH of enteral secretions, abnormal diet
Respiratory failure: respiratory acidosis/alkalosis, hypoxemia, mechanical ventilation
Muscle disorders: ↓ muscle mass, renal failure from rhabdo
CNS dysfunction: altered ventilation, coadministration of antiepileptic drugs, autonomic disturbance
Pharmacokinetics vs altered physiology
General trauma: AAG and cytokines affect PB and metabolism
Renal failure: altered drug excretion, fluid retention, acid/base disturbance, renal replacement therapy
Endothelial failure: ↑TBW and altered protein levels
Cardiovascular failure: ↓enteral absorption, ↓ hepatic and renal perfusion, fluid retention and metabolic acidosis
Endocrine dysfunction: stress response, adrenal-; thyroid-; or pancreatic dysfunction

Moving towards the individual



Ar Kar Aung1, David W Haas2, Todd Hulgan2, and Elizabeth J PhillipsPharmacogenomics. 2014 November ; 15(15): 1903–1930. doi:10.2217/pgs.14.147

Let's start wrapping this up!

- We need more hands on deck enabling Antimicrobial stewardship programs to get more and more attention
- Regardless of generalist vs. specialist practice model, multiple interventions will work
  - Ideally, best results use specialists and generalists working together
- Use a ASP checklist and multidisciplinary approach to assure success
- The highest levels of government have shined the spotlight on ASP - this will affect boots on the ground
- Use the practice model that works best for you to get best results
- Get the best use of your ASP by engaging in a multidisciplinary approach


I'M ON THE HUNT FOR WHO I'VE NOT YET BECOME
Long-term consistency
trumps short-term intensity.
Bruce Lee
quotefancy
"EXPECT PROBLEMS AND EAT THEM FOR BREAKFAST."
Alfred A. Montapert
BRIANTRACY.COM
People who are crazy enough to think they can change the world, are the ones who do.
ROB SILTANEN