Measurement

How do we assess prescribing practice and monitor improvement?

Assoc Professor Kirsty Buising
Infectious Diseases physician
Victorian Infectious Diseases Service Royal Melbourne Hospital
Deputy Director National Centre for Antimicrobial Stewardship
at the Peter Doherty Institute for Infection and Immunity, University of Melbourne

Outline

- Why measure?
- How to measure
  - Structural measures
  - Process measures
  - Outcome measures
- Auditing, Reporting and feedback

Why measure?

To assess the effectiveness of any implemented strategies to determine:

i) That they achieved what we wanted (led to improvement)

was it ***generalised***? – stratify by drugs/ indications/ units/ wards

was it ***sustained***? – must follow ***over time***

ii) That there are no unintended ***adverse consequences***

Why measure?

We need to do it to prove our worth!

- Executive
  - needed for continued funding and allocation of resources
  - for formal program support and endorsement
- Clinicians
  - needed for acceptance and participation in the program
  - for continued improvement in quality of patient care

How to measure

What to measure?

- Hospitals are struggling to identify appropriate measures of success for their antimicrobial stewardship programs

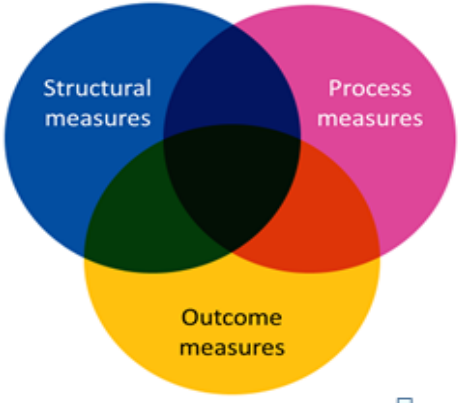
- The relevant measures for different hospitals will vary
  - One size does not fit all!

The literature is unnecessarily complicated

mixed terminology

Types of measures

- Structural measures
  - the context in which healthcare is provided
    - organisational structure and available resources (people, tools)
      - » *What we need to have in place*
- Process measures
  - the method by which health care is provided
    - quantity and quality of prescribing
      - » *What we are doing*
- Outcome measures
  - the consequence of the health care provided
    - Eg; morbidity and mortality from infection
      - » *What we are achieving*



Planning what to measure

Measures – all the things we could choose to measure

Indicators - a few things we choose, as markers of how we are going

Goals – targets we set, what we aim to achieve

Difficulties in measurement

The challenge of complex health care systems

- Data in multiple places
- Structured and unstructured data
  - Collected for other reasons eg; billing
- Inconsistent / variable definitions used
- Everyone is not doing the same thing

You want to find a way to collect data that is time efficient,
but you also want robust meaningful data

Tips on measurement

- Validity
  - Definitions are critical
    - Clearly define the patient population for monitoring (standardise case-finding)
    - Validate data (cross reference data sources) , what is the gold standard?
- Reliability
  - Different data collectors - same result?
- Reproducibility
  - Can we repeat it consistently? - compare with yourself over time
- Generalisability
  - Will it work in all units, all sites? - comparisons with similar sites
- Usability
  - Reports must be useful and actionable

Structural measures

Structural measures

Snapshot of the organisation at a point in time (stocktake, gap analysis)

Who:

AMS staff – funded dedicated time

- doctor (infectious diseases physician, clinical microbiologist)
- pharmacist (AMS, infectious diseases, clinical)
- infection control practitioner, nurse, biostatician

What:

AMS Committee, Prescribing policy, National guidelines, Electronic decision support system, Electronic approval system, Audit tools and plan

Indicators/ goals

- AMS staff dedicated EFT
  - 500 beds = 2 EFT pharmacist, 1 EFT doctor
- Antimicrobial stewardship committee – frequency of meetings
  - Aim 6 weekly meetings
- Antimicrobial prescribing policy - present and updated
  - Aim 2 yearly review
- Formulary with restrictions - present and updated
  - Aim 2 yearly review
- Guidelines, clinical pathways – number present / updated
  - Aim update every 2 years, create 4 new ones/ year, Map how often they are accessed
- Education sessions – number provided / attended
  - Aim to reach all levels/ disciplines every year – electronic plus in person
- Approval system (electronic, phone, paper) – procedure is present/ updated
  - Target 300 approvals/month
- Post prescription review system - procedure is present/ active
  - Target to sustain 3 times weekly rounds on wards, daily in ICU
- Antibiogram – produced/ updated

6 monthly ICU and whole hospital, yearly haematology

Why is this important?

For every structural measure, if present and being used, there is evidence or consensus expert opinion that they are linked to better AMS performance

Don’t forget to measure structural indicators!

- Correlate increased resources with greater impact
- Show that as staff are removed, activity falls, performance falls
- Uncover where things exist ‘in name alone’ but are not engaged

Process measures

Process measures

- Typically include:

1. **Quantitative measures**
    - Amount of antimicrobials being consumed

2. **Quality measures**
    - Appropriateness of the antimicrobial use

1. Quantity - Antibiotic consumption

- Cost of antibiotics consumed (budget)
  - Highly variable between sites/ over time, not easy to compare
- 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, count a day if 1 or more doses given
    - Can be done if electronic prescribing, otherwise too hard
  - Must be adjusted for population
    - usually /1000 occupied bed days for inpatients (per 1000 inhabitants for outpatients)
    - Beware confusion if use of per 1000 admissions in the denominator

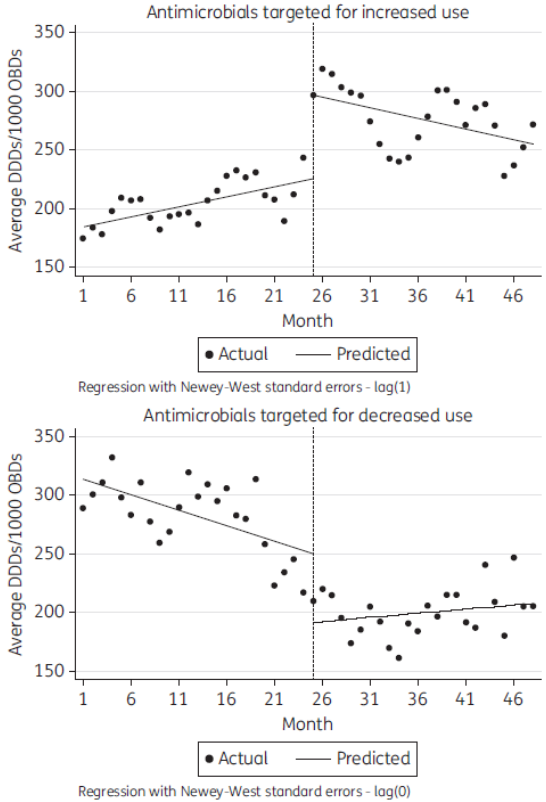
Quantity - Antibiotic consumption

- Commonly used, often easy to obtain
- Executive can understand these measures
- Allows for the monitoring of trends over time

- Lots of limitations….
  - Sometimes narrower spectrum agents more expensive
  - Consumption is biased against combination therapy
  - Does not explain the reasons for these changes
  - Cannot usually be linked to individual patients or prescribers

When measuring a behaviour change, we know change happens gradually

Always use <u>time series</u> to show effects of change



Assessing the impact of an intervention on volume of consumption Bond et al JAC April 2017

2. Quality measures

- Usually point prevalence surveys or period prevalence surveys
- Provide rich insight into the antimicrobial prescribing behaviour
- Uncover previously unrecognised issues
- Assist in the evaluation of any implemented changes
- They enable more intensive dedicated auditing of
  - particular wards, specialties, antimicrobials, indications

Quality measures you might use

Assess

- **Empiric use c/w guidelines or appropriateness of use**
- documentation of indication
- review or stop date documented
- correct dose/ frequency
- oral switch possible
- allergy mismatch
- microbiology susceptibility mismatch
- time to effective antimicrobial therapy in sepsis
- acceptance of AMS post prescription review team's recommendations

Compliance vs appropriateness

- **Compliance / concordance** with prescribing guidelines
  - require widely accepted or endorsed guidelines
  - Easy to assess

- '**Appropriateness**' of the prescription
  - More clinically meaningful
  - Can be subjective
  - Need trained auditors and robust tools

Simple tools

5x5 audit (NAPS QI)

1. Was an indication documented?
   - Did you ask why not
2. Was use compliant with guidelines?
   - If not - is there a reason given
   - If not – did you contact the doctor

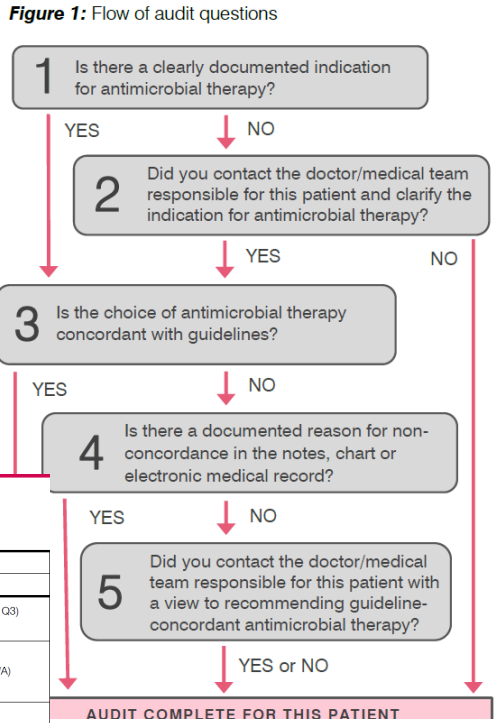


Figure 1: Flow of audit questions

5x5 Antimicrobial Audit

Data Collection Tool

Date Audited:		Daily Patient Number:	Patient Identifier:
Hospital:		Location/Unit:	Specialty/Team:
1	Is there a clearly documented indication for antimicrobial therapy?		○ YES (Mark Q2 N/A and go to Q3) ○ NO
2	Did you contact the doctor/medical team responsible for this patient and clarify the indication for antimicrobial therapy?		○ YES ○ NO (Mark Q3, Q4 and Q5 N/A) ○ N/A
3	Is the choice of antimicrobial therapy concordant with guidelines?		○ YES (Mark Q4 and Q5 N/A) ○ NO ○ N/A
4	Is there a documented reason for non-concordance in the notes, chart or electronic medical record?		○ YES (Mark Q5 N/A) ○ NO ○ N/A
5	Did you contact the doctor/medical team responsible for this patient with a view to recommending guideline-concordant antimicrobial therapy?		○ YES ○ NO ○ N/A

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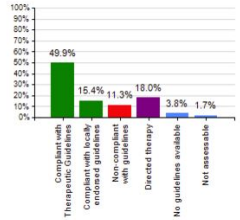
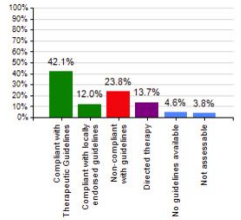
NCAS

hospital NAPS 2015

My Data	National Data (H=89)
number of prescriptions = 345	number of prescriptions = 7859

Compliance with Guidelines

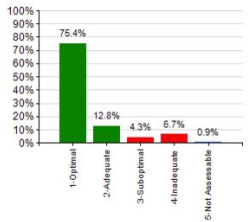


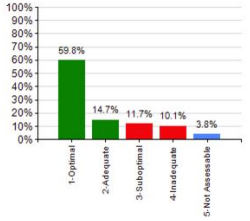


Compliant with Guidelines	65.2%	Compliant with Guidelines	54.1%
Noncompliant with Guidelines	11.3%	Noncompliant with Guidelines	23.8%
Directed Therapy	18.0%	Directed Therapy	13.7%
Other	5.5%	Other	8.3%

*Therapeutic Guidelines' and 'Local Guidelines' are deemed as being **compliant** with guidelines (displayed in green).*
None Available and Not Assessable are grouped as 'Other' (displayed in blue).

Appropriateness of Antimicrobial





Appropriate	88.1%	Appropriate	74.5%
Inappropriate	11.0%	Inappropriate	21.7%
Not Assessable	0.9%	Not Assessable	3.8%

*'Optimal' and 'Adequate' are deemed as being **appropriate** (displayed in green).*
*'Suboptimal' and 'Inadequate' are deemed as being **inappropriate** (displayed in red)*

Documentation of Indication

The percentage of total prescriptions where an indication was documented.
For best practice this should ideally be greater than 95% (green section)

Review or stop date documented

The percentage of total prescriptions where a review or stop date was documented.
For best practice this should ideally be greater than 95% (green section)

Surgical Prophylaxis given for greater than 24 hours

The percentage of surgical prophylaxis prescriptions where the duration of prophylaxis was for greater than 24 hours post surgery.
For best practice this should ideally be less than 5% (green section)

Overall Appropriateness for surgical prophylaxis prescriptions		Overall Appropriateness for surgical prophylaxis prescriptions	
Appropriate	14 (56.0%)	Appropriate	340 (51.8%)
Inappropriate	11 (44.0%)	Inappropriate	315 (48.0%)
Not Assessable	0 (0.0%)	Not Assessable	1 (0.2%)

IV to oral

On day 3 – did the patient meet criteria for oral switch?

1 month audit, general medicine

- On 72 hours or day 3, 65.4% of the patients (n=53) were still on IV antibiotics therapy; when they were further assessed with the criteria stated in the IV to oral switch pathway, 54.7% of them (n=29) had actually met the criteria for oral switch

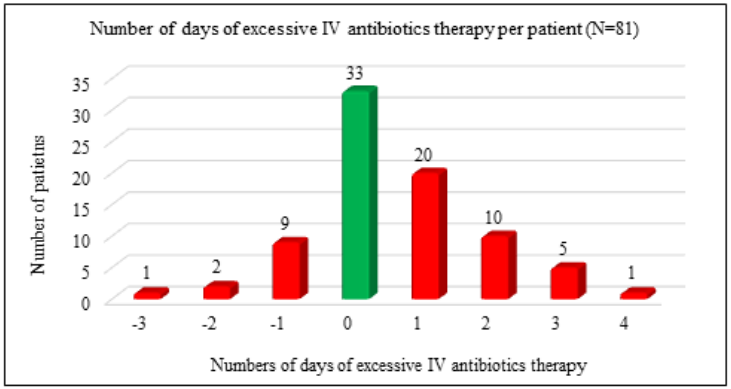


Figure 2: Number of days of excessive IV antibiotics therapy per patient

ACTION – develop a tool to prompt switch

Hoey Lin Oh 2017 in progress

Combined approach

Use both types of process measures for a comprehensive understanding

- Quantitative measures
  - continuous measure (passive)
    - may highlight areas to look at
- Qualitative measures
  - performed periodically (active)
    - Provides detail, reasons for changes

Indicators/ goals

- Quantitative measures

Indicators

Quantity broad spectrum Abx use measured as ddd/1000bd

Possible Goals

Fall in meropenem ddd/1000bd by 25% in 2 years

Aim 30 ddd/1000bd for ceftriaxone by December

Vancomycin use below national average >10/12 months

- Qualitative measures

Indicators

Appropriateness of use

Possible Goals

>95% of antimicrobial use judged appropriate at NAPS

<5% of surgical prophylaxis beyond 24 hours at NAPS

>90% meropenem use appropriate at dedicated annual audit

Reduce prolonged IV antibiotics at day 3 in general medicine unit from 40% to 20%

An Example

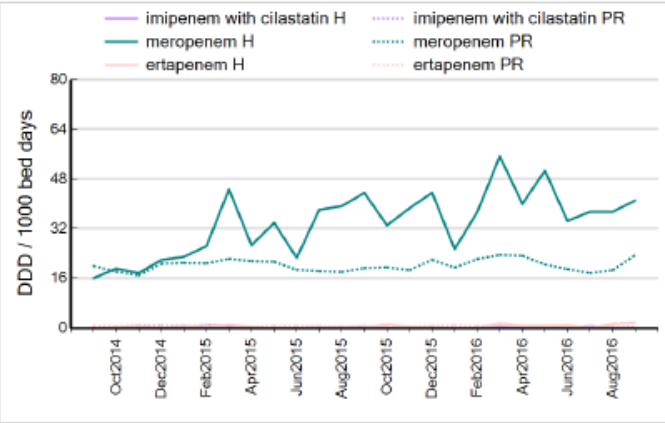


Chart 17: carbapenems

Meropenem

Process measure – quantitative

Ongoing, passive, time series

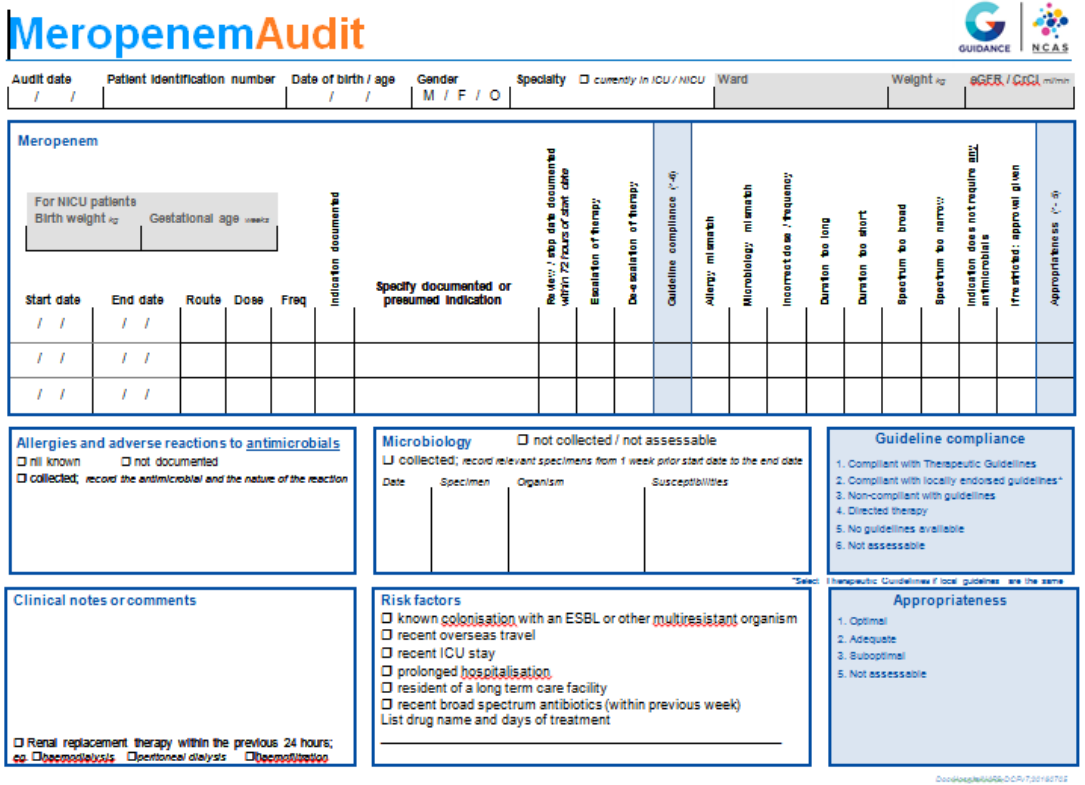
Consumption – ddd/1000 bed days

Standardised audit

Meropenem

Qualititive process measure

More detailed to understand appropriateness



MeropenemAudit

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Audit date / / | Patient identification number | Date of birth / age / / | Gender M / F / O | Specialty ☐ currently in ICU / NICU | Ward | Weight kg | eGFR / CrCl ml/min

Meropenem

For NICU patients: Birth weight kg | Gestational age weeks

Start date	End date	Route	Dose	Freq	Indication documented	Specify documented or presumed indication	Review / stop date documented within 72 hours of start date	Escalation of therapy	De-escalation of therapy	Guideline compliance (1-6)	Allergy mismatch	Microbiology mismatch	Incorrect dose / frequency	Duration too long	Duration too short	Spectrum too broad	Spectrum too narrow	Indication does not require any antimicrobials	If restricted: approval given	Appropriateness (1-5)
/ /	/ /																			
/ /	/ /																			
/ /	/ /																			

Allergies and adverse reactions to antimicrobials
☐ nil known ☐ not documented
☐ collected; record the antimicrobial and the nature of the reaction

Microbiology ☐ not collected / not assessable
☐ collected; record relevant specimens from 1 week prior start date to the end date

Date	Specimen	Organism	Susceptibilities

Guideline compliance
1. Compliant with Therapeutic Guidelines
2. Compliant with locally endorsed guidelines*
3. Non-compliant with guidelines
4. Directed therapy
5. No guidelines available
6. Not assessable

*Select 1 therapeutic Guidelines if local guidelines are the same

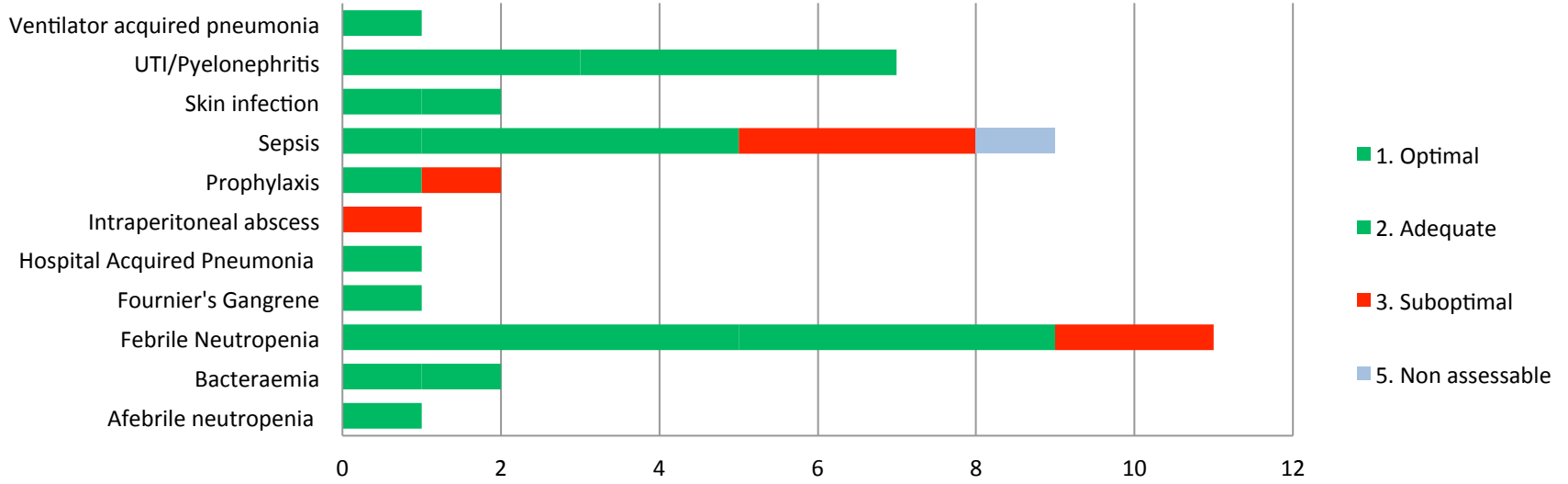
Clinical notes or comments

☐ Renal replacement therapy within the previous 24 hours;
eg. ☐haemodialysis ☐peritoneal dialysis ☐haemofiltration

Risk factors
☐ known colonisation with an ESBL or other multiresistant organism
☐ recent overseas travel
☐ recent ICU stay
☐ prolonged hospitalisation
☐ resident of a long term care facility
☐ recent broad spectrum antibiotics (within previous week)
List drug name and days of treatment

Appropriateness
1. Optimal
2. Adequate
3. Suboptimal
5. Not assessable

Appropriateness of Meropenem Use for Different Indications



Detailed auditing of meropenem identified reasons/ targets for action:

- Units
  - haematology a focus
- Allergies
  - not using cephalosporins when possible
- Directed therapy
  - Still narrower spectrum options available
- Prior ESBL colonisation
  - A possible driver – often >12 months ago

Outcome measures

Outcome measures

- Assumes that improved antimicrobial prescribing will result in better **patient outcomes** (morbidity, mortality)

- At a minimum, used as a **balancing measure** to ensure that patients are not harmed though changes to antimicrobial prescribing

- May be categorised as:
  - Clinical, Financial and Microbiological

Outcome measures

- Clinical
  - Length of hospital stay eg; pneumonia
  - Mortality eg: Gram negative bacteraemia
  - Surgical site infection rates
  - Treatment related toxicity e.g. aminoglycosides

- Financial
  - Cost effectiveness
  - Staffing for AMS, IT infrastructure vs Total hospital savings

- Microbiological
  - *Clostridium difficile* infection rates
  - Surveillance of antimicrobial resistance locally

Outcome measures

- Limitations
  - Rarely able to attribute these solely to AMS processes
  - They are confounded by other strategies
    - such as hand hygiene and infection control programs
    - general hospital and community education programs
  - They are confounded by outbreaks and seasonal variation in infections
    - rates of antimicrobial resistance in the community

Table 3. Length of stay and standardized mortality ratio by clinical infection group

	Length of stay (days)[a]					Standardized mortality ratio[b]			
	July 10–June 12		July 12–June 14			July 10–June 12		July 12–June 14	
Outcome measure[c]	Episodes	Median (IQR)	Episodes	Median (IQR)	*P* value	SMR (95% CI)	Actual/expected deaths	SMR (95% CI)	Actual/expected deaths
Respiratory infections	5489	4.8 (2.8–7.8)	5640	4.3 (2.5–7.1)	<0.01	1.10 (1.01–1.20)	534/485	0.75 (0.68–0.82)	436/584
Cellulitis	3696	3.2 (1.6–5.8)	3757	2.9 (1.2–5.0)	<0.01	0.55 (0.28–0.95)	12/22	0.66 (0.38–1.05)	17/26
Urinary and kidney infections	4323	3.3 (1.2–5.2)	4364	2.9 (1.0–5.2)	<0.01	0.78 (0.52–1.10)	30/39	0.63 (0.42–0.91)	29/46
Septicaemia	1610	6.8 (4.0–11.7)	2441	6.1 (3.5–10.9)	<0.01	1.25 (1.12–1.38)	350/281	0.80 (0.72–0.89)	359/450
Overall	224021	2.1 (0.6–5.6)	242,383	1.9 (0.5–5.0)	<0.01	1.19 (1.15–1.23)	3795/3193	0.90 (0.87–0.93)	3647/4063

[a]Codes for LOS used Australian refined diagnosis-related group definitions.
[b]Codes for SMR used principal diagnosis codes, based on International Classification of Diseases, 10th revision, Australian modification.
[c]Respiratory infections/inflammations, code E62; cellulitis, code J64; urinary and kidney infections, code L63; septicaemia, code T60; overall LOS excludes haemodialysis day admissions.

Before vs After AMS program 5 sites
Bond e al JAC April 2017

Auditing

Auditing

- Time consuming and resource intensive
  - Many audits go nowhere!
  - Choose what to audit carefully
  - Report things that are **able to be acted upon**

Target a few key issues that can be addressed within available resources

Auditing

- Audits should be:
  - Easy
  - Useful
  - Reportable
  - Actionable
  - Comparable
  - Reproducible

Auditing

- Think about why you are doing it
  - Smaller, regular audits can be very useful
    - Quality improvement audits – eg; 10 patients per month
  - Larger audits
    - Annual whole hospital point prevalence surveys
    - More generalisable, more comparable
    - May uncover new issues

- Do not agree to parameters that are unattainable
  - difficult to show reduction in antimicrobial resistance at a facility level

Auditing

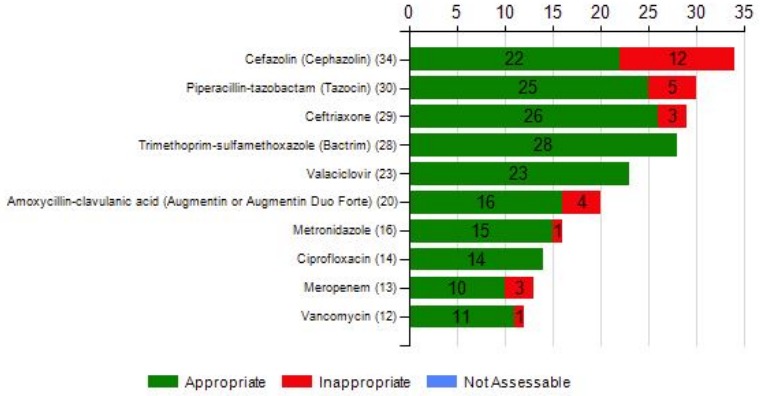
- Utilise established resources
  - Standardised
  - Validated
    - Antimicrobial Consumption Interactive Database (ESAC-Net) - European
    - National Antimicrobial Utilisation Surveillance Program (NAUSP) - Australian
    - National Antimicrobial Prescribing Survey (NAPS) - Australian

HOSPITAL NAPS National Antimicrobial Prescribing Survey

NCAS

Most commonly prescribed antimicrobials

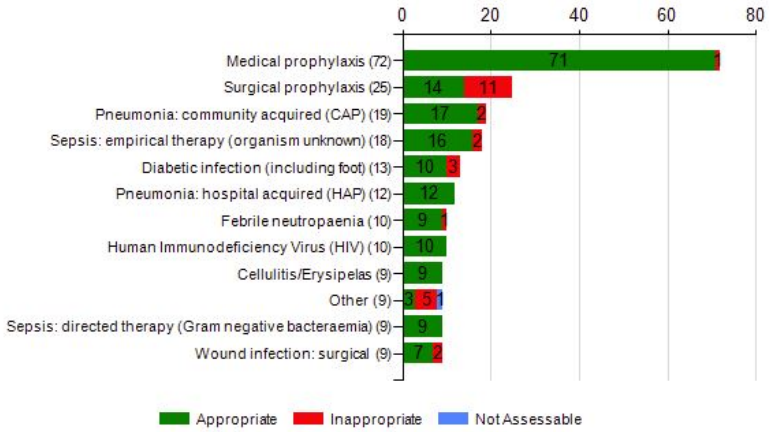
Total number of antimicrobial prescriptions: 345



Note: the total number of prescriptions is displayed next to each antimicrobial name.

Most common indications

Total number of antimicrobial prescriptions: 345



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NCAS

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Appropriateness definitions

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			If endorsed guidelines are present	If endorsed guidelines are absent
Appropriate	1	Optimal[1]	Antimicrobial prescription follows either the Therapeutic Guidelines[2] or endorsed local guidelines *optimally*, including antimicrobial choice, dosage, route and duration[3]	The antimicrobial prescription has been reviewed and endorsed by an infectious diseases clinician or a clinical microbiologist **OR** The prescribed antimicrobial will cover the likely causative or cultured pathogens ***and*** there is not a narrower spectrum or more appropriate antimicrobial choice, dosage, route or duration[3] available
	2	Adequate	Antimicrobial prescription does not optimally follow the Therapeutic Guidelines[2] or endorsed local guidelines, including antimicrobial choice, dosage, route or duration[3], however, is a ***reasonable*** alternative choice for the likely causative or cultured pathogens **OR** For surgical prophylaxis, as above ***and*** duration[3] is less than 24 hours	Antimicrobial prescription including antimicrobial choice, dosage, route and duration[3] is not the most optimal, however, is a ***reasonable*** alternative choice for the likely causative or cultured pathogens **OR** For surgical prophylaxis, as above ***and*** duration[3] is less than 24 hours
Inappropriate	3	Suboptimal	There may be a mild or non-life-threatening allergy mismatch **OR** Antimicrobial prescription including antimicrobial choice, dosage, route and duration[3], is an ***unreasonable*** choice for the likely causative or cultured pathogens, including: • spectrum excessively broad, unnecessary overlap in spectrum of activity, dosage excessively high or duration excessively long • failure to appropriately de-escalate with microbiological results	
	4	Inadequate	Antimicrobial prescription including antimicrobial choice, dosage, route or duration[3] is ***unlikely*** to treat the likely causative or cultured pathogens **OR** The documented or presumed indication does not require ***any*** antimicrobial treatment **OR** There may be a severe or possibly life-threatening allergy mismatch, or the potential risk of toxicity due to drug interaction **OR** For surgical prophylaxis, the duration[3] is greater than 24 hours (except where local guidelines endorse this)	
	5	Not assessable	The indication is not documented and unable to be determined from the notes **OR** The notes are not comprehensive enough to assess appropriateness **OR** The patient is too complex, due to multiple co-morbidities, allergies or microbiology results, *etc.*	

[1] Taking into account acceptable changes due to the patient's weight or renal function, if this information is available

[2] Antibiotic Expert Group. Therapeutic Guidelines: Antibiotic. Version 15 (2014), or online version

[3] Duration should only be assessed if the guidelines state a recommended duration and the antimicrobial has already been dispensed for longer than this, or if there is a clear planned 'end date' documented

Doc:nNAPS.AD.v6.1; 20161117

Comparing/ Benchmarking

National activity

- sense of common purpose
- comparison between similar hospitals/ similar units
- difficult without consistent definitions / guidelines

NAUSP

1. TOTAL HOSPITAL USE BY ANTIMICROBIAL CLASS

Total hospital antimicrobial utilisation rates for the period July 2004 to October 2011 are displayed in charts 1 and 2.

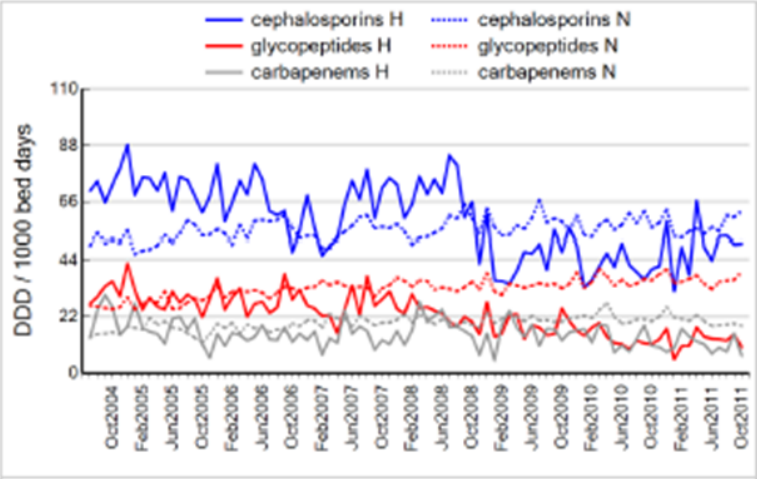


Chart1: Total hospital usage of 3rd/4th generation cephalosporins, glycopeptides and carbapenems.

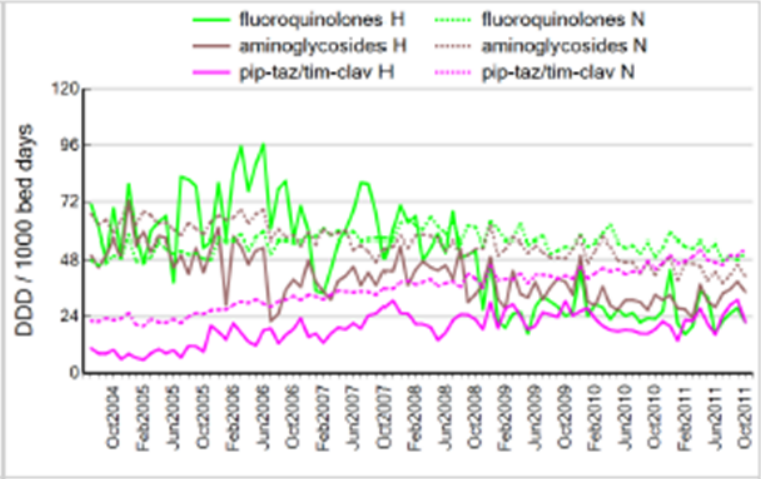
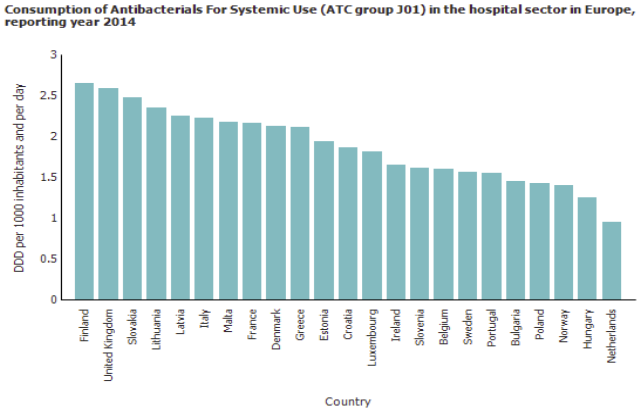
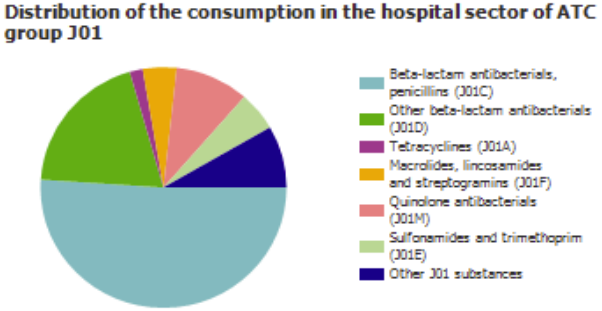
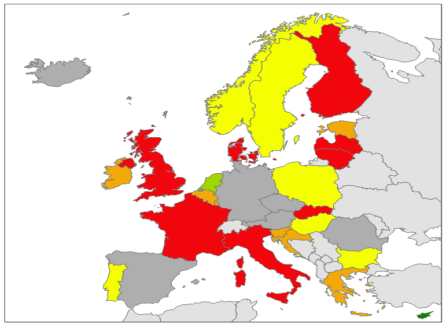


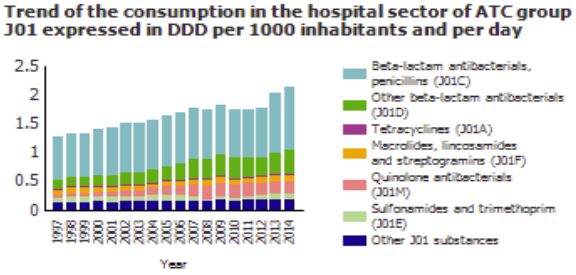
Chart2: Total hospital usage of fluoroquinolones, aminoglycosides and anti-pseudomonal penicillins plus ß-lactamase inhibitor.

ESAC-Net

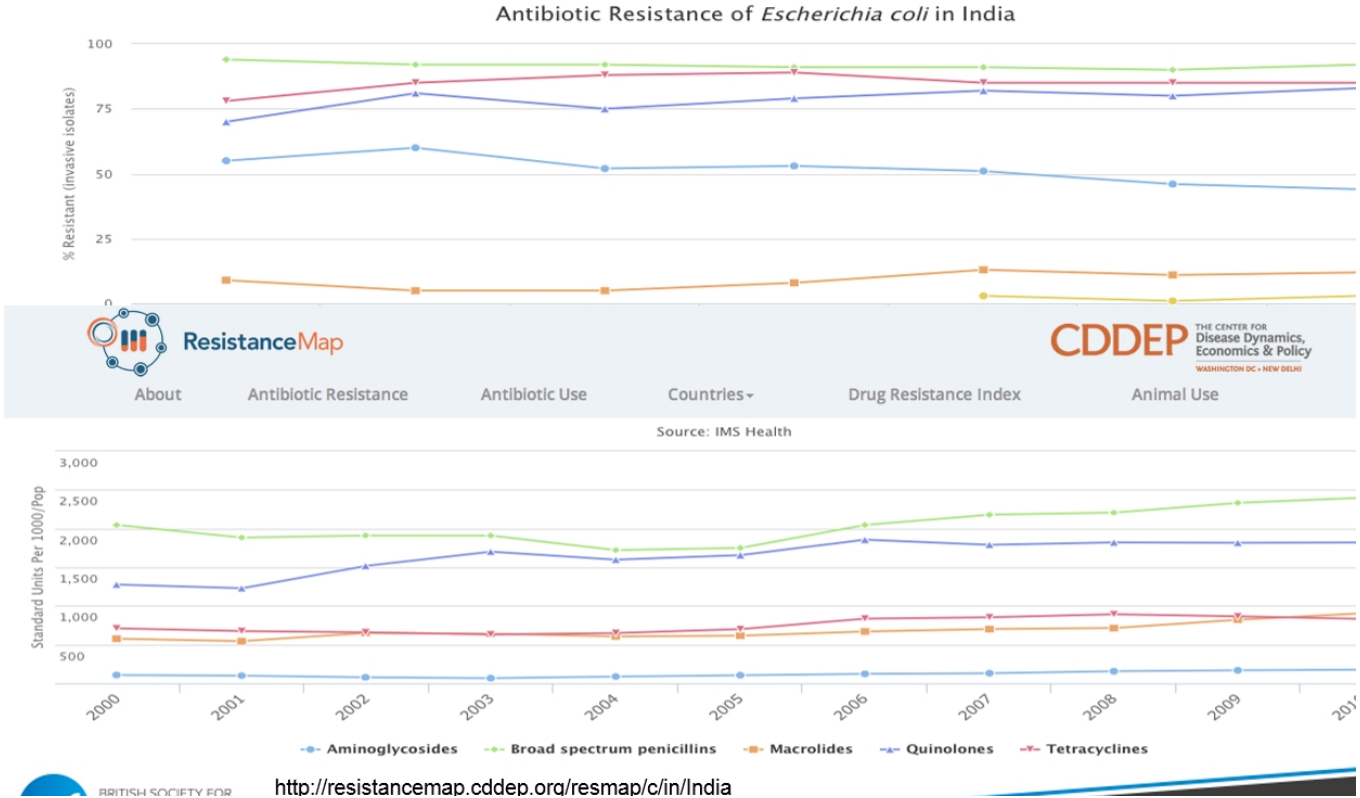

Consumption of Antibacterials For Systemic Use (ATC group J01) in the hospital sector in Europe, reporting year 2014
DDD per 1000 inhabitants and per day
3
2.5
2
1.5
1
0.5
0
Finland
United Kingdom
Slovakia
Lithuania
Latvia
Italy
Malta
France
Denmark
Greece
Estonia
Croatia
Luxembourg
Ireland
Slovenia
Belgium
Sweden
Portugal
Bulgaria
Poland
Norway
Hungary
Netherlands
Country


Distribution of the consumption in the hospital sector of ATC group J01
Beta-lactam antibacterials, penicillins (J01C)
Other beta-lactam antibacterials (J01D)
Tetracyclines (J01A)
Macrolides, lincosamides and streptogramins (J01F)
Quinolone antibacterials (J01M)
Sulfonamides and trimethoprim (J01E)
Other J01 substances




Trend of the consumption in the hospital sector of ATC group J01 expressed in DDD per 1000 inhabitants and per day
2.5
2
1.5
1
0.5
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year
Beta-lactam antibacterials, penicillins (J01C)
Other beta-lactam antibacterials (J01D)
Tetracyclines (J01A)
Macrolides, lincosamides and streptogramins (J01F)
Quinolone antibacterials (J01M)
Sulfonamides and trimethoprim (J01E)
Other J01 substances

Resistance map is an interactive collection of charts and maps that summerize national and subnational data on antimicrobial use and resistance worldwide.



http://resistancemap.cddep.org/resmap/c/in/India

Reporting and feedback

Reporting and feedback

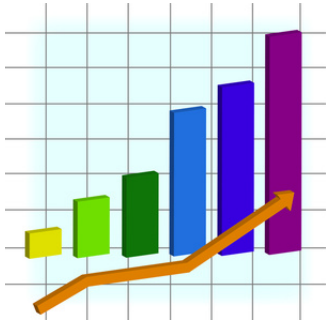
Reports

- To drug and therapeutic committee/ executive, external bodies, public reports

Ideally real time feedback is essential for change

- doctors rotate, difficult to remember individual patients
- seasonal variation, outbreaks

Discuss your findings – everyone learns!



Conclusion

Conclusion

- Measurement is essential for an AMS program
  - ensure continual quality improvement cycle
  - ensure prescribing is improving without unintended consequences
- Use established tools
  - standardised and validated
- Think hard about what you chose to audit
  - Time is wasted doing audits that are uninterpretable/ don't lead to change
- Try to compare
  - Motivation
- Have established mechanisms for reporting and feedback