What is a DoT?

Do we like it a lot?

Nadine Hillock

National Antimicrobial Utilisation Surveillance Program

Acknowledgment of country

We acknowledge the Traditional Owners of the lands we are on today and pay our respects to their Elders, past, present and emerging.

Overview: Surveillance of antimicrobial use & Days of Therapy (DoTs)

- Purpose of surveillance of antimicrobial use
- How are we currently quantitatively measuring usage in Australian hospitals?
- Alternative metrics
- The definition of a DoT
- Challenges of using DoTs for surveillance

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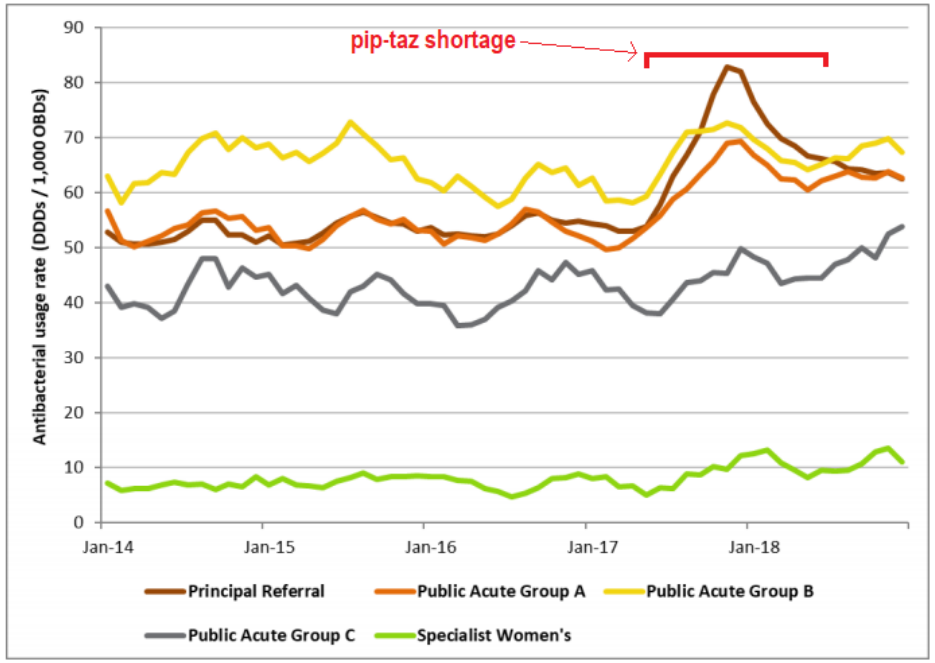
Why measure antimicrobial use?

- ***If you cannot measure it, you cannot improve it***
- Identify areas for more targeted interventions, or more detailed investigation of usage
- Trends over time –
  - Before and after interventions
  - Impact of shortages
  - Not always about decreasing use

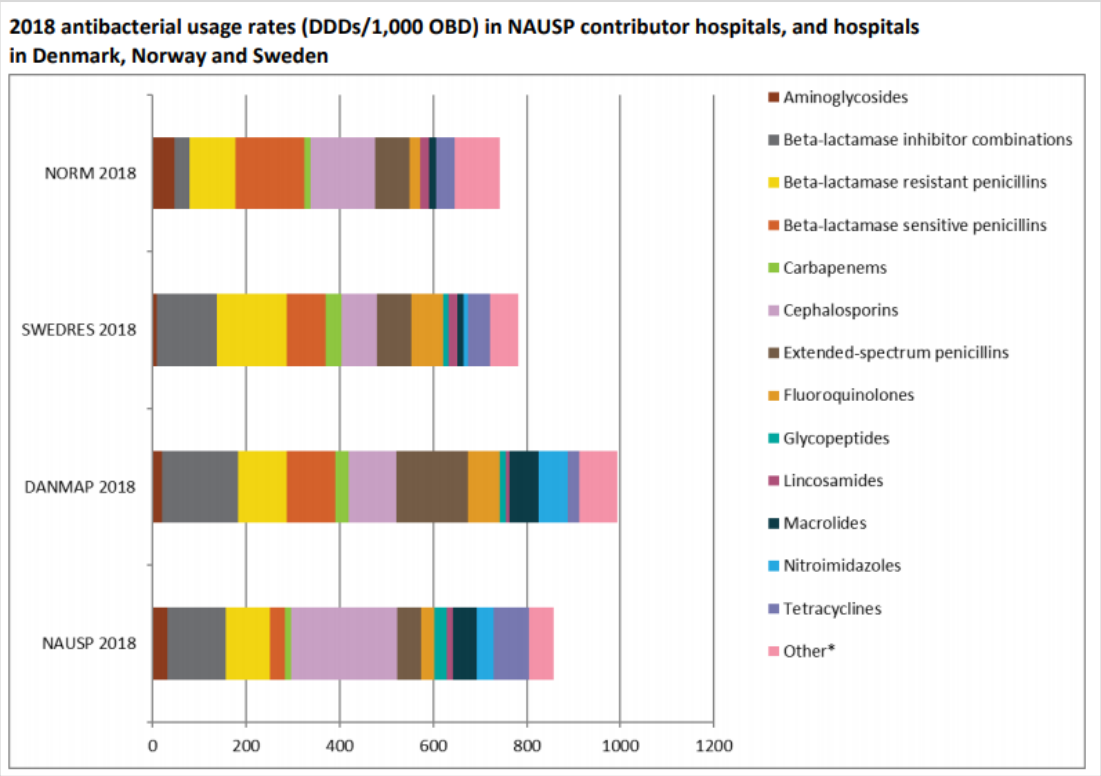
Figure 15: **Third- and fourth-generation cephalosporin usage rates in NAUSP contributor hospitals, by selected peer groups, 2014–2018 (3-month moving average)**



Source: Supplement: Biennial report of the NAUSP: 2017-2018

Why measure antimicrobial use?

- Benchmarking
  - Between hospitals, between units, between countries
  - Understanding change in comparison to others



Source: Supplement: Biennial report of the NAUSP: 2017-2018

Benchmarking internationally is limited to the countries using the same metric to quantify usage

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Surveillance to inform AMS & research

- Surveillance can help us ask better questions – target research
- Quantitative surveillance complements and informs qualitative surveillance
- Requires a standard unit of measure – usually expressed as a rate (or usage density):

$$\frac{\text{numerator}}{\text{denominator}} \rightarrow \frac{\text{measure of antimicrobial use}}{\text{number of opportunities for antimicrobial use}}$$

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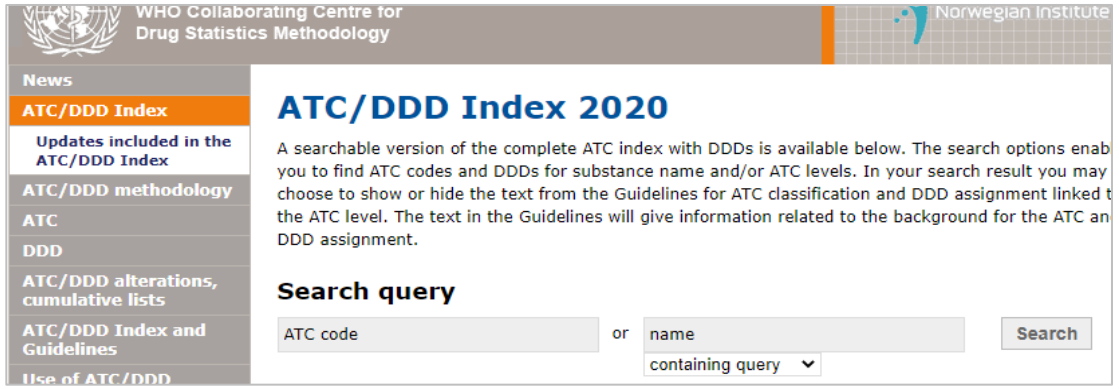
How do we currently quantify usage in hospitals?

- Volume-based surveillance, population data
- Antimicrobial usage rate = DDDs per 1,000 occupied bed days (OBDs)
  - Defined Daily Dose (DDD) specified by WHO ATC

    https://www.whocc.no/atc_ddd_index/



  - DDD = "*the assumed average maintenance dose per day for a drug used for its* ***main indication in adults***"
  - Surveillance definition: not intended to guide clinical dosing

What alternative metrics can be used?

- Many alternatives – what is optimal?
- Better information leads to better outcomes
- Systematic review to identify the “best” surveillance method

J Antimicrob Chemother 2018; **73** Suppl 6: vi50–vi58
doi:10.1093/jac/dky118

Journal of Antimicrobial Chemotherapy

Metrics for quantifying antibiotic use in the hospital setting: results from a systematic review and international multidisciplinary consensus procedure

Mirjana Stanić Benić [1,2]*, Romina Milanič[2], Annelie A. Monnier [3–5], Inge C. Gyssens[3,5], Niels Adriaenssens[6,7], Ann Versporten[6], Veronica Zanichelli[8], Marion Le Maréchal[9], Benedikt Huttner [8,10], Gianpiero Tebano[9], Marlies E. Hulscher[4], Céline Pulcini[9,11], Jeroen Schouten[4] and Vera Vlahović-Palčevski[1,2] on behalf of the DRIVE-AB WP1 group†

What alternative metrics can be used?

> Conclusion of the authors: “Antibiotic use should be preferable expressed in at least two metrics simultaneously”

Table 3. The final set of 12 evidence-based and consensually validated quantity metrics for antibiotic use in the inpatient setting

Inpatient quantity metric (IQM)
IQM 1: Defined daily doses (DDDs) per 100(0) PDs/BDs/OBDs[a]
IQM 2: Defined daily doses (DDDs) per admission
IQM 3: Defined daily doses (DDDs) per (100 bed-days per CMI[b])
IQM 4: Prescribed daily doses (PDDs) per 100 PDs
IQM 5: Days of therapy (DOT) per PD
IQM 6: Days of therapy (DOT) per patient
IQM 7: Days of therapy (DOT) per admission
IQM 8: Length of therapy (LOT) per admission
IQM 9: Length of therapy (LOT) per patient
IQM 10: Patients exposed to antibiotics per all patients
IQM 11: Patients exposed to antibiotics per admission
IQM 12: Antibiotic use should be preferably expressed in at least two metrics simultaneously

[a]100(0) patient-days (PD)/bed-days (BDs)/occupied bed-days (OBDs).
[b]CMI, case mix index. This is a relative value assigned to a diagnosis-related group of patients in a medical care environment.

Current metric in Australian hospitals

DoTs

Preferred option

What is a DoT?

- Definition of a Days of Therapy (DoTs)
  - ‘the aggregate sum of days for which any amount of a specific antimicrobial agent was administered to an individual patient as documented in the eMAR’
- Also known as ‘Antimicrobial days’
- Advantages:
  - Inclusive of paediatrics
  - Can benchmark against other countries where DoTs are commonly used

Other numerators

- LoT = Length of therapy
  - ‘Duration of antimicrobial exposure irrespective of the number of antimicrobials administered each day’
- More useful for patient-level monitoring than hospital level, e.g. by indication
- Can be used as a ratio with DoTs to provide an aggregate measure for combination therapy (DoT/LoT ratio)

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Advantages / Disadvantages of various numerators

	DDDs	DoTs	LoTs
Benefits	• Easily calculated • Does not require patient-level data • Can be used for cost calculations (because grams are measured) • Accounts for combination therapy	• Can be used for surveillance & benchmarking of paediatric usage • Not affected by dose	• Useful to monitor and inform AMS in specific specialty areas, or by indication
Limitations	• Adults usage only • Doesn't account for patients with altered pharmacokinetics • Over- or under-estimates where WHO reference DDD differs from administered dose	• Only days of administration counted (doesn't count if dosing interval >24hours) • Doesn't measure dose • Each drug is counted separately so a patient on combination therapy has double the DoTs compared to a patient on monotherapy	• Patient-level data required for calculation • Not drug specific

Denominators

- Occupied Bed Days (OBDs) - bed occupancy at midnight
  - Limitations: **allows surveillance of inpatient usage only**
  - No way of measuring usage in locations/specialties where no overnight stay
- Alternative denominators:
  - Theatre cases
  - ED presentations
  - Patient Days (PDs) – 'total number of days for all patients admitted for an episode of care and who separated during a specified reference period. A patient admitted and separated on the same day is allocated 1 PD' (AIHW)
    - Easily accessible administrative data
  - Separations
  - Admissions

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DoTs - definition and limitations

- Count DoTs by drug, or count DoTs by drug by route of administration?
- Illustrated by IV to oral switch
- Example 1: Same drug, different route
  - Flucloxacillin 1g IV 8am, then flucloxacillin 500mg po qid from 2pm for 5 days

	LoTs (cumulative)	DoTs (fluclox total)	DoTs (fluclox by route)
Day 1	1	1	2
Day 2	2	1	1
Day 3	3	1	1
Day 4	4	1	1
Day 5	5	1	1
Total	**5**	**5**	**6**

DoTs - definition and limitations

- Example 2: Combination therapy
  - E.g. Patient X on benzylpenicillin 1.2g IV every 6 hours for 5 days, and doxycycline 100mg orally twice daily for 5 days

	LoTs	DoTs
Day 1	1	2
Day 2	2	2
Day 3	3	2
Day 4	4	2
Day 5	5	2
Total	**5**	**10**

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DoTs - definition and limitations

- Example 3: Patient Y on gentamicin 80mg every 48 hours for 5 days

	LoTs	DoTs
Day 1	1	1
Day 2	2	0
Day 3	3	1
Day 4	4	0
Day 5	5	1
Total	**5**	**3**

- DoT surveillance only counts the **days of administration**

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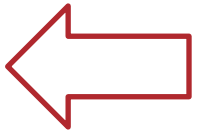
Sources of the data

- Pharmacy dispensing / distribution data
  - Current data source for DDDs
  - Not actual administration data
  - Supply ≠ consumption
- EMR – antimicrobial ordered (not administered)
- eMAR – antimicrobial administered



DoT data extraction

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Extracting data from EMR/eMAR

- Capability of NAUSP contributors – proportion with eMAR / EMR systems
- 231 hospitals currently / previously contributing data to NAUSP:
  - 119 (52%) have indicated some EMR / eMAR capacity
    - 66 have EMR with integrated eMAR
    - 13 EMR with separate eMAR
    - 23 eMAR with no EMR
    - 17 EMR with no eMAR

102 (44%) have some eMAR capability

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Extracting DoT data from eMAR

- Data fields required to extract DoTs at a patient level:
  - Patient identifier (name/MRN)
  - Date & time of administration of antimicrobial
  - Specialty of prescribing team
  - Antimicrobial name
  - Antimicrobial route of administration

- One data row represents one antimicrobial administered by patient by specialty, by route of administration

Hospital-level DoT data for National surveillance

- No patient identifiers
- Monthly aggregate of DoTs per antimicrobial, stratified by route of administration and specialty

AntimicrobialOrderedmapped	DateAdministered	DoseAdministered	UOMAdministered	RouteAdministered	DOTs	MappedSpecialty	Paediatric / Adult
flucloxacillin	08/01/2020 19:30	1000	mg	oral	1	Emergency	Adult
hydroxychloroquine	20/01/2020 11:14	200	mg	oral	1	Emergency	Adult
cefTRIAXONE	15/01/2020 07:43	1	g	intraVENOUS	1	Palliative care	Paediatric
doxycycline	05/01/2020 06:10	200	mg	oral	1	Emergency	Paediatric
cefTRIAXONE	05/01/2020 05:10	2	g	intraVENOUS	1	Emergency	Adult

- Can be aggregated by specialty when extracted from eMAR *or* can be summed by NAUSP portal
- Paediatric or adult use

Challenges of extracting data from eMAR or EMR

- Some sites have more that one eMAR system, e.g. different system in either ED or ICU
- Extraction time / formatting - may be long for larger sites (large data set)
- Patient identifiers need to be removed before data can be added into a national surveillance dataset
- Continuous infusions – variable methods of documentation in eMAR

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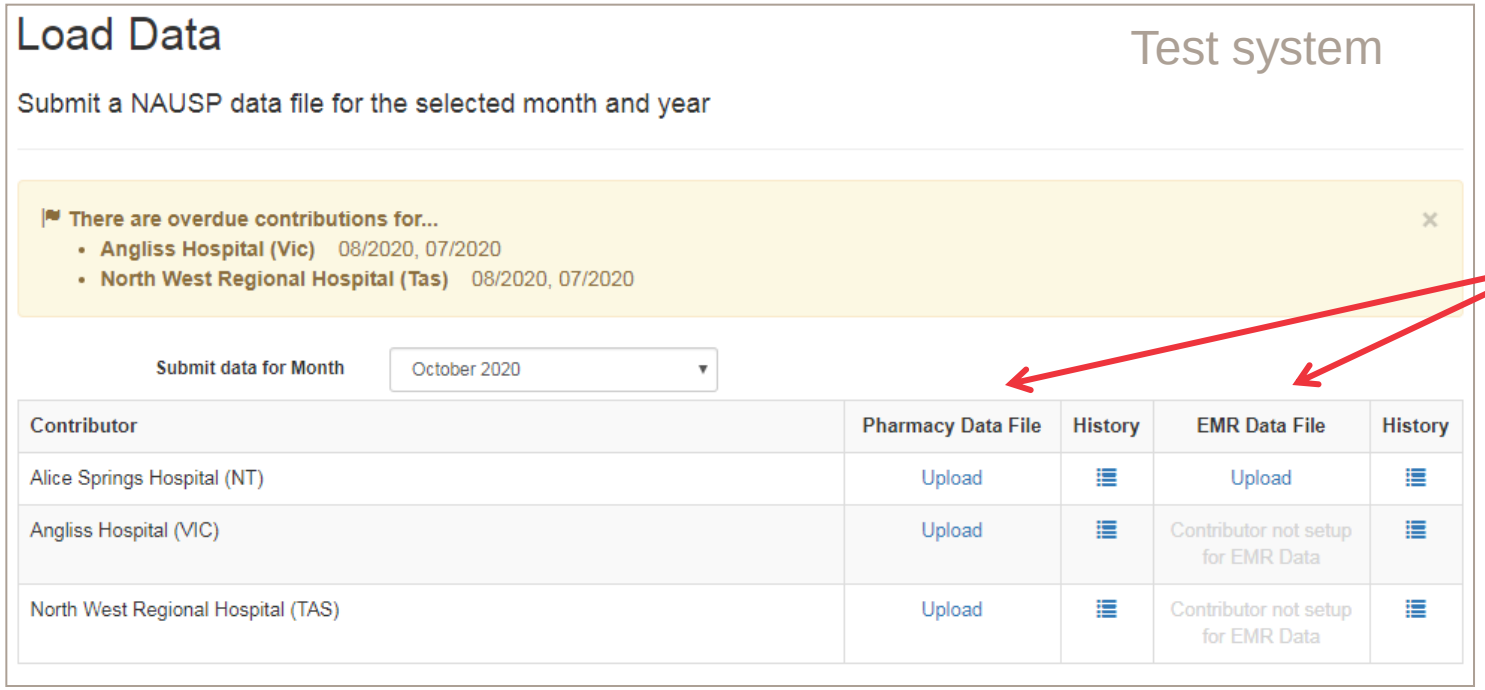
Challenges of collecting DoTs for national surveillance

- Many different EMR/eMAR systems across Australia – direct interface between the NAUSP portal & individual systems very resource intensive
- Monthly eMAR data extracts uploaded manually to the portal from each hospital



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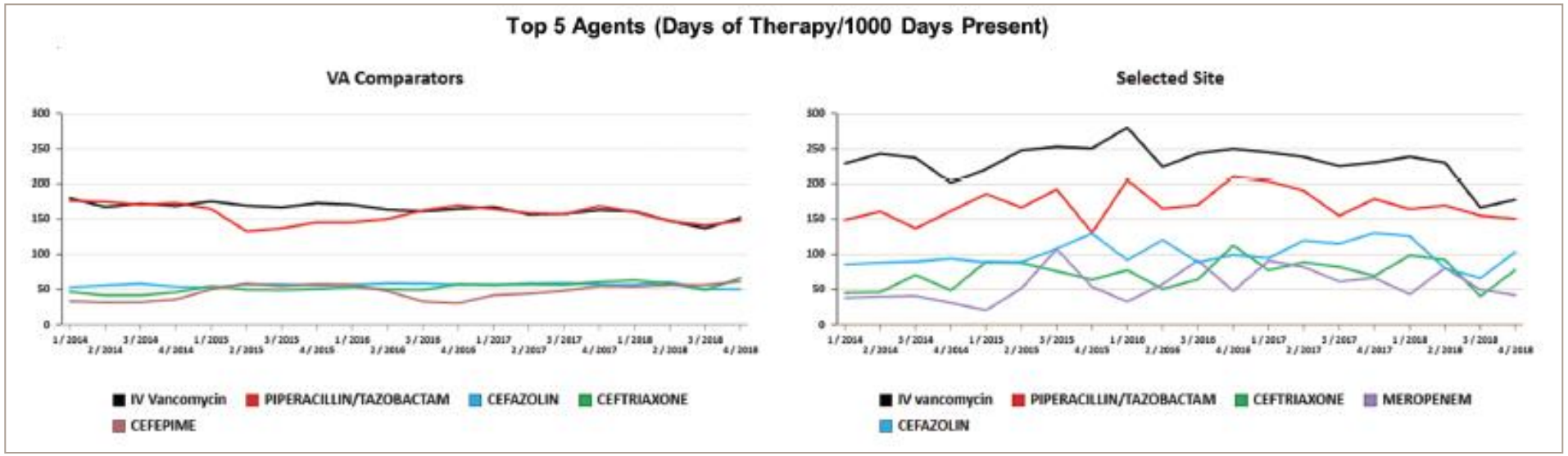
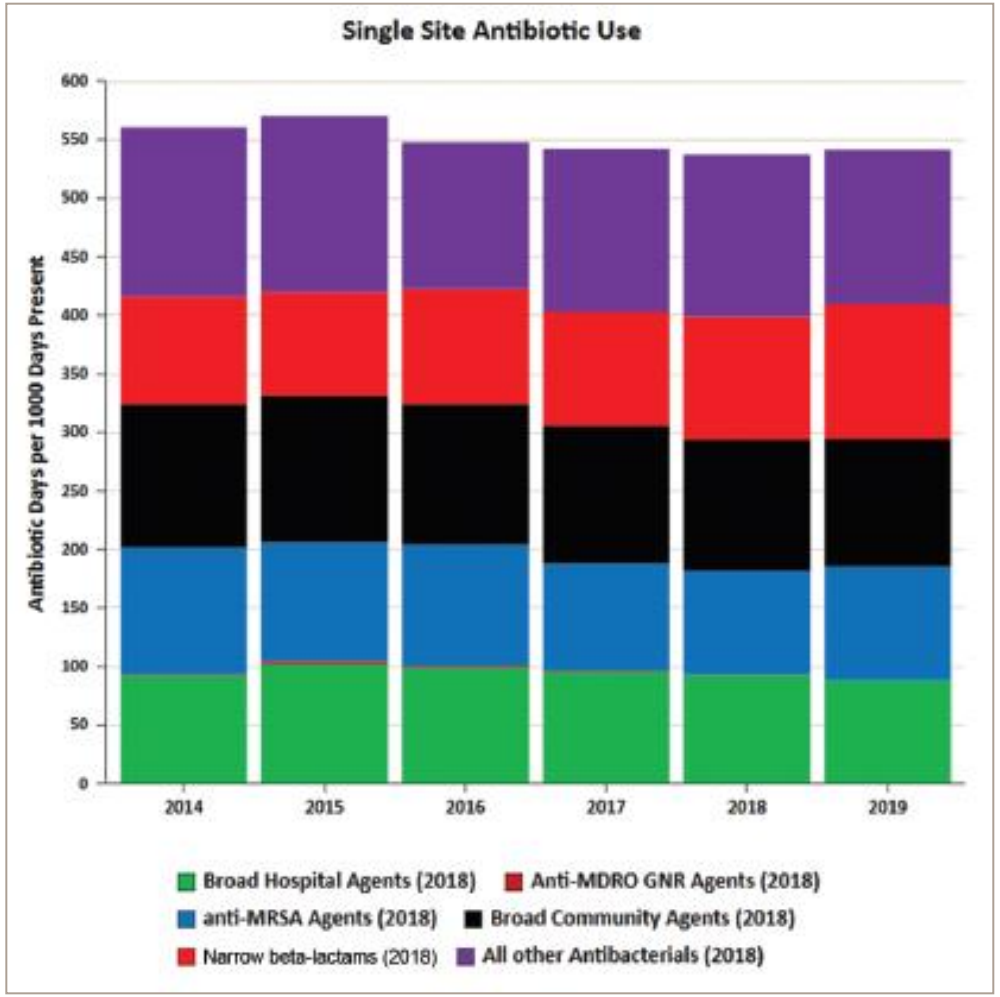
A DoT on a plot – is it hot, is it not?

- Surveillance data is not useful if we cannot interpret it
- Presentation of surveillance data - needs to be easy to understand, clinically relevant, timely
- Audience-specific, e.g. clinicians/prescribers, managers/policy-makers



Source: Graber, CJ., et al. CID 2020; 71(5): 1168-76

A DoT on a plot – is it hot, is it not?



Source: Graber, CJ., et al. CID 2020; 71(5): 1168-76

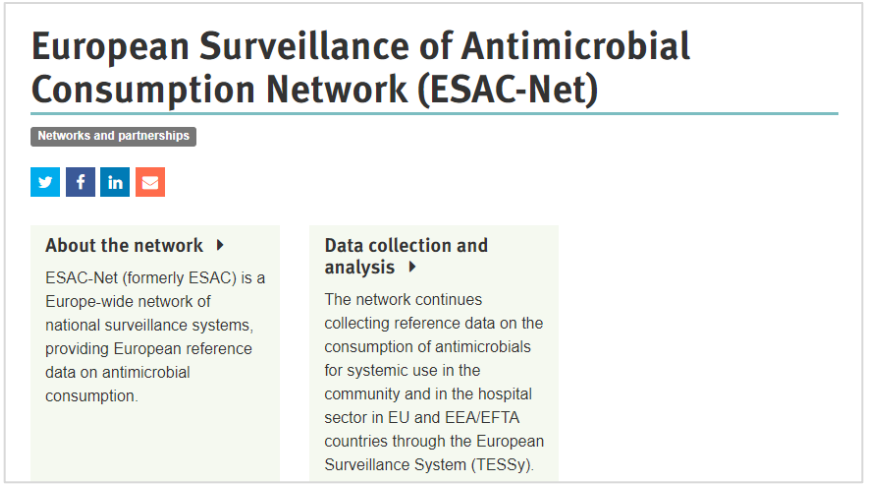
Benchmarking

- Inconsistent metrics used globally to quantify hospital usage
  - European countries favour DDDs as a numerator for comparative rates (and to measure total prescription volume)
  - USA – DOTs/ Days present (Patient days)
  - Japan – DDDs/1,000 inhabitants/day

Infection. 2018; 46(2): 207–214.
Published online 2017 Dec 22. doi: 10.1007/s15010-017-1097-x
PMCID: PMC5871632
PMID: 29273972

The first report of Japanese antimicrobial use measured by national database based on health insurance claims data (2011–2013): comparison with sales data, and trend analysis stratified by antimicrobial category and age group

Daisuke Yamasaki,[1] Masaki Tanabe,[✉1] Yuichi Muraki,[2] Genta Kato,[3] Norio Ohmagari,[4] and Tetsuya Yagi[5]



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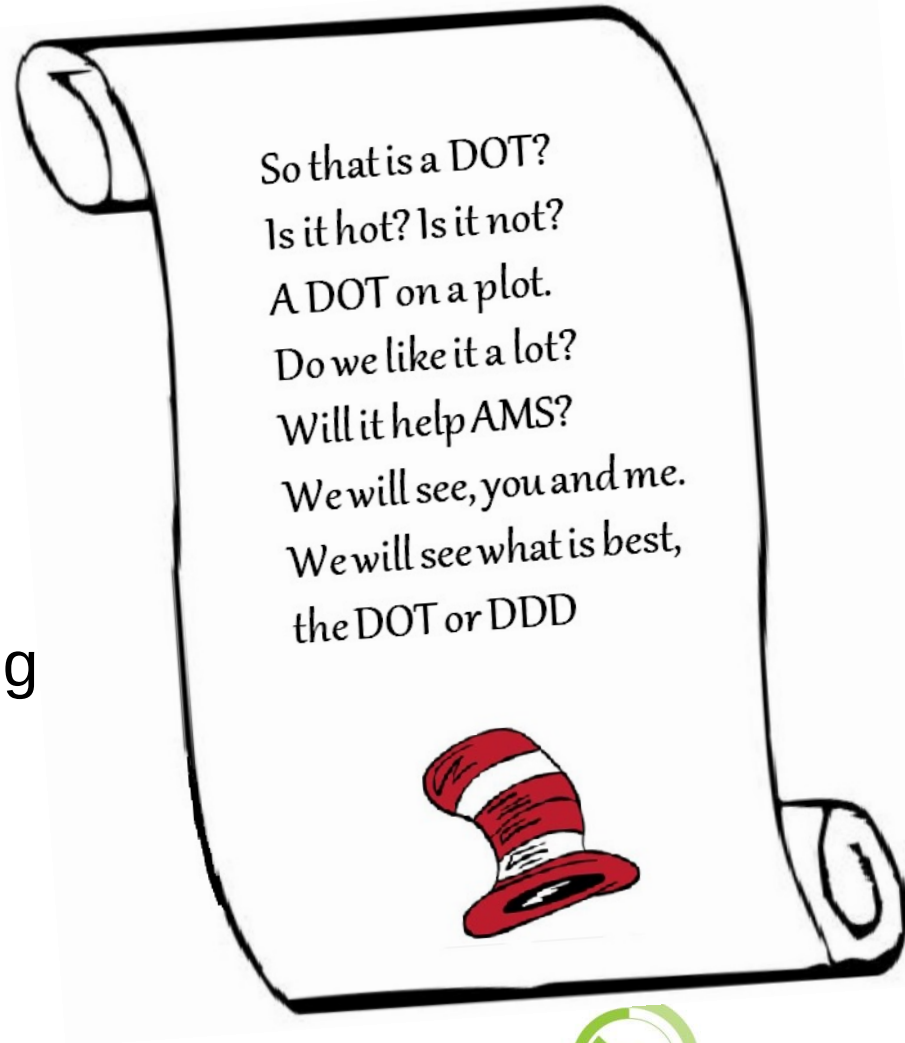
Conclusion: A DoT on a plot – do we like it a lot?

- No specific numerator or denominator is perfect – all have limitations
- Two metrics are better than one
- DoTs per Patient Days will allow surveillance and benchmarking of paediatric hospitals
- Many challenges to overcome in getting standardised data from the various eMAR systems



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