Public Health England

Protecting and improving the nation's health

English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) report 2019 to 2020

Annex

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Annex

Chapter 1: Introduction

None

Chapter 2: Antimicrobial resistance

Methods and caveats

Data on the antibiotic susceptibility of pathogens causing bacteraemia were obtained from SGSS (Second Generation Surveillance System), a national database maintained by Public Health England (PHE) that contains laboratory data supplied electronically by approximately 98% of hospital microbiology laboratories in England. SGSS comprises 2 modules, a communicable disease reporting (CDR; formerly CoSurv/LabBase2) module and an antimicrobial resistance (AMR; formerly AmSurv) module. The CDR module includes antimicrobial susceptibility test results for bloodstream isolates of the key pathogens being monitored as part of the UK 5-year AMR Strategy[1] covered in this report, although any test results suppressed from clinical reports by the sending laboratories are not captured when the data are submitted. In contrast, the AMR module contains more comprehensive antibiogram information as it includes results for all antibiotics tested (including results suppressed from clinical reports) for isolates from all clinical sources. However, when SGSS was launched in 2014, the AMR module had lower laboratory coverage than the CDR module. A comparison was undertaken for the ESPAUR report 2020 (summarised later in this section).

In previous ESPAUR Reports, hospital microbiology laboratories have reported antimicrobial susceptibility test results as “susceptible”, “intermediate” or “resistant”. These categories were defined as:

- Susceptible – a bacterial strain is said to be susceptible to a given antibiotic when its growth is inhibited in vitro by a concentration of the drug that is associated with a high likelihood of therapeutic success
- Intermediate – a bacterial strain is said to be intermediate when the concentration of antibiotic required to inhibit its growth in vitro is associated with an uncertain therapeutic outcome at standard antibiotic doses; it implies that an

[1] Advisory Committee on Antimicrobial Prescribing, Resistance and Healthcare Associated Infection Annual report 2015. Available online from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/707165/ARHAI_annual_report_2014_to_2015.pdf

infection due to the isolate may be appropriately treated in body sites where the antibiotic is physically concentrated or when a high dosage of drug can be used
- resistant – a bacterial strain is said to be resistant to a given antibiotic when the concentration required to inhibit its growth in vitro is associated with a high likelihood of therapeutic failure

The breakpoint criteria for categorising clinical isolates as susceptible, intermediate or resistant to individual antibiotics have changed over time. As noted in the ESPAUR report 2019[2], in 2019 the EUCAST definitions were amended to regroup the 'intermediate' category with those that are susceptible (with the standard dose), as, dosed appropriately, the antibiotic should still work for treatment.[3]

As patients may have more than one positive blood culture taken, blood cultures taken from the same patient that yielded growth of the same pathogen during a 14-day period from the initial positive blood culture were regarded as comprising the same episode of infection and were de-duplicated.

Data on the incidence of *E. coli*[4] and *S. aureus*[5] bacteraemia were from the national mandatory surveillance schemes while data on the incidence of other pathogens were derived from cases reported to the AMR module of SGSS. As the latter data were provided on a voluntary basis, case ascertainment will have been incomplete.

Antibiotic groupings used in the BSI antimicrobial susceptibility analyses within the report are:

- third-generation cephalosporins comprised cefotaxime, ceftazidime, cefpodoxime and ceftriaxone, unless otherwise indicated
- carbapenems comprised meropenem or imipenem, except where neither were tested, in which cases results for ertapenem were used if available; the exception was for *Pseudomonas* spp. where ertapenem was excluded
- the only aminoglycoside included was gentamicin
- fluoroquinolones are ciprofloxacin, unless otherwise defined
- glycopeptides comprised vancomycin and/or teicoplanin
- colistin included results recorded as polymyxin

[2] PHE. ESPAUR Report 2018-2019.
[3] European Committee on Antimicrobial Susceptibility Testing (EUCAST). New definitions of S, I and R. 2019. http://www.eucast.org/newsiandr/. Accessed 20 August 2019
[4] PHE. Mandatory Surveillance of *E. coli* bacteraemia annual report. Available: https://www.gov.uk/government/collections/escherichia-coli-e-coli-guidance-data-and-analysis
[5] PHE. Mandatory Surveillance of *S. aureus* bacteraemia annual report. Available: https://www.gov.uk/government/collections/staphylococcus-aureus-guidance-data-and-analysis

Population data used within the chapter were taken from the Office for National Statistics annual mid-year population estimates published data for the corresponding geographic region and year.[6]

SGSS module comparison

Overall there has been an improvement in the comparable number of bloodstream infection (BSI) 14-day patient organism episodes for key pathogens reported to the AMR module (annex table 2.3).

In 2019, an additional 307 antibiotic-resistant BSIs were identified using the AMR module (annex table 2.1) to estimate the burden of AMR (see below); this equated to an increase of 0.2% in the proportion of infections caused by resistant organisms (annex table 2.2). This Report marks the first time that five-year trend data were derived from the AMR module of SGSS.

[6] Office for National Statistics. Mid-year Population Estimates.

Annex Table 2.1. Comparison of the numbers of bacteraemia episodes identified in England using the CDR and from AMR modules of SGSS; 2015 to 2019

Pathogen	2015		2016		2017		2018		2019	
	CDR	AMR	CDR	AMR	CDR	AMR	CDR	AMR	CDR	AMR
E. coli	30,415	28,361	33,645	32,897	35,241	35,218	36,512	36,350	38,547	37,531
K. pneumoniae	5,431	5,158	6,384	6,353	6,601	6,704	6,745	6,891	7,376	7,328
K. oxytoca	1,314	1,319	1,347	1,415	1,528	1,569	1,513	1,527	1,669	1,646
Acinetobacter spp.	791	828	867	899	862	949	846	913	937	989
Pseudomonas spp.	3,779	3,499	3,986	3,960	4,419	4,468	4,249	4,315	4,483	4,533
Enterococcus spp.	5,889	5,706	6,684	6,719	6,854	7,020	7,096	7,269	7,537	7,491
S. pneumoniae	4,200	3,654	4,813	4,578	4,787	4,675	5,078	4,992	5,055	4,844
Percentage difference	**94%**		**98%**		**101%**		**100%**		**98%**	

Annex Table 2.2. The difference in the estimated numbers of antibiotic-resistant BSIs obtained by using the AMR module in place of the CDR module; 2015 to 2019

Pathogen	2015	2016	2017	2018	2019
E. coli	-69	182	177	65	126
K. pneumoniae	-30	-29	34	73	49
K. oxytoca	10	12	17	6	10
Acinetobacter spp.	15	-11	10	2	13
Pseudomonas spp.	8	1	38	35	39
Enterococcus spp.	10	91	90	120	61
S. aureus	0	0	0	0	0
S. pneumoniae	-13	-18	-2	14	9
total annual difference	**-68**	**229**	**364**	**314**	**307**

Annex Table 2.3. The burden of AMR expressed as the overall proportion of BSIs resistant to antibiotic combinations* as identified in SGSS CDR and AMR; 2015 to 2019

Pathogen	2015		2016		2017		2018		2019	
	CDR	AMR	CDR	AMR	CDR	AMR	CDR	AMR	CDR	AMR
E. coli	26.8%	26.6%	26.3%	26.8%	28.1%	28.6%	29.5%	29.7%	29.9%	30.2%
K. pneumoniae	16.8%	16.1%	17.7%	17.0%	19.9%	20.1%	23.0%	23.3%	23.8%	23.9%
K. oxytoca	4.8%	5.0%	7.3%	7.5%	6.8%	7.5%	9.2%	9.4%	7.2%	7.7%
***Acinetobacter* spp.**	3.1%	4.2%	4.3%	3.0%	4.4%	4.9%	3.7%	3.6%	3.0%	3.9%
***Pseudomonas* spp.**	7.1%	6.8%	8.6%	8.4%	8.5%	9.2%	7.7%	8.3%	9.1%	9.6%
***Enterococcus* spp.**	17.1%	16.6%	14.5%	15.2%	14.0%	14.8%	15.2%	16.2%	15.0%	15.4%
S. aureus	7.4%	7.4%	6.6%	6.6%	6.6%	6.6%	6.7%	6.7%	6.0%	6.0%
S. pneumoniae	1.6%	1.5%	2.0%	1.7%	1.3%	1.3%	1.5%	1.7%	1.5%	1.7%
Overall resistance	**18.3%**	**18.1%**	**18.0%**	**18.2%**	**19.0%**	**19.3%**	**20.1%**	**20.4%**	**20.4%**	**20.6%**

* as defined in annex table 2.5

Limitations and caveats

In England, the mandatory surveillance scheme for *E. coli* bacteraemia does not include susceptibility testing data, which is collected through a parallel voluntary laboratory reporting system. Comparison of the incidence reported between the 2 systems indicated that the ascertainment achieved in the laboratory reporting system was 86% in 2019 (76% in 2015) and varied by local geography across the country.

Annex Table 2.4 Ascertainment factor applied to estimate total number of resistant bloodstream infection

Year	Mandatory *E. coli* bacteraemia reports	SGSS *E. coli* bacteraemia reports	% ascertainment
2015	37,402	28,361	76%
2016	40,329	32,897	82%
2017	41,314	35,218	85%
2018	42,542	36,350	85%
2019	43,641	37,531	86%

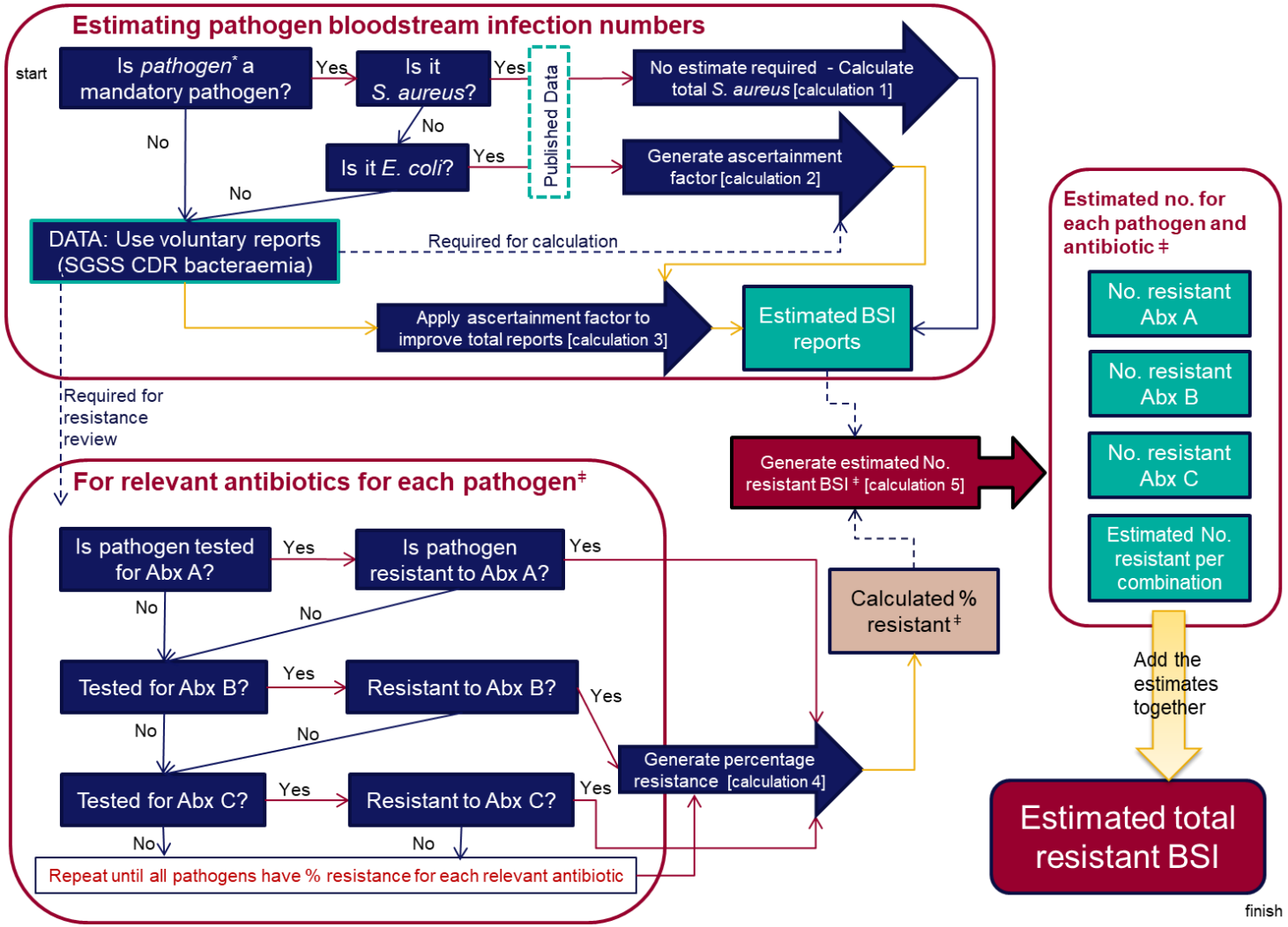
Since 2017 reporting of bacteraemia caused by *Klebsiella* spp. and *Pseudomonas aeruginosa* was also mandatory. Initial reviews of ascertainment between the mandatory and voluntary surveillance schemes for each pathogen were assessed for 2018 as 80% (*K. pneumoniae* only) and 84%, respectively.

Estimating the burden of antibiotic-resistant bloodstream infections

Data used to update the key drug/bug summaries within the ESPAUR report were utilised to generate a preliminary estimated burden of resistant bacteraemia in England. The total number of resistant infections is generated by calculating the proportion of each pathogen that were reported as resistant to one or more specific antibiotics and ensuring that that infection report is not counted in any subsequent antibiotic combinations to avoid double counting (process summarised in Annex figure 2.1, with a full list of pathogen and antibiotic combinations in Annex table 2.5).

For each year, the ascertainment level of cases of *E. coli* bacteraemia reported on a voluntary basis to the AMR module of SGSS was estimated by comparison with mandatory surveillance reports (Annex table 2.4). This value was then applied to the other pathogens under surveillance to estimate the total number of BSIs for each pathogen each year (except for *S. aureus* where the mandatory surveillance totals for both methicillin-resistant *S. aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA) were used).

Annex Figure 2.1. Flow diagram for generating the burden of resistant bloodstream infections (BSI) estimates



* full list of pathogens in annex table 2a.3 (next page); full list of numbered 'Calculations' in Annex Box 2.1
‡ per pathogen and antibiotic combination, full list in annex table 2a.3 (next page), all estimates are for a given time frame

Text alternative for Annex Figure 2.1. flow diagram for generating the burden of resistant bloodstream infections (BSI) estimates

Estimating pathogen BSI numbers

Question 1: Is *pathogen*[*] a mandatory pathogen?

- Yes: Go to question 2
- No: Go to DATA: Use voluntary reports (SGSS CDR bacteraemia), Generate ascertainment factor [calc box 2], Apply ascertainment factor to improve total reports [calc box 3], Estimated BSI reports, Generate estimated No. resistant BSI [ǂ] [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ

Question 2: Is it S. aureus?

- Yes: No estimate required - Calculate total *S. aureus* [calc box 1], Estimated BSI reports, Generate estimated No. resistant BSI [ǂ] [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- No: Go to Question 3

Question 3: Is it E.coli?

- Yes: Generate ascertainment factor [calc box 2], Apply ascertainment factor to improve total reports [calc box 3], Estimated BSI reports, Generate estimated No. resistant BSI [ǂ] [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- No: Go to DATA: Use voluntary reports (SGSS CDR bacteraemia)

DATA: Use voluntary reports (SGSS CDR bacteraemia)

- Required for calculation: Generate ascertainment factor [calc box 2], Apply ascertainment factor to improve total reports [calc box 3], Estimated BSI reports, Generate estimated No. resistant BSI [ǂ] [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- Not required for calculation: Apply ascertainment factor to improve total reports [calc box 3], Estimated BSI reports, Generate estimated No. resistant BSI [ǂ] [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- Required for resistance review: See ‘For relevant antibiotics for each pathogen’ text flow chart

For relevant antibiotics for each pathogen

Question 1: Is pathogen tested for Abx A?

- Yes: Question 2
- No: Question 3

Question 2: Is pathogen resistant to Abx A?

- Yes: Generate percentage resistance [calc box 4], Calculated % resistant ǂ , Generate estimated No. resistant BSI ǂ [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- No: Question 3

Question 3: Tested for Abx B?

- Yes: Question 4
- No Question 5

Question 4: Resistant to Abx B?

- Yes: Generate percentage resistance [calc box 4], Calculated % resistant ǂ , Generate estimated No. resistant BSI ǂ [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- No: Question 5

Question 5: Tested for Abx C?

- Yes: Question 6
- No: Repeat until all pathogens have % resistance for each relevant antibiotic. Generate percentage resistance [calc box 4], Calculated % resistant ǂ , Generate estimated No. resistant BSI ǂ [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ

Question 6: Resistant to Abx C?

- Yes: Generate percentage resistance [calc box 4], Calculated % resistant ǂ , Generate estimated No. resistant BSI ǂ [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ
- No: Repeat until all pathogens have % resistance for each relevant antibiotic. Generate percentage resistance [calc box 4], Calculated % resistant ǂ , Generate estimated No. resistant BSI ǂ [calc box 5]. See Estimated no. for each pathogen and antibiotic ǂ

Estimated no. for each pathogen and antibiotic ǂ

- No. resistant Abx A
- No. resistant Abx B
- No. resistant Abx C
- Estimated No. resistant per combination

Adding the estimates together equals the estimated total resistant BSI.

Annex Table 2.5 Bacteria and antibiotic resistance categories included in the AMR burden analysis

Pathogen	Antibiotic resistance
Escherichia coli	Carbapenem-resistant
	Third-generation cephalosporin-resistant (excluding isolates also resistant to carbapenem)
	Aminoglycoside-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin)
	Fluoroquinolone-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin and/or aminoglycoside)
Klebsiella pneumoniae	Carbapenem-resistant
	Third-generation cephalosporin-resistant (excluding isolates also resistant to carbapenem)
	Aminoglycoside-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin)
	Fluoroquinolone-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin and/or aminoglycoside)
Klebsiella oxytoca	Carbapenem-resistant
	Third-generation cephalosporin-resistant (excluding isolates also resistant to carbapenem)
	Aminoglycoside-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin)
	Fluoroquinolone-resistant (excluding isolates also resistant to carbapenem and/or third-generation cephalosporin and/or aminoglycoside)
Acinetobacter spp.	Carbapenem-resistant
	Aminoglycoside- and fluoroquinolone-resistant (excluding isolates also resistant to carbapenem)
Pseudomonas spp.	Carbapenem-resistant
	Resistant to three or more antimicrobial groups (excluding isolates also resistant to carbapenem)
Enterococcus spp.	Glycopeptide-resistant
Staphylococcus aureus	Meticillin-resistant
Streptococcus pneumoniae	Penicillin- and macrolide-resistant (excluding isolates only resistant to penicillin)
	Penicillin-resistant (excluding isolates also resistant to macrolides)

Annex Box 2.1 - Summary of calculations referenced in the flow diagram

All data used in each calculation should be for a comparable geography and time frame

- Calculation 1
  Total *S. aureus* = $no.MRSA\ mandatory\ reports\ +\ no.MSSA\ mandatory\ reports$

- Calculation 2
  Ascertainment factor (%) = $(no.E.coli\ mandatory\ reports \div no.E.coli\ voluntary\ reports)\ \times 100$

- Calculation 3
  Estimated BSI reports = $no.voluntary\ BSI\ reports\ \times\ \%\ ascertainment\ factor$

- Calculation 4
  Resistance (%) = $(no.resistant\ reports‡\ \div no.tested\ reports‡)\ \times 100$

- Calculation 5
  Estimated no. resistant = $\%\ resistance\ \times\ [estimated]\ BSI\ reports$

‡ per pathogen and antibiotic combination in each time frame (**Annex Table 2.5)**

Chapter 3: Carbapenemase-producing Enterobacterales

None

Chapter 4: Antibiotic consumption

Data sources

Primary care
Information on prescribing of antibiotics in the community was obtained from the PHE Antibiotic Prescribing Data Warehouse, a project initiated by the ESPAUR Oversight Group. Data is sourced from the NHS Digital database and are extracted each month as a snapshot in time from the GP Payments system.

Age-group data for primary care was obtained from ePACT2 from NHS BSA. A small proportion of age are unknown (2.6%), for details on patient age determination please see ePACT2's webpage[7]. Where record age is missing, it is not included in the analysis.

Primary care prescribing data includes antibiotic prescribed from general practice and other community settings such as out-of-hours services and walk-in centres. The full list of primary care prescribing settings is provided in the annex.

Dental care
Information on the use of antibiotics prescribed in NHS dental surgeries was obtained from NHS BSA through data requests.

Secondary care
Information on the use of antibiotics in secondary care was obtained from IQVIA (formerly QuintilesIMS, formed from the merger of IMS Health and Quintiles). The database held by IQVIA contains information from 99.0% of NHS hospital pharmacy systems for drugs dispensed to individual patients and wards. Data from all NHS acute Trusts were included, and organisational changes are reflected up to the latest year of data provided in the report. Trusts can amend their prescribing data for up to a period of 2 years, hence data for the last 2 years is provisional and is subject to change.

[7] NHS BSA. ePACT2. Available: https://www.nhsbsa.nhs.uk/epact2

All data presented in this chapter in Figures and Tables are available as a web Appendix in Excel format and a Figures slide set annex.

Classification of prescribing data

The classification of antibiotics for this report is based on the Anatomical Therapeutic Chemical / Daily Defined Dose (ATC/DDD) index 2019 managed by the World Health Organization (WHO) Collaborating Centre for Drug Statistics Methodology.[8] Data covered all antibiotics in the ATC group 'J01', (antibiotics for systemic use) and 3 additional oral agents outside the 'J01' group used to treat *Clostridium difficile* infections, fidaxomicin (A07AA12), metronidazole (P01AB01) and vancomycin (A07AA09).

Third level pharmacological sub-grouping within ATC group 'J01'
Penicillins ("β-lactam antibacterials, penicillins") include extended-spectrum penicillins, β-lactamase sensitive and resistant penicillins, and β-lactamase inhibitors either alone or in combination with penicillins.

"Other β-lactam antibacterials" includes cephalosporins, carbapenems, and monobactams.

Anti-*Clostridioides difficile* (formerly *Clostridium difficile*) agents include: oral vancomycin (ATC code: A07AA09) and fidaxomicin (ATC code: A07AA12). Oral metronidazole (ATC code: P01AB01) has been separated from this group, as opposed to previous years, following feedback from stakeholders.

"Other antimicrobials" (ATC 3rd level pharmacological subgroup 'J01X') includes glycopeptides, polymyxins, steroid antibacterials, imidazole derivatives, nitrofuran derivatives, and other antimicrobials: fosfomycin, methenamine, linezolid, daptomycin and tedizolid.

ATC/DDD methodology
The ATC system aims to identify the active therapeutic ingredient of all human medicines and assigns drugs a measure of use known as the DDD, which is the assumed average maintenance dose per day for a drug used for its main indication in adults. It is important to note however that while the DDD is used as a unit of measurement of drug use, it does not necessarily reflect the recommended or prescribed daily doses used in practice as therapeutic doses for individual patients may

[8] WHO Collaborating Centre for Drug Statistics Methodology. ATC/DDD Index 2019. 2018. Available: https://www.whocc.no/atc_ddd_index/

vary depending on characteristics such as age, weight, ethnic differences, type and severity of disease and pharmacokinetic considerations.

Denominators

Mid-year populations (inhabitants) for each year were extracted from the Office National Statistics (ONS).[9] Hospital admission data for each year was extracted from Hospital Episode Statistics (HES)[10] from NHS Digital. HES 2019/20 admissions data is provisional and will be updated as finalised data becomes available.

Trend analysis

National trends in the consumption of antibiotics were assessed using linear regression; the dependent variable was antibiotic consumption in DDD per 1,000 inhabitants per day and the explanatory variable being year. A statistically significant trend ($p<0.05$) is denoted with the inclusion of $^{+}$. STATA 15 was used in all analysis.

Other community settings categories

Other community settings to category look-up table

Other Community Settings	Setting Category
Other	Other
Walk-in Centre	Walk-in Centre
Out-of-hours	Out-of-hours
WIC and OOH Practice	Out-of-hours
Public Health Service	PH Service
Community Health Service	Community Service
Hospital Service	Hospital
Optometry Service	Other
Urgent & Emergency Care	Urgent Care
Hospice	Hospice
Care Home / Nursing Home	Nursing Home
Border Force	No data reported
Young Offender Institution	Custody
Secure Training Centre	No data reported

[9] Office for National Statistics. Population estimates. Available online from: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates
[10] NHS Digital. Hospital Episode Statistics (HES). Available online from: https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics

Secure Children's Home	Custody
Immigration Removal Centre	Custody
Court	No data reported
Police Custody	No data reported
Sexual Assault Referral Centre	No data reported
Other – Justice Estate	No data reported
Prison	Custody

Trusts definitions

Trusts definitions in the ESPAUR report are based on the Estates Returns Information Collection (ERIC) 2018/19.[11]

Trust	Definition
Acute Small/Medium/Large	Sites that provides a range of inpatient medical care and other related services for surgery, acute medical conditions or injuries (usually for short-term illnesses or conditions). Treatment Centres providing inpatient facilities are classed as General Acute Hospitals.
Acute Teaching	Sites that are a hospital that provides clinical education and training to future and current health professionals. Teaching hospitals work closely with medical students throughout their period of matriculation, and especially during their clerkship (internship) years.
Acute Specialist	Sites that undertake a single specialist function, inclusive of Oncology, Orthopaedics, Dental Hospital, Maternity Hospital, Children's Hospital, and Cardio/Thoracic. This category excludes specialist hospitals in the Mental Health or Learning Disabilities sector.
Acute Multiservice	Sites where 2 or more functions are provided by the same provider. Such functions would include any combination of single speciality, acute services, community services, mental health services and learning disabilities services.

[11] NHS Digital. Hospital Estates and Facilities Statistics. Available online from: https://digital.nhs.uk/data-and-information/areas-of-interest/estates-and-facilities/hospital-estates-and-facilities-statistics

Department speciality

Department speciality to department group look up table.

Department Speciality	Department Group
Mixed Outpatient Clinics	AE/Non-specific out-patient department
Aseptic unit	AE/Non-specific out-patient department
A & E	AE/Non-specific out-patient department
Psychogeriatric	Geriatrics
Geriatrics	Geriatrics
Intensive Care	Intensive Care Unit
Dermatology	General Medicine
Respiratory/ Chest/ Asthma clinic	General Medicine
Cardiology	General Medicine
Gastroenterology	General Medicine
Coronary care	General Medicine
Rheumatology	General Medicine
Thoracic/ Chest medicine	General Medicine
General Medicine	General Medicine
Endocrinology	General Medicine
Obstetrics & Gynaecology	Obstetrics and gynaecology
Fertility /Genetics	Obstetrics and gynaecology
Orthopaedics	Orthopaedics
Pain Clinic	Other
Radiology	Other
Physiotherapy	Other
Physically Disabled	Other
Rehabilitation/Long stay unit	Other
Pathology Lab	Other
Mental Handicap	Other
Occupational Health	Other
Learning Disabilities	Other
Child Adolescent Psychiatry	Other
Other Wards/ Units	Other
Psychiatry / Mental Illness	Other
Psychiatric Day Hospital	Other
Paediatric ICU	Paediatrics
Neonatal Unit	Paediatrics
Paediatric / Paediatric Surgery	Paediatrics

Acute Internal Medicine	Specialist medicine
Medical Oncology	Specialist medicine
Clinical Oncology (Radiotherapy)	Specialist medicine
A.I.D.S Unit	Specialist medicine
Infectious dis./Isolation	Specialist medicine
Renal Medicine	Specialist medicine
Liver Unit	Specialist medicine
Neurology	Specialist medicine
G.U.M	Specialist medicine
Haematology	Specialist medicine
GUM Medicine	Specialist medicine
Liver (failure) Unit	Specialist medicine
Transplantation Unit	Specialist Surgery
E.N.T.	Specialist Surgery
Cardio-thoracic Surgery	Specialist Surgery
Plastic Surgery	Specialist Surgery
Oral Surgery	Specialist Surgery
Vascular Surgery	Specialist Surgery
Ophthalmology	Specialist Surgery
Urology	Specialist Surgery
Neurosurgery	Specialist Surgery
General Surgery	General Surgery
Breast Treatment & Care	General Surgery
Day Case Theatres	General Surgery
Theatre/ Anaesthetics	General Surgery

Chapter 5: NHS Quality Improvement and Assurance Schemes

None

Chapter 6: Antimicrobial stewardship

TARGET Toolkit: process evaluation

The TARGET antibiotics toolkit is a suite of antimicrobial stewardship resources designed to be used by the whole primary care team within a GP practice or out of hours setting. These resources can be used flexibly, either as standalone materials or as part of an integrated package.

The toolkit is hosted in the Royal College of General Practitioners website and remains the most accessed section of their website throughout 2019/20. A yearly website evaluation is undertaken to identify which areas of the site are being used to guide

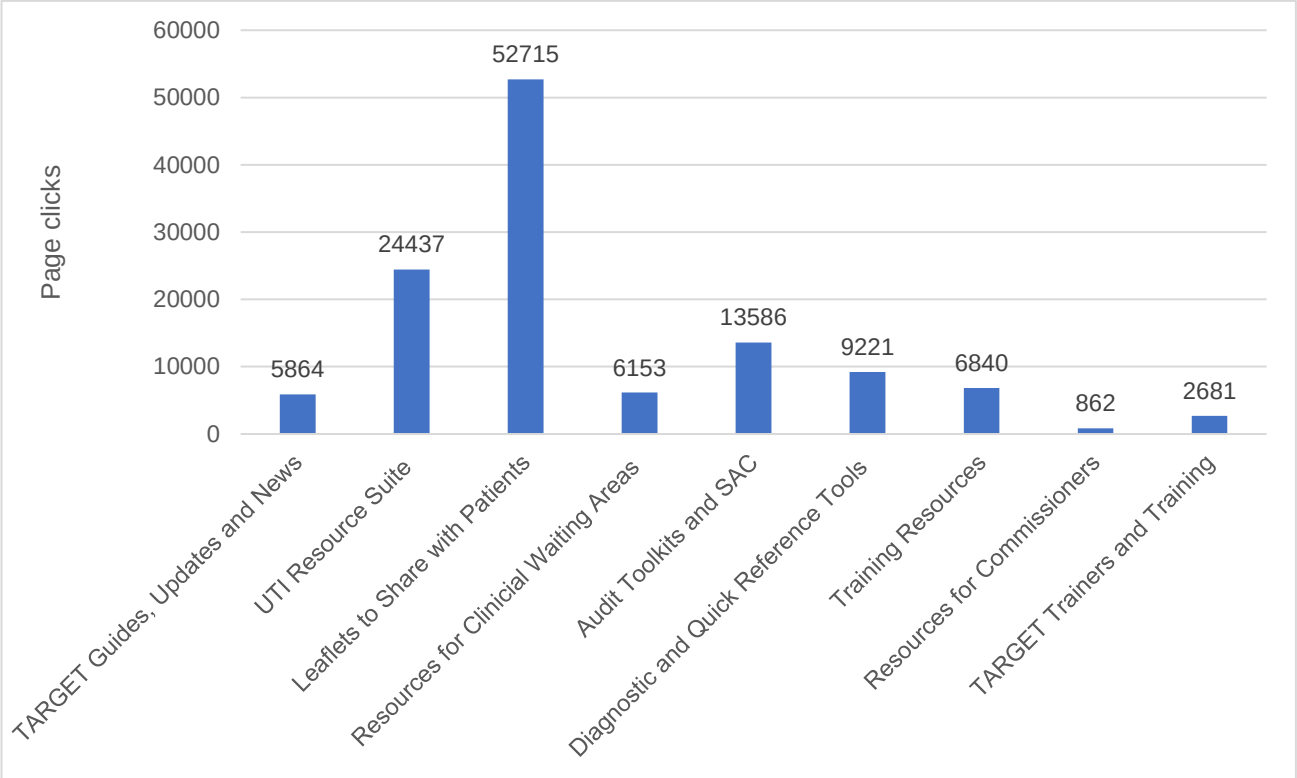
future resource development. In 2019/20 process evaluation of the TARGET Toolkit website demonstrated ongoing use of the TARGET toolkit throughout the year. Monthly website views (**Annex Figure 6.1**) show peaks in use following promotional activities.

Annex Figure 6.1 TARGET Toolkit website: monthly total views between April 2019 and March 2020. Data points represent total numbers of website views per month. Promotional activities and release of new resources are indicated by coloured lines

The average time each user spent on the TARGET website was 09:36 minutes.

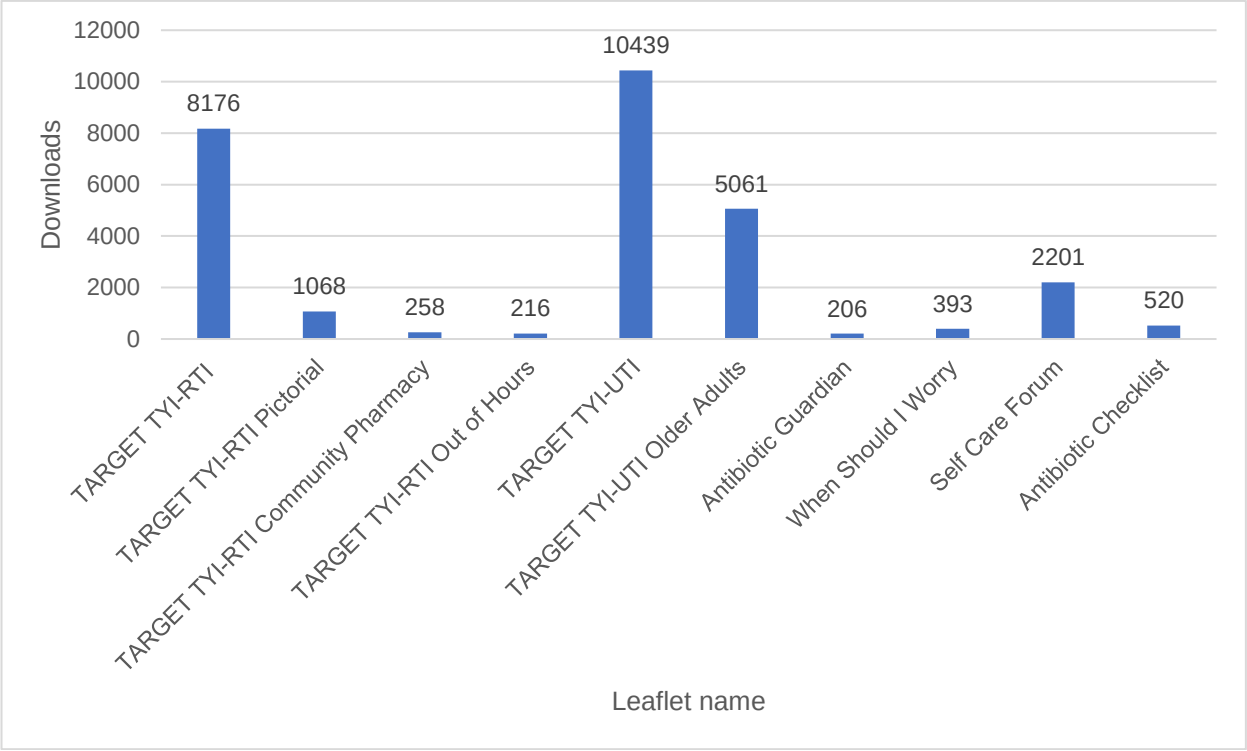
Popular TARGET Website Pages

The 'Leaflets for Patients' section was the most popular section of the TARGET Toolkit website (**Annex Figure 6.2**), with 52,715 visits with the 'UTI Resource Suite' the second most visited section with 24,437 visits; both sections show a 3.5 fold increase in visits compared to the previous year. The TARGET 'Audit Toolkits and Self-Assessment Checklist (SAC)' was the third most frequently visited page.



Annex Figure 6.2 TARGET Toolkit website: total clicks by section between April 2019 and March 2020. Bars represent total number of page clicks on each website section. Prior to the website redesign in October 2019, 'Audit Toolkits' and Self-Assessment Checklists (SAC) pages were separate, therefore figures prior to this date were combined. Abbreviations: UTI, urinary tract infection; SAC, self-assessment checklist

The TARGET Treating Your Infection (TYI)-UTI leaflet is the most popular website download, followed by the TYI-Respiratory Tract Infection (RTI) leaflet (**Annex Figure 6.3**), demonstrating the ongoing use of these patient facing materials.



Annex Figure 6.3 TARGET Toolkit website: leaflet downloads between April 2019 and March 2020. Bars represent number of resource downloads. Abbreviations: TYI, treating your infection; RTI, respiratory tract infection; UTI, urinary tract infection; SAC, self-assessment checklist.

Self-reported antimicrobial stewardship practices in primary care

Published paper – Jones, L.F.; Verlander, N.Q.; Lecky, D.M.; Altaf, S.; Pilat, D.; McNulty, C. Self-Reported Antimicrobial Stewardship Practices in Primary Care Using the TARGET Antibiotics Self-Assessment Tool. *Antibiotics* 2020, *9*, 253.

SafeConsume

SafeConsume is an EU-funded, transdisciplinary project aiming to improve consumers' food hygiene behaviours and mitigate the long-term risks of foodborne illness and subsequent antibiotic use. e-Bug led a needs assessment carried out in 4 different countries, to explore the needs of young people (11-18 years) and educators, to gain a better understanding of their attitudes and beliefs towards food hygiene, food safety and foodborne illness.

The findings from the needs assessment were analysed using behavioural frameworks within the participating countries (England, France, Hungary, Portugal) and common learning outcomes were identified. The findings were used to inform the development of educational materials, to tackle the gaps in knowledge and skills, and promote safer behaviours with regards to food safety.

Educational resources were developed and tested with students and teachers in England, and modifications were made based on pilot feedback from schools. Student teaching resources include: an animation on food safety practices to promote safer actions; a debate kit on the implications of food safety whilst cooking at home, versus eating out; a fictional food poisoning outbreak at a dinner party; an e-recipe book featuring traditional foods from European countries and additional food safety instructions. Other resources take the format of PowerPoint presentations and lesson plans on topics including cross-contamination, useful and harmful foodborne microbes, and food safety labels.

Current work includes the development of an online teacher training module to accompany the student resources. The resources will be adapted and translated into several EU languages for dissemination. Future project plans involve evaluation of some of the resources across England, France, Hungary and Portugal.

Chapter 7: Professional education and training and public engagement

None

Chapter 8: Stakeholder engagement

None

Acknowledgements

None