Summary Report on Antimicrobial Dispensed in Public Hospitals Report 2018

Infection Control Branch
Centre for Health Protection
Department of Health

November 2020

(Version as at 17 November 2020)

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Acknowledgements

This report would not have been completed successfully without the cooperation and support of staff of the Hospital Authority. The collaboration and contribution of the following parties are gratefully acknowledged (in alphabetical order):

- *Chief Infection Control Officer Office, Quality and Safety Division, Hospital Authority Head Office, Hospital Authority*
- *Chief Pharmacist's Office, Cluster Services Division, Hospital Authority Head Office, Hospital Authority*
- *Infection, Emergency & Contingency, Quality and Safety Division, Hospital Authority Head Office, Hospital Authority*
- *Information Technology and Health Informatics Division, Hospital Authority Head Office, Hospital Authority*
- *Special Working Group on Antimicrobial Resistance, Hospital Authority Head Office, Hospital Authority*
- *Strategy and Planning Division, Hospital Authority Head Office, Hospital Authority*
- *Workgroup on Supporting One Health Antimicrobial Resistance Information System, Hospital Authority*

Executive summary

1. The development of antimicrobial resistance (AMR) by bacteria against antibiotics is a natural process but is exacerbated by the overuse or misuse of antibiotics. The emergency of AMR makes regular treatments for bacterial infections less effective and costlier. Not only it threatens human health but also impacts the economic growth and the overall society development.

2. The Government of the Hong Kong Special Administrative Region addressed the threat of AMR by formulating a series of strategic interventions, which was published in the Hong Kong Strategy and Action Plan on Antimicrobial Resistance (2017 - 2022). One of the recommended actions is to collect antimicrobials dispensing data from the public hospitals and clinics of public sector as part of overall surveillance.

3. The Hospital Authority (HA) is the government-funded statutory body managing all 43 public hospitals and institutions, and a total of 122 general out-patient and specialist clinics. About 32% of out-patient service was provided by HA together with the Department of Health (DH), while about 90% of secondary and tertiary care service in Hong Kong were under public funding provided by HA through public hospitals and institutions. With an advanced and continual developing information system, HA captures all dispensing data through its dispensing service to both inpatient and out-patient service.

4. With the support and assistance of the Information Technology and Health Informatics Division, and the Strategy and Planning Division of HA, standardised dispensing data and relevant service statistics have been extracted and provided to the Department of Health (DH) for analysis. DH published the first Antimicrobial Use (AMU) Surveillance in Public Hospitals and Clinics - Hospital Authority Antibiotics Dispensing Data (2014 - 2016) report in 2019. This is the second similar report covering the period of 2014 to 2018. Since the Action Plan was published in 2017, the situation of 2016 has been chosen as baseline for comparison where appropriate.

Overview of results

5. The total dispensed volume of antimicrobials in all non-inpatient services in 2016 was 323.65 DDD per 1,000 attendances and dropped by 3.48% in 2017. A slight increase of 1.84% in 2018 was observed, when compared with that of 2017. For all inpatient services, the dispensed volume was found to peak in 2017 (1,081.69 DDD per 1,000 patient-days) since 2014 and decreased by 1.05% in 2018 from 2017.

6. The ten most dispensed antimicrobials accounted for over 80% of all antimicrobials dispensed for all HA services. Among them, amoxicillin/clavulanate topped the list since the surveillance started, accounted for 51.55% of all antimicrobials dispensed in 2018 and the trend appeared to be on the rise over the past five years. From 2016 to 2018, doxycycline registered the highest percentage increase (39.38%), followed by co-trimoxazole (30.23%) and piperacillin/tazobactam (17.85%), while ampicillin registered the highest percentage decrease by 30.36%, followed by cloxacillin (27.84%) and then clarithromycin (14.28%) within the same surveillance period.

7. For all HA non-inpatient services, i.e. the Primary Care (GOPC), Specialist Out-patient (Clinical) and Accident & Emergency), the overall percentage of patients attended the services and then with antimicrobials dispensed was observed with a steady decline from 3.45% in 2016 to 3.16% in 2018. Accident & Emergency service had the highest percentage of attendance with antimicrobials dispensed (9.13%), followed by Primary Care (GOPC) service (3.21%) and Specialist Out-patient (Clinical) service dispensed the least (1.49%) in 2018. This observation was probably due to the different disease nature of the patients attending these services.

8. While overall percentage of patients attended HA non-inpatient services with antimicrobials dispensed registered a decline, the DDD per 1,000 attendances in all three services in 2018 also dropped by 1.70% when compared with that of 2016.

9. For all HA inpatient services, though the total DDD of antimicrobials dispensed increased by 6.16% in 2018 when compared with that of 2016, the magnitude of increase almost completely cancelled out when the inflated number of patient-days (6.07%) was taken into account.

10. Among the ten most dispensed antimicrobials in all inpatient services, amoxicillin/clavulanate again was at the top of the list and accounted for at least 52% of the overall use from 2016 to 2018. It was also observed that the biggest percentage increase among these ten most dispensed antimicrobials from 2016 to 2018 was doxycycline (50.08%), followed by meropenem (32.44%) and piperacillin/tazobactam (11.10%), while the antimicrobials showing the biggest percentage decreases within the same period were cefuroxime (34.48%), cloxacillin (30.69%) and clarithromycin (30.05%).

11. Among various specialties of inpatient service, ICU/HDU (1,784.84 DDD per 1,000 patient-days) and Surgery (1,533.72 DDD per 1,000 patient-days) had the highest quantities of antimicrobials dispensed in 2018 when compared with other specialties. However, it is probably due to the very different disease nature of patients being treated by these two specialties.

12. In 2018, except Surgery, all specialties registered some decrease (ranged from 1.50% to 4.58% decrease) in terms of DDD per 1,000 patient-days when compared with that of 2016. Increase of 4.37% was observed with Surgery within the same surveillance period.

13. There were 15 locally-important broad-spectrum antimicrobials selected for special monitoring and an increase by 15.46% from 2016 to 2018 was observed (112.28 DDD per 1,000 patient-days in 2016 to 129.65 DDD per 1,000 patient-days in 2018). All specialties, except ICU/HDU, contributed to the increase with Surgery had the highest percentage increase.

Discussion and conclusion

14. Efforts to keep the overall antimicrobials dispensed steady or to reduce their use in non-inpatient service were almost tangible despite the increased service volume from 2016 to 2018. However, the rather sharp increase of use of the broad-spectrum antimicrobials such as piperacillin/tazobactam (11.10% increase in DDD per 1,000 patient-days), and meropenem (32.44%) and vancomycin (14.06%) within the same period suggested that a closer monitoring may be warranted.

15. Antibiotic Stewardship Programme provides guidance for front-line healthcare providers to choose the most suitable antimicrobial treatment for infections and provides appropriate feedbacks if needed. Adequate resources should be invested in its promulgation and implementation in all healthcare settings.

16. It must be emphasised that results of this report aim at providing the annual trend of antimicrobials dispensed in HA from 2014 to 2018, in order to facilitate ongoing assessment and evaluation. It does not contain any information to reflect the appropriateness of use of antimicrobials.

17. In addition, readers of this report are reminded to refrain from making direct comparisons between services and specialties as there are other factors which could affect dispensing quantity of antimicrobial, such as the burden of infectious diseases handled is different among services and specialties.

18. The results and observation of this report would be shared with all our stakeholders, including the healthcare providers and the general public, at CHP thematic webpage.

19. Antimicrobials are a precious resource for protecting human health and continuous development of modern medicines. Concerted efforts from every member of the society are needed if we want to successfully mitigate the threat of AMR to Hong Kong.

1 Introduction

1. Antimicrobial Resistance (AMR) is a global public health concern, as it will lead to reduced efficacy of antimicrobials given to commonly seen infections, which are routinely handled with standardised antimicrobial treatment. AMR makes the treatment of patients with infections more difficult and costly, as "newer" antimicrobials, which are usually more expensive, may have to be given, or even impossible if the microorganisms are resistant to the last resort of antimicrobial, such as carbapenems and colistin.

2. AMR occurs when microorganisms change in ways that render the medications used to cure the infections they caused ineffective.

3. AMR develops when microorganisms survive, adapt and grow in the presence of antimicrobials (including the situations in which the appropriate antimicrobials are properly given for infections under medical advice). However, resistance develops more rapidly through the misuse and overuse of antimicrobials.

4. Surveillance of antimicrobial use (AMU) can provide information to examine the effectiveness of measures implemented to combat AMR. It also provides the trend of use if the exercise has been conducted with the same methodology over a few years.

> Antimicrobial resistance is a broader term that encompasses resistance to drugs to treat infections caused by pathogens including bacteria, viruses, fungi and parasites. While all are significant to human health, resistance to antimicrobials in bacteria presents a more urgent and serious threat to public health in the current healthcare situation.

2 Background

5. The Government of the Hong Kong Special Administrative Region attaches great importance to the threat of AMR and has launched the Hong Kong Strategy and Action Plan on Antimicrobial Resistance (2017 - 2022) ("Action Plan") in 2017 to combat the problem.[1]

6. AMU monitoring is identified as one of the strategic actions in the Action Plan. It can provide information on level of use and types of antimicrobials for policy-makers and prescribers to examine the effectiveness of measures implemented to promote judicious use of antimicrobial, which is believed to be a measure to slow down the development of AMR.

7. Since 2017, the DH has been retrospectively collecting wholesale supply data through registered product certificate holders of antimicrobials and licensed drug wholesalers as a proxy to gauge the overall distribution of antimicrobials among various sectors in Hong Kong. The most updated wholesale supply report covering the distribution of year 2018 was published in July 2020 at the Centre for Health Protection (CHP) website.[2]

8. Further to the wholesale supply report, DH has been collaborating with the Hospital Authority ("HA") to collect dispensing data from public clinics and hospitals to understand the trend of antimicrobial dispensed in non-inpatient and inpatient services of public healthcare sector.

2.1 Healthcare system of Hong Kong

9. In Hong Kong, the private healthcare sector is the main provider of primary care services.[3] There is no statutory requirement for private medical practitioners to report their AMU data to the authority. Hence statistics in this area are sketchy and incomplete.

10. On the other hand, the HA is the government-funded statutory body managing 43 public hospitals and institutions, and a total of 122 general out-patient and specialist clinics.[4] Regarding the out-patient services, about 32% was provided by HA together with the Department of Health, while about 90% of secondary and tertiary healthcare services[1] in Hong Kong were under public funding provided by HA through public hospitals and institutions.[2][5,6]

11. Information on HA dispensing data can therefore contribute to the understanding of the trend of antimicrobial dispensed in inpatient and non-inpatient services of public sector.

[1] Secondary healthcare services refer to hospital or inpatient service.
[2] in terms of number of hospital beds

3 Data sources and methodology

3.1 Data sources

12. With the help of an advanced information system, HA has been capturing comprehensive dispensing data for both non-inpatient and inpatient services through its various clinics and institutions.

13. Dispensing record of selected antimicrobials based on core set of antimicrobials suggested by the World Health Organization (WHO) are included in Hong Kong territory-wide surveillance program was extracted for analysis (Table 1).

Table 1: Core set of antimicrobials suggested by WHO for AMU surveillance

Group of antimicrobials	Anatomical Therapeutic Chemical (ATC) classification code
Antibacterials for systemic use	J01
Antibiotics for alimentary tract	A07AA
Nitroimidazole derivatives for protozoal diseases	P01AB

Note:

External preparations are excluded according to the instruction of WHO.

14. With the assistance and support of the Information Technology and Health Informatics Division and Strategy and Planning Division of HA, a standardised dispensing dataset, covering the items in Section 5.1 of the British National Formulary (BNF), namely, Antibacterial Drugs, and relevant service statistics were extracted and provided to DH for analysis:

- Antimicrobial dispensing record with: i) generic name of antimicrobial, ii) strength of antimicrobial dispensed, iii) dosage form, iv) route of administration, v) quantity dispensed, vi) dispensing date, vii) type of service under which the drug was dispensed to the patient[3], and viii) specialty of Inpatient & Day Inpatient service[4]

[3] Type of services are categorised into: i) Accident & Emergency, ii) Inpatient & Day Inpatient (General Specialties), iii) Primary Care (GOPC), and iv) Specialist Out-patient (Clinical).

[4] Specialties of Inpatient & Day Inpatient service are categorised into: i) Intensive Care Unit/High Dependency Unit (ICU/HDU), ii) Medicine, iii) Orthopaedics & Traumatology, iv) Surgery, and v) Other Specialties.

- HA service statistics include total number of attendances for non-inpatient service, and patient-days for inpatient service

15. Antimicrobial dispensing record covering year 2014 to 2018 by calendar year was collated and reported in this report. Since the Action Plan was published in 2017, the situation of 2016 has been chosen as the baseline for comparison whether appropriate, as decided by the High Level Steering Committee (HLSC) in the meeting held in 2019.

3.2 Methodology

16. As different antimicrobials come with different weight for a single dose and have different dosing frequency, therefore dispensing data collected for each drug per route of administration[5] prescribed was converted into Defined Daily Dose (DDD)[6] according to the WHO Anatomical Therapeutic Chemical (ATC) classification system, which is a standardised unit promulgated by WHO to facilitate drug consumption comparison and research, and adopted by many health authorities for their surveillance activities. Though this report comprised of the dispensing data from 2014 to 2018, the 2018 version of WHO ATC classification system together with their respective DDD constants (ATC/DDD system) were adopted so that the same measurement criteria, i.e. same DDD constants, compiling the wholesale supply report of 2018 were adopted to avoid any confusion.[7]

17. If dosage form information of an antimicrobial in dispensing record cannot be found and matched with the route(s) of administration of the same antimicrobial as provided by WHO ATC classification system, such entry would be discarded.

18. In order to take into account for different service volume among different specialties and services, for non-inpatient service, DDD is divided by number of attendances and presented as DDD per 1,000 attendances[8].

[5] This implies that same antimicrobial of same strength may have different DDD constant for different route of administration as assigned by WHO ATC classification system.
[6] DDD is defined as the assumed average maintenance dose per day for a drug used for its main indication in adults.
[7] Refer to Table 18 in Appendix for more details in changes in DDD constant for calculation.
[8] In other countries, it may be presented as DDD per 1,000 consultations.

19. For inpatient service, antimicrobial dispensed quantity is presented as DDD per 1,000 patient-days[9,10] to reflect the amount of antimicrobials dispensed among hospitalised patients.[8]

20. In order to calculate the number of non-inpatient attendances with antimicrobial dispensed, for multiple antimicrobials dispensed to one patient within the same day from a single non-inpatient service, these drugs are assumed to be dispensed for single attendance.

3.3 Details on the ATC/DDD system

21. As a reference, in the WHO Report on Surveillance of Antibiotic Consumption: 2016 - 2018 Early Implementation,[9] introduction of the ATC/DDD classification system is stated as below:

> … the Anatomical Therapeutic Chemical (ATC) classification system to distinguish between pharmacological subgroups and substances of antimicrobials. The ATC system classifies active pharmacological substances based on the organ or system on which they act, and their therapeutic, pharmacological and chemical properties.
>
> To measure the consumption of antimicrobials, the methodology uses the number of defined daily doses (DDDs). The DDD is the assumed average maintenance dose per day of an antimicrobial substance(s) used for its main indication in adults, and is assigned to active ingredients with an existing ATC code. As a rule, the DDDs for antimicrobials are based on treatment for infections of moderate severity.
>
> The ATC/DDD system is maintained by the WHO Collaborating Centre for Drug Statistics Methodology, which updates the system continuously to account for new pharmaceutical substances or existing substances that are not yet captured by the system. Because of the continuous revision, readers should take note to the version of the ATC/DDD system used to calculate consumption/dispensed quantity when comparisons are made over time and between countries.
>
> Comparisons with estimates from other publications on antimicrobial consumption/dispensed quantity should be interpreted with caution.

[9] In other countries, it may be presented as DDD per 1,000 bed days, which the definition of a bed day may differ between hospitals or countries.

[10] In HA, patient-days include inpatient patient-days and day inpatient discharges and deaths. Day inpatients refer to those who are admitted into hospitals for non-emergency treatment and who are discharged within the same day. Inpatients are those who are admitted into hospitals via Accident & Emergency Department or those who have stayed for more than one day.[7]

22. Table 17 in Appendix summarises the ATC and DDD constant used in this report. Not all the antimicrobials under J01, A07AA and P01AB are available in HK and hence the Table 17 is only showing those antimicrobials ever dispensed by HA during the surveillance period from 2014 to 2018. Complete list can be found at the following link: https://www.whocc.no/atc_ddd_index/

3.4 Broad-spectrum antimicrobials

23. Antimicrobials with a broad-spectrum of coverage against a wide range of disease-causing bacteria, such as carbapenems and colistin, are particularly important to human. These drugs are usually reserved for treating infections caused by resistant bacteria in hospitals and patients who are serious ill, some of them are even regarded as last resort treatment for resistant or life-threatening bacterial infections.

24. Fifteen locally-important broad-spectrum antimicrobials listed in Table 2 were grouped and reported as broad-spectrum antimicrobials in this report.

Table 2: List of broad-spectrum antimicrobials with local importance

	ATC Chemical Substance	
ATC Pharmacological Subgroup	Description	Code
Beta-lactam antibacterials, penicillins (J01C)	Piperacillin/tazobactam	J01CR05
Other beta-lactam antibacterials (J01D)	Ceftazidime	J01DD02
	Ceftazidime/avibactam	J01DD52
	Cefoperazone/sulbactam	J01DD62
	Cefepime	J01DE01
	Meropenem	J01DH02
	Ertapenem	J01DH03
	Imipenem/cilastatin	J01DH51
	Ceftaroline fosamil	J01DI02
	Ceftolozane/tazobactam	J01DI54
Other antibacterials (J01X)	Vancomycin	J01XA01
	Teicoplanin	J01XA02
	Colistin	J01XB01
	Linezolid	J01XX08
	Daptomycin	J01XX09

3.5 Antimicrobial names

25. To avoid confusion and for the sake of simplicity, names of the antimicrobial listed in Table 3 are used interchangeably.

Table 3: Interchangeable names of antimicrobial

Name	Alternative Name
Ampicillin and beta-lactamase inhibitor	Ampicillin/sulbactam
Amoxicillin and beta-lactamase inhibitor	Amoxicillin/clavulanate
Cefoperazone and beta-lactamase inhibitor	Cefoperazone/sulbactam
Ceftazidime and beta-lactamase inhibitor	Ceftazidime/avibactam
Ceftolozane and beta-lactamase inhibitor	Ceftolozane/tazobactam
Piperacillin and beta-lactamase inhibitor	Piperacillin/tazobactam
Sulfamethoxazole and trimethoprim	Co-trimoxazole
Ticarcillin and beta-lactamase inhibitor	Ticarcillin/clavulanate

4 Results

4.1 Antimicrobial dispensed quantity in all HA services

4.1.1 Overall antimicrobials dispensed quantity in all HA services

26. Table 4 summaries overall antimicrobials dispensed by various HA service types from 2014 to 2018[11]. Refer to Figure 1 for graphical presentation.

27. The total dispensed quantity of antimicrobials in non-inpatient service[12] in 2016 was 323.65 DDD per 1,000 attendances, which dropped by 3.48% in 2017[13]. A slight increase of 1.84% in 2018[14] was observed when compared with that of 2017. For in-patient service[15], the dispensed quantity was found to peak in 2017[16] from 2014 and decreased by 1.05% from 2017 to 2018[17].

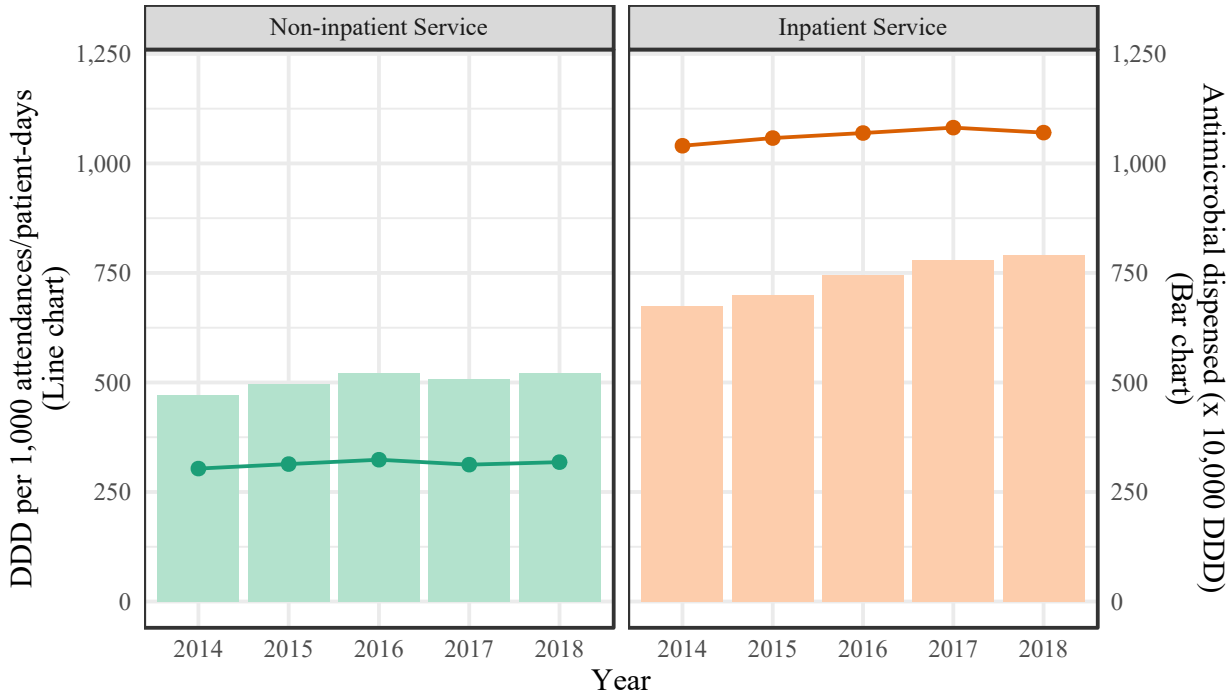
Table 4: Overall antimicrobials dispensed in various service types

Year	Service Types					
	Non-inpatient Service			Inpatient Service		
	Service Volume*‡	Antimicrobial Dispensed†‡	DDD per 1,000 attendances§¶	Service Volume‡**	Antimicrobial Dispensed†‡	DDD per 1,000 patient-days§¶
2014	15,542,000	4,716,000	303.44	6,490,000	6,752,000	1,040.33
2015	15,806,000	4,959,000	313.71	6,612,000	6,994,000	1,057.91
2016	16,095,000	5,209,000	323.65	6,967,000	7,450,000	1,069.38
2017	16,292,000	5,090,000	312.40	7,214,000	7,803,000	1,081.69
2018	16,416,000	5,222,000	318.13	7,390,000	7,909,000	1,070.32

* In terms of attendances
† In DDD
‡ Rounded to the nearest thousand
§ Rounded to two decimal places
¶ Due to rounding, figures may not precisely reflect the absolute figures.
** In terms of patient-days
Note:
Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

[11] Year 2016 data was chosen as the baseline because the Action Plan was published in July 2017, as decided by HLSC in the meeting held in 2019.
[12] in DDD per 1,000 attendances
[13] 312.40 DDD per 1,000 attendances
[14] 318.13 DDD per 1,000 attendances
[15] in DDD per 1,000 patient-days
[16] 1,081.69 DDD per 1,000 patient-days
[17] 1,070.32 DDD per 1,000 patient-days

Figure 1: Overall antimicrobials dispensed in various service types



4.1.2 Five most dispensed ATC pharmacological subgroups in all HA services

28. Among all the antimicrobials dispensed, the five most dispensed ATC pharmacological subgroups[18,19] in 2018 for all HA services are listed in Table 5. Refer to Figure 2 for graphical presentation.

29. From 2016[20] to 2018, these five ATC pharmacological subgroups together accounted for 92.30%[21] to 92.47%[22] of overall antimicrobials dispensed by HA. Beta-lactam antibacterials, penicillins (J01C) has been the most dispensed pharmacological subgroup by large for the past at least five years (2014 - 2018). It was followed by quinolone antibacterials (J01M), other beta-lactam antibacterials (J01D), then macrolides, lincosamides and streptogramins (J01F) respectively and with tetracyclines (J01A) very much close-by.

[18] in DDD
[19] The five most dispensed pharmacological subgroups were identified from year 2018 data.
[20] Year 2016 data was chosen as the baseline because the Action Plan was published in July 2017, as decided by HLSC in the meeting held in 2019.
[21] year 2018
[22] year 2016

30. Tetracyclines (J01A) group registered the biggest increase in dispensed quantity in terms of percentage by 35.75%, while macrolides, lincosamides and streptogramins (J01F) group registered a decrease by 7.59% from 2016 to 2018.

Table 5: The five most dispensed ATC pharmacological subgroups in year 2018 in all HA services (by WHO ATC classification)

ATC Pharmacological Subgroup		Antimicrobial dispensed in DDD					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)†‡
J01C	Beta-lactam antibacterials, penicillins	7,222,000	7,672,000	8,168,000	8,313,000	8,377,000	2.56%
J01M	Quinolone antibacterials	963,000	998,000	1,011,000	1,027,000	1,045,000	3.32%
J01D	Other beta-lactam antibacterials	963,000	928,000	928,000	895,000	943,000	1.60%
J01F	Macrolides, lincosamides and streptogramins	933,000	883,000	955,000	933,000	882,000	-7.59%
J01A	Tetracyclines	447,000	535,000	643,000	747,000	873,000	35.75%
	Others	940,000	937,000	954,000	977,000	1,011,000	6.03%
	Total	11,468,000	11,953,000	12,659,00	12,893,00	13,132,00	3.73%

* Rounded to the nearest thousand

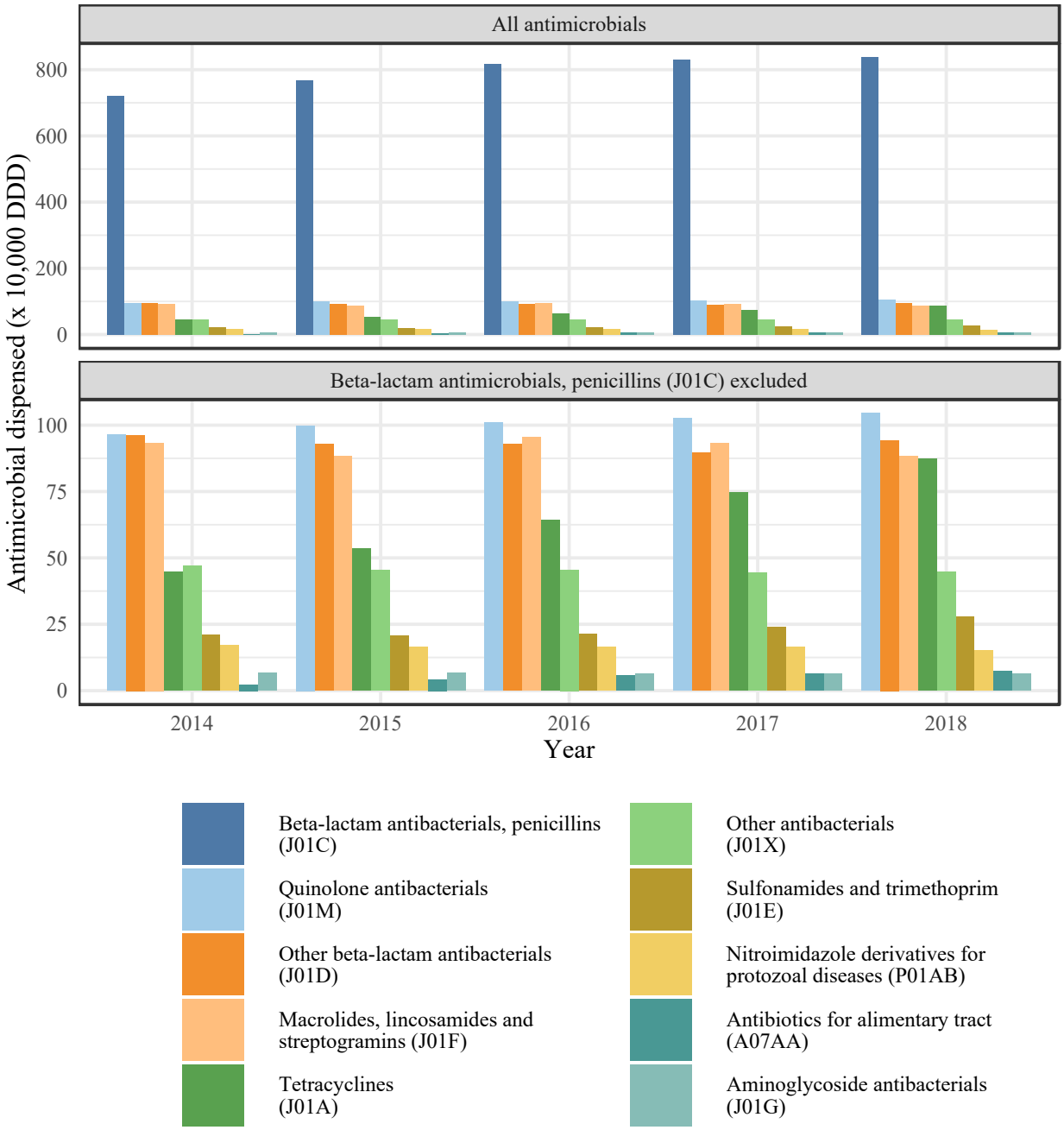
† Rounded to two decimal places

‡ Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 2: Antimicrobials dispensed in all HA services grouped by WHO ATC classification



31. Details on volume of individual drugs dispensed among the five most dispensed ATC pharmacological subgroups can be referred to the Table 19 in Appendix.

4.1.2.1 Beta-lactam antibacterials, penicillins (J01C)

32. Within the beta-lactam antibacterials, penicillins group (J01C), the three most commonly dispensed antimicrobials in 2018 were amoxicillin/clavulanate, amoxicillin and piperacillin/tazobactam. These three drugs together accounted for 57.98% of total antimicrobial dispensed[23] in all services of HA during the same year. The overall dispensed quantity of this pharmacological subgroup (J01C) in HA has been increased by 2.56% between year 2016 and 2018.[24] From 2017 to 2018, there was a 0.77% increase in dispensed quantity in HA.[25]

33. Dispensed quantity of amoxicillin/clavulanate[26] and piperacillin/tazobactam[27] between 2016 and 2018 increased by 6.80% and 17.85% respectively, whereas cloxacillin[28] and ampicillin[29] dispensed quantity decreased by 27.84% and 30.36% respectively.

4.1.2.2 Quinolone antibacterials (J01M)

34. In 2018, the three most commonly dispensed antimicrobials under the quinolone antibacterials group (J01M) were levofloxacin, ciprofloxacin and moxifloxacin. This group of antimicrobials registered a higher rate of increase when compared with that of beta-lactam antibacterial, penicillins group (J01C), with a 3.32% increase from 2016 to 2018. Levofloxacin was the main quinolone antibacterial dispensed, accounted for 74.54% of total quinolones dispensed in 2018. The dispensed quantity of ciprofloxacin[30] and moxifloxacin[31] have declined from 2016 to 2018, whereas the rising trend of levofloxacin continued in 2018 with a 6.14% increase from 0.73 to 0.78 million DDD over the three-year period.

[23] in DDD
[24] from 8.17 to 8.38 million DDD
[25] from 8.31 to 8.38 million DDD
[26] from 6.34 to 6.77 million DDD
[27] from 0.35 to 0.41 million DDD
[28] from 515,000 DDD to 372,000 DDD
[29] from 382,000 DDD to 266,000 DDD
[30] from 261,000 DDD to 252,000 DDD
[31] from 17,000 DDD to 14,000 DDD

4.1.2.3 Macrolides, lincosamides and streptogramins (J01F)

35. For the macrolides, lincosamides and streptogramins group (J01F), a 7.59% decrease from year 2016 to 2018 was observed, and clarithromycin and azithromycin had the highest dispensed quantity within the group. Clarithromycin is the most commonly dispensed antimicrobial under this group and the dispensed quantity has declined by 14.28% since 2016.[32] In contrast, azithromycin, being the second most commonly dispensed antimicrobial under this group, has risen by 8.12% over the same period[33].

4.1.2.4 Other beta-lactam antibacterials (J01D)

36. This group comprises other beta-lactam antimicrobials (J01D), other than penicillins under J01C, such as the various generations of cephalosporins and carbapenems[34]. Overview on dispensed quantity of the two subgroups will be described separately in the ensuing paragraphs. The newest fifth-generation cephalosporins and penems are also under this group[35] but the quantity dispensed was rather minute.

4.1.2.4.1 Cephalosporins (J01DB; J01DC; J01DD; J01DE; J01DI)

37. The three most dispensed cephalosporins in 2018 were cefuroxime, ceftriaxone and cefazolin, with dispensed quantity of all cephalosporin antimicrobials decreased from 0.69 to 0.63 million DDD (9.28%) over the three-year period from 2016 to 2018. This was largely due to the decreased use of cefuroxime, which dropped from 0.33 to 0.24 million DDD in the same period. Meanwhile, the use of both ceftriaxone and cefazolin, a third- and first-generation injectable cephalosporins, increased by 9.69% and 13.23% respectively in the same period. The use of two fifth-generation cephalosporins, namely, ceftaroline fosamil and ceftolozane/tazobactam was noted to have increased since 2014 and 2016 respectively, but the dispensed quantities were rather minute, with annual total dispensed quantity being less than 3,500 DDD.

[32] from 583,000 DDD to 500,000 DDD
[33] from 240,000 DDD to 260,000 DDD
[34] Monobactams (J01DF) also belongs to this pharmacological subgroup, it is not discussed in this section due to a very low annual dispensed quantity (less than 150 DDD).
[35] These drugs are put under “Other cephalosporins and penems” (J01DI).

4.1.2.4.2 Carbapenems (J01DH)

38. Carbapenems, a group of antibacterials normally reserved for the most severe infections and seriously ill patients, were not dispensed in a significant quantity[36], but the raising trend was very much noticeable over the same period. Meropenem, being the most dispensed carbapenem in HA, had its dispensed quantity continued to increase in 2018[37] and the overall dispensed quantity has risen 40.57% since 2016. In contrast, the dispensed quantity of imipenem/cilastatin has declined[38] over the same period by 26.87%.

4.1.2.5 Tetracyclines (J01A)

39. The overall dispensed quantity of antimicrobials under tetracyclines group (J01A) increased from 0.64 to 0.87 million DDD (35.75%), which was mostly reflecting the increased dispensed quantity of doxycycline, also being the most commonly dispensed antimicrobial in this group, which increased from 0.58 to 0.80 million DDD (39.38%) during the same period of time.

4.1.3 Ten most dispensed antimicrobials in all HA services

40. For individual antimicrobial, the ten most dispensed antimicrobials[39,40] in 2018 in all HA services are listed in Table 6. Refer to Figure 3 for graphical presentation.

41. These ten antimicrobials together accounted for 81.94%[41] and 82.72%[42] of overall antimicrobials dispensed in all HA services in 2016 and 2018.

42. The most dispensed antimicrobial was amoxicillin/clavulanate in three consecutive years (2016 - 2018). It accounted for 51.55% of all antimicrobials dispensed in 2018 and the trend appeared to be on the rise over the last three years.

43. From 2016 to 2018, doxycycline registered the highest percentage increase[43] by 39.38%, followed by co-trimoxazole (30.23%) and piperacillin/tazobactam (17.85%).

[36] from 0.23 million DDD in 2016 to 0.31 million DDD in 2018
[37] from 0.18 million DDD in 2016 to 0.26 million DDD in 2018
[38] from 9,000 DDD in 2016 to 7,000 DDD in 2018
[39] in DDD
[40] The ten most dispensed antimicrobials were identified from year 2018 data.
[41] 10.37 million DDD in 2016
[42] 10.86 million DDD in 2018
[43] from 0.58 million DDD in 2016 to 0.80 million DDD in 2018

44. From 2016 to 2018, ampicillin registered the highest percentage decrease[44] by 30.36%, followed by cloxacillin (27.84%) and then clarithromycin (14.28%).

Table 6: The ten most dispensed antimicrobials in all HA services

ATC Chemical Substance		Antimicrobial dispensed in DDD					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)†‡
J01CR02	Amoxicillin/clavulanate	5,101,000	5,724,000	6,339,000	6,565,000	6,769,000	6.80%
J01AA02	Doxycycline	377,000	466,000	575,000	671,000	801,000	39.38%
J01MA12	Levofloxacin	684,000	708,000	734,000	758,000	779,000	6.14%
J01FA09	Clarithromycin	612,000	554,000	583,000	540,000	500,000	-14.28%
J01CA04	Amoxicillin	494,000	450,000	449,000	441,000	435,000	-3.08%
J01CR05	Piperacillin/tazobactam	250,000	307,000	347,000	385,000	409,000	17.85%
J01CF02	Cloxacillin	687,000	608,000	515,000	455,000	372,000	-27.84%
J01EE01	Co-trimoxazole	201,000	200,000	208,000	234,000	271,000	30.23%
J01CA01	Ampicillin	535,000	457,000	382,000	326,000	266,000	-30.36%
J01FA10	Azithromycin	197,000	206,000	240,000	270,000	260,000	8.12%
	Others	2,330,000	2,273,000	2,287,000	2,248,000	2,269,000	-0.78%
	Total	11,468,000	11,953,000	12,659,000	12,893,000	13,132,000	3.73%

* Rounded to the nearest thousand

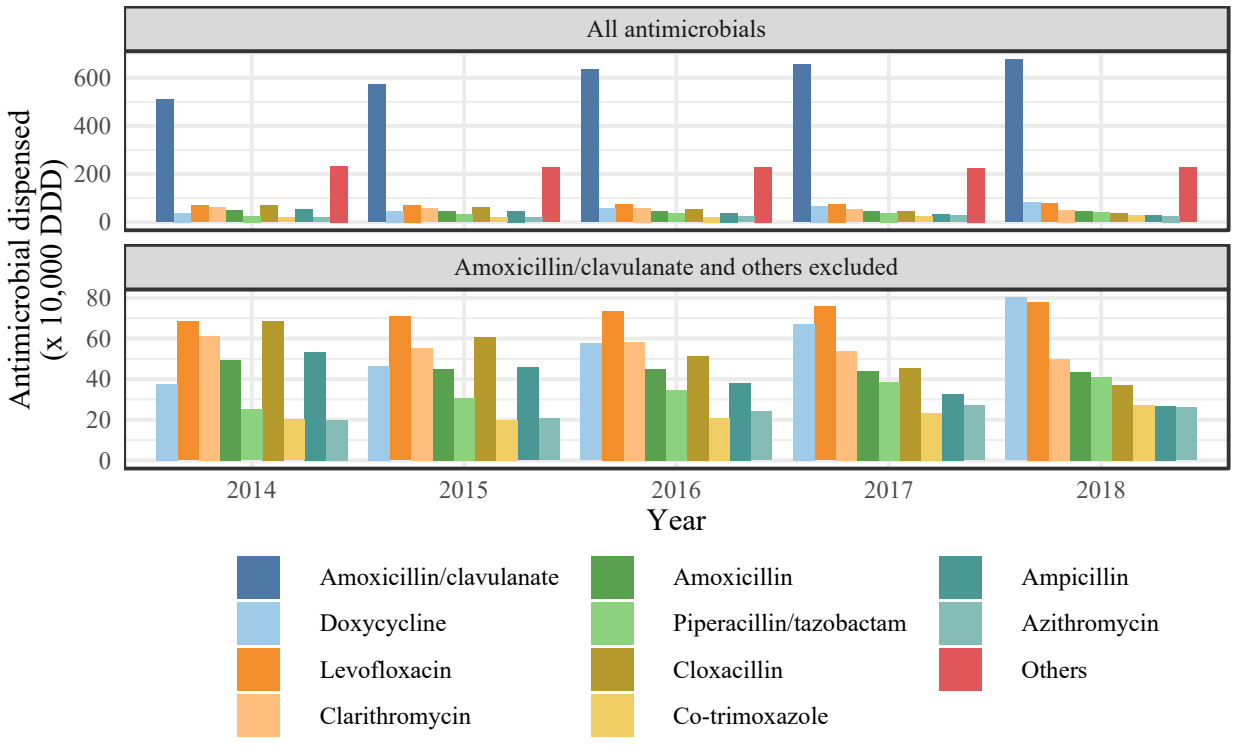
† Rounded to two decimal places

‡ Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 3: The ten most dispensed antimicrobials in all HA services



[44] from 0.38 million DDD in 2016 to 0.27 million DDD in 2018

4.2 Antimicrobial dispensed quantity in HA non-inpatient service

4.2.1 Overall annual dispensed quantity and percentage changes in HA non-inpatient service

45. Antimicrobials for non-inpatient service accounted for 39.77% of all antimicrobials dispensed[45] in HA in 2018. This section describes antimicrobial dispensed quantity in DDD per 1,000 attendances.

46. Table 7 summarises overall antimicrobials dispensed in HA non-inpatient service, respective attendance statistics and percentage of attendance with antimicrobials dispensed from 2014 to 2018.

47. Antimicrobial dispensed in HA non-inpatient services, was about 323.65 DDD per 1,000 attendances in 2016. In 2018, there was a 1.70% reduction in dispensed quantity compared to 2016. The decline observed is predominantly driven by reduction in Primary Care (GOPC)[46] and Accident & Emergency[47] antimicrobial dispensing. These two services accounted for 30.85% and 30.02%[48] of total antimicrobial dispensed quantity in HA non-inpatient services in 2018 respectively.

48. The overall percentage of non-inpatient service attendance with antimicrobials dispensed from 2016 to 2018 remained quite stable, being at no higher than 3.5%.[49]

49. Accident & Emergency service has been the one with the highest percentage[50] of attendance with antimicrobials dispensed, while Specialist Out-patient (Clinical) service has been the service with the lowest percentage[51] of attendance with antimicrobials dispensed.

[45] in DDD
[46] 3.46% decrease from 2016 to 2018
[47] 1.03% decrease from 2016 to 2018
[48] in DDD
[49] from 3.45% in 2016 to 3.16% in 2018
[50] from 9.57% in 2016 to 9.13% in 2018
[51] from 1.57% in 2016 to 1.49% in 2018

Table 7: Summary on attendance count and antimicrobials dispensed in HA non-inpatient service

	Primary Care (GOPC)	Specialist Out-patient (Clinical)	Accident & Emergency	All Non-inpatient Services
Year 2014				
Total DDD of antimicrobials dispensed*	1,433,000	1,708,000	1,574,000	4,716,000
Total number of attendances*	6,174,000	7,141,000	2,227,000	15,542,000
No. of attendance with antimicrobials dispensed*†	195,000	111,000	215,000	521,000
Percentage of attendance with antimicrobials dispensed‡§	3.16%	1.55%	9.66%	3.35%
DDD per 1,000 attendances‡§¶	232.17	239.24	706.87	303.44
Year 2015				
Total DDD of antimicrobials dispensed*	1,547,000	1,775,000	1,636,000	4,959,000
Total number of attendances*	6,276,000	7,305,000	2,225,000	15,806,000
No. of attendance with antimicrobials dispensed*†	207,000	112,000	217,000	536,000
Percentage of attendance with antimicrobials dispensed‡§	3.30%	1.53%	9.74%	3.39%
DDD per 1,000 attendances‡§¶	246.51	243.04	735.19	313.71
Year 2016				
Total DDD of antimicrobials dispensed*	1,658,000	1,884,000	1,668,000	5,209,000
Total number of attendances*	6,360,000	7,476,000	2,260,000	16,095,000
No. of attendance with antimicrobials dispensed*†	221,000	117,000	216,000	555,000
Percentage of attendance with antimicrobials dispensed‡§	3.48%	1.57%	9.57%	3.45%
DDD per 1,000 attendances‡§¶	260.68	251.94	738.16	323.65
Year 2017				
Total DDD of antimicrobials dispensed*	1,590,000	1,932,000	1,568,000	5,090,000
Total number of attendances*	6,400,000	7,695,000	2,197,000	16,292,000
No. of attendance with antimicrobials dispensed*†	213,000	116,000	198,000	527,000
Percentage of attendance with antimicrobials dispensed‡§	3.33%	1.51%	9.03%	3.24%
DDD per 1,000 attendances‡§¶	248.37	251.00	714.06	312.40
Year 2018				
Total DDD of antimicrobials dispensed*	1,611,000	2,044,000	1,568,000	5,222,000
Total number of attendances*	6,401,000	7,870,000	2,146,000	16,416,000
No. of attendance with antimicrobials dispensed*†	205,000	117,000	196,000	518,000
Percentage of attendance with antimicrobials dispensed‡§	3.21%	1.49%	9.13%	3.16%
DDD per 1,000 attendances‡§¶	251.66	259.74	730.60	318.13
Percentage change (2018 over 2016)‡				
Total DDD of antimicrobials dispensed	-2.83%	8.52%	-6.02%	0.25%
Total number of attendances	0.65%	5.26%	-5.05%	1.99%
No. of attendance with antimicrobials dispensed	-7.37%	-0.23%	-9.43%	-6.66%
Percentage of attendance with antimicrobials dispensed	-7.97%	-5.22%	-4.62%	-8.49%
DDD per 1,000 attendances	-3.46%	3.10%	-1.03%	-1.70%

* Rounded to the nearest thousand

† Number of attendances with antimicrobials dispensed is defined as the annual sum of daily number of patients with antimicrobial dispensed in each cluster and each specialty.

‡ Rounded to two decimal places

§ Due to rounding, figures may not precisely reflect the absolute figures.

¶ Attendance refers to total attendance.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

4.2.2 Five most dispensed ATC pharmacological subgroups in HA non-inpatient service

50. Among all antimicrobials dispensed, the five most dispensed ATC pharmacological subgroups[52,53] in HA non-inpatient service from 2014 to 2018 are listed in Table 8. Refer to Figure 4 for graphical presentation.

51. Beta-lactam antibacterials, penicillins (J01C) group was by large the most dispensed antimicrobials in HA non-inpatient service from year 2016 to 2018[54] followed by macrolides, lincosamides and streptogramins group (J01F)[55] though both of these groups showed decreases in dispensed quantity[56] in 2018 when compared with those of 2016. Third in place was tetracyclines group (J01A) and a steady increase was noted for the past few years[57], followed by quinolones antibacterials (J01M)[58] and other antibacterials (J01X)[59], both registered a decrease in 2018 when compared with figures in 2016.

52. These five ATC pharmacological subgroups accounted for 93.17%[60] to 93.55%[61] of overall antimicrobials dispensed in non-inpatient service over the three-year period.

53. Details on the five ATC pharmacological subgroups most commonly dispensed among non-inpatient services in HA can be referred to Table 20 in Appendix.

[52] The five most dispensed ATC pharmacological subgroups were identified from year 2018 data.
[53] in DDD per 1,000 attendances
[54] from 64.60% in 2016 to 64.00% in 2018
[55] from 11.32% in 2016 to 10.67% in 2018
[56] by DDD per 1,000 attendances
[57] from 6.91% in 2016 to 8.22% in 2018
[58] from 6.84% in 2016 to 6.77% in 2018
[59] from 3.88% in 2016 to 3.51% in 2018
[60] in year 2018
[61] in year 2016

Table 8: The five most dispensed ATC pharmacological subgroups dispensed in HA non-inpatient service

ATC Pharmacological Subgroup		DDD per 1,000 attendances					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
J01C	Beta-lactam antibacterials, penicillins	194.18	202.81	209.08	200.36	203.61	-2.62%
J01F	Macrolides, lincosamides and streptogramins	35.58	34.16	36.63	35.00	33.95	-7.31%
J01A	Tetracyclines	17.70	21.11	22.36	23.23	26.15	16.97%
J01M	Quinolone antibacterials	21.88	22.46	22.14	21.34	21.53	-2.77%
J01X	Other antibacterials	13.00	12.25	12.56	11.85	11.17	-11.03%
	Others	21.09	20.93	20.89	20.62	21.73	4.01%
	Total	303.44	313.71	323.65	312.40	318.13	-1.70%

* Rounded to two decimal places

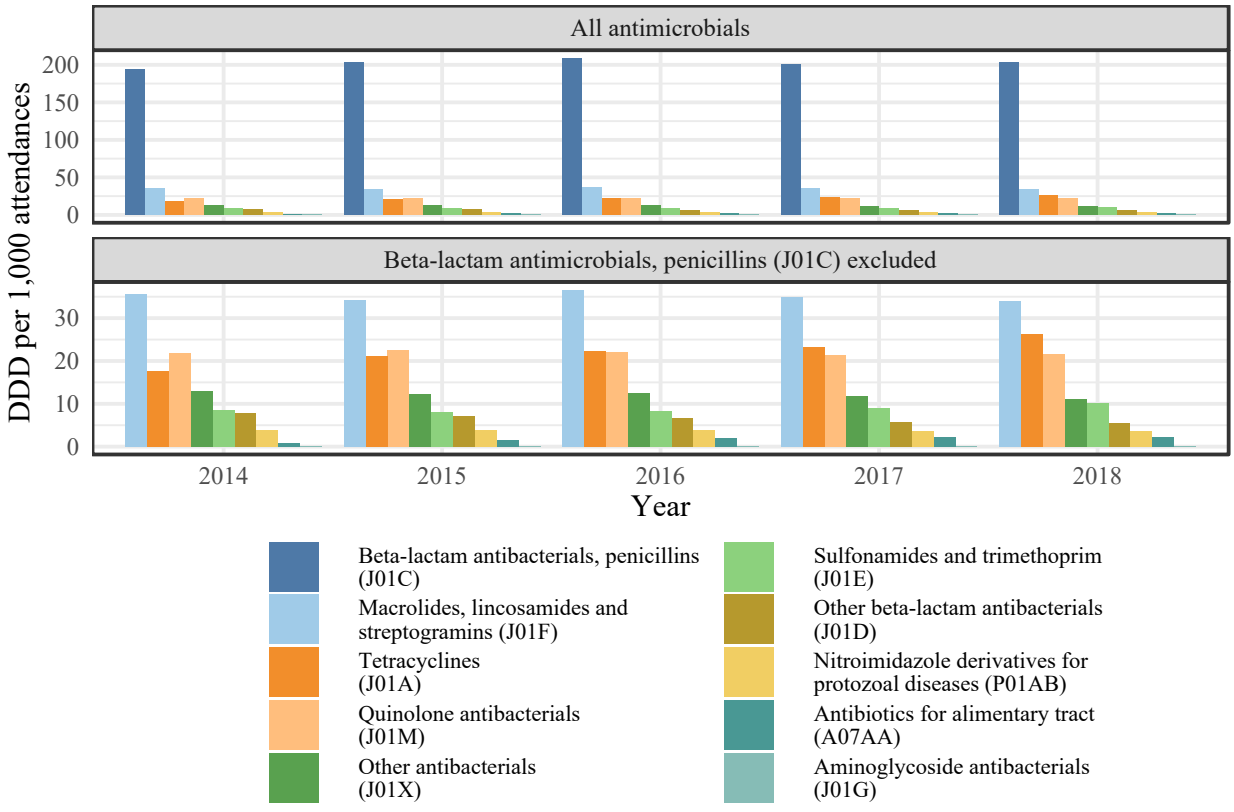
† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

The five most dispensed ATC pharmacological subgroups were identified from year 2018 data.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 4: Antimicrobials dispensed in HA non-inpatient service grouped by WHO ATC classification



54. Table 9 tabulates the five most dispensed ATC pharmacological subgroups in HA non-inpatient service, stratified by service type.

4.2.2.1 Primary Care (GOPC)

55. The beta-lactam antibacterials, penicillins group (J01C) remained the most commonly dispensed pharmacological subgroup in Primary Care (GOPC) setting, account for 76.61%[62] of all antimicrobials dispensed in 2018 in this service. The second highest dispensed pharmacological subgroup was macrolides, lincosamides and streptogramins (J01F) (7.09%)[63], followed by other antibacterials (J01X) (5.44%)[64].

56. The reduction in dispensing of tetracyclines (J01A) (-15.36%)[65] was the main contributor to the decreased rate of total antimicrobial dispensed in Primary Care (GOPC) service. Dispensing of other antimicrobials in the same setting also decreased from 2016 to 2018, including macrolides, lincosamides and streptogramins (J01F) (-14.79%)[66], other antibacterials (J01X) (-8.15%)[67], quinolone antibacterials (J01M) (-1.47%)[68], and beta-lactam antibacterials, penicillins (J01C) (-0.09%)[69].

4.2.2.2 Specialist Out-patient (Clinical)

57. Total volume of antimicrobial dispensed from Specialist Out-patient (Clinical) service has increased by 3.10% since 2016.[70] Increased dispensed quantity of tetracyclines (J01A) (increased by 27.73%) and sulfonamides and trimethoprim (J01E) (increased by 25.06%) over the three-year period have been the main contribution to the overall increase in antimicrobial dispensed quantity in the same setting.

[62] 192.80 DDD per 1,000 attendances
[63] 17.84 DDD per 1,000 attendances
[64] 13.68 DDD per 1,000 attendances
[65] from 15.70 DDD per 1,000 attendances in 2016 to 13.28 DDD per 1,000 attendances in 2018
[66] from 20.93 DDD per 1,000 attendances in 2016 to 17.84 DDD per 1,000 attendances in 2018
[67] from 14.90 DDD per 1,000 attendances in 2016 to 13.68 DDD per 1,000 attendances in 2018
[68] from 7.66 DDD per 1,000 attendances in 2016 to 7.55 DDD per 1,000 attendances in 2018
[69] from 192.98 DDD per 1,000 attendances in 2016 to 192.80 DDD per 1,000 attendances in 2018
[70] from 251.94 DDD per 1,000 attendances in 2016 to 259.74 DDD per 1,000 attendances in 2018

4.2.2.3 Accident & Emergency

58. For beta-lactam antibacterials, penicillins (J01C), being the most commonly dispensed pharmacological subgroup in Accident & Emergency service, its volume dispensed increased from 2016 to 2018 by 0.63%[71]. Meanwhile, dispensed quantity of tetracyclines (J01A) raised by 19.76%[72] from 2016 to 2018.

Table 9: The five most dispensed ATC pharmacological subgroups dispensed in HA non-inpatient service, stratified by service type

ATC Pharmacological Subgroup		DDD per 1,000 attendances					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
Primary care							
J01C	Beta-lactam antibacterials, penicillins	167.70	182.26	192.98	186.73	192.80	-0.09%
J01F	Macrolides, lincosamides and streptogramins	16.41	17.68	20.93	18.41	17.84	-14.79%
J01X	Other antibacterials	16.73	15.46	14.90	14.22	13.68	-8.15%
J01A	Tetracyclines	17.29	16.40	15.70	14.15	13.28	-15.36%
J01M	Quinolone antibacterials	5.86	6.46	7.66	7.42	7.55	-1.47%
	Others	8.19	8.25	8.51	7.44	6.51	-23.45%
	Total	232.17	246.51	260.68	248.37	251.66	-3.46%
Specialist Out-patient (Clinical)							
J01C	Beta-lactam antibacterials, penicillins	102.56	101.26	104.82	101.94	103.48	-1.28%
J01F	Macrolides, lincosamides and streptogramins	52.71	48.63	50.48	50.12	49.00	-2.92%
J01A	Tetracyclines	20.94	28.71	31.33	34.34	40.01	27.73%
J01M	Quinolone antibacterials	28.78	28.75	28.01	26.76	26.49	-5.42%
J01E	Sulfonamides and trimethoprim	14.86	14.97	15.30	16.61	19.13	25.06%
	Others	19.41	20.72	22.01	21.25	21.63	-1.73%
	Total	239.24	243.04	251.94	251.00	259.74	3.10%
Accident & Emergency							
J01C	Beta-lactam antibacterials, penicillins	561.44	594.11	599.35	584.89	603.11	0.63%
J01M	Quinolone antibacterials	44.17	46.90	43.50	42.97	45.04	3.55%
J01F	Macrolides, lincosamides and streptogramins	33.83	33.10	34.99	30.36	26.82	-23.34%
J01X	Other antibacterials	28.88	27.29	29.14	27.43	25.04	-14.06%
J01A	Tetracyclines	8.45	9.45	11.43	10.75	13.69	19.76%
	Others	30.10	24.34	19.76	17.66	16.90	-14.49%
	Total	706.87	735.19	738.16	714.06	730.60	-1.03%

* Rounded to two decimal places.

† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

The five most dispensed ATC pharmacological subgroups were identified from year 2018 data, stratified by service type.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

[71] from 599.35 DDD per 1,000 attendances in 2016 to 603.11 DDD per 1,000 attendances in 2018

[72] from 11.43 DDD per 1,000 attendances in 2016 to 13.69 DDD per 1,000 attendances in 2018

4.2.3 Ten most dispensed antimicrobials in HA non-inpatient service

59. For individual antimicrobials, the ten most dispensed antimicrobials[73,74] from 2014 to 2018 are listed in Table 10. Refer to Figure 5 for graphical presentation.

60. These ten antimicrobials together accounted for 89.38%[75] to 90.25%[76] of the overall antimicrobials dispensed in HA non-inpatient service over the three-year period of 2016 to 2018. Again, amoxicillin/clavulanate was by large the most dispensed antimicrobial and accounted for 49.35%[77] of all antimicrobials dispensed[78] in HA non-inpatient service in 2018. Doxycycline, with obvious increase for the past 3 years (2016 - 2018), was in second place in 2018[79], taking over from clarithromycin which was third in 2018[80] but was second in both 2016 and 2017.

61. Percentage on dispensed quantity of amoxicillin/clavulanate increased from 46.38% to 49.35% among the total volume of antimicrobial dispensed over the three-year period.

62. Among these ten antimicrobials, drug with the biggest increase in percentage[81] from 2016 to 2018 was co-trimoxazole (24.23%)[82] followed by doxycycline (19.73%)[83] while the biggest decreases were ampicillin (-31.34%)[84] and cloxacillin (-30.14%)[85].

[73] The ten most dispensed antimicrobial were identified from year 2018 data.
[74] in DDD per 1,000 attendances
[75] 289.29 DDD per 1,000 attendances in year 2016
[76] 287.13 DDD per 1,000 attendances in year 2018
[77] 157.00 DDD per 1,000 attendances
[78] 318.13 DDD per 1,000 attendances
[79] 7.19%, 22.86 DDD per 1,000 attendances
[80] 6.88%, 21.90 DDD per 1,000 attendances
[81] in DDD per 1,000 attendances
[82] from 8.04 DDD per 1,000 attendances in 2016 to 9.98 DDD per 1,000 attendances in 2018
[83] from 19.10 DDD per 1,000 attendances in 2016 to 22.86 DDD per 1,000 attendances in 2018
[84] from 13.89 DDD per 1,000 attendances in 2016 to 9.54 DDD per 1,000 attendances in 2018
[85] from 19.22 DDD per 1,000 attendances in 2016 to 13.43 DDD per 1,000 attendances in 2018

Table 10: The ten most dispensed antimicrobials in HA non-inpatient service

ATC Chemical Substance		DDD per 1,000 attendances					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
J01CR02	Amoxicillin/clavulanate	121.68	138.45	150.11	148.04	157.00	4.59%
J01AA02	Doxycycline	13.94	17.55	19.10	19.70	22.86	19.73%
J01FA09	Clarithromycin	24.29	22.71	24.48	22.98	21.90	-10.53%
J01CA04	Amoxicillin	25.47	22.86	22.11	20.73	20.29	-8.22%
J01MA12	Levofloxacin	12.66	13.15	13.50	13.58	14.02	3.85%
J01CF02	Cloxacillin	24.93	22.10	19.22	16.42	13.43	-30.14%
J01XE01	Nitrofurantoin	12.51	11.82	12.05	11.31	10.64	-11.64%
J01EE01	Co-trimoxazole	8.21	7.84	8.04	8.68	9.98	24.23%
J01CA01	Ampicillin	18.28	15.81	13.89	11.51	9.54	-31.34%
J01FA10	Azithromycin	5.95	6.17	6.80	7.16	7.46	9.62%
	Others	35.53	35.26	34.36	32.28	31.01	-9.76%
	Total	303.44	313.71	323.65	312.40	318.13	-1.70%

* Rounded to two decimal places

† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

The ten most dispensed antimicrobials were identified from year 2018 data.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 5: The ten most dispensed antimicrobials in HA non-inpatient service

4.3 Antimicrobial dispensed quantity in HA inpatient service

4.3.1 Overall annual dispensed quantity and percentage changes in HA inpatient service

63. Table 11 summarises the overall antimicrobials dispensed in HA inpatient service from 2014 to 2018.

64. It was observed that there was an increase in total DDD by 6.16% from 2016 to 2018 but the percentage increase was 0.09% when measured in terms of DDD per 1,000 patient-days. The discrepancy between DDD and DDD per 1,000 patient-days could be explained by the 6.07% increase in patient-days from 2016 to 2018.

Table 11: Summary on number of patient-days and antimicrobials dispensed in HA inpatient service

	Medicine	Surgery	O&T	ICU/HDU	Others	All Inpatient Services
Year 2014						
Total DDD of antimicrobials dispensed*	3,424,000	1,235,000	781,000	124,000	1,188,000	6,752,000
Total number of patient-days*	3,039,000	860,000	747,000	68,000	1,777,000	6,490,000
DDD per 1,000 patient-days†	1,126.68	1,436.27	1,044.93	1,835.37	668.72	1,040.33
Year 2015						
Total DDD of antimicrobials dispensed*	3,612,000	1,282,000	787,000	120,000	1,195,000	6,994,000
Total number of patient-days*	3,137,000	865,000	754,000	69,000	1,786,000	6,612,000
DDD per 1,000 patient-days†	1,151.24	1,482.05	1,043.27	1,732.47	668.73	1,057.91
Year 2016						
Total DDD of antimicrobials dispensed*	3,823,000	1,345,000	801,000	130,000	1,350,000	7,450,000
Total number of patient-days*	3,308,000	916,000	785,000	71,000	1,887,000	6,967,000
DDD per 1,000 patient-days†	1,155.56	1,469.44	1,019.94	1,841.38	715.78	1,069.38
Year 2017						
Total DDD of antimicrobials dispensed*	4,036,000	1,436,000	821,000	126,000	1,384,000	7,803,000
Total number of patient-days*	3,464,000	962,000	813,000	70,000	1,905,000	7,214,000
DDD per 1,000 patient-days†	1,165.14	1,492.11	1,010.53	1,789.96	726.78	1,081.69
Year 2018						
Total DDD of antimicrobials dispensed*	4,053,000	1,522,000	833,000	128,000	1,374,000	7,909,000
Total number of patient-days*	3,560,000	992,000	855,000	72,000	1,910,000	7,390,000
DDD per 1,000 patient-days†	1,138.23	1,533.72	973.22	1,784.84	719.61	1,070.32
Percentage change (2018 over 2016)†‡						
Total DDD of antimicrobials dispensed	6.00%	13.12%	3.93%	-1.66%	1.77%	6.16%
Total number of patient-days	7.62%	8.38%	8.91%	1.45%	1.23%	6.07%
DDD per 1,000 patient-days	-1.50%	4.37%	-4.58%	-3.07%	0.53%	0.09%

* Rounded to the nearest thousand

† Rounded to two decimal places

‡ Due to rounding, figures may not precisely reflect the absolute figures.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

4.3.2 Five most dispensed ATC pharmacological subgroups in HA inpatient service

65. Among all antimicrobials dispensed in inpatient service, the five most dispensed ATC pharmacological subgroups[86,87] from 2014 to 2018 are listed in Table 12. Refer to Figure 6 for graphical presentation.

66. These five most dispensed ATC pharmacological subgroups accounted for at least 92% of the overall antimicrobials dispensed from 2016 to 2018.

67. Antimicrobial dispensed in inpatient service in 2018 has broadly remained similar to that of 2016 and registered a 0.09% increase when compared with that of 2016. Increase of antimicrobial dispensing was observed in tetracyclines (J01A) (47.68%). In contrast, beta-lactam antibacterials, penicillins (J01C) (-1.18%), other beta-lactam antibacterials (J01D) (-2.19%), quinolone antibacterials (J01M) (-0.46%) and macrolides, lincosamides and streptogramins (J01F) (-16.11%) have declined over the same period.

68. Beta-lactam antibacterials, penicillins (J01C) group alone accounted for at least 63% of overall antimicrobials dispensed in inpatient service during the three-year period from 2016 to 2018.

69. Details on the five ATC pharmacological subgroups most commonly dispensed among inpatient services in HA can be referred to Table 22 in Appendix.

[86] The five most dispensed ATC pharmacological subgroups were identified from year 2018 data.
[87] in DDD per 1,000 patient-days

Table 12: The five most dispensed ATC pharmacological subgroups in HA inpatient service

ATC Pharmacological Subgroup		DDD per 1,000 patient-days					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
J01C	Beta-lactam antibacterials, penicillins	647.76	675.46	689.45	699.94	681.34	-1.18%
J01D	Other beta-lactam antibacterials	129.84	123.13	117.92	111.24	115.34	-2.19%
J01M	Quinolone antibacterials	96.05	97.32	93.96	94.15	93.53	-0.46%
J01A	Tetracyclines	26.48	30.47	40.69	51.13	60.10	47.68%
J01F	Macrolides, lincosamides and streptogramins	58.59	51.94	52.43	50.24	43.98	-16.11%
	Others	81.60	79.59	74.93	74.97	76.03	1.48%
	Total	1,040.33	1,057.91	1,069.38	1,081.69	1,070.32	0.09%

* Rounded to two decimal places

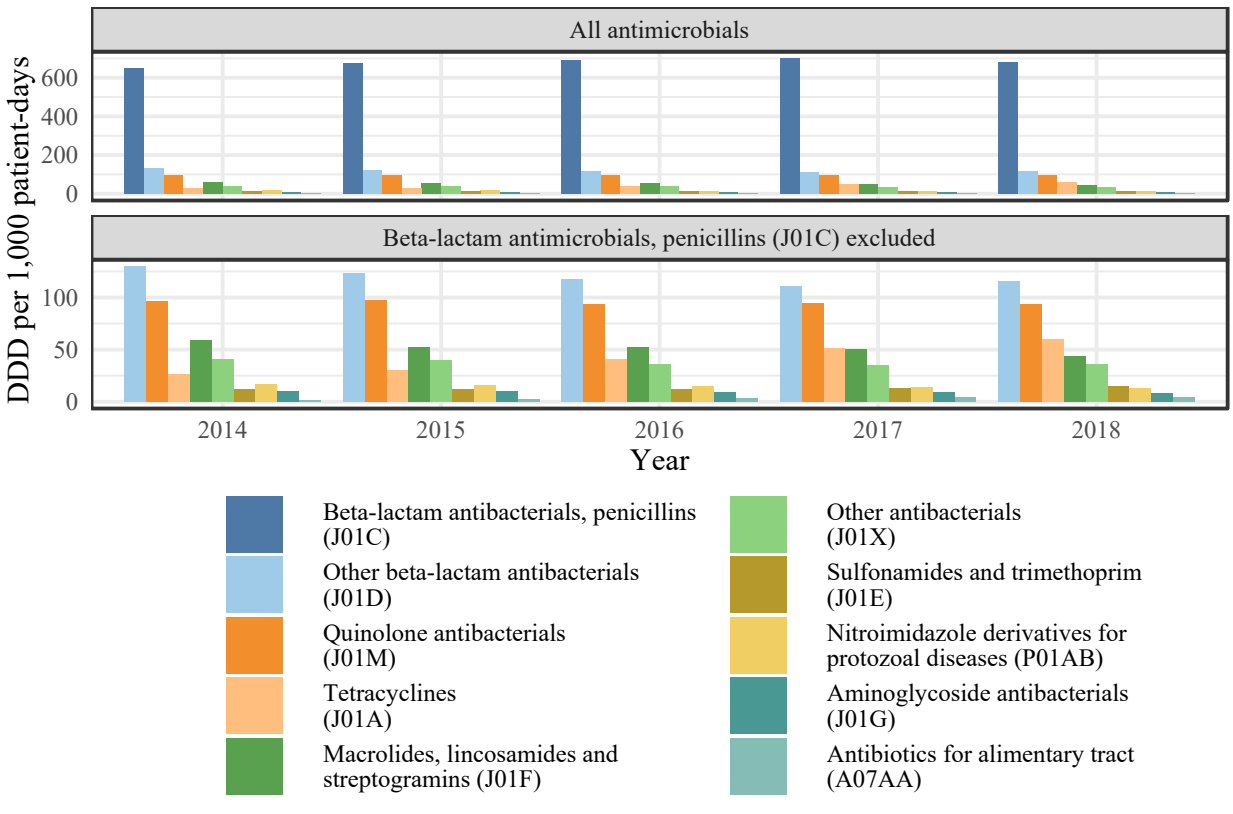
† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

The five most dispensed ATC pharmacological subgroups were identified from year 2018 data.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 6: Antimicrobials dispensed in HA inpatient service grouped by WHO ATC classification



4.3.3 Ten most dispensed antimicrobials in HA inpatient service

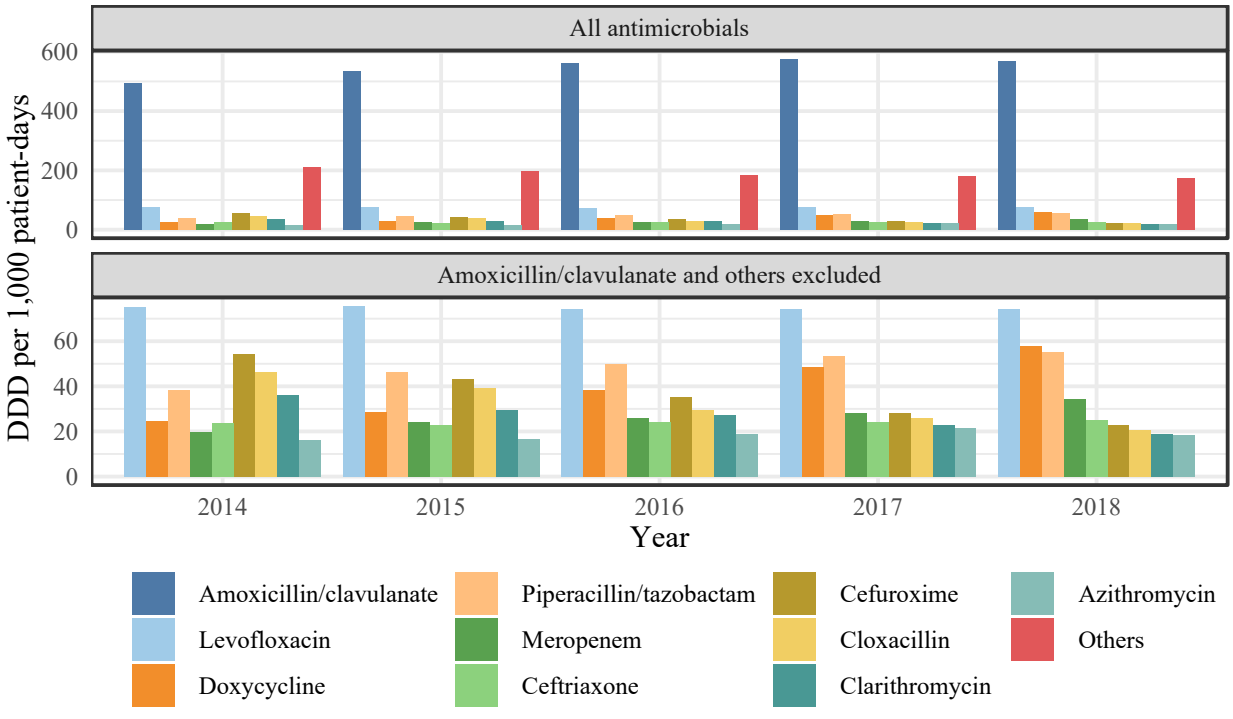
70. For individual antimicrobial, the ten most dispensed antimicrobials[88] in HA inpatient service[89] from 2014 to 2018 are listed in Table 13. Refer to Figure 7 for graphical presentation.

71. These ten most dispensed antimicrobials together accounted for at least 82% of the overall antimicrobials dispensed in inpatient service from 2016 to 2018.

72. Similar to non-inpatient service, amoxicillin/clavulanate alone accounted for at least 52% of the overall use during the three-year period.

73. It was also observed the biggest percentage increase among these ten most dispensed antimicrobials from 2016 to 2018 was doxycycline (50.08%)[90], followed by meropenem (32.44%)[91] and piperacillin/tazobactam (11.10%)[92], while the antimicrobials showing the biggest percentage decreases within the same period were cefuroxime (34.48%)[93], cloxacillin (30.69%)[94] and clarithromycin (30.05%)[95].

Figure 7: The ten most dispensed antimicrobials in HA inpatient service



[88] The ten most dispensed antimicrobials were identified from year 2018 data.
[89] in DDD per 1,000 patient-days
[90] from 38.42 DDD per 1,000 patient-days in 2016 to 57.66 DDD per 1,000 patient-days in 2018
[91] from 26.04 DDD per 1,000 patient-days in 2016 to 34.48 DDD per 1,000 patient-days in 2018
[92] from 49.85 DDD per 1,000 patient-days in 2016 to 55.38 DDD per 1,000 patient-days in 2018
[93] from 35.13 DDD per 1,000 patient-days in 2016 to 23.02 DDD per 1,000 patient-days in 2018
[94] from 29.51 DDD per 1,000 patient-days in 2016 to 20.45 DDD per 1,000 patient-days in 2018
[95] from 27.17 DDD per 1,000 patient-days in 2016 to 19.00 DDD per 1,000 patient-days in 2018

Table 13: The ten most dispensed antimicrobials in HA inpatient service

ATC Chemical Substance		DDD per 1,000 patient-days					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
J01CR02	Amoxicillin/clavulanate	494.48	534.78	563.03	575.68	567.29	0.76%
J01MA12	Levofloxacin	75.07	75.68	74.11	74.36	74.22	0.15%
J01AA02	Doxycycline	24.68	28.48	38.42	48.54	57.66	50.08%
J01CR05	Piperacillin/tazobactam	38.47	46.45	49.85	53.31	55.38	11.10%
J01DH02	Meropenem	19.94	24.00	26.04	28.16	34.48	32.44%
J01DD04	Ceftriaxone	23.83	22.80	23.98	24.01	24.84	3.57%
J01DC02	Cefuroxime	54.47	43.03	35.13	28.13	23.02	-34.48%
J01CF02	Cloxacillin	46.15	39.09	29.51	25.98	20.45	-30.69%
J01FA09	Clarithromycin	36.20	29.54	27.17	22.95	19.00	-30.05%
J01FA10	Azithromycin	16.18	16.41	18.78	21.29	18.60	-0.98%
	Others	210.85	197.65	183.37	179.28	175.37	-4.36%
	Total	1,040.33	1,057.91	1,069.38	1,081.69	1,070.32	0.09%

* Rounded to two decimal places

† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

The ten most dispensed antimicrobials were identified from year 2018 data.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

4.3.4 Overall antimicrobials dispensed in HA inpatient service, stratified by specialty

74. Table 14 presents the overall antimicrobials dispensed stratified by specialty in HA inpatient service[96]. Refer to Figure 8 for graphical presentation.

75. The rather drastic variation[97] among various specialties in HA inpatient service were probably due to the very much different disease natures of patients being treated under the different specialties.

76. It was observed that there was a minute (0.09%) increase[98] of antimicrobials dispensed in inpatient service from 2016 to 2018.

[96] in DDD per 1,000 patient-days
[97] in DDD per 1,000 patient-days
[98] in DDD per 1,000 patient-days

77. When stratified by specialty, Surgery was the specialty that registered the biggest percentage increase in volume of antimicrobial dispensed (4.37%) while the largest percentage decrease of 4.58% was observed in Orthopaedics & Traumatology[99,100].

Table 14: Overall antimicrobials dispensed in HA inpatient service, stratified by specialty

Specialty	DDD per 1,000 patient-days					Percentage change (2018 over 2016)*†
	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	
Medicine	1,126.68	1,151.24	1,155.56	1,165.14	1,138.23	-1.50%
Surgery	1,436.27	1,482.05	1,469.44	1,492.11	1,533.72	4.37%
Orthopaedics & Traumatology	1,044.93	1,043.27	1,019.94	1,010.53	973.22	-4.58%
ICU/HDU	1,835.37	1,732.47	1,841.38	1,789.96	1,784.84	-3.07%
Others	668.72	668.73	715.78	726.78	719.61	0.53%
All Inpatient Services	1,040.33	1,057.91	1,069.38	1,081.69	1,070.32	0.09%

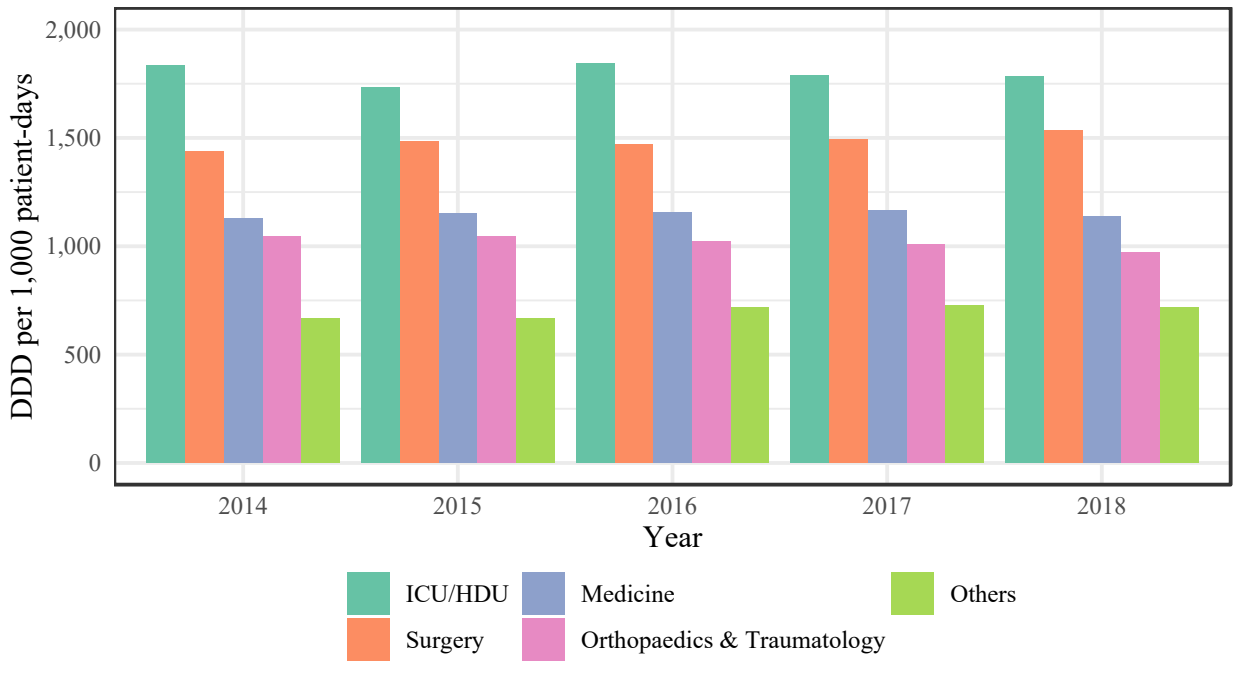
* Rounded to two decimal places

† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 8: Overall antimicrobials dispensed in HA inpatient service, stratified by specialty



[99] from 1,019.94 DDD per 1,000 patient-days in 2016 to 973.22 DDD per 1,000 patient-days in 2018

[100] "Others" specialty was not included in this analysis.

4.3.5 Dispensed broad-spectrum antimicrobials in HA inpatient service

78. Table 15 presents the selected broad-spectrum antimicrobials dispensed in HA inpatient service and Table 16 presents the selected broad-spectrum antimicrobials dispensed in HA inpatient service stratified by specialty . Refer to Figure 9 and Figure 10 for respective graphical presentation.

79. It was observed that there was a 15.46% increase[101] of the selected broad-spectrum antimicrobials dispensed in HA inpatient service from 2016 to 2018. The most dispensed broad-spectrum antimicrobial from 2016 to 2018 was piperacillin/tazobactam[102], followed by meropenem[103], and the third most dispensed one was vancomycin[104].

80. The use of two new fifth generation cephalosporins, namely, ceftaroline fosamil (J01DI02) and ceftolozane/tazobactam (J01DI54), from 2016 to 2018 registered even higher percentage increase but the absolute amount used was rather minute.[105] The high percentage increase was due to the low base of comparison in 2016 when they were introduced into HA shortly.

81. Nevertheless, the increasing trend of broad-spectrum antimicrobial use in HA was noticeable from 2016 to 2018. Particular attention should be paid to piperacillin/tazobactam, meropenem and vancomycin as their absolute dispensed amount were the highest among all the selected broad-spectrum antimicrobials under monitoring.

[101] from 112.28 DDD per 1,000 patient-days in 2016 to 129.65 DDD per 1,000 patient-days in 2018

[102] from 49.85 DDD per 1,000 patient-days in 2016 to 55.38 DDD per 1,000 patient-days in 2018, with an increase of 11.10%

[103] from 26.04 DDD per 1,000 patient-days in 2016 to 34.48 DDD per 1,000 patient-days in 2018, with an increase of 32.44%

[104] from 13.26 DDD per 1,000 patient-days in 2016 to 15.12 DDD per 1,000 patient-days in 2018, with an increase of 14.06%

[105] 0.30 DDD per 1,000 patient-days for ceftaroline fosamil and 0.11 DDD per 1,000 patient-days for ceftolozane/tazobactam in 2018

Table 15: Dispensed broad-spectrum antimicrobials in HA inpatient service

ATC Chemical Substance		DDD per 1,000 patient-days					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
Beta-lactam antibacterials, penicillins							
J01CR05	Piperacillin/tazobactam	38.47	46.45	49.85	53.31	55.38	11.10%
Other beta-lactam antibacterials (Cephalosporins)‡							
J01DE01	Cefepime	2.28	3.20	3.29	3.67	4.70	42.70%
J01DD62	Cefoperazone/sulbactam	4.69	4.63	4.47	3.88	3.85	-13.89%
J01DD02	Ceftazidime	2.72	3.35	3.31	3.27	3.65	10.22%
J01DI02	Ceftaroline fosamil	0.11	0.16	0.18	0.31	0.30	67.06%
J01DI54	Ceftolozane/tazobactam	-	-	<0.005	0.03	0.11	4,478.03%
J01DD52	Ceftazidime/avibactam	-	-	-	-	<0.005	-
Other beta-lactam antibacterials (Carbapenems)‡							
J01DH02	Meropenem	19.94	24.00	26.04	28.16	34.48	32.44%
J01DH03	Ertapenem	5.70	6.10	5.97	6.26	6.74	12.87%
J01DH51	Imipenem/cilastatin	1.78	1.68	1.29	1.07	0.92	-28.90%
Other antibacterials							
J01XA01	Vancomycin	11.40	12.59	13.26	13.84	15.12	14.06%
J01XX08	Linezolid	1.68	1.57	1.71	1.63	1.64	-4.20%
J01XB01	Colistin	2.47	2.47	2.01	1.80	1.58	-21.19%
J01XX09	Daptomycin	0.53	0.75	0.84	1.13	1.17	39.44%
J01XA02	Teicoplanin	0.09	0.09	0.07	<0.005	0.01	-91.53%
	Total	91.84	107.03	112.28	118.38	129.65	15.46%

* Rounded to two decimal places

† Due to rounding, figures may not precisely reflect the absolute figures.

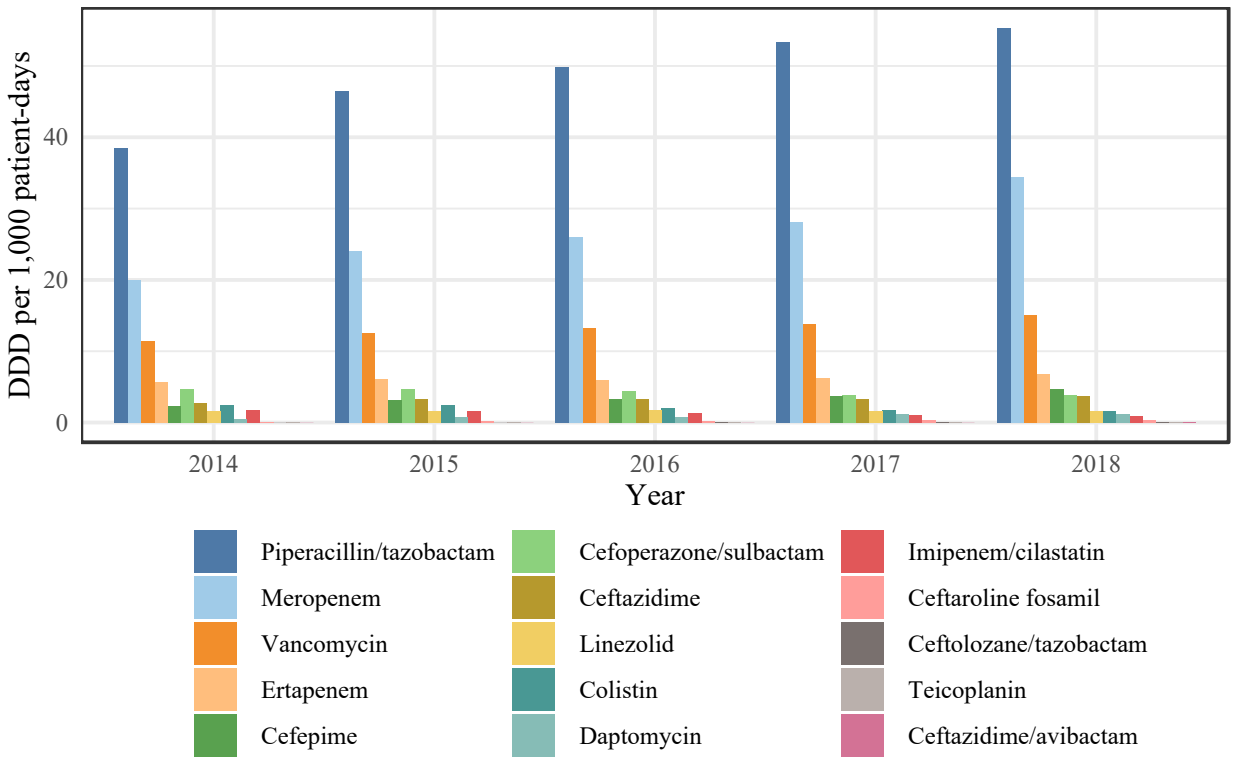
‡ ATC pharmacological subgroup "other beta-lactam antibacterials (J01D)" is further categorised into cephalosporins and carbapenems groups.

Note:

Broad-spectrum antimicrobials not categorised as antimicrobials for systemic use (J01) under WHO ATC were excluded from analysis.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 9: Dispensed broad-spectrum antimicrobials in HA inpatient service



82. When stratified by specialty, though ICU/HDU was the one with the highest dispensed quantity of broad-spectrum antimicrobials[106], the result is not surprising as ICU/HDU is the unit taking care of patients who are the most ill and vulnerable to resistant infections, it registered a percentage decrease of 3.91% from 2016 to 2018 though. An increase from 11.77% to 20.65% was observed among all other units including Medicine, Surgery, Orthopaedics & Traumatology and Others within the same period, with Surgery showing the highest increase. (Table 16)

[106] from 641.83 DDD per 1,000 patient-days in year 2016 to 616.74 DDD per 1,000 patient-days in year 2018

Table 16: Dispensed broad-spectrum antimicrobials in HA inpatient service, stratified by specialty

Specialty	DDD per 1,000 patient-days					
	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
Medicine	116.71	138.83	143.96	151.35	166.82	15.88%
Surgery	91.36	106.95	116.60	125.03	140.68	20.65%
Orthopaedics & Traumatology	44.37	52.75	62.93	67.37	72.61	15.39%
ICU/HDU	648.44	604.16	641.83	626.39	616.74	-3.91%
Others	48.29	54.87	55.35	58.09	61.87	11.77%
All Inpatient Services	91.84	107.03	112.28	118.38	129.65	15.46%

* Rounded to two decimal places

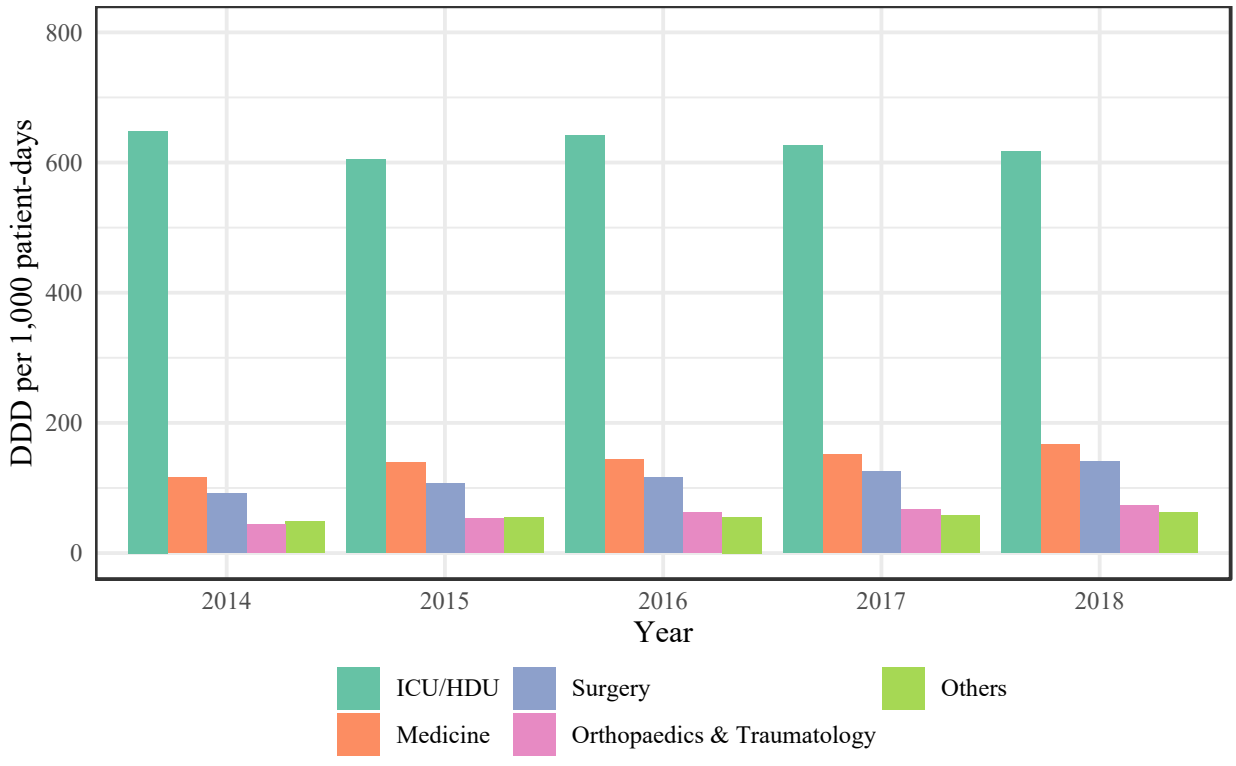
† Due to rounding, figures may not precisely reflect the absolute figures.

Note:

Broad-spectrum antimicrobials not categorised as antimicrobials for systemic use (J01) under WHO ATC were excluded from analysis.

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Figure 10: Dispensed broad-spectrum antimicrobials in HA inpatient service, stratified by specialty



5 Discussion

83. Among all the dispensed antimicrobials in HA hospitals and clinics, Amoxicillin/clavulanate has been by far the most dispensed one[107] in 2018. Doxycycline was noted to have increased most by percentage (39.38%), followed by co-trimoxazole (30.23%) and a broad-spectrum antimicrobial piperacillin/tazobactam (17.85%) when compared the 2018 figures with those of 2016. Ampicillin and cloxacillin was found to have decreased most by percentage in the same period.[108]

84. When stratified by service types, the overall dispensed quantity of antimicrobials in non-inpatient service[109] decreased slightly in 2018 when compared with that of 2016 (-1.70%). When further stratified by specialty, only Specialist Out-patient (Clinical) was observed with a slight increase by 3.10% during the same period, while Primary Care (GOPC) and Accident & Emergency were observed with a decrease by 3.46% and 1.03% respectively.

85. Percentage of attendance with antimicrobials dispensed was dropped in all three specialties and together they led to the drop in all non-inpatient services by 8.49% in 2018 when compared with 2016, i.e. fewer patients were prescribed with antimicrobials after attending these specialties service.

86. Though the overall antimicrobials dispensed in DDD in inpatient service increased by 6.16% in 2018 when compared with that of 2016, after considering the increased service volume for inpatient service, the overall quantity of antimicrobials dispensed in DDD per 1,000 patient-days remained rather stable in 2018 when compared with that of 2016.[110]

87. When stratified by specialty, all specialties of inpatient service, except Surgery, showed some decrease or a stable antimicrobials dispensed quantity in 2018 when compared with that of 2016. Both ICU/HDU and Orthopaedics & Traumatology showed a steady decline in antimicrobial dispensed quantity from 2016 to 2018 consecutively.

[107] with 51.55% of the overall quantity dispensed
[108] -30.36% for ampicillin; -27.84% for cloxacillin
[109] in DDD per 1,000 attendances
[110] 2018: 1,070.32 DDD per 1,000 patient-days; 2016: 1,069.38 DDD per 1,000 patient-days

88. For the HA inpatient service in 2018, amoxicillin/clavulanate was by far the most dispensed antimicrobial which contributed 53.00% of overall dispensed quantity. Doxycycline showed the sharpest increase and contributed to the obvious increase trend of use of tetracyclines group from 2016 to 2018. Increase was also observed with meropenem and piperacillin/tazobactam, which are among selected broad-spectrum antimicrobials under special monitoring. Furthermore, over 30% decrease was observed with cefuroxime, cloxacillin and clarithromycin from 2016 to 2018.

89. When focusing on the selected broad-spectrum antimicrobials, piperacillin/tazobactam, meropenem and vancomycin were the top three most dispensed broad-spectrum antimicrobials in HA inpatient service from 2016 to 2018. These three antimicrobials accounted for 79.39% in 2016 to 80.98% in 2018 of the overall dispensed quantity of broad-spectrum antimicrobials, and have shown a steady increase since 2014. Piperacillin/tazobactam, and meropenem were also ranked the fourth and fifth place among the 10 most dispensed antimicrobials in HA inpatient service in year 2018.

90. The two relatively new fifth generation cephalosporins, namely, ceftaroline fosamil and ceftolozane/tazobactam showed rapid increase in use since their introduction in HA though the absolute dispensed amount were rather small. Both cefepime and daptomycin showed an increase of about 40% from 2016 to 2018 though they together only accounted for 3.68% in 2016 and 4.53% in 2018. Colistin, being considered as the last resort antimicrobial for treating resistant Gram-negative bacterial infections when all other antimicrobials failed, was found to have decreased by 21.19% in 2018 when compared with that of 2016.

5.1 Limitations

91. Results of this report are based on data captured from the HA dispensing system and are only intended to reflect the annual trend of various antimicrobials dispensed at various specialties through this system. The dispensing data collected did not contain information on indications (i.e. intended use). It is not meant to gauge the appropriateness of the prescribed antimicrobial for infectious diseases on whether the right dose and the duration were given. For assessment on prescription appropriateness, other information including but not limited to clinical symptoms, laboratory results, other epidemiological information such as age, comorbidity, medication history are needed. In addition, the analysis assumes that amount of antimicrobials dispensed equals to the amount consumed, and the DDD constants applied in this surveillance exercise for each antimicrobial may not be aligned with the local practice.

92. During analysis, ambiguity on route of administration information was observed in the dataset. Since information on route of administration is required in WHO ATC classification system for DDD conversion, after discussion with HA, a consensus has been reached that dosage form of the drug will be used to determine route of administration if this piece of information is not available in dispensing record.

93. Furthermore, it was observed that the pharmaceutical dosage form of some antimicrobials did not match with the prescribed route of administration. Readers should pay special attention to vancomycin, as it classified both as an antibiotic for alimentary tract (A07AA09) and a glycopeptide antibacterials (J01XA01). The DDD under glycopeptide antibacterials only included those vancomycin prescribed with assigned route of administration being parenteral, while those vancomycin prescribed to be given orally, even the pharmaceutical dosage form is for parenteral use, would be assigned as antibiotic for alimentary tract, because there is no registered vancomycin product in Hong Kong comes in oral dosage form.

94. Readers are again reminded to refrain from making direct cross-service or cross-specialty comparisons of the results as there are other factors which could affect the dispensed quantity for each service and specialty, such as case-mix. The DDD figures are only meant to reflect the annual trend of antimicrobial dispensed under that service or specialty.

6 Conclusion

95. Collecting antimicrobial dispensing data as routine AMU surveillance can be used for several purposes, such as: i) to raise awareness on appropriate use of antimicrobial, ii) to inform stakeholders of their performance and prescribed quantities of various antimicrobials, and iii) to consider whether it is necessary to make changes to existing prescribing policy and/or to strengthen Antibiotic Stewardship Programme.

96. AMR is a threat to all members of the general public regardless of race, age and gender. Coordinated joint effort from every sectors and stakeholders is the only way to lessen and mitigate the threat.

97. In conclusion, antimicrobials are a very precious resource for modern medicine and should only be used judiciously to preserve its effectiveness against common infections or human race may fall back to pre-antibiotic era.

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8 Appendix

Table 17: DDD constant applied for DDD calculation in surveillance report

WHO ATC Grouping		DDD Constant			
ATC Code	Chemical Substance	Oral	Parenteral	Rectal	Inhalation Sol.
Antibiotics for alimentary tract (A07AA)					
A07AA06	Paromomycin	3000 mg	-	-	-
A07AA09	Vancomycin	2000 mg	-	-	-
A07AA11	Rifaximin	600 mg	-	-	-
Tetracyclines (J01A)					
Tetracyclines (J01AA)					
J01AA02	Doxycycline	100 mg	100 mg	-	-
J01AA06	Oxytetracycline	-	1000 mg	-	-
J01AA07	Tetracycline	1000 mg	-	-	-
J01AA08	Minocycline	200 mg	200 mg	-	-
J01AA12	Tigecycline	-	100 mg	-	-
Beta-lactam antibacterials, penicillins (J01C)					
Penicillins with extended spectrum (J01CA)					
J01CA01	Ampicillin	2000 mg	2000 mg	-	-
J01CA04	Amoxicillin	1000 mg	-	-	-
J01CA12	Piperacillin	-	14000 mg	-	-
Beta-lactamase sensitive penicillins (J01CE)					
J01CE01	Benzylpenicillin	-	3600 mg	-	-
J01CE02	Phenoxymethyl-penicillin	2000 mg	-	-	-
J01CE08	Benzathine benzylpenicillin	-	3600 mg	-	-
J01CE09	Procaine benzylpenicillin	-	600 mg	-	-
Beta-lactamase resistant penicillins (J01CF)					
J01CF02	Cloxacillin	2000 mg	2000 mg	-	-
J01CF05	Flucloxacillin	-	2000 mg	-	-
Combinations of penicillins, incl. beta-lactamase inhibitors (J01CR)					
J01CR01	Ampicillin/sulbactam	-	6000 mg	-	-
J01CR02	Amoxicillin/clavulanate	1000 mg	3000 mg	-	-

Table 17: DDD constant applied for DDD calculation in surveillance report *(continued)*

WHO ATC Grouping		DDD Constant			
ATC Code	Chemical Substance	Oral	Parenteral	Rectal	Inhalation Sol.
J01CR03	Ticarcillin/clavulanate	-	15000 mg	-	-
J01CR04	Sultamicillin	1500 mg	-	-	-
J01CR05	Piperacillin/tazobactam	-	14000 mg	-	-
Other beta-lactam antibacterials (J01D)					
First-generation cephalosporins (J01DB)					
J01DB01	Cefalexin	2000 mg	-	-	-
J01DB04	Cefazolin	-	3000 mg	-	-
Second-generation cephalosporins (J01DC)					
J01DC01	Cefoxitin	-	6000 mg	-	-
J01DC02	Cefuroxime	500 mg	3000 mg	-	-
J01DC04	Cefaclor	1000 mg	-	-	-
Third-generation cephalosporins (J01DD)					
J01DD01	Cefotaxime	-	4000 mg	-	-
J01DD02	Ceftazidime	-	4000 mg	-	-
J01DD04	Ceftriaxone	-	2000 mg	-	-
J01DD13	Cefpodoxime	400 mg	-	-	-
J01DD14	Ceftibuten	400 mg	-	-	-
J01DD52	Ceftazidime/avibactam	-	6000 mg	-	-
J01DD62	Cefoperazone/sulbactam	-	4000 mg	-	-
Fourth-generation cephalosporins (J01DE)					
J01DE01	Cefepime	-	2000 mg	-	-
Monobactams (J01DF)					
J01DF01	Aztreonam	-	4000 mg	-	-
Carbapenems (J01DH)					
J01DH02	Meropenem	-	2000 mg	-	-
J01DH03	Ertapenem	-	1000 mg	-	-
J01DH51	Imipenem/cilastatin	-	2000 mg	-	-
Other cephalosporins and penems (J01DI)					
J01DI02	Ceftaroline fosamil	-	1200 mg	-	-
J01DI54	Ceftolozane/tazobactam	-	3000 mg	-	-

Table 17: DDD constant applied for DDD calculation in surveillance report *(continued)*

WHO ATC Grouping		DDD Constant			
ATC Code	Chemical Substance	Oral	Parenteral	Rectal	Inhalation Sol.
Sulfonamides and trimethoprim (J01E)					
Trimethoprim and derivatives (J01EA)					
J01EA01	Trimethoprim	400 mg	400 mg	-	-
Intermediate-acting sulfonamides (J01EC)					
J01EC02	Sulfadiazine	600 mg	-	-	-
Combinations of sulfonamides and trimethoprim, incl. derivatives (J01EE)					
J01EE01	Co-trimoxazole*	-	-	-	-
Macrolides, lincosamides and streptogramins (J01F)					
Macrolides (J01FA)					
J01FA01	Erythromycin	1000 mg	1000 mg	-	-
	Erythromycin ethylsuccinate	2000 mg	-	-	-
J01FA09	Clarithromycin	500 mg	1000 mg	-	-
J01FA10	Azithromycin	300 mg	500 mg	-	-
Lincosamides (J01FF)					
J01FF01	Clindamycin	1200 mg	1800 mg	-	-
Aminoglycoside antibacterials (J01G)					
Streptomycins (J01GA)					
J01GA01	Streptomycin	-	1000 mg	-	-
Other aminoglycosides (J01GB)					
J01GB01	Tobramycin	-	240 mg	-	300 mg
J01GB03	Gentamicin	-	240 mg	-	-
J01GB04	Kanamycin	-	1000 mg	-	-
J01GB05	Neomycin	1000 mg	-	-	-
J01GB06	Amikacin	-	1000 mg	-	-
Quinolone antibacterials (J01M)					
Fluoroquinolones (J01MA)					
J01MA01	Ofloxacin	400 mg	-	-	-
J01MA02	Ciprofloxacin	1000 mg	500 mg	-	-
J01MA12	Levofloxacin	500 mg	500 mg	-	-
J01MA14	Moxifloxacin	400 mg	400 mg	-	-

Table 17: DDD constant applied for DDD calculation in surveillance report *(continued)*

WHO ATC Grouping		DDD Constant			
ATC Code	Chemical Substance	Oral	Parenteral	Rectal	Inhalation Sol.
Other antibacterials (J01X)					
Glycopeptide antibacterials (J01XA)					
J01XA01	Vancomycin	-	2000 mg	-	-
J01XA02	Teicoplanin	-	400 mg	-	-
Polymyxins (J01XB)					
J01XB01	Colistin	-	3 MU	-	3 MU
Steroid antibacterials (J01XC)					
J01XC01	Fusidic acid	1500 mg	-	-	-
Imidazole derivatives (J01XD)					
J01XD01	Metronidazole	-	1500 mg	-	-
Nitrofuran derivatives (J01XE)					
J01XE01	Nitrofurantoin	200 mg	-	-	-
Other antibacterials (J01XX)					
J01XX01	Fosfomycin	3000 mg	8000 mg	-	-
J01XX08	Linezolid	1200 mg	1200 mg	-	-
J01XX09	Daptomycin	-	280 mg	-	-
Nitroimidazole derivatives for protozoal diseases (P01AB)					
P01AB01	Metronidazole	2000 mg	-	2000 mg	-
P01AB02	Tinidazole	2000 mg	-	-	-

* Since co-trimoxazole is a combination antimicrobial, as referenced from WHO ATC every 4 tablets of sulfamethoxazole 400mg and trimethoprim 80mg equal to 1 DDD.

Table 18: Change in DDD constant applied for calculation of DDD in the surveillance report

WHO ATC Grouping			DDD Constant used for calculation	
ATC Code	Chemical Substance	Adm. Route	Report 14-16	Report 14-18
J01DD52	Ceftazidime/avibactam	Parenteral	-	6000 mg
J01DD13	Cefpodoxime	Oral	-	400 mg
J01XC01	Fusidic acid	Oral	-	1500 mg
J01MA14	Moxifloxacin	Parenteral	-	400 mg
J01AA06	Oxytetracycline	Parenteral	-	1000 mg
A07AA06	Paromomycin	Oral	-	3000 mg
A07AA11	Rifaximin	Oral	-	600 mg
J01DI54	Ceftolozane/tazobactam	Parenteral	-	3000 mg
J01GB01	Tobramycin	Inhal. Sol.	-	300 mg
		Parenteral	-	240 mg
A07AA09	Vancomycin	Oral	-	2000 mg

Note:
Addition in DDD constant applied may be due to: i) some DDD constants used in the current report (14-18) were not available from WHO ATC when the previous report (14-16) was being prepared; or ii) the chemical substance was dispensed in year 2017 - 2018, but not in year 2014 - 2016.

Table 19: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in all HA services (by WHO ATC classification)

ATC Chemical Substance		Antimicrobial dispensed in DDD					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)†‡
Beta-lactam antibacterials, penicillins (J01C)							
J01CR02	Amoxicillin/clavulanate	5,101,000	5,724,000	6,339,000	6,565,000	6,769,000	6.80%
J01CA04	Amoxicillin	494,000	450,000	449,000	441,000	435,000	-3.08%
J01CR05	Piperacillin/tazobactam	250,000	307,000	347,000	385,000	409,000	17.85%
	Others	1,378,000	1,191,000	1,033,000	923,000	763,000	-26.14%
Quinolone antibacterials (J01M)							
J01MA12	Levofloxacin	684,000	708,000	734,000	758,000	779,000	6.14%
J01MA02	Ciprofloxacin	264,000	274,000	261,000	254,000	252,000	-3.40%
J01MA14	Moxifloxacin	15,000	16,000	17,000	15,000	14,000	-14.30%
	Others	≤500	≤500	≤500	≤500	≤500	-72.43%
Other beta-lactam antibacterials (J01D) (Cephalosporins)§							
J01DC02	Cefuroxime	455,000	381,000	333,000	282,000	244,000	-26.81%
J01DD04	Ceftriaxone	157,000	153,000	169,000	175,000	185,000	9.69%
J01DB04	Cefazolin	51,000	53,000	56,000	58,000	64,000	13.23%
	Others	120,000	130,000	136,000	123,000	137,000	0.74%
Other beta-lactam antibacterials (J01D) (Carbapenems)§							
J01DH02	Meropenem	130,000	159,000	182,000	204,000	256,000	40.57%
J01DH03	Ertapenem	38,000	41,000	43,000	46,000	51,000	18.91%

Table 19: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in all HA services (by WHO ATC classification) *(continued)*

ATC Chemical Substance		Antimicrobial dispensed in DDD					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)†‡
J01DH51	Imipenem/cilastatin	12,000	12,000	9,000	8,000	7,000	-26.87%
Macrolides, lincosamides and streptogramins (J01F)							
J01FA09	Clarithromycin	612,000	554,000	583,000	540,000	500,000	-14.28%
J01FA10	Azithromycin	197,000	206,000	240,000	270,000	260,000	8.12%
J01FA01	Erythromycin	85,000	81,000	85,000	77,000	69,000	-18.53%
	Others	39,000	42,000	46,000	45,000	53,000	15.48%
Tetracyclines (J01A)							
J01AA02	Doxycycline	377,000	466,000	575,000	671,000	801,000	39.38%
J01AA08	Minocycline	24,000	28,000	31,000	40,000	37,000	18.67%
J01AA07	Tetracycline	44,000	39,000	34,000	33,000	32,000	-6.94%
	Others	2,000	3,000	3,000	4,000	4,000	5.65%

* Rounded to the nearest thousand

† Rounded to two decimal places

‡ Due to rounding, percentages may not precisely reflect the absolute figures.

§ WHO ATC Pharmacological subgroup "other beta-lactam antibacterials (J01D)" is further categorised into cephalosporins and carbapenems groups.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Table 20: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in HA non-inpatient service (by WHO ATC classification)

ATC Chemical Substance		DDD per 1,000 attendances					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
Beta-lactam antibacterials, penicillins (J01C)							
J01CR02	Amoxicillin/clavulanate	121.68	138.45	150.11	148.04	157.00	4.59%
J01CA04	Amoxicillin	25.47	22.86	22.11	20.73	20.29	-8.22%
J01CF02	Cloxacillin	24.93	22.10	19.22	16.42	13.43	-30.14%
	Others	22.11	19.41	17.64	15.16	12.88	-26.95%
Macrolides, lincosamides and streptogramins (J01F)							
J01FA09	Clarithromycin	24.29	22.71	24.48	22.98	21.90	-10.53%
J01FA10	Azithromycin	5.95	6.17	6.80	7.16	7.46	9.62%
J01FA01	Erythromycin	4.33	4.28	4.40	3.94	3.57	-18.95%
	Others	1.02	0.99	0.95	0.92	1.03	8.43%
Tetracyclines (J01A)							
J01AA02	Doxycycline	13.94	17.55	19.10	19.70	22.86	19.73%
J01AA07	Tetracycline	2.79	2.38	2.05	1.90	1.80	-12.04%
J01AA08	Minocycline	0.97	1.17	1.21	1.63	1.49	22.31%
Quinolone antibacterials (J01M)							
J01MA12	Levofloxacin	12.66	13.15	13.50	13.58	14.02	3.85%
J01MA02	Ciprofloxacin	8.76	8.94	8.27	7.44	7.18	-13.27%
J01MA14	Moxifloxacin	0.45	0.35	0.36	0.32	0.33	-7.63%

Table 20: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in HA non-inpatient service (by WHO ATC classification) *(continued)*

ATC Chemical Substance		DDD per 1,000 attendances					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
	Others	0.01	0.02	0.01	<0.005	<0.005	-80.15%
Other antibacterials (J01X)							
J01XE01	Nitrofurantoin	12.51	11.82	12.05	11.31	10.64	-11.64%
J01XC01	Fusidic acid	0.30	0.25	0.20	0.23	0.22	12.89%
J01XX08	Linezolid	0.06	0.06	0.15	0.16	0.14	-3.42%
	Others	0.13	0.12	0.16	0.16	0.16	-2.48%

* Rounded to two decimal places

† Due to rounding, percentages may not precisely reflect the absolute figures.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Table 21: Changes in quantity dispensed of the ten most dispensed antimicrobials in HA non-inpatient service, stratified by service type

ATC Chemical Substance		Changes in DDD per 1,000 attendances from 2016 to 2018 (% Change)			
Code	Description	All Non-inpatient Services	Primary care	Specialist Out-patient (Clinical)	Accident & Emergency
J01EE01	Co-trimoxazole	1.95 (24.23%)	-0.36 (-14.80%)	3.88 (26.43%)	0.29 (17.16%)
J01AA02	Doxycycline	3.77 (19.73%)	-1.44 (-11.40%)	7.90 (29.22%)	2.40 (21.82%)
J01FA10	Azithromycin	0.65 (9.62%)	-0.39 (-20.74%)	1.60 (16.39%)	0.09 (0.83%)
J01CR02	Amoxicillin/clavulanate	6.89 (4.59%)	20.92 (18.26%)	-1.59 (-2.20%)	30.21 (5.94%)
J01MA12	Levofloxacin	0.52 (3.85%)	0.80 (27.14%)	-0.65 (-3.17%)	3.20 (16.22%)
J01CA04	Amoxicillin	-1.82 (-8.22%)	-7.62 (-26.08%)	2.81 (15.15%)	-1.43 (-10.38%)
J01FA09	Clarithromycin	-2.58 (-10.53%)	-2.14 (-13.59%)	-1.96 (-5.93%)	-7.75 (-37.80%)
J01XE01	Nitrofurantoin	-1.40 (-11.64%)	-1.21 (-8.16%)	-0.19 (-4.33%)	-4.15 (-14.29%)
J01CF02	Cloxacillin	-5.79 (-30.14%)	-7.97 (-29.18%)	-1.34 (-20.72%)	-12.41 (-32.12%)
J01CA01	Ampicillin	-4.35 (-31.34%)	-4.92 (-27.70%)	-1.05 (-23.03%)	-12.08 (-35.69%)

Note:

Figures are rounded to two decimal places.

Table 22: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in HA inpatient service (by WHO ATC classification)

ATC Chemical Substance		DDD per 1,000 patient-days					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
Beta-lactam antibacterials, penicillins (J01C)							
J01CR02	Amoxicillin/clavulanate	494.48	534.78	563.03	575.68	567.29	0.76%
J01CR05	Piperacillin/tazobactam	38.47	46.45	49.85	53.31	55.38	11.10%
J01CF02	Cloxacillin	46.15	39.09	29.51	25.98	20.45	-30.69%
	Others	68.67	55.14	47.06	44.96	38.22	-18.79%
Other beta-lactam antibacterials (J01D) (Cephalosporins)‡							
J01DD04	Ceftriaxone	23.83	22.80	23.98	24.01	24.84	3.57%
J01DC02	Cefuroxime	54.47	43.03	35.13	28.13	23.02	-34.48%
J01DB04	Cefazolin	7.74	7.85	7.96	7.92	8.50	6.84%
	Others	16.37	17.66	17.54	15.67	16.82	-4.07%
Other beta-lactam antibacterials (J01D) (Carbapenems)‡							
J01DH02	Meropenem	19.94	24.00	26.04	28.16	34.48	32.44%
J01DH03	Ertapenem	5.70	6.10	5.97	6.26	6.74	12.87%
J01DH51	Imipenem/cilastatin	1.78	1.68	1.29	1.07	0.92	-28.90%
Quinolone antibacterials (J01M)							
J01MA12	Levofloxacin	75.07	75.68	74.11	74.36	74.22	0.15%
J01MA02	Ciprofloxacin	19.72	20.01	18.28	18.39	18.11	-0.91%
J01MA14	Moxifloxacin	1.24	1.62	1.55	1.40	1.19	-23.48%

Table 22: The three most commonly dispensed antimicrobials, among the five most dispensed ATC pharmacological subgroups in year 2018 in HA inpatient service (by WHO ATC classification) *(continued)*

ATC Chemical Substance		DDD per 1,000 patient-days					
Code	Description	Year 2014*	Year 2015*	Year 2016*	Year 2017*	Year 2018*	Percentage change (2018 over 2016)*†
	Others	0.02	0.02	0.02	0.01	0.01	-66.64%
Tetracyclines (J01A)							
J01AA02	Doxycycline	24.68	28.48	38.42	48.54	57.66	50.08%
J01AA08	Minocycline	1.31	1.44	1.63	1.87	1.67	2.04%
J01AA12	Tigecycline	0.28	0.36	0.45	0.48	0.47	4.78%
	Others	0.20	0.18	0.19	0.25	0.30	55.78%
Macrolides, lincosamides and streptogramins (J01F)							
J01FA09	Clarithromycin	36.20	29.54	27.17	22.95	19.00	-30.05%
J01FA10	Azithromycin	16.18	16.41	18.78	21.29	18.60	-0.98%
J01FF01	Clindamycin	3.53	3.93	4.41	4.22	4.91	11.15%
	Others	2.68	2.06	2.07	1.79	1.47	-28.72%

* Rounded to two decimal places

† Due to rounding, percentages may not precisely reflect the absolute figures.

‡ WHO ATC Pharmacological subgroup "other beta-lactam antibacterials (J01D)" is further categorised into cephalosporins and carbapenems groups.

Note:

Comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution, due to continuous revisions of the ATC/DDD system and possible difference between consumption/dispensed quantity data.

Table 23: Changes in quantity dispensed of the ten most dispensed antimicrobials in HA inpatient service, stratified by service type

ATC Chemical Substance		Changes in DDD per 1,000 patient-days from 2016 to 2018 (% Change)					
Code	Description	All Inpatient Services	Medicine	Surgery	O&T	ICU/HDU	Others
J01AA02	Doxycycline	19.24 (50.08%)	33.87 (57.82%)	3.23 (18.72%)	4.46 (68.68%)	47.63 (39.25%)	5.34 (22.68%)
J01DH02	Meropenem	8.45 (32.44%)	13.01 (39.93%)	9.56 (30.49%)	2.50 (35.99%)	2.96 (1.70%)	1.91 (13.31%)
J01CR05	Piperacillin/tazobactam	5.53 (11.10%)	5.12 (7.11%)	8.52 (19.45%)	4.82 (25.96%)	3.43 (1.69%)	3.86 (18.31%)
J01DD04	Ceftriaxone	0.86 (3.57%)	0.21 (0.67%)	1.25 (16.50%)	-1.76 (-9.57%)	3.83 (4.00%)	2.75 (15.83%)
J01CR02	Amoxicillin/clavulanate	4.26 (0.76%)	-57.67 (-9.10%)	121.00 (14.81%)	50.82 (9.77%)	-5.86 (-2.42%)	23.39 (6.77%)
J01MA12	Levofloxacin	0.11 (0.15%)	-4.21 (-4.92%)	7.30 (6.67%)	1.21 (1.68%)	4.02 (2.70%)	1.39 (3.99%)
J01FA10	Azithromycin	-0.18 (-0.98%)	-1.35 (-4.17%)	0.18 (9.34%)	0.64 (49.01%)	-13.84 (-22.64%)	1.57 (18.19%)
J01FA09	Clarithromycin	-8.16 (-30.05%)	-7.47 (-26.08%)	1.64 (4.07%)	-0.86 (-13.64%)	-17.43 (-67.90%)	-17.43 (-64.44%)
J01CF02	Cloxacillin	-9.06 (-30.69%)	-2.80 (-14.03%)	-4.82 (-33.41%)	-54.58 (-49.90%)	-26.50 (-38.92%)	-2.82 (-15.00%)
J01DC02	Cefuroxime	-12.11 (-34.48%)	-2.83 (-19.56%)	-61.88 (-48.85%)	-9.80 (-47.13%)	-8.00 (-26.16%)	-5.15 (-15.57%)

Note:

Figures are rounded to two decimal places.

Table 24: Changes in quantity dispensed of broad-spectrum antimicrobials in HA inpatient service, stratified by service type

ATC Chemical Substance		Changes in DDD per 1,000 patient-days from 2016 to 2018 (% Change)					
Code	Description	All Inpatient Services	Medicine	Surgery	O&T	ICU/HDU	Others
J01DD52	Ceftazidime/avibactam	<0.005 (-)*	<0.005 (-)*	<0.005 (-)*	-	0.07 (-)*	-
J01DI54	Ceftolozane/tazobactam	0.11 (>1,000%)	0.13 (-)*	0.12 (-)*	0.05 (-)*	0.95 (-)*	0.04 (498.64%)
J01DI02	Ceftaroline fosamil	0.12 (67.06%)	0.13 (50.84%)	0.23 (>1,000%)	0.07 (33.04%)	2.08 (277.54%)	<0.005 (3.58%)
J01DE01	Cefepime	1.41 (42.70%)	2.19 (59.52%)	2.05 (93.32%)	1.17 (67.39%)	-14.12 (-30.23%)	0.33 (15.31%)
J01XX09	Daptomycin	0.33 (39.44%)	0.57 (95.74%)	-0.04 (-4.29%)	-0.13 (-5.75%)	2.63 (60.10%)	0.18 (34.27%)
J01DH02	Meropenem	8.45 (32.44%)	13.01 (39.93%)	9.56 (30.49%)	2.50 (35.99%)	2.96 (1.70%)	1.91 (13.31%)
J01XA01	Vancomycin	1.86 (14.06%)	2.27 (18.84%)	4.24 (33.11%)	1.51 (6.91%)	-2.88 (-3.17%)	0.09 (0.93%)
J01DH03	Ertapenem	0.77 (12.87%)	0.71 (10.96%)	0.74 (5.04%)	0.20 (6.84%)	7.64 (141.64%)	0.63 (29.63%)
J01CR05	Piperacillin/tazobactam	5.53 (11.10%)	5.12 (7.11%)	8.52 (19.45%)	4.82 (25.96%)	3.43 (1.69%)	3.86 (18.31%)
J01DD02	Ceftazidime	0.34 (10.22%)	0.58 (12.95%)	0.53 (26.64%)	-0.01 (-0.21%)	-2.03 (-10.00%)	-0.03 (-1.81%)
J01XX08	Linezolid	-0.07 (-4.20%)	-0.31 (-16.94%)	0.24 (32.66%)	0.02 (1.06%)	1.66 (7.31%)	0.11 (10.65%)
J01DD62	Cefoperazone/sulbactam	-0.62 (-13.89%)	-1.05 (-15.29%)	-0.36 (-11.77%)	-0.43 (-25.92%)	-2.57 (-18.31%)	-0.10 (-5.58%)
J01XB01	Colistin	-0.42 (-21.19%)	-0.10 (-5.97%)	-0.69 (-28.86%)	0.20 (16.43%)	-23.93 (-44.85%)	-0.25 (-28.87%)
J01DH51	Imipenem/cilastatin	-0.37 (-28.90%)	-0.39 (-27.50%)	-1.01 (-38.05%)	-0.24 (-25.13%)	-0.06 (-1.05%)	-0.14 (-33.55%)
J01XA02	Teicoplanin	-0.06 (-91.53%)	-0.01 (-100.00%)	-0.06 (-100.00%)	-0.06 (-100.00%)	-0.92 (-100.00%)	-0.12 (-84.44%)

* There were no records of the particular antimicrobial dispensed in year 2016.

Note:

Figures are rounded to two decimal places.