5

ANTIMICROBIAL CONSUMPTION IN HUMANS

5. Antimicrobial consumption in humans

Highlights

Antimicrobial consumption in Denmark was 16.54 DID in 2023, 6.3% lower than consumption in 2014 (17.64 DID) and 6.6% higher than in 2022 (15.51.44 DID) underlining that consumption has resurged since the COVID-19 related decreases in 2020 and 2021.

In primary health care, total antimicrobial consumption was 14.56 DID in 2023, 7.2% higher than the 13.59 DID in 2022 and 6.9% lower than in 2014 (15.64 DID). The increase was driven by a 23% increase in beta-lactamase sensitive penicillins in primary health care. The four groups of penicillins constituted 67% of the consumption and beta-lactamase sensitive penicillins were the most used group of antimicrobials (accounting for 27% of total consumption in primary health care).

Antimicrobials prescribed for respiratory tract infections dropped sharply with the emergence of COVID-19 in 2020 due to the implemented societal restrictions. In 2022 and 2023, the usual winter peak in antimicrobial consumption reached a higher level than observed for 2018-2019. This was due to high rates of viral infections, in particular an early and more severe RSV and influenza season, and an outbreak of Group A streptococci.

Antimicrobials prescribed to children demonstrated marked increases in the recent two years. Among the 0-4 year olds, consumption in 2023 was 298 treated patients per 1,000 inhabitants, a 30% increase compared to 229 treated patients per 1,000 inhabitants in 2022. For the 5-9 year olds, 197 patients per 1,000 inhabitants were treated in 2023 compared to 122 patients per 1,000 inhabitants in 2022 (60% increase).

Elderly inhabitants living at care homes during 2023 received 90% more antimicrobials than elderly inhabitants living in their own homes (1,819 prescriptions per 1,000 inhabitants at long term care facilities compared to 957 prescriptions per 1,000 inhabitants in their own homes). Urinary tract infections were the main cause of the observed difference in the treatment frequency. However, consumption for elderly inhabitants living at care homes has decreased by 28% from 2017 to 2023, while consumption for elderly living in their own homes has decreased by 16%.

Antimicrobial consumption in hospital care measured in DID (i.e. not accounting for hospital activity) was 1.91 DID in 2023, 3% higher than in 2022 (1.86 DID). When measuring in DDD per 100 bed-days (DBD), the consumption in 2023 (135.6 DBD) was 5.6% higher than in 2022 (128.42 DBD) and 36% higher than in 2014 (99.44 DBD).

Product shortages are of increasing concern in antimicrobial supply. In 2023, nitrofurantoin was unavailable in several months due to product shortage. Simultaneously, the supply through special deliveries increased. Also other antimicrobials for urinary tract infection treatment increased at the same time.

AWaRe classification of antimicrobials used in Denmark showed that 84% consisted of access antimicrobials (WHO's goal is 60% access antimicrobials).

5.1 Introduction

In Denmark, antimicrobials are available by prescription from medical doctors, veterinarians and dentists. Sale is restricted to licensed pharmacies who have exclusive rights to sell prescription-only medicines. Thus no over-the-counter sale takes place. All consumption of medicinal products for humans is recorded through the Register of Medicinal Product Statistics at the Danish Health Data Authority (Figure 2.1). This includes sales data from all public and private healthcare providers. Antimicrobial sales data have been submitted from the primary care sector since 1994 and from the hospital sector since 1997.

Registration of medicines consumption in the primary care sector covers sales from pharmacies to individuals and private clinics. Sales data contain an identifier of the prescriber and the patient in addition to information about the prescribed antimicrobial, including ATC code, formulation, package size and number of packages sold. Since 2004, the Register of Medicinal Product Statistics also receives information on the indication for prescribing. This allows a very detailed and near-complete surveillance of all systemic antimicrobials used in Denmark in the primary health care.

For the hospital sector, antimicrobial consumption data from all public somatic hospitals with acute care function (referred to as somatic hospitals) are included in the report. Data from psychiatric hospitals, private hospitals and hospices are excluded, since they only account for a minor share of the consumption and no reliable denominator for measuring antimicrobial consumption in these facilities is available.

In this chapter, the term 'antimicrobials' covers all systemic antibacterial agents for human use listed in the Anatomical Therapeutic Chemical (ATC) Classification under the code J01. In addition, since 2014 metronidazole (ATC code P01AB01) and for hospitals vancomycin (ATC code A07AA09) have been included. Consumption of tuberculostica, antifungal drugs and antivirals are not included in this chapter.

Changes in consumption of antimicrobials often mirror initiatives promoting prudent use of antibiotics and changes in health care organization. In recent years fluctuations in recorded sales also owe to shortages of the generic products (further described in textbox 5.1 on page 71). Initiatives regarding prudent use of antibiotics were undertaken through the years with particular focus on better diagnostics guiding antibiotic prescribing by general practitioners and working with antibiotic stewardship at hospitals. The former led to the establishment of the Danish Research Center for General Medicine while the latter was supported by the establishment of a network based on experiences from the Learning and Quality Teams at the bigger regional hospitals.

Reorganization of the Danish healthcare system has led to functions being reassigned from hospital ambulatory care to smaller health units, rehabilitation centers and general practitioners. The resulting changes in activity across the healthcare sector may affect the consumption of antimicrobials. Also, the COVID-19 pandemic had significant impact on the spread of a multitude of different infectious diseases, and associated treatments, which still could be observed three years later in 2023. These changes need to be considered when interpreting antimicrobial consumption surveillance data.

As many other European countries Denmark has also worked with annual antibiotic awareness campaigns since 2013, - except for in the pandemic years 2020-2022 - many of which can be found at www.antibiotikaellerej.dk.

5.2 Total antimicrobial consumption in the Danish healthcare system

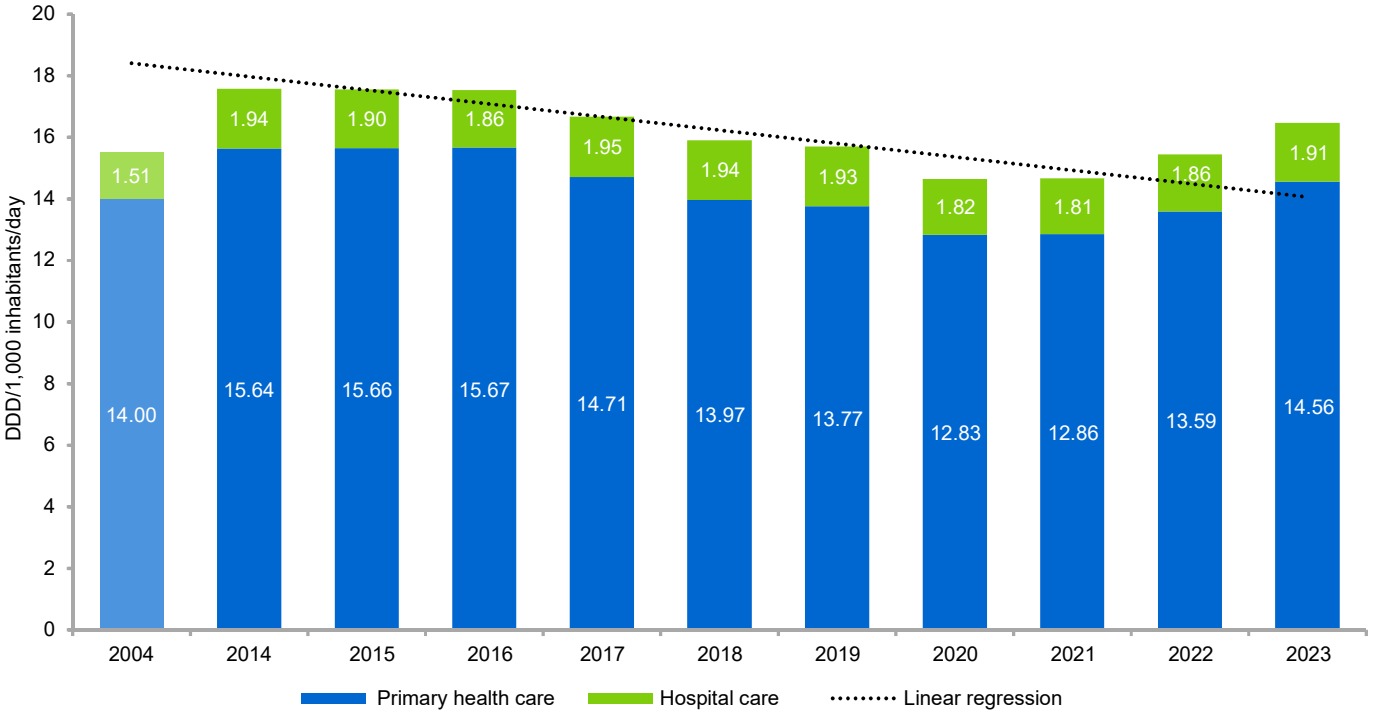
During the first five years of surveillance from 1996 to 2000, the consumption of systemic antimicrobials in Denmark showed no significant changes and consumption was estimated to be at 13 to 14 Defined Daily Doses per 1,000 inhabitants per day (DID). These first five years of reporting are not fully comparable to later years due to changes in reporting and in data systems. Between 2001 and 2011, consumption of antimicrobials increased steadily and peaked at a total of 18.95 DID in 2011 (not shown). From 2011 to 2021, consumption decreased markedly (Figure 5.1). However, from 2022 to 2023, the consumption increased by 6.6% from 15.51 DID to 16.54 DID. The primary care sector accounted for the majority of the consumption in Denmark (88%).

The decrease in total antimicrobial consumption since 2013 in Denmark has mainly been driven by reduced prescribing in primary health care. Measured in DID and not adjusted for hospital activity, antimicrobial consumption at hospitals fluctuated over the years; moving between the lowest levels of 1,86 DID in 2016 to highest levels of 1,95 DID in 2017. The notably lower levels in 2020 and 2021 are considered exceptions due to the COVID-19 pandemic. The hospital share of the total antimicrobial consumption was 12% in 2023.

Consumption of antimicrobials in primary health care and somatic hospitals in the five Danish health regions is presented in Figure 5.2. The trends in consumption are similar in all five regions. Region Zealand showed the highest total consumptions of 17.06 DID in 2023, whereas Central Region of Denmark had the lowest total consumption of 14.66 DID.

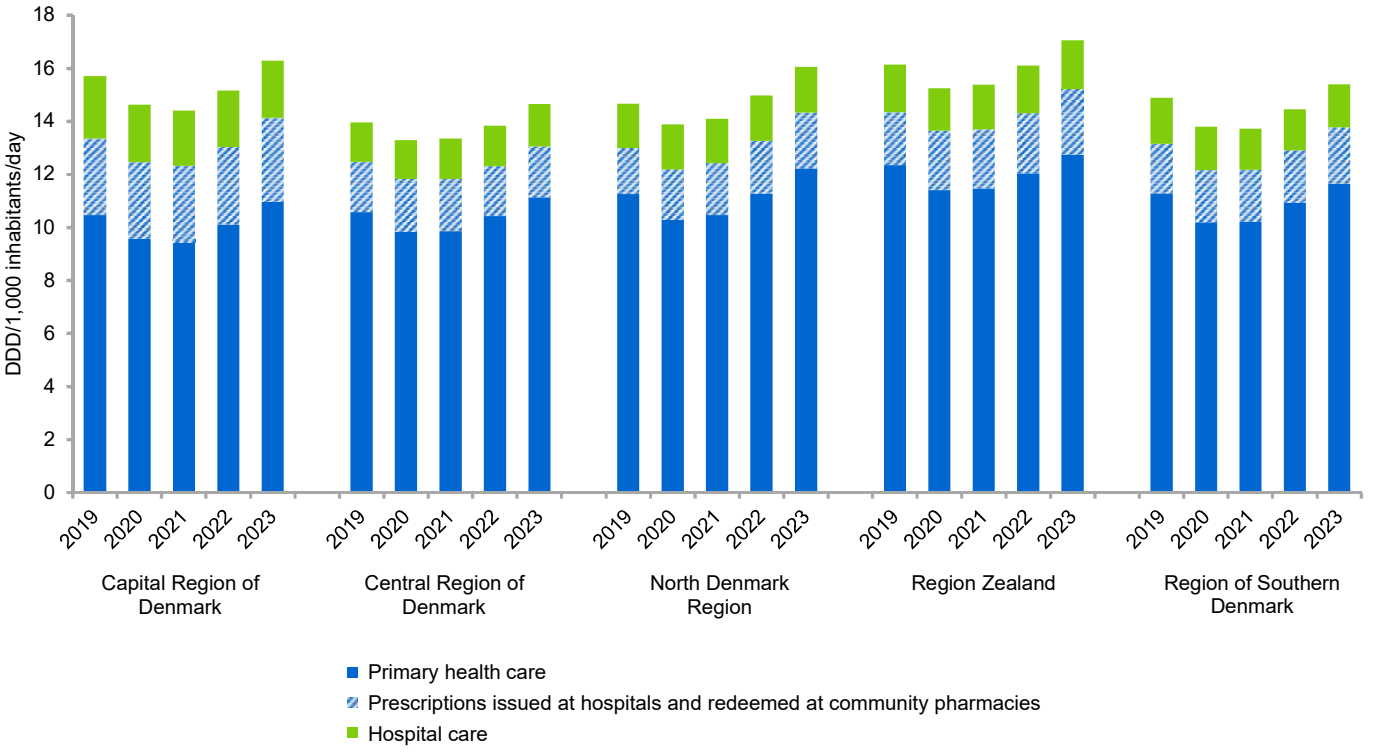
The main antimicrobial drug classes and their consumption in primary health care and at somatic hospitals are presented in Figure 5.3. Most notable are high use of beta-lactams in both health care sectors and low to none use of cephalosporins/aminoglycosides and of carbapenems in primary health care (Figure 5.4).

Figure 5.1 Total consumption of systemic antimicrobial agents in humans, DDD per 1,000 inhabitants per day, Denmark, 2004 and 2014-2023
DANMAP 2023



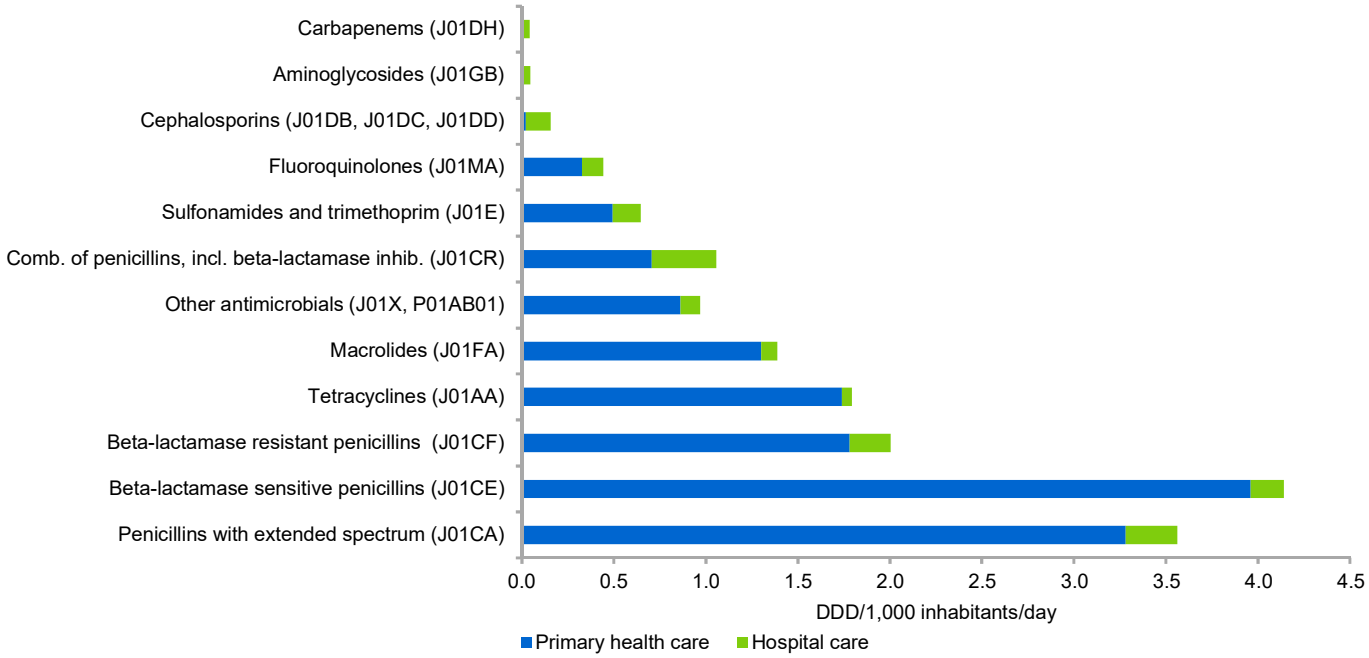
Data: Total sale of antimicrobials in Denmark
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.2 Consumption of systemic antimicrobial agents in primary health care and at somatic hospitals, DDD per 1,000 inhabitants per day, by Danish region, 2019-2023
DANMAP 2023



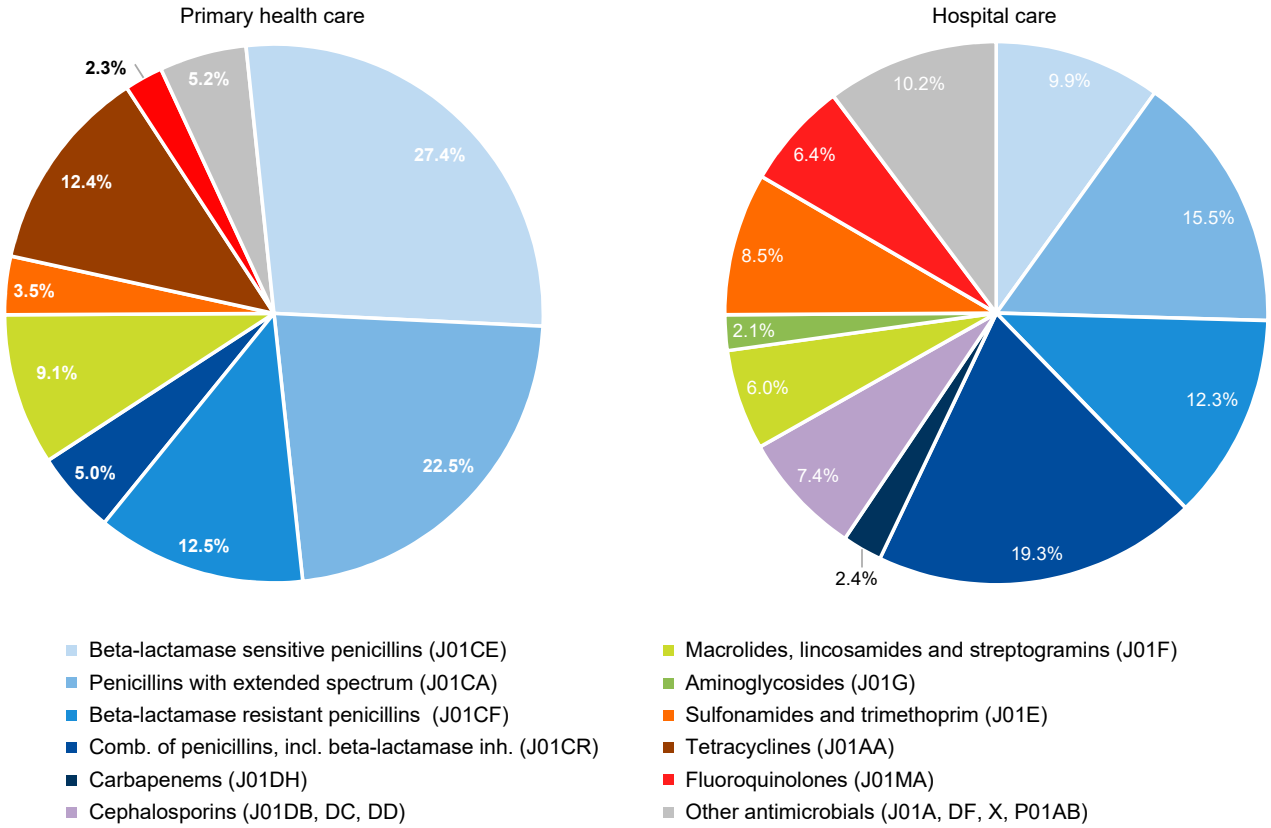
Data: Registered sale of antimicrobials to individuals and antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.3 Distribution of main antimicrobial classes used for humans in primary and hospital care, DDD per 1,000 inhabitants per day, Denmark, 2023 DANMAP 2023



Data: Registered sale of antimicrobials to individuals and antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.4 Percentage distribution of antimicrobial agents in primary health care and hospital care, DDD, Denmark, 2023 DANMAP 2023



Data: Registered sale of antimicrobials to individuals and antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

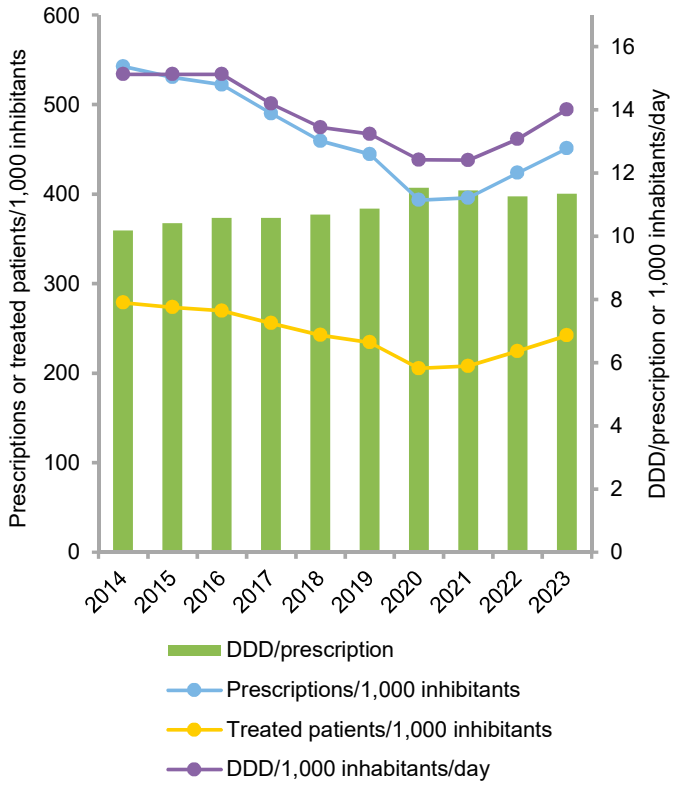
5.3 Antimicrobial consumption in primary health care

In the following sections, the consumption of antimicrobials in primary health care is described by the units DDD per 1,000 inhabitants per day, number of prescriptions per 1,000 inhabitants and number of treated patients per 1,000 inhabitants. The estimates are thus based on sales to individuals and do not include the approximately 4% of antimicrobials, mainly penicillins, sold to clinics and doctors on call.

5.3.1 Overall antimicrobial consumption in primary health care

Comparison of trends over time by different indicators showed decreased consumption from 2014-2020, no change from 2020-2021 and increased consumption from 2021-2023 (Figure 5.5). Thus, the COVID-19 related decrease in consumption was caught up in 2023. In 2023, the average DDD/prescription was 11.3, 11% higher than 2014 (10.2 DDD per prescription). The total number of prescriptions was 451 per 1,000 inhabitants in 2023, a 6% increase since 2022 and a 17% reduction from the 543 prescriptions per 1,000 inhabitants in 2014.

Figure 5.5 Consumption of systemic antimicrobial agents in primary health care, Denmark, 2014-2023 DANMAP 2023



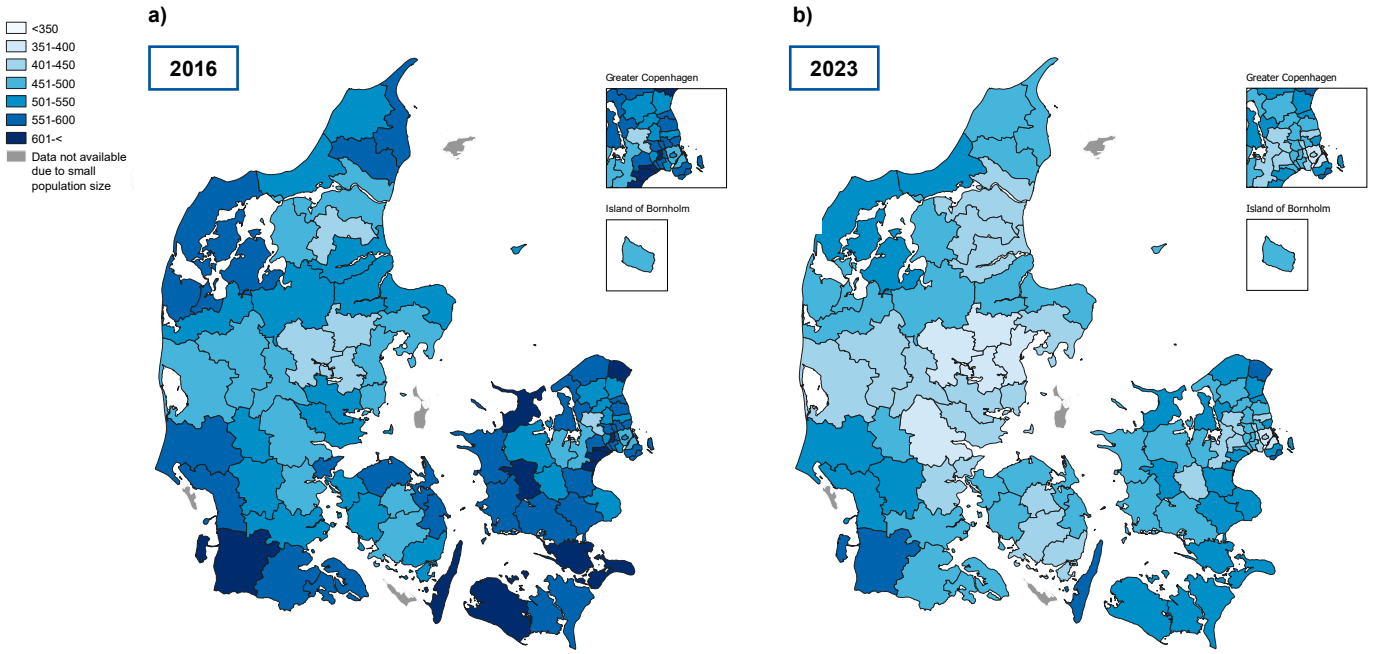
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2023 edition of the Anatomical Therapeutic Chemical (ATC) classification system

The number of treated patients and prescriptions has decreased over the decade, probably due to raising awareness among prescribers and the public. However, doses per prescription have increased, partly due to switch to antibiotics that contribute with more DDDs per treatment, e.g. the switch to pivmecillinam as drug of choice in the treatment of urinary tract infections and the switch to tetracycline as drug of choice in the treatment of chlamydia.

Interregional differences in the levels of prescribing have been described in DANMAP since 2017 (Table 5.1). In general, the Danish population is relatively homogenous and health care is of standardized quality, which, combined with several initiatives to educate GPs in appropriate prescribing, diminishes potential differences in prescribing trends. However, observed variations in prescribing may owe to differences in population density (distance to nearest general practitioner), differences in age and comorbidity of the population (younger populations in bigger cities and in the capital region) as well as behavioral differences between urban and rural populations.

Figure 5.6 shows the number of prescriptions per 1,000 inhabitants at municipality level in 2016 and 2023, respectively. In 2023, the consumption ranged from 384 to 596 prescriptions per 1,000 inhabitants. In 2016, the range was 434-727 prescriptions per 1,000 inhabitants. Of note is that prescribers in all municipalities reduced their prescribing activities in the shown period. Demographic differences might impact the range of prescribing. Distribution of elderly inhabitants above 60 years in the municipalities follows almost the distribution of prescriptions per 1,000 inhabitants with higher prescription rates in municipalities with bigger population of elderly inhabitants above 60 years (data not shown).

Figure 5.6 Number of prescriptions in primary health care per 1,000 inhabitants in Danish municipalities in a) 2016 and b) 2023
DANMAP 2023



Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.1 Consumption of antimicrobial agents for systemic use in primary health care at regional level, Denmark, 2019-2023 DANMAP 2023

Region	Indicator	Year				
		2019	2020	2021	2022	2023
Capital Region	DDD/1,000 inhabitants/day	13.35	12.47	12.32	13.03	14.14
	Prescriptions/1,000 inhabitants	441	382	378	409	443
Region Zealand	DDD/1,000 inhabitants/day	14.34	13.65	13.71	14.31	15.21
	Prescriptions/1,000 inhabitants	482	436	440	466	489
Region of Southern Denmark	DDD/1,000 inhabitants/day	13.15	12.17	12.17	12.91	13.78
	Prescriptions/1,000 inhabitants	455	401	405	434	460
Central Denmark Region	DDD/1,000 inhabitants/day	12.47	11.82	11.83	12.32	13.07
	Prescriptions/1,000 inhabitants	417	374	380	402	425
North Denmark Region	DDD/1,000 inhabitants/day	12.99	12.20	12.42	13.27	14.33
	Prescriptions/1,000 inhabitants	436	390	400	432	458
Denmark (total)	DDD/1,000 inhabitants/day	13.24	12.42	12.40	13.07	14.01
	Prescriptions/1,000 inhabitants	445	393	396	424	451

Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

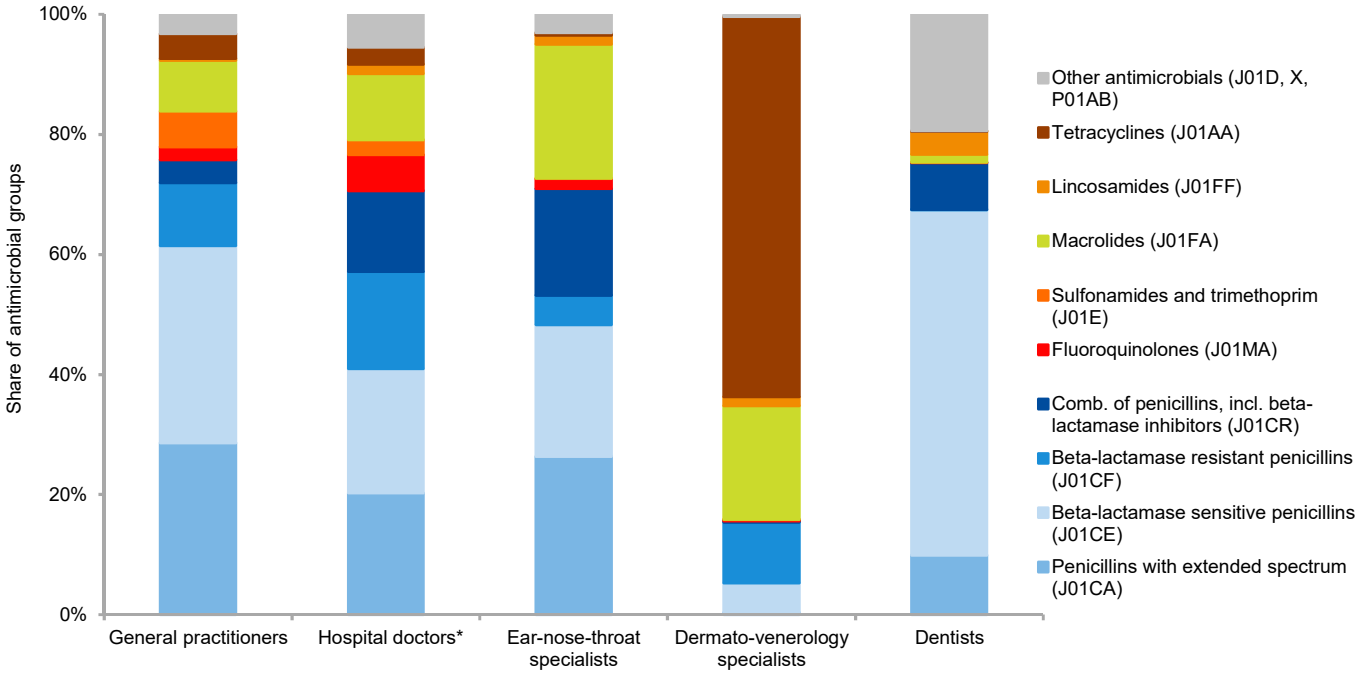
5.3.2 Antimicrobial consumption by prescriber

Prescribing trends in primary health care also clearly differ by prescriber's specialty. Table 5.2 shows an overview of number of prescriptions issued by different specialists, including hospital doctors issuing prescriptions for patients at hospitals, which then are redeemed at a community pharmacy.
Figure 5.7 shows the main antimicrobial groups prescribed by medical specialty in primary health care in 2023. In 2023, 63% of antimicrobial prescriptions from dermato-venerology specialists were tetracyclines, which are indicated for treatment of severe acne and sexually transmitted chlamydia/mycoplasma infections.

Majority of prescriptions by dentists were narrow-spectrum beta-lactamase sensitive penicillins (58%) reflecting adherence to the recommended first-line treatment for common dental infections in primary health care.

General practitioners have access to their own prescribing data through ordiprax+, an online dashboard with personal log-in which visualises prescribing data and enables comparisons with other practices on regional level (DANMAP 2020 Textbox 5.2). Additionally, general practitioners are organized in quality clusters where improving rational antimicrobial prescribing is discussed among other topics.

Figure 5.7 Antimicrobial groups prescribed by main medical specialities in primary health care, Denmark, 2023 DANMAP 2023



* Hospital doctors issuing prescriptions for patients in ambulatory care or upon discharge from hospital
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.2 Number of prescriptions per 1,000 inhabitants by main medical specialities, Denmark, 2019-2023 DANMAP 2023

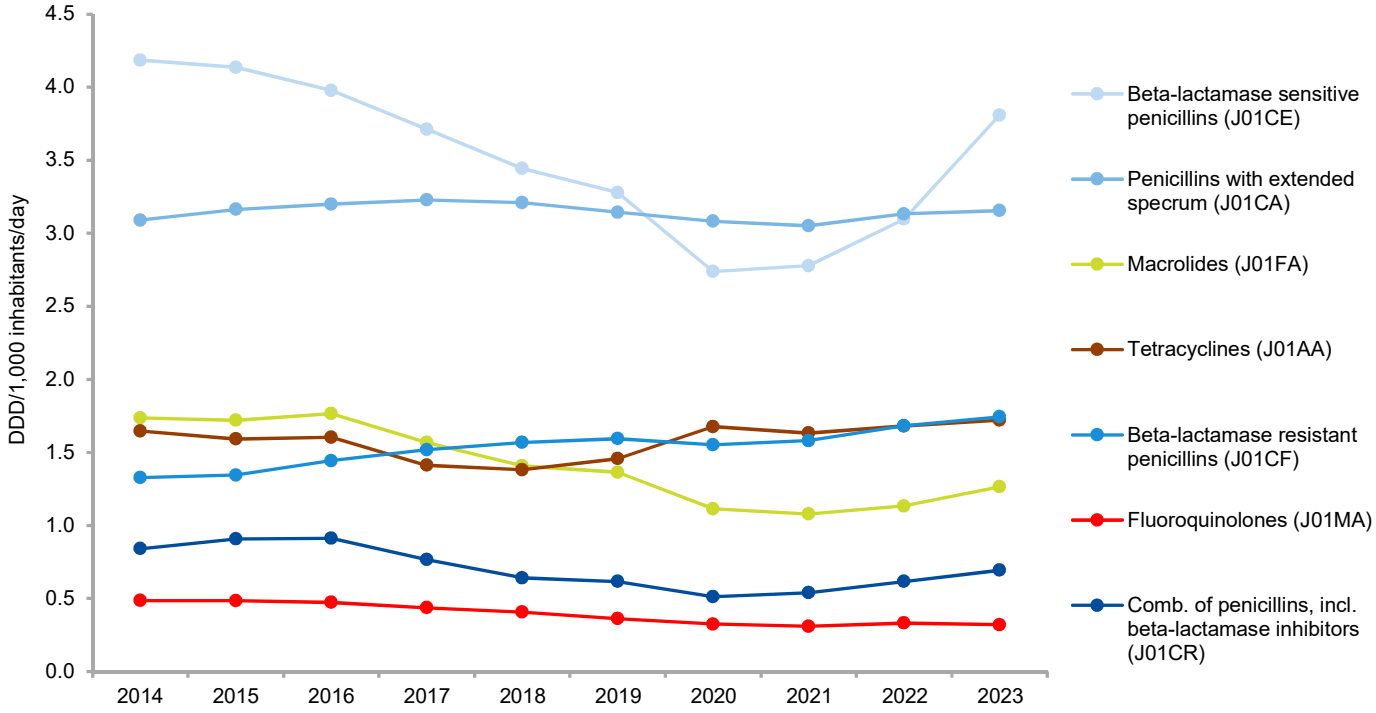
Prescriber		Year				
		2019	2020	2021	2022	2023
General practitioners	Prescriptions per 1,000 inhabitants	327.1	280.4	279.0	300.9	323.1
	DDD per prescription	10.4	11.1	11.0	10.8	10.9
Hospital doctors*	Prescriptions per 1,000 inhabitants	63.2	64.6	63.5	62.0	65.6
	DDD per prescription	12.7	13.0	13.2	13.6	13.7
Ear-nose-throat specialists	Prescriptions per 1,000 inhabitants	7.8	6.1	6.9	8.1	8.5
	DDD per prescription	8.1	8.9	8.3	8.1	8.0
Dermato-venerology specialists	Prescriptions per 1,000 inhabitants	5.4	5.3	5.0	4.6	4.4
	DDD per prescription	33.4	33.8	35.4	35.0	34.6
Dentists	Prescriptions per 1,000 inhabitants	28.8	25.6	28.9	34.4	33.1
	DDD per prescription	7.9	7.9	7.7	7.7	8.2

* Hospital doctors issuing prescriptions for patients in ambulatory care or upon discharge from hospital
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

5.3.3 Consumption of antimicrobial groups

In compliance with treatment guideline, beta-lactamase sensitive penicillins were the most used antimicrobials in primary health care in Denmark for decades (Figure 5.8). In 2023, beta-lactamase sensitive penicillins accounted for 27% of total consumption in primary health care. Altogether the four penicillin groups (penicillins with extended spectrum; beta-lactamase sensitive penicillins; beta-lactamase resistant penicillins; combinations of penicillins, including beta-lactamase inhibitors) accounted for 9.73 DID corresponding to 67% of antimicrobials consumed in primary health care in 2023. Other beta-lactams such as cephalosporins, monobactams and carbapenems were either used at extremely low level or restricted to hospital use only.

Figure 5.8 Consumption of leading antimicrobial groups for systemic use in primary health care, DDD per 1,000 inhabitants per day, Denmark, 2014-2023
DANMAP 2023



Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.3 Consumption of antimicrobial agents for systemic use in primary health care, DDD per 1,000 inhabitants per day, Denmark, 2004 and 2014-2023
DANMAP 2023

ATC group	Therapeutic group	Year										
		2004	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01AA	Tetracyclines	1.18	1.66	1.60	1.62	1.42	1.40	1.48	1.69	1.64	1.70	1.74
J01CA	Penicillins with extended spectrum	2.28	3.20	3.28	3.33	3.36	3.35	3.28	3.19	3.17	3.26	3.28
J01CE	Beta-lactamase sensitive penicillins	5.25	4.38	4.33	4.16	3.88	3.61	3.44	2.84	2.89	3.23	3.96
J01CF	Beta-lactamase resistant penicillins	0.93	1.36	1.38	1.48	1.56	1.60	1.63	1.58	1.61	1.72	1.78
J01CR	Combinations of penicillins, including beta-lactamase inhibitors	0.04	0.87	0.95	0.95	0.79	0.66	0.63	0.52	0.55	0.63	0.71
J01D	Cephalosporins and other betalactam antibiotics	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
J01EA	Trimethoprim and derivates	0.41	0.55	0.56	0.56	0.56	0.53	0.45	0.43	0.42	0.39	0.41
J01EB	Short-acting sulfonamides	0.36	0.21	0.18	0.16	0.15	0.14	0.13	0.11	0.09	0.09	0.08
J01EE	Combination of sulfonamides and trimethoprim, including derivates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
J01FA	Macrolides	2.25	1.79	1.77	1.82	1.62	1.46	1.41	1.15	1.11	1.17	1.30
J01FF	Lincosamides	0.01	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08
J01GB	Aminoglycosides	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
J01MA	Fluroquinolones	0.29	0.50	0.49	0.48	0.44	0.41	0.37	0.33	0.32	0.34	0.33
J01XC	Steroid antibacterials (combination fusidic acid)	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
J01XE	Nitrofuran derivates (nitrofurantoin)	0.43	0.48	0.45	0.43	0.26	0.15	0.27	0.27	0.28	0.27	0.12
J01XX	Other antibacterials (metheamine >99%)	0.30	0.24	0.25	0.27	0.28	0.29	0.32	0.34	0.39	0.42	0.47
J01XD and P01AB01	Nitroimidazole derivates (metronidazole)	0.20	0.28	0.28	0.28	0.25	0.24	0.24	0.23	0.24	0.24	0.25
J01 and P01AB01	Antimicrobial agents for systemic use (total)	14.00	15.64	15.66	15.67	14.71	13.97	13.77	12.83	12.86	13.59	14.56

Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.4 Number of treated patients per 1,000 inhabitants for leading antimicrobial agents in primary health care, Denmark, 2004 and 2014-2023

DANMAP 2023

ATC group	Therapeutic group	Year										
		2004	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01AA	Tetracyclines	11.60	12.20	11.32	11.04	10.35	9.69	10.10	14.43	12.99	13.64	14.06
J01CA	Penicillins with extended spectrum	70.56	75.32	74.87	74.05	74.04	73.56	71.97	67.14	68.60	71.45	72.42
J01CE	Beta-lactamase sensitive penicillins	171.23	134.79	130.06	125.69	119.32	110.90	104.70	84.93	87.69	100.09	116.67
J01CF	Beta-lactamase resistant penicillins	27.11	29.24	28.85	29.70	29.96	31.10	31.06	30.52	30.89	32.92	33.77
J01CR	Combinations of penicillins, including betalctamase inhibitors	1.28	20.52	22.03	22.17	19.89	17.73	17.33	14.43	15.50	17.90	20.28
J01E	Sulphonamides and trimethoprim	36.39	24.65	22.45	21.17	19.87	18.42	16.63	15.04	13.66	12.67	12.47
J01FA	Macrolides	65.89	51.38	51.75	53.21	46.01	40.11	38.45	25.13	24.97	27.16	30.06
J01MA	Fluoroquinolones	10.83	15.30	15.04	14.37	13.36	12.26	10.74	9.01	8.52	9.10	8.87
J01X	Other antibacterials (methenamine >99%)	7.10	7.16	7.35	7.47	5.01	3.62	5.66	5.80	5.95	5.91	2.65
P01AB01	Nitroimidazole derivatives (metronidazole)	12.58	16.31	16.47	16.03	14.84	14.05	13.57	13.36	13.77	13.94	14.11
J01 and P01AB01	Antimicrobial agents for systemic use (total)	306.28	278.62	273.49	269.72	255.72	242.55	234.34	205.27	207.85	224.57	242.07

Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.5 Number of prescriptions per 1,000 inhabitants for leading antimicrobial agents in primary health care, Denmark, 2004 and 2014-2023

DANMAP 2023

ATC group	Therapeutic group	Year										
		2004	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01AA	Tetracyclines	19.21	20.00	17.90	17.18	15.89	14.63	15.11	20.19	18.25	18.71	19.10
J01CA	Penicillins with extended spectrum	102.84	113.83	113.53	113.16	114.37	114.31	112.19	105.93	107.97	112.19	114.04
J01CE	Beta-lactamase sensitive penicillins	226.56	170.70	163.09	157.13	148.52	136.81	128.77	104.07	107.28	122.87	145.45
J01CF	Beta-lactamase resistant penicillins	38.66	41.04	40.81	41.87	41.87	43.35	43.16	42.87	43.17	45.66	47.05
J01CR	Combinations of penicillins, including betalctamase inhibitors	1.95	29.02	30.73	31.13	27.09	23.71	23.07	19.14	20.36	23.45	26.32
J01E	Sulphonamides and trimethoprim	55.02	41.51	38.39	36.41	34.29	31.74	28.14	25.59	23.07	21.26	21.30
J01FA	Macrolides	90.05	68.01	68.00	68.85	60.00	52.64	50.71	33.66	33.80	36.94	40.32
J01MA	Fluoroquinolones	14.16	19.67	19.50	18.74	17.37	15.97	13.99	12.07	11.41	11.96	11.57
J01X	Other antibacterials (methenamine >99%)	15.08	16.73	16.28	15.82	10.18	6.76	10.29	10.62	10.70	10.72	5.47
P01AB01	Nitroimidazole derivatives (metronidazole)	14.72	19.06	19.15	18.63	17.26	16.31	15.78	15.62	16.00	16.17	16.25
J01 and P01AB01	Antimicrobial agents for systemic use (total)	579.54	542.53	530.56	522.19	490.08	459.39	444.53	393.34	395.76	423.70	451.05

Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

5.3.4 Antimicrobial consumption by patient case mix

Antimicrobial consumption is highly affected by patient case mix. The need for antimicrobials is different throughout life and for the two genders. Antimicrobial consumption is also affected by other sociodemographic factors (DANMAP 2022, Textbox 5.2). Figure 5.9a-c presents consumption of antimicrobials by age group based on different denominators: Figure 5.9a presents consumption in DDD per 1,000 inhabitants per day, Figure 5.9b in crude DDD, i.e. not corrected for population size. Figure 5.9c presents the number of patients treated per 1,000 inhabitants. Figure 5.9d presents population size by age group. Children and adolescents are presented in five-year age groups, while adults are clustered in 10-year age groups.

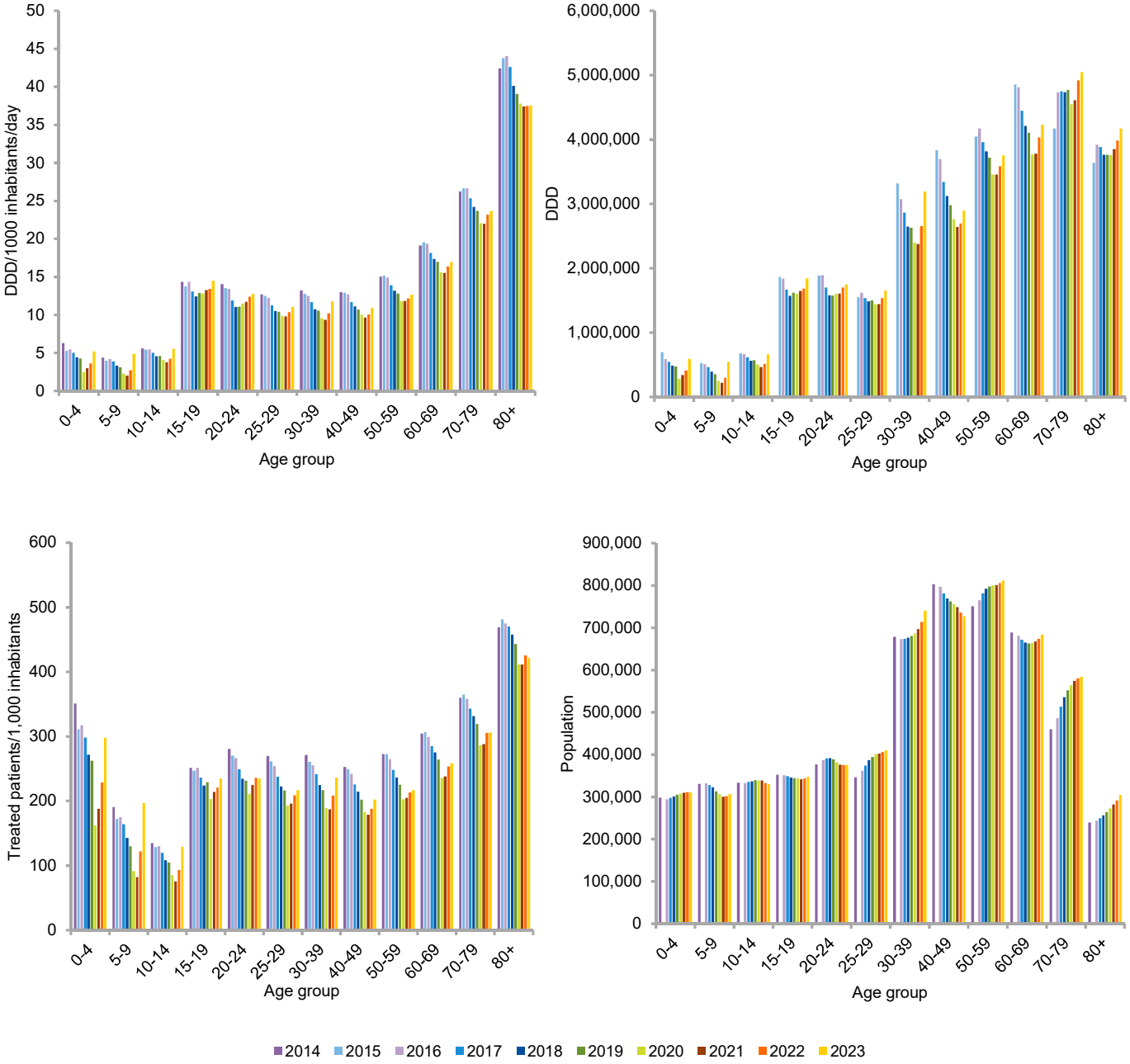
Estimates of antimicrobial consumption for children using DDD need to be interpreted with caution since the DDD is defined as "maintenance dose per day for its main indication in adults". The maintenance dose per day for children may differ from the one for adults due to different pharmacodynamics and -kinetics. Furthermore, infants and young children in the same age group might be treated with different doses based on body weight. Therefore, other units of measurement might be more suitable to monitor consumption in children, e.g. number of treated patients per 1,000 inhabitants and number of prescriptions per 1,000 inhabitants.

In 2023, 242 patients per 1,000 inhabitants were treated with antimicrobials, receiving 451 prescriptions per 1,000 inhabitants. In 2022, the corresponding numbers were approximately 6-8% lower, 225 treated patients and 424 prescriptions per 1,000 inhabitants. Since 2014, the consumption decreased from 279 treated patients per 1,000 inhabitants and 543 prescriptions per 1,000 inhabitants (reduction by 13% and 17% from 2014 to 2023, respectively).

Macrolides play an important role in the treatment of bacterial respiratory tract infections in children and adolescents (Figure 5.10). Macrolides were also used as first-line treatment for chlamydia infections until the change in guidance (already described in DANMAP2020) which may be the reason for the relatively high consumption of macrolides in the 15-24 year olds. However, penicillins are the most used antimicrobial agents for children and adolescents, constituting between 47% and 89% of all antimicrobials prescribed depending on age group (Figure 5.10).

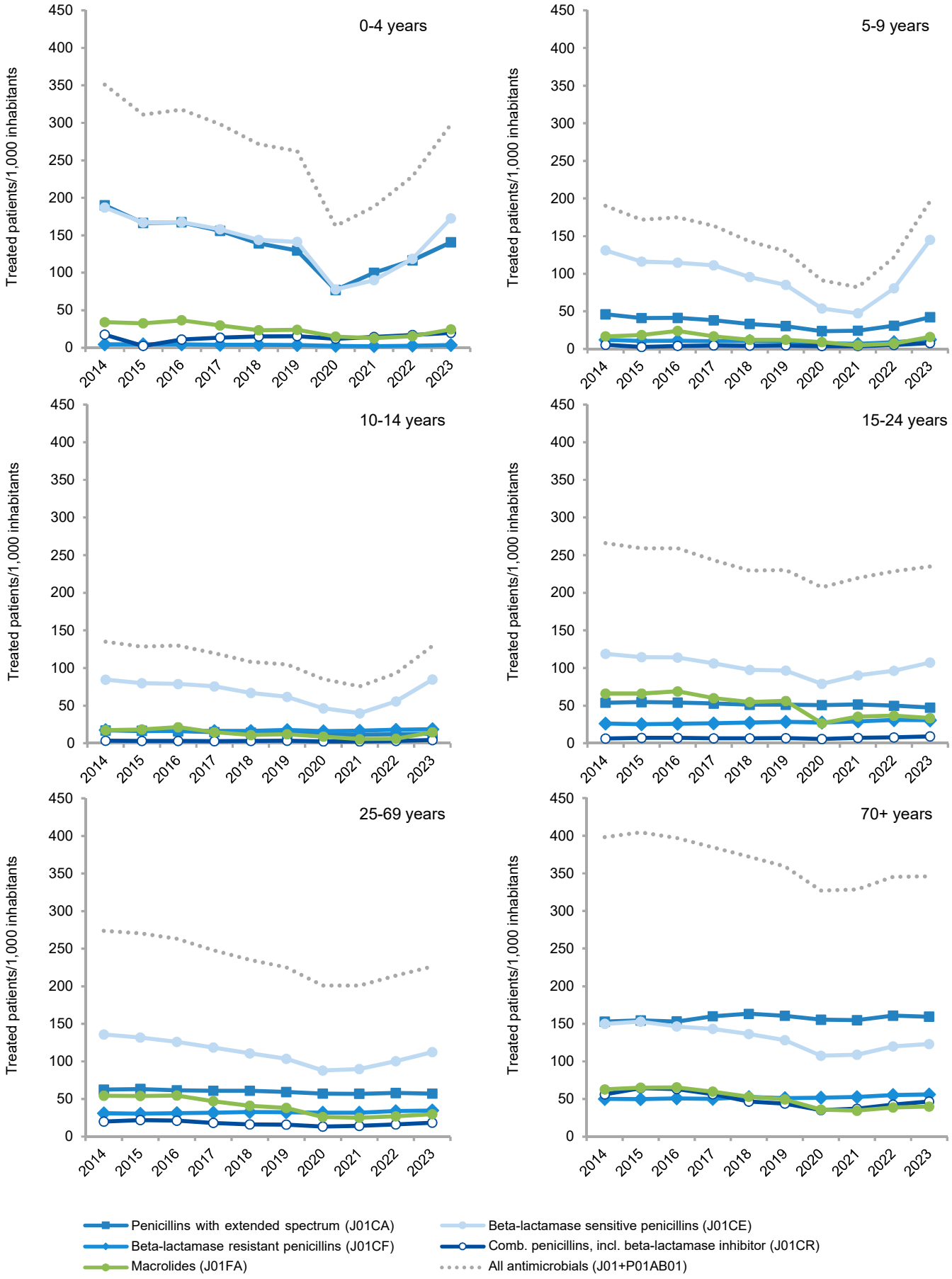
Differences in antimicrobial consumption between genders are well known. In 2023, the number of treated females (all age groups) was 282 per 1,000 inhabitants and the number of treated males was 202 per 1,000 inhabitants. In general, females receive more treatment – a trend driven by higher incidence of urinary tract infections and different healthcare-seeking behavior. Thus, the consumption of pivmecillinam, sulfonamides, trimethoprim and nitrofurantoin, all indicated for treatment of urinary tract infections, is approximately three times higher for females than for males (Figure 5.11). The reduction in consumption of these antimicrobials was primary driven by fewer prescriptions for elderly women (80+ years), who were the most frequently treated (578 prescriptions per 1,000 females above 80 years).

Figure 5.9 Consumption of systemic antimicrobial agents in primary health care by age group, measured in a) DDD per 1,000 inhabitants per day, b) DDD, c) treated patients per 1,000 inhabitants and d) population size, Denmark, 2014-2023 DANMAP 2023



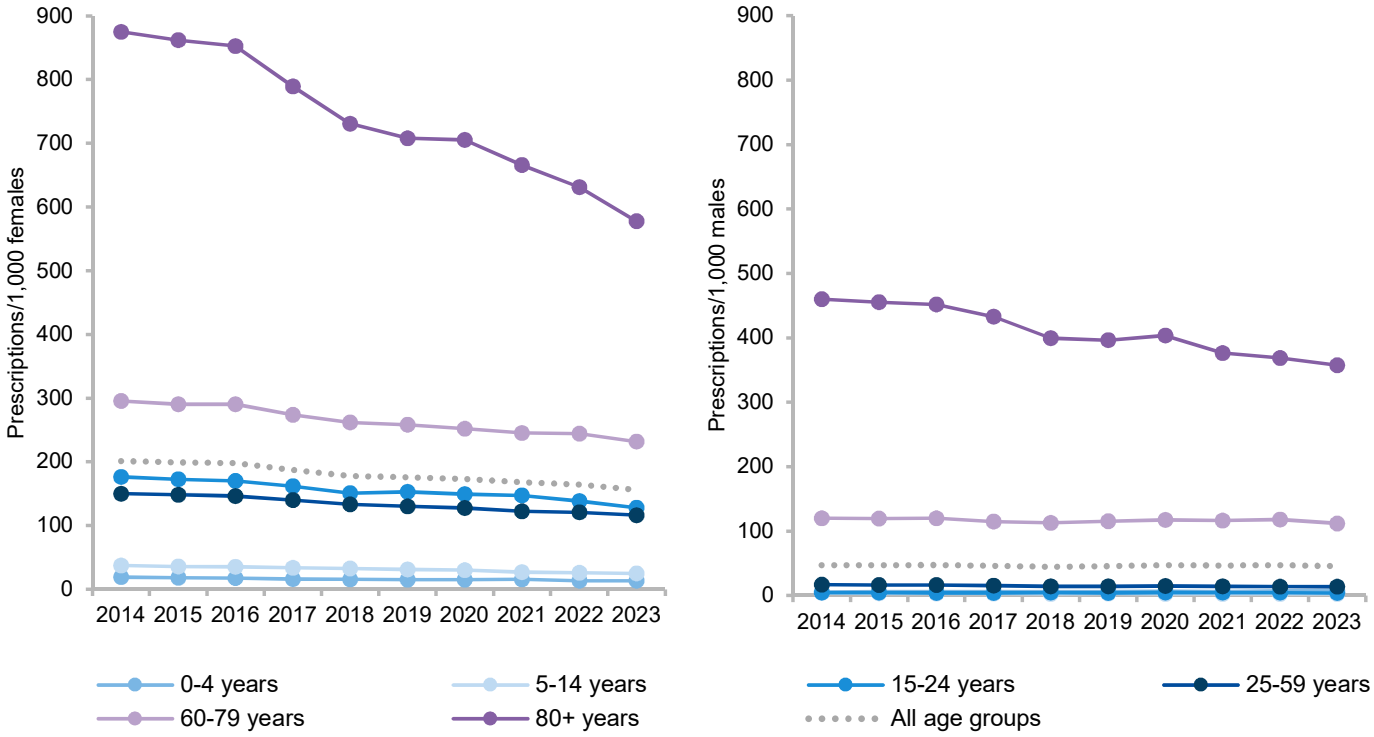
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and Statistics Denmark

Figure 5.10 Consumption of main antimicrobial agents by age group, treated patients/1,000 inhabitants, Denmark, 2014-2023 DANMAP 2023



Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.11 Consumption of antimicrobials primarily used for treatment of urinary tract infections* in primary health care for a) females and b) males, prescriptions per 1,000 inhabitants, Denmark, 2014-2023 DANMAP 2023



* Pivmecillinam, sulfonamides, trimethoprim and nitrofurantoin
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

5.3.5 Antimicrobial consumption for treatment of respiratory tract infections

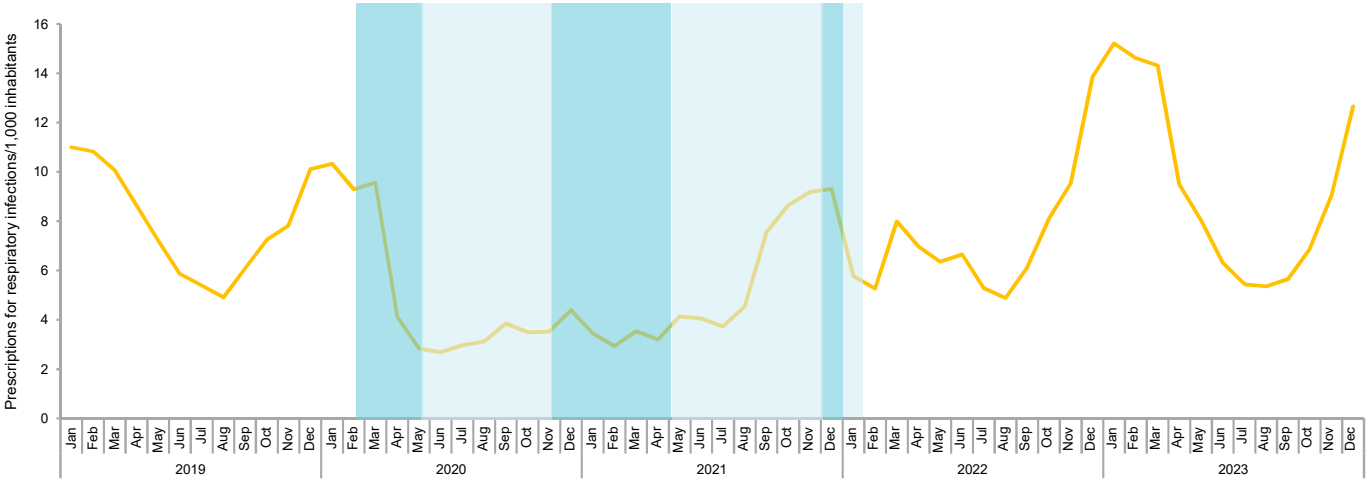
One of the main indications provided by prescribers in primary health care for treatment with antimicrobials is upper and/or lower respiratory tract infections. In 2020, consumption of antimicrobials prescribed for treatment of respiratory tract infections started slightly lower compared to previous years, and was followed by a sharp drop in consumption from April 2020 to July 2021 (Figure 5.12). This coincided with a sharp decrease in number of laboratory confirmed influenza and RSV infections, most likely due to the societal restriction implemented in March 2020 due to the COVID-19 pandemic. However, from August 2021 the consumption went back to levels similar to the corresponding pre-pandemic months in 2019, again coinciding with the Respiratory Syncytial Virus (RSV) summer epidemic in 2021. Antimicrobial consumption during the winter 2022-2023 reached a higher level than observed in 2018-2019. This coincided with an early RSV and influenza season as well as an outbreak of Group A streptococci, as also observed in other European countries.

5.3.6 Antimicrobial consumption for elderly inhabitants

One of the recent surveillance approaches added to the DANMAP program is surveillance of antimicrobial consumption in elderly inhabitants aged 65 years and above. Close surveillance of antimicrobial consumption in this population is necessary as it is one of the most fragile populations in society. Surveillance contributes to high quality treatment of infections and thereby prevents emergence of antimicrobial resistant pathogens. The surveillance is based on the Danish Care Home Register and Danish Civil Registry. By combining these registries, it is possible to divide elderly inhabitants into two populations; elderly inhabitants living in their own homes and elderly inhabitants living at long term care facilities.

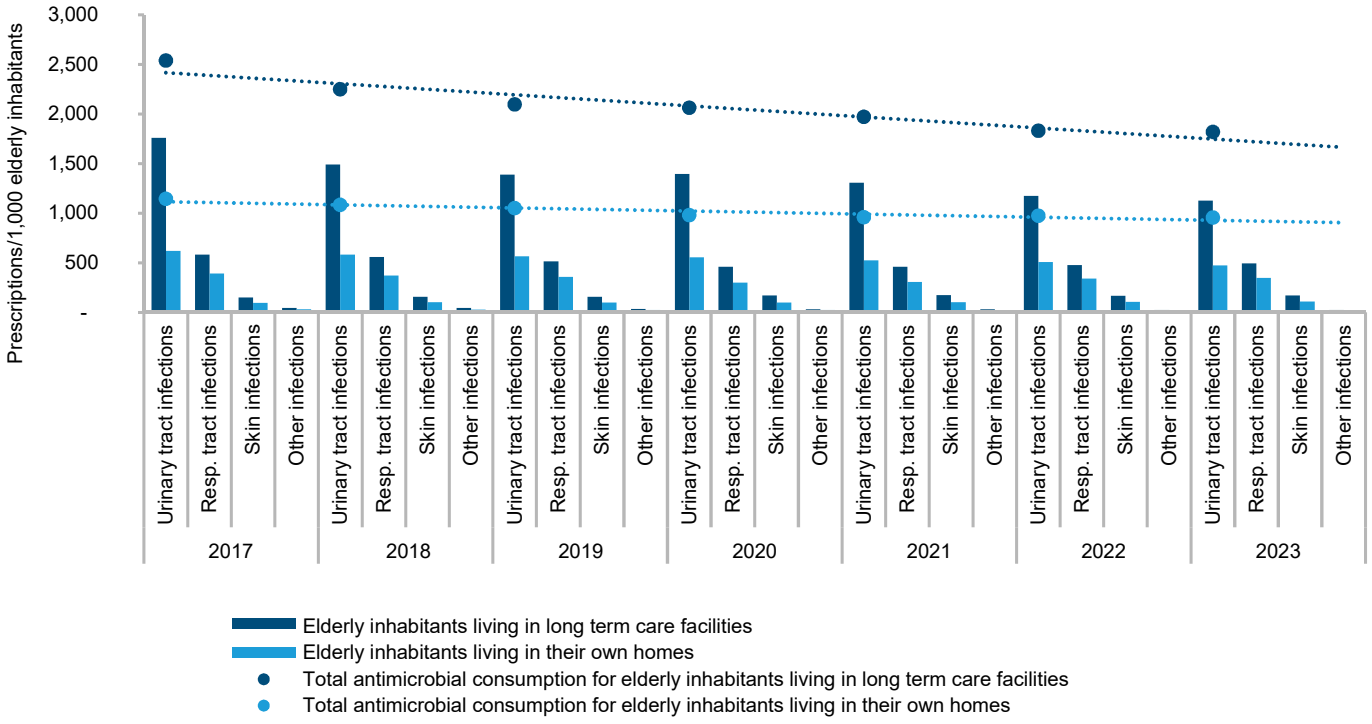
Figure 5.13 shows antimicrobial consumption for elderly inhabitants aged 65 years and above in 2017-2023. Elderly inhabitants living at care homes received 90% more antimicrobials than elderly inhabitants living in their own homes in 2023. The figure also compares treatment of specific infections in the two populations as it is well known that treatment of urinary tract infections is the main cause of the difference observed in the treatment frequency of the two populations of elderly inhabitants. These differences in treatment of elderly inhabitants are observed despite a continuous decrease in the antimicrobial consumption for elderly inhabitants living at long term care facilities.

Figure 5.12 Monthly antimicrobial prescriptions indicated for treatment of respiratory tract infections in primary health care, prescriptions per 1,000 inhabitants, Denmark, 2019-2023 DANMAP 2023



COVID-19 restrictions in place
Fewer restrictions in place
Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics and 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.13 Consumption of antimicrobials (J01 and P01AB01) in primary health care for elderly inhabitants living in long term care facilities and for elderly inhabitants living in their own homes, Denmark, 2017-2023 DANMAP 2023



Elderly inhabitants living in long term care facilities
Elderly inhabitants living in their own homes
Total antimicrobial consumption for elderly inhabitants living in long term care facilities
Total antimicrobial consumption for elderly inhabitants living in their own homes

Data: Registered sale of antimicrobials to individuals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system, Care Home Register and Danish Civil Registry

5.4 Antimicrobial consumption in hospital care

Surveillance of antimicrobial consumption in hospital care is based on sale of systemic antimicrobials (ATC code J01, P01AB01 and A07AA09) from Danish hospital pharmacies to hospitals, excluding private hospitals and psychiatric departments (approximately 2-3% of the total hospital consumption). Antimicrobial consumption data are presented as DDD per 100 occupied bed-days (DBD) and per 100 admissions (DAD) to account for hospital activity.

Hospital activity has changed over the years with decreasing number of bed-days and admissions, but with different rates (Figure 5.14). Earlier discharge of patients, increasing ambulatory care functions in the community as well as in care homes and changed workflow due to new electronic systems all affect the activity and need to be considered when interpreting antimicrobial consumption trends in hospitals (see Table 2.1 in Chapter 2 'Introduction').

Information on consumption at patient level is currently not available to DANMAP for the hospital sector. This information is expected to become available to DANMAP through the "Hospital Medicine Register" in coming years.

5.4.1 Antimicrobial consumption at public somatic hospitals accounting for hospital activity

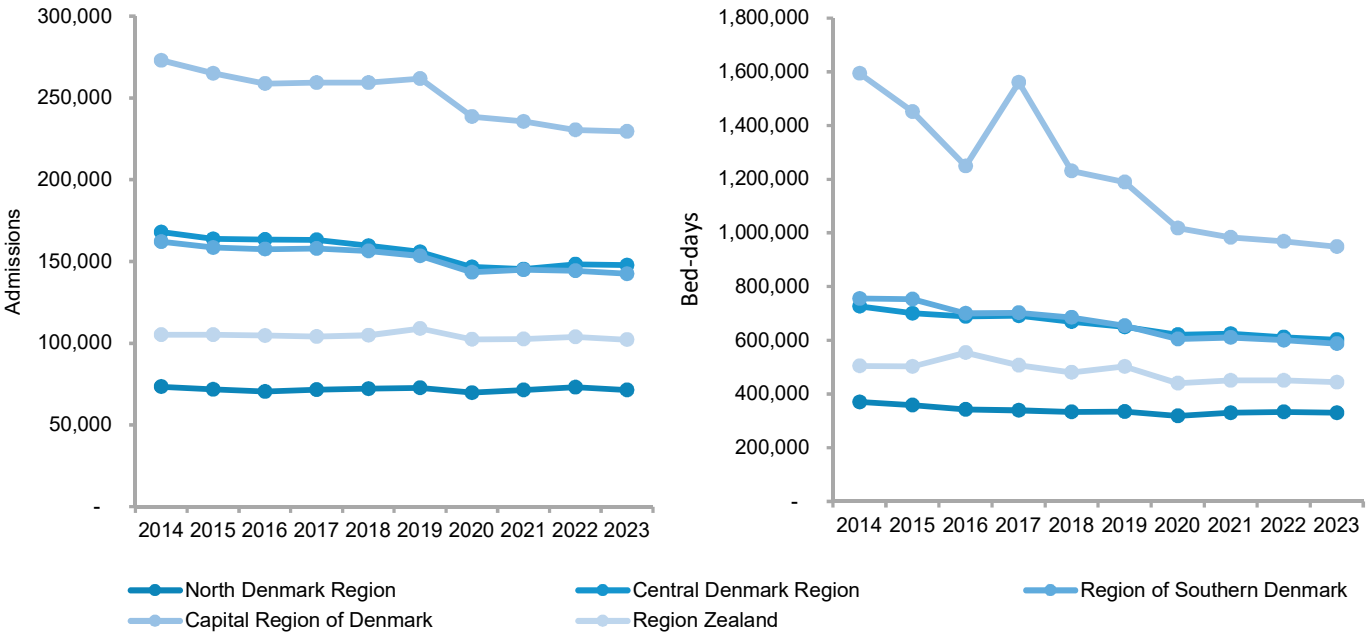
In 2023, the consumption of antimicrobial agents at somatic hospitals was 135.6 DBD. This is 5.6% higher than in 2022 (128.42 DBD) and 36% higher than a decade ago (99.44 DBD in 2014) (Table 5.6).

The four penicillin groups (penicillins with extended spectrum, beta-lactamase sensitive penicillins, beta-lactamase resistant penicillins and combinations of penicillins, including beta-lactamase inhibitors) accounted for 77.12 DBD, corresponding to 57% of the total consumption of antimicrobials at somatic hospitals in Denmark in 2023. The main group of antimicrobials in 2023; combinations of penicillins, including beta-lactamase inhibitors increased by 89.5% since 2014.

Linezolid consumption has increased to 0.65 DBD in 2023 which is the highest level observed the last decade. Over the past decade, the consumption of linezolid increased by 77% (0.37 DBD in 2014). Consumption of daptomycin peaked in 2018 (0.17 DBD), and has since been fluctuating over the years reaching 0.12 DBD in 2023 (Table 5.6). Although the overall consumption of both antimicrobials is low, these changes are of concern since both are reserved for treatment of serious infections caused by vancomycin-resistant enterococci (VRE) or methicillin-resistant *Staphylococcus aureus*.

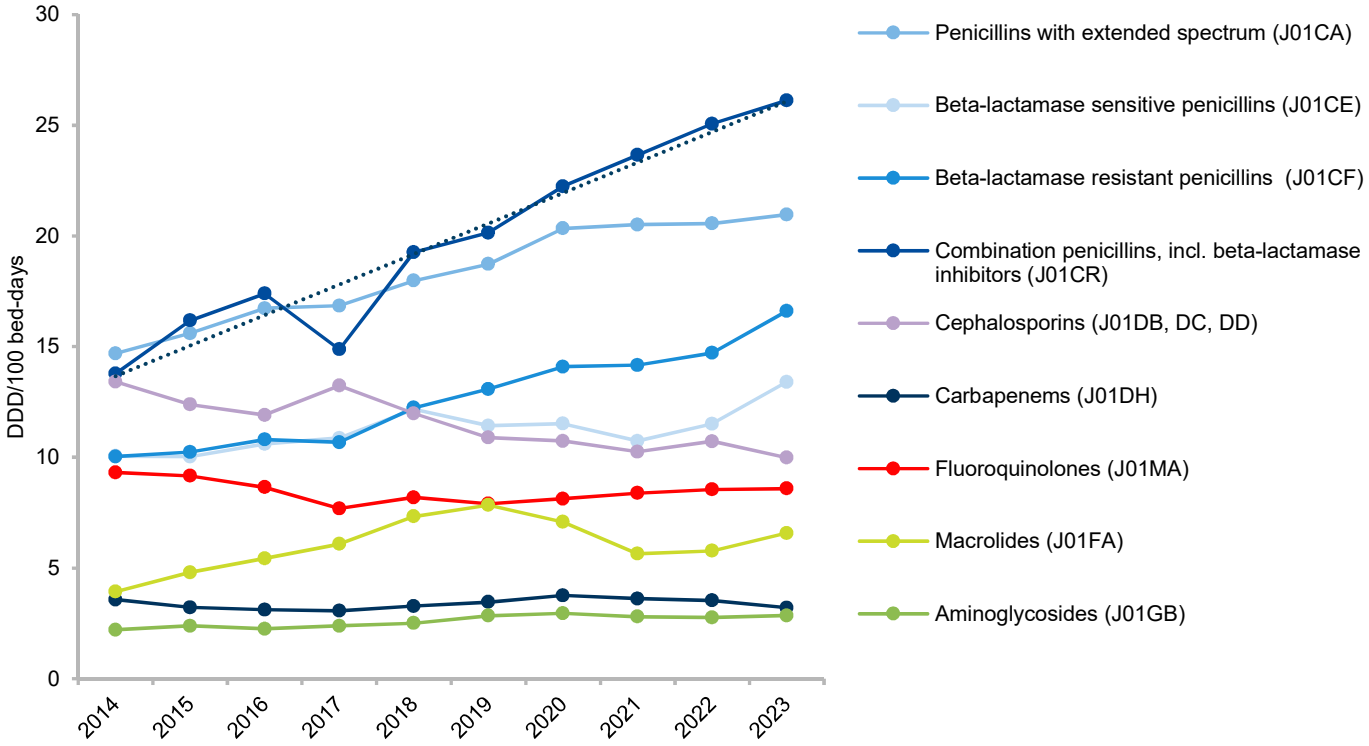
The consumption of antimicrobials at hospitals can also be measured in relation to the number of patients being admitted, i.e. DDD per 100 admissions (DAD) (Table 5.7).

Figure 5.14 Activity at somatic hospitals, bed-days and admissions, Denmark, 2014-2023 DANMAP 2023



Data source: The National Patient Register

Figure 5.15 Consumption of leading groups of antimicrobial agents at somatic hospitals, DDD per 100 bed-days, Denmark, 2014-2023
DANMAP 2023



Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

Table 5.6 Consumption of antimicrobial agents for systemic use in somatic hospitals, DDD per 100 bed-days, Denmark, 2014-2023

DANMAP 2023

ATC group	Therapeutic group	Year									
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01AA	Tetracyclines	1.78	2.00	2.42	2.18	2.78	3.67	3.13	3.25	3.53	4.00
J01CA	Penicillins with extended spectrum	14.69	15.60	16.73	16.85	17.98	18.73	20.34	20.51	20.56	20.97
J01CE	Beta-lactamase sensitive penicillins	10.05	10.03	10.60	10.87	12.17	11.42	11.52	10.74	11.51	13.41
J01CF	Beta-lactamase resistant penicillins	10.03	10.24	10.80	10.67	12.24	13.08	14.09	14.17	14.72	16.61
J01CR	Comb. of penicillins. incl. beta-lactamase inhibitors	13.79	16.18	17.40	14.87	19.27	20.15	22.24	23.66	25.07	26.13
J01DB	1st generation cephalosporins	0.07	0.05	0.05	0.04	0.04	0.03	0.04	0.03	0.03	0.03
J01DC	2nd generation cephalosporins	12.27	11.19	10.67	11.77	10.53	9.47	9.32	8.84	9.16	8.50
J01DD	3rd generation cephalosporins	1.08	1.15	1.19	1.42	1.40	1.39	1.38	1.38	1.53	1.46
J01DF	Monobactams	0.07	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
J01DH	Carbapenems	3.57	3.22	3.12	3.06	3.27	3.46	3.76	3.61	3.53	3.20
J01EA	Trimethoprim and derivatives	0.50	0.44	0.43	0.44	0.51	0.47	0.52	0.49	0.46	0.43
J01EB	Short-acting sulfonamides	0.15	0.13	0.12	0.11	0.12	0.10	0.07	0.07	0.06	0.04
J01EE	Comb. of sulfonamides and trimethoprim. incl. derivatives	5.22	5.76	6.19	5.97	7.01	7.77	8.42	9.29	9.62	10.64
J01FA	Macrolides	3.93	4.80	5.43	6.08	7.33	7.84	7.08	5.64	5.78	6.57
J01FF	Lincosamides	0.70	0.63	0.72	0.69	0.89	0.86	0.83	0.79	0.82	1.51
J01GB	Aminoglycosides	2.21	2.38	2.25	2.38	2.51	2.85	2.95	2.80	2.76	2.85
J01MA	Fluoroquinolones	9.31	9.16	8.65	7.69	8.19	7.90	8.13	8.38	8.54	8.59
J01XA	Glycopeptides	1.24	1.28	1.25	1.40	1.48	1.56	1.73	1.74	1.70	1.58
J01XB	Polymyxins	0.24	0.21	0.22	0.21	0.27	0.26	0.28	0.27	0.28	0.34
J01XC	Steroid antibacterials (fusidic acid)	0.25	0.18	0.13	0.07	0.07	0.07	0.06	0.07	0.05	0.05
J01XD	Imidazole derivatives	4.77	4.66	5.21	4.96	5.06	4.79	4.94	4.57	4.45	4.34
J01XE	Nitrofuran derivatives (nitrofurantoin)	0.34	0.30	0.27	0.27	0.31	0.33	0.40	0.36	0.37	0.44
J01XX05	Methenamine	0.06	0.10	0.09	0.08	0.12	0.09	0.10	0.13	0.13	0.15
J01XX08	Linezolid	0.37	0.48	0.42	0.40	0.61	0.62	0.57	0.58	0.65	0.65
J01XX09	Daptomycin	0.06	0.04	0.06	0.09	0.17	0.08	0.11	0.14	0.13	0.12
P01AB01	Nitroimidazole derivatives (metronidazole)	2.13	2.21	2.52	2.17	2.28	2.23	2.30	2.22	2.18	2.17
A07AA09	Intestinal antiinfectives (vancomycin)	0.56	0.52	0.56	0.55	0.58	0.64	0.77	0.67	0.79	0.83
J01, P01AB01, A07AA09	Antimicrobial agents for systemic use, incl. metronidazole and vancomycin	99.44	102.96	107.53	105.29	117.20	119.85	125.11	124.42	128.42	135.60

Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

Table 5.7 Consumption of antimicrobial agents for systemic use in somatic hospitals, DDD per 100 admissions, Denmark, 2014-2023
DANMAP 2023

ATC group	Therapeutic group	Year									
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01AA	Tetracyclines	9.00	9.86	11.35	10.96	12.54	16.22	13.43	13.92	14.96	16.78
J01CA	Penicillins with extended spectrum	74.25	76.87	78.34	84.73	81.26	82.84	87.16	87.91	87.08	88.07
J01CE	Beta-lactamase sensitive penicillins	50.80	49.41	49.65	54.65	54.99	50.53	49.36	46.03	48.75	56.31
J01CF	Beta-lactamase resistant penicillins	50.72	50.45	50.58	53.68	55.28	57.87	60.39	60.71	62.33	69.77
J01CR	Comb. of penicillins. incl. beta-lactamase inhibitors	69.68	79.72	81.46	74.80	87.05	89.12	95.31	101.38	106.18	109.73
J01DB	1st generation cephalosporins	0.34	0.24	0.23	0.22	0.20	0.14	0.16	0.15	0.14	0.11
J01DC	2nd generation cephalosporins	62.01	55.14	49.97	59.19	47.58	41.87	39.91	37.88	38.80	35.69
J01DD	3rd generation cephalosporins	5.45	5.65	5.57	7.13	6.34	6.14	5.92	5.91	6.46	6.13
J01DF	Monobactams	0.35	0.15	0.06	0.04	0.03	0.05	0.04	0.03	0.06	0.03
J01DH	Carbapenems	18.02	15.84	14.60	15.41	14.79	15.29	16.12	15.47	14.96	13.45
J01EA	Trimethoprim and derivatives	2.55	2.16	2.02	2.22	2.31	2.06	2.23	2.09	1.94	1.81
J01EB	Short-acting sulfonamides	0.78	0.65	0.55	0.55	0.53	0.45	0.32	0.31	0.25	0.19
J01EE	Comb. of sulfonamides and trimethoprim. incl. derivatives	26.38	28.40	29.00	30.01	31.66	34.37	36.10	39.82	40.76	44.69
J01FA	Macrolides	19.86	23.67	25.42	30.59	33.12	34.69	30.32	24.18	24.47	27.60
J01FF	Lincosamides	3.53	3.10	3.38	3.46	4.03	3.82	3.57	3.39	3.46	6.32
J01GB	Aminoglycosides	11.15	11.74	10.54	11.96	11.34	12.58	12.63	11.99	11.69	11.97
J01MA	Fluoroquinolones	47.07	45.14	40.51	38.65	36.99	34.94	34.83	35.92	36.18	36.08
J01XA	Glycopeptides	6.29	6.29	5.87	7.03	6.70	6.89	7.42	7.47	7.21	6.64
J01XB	Polymyxins	1.22	1.05	1.05	1.03	1.20	1.14	1.18	1.17	1.20	1.42
J01XC	Steroid antibacterials (fusidic acid)	1.25	0.89	0.62	0.36	0.33	0.29	0.26	0.29	0.22	0.23
J01XD	Imidazole derivatives	24.13	22.94	24.42	24.92	22.88	21.19	21.15	19.57	18.83	18.24
J01XE	Nitrofuran derivatives (nitrofurantoin)	1.72	1.46	1.28	1.36	1.42	1.45	1.73	1.53	1.55	1.83
J01XX05	Methenamine	0.30	0.48	0.43	0.38	0.55	0.41	0.45	0.56	0.57	0.61
J01XX08	Linezolid	1.85	2.38	1.97	1.99	2.76	2.74	2.43	2.49	2.74	2.72
J01XX09	Daptomycin	0.30	0.21	0.27	0.44	0.75	0.33	0.48	0.61	0.55	0.52
P01AB01	Nitroimidazole derivatives (metronidazole)	10.77	10.91	11.80	10.92	10.28	9.88	9.87	9.51	9.21	9.09
A07AA09	Intestinal antiinfectives (vancomycin)	2.84	2.55	2.63	2.79	2.62	2.81	3.30	2.88	3.33	3.47
J01, P01AB01, A07AA09	Antimicrobial agents for systemic use, incl. metronidazole and vancomycin	502.61	507.35	503.57	529.46	529.52	530.10	536.06	533.19	543.88	569.52

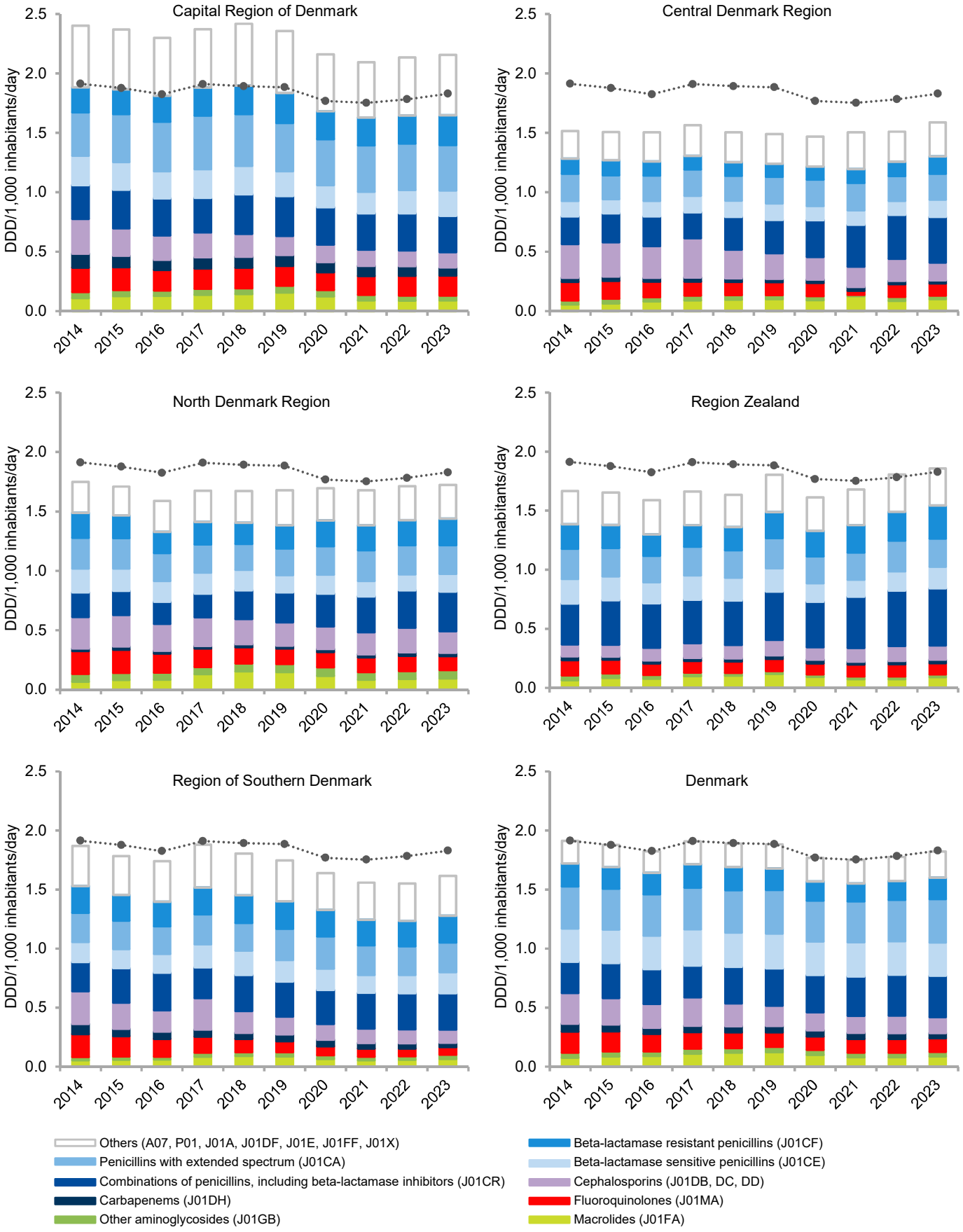
Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

5.4.2 Antimicrobial consumption at regional level at public somatic hospitals

Trends in hospital consumption at regional level measured in DDD per 100 bed-days are presented in Figure 5.17. The Capital Region of Denmark shows the highest level of consumption when compared to the other regions in 2023. It is also notable that consumption increased for each region the last decade when measured in DBD (Figure 5.17) but remains almost unchanged over the same period when measured in DID (Figure 5.16). This reflects that hospital activity changes during the years and more antimicrobials were used in relation to hospital patients' bed-days.

Figure 5.16 Consumption of antimicrobial agents for systemic use at hospitals in the five health regions, DDD per 1,000 inhabitants per day, Denmark, 2014-2023

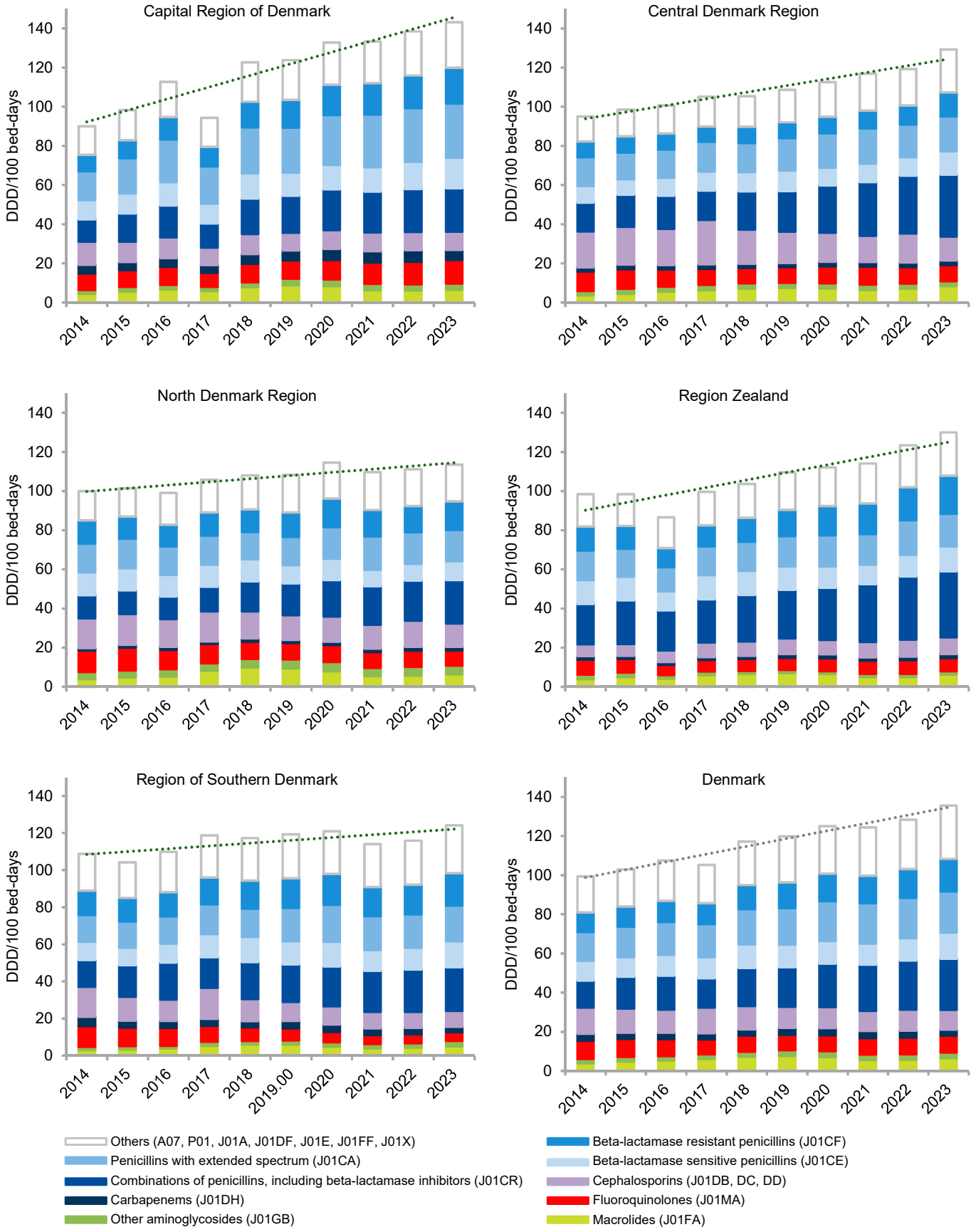
DANMAP 2023



Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Figure 5.17 Consumption of antimicrobial agents for systemic use at hospitals in the five health regions, DDD per 100 bed-days, Denmark, 2014-2023

DANMAP 2023



Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

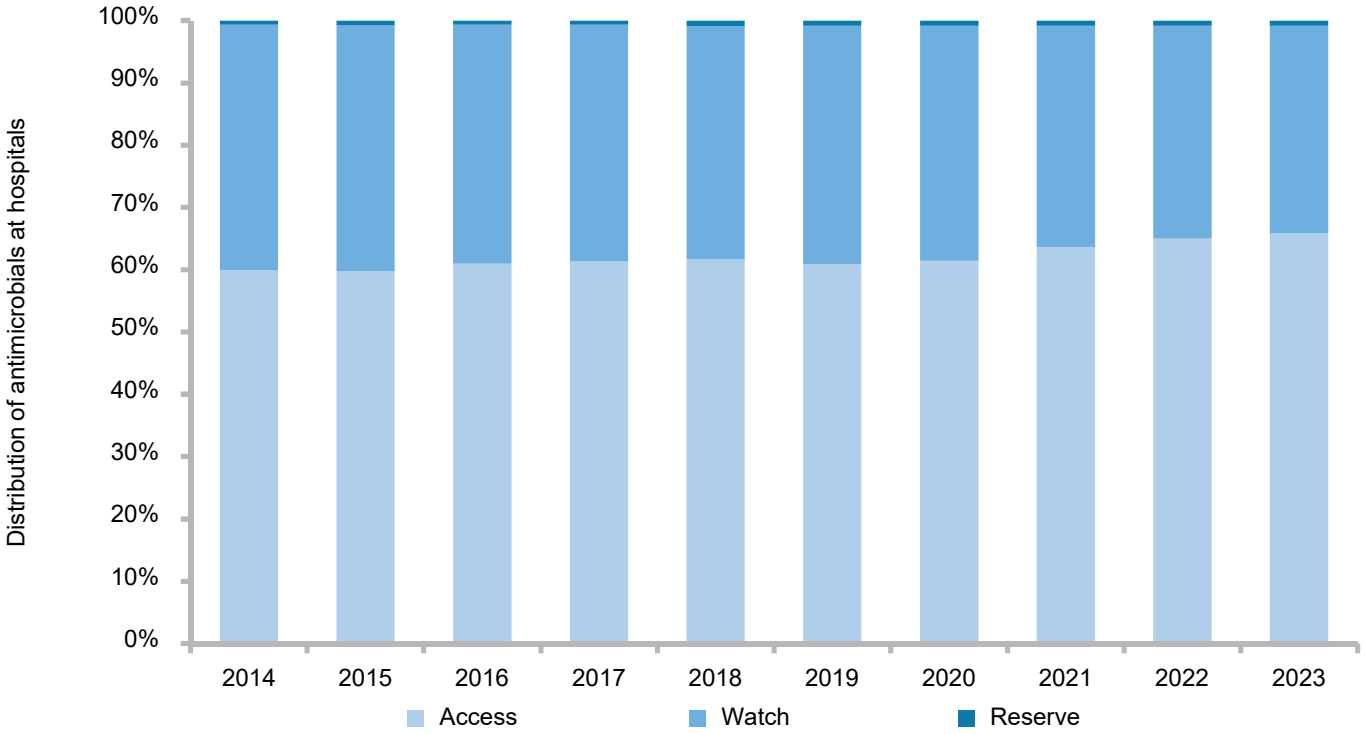
5.4.4 AWaRe classification of antimicrobials at Danish somatic hospitals

The World Health Organization (WHO) has developed the AWaRe classification system as a tool to assist antibiotic stewardship and to reduce antimicrobial resistance. Antibiotics are classified into three groups to emphasise the importance of their appropriate use:

- **Access:** Antibiotics used to treat common susceptible pathogens with lower resistance potential than antibiotics in the other groups. 60% of total antimicrobial consumption should consist of access agents.
- **Watch:** Antibiotics that have higher resistance potential, including most of the highest priority agents. These antibiotics should be prioritised as key targets of stewardship programs and monitoring.
- **Reserve:** Antibiotics reserved for treatment of confirmed or suspected infections due to multi-drug resistant organisms. These antibiotics should be considered as "last resort" options.

Antimicrobial consumption at somatic hospitals has consisted of more than 60% "access antimicrobials" since 2016, whereas "reserve antimicrobials" consituted 1% in all years (Figure 5.18). On national level, i.e. including antimicrobial consumption in primary health care, "access antimicrobials" consitituted at least 80% since 2014 (84% in 2023).

Figure 5.18 Percentage distribution of antimictobials at somatic hospitals according to WHO AWaRe classification, DDD, Denmark, 2014-2023
DANMAP 2023



Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

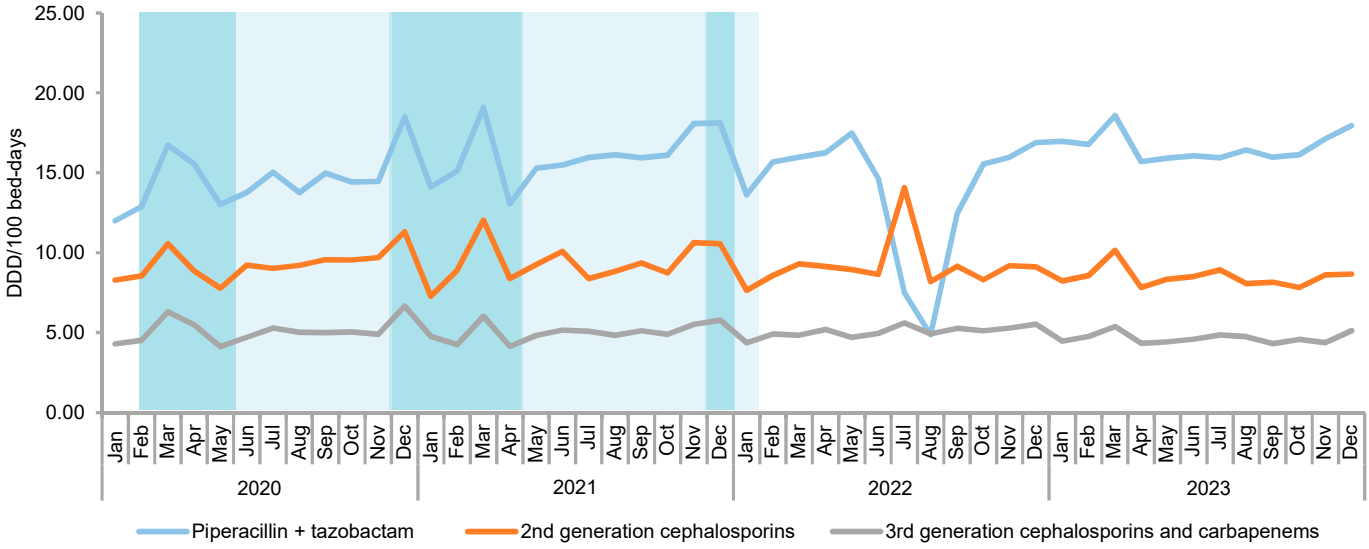
5.4.5 Shortage of antimicrobials

Issues with supply chains of antimicrobials can lead to product shortages. Some shortages do not reach the patient due to the substitution rules in Denmark. Shortages can also be solved by using antimicrobials on special delivery, which requires permission from the Danish Medicines Agency.

Monthly consumption of the main antimicrobial groups for treatment of critically ill patients at hospitals from 2019 to 2022 are shown in Figures 5.19. In 2022, penicillin/beta-lactamase inhibitor combinations decreased sharply in July and August due to product shortages. However, prescribers had access to penicillin/beta-lactamase inhibitor combinations via special deliveries. Approximately 70,000 DDD penicillin/beta-lactamase inhibitor combinations were purchased through special delivery in 2022, whereas in 2019-2021 the number was approximately 4,000 DDD (Table 5.8).

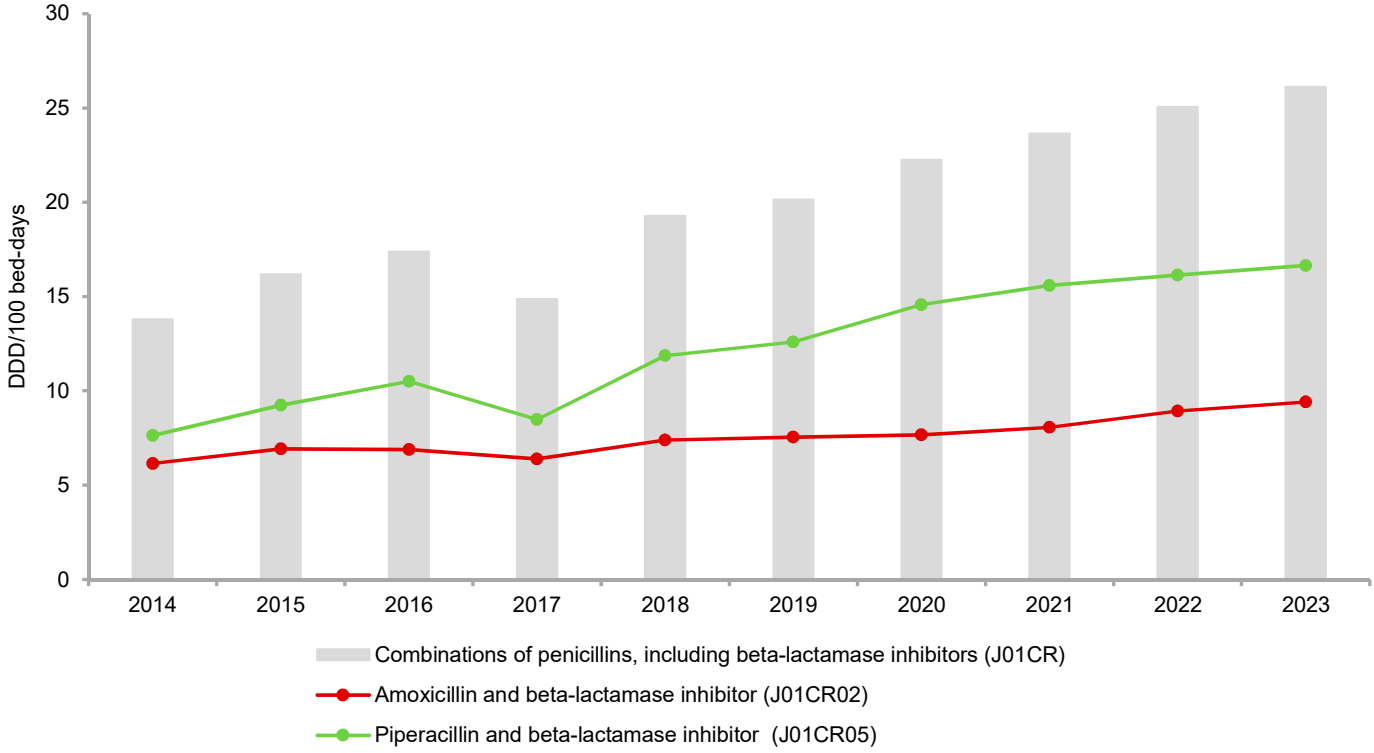
Special deliveries could not solve the shortage of penicillin/beta-lactamase inhibitor combinations in 2017, which lead to a significant decrease in consumption that year (Figure 5.20). Simultaneously, an increase in consumption of cephalosporins was observed (Figure 5.15). In 2023, nitrofurantoin was hit by shortage (Figure 5.21) and even with increased supply via special deliveries, it was not possible to cover the whole need of it, why other antimicrobials were chosen for treatment (Table 5.8).

Figure 5.19 Consumption of key antimicrobials used for treatment of seriously ill patients in hospital, DDD per 100 bed-days, Denmark, 2020-2023 DANMAP 2023



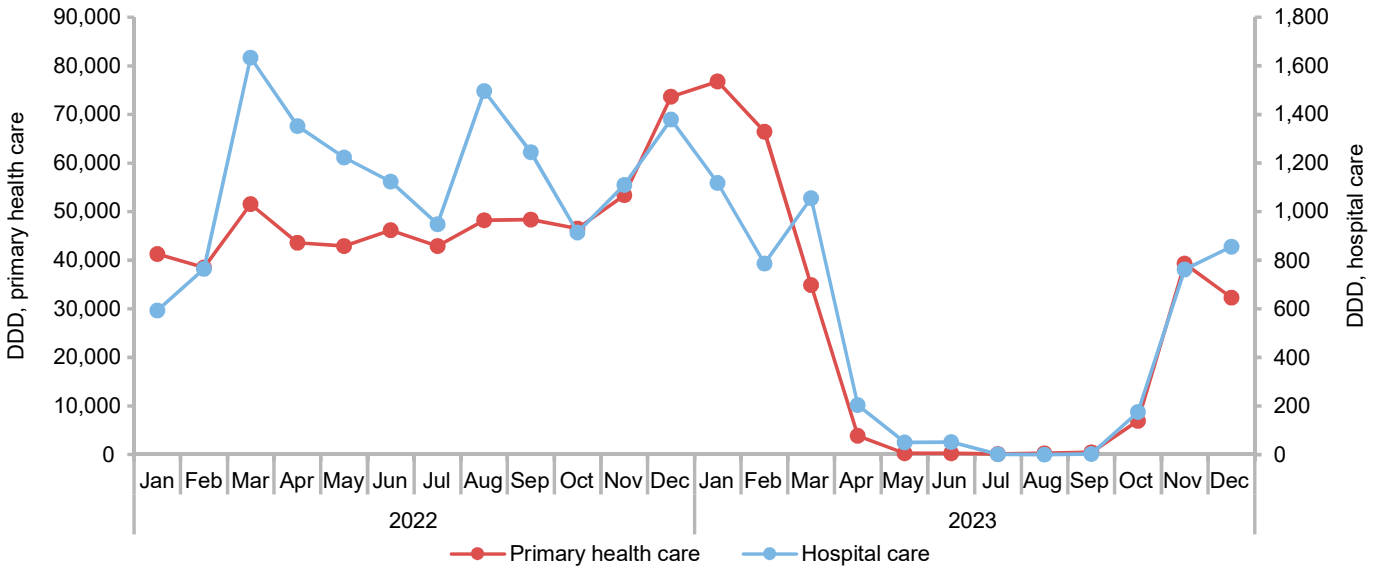
Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

Figure 5.20 Consumption of combination penicillins at somatic hospitals, DDD per 100 bed-days, Denmark, 2014-2023 DANMAP 2023



Data: Antimicrobial consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

Figure 5.21 Monthly consumption of nitrofurantoin by health care sector, DDD, Denmark, 2022-2023 DANMAP 2023



Data: Antimicrobial consumption in Denmark
Data source: Register of Medicinal Product Statistics, 2024 edition of the Anatomical Therapeutic Chemical (ATC) classification system

Table 5.8 Consumption of selected antimicrobials on special delivery to hospitals, DDD, 2014-2023 DANMAP 2023

Antimicrobial	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
J01MA12 Levofloxacin	4,470	7,240	8,080	8,180	6,710	7,360	20,370	44,200	41,530	45,360
J01XE01 Nitrofurantoin										7,950
J01EE01 Sulfamethoxazol and trimethoprim	6,820	6,590	6,704	8,188	7,596	7,136	3,094	8,585	2,610	3,760
J01CE02 Phenoxymethylpenicillin				5,085	417			5,183		2,792
J01GB01 Tobramycin						6,895	6,840	4,790	3,850	2,620
J01CF05 Flucloxacillin	2,690	2,313	2,275	2,200	1,783	1,790	1,665	1,873	2,540	2,233
J01CR02 Amoxicillin and beta-lactamase inhibitor	721	10,743	3,276	2,579	3,882	4,348	4,277	3,934	4,177	1,726
J01MA02 Ciprofloxacin	710	1,155	1,195	690	766	726	1,028	908	935	890
J01CR05 Piperacillin og beta-lactamaseinhibitor				16,465	4,457				63,808	
J01CE08 Benzathine benzylpenicillin	316	562	372	1,514	618	538	748	544	524	652

Data: Consumption of antimicrobials on special delivery
Data source: Danish Hospital Pharmacies

We would like to acknowledge Maja Laursen from the National Health Data Authority in Denmark for data on antimicrobial consumption and activity in hospital care. We would also like to acknowledge all hospital pharmacies in Denmark for data on special delivery of antimicrobials to the hospitals.

Finally, we would like to acknowledge the panel of experts from clinical microbiology laboratories and from research centers for general practice for their valuable input to this chapter.

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