Evaluation of consumption in defined daily doses of antimicrobial drugs for systemic use in hospitals

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Abstract

Background: Defined daily doses remain as the most objective factor and can be considered as the cornerstone for making decision on determining the needs and organization of rational use of medicines, as well as for providing in practices suggestion of WHO Global Strategy that defines the use of antimicrobials in hospital treatment of patients.

Material and methods: For this study we used data of 2009-2014 period, in the Emergency Medicine Institute of the Republic of Moldova which shows the dynamics of consumption of medicinal remedies of pharmaco-therapeutic group J – Antibacterials for systemic use of the Anatomical Therapeutical Chemical World Health Organization's classification.

Results: Total annual consumption of drugs group J – Antibacterials for systemic use in the evaluated period records a decrease from 662.2 DDD/1000 in 2009 to 464.1 in 2014 or by 29.9%, of which for parenteral use from 568.9 in 2009 to 346.9 or by 39% and for oral use from 93.28 to 117.20 or an increase by 25.6%. From total concumption the ratio between parenteral and oral use in the evaluated period varied from 85.9/14.1 to 74.8/25.2 percentage.

Conclusions: The obtained data reveals that consumption of drugs group J – Antibacterials for systemic use in the evaluated period decreased significantly and in 2014 recorded a mean consumption of European hospitals.

Key words: antibiotics, consumption, defined daily doses, occupied-bed days, rational use.

Introduction

We can find more international, regional and national programs [1-8] aimed to survey the usage of antibiotics, involving dozens of countries which have thousands of hospitals and other public health institutions. The article aims at collating and evaluating data on antimicrobial or antibacterials (antibiotics) usage in the Emergency Medicine Institute over a certain time, enabling monitoring of trends in use of this group of drugs based on the Anatomical Therapeutical Chemical (ATC) World Health Organization's (WHO) classification system standards. Present research covers antibiotics utilization data, as a rate based on defined daily doses, enables reporting and comparison of total-hospital usage for the period from January 2009 to January 2014. This report provides data which could be used to target particular areas of antibiotics' usage. At the hospital level the usage trends is a parameter for identifying overall changes in anti-infective treatment practices.

Emergency Medicine Institute of the Republic of Moldova (EMI), was founded in 1959. Clinical Services of EMI include: Orthopedic-Traumatology Clinic for 150 beds, Surgery Clinic for 140 beds, Neurosurgery Clinic for 80 beds, Neurology Clinic for 70 beds, Maxillo-facial clinic for 30 beds, Urology Clinic for 40 beds, Gynecology Clinic for 30 beds, Microsurgery Clinic for 30 beds, Municipal Center with 8 seats hemodialysis and 9 beds, Clinical intensive care units (CICU) for 30 beds, in total the above clinical services of the institution include 600 beds, also are included 5 emergency medical help substations and 4 out-patient departments of traumatology and orthopedics [9].

The primary aim of the study was to evaluate institutional representative data on antibiotics utilization for a period of six years (2009-2014), according to WHO requirements to determine the value of defined daily doses (DDD) per 1000 occupied-bed days (OBD) and compare these data with the results of the use of antibiotics in hospitals from other countries. Based on obtained data it aimed to make conclusions on the consumption of antibiotics in hospitals for ensuring the optimization of planning needs and their rational use.

To determine DDD and compare the consumption of antibiotics for the period of 2009-2014, the statistics data concerning the number of treated patients, the number of occupied bed/days and total annual quantities of antibiotics were used. The total number of occupied bed/days in the institution was 188762 in 2009, 191556 in 2010, 186246 in 2011, 199816 in 2012, 193019 in 2013 and 187558 in 2014 [10, 11, 12].

Antimicrobial data are aggregated over the time period of interest at hospital level and converted to standardized usage route based on the WHO definition of DDD with 1000 OBD as the denominator [13, 14, 15].

Material and methods

For this study we used data on a six-year (2009-2014) period in EMI, which show the dynamics of consumption of medicinal remedies of pharmaco-therapeutic group J – Antibacterials for systemic use, as classified ATC, classification system of World Health Organization indicating the nature value. Statistical, analytical, mathematical, comparative, logical and descriptive methods of study were used.

Results and discussion

To determine DDD and compare the consumption of antibiotics for the period of 2009-2014, the statistics data concerning the number of treated patients (only patients with health insurance and other free treated by the state categories

of citizens), the number of occupied bed/days and total annual quantities of medicines were used.

In figure 1 are demonstrated the total (parenteral and oral forms) antibiotic groups use rates of DDD/1000 OBD in EMI. The average aggregate annual rate for total-hospital antibiotics utilization period decreased from 662.4 DDD/1000 OBD in 2009 to 464.1 DDD/1000 OBD in 2014, or by 29, 9%. Near every group of antibiotics is shown the usage rate for 2014 and the yearly trends for the evaluation period in comparison with 2009.

Annual usage rate data, aggregated by year and therapeutic group, for six years from January 2009 to January 2014, demonstrated the increase in usage rates for tetracyclines by 253.7% (from 8.2 to 20.8 DDD/1000), amphenicols by 160% (from 0.5 to 0.8 DDD/1000), other beta-lactam antibiotics by 100.7% (from 270.8 to 272.6 DDD/1000) and antimycotics for systemic use by 178.5% (from 12.1 to 21.6 DDD/1000). A decline in usage rates was recorded for beta-lactam antibiotics, penicillin by 75.6% (from 85.5 to 20.8 DDD/1000), sulfonamides and trimethoprim by 100% (from 5.7 to 0 DDD/1000), macrolides and lincosamides by 96,6% (from 44.4 to 1.5 DDD/1000), aminoglycoside antibiotics by 47.4% (from 83.1 to 43.7 DDD/1000), quinolone antibiotics by 49.2% (from 91.0 to 46.2 DDD/1000) and other antibiotics by 40.9% (from 61.1 to 36.1 DDD/1000).

In figure 2 are presented trends of usage rates DDD/1000 OBD of antibiotic groups (parenteral forms) in EMI. The average consumption annual rate in the evaluation period recorded a decline from 568.9 DDD/1000 OBD in 2009 to 346.9 DDD/1000 OBD in 2014 or by 39%. Near every grupe of antibiotics is showen usage rate for 2014 and the yearly trends for the evaluation period in comparison with 2009.

During the evaluated period was registered an increased usage of amphenicols by 160% (from 0.5 to 0.8 DDD/1000) and antimycotics for systemic usage by 180% (from 0.5 to 0.9 DDD/1000). A decline in usage rates was recorded for beta-lactam antibiotics by 95.1% (from 79.9 to 3.9 DDD/1000), other beta-lactam antibiotics by 7.9% (from 268.5 to 247.3 DDD/1000), macrolides, lincosamides and streptogramins by 98% (from 43.7 to 0.9 DDD/1000), aminoglycoside for systemic by 47.4% (from 83.1 to 43.7 DDD/1000), quinolone antibiotics by 65.7% (from 41.7 to 14.3 DDD/1000) and other antibiotics by 31% (from 50.9 to 35.1 DDD/1000).

In figure 3 are presented trends in groups of antibiotics for oral use in EMI in the evaluation period. The average consumption annual rate of antibiotics for oral usage increased from 93.28 DDD/1000 OBD in 2009 to 117.2 DDD/1000 OBD in 2014 or by 125.7%. Near every group of antibiotics is shown usage rate for 2014 and the yearly trends for the evaluation period in comparison with 2009.

As we can see from fig. 3 in the consumption of oral forms of antibiotics in the evaluated period was registered an increased usage for tetracyclines by 253.7% (from 8.2 to 20.8 DDD/1000), beta-lactam antibiotics by 301.8% (from 5.6 to 16.9 DDD/1000), other beta-lactam antibiotics by 11.5 times (from 2.2 to 25.3 DDD/1000) and antimycotics for systemic use by 180% (from 11.5 to 20.7 DDD/1000). A decline in

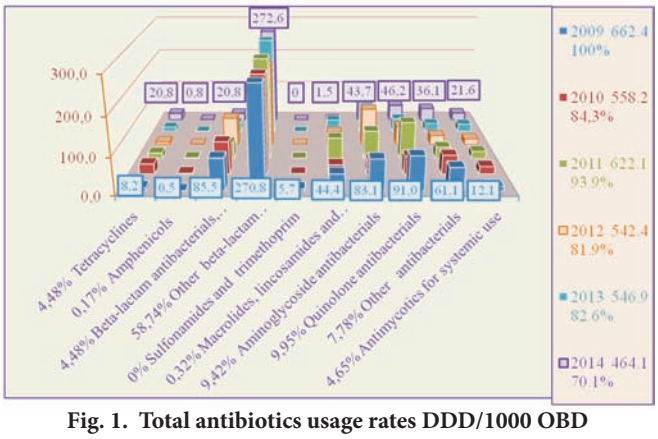

Fig. 1. Total antibiotics usage rates DDD/1000 OBD in 2009-2014 (parenteral and oral forms).

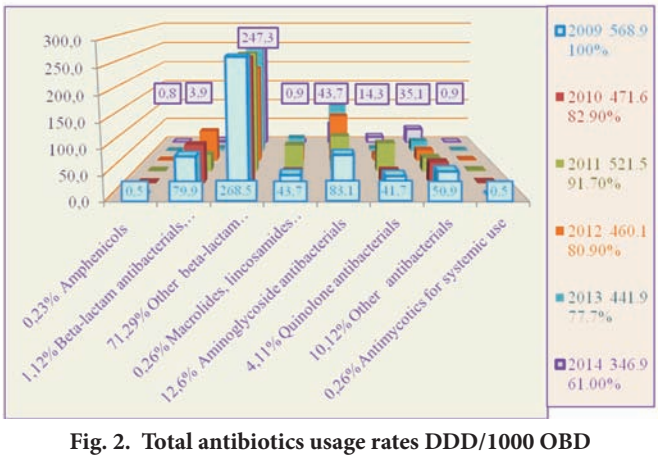

Fig. 2. Total antibiotics usage rates DDD/1000 OBD in 2009-2014 (parenteral forms).

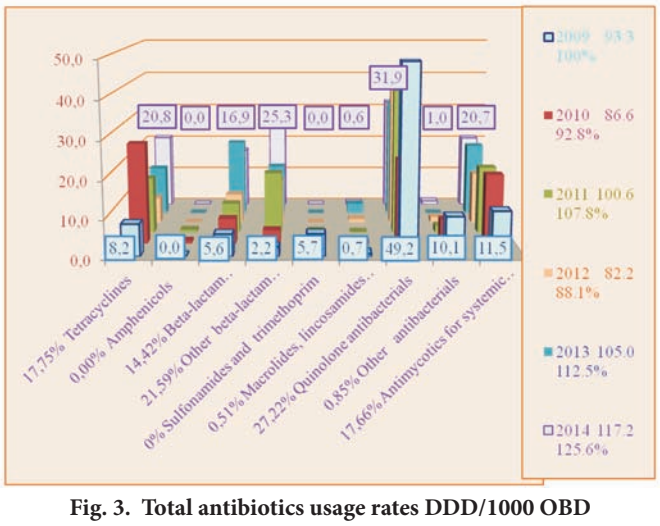

Fig. 3. Total antibiotics usage rates DDD/1000 OBD in 2009-2014 (oral usage).

usage rates was recorded for sulfonamides and trimetoprim by 100% (from 5.0 to 0 DDD/1000), macrolides, lincosamides and streptogramins by 14.2% (from 0.7 to 0.6 DDD/1000), quinolone antibiotics by 35.2% (from 49.2 to 31.9 DDD/1000), other antibiotics by 90.1% (from 10.1 to 1.0 DDD/1000). The annual trends of consumption of antibiotics for parenteral and oral use are presented in table 1.

From the data presented in table 1 we can state that the usage trends of antibiotics for parenteral and oral use during

Table 1

Trends of antibiotics for parenteral and oral usage in NSPCEM in 2009-2014

Route/years	2009		2010		2011		2012		2013		2014	
TOTAL parenteral	568.9	85.9%	471.6	84.5%	521.5	78.7%	460.1	84.8%	441.9	80.8%	346.9	74.8%
TOTAL oral	93.28	14.1%	86.6	15.5%	100.6	21.3%	82.25	15.2%	105.0	19.2%	117.2	25.2%
TOTAL	662.2	100%	558.2	84.3%	622.1	93.9%	542.4	81.9%	546.9	82.6%	464.1	70.1%

Table 2

Percentage usage trends of DDD/1000 OBD per day of antibiotics group ATC J01 between the EMI of the Republic of Moldova and seven European courtiers

Country/ Antibacterial groups	EMI of RM	Bulgaria	Ireland	Estonia	Lithuania	Latvia	Sweden	Finland
Tetracyclines	4.37	1.42	1.12	4.44	2.5	3.0	12.01	7.5
Beta-lactam Penicilins	4.48	20.0	9.44	32.77	24.16	30.33	50.66	18.57
Other Beta-lactam antibiotics	58.74	51.44	49.44	26.11	22.	37.66	13.33	32.5
Macrolides Lincosamides and streptogramins	0.32	7.85	14.44	10.55	2.5	4.33	4.0	5.35
Quinolone antibiotics	9.95	7.85	7.77	10.55	6.25	11.66	10.66	12.14
Other antibiotics	7.78	14.28	14.44	14.15	40.41	10.66	7.33	20.71

the evaluated period, recorded for parenteral use a decline by 11.1 % (85.9% - 74.8%), and for oral use respectively an increase by the same 11.1% (25.2%-14.1%).

The percentage usage trends of DDD/1000 OBD per day of antibiotics group J – Antibacterials (ATC J01) for systemic use of the EMI of Republic of Moldova and other seven countries from the European Union, such as: Bulgaria, Ireland, Estonia, Lithuania, Latvia, Sweden and Finland are presented in table 2.

Utilizing the DDD/1000 OBD per day data [15, 16], we have calculated the percentage usage trends for the large antibiotics groups ATC J01 of the EMI and seven countries from European Union. The results demonstrate that the average proportion of consumption in seven countries from European Union and EMI are for tetracyclines 4.37:4.6, beta-lactam antibiotics 26.6:4.48, other beta- antibiotics 58.47:33.3, macrolides, lincosamides and streptogramins 7:0.32, quinolone antibiotics 9.6:9.95, other antibiotics 15.4:7.78.

In table 3 is presented total-hospital usage rates of DDD/1000 OBD of antimicrobials between the EMI and ten international researches with the data from more than 2000 hospitals of European countries.

The results show that in ten international researches [4, 20, 21, 22, 23, 24] the medium minimal consumption of DDD/1000 is 433.77 and medium maximal – 499.31 units. So, recorded consumption in EMI of 464.1 DDD/1000 units of antibiotics in 2014 in comparison with the presented below results is intermediate.

Table 3

Comparison of total-hospital usage rates of DDD/1000 OBD of antibiotics between the EMI and ten international researches

Hospitals	DDD/1000	% consumption
EMI of the Republic of Moldova	464.1	464.1 = 100%
34 public/43 private hospitals in France [17]	395 - 422	85.11% - 90.93%
Antibiotic use in 530 French hospitals [18]	62.3 - 557.7	13.42%-120.17%
University Hospital of Geneva [19]	400	86.62%
Besancon University Hospital in France [20]	535.4	115.36%
74 south-western French hospitals [21]	400 - 450	86.19% - 96.96%
University Medical Center Rotterdam The Netherlands [22]	547	117.86%
1115 hospitals in France [23]	370 - 393	79.72% - 84.68%
University Hospital Huddinge, Sweden [24]	430	92.65%
139 hospitals from 30 European countries [25]	496	106.87%
All hospitals in Netherlands [4]	702	151.26%

Conclusions

1. The average aggregate annual rate for total-institutional antibiotics utilization decreased from 662.4 in 2009 to 464.1 DDD/1000 OBD in 2014, or by 29. 9%. Of which a significant decline in usage rates was recorded for beta-lactam antibiotics, penicillin by 75.6% (from 85.5 to 20.8 DDD/1000), macrolides and lincosamides by 96.6% (from 44.4 to 1.5 DDD/1000), aminoglycoside antibiotics by 47.4% (from 83.1 to 43.7 DDD/1000), quinolone antibiotics by 49.2% (from 91.0 to 46.2 DDD/1000) and other antibiotics by 40.9% (from 61.1 to 36.1 DDD/1000). At the same time an increase in usage rates was recorded for tetracyclines by 253.7% (from 8.2 to 20.8 DDD/1000) and antimycotics for systemic useg by 178.5% (from 12.1 to 21.6 DDD/1000).

2. For parenteral form of use the consumption annual rate in the evaluation period recorded a decline from 568.9 DDD/1000 OBD in 2009 to 346.9 DDD/1000 OBD in 2014 or by 39%. Of which a significant decline in usage rates was recorded for beta-lactam antibiotics by 95.1% (from 79.9 to 3.9 DDD/1000) lincosamides and streptogramins by 98% (from 43.7 to 0.9 DDD/1000), aminoglycoside for systemic use by 47.4% (from 83.1 to 43.7 DDD/1000), quinolone antibiotics by 65.7% (from 41.7 to 14.3 DDD/1000) and other antibiotics by 31% (from 50.9 to 35.1 DDD/1000).

3. For oral form of use the consumption annual rate recorded an increase from 93.28 DDD/1000 OBD in 2009 to 117.2 DDD/1000 OBD in 2014 or by 125.7%, of which more significantly for tetracyclines by 253.7% (from 8.2 to 20.8 DDD/1000), beta-lactam antibiotics by 301.8% (from 5.6 to 16.9 DDD/1000), other beta-lactam antibiotics by 11.5 times (from 2.2 to 25.3 DDD/1000) and antimycotics for systemic use by 180% (from 11.5 to 20.7 DDD/1000). At the same time a decline in usage rates was recorded for sulfonamides and trimetoprim by 100% (from 5.0 to 0 DDD/1000), quinolone antibiotics by 35.2% (from 49.2 to 31.9 DDD/1000) and other antibiotics by 90.1% (from 10.1 to 1.0 DDD/1000).

4. The average proportions of consumption of main groups of antibiotics in seven countries from the European Union and EMI are for tetracyclines 4.37:4.6, beta-lactam antibiotics 26.6:4.48, other beta- antibiotics 58.47:33.3, macrolides, lincosamides and streptogramins 7:0.32, quinolone antibiotics 9.6:9.95, other antibiotics 15.4:7.78.

5. The recorded consumption of 464.1 DDD/1000 units of antibiotics in EMI in 2014 in comparison with medium minimal consumption of 433.77 and medium maximal of 499.31 units of DDD/1000 from ten international researches is intermediate. This is a result of six years efforts for rational use of antibiotics since 2009 when consumption of antimicrobials DDD/1000 in EMI was 662.2 units or by 132.7% more than medium maximal in European countries.

6. One of the most evident results of the present research is a clear demonstration that today implementation of DDD program consumption study of antibiotics in all hospitals of health system of the Republic of Moldova is indubitable necessity for qualitative determination of annual planning of necessary drugs and their rational use organization.

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