Surveillance of quinolone generations in Emergency Medicine Institute

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Abstract

Background: The main goal of the study was to evaluate the institutional representative data on quinolones antibacterial generations in accordance with WHO requirements, to determine the value of Defined Daily Doses per 1000 Occupied-Bed Days (DDD/1000) and cost in most important departments, comparing it with the same published data of international scientific journals.

Material and methods: For this study we used the data of a six-year (2009-2014) period in the Emergency Medicine Institute and their subdivisions with main consumption of antibiotics which shows the consumption dynamics of quinolone generations use in grams and value indexes.

Results: In the evaluated period, the medium yearly consumption of all quinolone generations recorded 63.03 DDD/1000 or a share of 11.14% from medium annual total of 566.02 DDD/1000 antibiotics. The same data in other international hospitals recorded 71.24 or 11.84% from total of 601.36 DDD/1000. In the end of the evaluated period, in IC departaments, the consumption of the first and the second generations registered 112.13 DDD/1000 and respectively the third and the fourth 6.02 DDD/1000 or a decrease by 2.27 and 13.85 times. In SSOT departments in the end of the evaluation the first and the second generations recorded 57.59 DDD/1000 or an increase by 40.25%. Medium annual cost per DDD/1000 for the first and the second generations of quinolone antibacterials in ICD recorded 4731.78 lei, the third and the fourth generations 6526.15 lei and respectively in SSOTD 365.78 lei and 149.20 lei.

Conclusions: In the end of the evaluated period in ICD of EMI quinolones of the first and the second generations represent 94.90% and the third and the fourth generations 5.10% from the total consumption. In SSOTD departments and in the entire EMI, the third and the fourth generations represent less than 1% of all consumption. This evaluation, as a part of multidisciplinary approach, serves as an important point for further survey of protocols and guides concerning the antibiotic consumption in one hospital.

Key words: quinolone antibacterials, generations, defined daily dose, consumption, rational use, hospitals.

Introduction

Since its discovery in the early 1960s, the quinolone antibacterial generations have considerably increased the clinical and scientific interest [1, 2]. A new four-generation classification of the quinolone drugs which have broad-spectrum bactericidal activity, excellent oral bioavailability, good tissue penetration and favorable safety and tolerability profiles, takes into account the expanded antimicrobial spectrum and their clinical indications. With

the increasing number of available quinolone antibiotics, prescribing these drugs has become a challenge [3, 4, 5, 6, 7] and will likely gain more important indications in the future [8]. In some countries fluoroquinolones became the most commonly prescribed class of antibiotics to adults [9]. The adverse events in patients treated with quinolones are roughly similar to that observed in patients treated with other antibiotic classes [10, 11] and it is one more argument to be appreciated as first-line therapy [12]. Based on their antibacterial spectrum quinolones are divided into generations including many medical remedies [13]: first-generation (cinoxacin, flumequine, nalidixic acid, oxolinic acid, nemonoxacin, piromidic acid, pipemidic acid, rosoxacin), second-generation (ciprofloxacin, enoxacin, fleroxacin, omefloxacin, nadifloxacin, norfloxacin, ofloxacin, pefloxacin, rufloxacin), third-generation (balofloxacin, grepafloxacin, levofloxacin, pazufloxacin, sparfloxacin, temafloxacin, tosufloxacin), fourth-generation (clinafloxacin, gatifloxacin, gemifloxacin, moxifloxacin, sitafloxacin, trovafloxacin, prulifloxacin) [14, 15, 16, 17].

The main goal of the study was to evaluate the institutional representative data on quinolones antibacterial generations in accordance with World Health Organization (WHO) requirements to determine the value of Defined Daily Doses per 1000 Occupied-Bed Days (DDD/1000) and value cost in the dynamics per total institution and most important departments [18] compared with the same published data of international scientific journals.

Material and methods

The data of a six-year (2010-2014) period for this study were used. DDD/1000 consumption of quinolone antibacterial generations of Emergency Medicine Institute (EMI) shows the dynamics of consumption of antiinfectives for systemic use drugs indicated in grams and value indexes. Statistical, mathematical, analytical, logical, comparative and descriptive were used as the methods of study.

Results and discussion

For determining the number of DDD/1000, was used the data concerning the total annual consumption of quinolones generations and the statistics data concerning the number of treated patients (only patients with health insurance and other free treated by the state categories of citizens) in EMI, ICD (Reanimation, intensive Therapy and intensive Neurological "STROKE" departments) and SSOTD (Septic surgical and Septic orhtotraumotology departments) [19]. The evaluated period in the EMI is characterized by the use of parenteral (P) and enteral (E) forms of quinolones as following: first-generation: acidum pipemidicum DDD 0.8 E.P, second-generation: ofloxacinum DDD 0.4 E, ciprofloxacinum DDD 1.0 E. 0.5 P, third generation: gatifloxacinum DDD 0.4 E.P, fourth-generation: mofloxacin DDD 0.4 E.P. Total of the first and the second generations of quinolone antibacterial consumption in DDD/1000 during 2009-2014 is shown in figure 1.

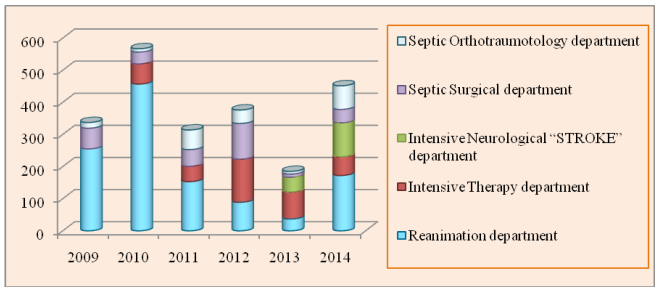

Fig. 1. Total of the first and the second generations of quinolone antibacterial consumption in DDD/1000 during 2009–2014.

As it could be mentioned from chart 1, in 2014 total departments consumption of the first and the second generations of quinolone antibacterials recorded 451.58 DDD/1000, which could be placed as following: first place – Reanimation department with 172.42 DDD/1000 or 38.18%, second – intensive Neurological "STROKE" department with 105.83 DDD/1000 or 23.44 %, third – septic Orhtotraumotology department with 73.62 DDD/1000 or 16.30%, fourth – intensive Therapy department with 58.15 DDD/1000 or 12.88% and septic Surgical department with 9.20 DDD/1000 or 9.20% on the fifth position. Since 2009 to 2014 a decrease in consumption by 32.43% recorded Reanimation department, by 35.43% septic surgical department and an increase by 4.14 times septic Orthotraumotology department. In figure 2, the consumption of parenteral forms of the first and the second generations of quinolone antibacterials in DDD/1000 during 2010-2014 is shown.

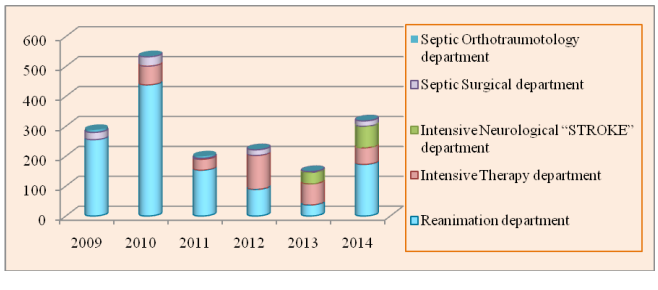

Fig. 2. Total of the first and the second generations of quinolone antibacterial consumption in DDD/1000 (parenteral forms).

In figure 2 parenteral forms of the first and the second generations quinolone antibacterial consumption are presented.

In 2014 parenteral forms represented 319.56 DDD/1000 or 70.76% from total consumption which could be placed as following: first place – Reanimation department with 172.42 DDD/1000 or 53.96%, second – intensive Neurological "STROKE" department with 72.08 DDD/1000 or 22.56%, third – intensive Therapy department with 55.49 DDD/1000 or 17.36%, septic Surgical department with

5.57 DDD/1000 or 5.57%, fourth – and septic Orhtotraumotology department with 1.78 DDD/1000 or 0.56% on the fifth position. Since 2009 to 2014 a decrease in consumption by 32.43% recorded Reanimation department, by 27.00% septic Surgical department and by 78.83% septic Orthotraumotology department. In figure 3, DDD/1000 of the first and the second generations of quinolone antibacterials (enteral forms) consumption during 2009-2014 is shown.

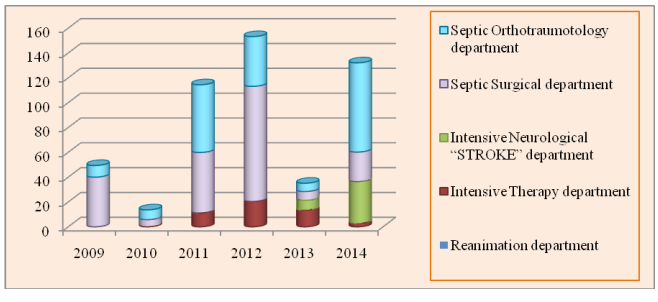

Fig. 3. Total of first and second generations of quinolone antibacterial consumption in DDD/1000 (enteral forms).

Figure 3 shows that in the evaluated period enteral forms of quinolone antibacterials recorded a considerable increment of consumption in all departments from 49.33 in 2009 to 132.02 DDD/1000 or by 2.68 times. In 2014 enteral forms represented 29.24% from total consumption, which could be placed as following: first place – septic Orhtotraumotology department with 71.84 DDD/1000 or 54.42%, second – intensive Neurological "STROKE" department with 33.75 DDD/1000 or 25.56%, third – septic Surgical department with 23.77 DDD/1000 or 18.00% and intensive Therapy department with 2.66 DDD/1000 or 2.01% on the fourth position. Since 2009 to 2014 septic Surgical department recorded a decrease in consumption by 40.56% and septic Orthotraumotology department registered an increase by 7.69 times.

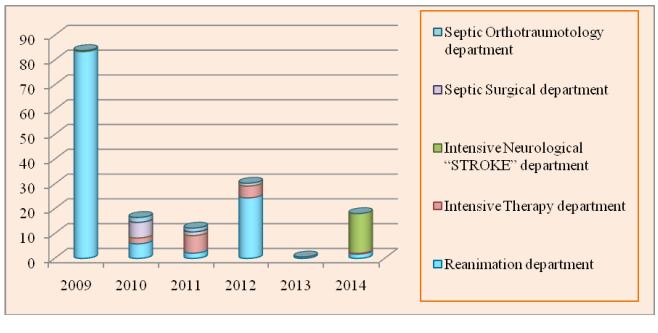

Fig. 4. Total of the third and the fourth generations of quinolone antibacterial consumption in DDD/1000 (parenteral forms).

The diagram from figure 4 proves a significant decrease of the third and the fourth generations of quinolone antibacterial consumption during the evaluated period from 83.86 to 18.07 DDD/1000 or by 78.45%. From all departments consumption in 2014, could be placed as following: first place – intensive Neurological "STROKE" department with 16.04 DDD/1000 or 88.77%, second – Reanimation department with 1.74 DDD/1000 or 9.63% and intensive Therapy department with 0.29 DDD/1000 or 1.60% on the third position.

Taking into consideration the situation that in the scientific journals published data about drugs consumption include the use of them in all intense care unites we determined medium consumption of DDD/1000 separately for ICD and SSOTD of EMI, for which was counted the total of DDD/1000 separately for ICD and SSOTD and divided by the number of these departments (3 and respectively 2). The results are shown in table 1.

Table1

The first, second, third and fourth generations of quinolone antibacterial consumption of DDD/1000 in ICD and SSOTD departments of EMI

The first and the second generations of quinolone antibacterials							
		2009	**2010**	**2011**	**2012**	**2013**	**2014**
ICD	Parenteral	255.17	250.52	94.87	101.22	48.56	100.00
	Enteral	0	9.37	5.56	10.2	7.11	12.14
	Total	255.17	259.89	100.43	111.42	55.67	112.13
SSOTD	Parenteral	16.39	16.75	4.92	10.28	2.15	9.79
	Enteral	24.67	6.82	51.63	66.39	6.88	47.81
	Total	41.06	23.57	56.55	76.67	9.02	57.59
EMI	Parenteral	41.7	25.6	62	14.3	6.4	14.3
	Enteral	49.2	22.6	39.1	38	33	31.9
	Total	86.9	46.46	87.94	50.5	39.13	45.97
The third and the fourth generations of quinolone antibacterials							
ICU	Total = Parenteral	83.43	4.12	4.62	14.6	0.19	6.02
SSOTD		0.22	4.15	1.50	0.57		
EMI		4.1	1.74	13.16	1.8	0.27	0.23

The data from table 1 shows that in the evaluated period consumption of the first and the second generations quinolone antibacterials in IC departments decreased by 56.06%, with P to E forms share from the yearly medium consumption in 2014 of 89.18% and 10.82% and vice versa in SSOTD increased by 40.28%, with P to E forms share of 17.00% and 83.00%, as well as the total EMI decreased by 49.2% and P to E forms share of 31.11% to 68.89%. Consumption in ICD comparatively to SSOTD departments in 2014 was (112.13:57.59) = 1.95 times more. Use of the third and the fourth generations of quinolone antibacterials registered only parenteral forms and represents from the total of 106.02 DDD/1000 quinolone antibacterials in 2014 in ICD a share of 5.68% and in SSOTD of 4.32%.

Calculated of all quinolone generations yearly medium consumption of 63.03 represents a share of 11.14% from 6 year medium annual total of 566.02 DDD/1000, [20]. The same data in large acute Australian public hospitals represents 49.54 or 5.29% from the medium total of

937.22 DDD/1000, [21, 22] and in all other international hospitals in different periods of time the yearly medium use was 71.24 or 11.84% from the medium total of 601.36 DDD/1000, [23, 24, 25, 26, 27, 28, 29, 30, 31, 32]. So, the yearly medium consumption of quinolone antibacterials in EMI is by 13.02% lower than presented data from other international hospitals and by 27.23% higher than recorded in large acute Australian public hospitals. The total value cost of four generations of quinolone antibacterial use per DDD/1000 in Reanimation department lei is presented in figure 5.

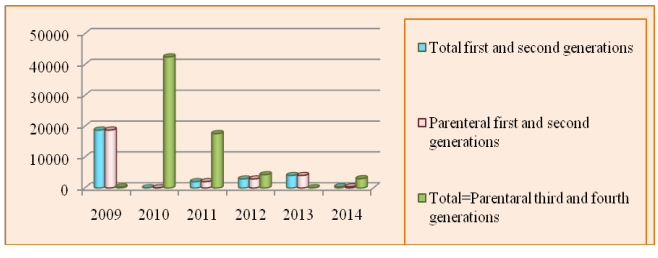

Fig. 5. Total value cost of quinolone antibacterial generations per DDD/1000 in lei in reanimation department.

From chart 5, it could be observed that the value cost per DDD/1000 in Reanimation department for the first and the second generations varied considerably during the evaluated period from 18746.33 lei in 2009 to 381.1 lei in 2014, as well as for the third and the fourth generations from 335.85 lei in 2009 to 42477.46 lei in 2010, to 17609.88 lei in 2011 and to 2985.5 lei in 2014.

Total value cost of quinolone antibacterials generations per DDD/1000 in lei in intensive Therapy department is shown in figure 6.

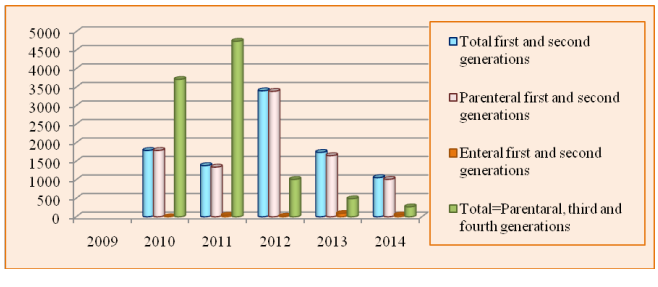

Fig. 6. Total value cost of quinolone antibacterial generations per DDD/1000 in lei in intensive therapy department.

As it could be observed from figure 6, the total cost of the first and the second generations of quinolone antibacterials in intensive Therapy department per DDD/1000 recorded a value of 1791,23 lei in 2010 and 1056.3 lei in 2014 from which the enteral forms of consumption represent a share from 0.41% to 4.48%. For the third and the fourth generations, the value cost per DDD/1000 in the same period decreased from 3710.08 lei to 267.38 lei. The total value cost of four generations of quinolone antibacterials use per DDD/1000 in intensive Neurological "STROKE" department in lei is presented in figure 7.

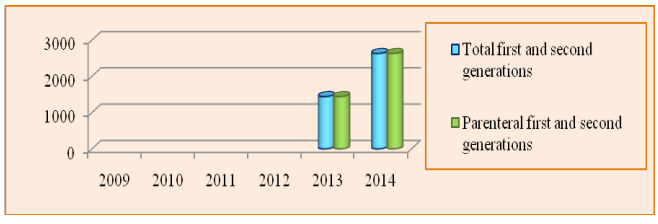

Fig. 7. Total value cost of quinolone antibacterial generations per DDD/1000 in lei in intensive neurological "STROKE" department.

From figure 7, it could be mentioned that the value cost per DDD/1000 of the first and the second quinolone antibacterials generations in intensive Neurological "STROKE" department varied from 1440.20 lei in 2013 to 2629.20 lei in 2014 or by 82.56%.

The total value cost of quinolone antibacterials generations use per DDD/1000 in septic Surgical department in lei is presented in figure 8.

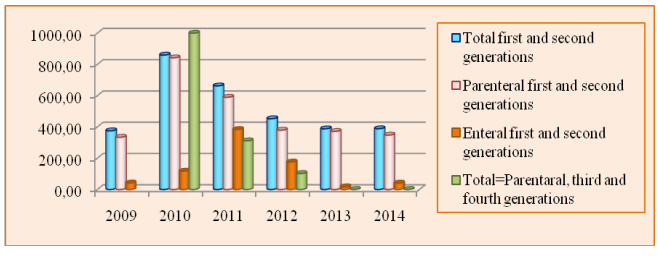

Fig. 8. Total value cost of quinolone antibacterial generations per DDD/1000 in lei in septic surgical department.

As it could be seen in figure 8 from the total value cost of the first and the second generations of quinolone antibacterials per DDD/1000 in 2014 share of enteral forms of use represents from the total cost 40,71 lei or 10.49%, with the higher records in 2011 of 383,47 lei or 57.90%. Value cost of the third and the fourth generations per DDD/1000 varied from 1018.5 to 999.49 lei.

The total value cost of four generations of quinolone antibacterials use per DDD/1000 in septic Orthotraumotology department in lei is presented in figure 9.

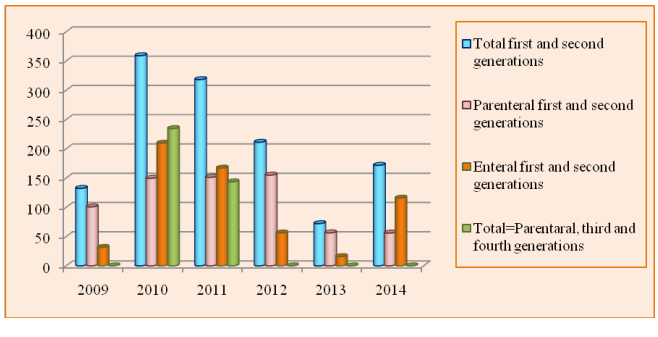

Fig. 9. Total value cost of four quinolone antibacterials per DDD/1000 in lei in septic orthotraumotology department.

Table 2

Medium cost of DDD/1000 in lei of quinolone antibacterial generations (parenteral and enteral forms) in EMI

Department	Structure of consumption	2009	2010	2011	2012	2013	2014
ICD	Parenteral first and second generations	18746.33	921.13	1678.183	3144.1	2370	1340.4
	Enteral first and second generations	0	0	41.75	13.95	89.49	45.28
	Total first and second generations	18746.33	921.13	1719.933	3158.1	2459.5	1385.7
	Total=Parentaral third and fourth generations	335.85	23093.77	11175.18	2646.2	279.47	1626.4
SSOTD	Parenteral first and second generations	217.19	495.68	370.45	266.95	213.57	201.68
	Enteral first and second generations	36.4	163.31	275.25	115.72	16.31	78.22
	Total first and second generations	253.6	609.24	490.3	331.74	229.87	279.9
	Total=Parentaral third and fourth generations	0	617.05	227.21	50.93	0	0

From chart 9, it could be mentioned that from the total value cost of the first and the second generations of quinolone antibacterials per DDD/1000 in 2014 share of enteral forms of use represents 40,71 lei or 10.49%, with the higher records in 2011 of 383,47 lei or 57.90%. Value cost of the third and the fourth quinolone antibacterial generations per DDD/1000 varied from 1018.5 to 999.49 lei.

To determine the medium cost of quinolone antibacterials in DDD/1000 separately for ICD and SSOTD was counted the total cost of DDD/1000 and divided by the number of these departments (3 and respectively 2) in the evaluated period.

As we can see from table 2, in the evaluated period total cost of DDD/1000 for the first and the second generations of quinolone antibacterials in ICD recorded a value from 18746.33 lei in 2009 to 1385.7 lei in 2014 from which enteral forms represent a share of 0.44% to 3.78% and respectively in SSOTD a value from 253.6 lei in 2009 to 279.9 lei in 2014 from which enteral forms represent a share of 7.10% to 56.14%. Total cost of DDD/1000 for the third and the fourth generations of quinolone antibacterials in ICD recorded a value from 335.85 lei in 2009 to 1626.4 lei in 2014.

Calculated medium annual cost per DDD/1000 for 6 evaluated years for the first and the second generations of quinolone antibacterials in ICD recorded 4731.78 lei, for the third and the fourth generations 6526.15 lei and respectively in SSOTD 365.78 lei and 149.20 lei or a share from ICD of 7.73% and 2.29%.

Conclusions

1. Annual consumption of all quinolone generations of 63.03 DDD/1000 in EMI represents a share of 88.47% from presented data of medium use 71.24 DDD/1000 recorded in others international hospitals and was by 27.23% higher than recorded 49.54 DDD/1000 in large acute Australian public hospitals.

2. Consumption of DDD/1000 in ICD departments of the first and the second generations quinolone antibacterials decreased by 56.06% during the evaluated period and in 2014 recorded 112.13 DDD/1000, with P to E forms share from of 89.18 and 10.82% and vice versa in SSOTD increased to 57.59 DDD/1000 or by 40.28%, with P to E forms share of 17.00 and 83.00%, as well as the total EMI decreased to 49.54 DDD/1000 or by 49.2% with a P to E forms share of 31.11 to 68.89%. Consumption in ICD comparatively to SSOTD departments in 2014 was by 1.95 times more. Use of the third and the fourth generations of quinolone antibacterials registered only parenteral forms and represents from the total 106.02 DDD/1000 quinolone antibacterials in 2014 in ICD a share of 5.68% and in SSOTD of 4.32%.

3. From the total departments consumption of 451.58 DDD/1000 in 2014 of the first and the second generations represents 94.90% and of all quinolone antibacterials in ICD could be placed as following: first place – Reanimation department with 172.42 DDD/1000 or 38.18%, second – intensive Neurological "STROKE" department with 105.83 DDD/1000 or 23.44 %, third – septic Orh-

totraumotology department with 73.62 DDD/1000 or 16.30%, fourth – intensive Therapy department with 58.15 DDD/1000 or 12.88% and septic Surgical department with 41.56 DDD/1000 or 9.20% on the fifth position. In SSOTD departments and in entire EMI the third and the fourth generations represent less than 1% of all consumption.

4. Medium annual cost per DDD/1000 recorded for the first and the second generations of quinolone antibacterials in ICD 4731.78 lei, for the third and the fourth generations 6526.15 lei, respectively in SSOTD 365.78 lei and 149.20 lei or a share from ICD of 7.73% and 2.29%.

5. Though this study has been limited to only EMI, the obtained data allows comparisons with a considerable number of international hospitals indicated by a big amount of differences in consumption, that can serve as a point for reviewing and optimisation of planning annual institutional necessities, as well as rationalisation the administration of quinolone antimicrobials on the one hand, and on the other hand can be as one of points for further survey of protocols and guide concerning the antibiotic consumption in one hospital.

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