Evaluation of quinolone antibacterial consumption

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Abstract _ Quinolones are broad-spectrum antibiotics that play an important role in the treatment of serious bacterial infections, especially hospital-acquired infections and others, in which resistance to older antibacterial classes is suspected and as first-line therapy is recommended. To determine the place, compare and analyze the use of quinolone antibacterial in the most important departments of EMI during 2009 to 2014, and to assess their results for improvement of patients treatment quality, this study was designed. In the evaluated period, the consumption of quinolone antibacterial in EMI recorded a decline from 91 to 46 DDD/1000 or by 49.45%, in IC departaments from 338.6 to 132.07 or by 61%, and vice versa in SSOT departments an increase from 41.28 to 57.59 DDD/1000 or by 31.51%. Medium annual consumption in all institution recorded 63.03 DDD/1000, respectvely 174.90 in IC and 45.10 in SSOT departments. In 2014 IC departments recorded 2439.8 lei per DDD/1000, that was 8.72 times more than the cost of 279.9 lei in SSOT departments and 7.51 times than 324.96 lei per DDD/1000 in all EMI. The yearly medium in EMI is around the same with all other international hospitals of 66.13 DDD/1000 and by 27.23% higher than 49.54 DDD/1000 recorded in large acute Australian public hospitals. The obtained results will be an important data for the optimization in planning the annual hospital necessities and rational antimicrobial prescribing, as well as suggest the idea for expansion of the development and support antimicrobial stewardship initiatives.

Key words: Quinolone antibacterial, defined daily dose, consumption, rational use, hospitals.

Introduction

There is a global concern that antimicrobial resistance is a major threat to healthcare. Quinolones are broad-spectrum antibiotics (effective for both gram-negative and gram-positive bacteria) [1, 2, 3, 4] that play an important role in treatment of serious bacterial infections. The overall rate of adverse events in patients treated with quinolones is roughly similar to that seen at patients treated with other antibiotic classes [5, 6, 7]. That is one more priority to be recommended as first-line therapy [8].

The primary aim of the study was to evaluate institutional representative data on quinolones antibacterial utilization in accordance to World Health Organization (WHO) requirements, directed 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 [9] and compare it with the same published data in internationals scientific journals.

Material and methods

For this study we used the data of a six-year (2010-2014) period. DDD/1000 consumption of quinolone antibacterial antibiotics in EMI used rates are demonstrated. EMI (Emergency Medicine Institute). ICD (Reanimation, intensive Therapy and intensive Neurological „STROKE" departments) and SSOD (septic Surgical and septic Orhtotraumotology departments) of EMI which show the dynamics of consumption of antiinfective for systemic use drugs. as classified by Anatomical Therapeutic Chemical (ATC). classification system of World Health Organization (WHO) indicated in grams and value indexes. Statistical, analytical, mathematical, comparative, logical and descriptive were used as the methods of study.

Results and discussion

To determine the number of DDD/1000, we used the data about total annual consumption of quinolones 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). 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 and respectively for the evaluated departments of EMI: Reanimation department (2009 = 3990; 2010 = 6551; 2011 = 6985; 2012 = 9051; 2013 = 7384; 2014 = 7361), intensive Therapy department (2010 = 2922; 2011 = 3327; 2012 = 3239; 2013 = 3407; 2014 = 3388), intensive Neurological "STROKE" department (2013 = 2553; 2014 = 4193), septic Surgical (2009 = 14030; 2010 = 14212; 2011 = 12875; 2012 = 12372; 2013 = 12464; 2014 = 12104), septic Orthopedic-traumotology (2009 =10664; 2010 = 10017; 2011 = 9540; 2012 = 10178; 2013 = 9701; 2014 = 9535) [10, 11, 12, 13].

Based on their antibacterial spectrum quinolones are divided into generations [14] consumption of which in EMI is caracterised by the use of parenteral (P) and enteral (E) forms 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, fourth-generation: gatifloxacinum DDD 0.4 E,P, mofloxacin DDD 0.4 E,P.

Total quinolone antibacterial consumption in DDD/1000 during 2009-2014 is shown in figure 1.

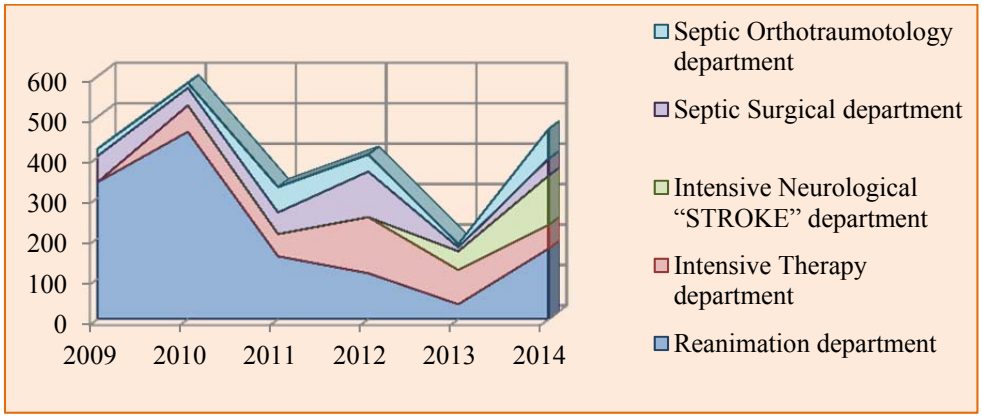

Fig. 1. Total quinolone antibacterial consumption in DDD/1000 during 2009–2014

From figure 1, it could be observed a total decrease in consumption of quinolone antibacterial for the period from 2009 to 2013, followed by a sharp increase during 2013 to 2014 that as a whole represents 421.14 in 2009 to 469.65 DDD/1000 in 2014 or by 11.52%. The summary of anual medium consumption for every department and procentage from the total medium anual consumption (468.16 DDD/1000) of all departments in the evaluated period could be placed as following: first seat - Reanimation department with 213.16 DDD/1000 or 45.62%, second - intensive Neurological "STROKE" department with 84.04 DDD/1000 or 17.95%, third - intensive Therapy department with 80.26 DDD/1000 or 17.14%, fourth - septic Surgical department with 54.28 DDD/1000 or 11.60% and septic Orhtotraumotology department with 36.01 DDD/1000 or 7.69% on the fifth position. In figure 2 the total quinolone antibacterial consumption of parenteral forms in DDD/1000 during 2010-2014 is shown.

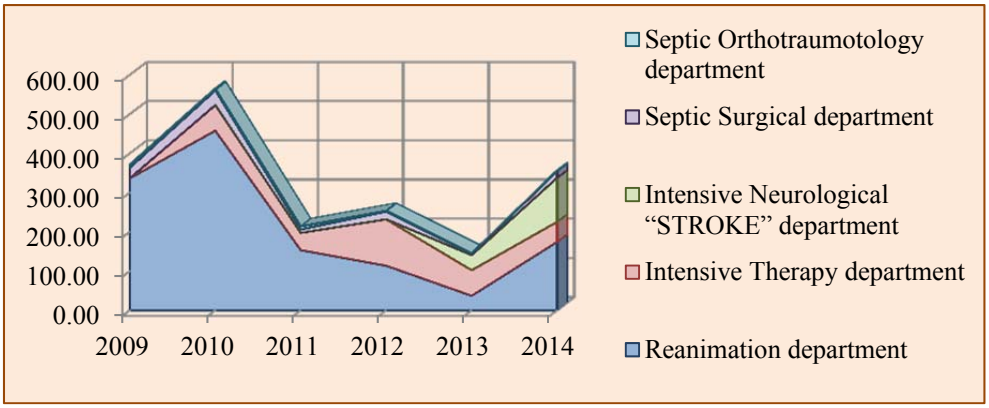

Fig. 2. Total quinolone antibacterial consumption in DDD/1000 (parenteral forms)

In figure 2, parenteral forms of quinolone antibacterial consumption are presented. The consumption of parenteral forms of this group recorded a step decrease from 2010 to 2011 with a slow to 2013 and a spontaneous increase until 2014. The overall dynamics shows a light decrease from 371.44 in 2009 to 356.27 DDD/1000 in 2014, or by 4.08%. Summary of anual medium consumption for every department and procentage from the total medium anual consumption (379.10 DDD/1000) places: first - Reanimation department with 211.89 DDD/1000 or 55.89%, second - intensive Neurological "STROKE" department with 75.36 DDD/1000 or 19.88%, third - intensive Therapy department with 68.68 DDD/1000 or 118.12%, fourth - septic Surgical department with 18.83 DDD/1000 or 4.97% and septic Orthotraumotology department with 4.35 DDD/1000 or 1.15% on the fifth position. In figure 3 DDD/1000 of quinolone antibacterial (enteral forms) consumption during 2009 - 2014 is shown.

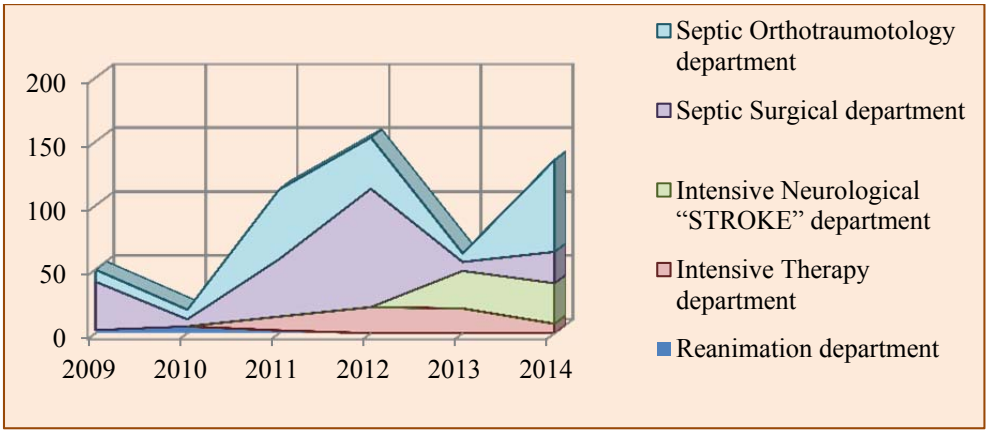

Fig. 3. Total quinolone antibacterial consumption in DDD/1000 (enteral forms)

Figure 3, shows that in the evaluated period enteral forms of quinolone antibacterial recorded an considerable increment of consumption in all departments from 49.70 in 2009 to 135.56 DDD/1000 in 2014 or by 2.73 times. Anual medium consumption of 110.92 DDD/1000 per all departments places: first - septic Surgical department with 35.45 DDD/1000 or 31.96%, second – septic Orhtotraumotology department with 31.66 DDD/1000 or 28.55%, third - intensive Neurological "STROKE" department with 30.55 DDD/1000 or 27.54%, fourth - intensive Therapy department with 11.59 DDD/1000 or 10.45%, and Reanimation department with 1.67 DDD/1000 or 1.51%, on the fifth position.

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

Table1. Quinolone antibacterial (parenteral and enteral forms) consumption of DDD/1000 in IC and SSOT departments of EMI

Department	Administration /time	2009	2010	2011	2012	2013	2014	Procent 2009/ 2014	Medium yearly consumption
ICD	Parenteral	336.1	261.3	98.5	115.8	46.8	112.5	- 66.5	161.9
	Enteral	2.51	5.4	6.5	20.4	24.4	19.6	7.8	13.1
	Total	338.6	266.7	105.1	136.0	71.2	132.1	- 61	175
SSOTD	Parenteral	17.7	21.2	8.3	10.8	2.1	9.4	- 47.1	11.6
	Enteral	23.6	6.5	49.7	66.4	6.9	48.2	104.4	33.6
	Total	41.3	27.7	58.1	77.2	9.0	57.6	39.5	45.1
Total EMI	Parenteral	41.7	25.6	62	14.3	6.4	14.3	- 65.7	27.4
	Enteral	49.2	22.6	39.1	38	33	31.9	- 35.2	35.6
	Total	90.9	48.2	101.1	52.3	39.4	46.2	- 49.2	63.0

The data in table 1, shows that in the evaluated period consumption of DDD/1000 in IC departamentals of quinolone antibacterial decreased by 61%, with P to E forms share of 92.5 and 7.5% from the yearly medium consumption and vice versa in SSOTD increased by 39.5%, with P to E forms share of 25.7 and 74.3%, as well the total EMI decreased by 49.2% and P to E forms share of 43.45 to 56.55%. Consumption in ICD comparatively to SSOTD departments in 2014 was (132.07:57.59) = 2.29 times more.

Table 2. Total DDD/1000 consumption of quinolone antibacterial in EMI and some international hospitals

Institution/data/year			2009	2010	2011	2012	2013	2014	Medium
Emergency Medicine Institute			91.00	48.20	101.1	52.30	39.40	46.20	63.03
Total			662.4	558.2	622.1	542.4	546.9	464.1	566.02
Percentage			13.7%	8.6%	16.3%	9.6%	7.2%	10%	11.14%
Large acute Australian pub. hospitals [15,16]			59.30	51.80	51.30	48.40	47.20	39.21	49.54
Total			931.8	933.7	946.5	931.6	943.4	936.3	937.22
Percentage			6.4%	5.6%	5.4%	5.2%	5%	4.2%	5.29%
Other international hospitals	1997-2001	2007	2001-2012	2012		2012-2013	2013		
Dutch acute care hospitals[17]	47.6								66.13
530 French hospitals[18]		51.7							
University Hospital [19]			85.6						
DANMAP; SWEDRES				100.2	62.00				
NAUSP						42.70			
SAAUSP; NETHMAP[15]							47.20	92.0	
Total	503.4	359.3	631.0	931.0	609.0	945.0	943.0	712.0	704.21
Percentage	9.46%	14.4%	13.6%	10.8%	10.2%	4.5%	5%	12.9%	9.4%

From table 2, it could be observed that during the evaluated period, the consumption of quinolone antibacterial in EMI recorded a decline from 91 to 46 DDD/1000 or by 49.45% and calculated the yearly medium of 63.03 represents a share of 11.14% from the 6 years medium annual total of 566.02 DDD/1000. These data in large acute Australian public hospitals represents a decline from 59.30 to 39.21 DDD/1000 or by 33.88%, with a yearly medium 49.54 or 5.29% from the medium total of 937.22 DDD/1000 and in all others international hospitals in different period of time the yearly medium use was 66.13 or 9.4% from the medium total of 704.21 DDD/1000. So, the yearly medium of 63.03 DDD/1000 in EMI is around the same with all other international hospitals of 66.13 DDD/1000 and by 27.23% higher than 49.54 DDD/1000 recorded in large acute Australian public hospitals. The total value cost of quinolone antibacterial use per DDD/1000 in lei is presented in figure 4.

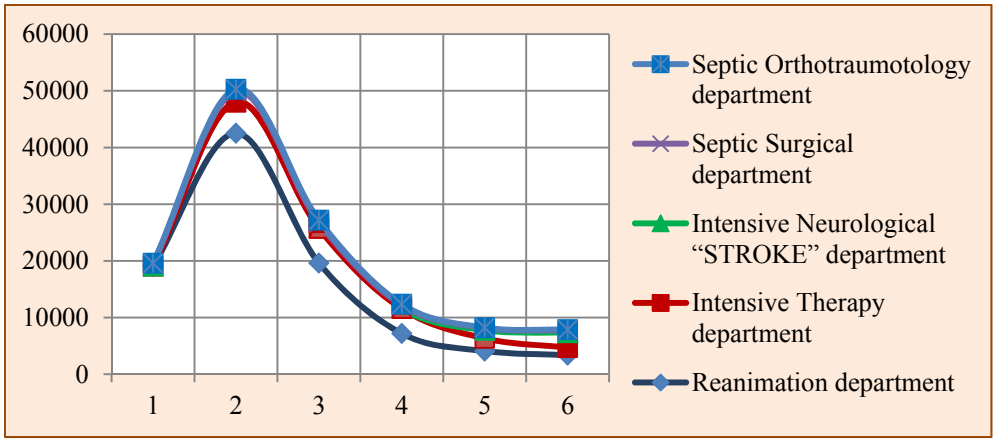

Fig. 4. Total value cost of quinolone antibacterial per DDD/1000 in lei

As it can be stated from figure 4, during the evaluated period cost per DDD/1000 decreased in all departments from 19589.4 to 7879 lei or by 2.49 times, with a higher cost in 2010 of 50290.62 lei.

The main medium yearly value cost of 15979 lei for DDD/1000 or 69.69%, from the medium total all departmental cost of 22929.5 lei refers to Reanimation department, the second to intensive Therapy department with 3917.3 lei or 17.09%, the third position to intensive Neurological "STROKE" department with 2034.7 lei or 8.87%, followed by septic Surgical department with 756.1 lei or 3.30% lei and the fifth position to septic Orthotraumotology department with 241.88 lei or 1.05%. In figure 5 the total value cost of quinolone antibacterial in DDD/1000 (parenteral forms) is presented.

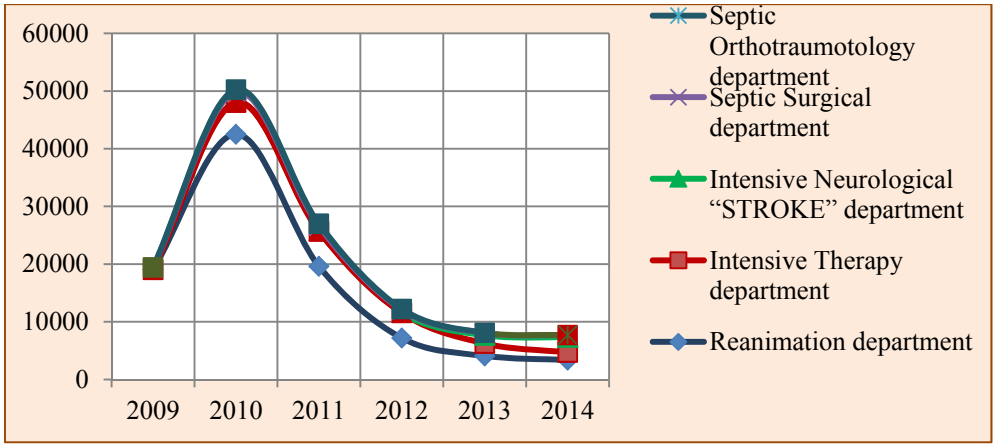

Fig. 5. Valuie cost of quinolone antibacterialin DDD/1000 of parenteral forms in lei

The cost of parenteral quinolone antibacterial DDD/1000 for all departments remains aproximately the similar, comparatively to total consumption because of the low cost of enteral forms per DDD/1000.

In figure 6 the value cost DDD/1000 in lei of quinolone antibacterial enteral forms is shown.

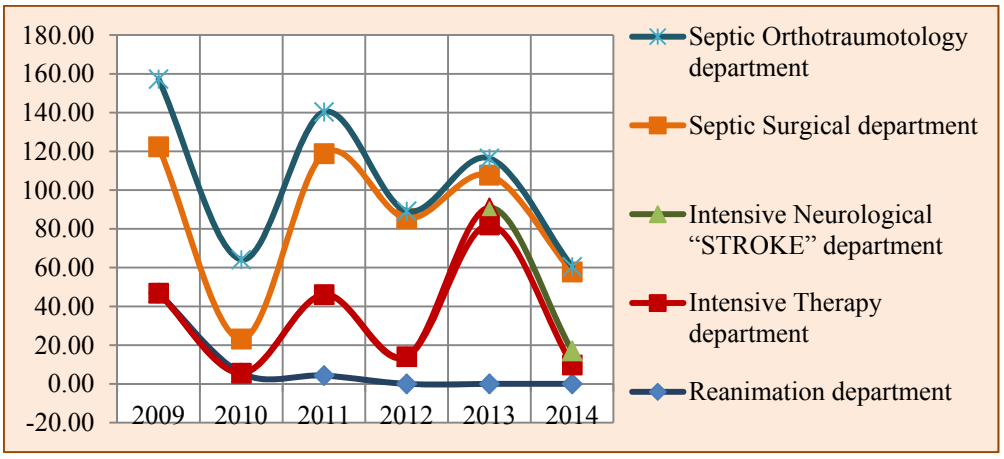

Fig. 6. Valuie cost of quinolone antibacterial in DDD/1000 (enteral forms) in lei

Presented data in chart 6, demonstrates that in the evaluated period the value cost of DDD/1000 for all departments decreased from 157.24 to 60.49 lei or by 61.53%. The medium of 104.62 lei total cost per all departmentswas placed as follows first - septic Surgical department with the medium annual cost of 49.10 lei per DDD/1000or 46.93%, second - intensive Therapy department with 29.51 lei or 28.21%, third - Orthotraumotology department with 18.56 lei or 17.93%, fourth - Reanimation department with 9.46 lei or 3.94% and the fifth - intensive Neurological "STROKE" department with 8.10 lei per DDD/1000 or 9.05%.

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

Table 3 Medium cost of DDD/1000 in lei of quinolone antibacterial (parenteral and enteral forms) in EMI

Department	Structure of consumption	2009	2010	2011	2012	2013	2014
ICD	Parenteral	9517.65	24012.11	12851.20	5790.26	2555.80	2434.13
	Enteral	1.25	2.67	21.98	7.02	30.30	5.69
	Total	9541.9	24014.78	12873.18	5797.3	2586.1	2439.8
SSOTD	Parenteral	200.06	1112.73	646.34	318.89	213.46	201.69
	Enteral	53.54	17.68	71.17	63.78	16.42	78.21
	Total	253.6	1130.41	717.51	382.67	229.88	279.9
Total EMI	Parenteral	559.33	2217.6	1117.02	521.6	294.79	265.02
	Enteral	66.32	31.39	67.43	62.32	46.59	59.94
	Total	625.65	2248.99	1184.45	583.92	341.38	324.96

As we can see from table 3, the total cost of DDD/1000 for quinolone antibacterial recorded a decrease in IC departments from 9517.65 in 2009 to 2434.13 lei or by 74.26% in 2014 and vice versa in SSOT departments recorded an increase from 253.6 to 279.9 lei or by 10.37%.

The value cost of 279.9 lei per DDD/1000 in SSOT departments and 324.96 lei per total institutional was 8.72 and 7.51 times less than 2439.8 lei recorded in IC departments in 2014.

Conclusions:

1. Consumption of quinolone antibacterial in EMI during the evaluated period recorded a decline from 91 to 46 DDD/1000 or by 49.45%. The yearly medium of 63.03 DDD/1000 in EMI is approximately the same with yearly medium of 66.13 DDD/1000 recorded in all others international hospitals and by 27.23% higher than 49.54 DDD/1000 recorded in large acute Australian public hospitals.

2. The medium anual consumption of all departments was 468.16 DDD/1000. The higher consomption belongs to Reanimation department with 213.16 DDD/1000 or 45.62%, the second to intensive Neurological "STROKE" department with 84.04 DDD/1000 or 17.95%, the third to intensive Therapy department with 80.26 DDD/1000 or 17.14%, the fourth to septic Surgical department with 54.28 DDD/1000 or 11.60% and the last to septic Orhtotraumotology department with 36.01 DDD/1000 or 7.69%.

3. In the evaluated period share from the medium yearly consumption of P to E forms of quinolone antibacterial in ICD departaments was 92.5 to 7.5% and vice versa in SSOTD of 25.7 to 74.3%, as well as 43.45 to 56.55% for the total EMI. Consumption in IC comparatively to SSOT departments and total institutional in 2014 was respectively 2.29 times and 2.13 more.

4. The value cost of 279.9 lei per DDD/1000 in SSOTD departments and 324.96 lei per total institutional was 8.72 and 7.51 times less than 2439.8 lei recorded in ICD departments in 2014.

5. Longitudinal evaluation of quinolones use demonstrated remarkable changes in many important departments of EMI and wide variation in usage between international hospitals. The obtained results will be an important data for optimal hospital antimicrobial prescribing and suggest the idea for expansion development and support antimicrobial stewardship initiatives.

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