# POSSIBLE VARIANCES IN ASSESSMENT OF ANTIMICROBIAL CONSUMPTION IN MULTI-FIELD HOSPITALS WITH PEDIATRIC INPATIENTS: CONVENTIONAL VS. NOVEL PEDIATRIC-ADJUSTED METHODOLOGY

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## Background

It has been estimated that about 30% of patients in multi-field hospitals receive antimicrobial (AM) agents with total expenditures for pharmacotherapy amounting up to 30-50% of hospital budget. Drug utilization assessment is essential for optimization of AM consumption and WHO recommended ATC/DDD methodology is considered to be the universal tool for such studies. At the same time the above-mentioned methodology has a series of limitations including incorrect assessment of drug consumption in children due to diversity in body weight within this population and age-dependent dose variations. For these reasons pediatric inpatients can compromise accuracy of AM consumption assessment in multi-field hospitals to an extent uncertain due to heterogeneity in their population across various institutions.

We aimed to estimate variances in AM consumption in multi-field hospitals calculated by means of conventional vs. novel pediatric-adjusted methodology.

## Materials and methods

A calculating tool based on MS Excel has been created (pic. 1) to assess AM consumption by means of conventional ATC/DDD methodology vs. novel pediatric-adjusted methodology based on child Defined Daily Doses (cDDD) for children aged 0 to 12 years [1] on a simulated cohort of inpatients as well as cohort of inpatients from 3 multi-field hospitals. cDDD were calculated per each age group as recommended by national guidelines average maintenance dose of AM per day per unit of body weight adjusted in accordance with prescribed daily doses derived from a large AM prescription database. Data on amount of AM (ATC J01) were extracted from a multicentre consumption assessment study (OPTIMA Project) [2] and adjusted in accordance with national age-related restrictions. Aggregate data on AM use were expressed in numbers of DDD/100 bed-days (DBD). Results were analysed by means of descriptive statistics.

## Results

On a simulated cohort of inpatients with pediatric share increasing by 10% for age groups 0 to 12 years old separately up to 10% consumption increase in comparison to conventional assessment was observed for all age groups in case of pediatric share less than 10%, 10-20% increase for 20-30% share of 0-8 years old patients, 10-50% increase for 20-90% share of 0-6 year old patients and ≥2 times increase for 80-90% share of children younger than 1 year (pic. 2).

Consumption rates of lincosamides (60% increase for 50% pediatric share in equal proportion for age groups), nitroimidazoles (51%), aminoglycosides (39%), co-trimoxazole (30%), nitrofurans (26%), glycopeptides (23%), cephalosporins (20%) were most sensitive to age differences probably due to significant age-dependent dose variations.

On a real population of inpatients less than 0.5% difference in total consumption was observed for 2 multi-field hospitals with pediatric inpatients share 1.3-1.7%. In a hospital with 22.8% pediatric share consumption rates were 5% higher than those based on conventional assessments with more prominent increase for nitroimidazoles (19%), aminoglycosides (16%), co-trimoxazole (13%), glycopeptides, nitrofurans, cephalosporins (each 11%) and macrolides (10%) (pic. 3).

## Discussion

Adult DDDs do not correlate with actual dosing methods in children especially those younger than 6 years which can lead to underestimation of AM consumption in this age group and in total population of inpatients. Heterogeneity in amount and age of pediatric inpatients across various multi-field hospitals does not allow creating a uniform approach to the estimation. Application of pediatric-adjusted methodology to improve accuracy of AM consumption assessment seems appropriate in hospitals with substantial share of pediatric inpatients.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | INN | Rout of administration | ATC | Amount, g | Consumption, DBD | DDD | cDDD | | | | | | | | |
| 2 | | | | | | | 1 - 11 month | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 yea |
| 3 | azithromycin | O | J01FA10 | 1563 | 0,25 | 0,30 | 0,073 | 0,119 | 0,132 | 0,148 | 0,166 | 0,178 | 0,188 | 0,210 | 0,25 |
| 4 | azithromycin | P | J01FA10 | 1405 | 0,12 | 0,50 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 5 | amikacin | P | J01GB06 | 37656 | 1,88 | 1,00 | 0,146 | 0,238 | 0,265 | 0,296 | 0,332 | 0,355 | 0,375 | 0,420 | 0,50 |
| 6 | amoxicillin | O | J01CA04 | 45630 | 2,06 | 1,00 | 0,438 | 0,713 | 0,794 | 0,887 | 0,996 | 1,000 | 1,000 | 1,000 | 1,00 |
| 7 | amoxicillin + enzyme inhibitor | O | J01CR02 | 24759 | 1,15 | 1,00 | 0,292 | 0,476 | 0,529 | 0,591 | 0,664 | 0,710 | 0,750 | 0,839 | 1,00 |
| 8 | amoxicillin + enzyme inhibitor | P | J01CR02 | 34991 | 0,58 | 3,00 | 0,438 | 0,713 | 0,794 | 0,887 | 0,996 | 1,065 | 1,125 | 1,259 | 1,51 |
| 9 | ampicillin | O | J01CA01 | 2460 | 0,05 | 2,00 | 1,095 | 1,784 | 1,984 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,00 |

**Picture 1. Calculating tool to assess AM consumption (screenshots).**

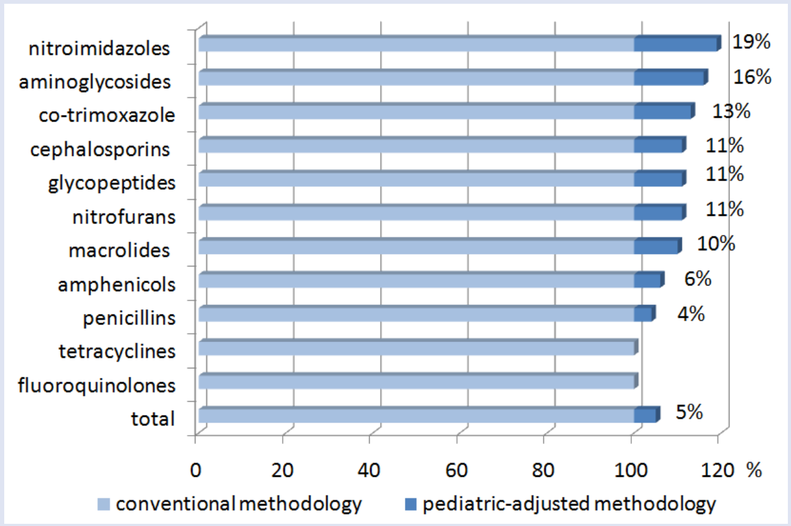
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Age, years | Amount | Share | Age-related restrictions | | | | |
| 2 | | | | >1 y | >2 y | >3 y | >4 y | >5 |
| 3 | 0 | 31 | 0,002 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 4 | 1 | 106 | 0,007 | 0,007 | 0,000 | 0,000 | 0,000 | 0,00 |
| 5 | 2 | 39 | 0,002 | 0,002 | 0,002 | 0,000 | 0,000 | 0,00 |
| 6 | 3 | 23 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,00 |
| 7 | 4 | 6 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 8 | 5 | 9 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,00 |
| 9 | 6 | 11 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,00 |
| 10 | 7 | 11 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,00 |
| 11 | 8 | 6 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 12 | 9 | 8 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,00 |
| 13 | 10 | 6 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 14 | 11 | 7 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 15 | 12 | 3 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,00 |
| 16 | >=13 | 15786 | 0,983 | 0,985 | 0,992 | 0,994 | 0,996 | 0,99 |
| 17 | total | 16052 | 1 | 1 | 1 | 1 | 1 | 1 |

## Conclusion

Assessment by means of conventional ATC/DDD methodology leads to underestimation of AM consumption levels in multi-field hospitals with pediatric inpatients share ≥20%. The results are most sensitive to increase in pediatric patients share, age ≤6 years old as well as for such AM as lincosamides, nitroimidazoles, aminoglycosides, co-trimoxazole, nitrofurans, glycopeptides and cephalosporins.

| Share / Age group | 0-1 year | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years | 9 years | 10 years | 11 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10% | 107 | 105 | 104 | 104 | 104 | 103 | 103 | 103 | 102 | 101 | 101 | 101 | 101 |
| 20% | 114 | 110 | 109 | 108 | 107 | 107 | 106 | 105 | 103 | 103 | 102 | 102 | 101 |
| 30% | 123 | 117 | 115 | 114 | 112 | 111 | 110 | 108 | 106 | 104 | 103 | 103 | 102 |
| 40% | 134 | 124 | 122 | 119 | 117 | 116 | 114 | 112 | 108 | 106 | 105 | 104 | 103 |
| 50% | 148 | 133 | 130 | 126 | 123 | 121 | 119 | 116 | 110 | 108 | 106 | 105 | 104 |
| 60% | 166 | 144 | 139 | 135 | 130 | 127 | 125 | 121 | 113 | 110 | 108 | 106 | 104 |
| 70% | 190 | 158 | 151 | 145 | 138 | 135 | 132 | 126 | 116 | 112 | 110 | 108 | 105 |
| 80% | 225 | 177 | 166 | 158 | 149 | 144 | 140 | 132 | 120 | 115 | 112 | 109 | 107 |
| 90% | 279 | 202 | 187 | 175 | 162 | 156 | 150 | 140 | 125 | 119 | 115 | 111 | 108 |

**Picture 2. Influence of pediatric patients share on total AM consumption level in a multi-field hospital, %**




**Picture 3. Difference in levels of total AM consumption assessed by conventional vs. pediatric-adjusted methodology in a multi-field hospital with 22.8% share of pediatric inpatients, %**

## Reference

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2. Belkova Y., Ratchina S., Kozlov R., Mischenko V., Kozhuhova L., Abubakirova A., et al. Assessment of systemic antimicrobials use and expenditures in Russian multi-profile hospitals: the results of multicenter trial. 15th ICID; 2012. Abstract ISE.468.