

Patterns of Antibiotic Use In European Hospitals



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“Development of Strategies for Control and Prevention of Antibiotic Resistance in European Hospitals”

Antibiotic resistance
Antibiotic policies

Antibiotic use
Antibiotic policies



Policies associated with
low antibiotic use
low antibiotic resistance rates
low rates of transmissible pathogens

ARPAC: Antibiotic Use data



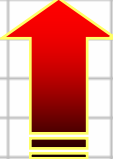


- Annual, aggregated hospital data (2001)
- Unit = Defined Daily Dose /100 bed-days

DDD = assumed average maintenance dose per day for a drug for its main indication in a 70kg adult

DDDs assigned by WHO collaborative Centre for Drug Statistics Methodology (Norway)

Anatomical Therapeutic Chemical (ATC) classification

J01 subclass; "antibacterials for systemic use"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1				Name of product	Grams per unit dose	Nr. unit doses per packag	Name of antibacterial	ATC code	Adm. route	DDD (WHO 2002)	U	Nr. packages	Nr. grams	Nr. DDD
2	J01A - Tetracyclines						Demeclocycline	J01AA01	O	0.6 g			0.0	0.0
3							Doxycycline	J01AA02	O, P	0.1 g			0.0	0.0
4							Chlortetracycline	J01AA03	O	1 g			0.0	0.0
5							Lymecycline	J01AA04	O, P	0.6 g			0.0	0.0
6							Metacycline	J01AA05	O	0.6 g			0.0	0.0
7							Oxytetracycline	J01AA06	O, P	1 g			0.0	0.0
8							Tetracycline	J01AA07	O, P	1 g			0.0	0.0
9							Minocycline	J01AA08	O, P	0.2 g			0.0	0.0
10							Rolitetraacycline	J01AA09	P	0.35 g			0.0	0.0
11							Penimepicycline	J01AA10					0.0	
12							Clomocycline	J01AA11	O	1 g			0.0	0.0
13							Tet.+chlor.+demecl.(115.4:115.4:89.2)	J01AA20	O	0.6 g			0.0	0.0
14							Comb. of tetracyclines (other)	J01AA20						
15							Oxytetracycline, combination:	J01AA56						
16							J01B Amphenicol							Chloramphenicol
17							Thiamphenicol	J01BA02	O, P	1.5 g		0.0	0.0	
18	J01C beta-lactams anti-pseudomonal activity						Ampicillin	J01CA01	O, P, R	2 g		0.0	0.0	
19							Pivampicillin	J01CA02	O	1.05 g		0.0	0.0	
20							Amoxicillin	J01CA04	O, P	1 g		0.0	0.0	
21							Bacampicillin	J01CA06	O	1.2 g		0.0	0.0	
22							Epicillin	J01CA07	O, P	2 g		0.0	0.0	
23							Pivmecillinam	J01CA08	O	0.6 g		0.0	0.0	
24							Mecillinam	J01CA11	P	1.2 g		0.0	0.0	
25							Metampicillin	J01CA14	O, P	1.5 g		0.0	0.0	
26							Talampicillin	J01CA15	O	2 g		0.0	0.0	



ABC Calc

Monnet DL. ABC Calc - Antibiotic consumption calculator
 [Microsoft® Excel application]. Version 3.0
 Copenhagen (Denmark): Statens Serum Institut 2005



Nr. beds	453
Occupancy index (during study period)	0.86
Nr. days (during study period)	365

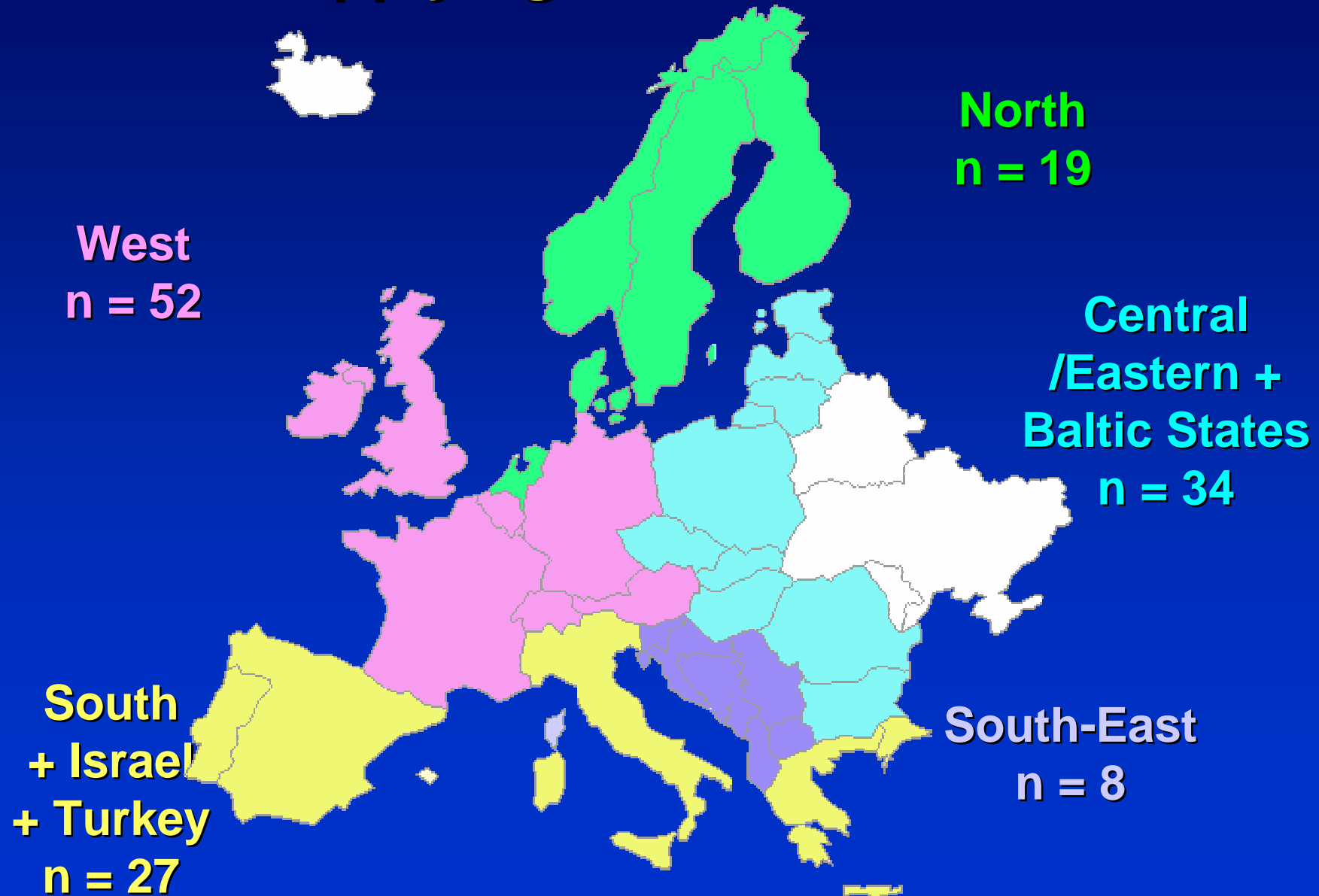
OR

Nr. bed-days	142196.7
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OR

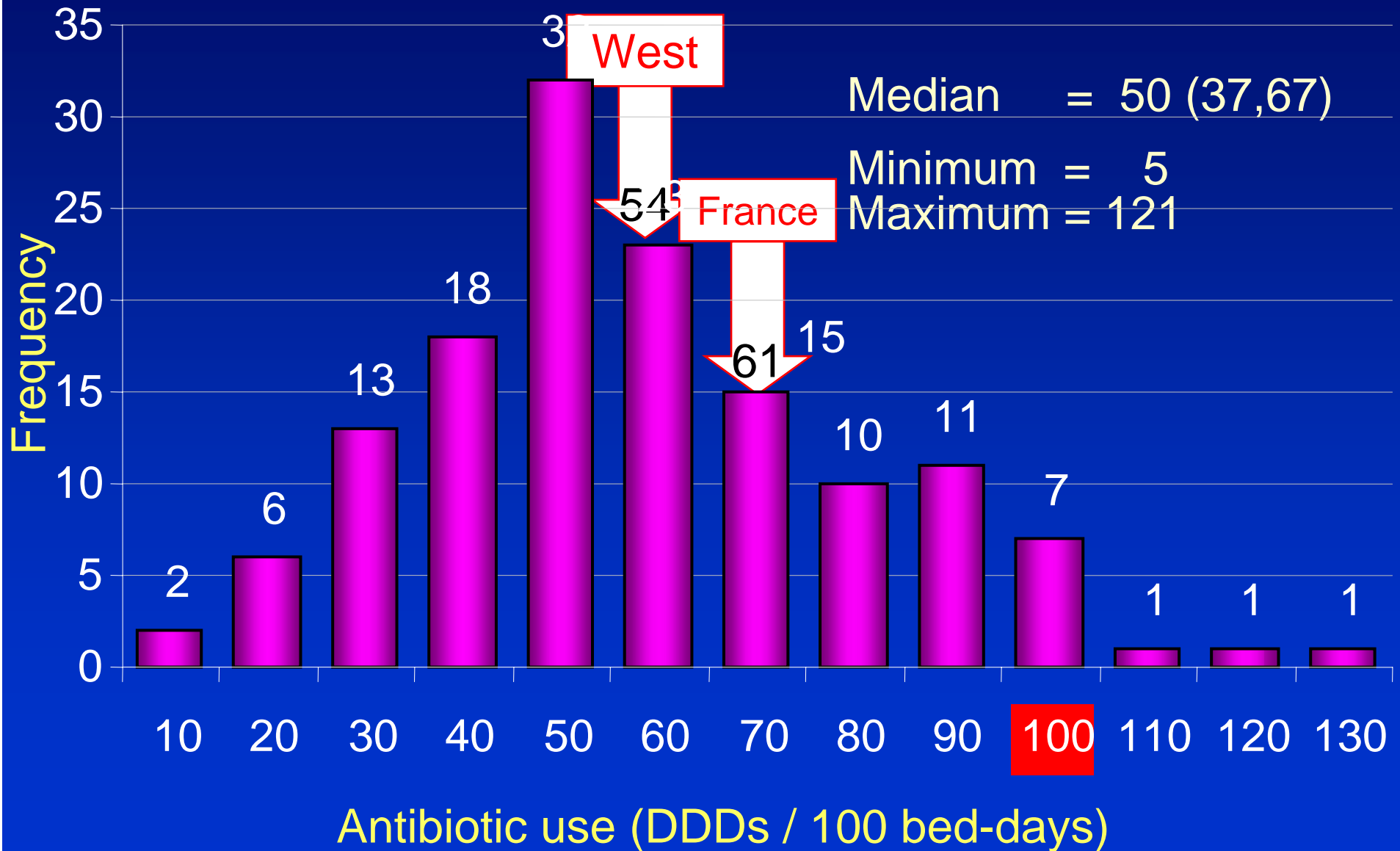
Antibacterials for systemic use, by ATC level								
ATC level 2	ATC level 3	ATC level 4	Additional level of subdivision (not defined by the official ATC classification system)	Excl. colistin (in MU)	Nr. grams	Nr. DDD	Nr. grams per 100 bed-days	Nr. DDD per 100 bed-days
J01 - Antibacterials for systemic use (overall)					150366.4	115317.9	105.7	81.1
J01A - Tetracyclines					137.3	1267.0	0.1	0.9
J01B - Amphenicols					0.0	0.0	0.0	0.0
J01C - Beta-lactam antibacterials, Penicillins					103082.4	66177.3	72.5	46.5
J01CA - Penicillins with extended spectrum (PES)					14362.0	10147.8	10.1	7.1
<i>PES without anti-pseudomonal activity</i>					10746.0	9889.5	7.6	7.0
<i>PES with anti-pseudomonal activity</i>					3616.0	258.3	2.5	0.2
J01CE - Beta-lactamase sensitive penicillins					796.4	272.8	0.6	0.2
J01CF - Beta-lactamase resistant penicillins					5136.6	2568.3	3.6	1.8
J01CG - Beta-lactamase inhibitors					0.0	0.0	0.0	0.0
J01CR - Comb. of penicillins (incl. beta-lactamase inhibitors, BLI)					82787.5	53188.4	58.2	37.4
<i>PES without anti-pseudomonal activity + BLI</i>					50911.5	50911.5	35.8	35.8
<i>PES with anti-pseudomonal activity + BLI</i>					31876.0	2276.9	22.4	1.6
<i>Other combinations of penicillins</i>					0.0	0.0	0.0	0.0
J01D - Other beta-lactam antibacterials					34568.5	14963.8	24.3	10.5
J01DA - Cephalosporins and related substances					34266.5	14823.3	24.1	10.4
<i>First-generation cephalosporins</i>					15963.5	5538.8	11.2	3.9

Number of hospitals supplying antibiotic use data



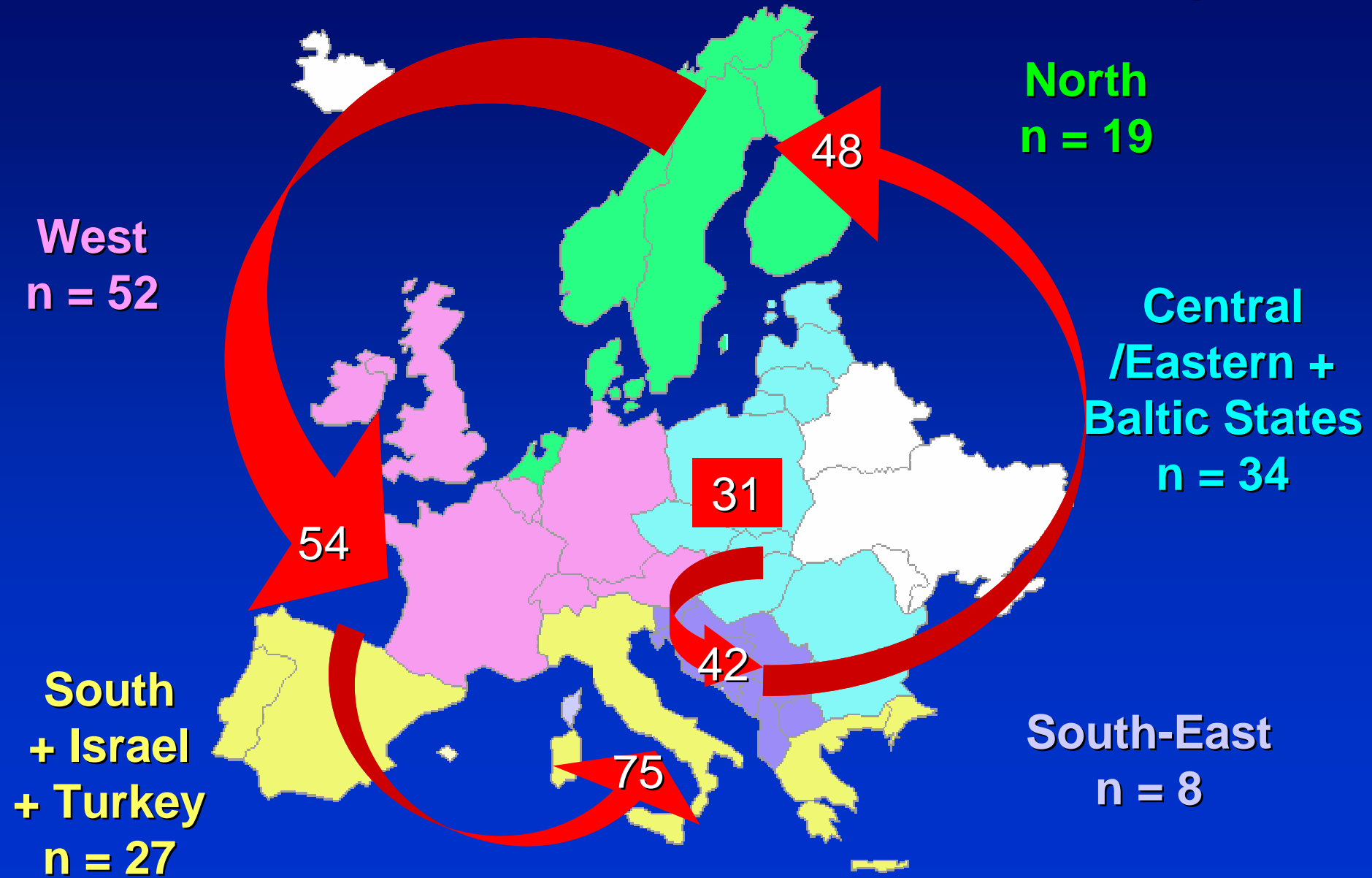
***Total
Antibiotic Consumption***

Antibiotic use data: Distribution (n = 140) 2001



Antibiotic Use

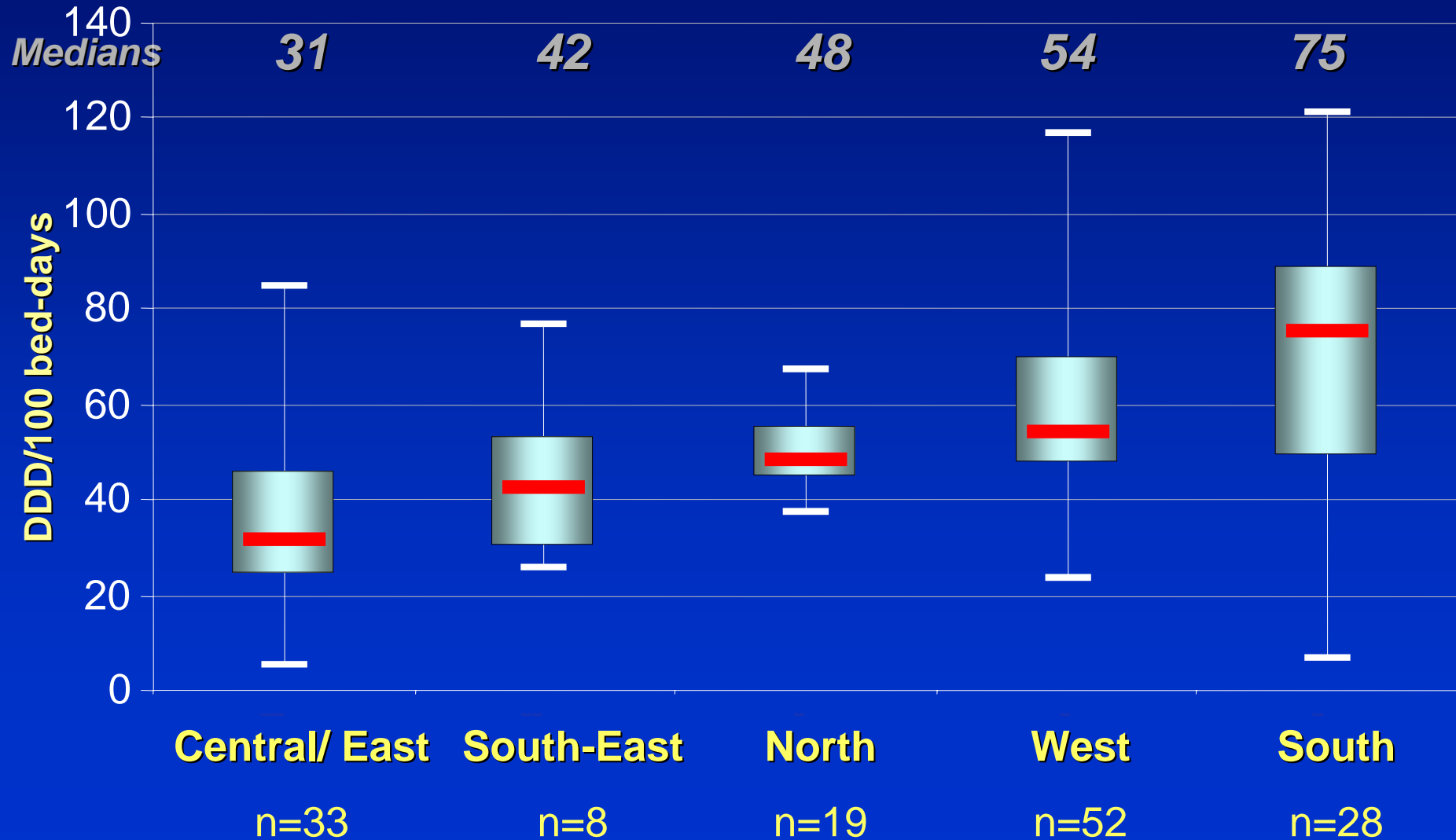
J01 Median values (DDDs/100 BD)



Median total antibiotic use: 2001

By Geographical Region, n = 140

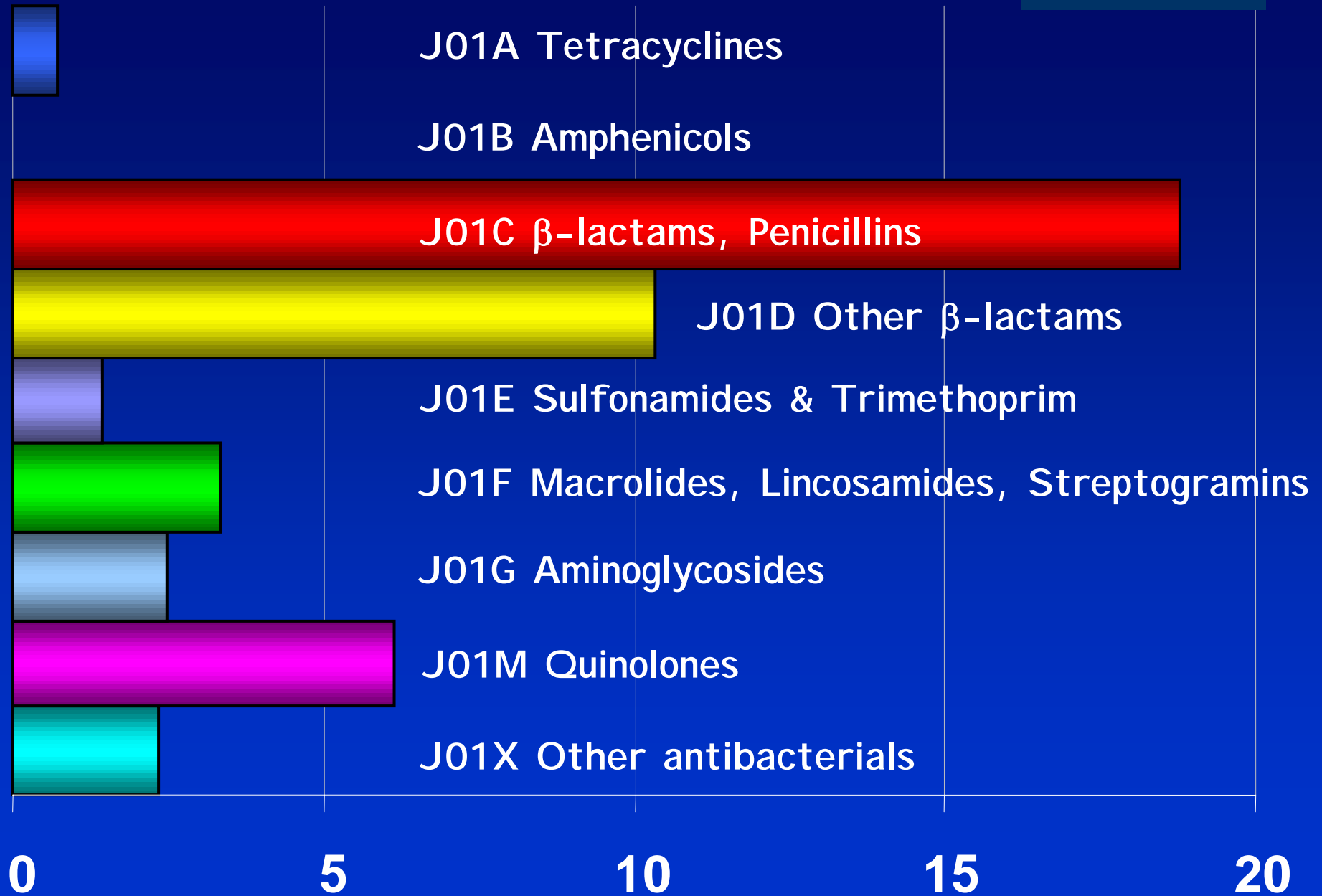
$p < 0.001$



Antibiotic Consumption:

The major classes

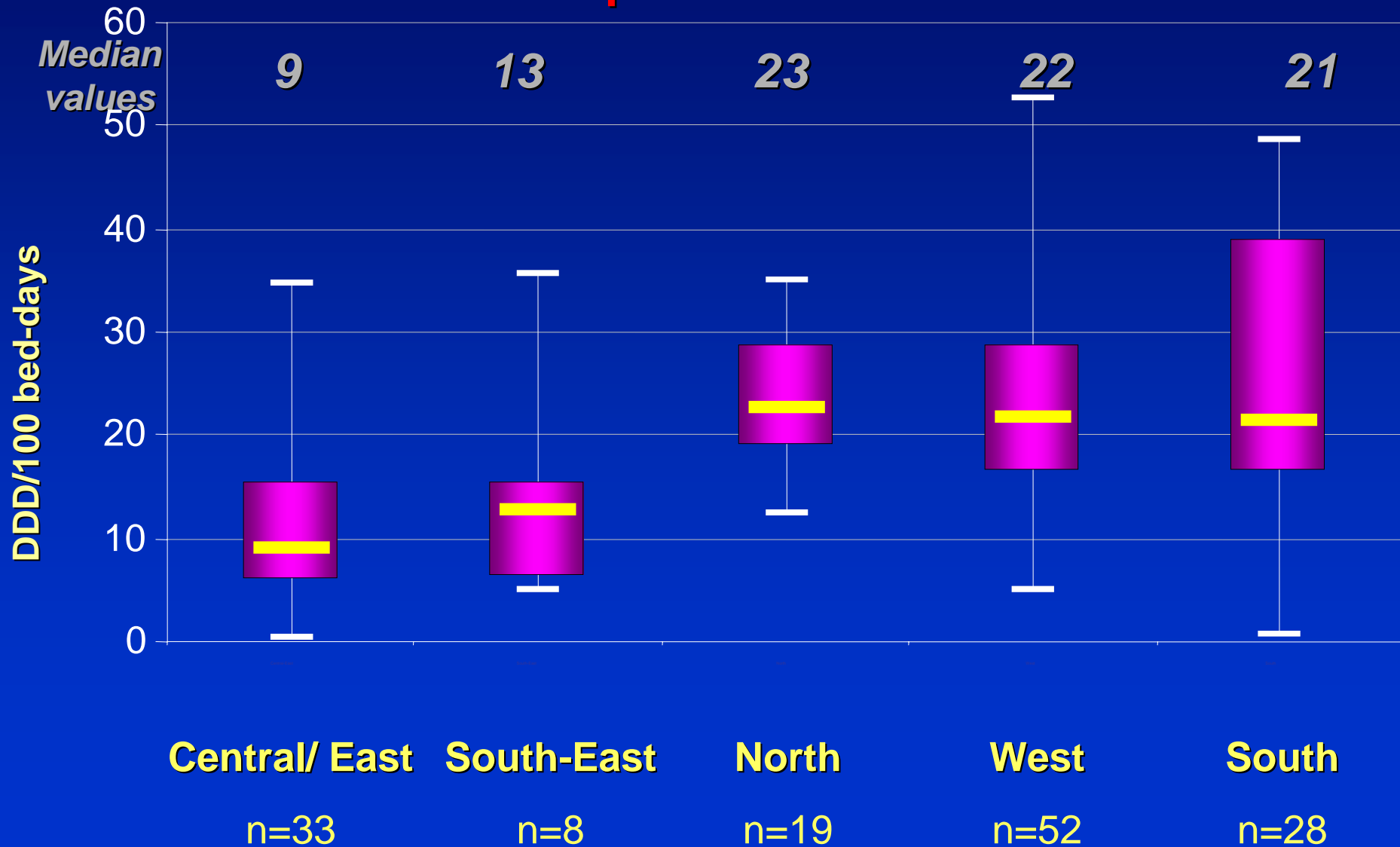
n = 140



DDD's /100 bed-days, Median values (n = 140)

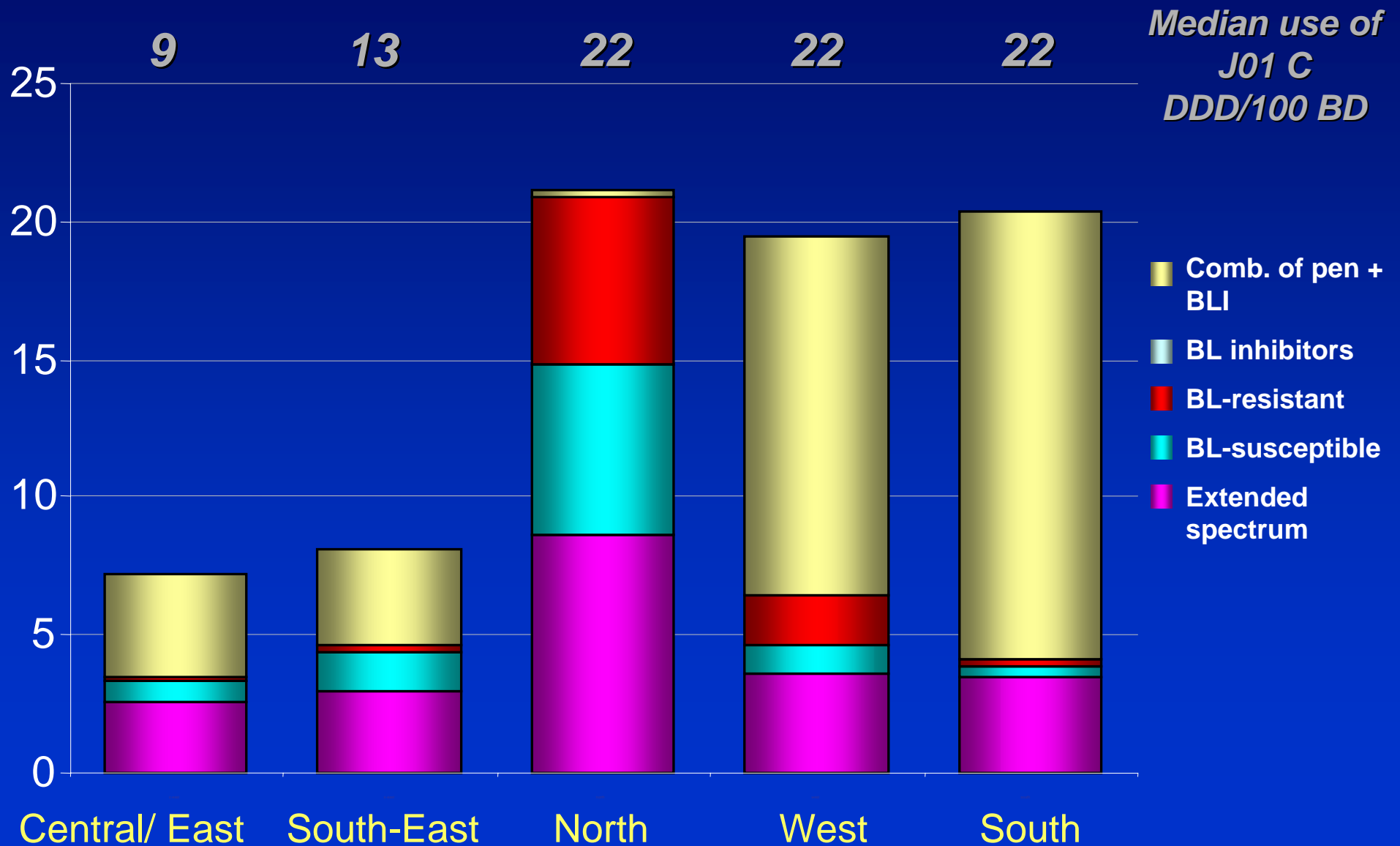
Median use of penicillin class (J01 C) By Geographical Region, n = 140

$p < 0.001$



Penicillins

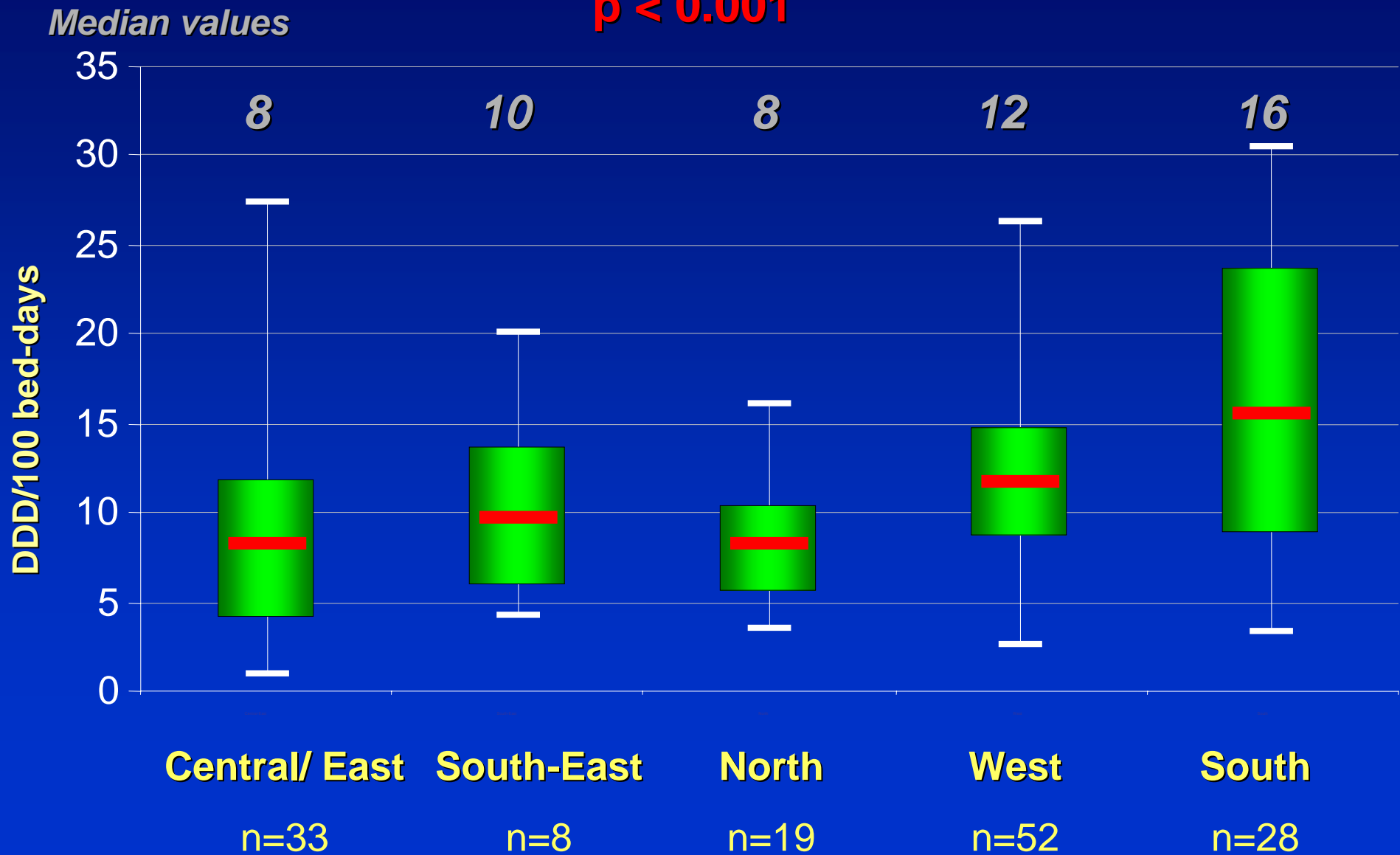
J01C sub-classes – as proportion of total J01 C use



Median use of non-penicillin beta lactams (J01 D)

By Geographical Region, n = 140

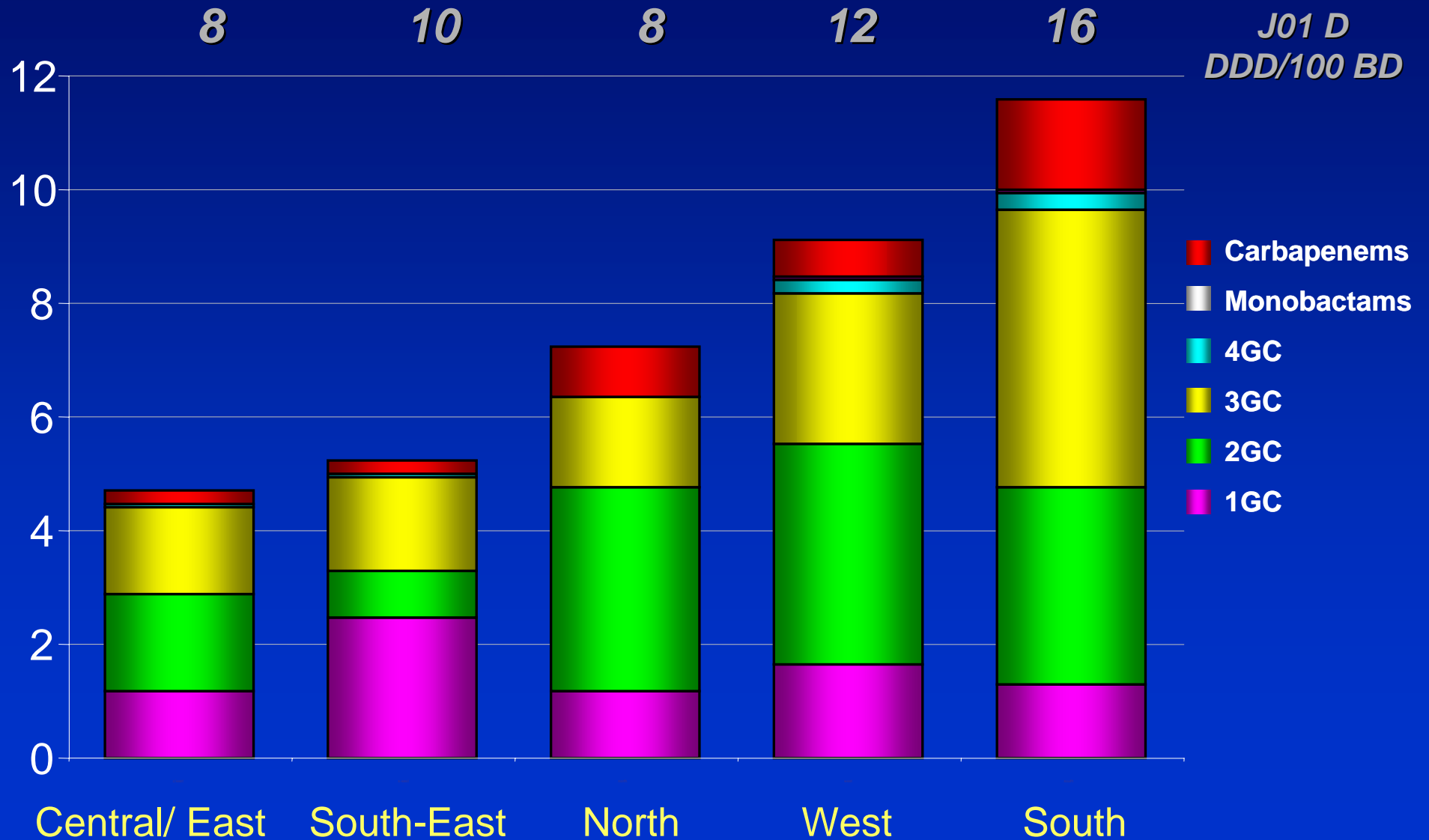
$p < 0.001$



Non-penicillin B-lactams

J01 D sub-classes – as proportion of total J01 D use

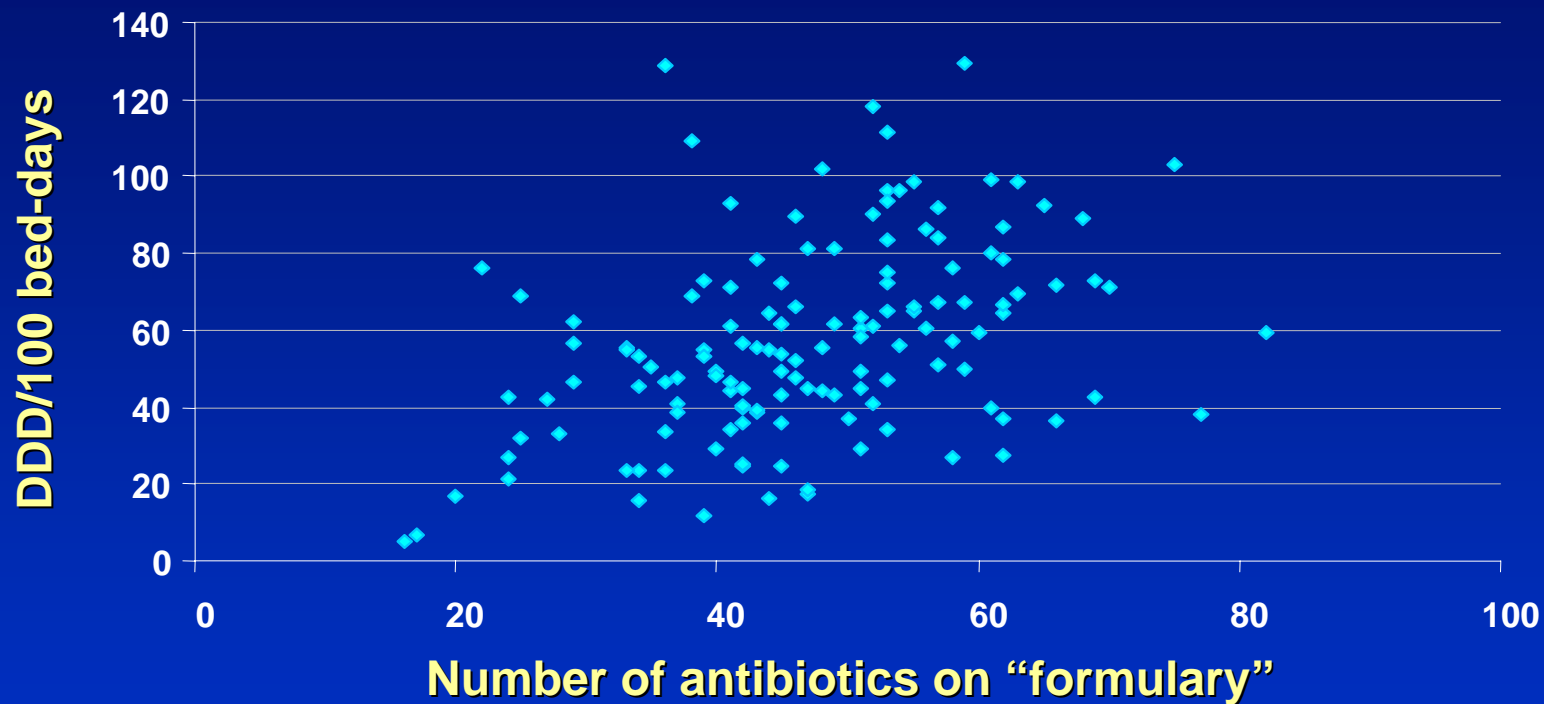
*Median use of
J01 D
DDD/100 BD*



Antibiotic Consumption:

Individual antibiotics

Relationship between number of individual antibiotics used and total antibiotic use



Spearman Rank Correlation Coefficients

$r = 0.431$

$P < 0.01$

Top - 5 antibiotics used

All hospitals, n = 140

1	Amox + BLI	O
2	Amox + BLI	P
3	Ciprofloxacin	O
4	Cefuroxime	P
5	Amoxicillin	O

WEST, n = 52

1	Amox + BLI	P
2	Amox + BLI	O
3	Ciprofloxacin	O
4	Cefuroxime	P
5	Amoxicillin	O

Top - 10 antibiotics used (Median values. % of total use) France

1	Amox + BLI	O	27%
2	Amoxicillin	O	16%
3	Ofloxacin	O	5%
4	Amoxicillin	P	5%
5	Amox + BLI	P	4%
6	Ceftriaxone	P	3%
7	Ciprofloxacin	O	2%
8	Pristinamycin	O	2%
9	Ciprofloxacin	P	2%
10	Sulfa - Trim	O	1%

67 agents used

Top-10 = 67% of total use

Recommendations Hospitals

- Agree universal unit
- Local surveillance of antibiotic use
- Feedback to prescribers
- Investigate fluctuations & relationship with resistance
- Clinical pharmacy services to support prescribing

Recommendations

National / European Health Authorities

- National programmes to monitoring antibiotic use.
- Implementation of a national surveillance system for collation, feedback and benchmarking of antibiotic consumption data in hospitals.
- Integrate with National programmes co-ordinating antibiotic resistance, antibiotic stewardship, policy and practice.
- Education.

Acknowledgements



ARPAC participating hospitals

ARPAC Steering Group

Benjamin Pelle

European Commission

ESCMID (ESGAP)

www.abdn.ac.uk/arpac

Antibiotic Consumption
and
Antibiotic resistance

Antibiotic Use versus MRSA Prevalence

Overview

All antibiotics (J01)

J01 less glycopeptides

Cephalosporins

3rd GC

MRSA

Fluoroquinolones

Macrolides

Aminoglycosides

● Correlations

Scatterplots (antibiotic use versus Alert organism prevalence)

Correlation coefficients

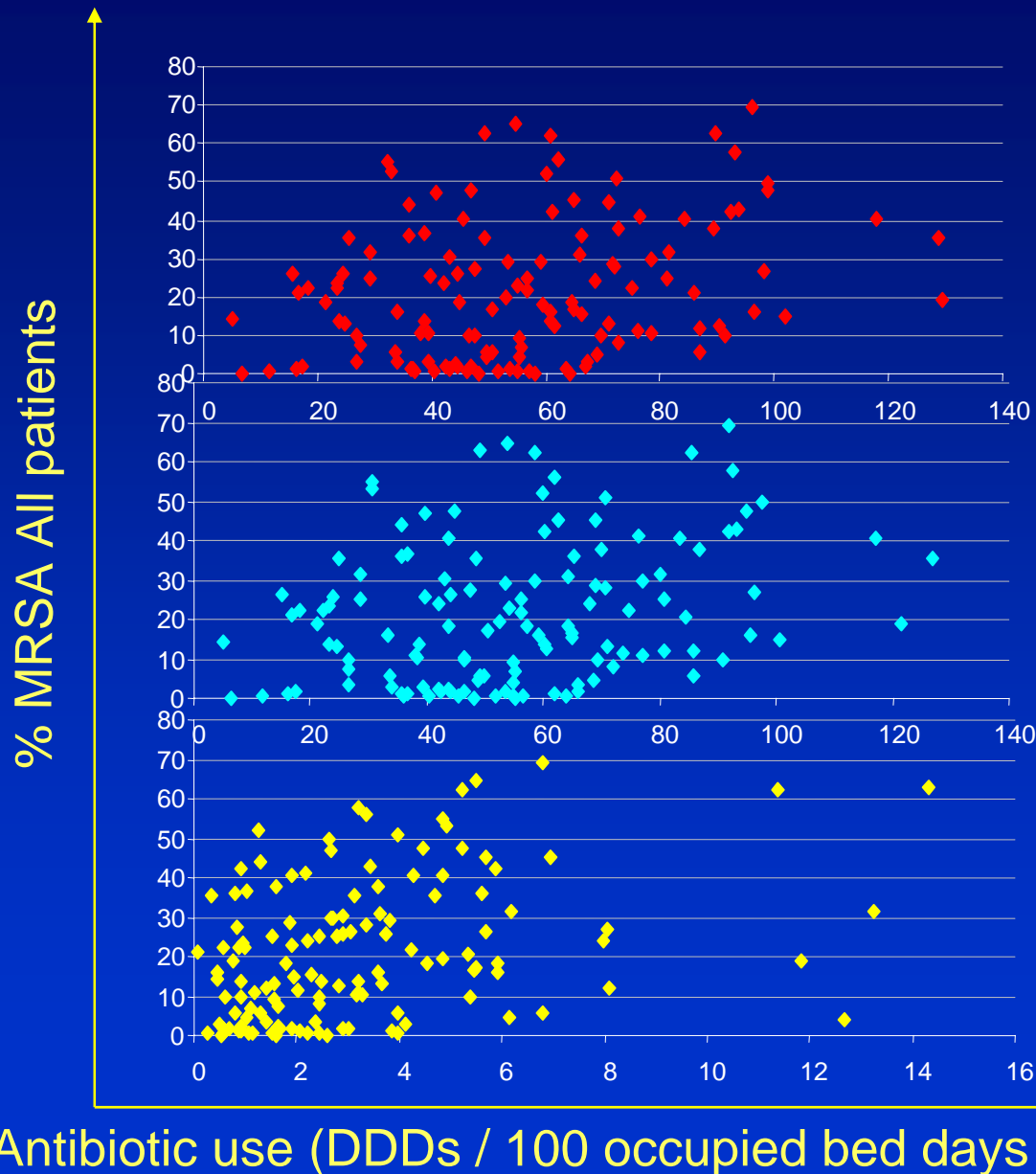
● Regression Modelling

Linear regression modelling

Adjustment for case mix and geographical variation

Relationship between MRSA prevalence and antibiotic use

Spearman Rank Correlation Coefficients



Total antibiotic use

$r = 0.262$

$p = 0.003$

Total antibiotic use less glycopeptides

$r = 0.258$

$p = 0.003$

3rd generation cephalosporins

$r = 0.387$

$p < 0.001$

ARPAC European hospitals (n=263)

- 140 ARPAC hospitals submitted useable antibiotic consumption data
- Project ICARE n=45
(Intensive Care Antimicrobial Resistance Epidemiology)
- CDC / NNIS system n=68
(National Nosocomial Infections Surveillance)
- SCOPE n=37
(Surveillance and Control of Pathogens of Epidemiological Importance)

Exploration of variation in Antibiotic Use

Geographical region



Expenditure on health as % of GDP



EU status



Hospital size



Teaching status



ICU size



ICU beds as proportion of total



Number of paediatric beds



Paediatric beds as proportion of total



Number of long stay beds

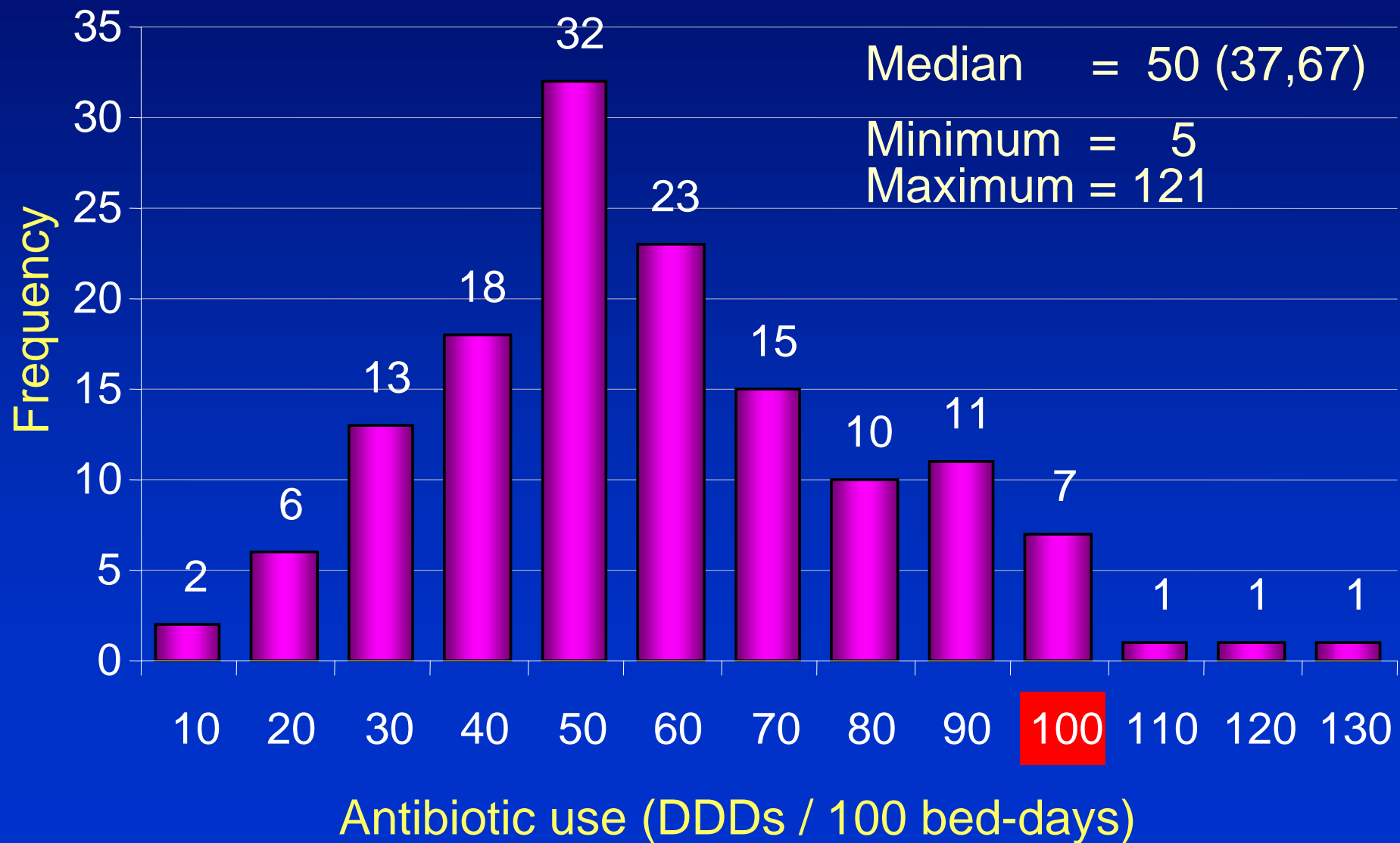


Long stay beds as proportion of total



Case mix indicators

Antibiotic use data: Distribution (n = 140) 2005



Usage of antibiotics ranked 1-10, expressed as % of total usage

(n = 140)

Median

20%

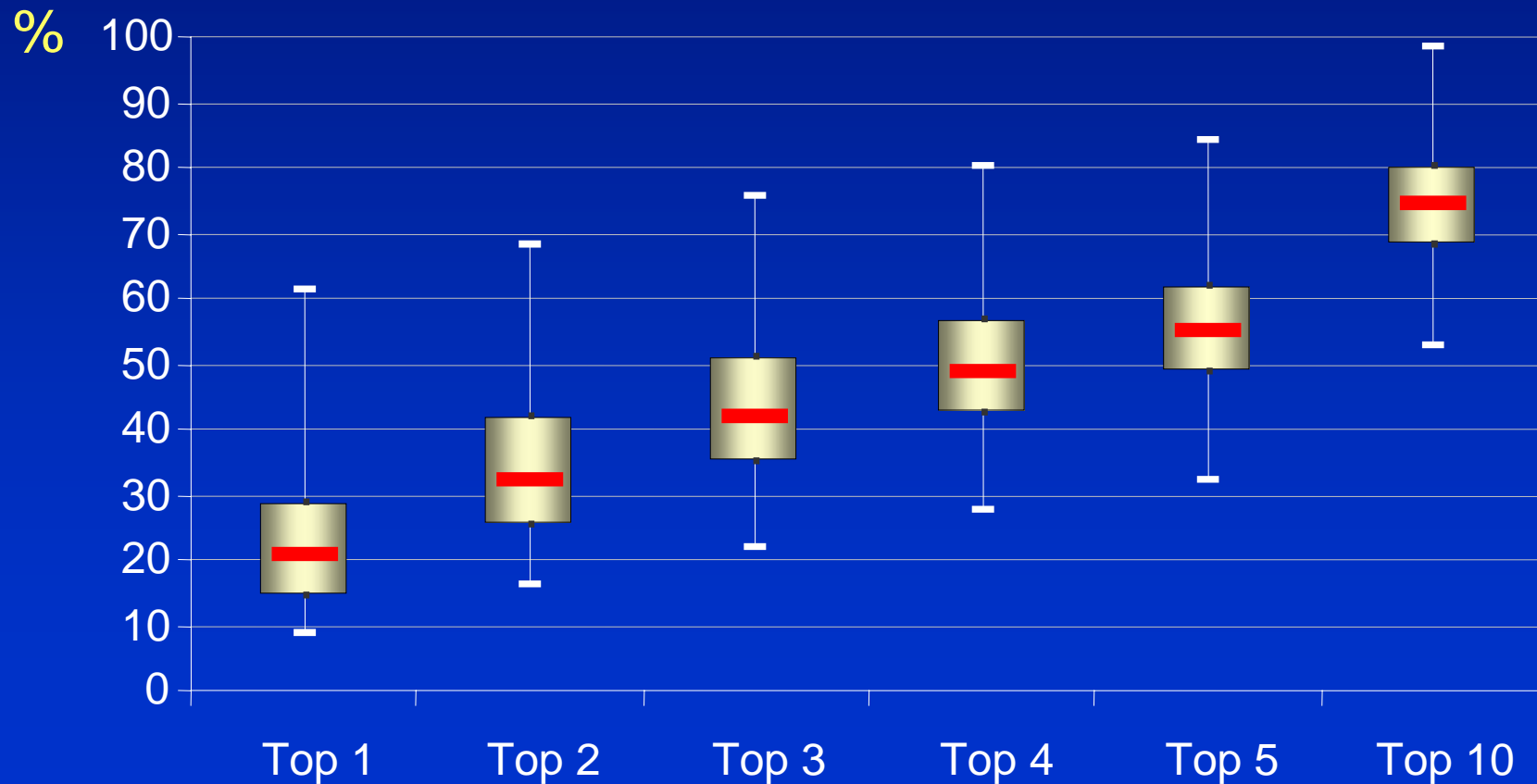
32%

41%

49%

55%

75%



Top - 5 antibiotics used

Central / Eastern Europe, n = 34

1	Gentamicin	P
2	Amox + BLI	O
3	Ciprofloxacin	O
4	Amox + BLI	P
5	Ampicillin	P

South East Europe, n = 8

1	Gentamicin	P
2	Ciprofloxacin	O
3	Amox + BLI	O
4	Ampicillin	P
5	Sulfa + Trim	O

Top - 5 antibiotics used

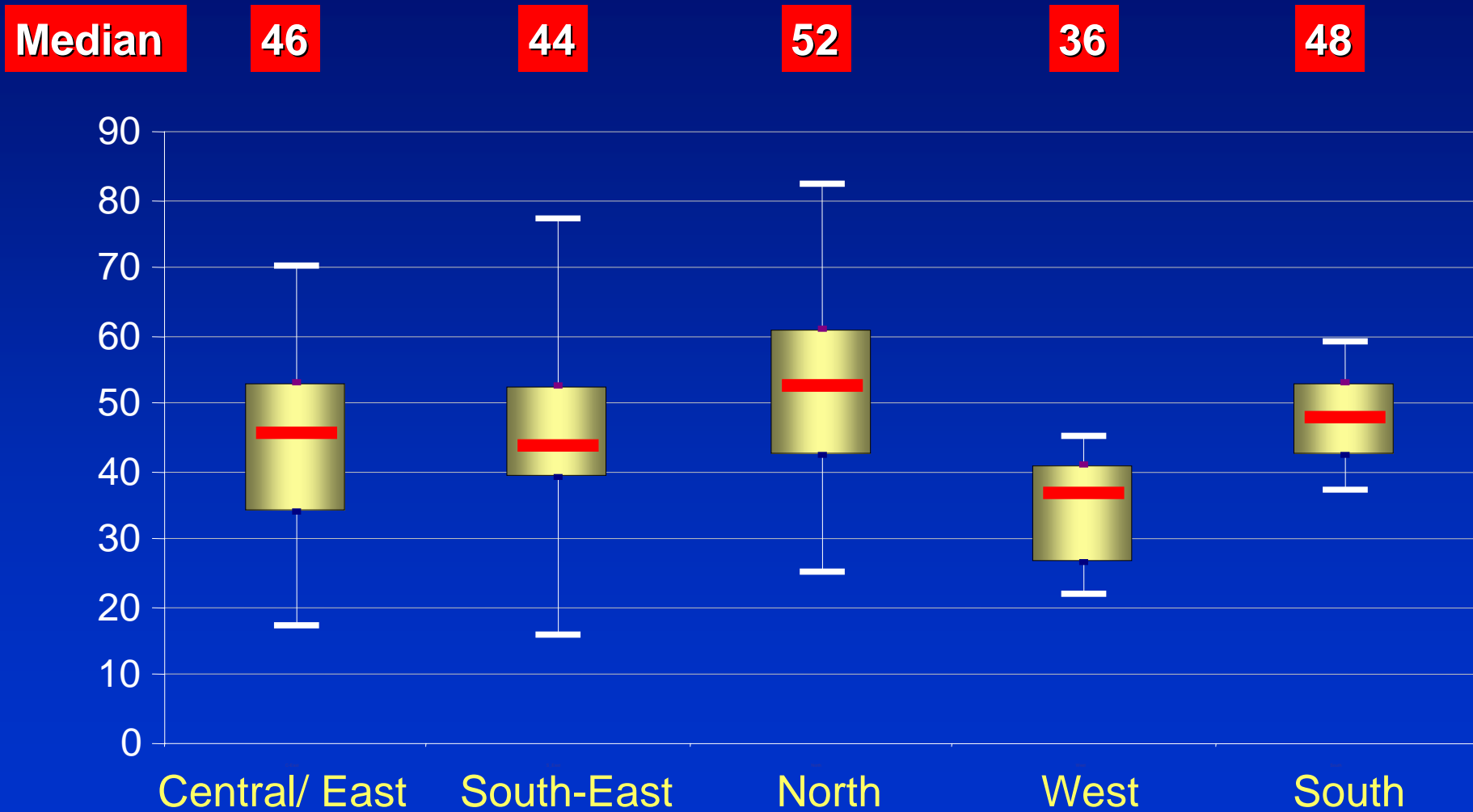
Northern Europe, n = 19

1	Penicillin V	O
2	Cefuroxime	P
3	Penicillin G	P
4	Ciprofloxacin	O
5	Amoxicillin	O

Southern Europe, n = 26

1	Amox + BLI	O
2	Amox + BLI	P
3	Ciprofloxacin	O
4	Ceftriaxone	P
5	Cefuroxime	O

European differences in numbers of antibiotics prescribed (formulary)



Kruskal Wallis Test, $p = 0.001$