

Introduction

Carbapenem-resistance in gramnegative bacteria, mostly associated with multiresistance, has emerged as a serious public health problem worldwide requiring consistent and intensified surveillance efforts. Data from ARS, the German Antibiotic Resistance Surveillance system are presented.

Material and Methods

ARS is a voluntary laboratory based surveillance system collecting resistance data of all clinical pathogens and sample types. Data are transmitted electronically to the central data-base of the national public health institute. The development of single susceptibility-rates and of resistance patterns of *Pseudomonas (P.) aeruginosa* from 2008 to 2011 is presented. Overall carbapenem-non-susceptibility was defined as non-susceptibility to imipenem (IMP) and/or meropenem (MER). In addition, analyses have been done using two different resistance patterns defined as combined non-susceptibility to IMP AND MER and singular non-susceptibility to IMP OR MER, respectively. The panel of antibiotics and antibiotic classes used for the estimation of multiresistant isolates included piperacillin, ceftazidim, ciprofloxacin, carbapenems (IMP AND MER) and aminoglycosides (gentamycin AND tobramycin). Multiresistance was defined as non-susceptibility to three or more antibiotic classes. For all analyses only data from hospitals participating over the whole time period have been considered. Copy-strains and screening samples have been excluded.

Results

In hospital care, susceptibility testing was performed in more than 5000 *P. aeruginosa* isolates in each year. The overall carbapenem-non-susceptibility remained nearly constant during the time period 2008 to 2011 (Table 1). Differentiation according to resistance patterns revealed that the percentage of isolates with combined non-susceptibility to IMP AND MER rose from 10.7% to 14.0% ($p < 0.001$), while singular non-susceptibility to IMP OR MER declined from 8.8% to 5.8% ($p < 0.001$) (Figure 1). Stratification according to ward and hospital type revealed that the rise of combined non-susceptibility was primarily seen on general wards, in general acute care and single speciality hospitals. Considering all *P. aeruginosa* isolates, the percentage of multiresistant isolates (non-susceptibility to three or more antibiotic classes) rose from 11.7% to 14.9% ($p = 0.004$) and from 1.3% to 2.1% ($p = 0.003$) in isolates with non-susceptibility to 5 antibiotic classes. Within the group of carbapenem-non-susceptible isolates the portion of isolates with simultaneous non-susceptibility to four additional antibiotics/antibiotic classes significantly increased from 10.7% to 16.1% ($p = 0.02$) (Figure 2).

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Table 1. Carbapenem-non-susceptibility (overall and according to resistance patterns) of *P. aeruginosa* in hospital care

<i>Pseudomonas aeruginosa</i>	2008		2009		2010		2011	
	n	%R/l	n	%R/l	n	%R/l	n	%R/l
Hospital care, total								
Non-susceptibility to IMP and/or MER ^a	5512	19.5	6276	19.5	6698	20.7	6423	19.7
Resistance patterns								
Combined non-susceptibility to IMP and MER		10.7		11.5		13.2		14
Singular non-susceptibility to IMP or MER		8.8		8.0		7.6		5.8
Ward type ^b								
Intensive Care Units	886	22.2	1018	22.1	1138	25	1107	23.5
General wards	4626	8.5	5258	9.4	5560	10.8	5316	12
Hospital type ^b								
Tertiary care hospitals	1723	12.8	2122	13.2	2400	14.8	2128	12.3
General care hospitals	2927	8.6	3303	9.4	3506	10.8	3570	13.2
Single speciality	635	13.2	691	14	593	18	563	23.8

^aIMP, Imipenem; MER, Meropenem; ^bCombined non-susceptibility to IMP AND MER

Figure 1. Carbapenem-non-susceptibility according to resistance patterns of *P. aeruginosa* in hospital care

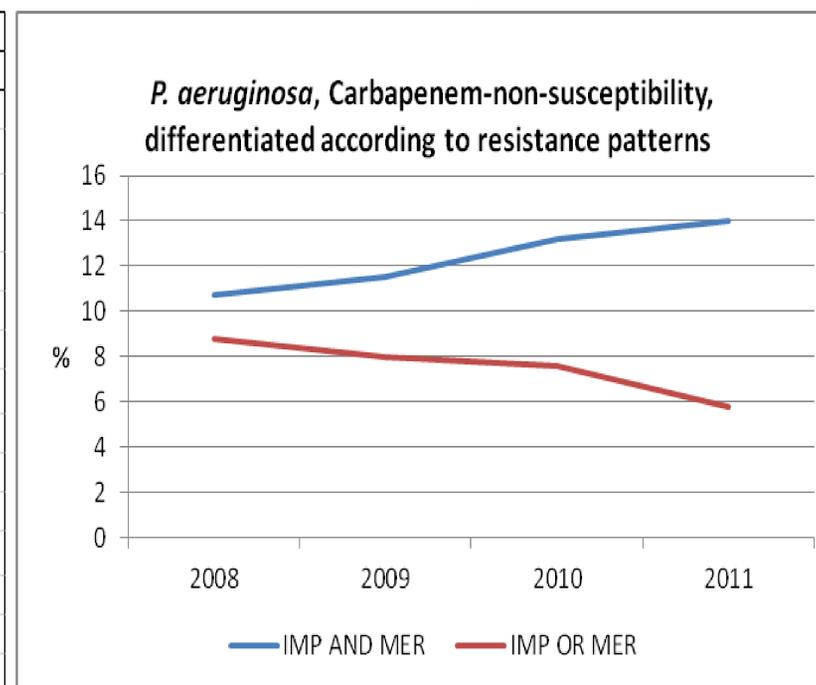
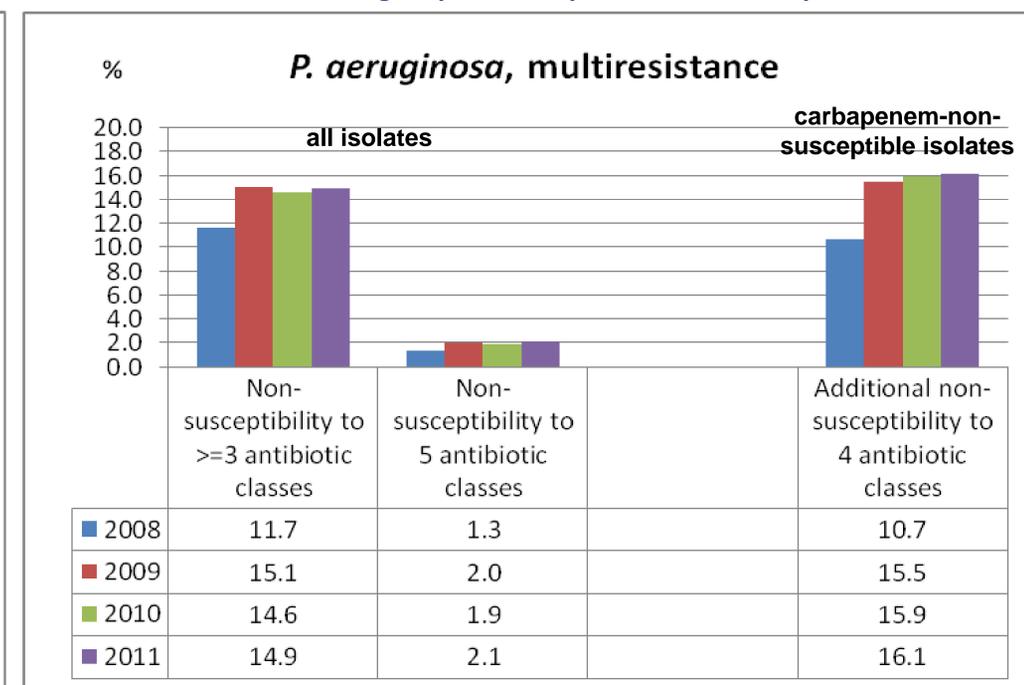


Figure 2. Development of multiresistance in *P. aeruginosa* over time in all isolates and in the group of carbapenem-non-susceptible isolates



Panel of antibiotics/antibiotic classes: piperacillin, ceftazidim, ciprofloxacin, carbapenems, aminoglycosides

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Conclusions

Singular non-susceptibility to IMP OR MER decreased in favour to an increase of combined non-susceptibility to IMP AND MER, resulting in a constant course of the overall non-susceptibility to IMP and/or MER. Differentiation according to resistance patterns might be helpful in early detection of changes in the features of bacterial resistance.

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