7.3 Pseudomonas aeruginosa

Pseudomonas aeruginosa is a non-fermentative Gram-negative rod and the most important human pathogen in this group of bacteria. *P. aeruginosa* is one of the leading causes of nosocomial respiratory tract infections and is also found in hospital-acquired urinary tract, wound and bloodstream infections. It is a feared pathogen, especially in burn units. Mucoid strains frequently infect cystic fibrosis patients and are very difficult to eradicate. The main community-acquired infections caused by *P. aeruginosa* in immunocompetent hosts are external otitis (swimmer's ear) and sinusitis.

P. aeruginosa is intrinsically resistant to amoxicillin, amoxicillin-clavulanic acid, first- and second-generation cephalosporins, cefixime, cefpodoxime, ceftriaxone, ertapenem, trimethoprim-sulfamethoxazole as well as tetracyclines, including tigecycline. Quinolones are among the rare orally given antibiotics which retain activity against *P. aeruginosa*. In Switzerland, in 2021, resistance rates were highest for aminoglycosides (14.2%), followed by piperacillin-tazobactam and carbapenems (between 10 and 11%), ceftazidime and cefepime (around 9%) and ciprofloxacin (7.3%). Swiss regional data are shown in Table 7. e, data on coresistance in Table 7. f and Figure 7. g.

Table 7. e: Resistance rates of invasive *Pseudomonas aeruginosa* isolates in humans in 2021.

Pseudomonas aeruginosa											**2021**
	West		**North–East**		**South**		**Total**			**Trend**	
Antimicrobial	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**	**4y**	**10y**
Piperacillin-tazobactam	142	12.7	464	10.3	33	12.1	639	11	9.8–12.2	–	–
Ceftazidime	140	12.1	466	8.2	33	12.1	639	9.2	8.1–10.3	–	–
Cefepime	143	10.5	474	7.8	33	9.1	650	8.5	7.4–9.6	–	↑
Carbapenems[1]	140	15.7	474	8.6	33	12.1	647	10.4	9.2–11.6	–	–
Aminoglycosides	142	7	486	17.3	33	0	661	14.2	12.8–15.6	↑	↑
Ciprofloxacin	144	10.4	482	6.8	33	0	659	7.3	6.3–8.3	–	–

[1] Carbapenems: imipenem, meropenem

West (GE, NE, VD, JU, FR), South (TI), North–East (other cantons) according to linguistic regions. 95% confidence intervals (CI) were calculated by the Wilson score method, calculations of trends were performed by logistic regression. Trends were modeled with logistic regressions. Arrows represent a significant effect ($p < 0.05$) of the year on the corresponding outcome (increase, decrease).

Figure 7. f: Resistance rates of invasive *Pseudomonas aeruginosa* isolates in humans from 2012 to 2021.

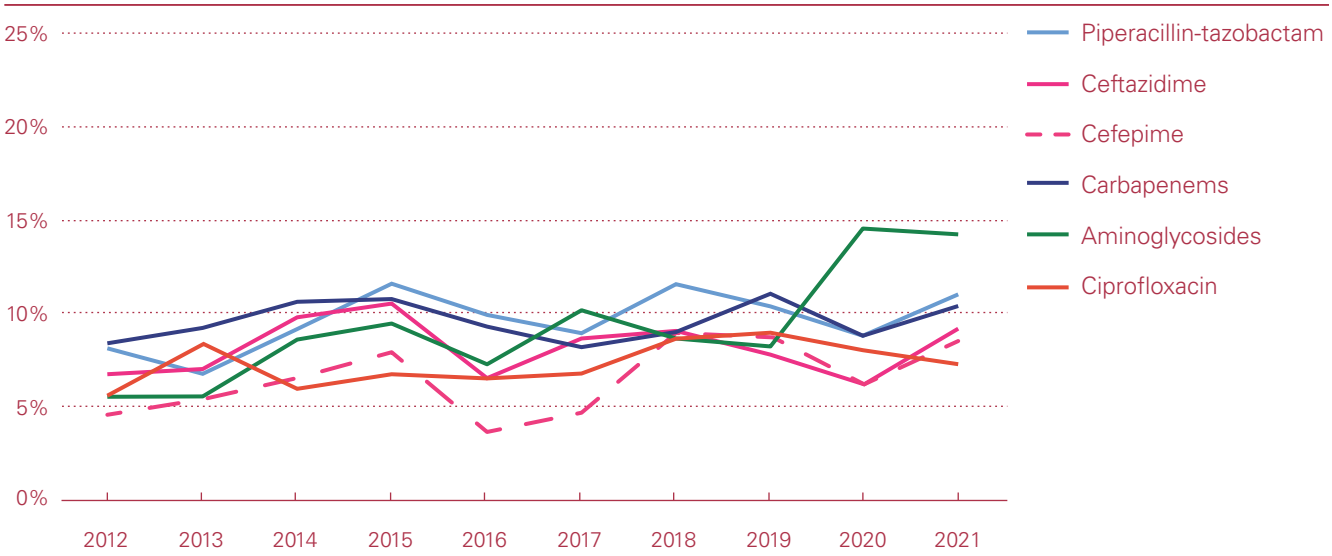

Table 7. f: Resistance combinations in invasive *P. aeruginosa* isolates in humans in 2021. Only isolates tested against all five antibiotics or antibiotic groups (piperacillin-tazobactam, cefepime, carbapenems, aminoglycosides, ciprofloxacin) were considered (n = 595/670 [88.8%]).

Resistance patterns	Number of isolates	% of total
Fully susceptible	**410**	**68.9%**
Resistance to one antimicrobial group	**113**	**19.0%**
Piperacillin-tazobactam	11	1.8%
Ciprofloxacin	13	2.2%
Cefepime	1	0.2%
Carbapenems	26	4.4%
Aminoglycoside	62	10.4%
Resistance to two antimicrobial groups	**32**	**5.4%**
Piperacillin-tazobactam + ciprofloxacin	1	0.2%
Cefepime + piperacillin-tazobactam	16	2.7%
Cefepime + ciprofloxacin	1	0.2%
Carbapenems + piperacillin-tazobactam	3	0.5%
Carbapenems + ciprofloxacin	6	1.0%
Aminoglycosides + ciprofloxacin	4	0.7%
Aminoglycosides + carbapenems	1	0.2%
Resistance to three antimicrobial groups	**23**	**3.9%**
Cefepime + piperacillin-tazobactam + ciprofloxacin	4	0.7%
Cefepime + carbapenems + piperacillin-tazobactam	9	1.5%
Aminoglycosides + piperacillin-tazobactam + ciprofloxacin	1	0.2%
Aminoglycosides + cefepime + piperacillin-tazobactam	3	0.5%
Aminoglycosides + cefepime + ciprofloxacin	3	0.5%
Aminoglycosides + carbapenems + piperacillin-tazobactam	1	0.2%
Aminoglycosides + carbapenems + ciprofloxacin	2	0.3%
Resistance to four antimicrobial groups	**9**	**1.5%**
Cefepime + carbapenems + piperacillin-tazobactam + ciprofloxacin	3	0.5%
Aminoglycosides + cefepime + carbapenems + piperacillin-tazobactam	6	1.0%
Resistance to all five antimicrobial groups	**8**	**1.3%**
Aminoglycosides + cefepime + carbapenems + piperacillin-tazobactam + ciprofloxacin	8	1.3%

Resistance rates to all antibiotics have trended upwards over the past ten years. In particular, significant increases for cefepime (from 4.6% to 8.5%) and aminoglycosides (from 5.6% to 14.2%) have led to a decrease in pansusceptible isolates from 82.2 to 68.4% (Figure 7. g). Decreasing resistance trends between 2016 and 2020 were observed in the EU/EEA for aminoglycosides, fluoroquinolones and carbapenems, while resistance to ceftazidime and piperacillin-tazobactam remained stable during this period [2].

Figure 7. g: Multiresistance in invasive *Pseudomonas aeruginosa* isolates in humans between 2012 and 2021 (for details refer to Table 7. f).