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# Antibiotic-resistant bacteria in patient wet rooms of a maximum care oncology ward

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## Approach

Numerous long-lasting nosocomial outbreaks with carbapenem-resistant or carbapenemase-producing gram-negative bacteria have been traced back to sanitary systems such as sink and shower drains, toilets or spill basins in the direct surroundings of the patient. So far the role of the wastewater system in medical facilities has been underestimated as an infectious reservoir and is not yet sufficiently regulated. To better characterize the clinical pathway for antibiotic-resistant bacteria (ARB), a sub-study of the multidisciplinary, BMBF-funded joint project "HyReKA" investigated shower drains, toilets and sink drains from patient wet rooms.

## Methods

Following the initial screening of the whole ward, three patient wet rooms were examined every six weeks over one year to investigate a possible seasonal course. Each sample included not only the wastewater but also biofilm material from the walls of the drains. The samples were tested for about 40 antibiotics and different ARB. The methods used for the detection of clinical relevant Extended Spectrum Beta-Lactamase-producing gram negative bacteria (ESBL), Methicillin-resistant *Staphylococcus aureus* (MRSA), and Vancomycin-resistant *Enterococcus* (VRE) were adapted and optimized for analysis of environmental samples. The characterization of the isolates and their resistance properties were carried out using classical molecular biological methods (MALDI-TOF-MS, qPCR).

## Results Screening

In 13 out of 14 rooms *P. aeruginosa* was found in the drains (n=23). KEC (*Klebsiella* spp., *Enterobacter* spp., *Citrobacter* spp.) could be detected 13 times in nine rooms. *E. coli* could be detected four times in three rooms and VRE seven times in five rooms.

*A. baumannii* was detected only in two rooms, each in one runoff. MRSA and *P. mirabilis* were not found in any of the samples during the study period (figure 1).

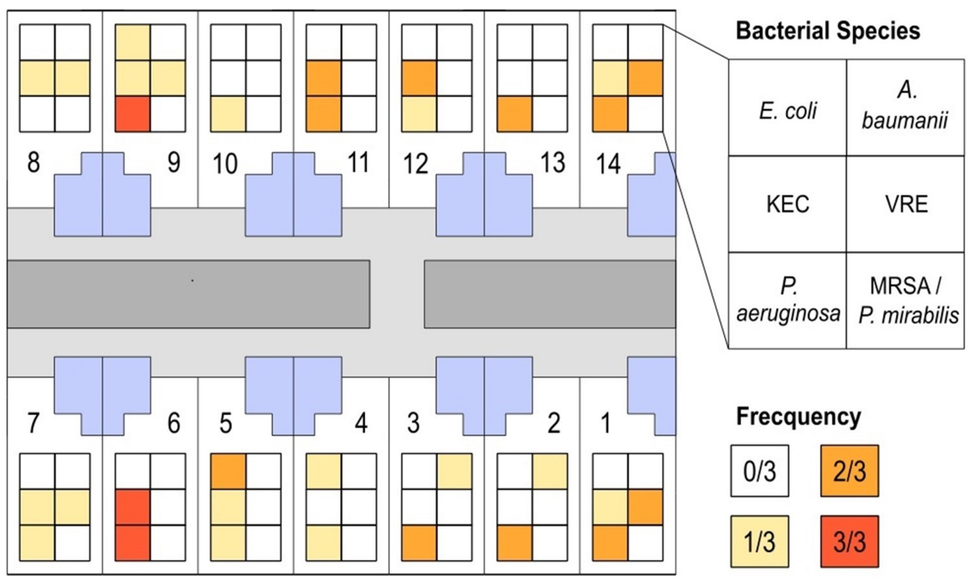


**Figure 1:** Number of findings of the respective bacterial species (white = no findings, light yellow = 1 PNS with positive findings, orange = 2 PNS with positive findings, red = positive findings on all three outflow types).

## Consequences

This results in ramifications regarding near-patient drains, the basic cleaning and final disinfection of patient rooms as well as in outbreak management. The results should also have consequences regarding structural-functional measures. The findings presented are currently being used in the preparation of a new recommendation of the KRINKO on hygiene requirements for wastewater-bearing systems in medical facilities.

## Results Monitoring

*E. coli* was detected four times in room 1 and 4 during the monitoring phase. Of the 15 investigated *E. coli* isolates from both phases, 8 isolates could be classified as 3 MRGN; none of these *E. coli* isolates exhibited carbapenemase or colistin resistance.

Representatives of the *A. baumannii* complex were detectable only in 8/123 samples, of which only one isolate was classified as 3 MRGN. All the other isolates showed no significant resistance.

*A. baumannii* was most frequently detected in the sink siphons. VRE was rarely detectable; mostly in the toilets.

*P. aeruginosa* was frequently isolated from siphons of the sink. In 32% of the samples of both test phases *P. aeruginosa* was detected, of which 70% of the isolates had neither 3-fold nor 4-fold resistance; 3 of the 83 isolates were classified as 4 MRGN with additional colistin resistance or additional positive detection of carbapenemases.

**Table 1:** KEC isolates detected during the monitoring phase. Divided according to the degree of resistance and bacterial species. The phenotypic categorization into the different resistance groups was based on the KRINKO recommendation of 2012.

| Resistance types | Number Isolates | Species | | |
|---|---|---|---|---|
| | | *K. pneumoniae* | *E. cloacae*-complex | *C. freundii* |
| No 3- / 4-fold resistance | 10 | 1 | 8 | 1 |
| 3 MRGN* | 12 | 8 | 3 | 1 |
| 4 MRGN* | 2 | 1 | | 1 |
| Only Colistinresistance* | 14 | | 14 | |
| Only Carbapenemase** | 0 | | | |
| 3 MRGN* + Colistinresistance* | 3 | | 3 | |
| 4 MRGN* + Colistinresistance* | 0 | | | |
| 3 MRGN* + Carbapenemase** | 0 | | | |
| 4 MRGN* + Carbapenemase** | 38 | 3 | 15 | 20 |
| 3 MRGN* + Colistinresistance* + Carbapenemase** | 0 | | | |
| 4 MRGN* + Colistinresistance* + Carbapenemase** | 11 | | 11 | |
| Total | 90 | 13 | 54 | 23 |

* phenotypical ** positiv Carbapenemase-qPCR

## Summary

In all rooms in the sanitary area ESBL-forming gram-negative bacteria could be detected. The main representatives were ESBL-forming *P. aeruginosa*. The investigations revealed no seasonality. The examined rimless toilets showed hardly any positive results, whereas the shower and washbasin drains were focal points of a possible contamination.

**References**

- KRINKO. Hygienemaßnahmen bei Infektionen oder Besiedlung mit multiresistenten gramnegativen Stäbchen. Bundesgesundheitsblatt - Gesundheitsforschung – Gesundheits-schutz (*Hygiene measures for infections or colonization with multidrug-resistant Gram-negative rods. Federal Health Gazette - Health Research - Health Protection*) 2012 Oct; 55:1311 – 1354

**Funding**

- HyReKA: "Biological and hygienic–medical relevance and control of antibiotic-resistant pathogens in clinical, agricultural and municipal waste water and their relevance in raw water“ funded by the federal ministry of education and research (FKZ: 02WRS1377A)
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