Fourier-transform infrared (FTIR) spectroscopy reveals dialysis panel as source of prolonged KPC *Klebsiella pneumoniae* outbreak in intensive care unit

P3702

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Background

Carbapenem-resistant Enterobacterales (CRE) are still rare in Germany, but are brought to hospitals by patients from high-prevalence countries or patients with a long history of antibiotic use. Infection control measures in our hospital include screening of patients with a high risk of harbouring CRE, contact precaution of CRE positive patients and strict cleaning protocol after discharge, including controlling the cleaning effect by taking environmental swabs. The BG Bergmannsheil University Clinic has 600 beds, including four intensive care units (surgery, cardiac surgery, internal medicine and burn unit). We describe two independent events that were linked by FTIR.

June 2025, ICU 4

KPC Klebsiella pneumonieae outbreak

- The index patient is KPC *K. pneumoniae* positive on admission, patient is on dialysis
- KPC *K. pneumoniae* is transmitted to **four** more patients
  - 3 patients are colonized
  - 1 patients gains wound infection and prolonged stay in hospital
  - 1 patient gets pneumonia and dies of multi organ failure

Infection control measures

- Notification of local public health department
- Three meetings of outbreak team
- Contact precautions for KPC *K. pneumoniae* positive patients
- Screening of all patients of the ward for CRE
- Environmental swabs to identify a source
- Enhanced cleaning of medical products
- Enhanced awareness to hand hygiene

Follow-up

- Four of five outbreak strains of KPC *K. pneumoniae* were submitted to whole genome sequencing (WGS) and FTIR and clustered in both methods
- The outbreak was terminated without finding a source

FTIR links diaysis panel to outbreak strains

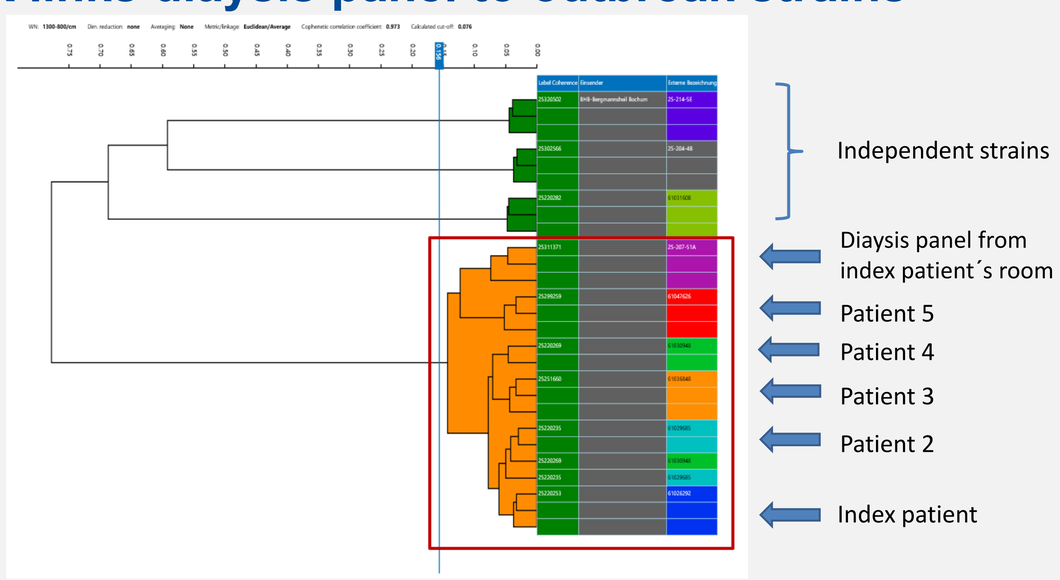

Figure 2: FTIR showed one KPC positive *K. pneumoniae* strain from ICU4 (dialysis panel of the index patient of the outbreak) clustering with five KPC *K. pneumoniae* strains obtained from a prolonged outbreak on the same ICU a few months earlier and therefore coincidentally revealed the probable route of transmission.

September 2025, ICU 2

Environmental swabs

were taken after intensified cleaning after discharge of a patient harbouring a **carbapenem-resistant *Enterobacter cloacae***.
Hereby, **a KPC-positive *K. pneumoniae*** was found in the **dialysis panel** of **ICU 2.**

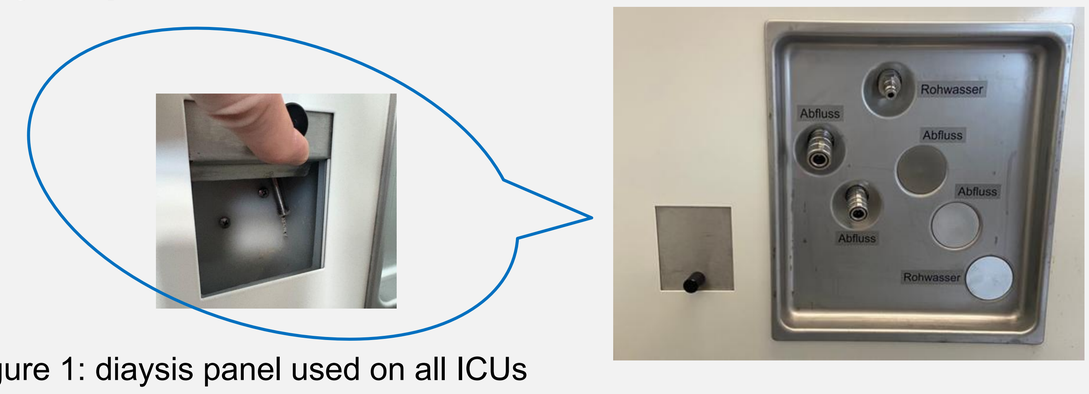

Figure 1: diaysis panel used on all ICUs

Regarding a KPC-positive *K. pneumoniae* outbreak on ICU4 a few months earlier, all dialysis panels were tested.

Methods

In total, 131 swabs were taken from the discharge nozzles and drains (figure 1) of 47 dialysis panels on four ICUs: ICU1 (9 panels/18 swabs), ICU2 (9 panels/27 swabs), ICU3 (8 panels/24 swabs), ICU4 (21 panels/62 swabs).

Carbapenemases were confirmed by PCR (Cepheid, Krefeld, Germany). For strain typing FTIR was employed (IR Biotyper®, Bruker Daltonics, Germany) using Hierarchical Cluster Analysis (HCA) and Principal Component Analysis (PCA) for exploratory analysis and clustering.

Results

The proportion of contaminated dialysis panels varied: for ICU1 4/9, ICU2 9/9, ICU3 4/8 and ICU4 8/21 dialysis panel harboured at least one CRE, respectively. A total of 35 CRE were detected: 22 *Klebsiella* spp. (9 *K. pneumoniae*, 13 K. *oxytoca*), four *Enterobacter* spp., nine *Citrobacter* spp., three *Escherichia coli*, one *Providentia rettgeri* and one *Morganella morganii*, including various combinations of NDM, KPC, OXA-48 and VIM carbapenemases, respectively.

While all *Citrobacter* spp. and *E. coli* strains appeared as singeltons in the FTIR analysis, there were several clusters among *Klebsiella* spp. For *Klebsiella oxytoca*, one cluster of n=5, and 3 clusters with 2 strains each were found.

Conclusions

- Dialysis is part of modern intensive-care medicine and if dialysis panels are used, regular testing for CRE seems advisable.
- FTIR seems to be a helpful new typing method for outbreak investigations and unveiled the probable route of transmission of a prolonged outbreak with a KPC positive *K. pneumoniae*.

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