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## Concise Communication

# A cluster of *Chryseobacterium indologenes* cases related to drainage water in intensive care units

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**Abstract**

In this outbreak, 12 patients in intensive care units acquired a *Chryseobacterium indologenes* infection. Cultures from sinkholes and air samples were positive for *C. indologenes*. After removing wash basins, no new cases appeared. Sinkholes, potentially contaminated, can act as a reservoir for *C. indologenes* and other microorganisms. Thus, patients and equipment should be protected from sink splashes to avoid contamination.

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Hospital water is an important source of healthcare-associated infections, mostly caused by *Pseudomonas aeruginosa*. Nevertheless, other nonfermentative gram-negative bacilli (NFGNB) present in water are increasingly recognized as a cause of infection, especially in immunocompromised and critically ill patients.[1] *Chryseobacterium indologenes* is an NFGNB primarily found in soil and water.[2] It has intrinsic resistance to several antimicrobial classes, such as cephalosporins and carbapenems, due to the presence of metallo-β-carbapenemases.[3] Since 2009, *Chryseobacterium* has been identified in environmental samples from hospital tap water, disinfectants, and respiratory equipment. It has also been postulated to be a potential pathogen in critically ill patients.[1,4–6]

Several healthcare-facility outbreaks of NFGNB and Enterobacteriaceae related to contaminated drainage system water have been described.[7,8] Immunocompromised host and critically ill adults as well as neonates are the groups most commonly affected.[9]

This study describes a cluster of *C. indologenes* infections and colonizations, probably related to sink drainage water, in intensive care unit (ICU) patients and the measures implemented to control it.

## Methods

The study was conducted in 2 adult ICUs in a 613-bed tertiary-care hospital. The hospital attends a range of patients referred from other hospitals. The medical ICU admits coronary as well as any other nonsurgical adult patients; the ICU comprises 2 units of 11 single rooms with 1 handwashing sink per bed. Patients from most surgical specialties, including heart, lung, liver, and kidney transplant, are attended in the surgical ICU, which has two 10-bed bays sharing 6 handwashing sinks per bay. A room for reprocessing and storage of respiratory devices for the surgical ICU occasionally serves both ICUs. The ICUs do not share healthcare personnel.

All patients admitted to these critical units are sampled for methicillin-resistant *Staphylococcus aureus* (MRSA; nasal and pharyngeal swabs) and for extended-spectrum beta-lactamase (ESBL) and/or carbapenem-resistant gram-negative bacilli (GNB; rectal and respiratory tract samples) at admission and weekly thereafter.

A case patient was defined as an ICU patient in whom *C. indologenes* was isolated from a clinical or surveillance culture. A patient was considered infected when (1) the patient met Centers for Disease Control and Prevention (CDC) criteria for healthcare-associated infection[10] or (2) the patient developed changes in clinico-physiologic parameters (ie, systemic inflammatory response syndrome) concurrently with *C. indologenes* isolation. Colonized patients were those who did not meet any of the above criteria.

Swab samples from tap, faucet aerators, sinkholes, hemodialysis draining traps, and wash basins, as well as tap and distilled water, bronchoscope rinse water, dialysate solution, intravenous infusions, and aqueous chlorhexidine were obtained. Free residual chlorine tests of ICU tap water were performed. Air sampling was performed using an SAS-SuperISO-180 air sampler (International PBI, Milano, Italy) in a standard blood-agar media. One cubic meter of air was sampled close to the basin (within 50 cm) while flushing tap water.

All microbiological samples were seeded on blood agar. Identification of isolates from patients and environment samples

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was made using matrix-assisted laser desorption/ionization time-of-flight mass spectroscopy (MALDI-TOF MS), and the susceptibility tests in clinical samples were performed using a MicroScan system (Beckman Coulter, Brea, California, USA). The genetic relationship between the *C. indologenes* isolates was determined by pulsed-field gel electrophoresis (PFGE).

We undertook a spatiotemporal analysis of cases by associating bed occupancy of confirmed case patients against each other and possible environmental reservoirs to identify possible routes of cross transmission or point sources. This analysis was reviewed against the sequential effect of the control measures implemented. Mortality attributable to infection was determined by clinical evaluation.

## Results

We identified a total of 12 cases from April 4 through May 18 (a rate of 2.72 per 1,000 patient days). All patients had positive samples from the respiratory tract (1 patient also had a positive blood sample). Of these cases, 4 developed pneumonia, and 3 infected patients died. One of these deaths was attributable to the infection. Other clinical and demographical characteristics are displayed in Table 1.

Most case patients had been previously receiving 3 or more broad-spectrum antibiotics. The previous mean lengths of stay in the hospital and in the ICU were 37 and 17 days, respectively (Table 1). This outbreak was controlled after a third tier of control measures (Figure 1).

In total, 232 environmental samples were collected. All tap and distilled water, aqueous chlorhexidine, dialysate solution, and intravenous infusions samples were negative for microorganisms. Tap water free residual chlorine levels were above 0.2 ppm.

In addition to the isolates derived from the patients, *C. indologenes* was recovered from 8 sinkholes of handwashing sinks in patient boxes; 5 of these related to patient cases. Also, *C. indologenes* was recovered from 3 air samples taken close to the sinks: 1 from the reprocessing room and 2 near handwashing stations in patient boxes. Only 5 of these environmental samples could be analyzed by PFGE typing due to overgrowth of other microorganisms.

The PFGE results from all 12 patients showed a unique pattern indistinguishable from the isolate recovered from the air close to the reprocessing room sink (pattern 1). The other 4 environmental isolates had distinct PFGE patterns, except for a couple of samples from the same box (sinkhole and air close to the basin) sharing the same pattern (pattern 2).

Furthermore, many other species of bacteria, mainly NFGNB but also *Enterobacteriaceae* and fungi, were recovered from the water drainage system (ie, sinkholes and the hemodialysis draining trap). Most of these microorganisms where also recovered from air samples close to the sinks (Supplementary Table 1).

## Discussion

We describe an outbreak of *C. indologenes* infections and colonizations that resulted in important morbidity and mortality in a critically ill population. In total, 12 patients acquired the microorganism during a 6-week period; 33% of them developed serious infections, and 3 infected patients died (75%). We were able to control the outbreak after 6 weeks.

Interventions to contain the outbreak started shortly after identification of the first cases. They included reeducation of staff on

**Table 1.** Characteristics of Patients Infected and Colonized by *Chryseobacterium indologenes*

| Characteristics | Cases (N = 12) No. (%)[a] |
|---|---|
| Demographic | |
| Male sex | 8 (66.6) |
| Age, median y (range) | 56 (35–78) |
| Surgical ICU | 9 (75.0) |
| Clinical characteristics | |
| Infected cases | 4 (33.3) |
| Main diagnosis | |
| Heart disease[b] | 4 (33.3) |
| Solid organ transplant[c] | 4 (33.3) |
| Cystic fibrosis | 1 (8.3) |
| Colorectal cancer | 1 (8.3) |
| Others[d] | 2 (16.6) |
| Hospital stay | |
| Hospital days before event, median (range) | 37 (3–110) |
| ICU days before event, median (range) | 17 (3–96) |
| Invasive devices | |
| Mechanical ventilation | 12 (100.0) |
| Central line | 12 (100.0) |
| Hemodialysis | 6 (50.0) |
| Previous antibiotic exposure | 10 (83.3) |
| Overall mortality, within 30 d | 6 (50.0) |
| Case fatality (infected patients) | 3 (75.0) |
| Death directly related to infection | 1 (25.0) |

NOTE. ICU, intensive care unit.
[a]Unless otherwise specified.
[b]Cardiac valvular disease (n = 3), aortic aneurysm (n = 1).
[c]Lung transplant (n = 2), cardiopulmonary transplant (n = 1), kidney transplant (n = 1).
[d]Traumatic brain injury (n = 1), idiopathic pulmonary fibrosis (n = 1).

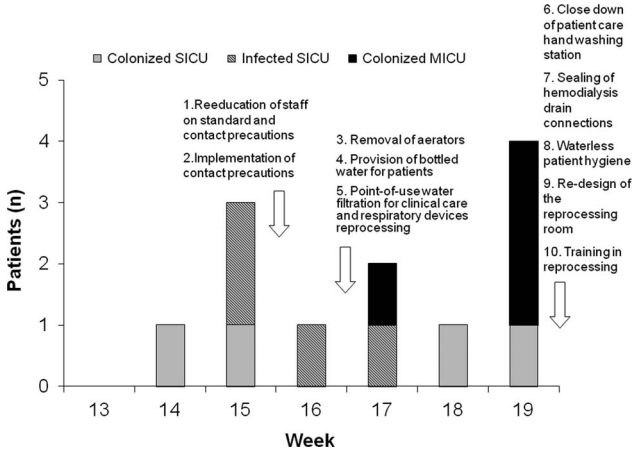


**Fig. 1.** Epidemic curve and timing of control measures.

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standard and contact precautions, implementation of contact precautions, removal of aerators, provision of bottled water for patients, and point-of-use water filtration for clinical care and respiratory devices reprocessing, but new cases occurred. After closing patient-care handwashing stations, sealing hemodialysis drain connections, establishing waterless patient hygiene, redesigning the reprocessing and storage of material, and training in reprocessing, no new cases appeared for the next 5 months (Figure 1).

We were unable to assure the real mode of transmission. The recovery of the same PFGE of *C. indologenes*, as well as other microorganisms, from drainage sinks and air in its vicinity, demonstrates that contamination of devices close to the sinks is possible by aerosolization of drainage water, which potentially played a role in this outbreak. Also, contamination of respiratory devices during reprocessing could have played an important role because the same PFGE pattern was shared by patients and the air sample close to the sink in the reprocessing room that occasionally serves both ICUs. Unfortunately, only 5 of the 11 environmental specimens could be analyzed by PFGE; thus, we were not able to prove the contamination of handwashing sinks as the cause of the outbreak. The immediate control of the outbreak after implementation of the third tier of measures would support both hypotheses. Other hypotheses, such as lapses in hand hygiene between patients, also cannot be ruled out.

In conclusion, sinkholes and drains are potentially contaminated and can act as a reservoir for NFGNB and other microorganisms. Tap water flushing may spread them to surrounding areas. Susceptible patients and their equipment should be protected from these splashes because contamination can occur.

**Supplementary materials.** To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2018.126

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