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bla_{VIM} in wastewater drains: A hidden circulation of VIM-producing Enterobacterales in the hospital setting?

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To the Editor—Infections with carbapenemase-producing Enterobacteriaceae (CPE) are an increasing threat to public health.[1] The risk of in-hospital mortality due to CPE bloodstream infection is considerably greater than that for carbapenemase-susceptible bloodstream infections. In France, VIM-producing Enterobacteriaceae represent <5% of all CPE.[2] In our teaching hospital in western France, only 3 patients with VIM-producing *Enterobacter cloacae* had been identified before January 2020 (November 2015, October 2016, and December 2018). These patients had been hospitalized in 3 different wards and had been fortuitously identified by rectal screening, with lengths of hospitalization preceding positive screening of 6, 34, and 204 days, which could suggest in-hospital acquisitions. We questioned whether these 3 cases were really isolated or if additional but undetected cases did or could occur. Concurrently, concerns are growing over the importance of the hospital water environment as a long-term reservoir of CPE.[3–5] We investigated the potential role of wastewater drains in the hidden circulation of VIM-producing Enterobacteriaceae.

The study was performed in a 1,500-bed French teaching hospital. CPE carriage is systematically screened by rectal swabbing patients hospitalized in the intensive care units, at the time of admission, and once each week during hospitalization. In the other wards, CPE carriage is screened at the time of admission in patients who have been hospitalized in a foreign country within the preceding year and for contact cases. Wastewater drain sampling was performed in December 2019 in 4 intensive care units (ICUs), 11 medical units and 3 surgical units. In the ICUs, all sink drains of patient rooms were sampled (1 sink drain in each room). Outside the ICUs, the 3 rooms in which VIM-positive patients had been hospitalized were sampled, and 30 other rooms were randomly chosen for sampling. In each of these rooms, the sink drain and the shower drain were sampled. Samples were performed by inserting eSwab sterile swabs (Copan Italia, Brescia, Italy) to a depth of ∼5 cm in each drain and rotating them to collect specimens from the inner wall of the drain for a minimum of 3 insertions. Specimens were stored at 4°C before culture, and an aliquot of the eSwab broth was immediately stored at −80°C before molecular analysis. Swabs were plated onto selective agar plates (CHROMID Carba Smart, bioMérieux, Marcy l'Etoile, France). No enrichment in nutrient broth was performed before plating. Identification of suspicious colonies was performed by matrix-assisted laser desorption/ionization-time of flight mass spectrometry using a VITEK MS mass spectrometer (bioMérieux). For suspicious colonies, carbapenemases were detected by immunochromatography (RESIST-4 O.K.N.V., Coris Bioconcept, Gembloux, Begium). A confirmation was planned, if appropriate, using the method of combined test (Rosco Diagnostica, Taastrup, Denmark). To increase the sensitivity of the screening, detection of carbapenemase genes was performed in the eSwab broth by qualitative real-time polymerase chain reaction (PCR) with a GeneExpert System (Xpert Carba-R; Cepheid, Sunnyvale, CA), which allowed us to identify bla_{OXA-48}, bla_{KPC}, bla_{IMP}, bla_{NDM}, and bla_{VIM}.

Overall, 102 wastewater drains (69 sink drains and 33 shower drains) were sampled from 36 rooms in ICUs and 33 rooms in the other wards. The results of cultures and PCR are presented in Table 1. We identified 29 carbapenemase genes in 26 rooms: 15 rooms in ICUs and 11 rooms in the other wards. Therefore, the

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Table 1. Number of Carbapenemase-Producing Enterobacterales and Corresponding Carbapenemase Genes Identified in 102 Wastewater Drains From Intensive Care Units, Medical Wards, and Surgical Wards

Drain	OXA-48-CPE, No. (%)	bla_{OXA-48}, No. (%)	KPC-CPE, No. (%)	bla_{KPC}, No. (%)	NDM-CPE, No. (%)	bla_{NDM}, No. (%)	VIM-CPE, No. (%)	Bla_{VIM}, No. (%)
Sink drains (N = 69)	8 (11.6)	10 (14.5)	2 (2.9)	2 (2.9)	0	2 (2.9)	0	2 (2.9)
Shower drains (N = 33)	0	3 (9.1)	0	0	0	3 (9.1)	0	7 (21.2)
Overall water drains (N = 102)	8 (7.8)	13 (12.7)	2 (2.0)	2 (2.0)	0	5 (4.9)	0	9 (8.8)

Note. OXA-48-CPE, OXA-48-like producing Enterobacterales; KPC-CPE, KPC-producing Enterobacterales; NDM-CPE, NDM-producing Enterobacterales; VIM-CPE, VIM-producing Enterobacterales; %, proportion of contaminated drains.

proportion of rooms with at least 1 carbapenemase gene in wastewater drains was 37.7%. bla_{VIM} was identified in 13.0% of wastewater drains and represented 31.0% of the carbapenemase genes identified. Notably, bla_{VIM} was identified in the shower drain of a room where a VIM-positive patient had been hospitalized in 2015, 4 years before the wastewater drain sampling campaign. Also, no CPE was isolated from wastewater drains sampled in medical or surgical wards. Overall, no VIM-CPE was isolated from cultures.

These results raised the high proportion of wastewater drains with carbapenemase genes in both ICUs and other wards, which is concerning, even though the risk of patient contamination from wastewater drains is still a matter of discussion, especially in the context of an outbreak.[4–8] Unexpectedly, bla_{VIM} was detected in 1 of 7 wastewater drains, whereas only 3 VIM-positive patients had been previously identified in our hospital. Importantly, there were no VIM-CPE–positive cultures from wastewater drains with bla_{VIM}. This finding could be due to a lower sensitivity of the culture methods compared to polymerase chain reaction (PCR), or it could represent low levels of contamination of wastewater drains with VIM-CPE. The presence of bla_{VIM} in the room where a patient had been previously identified as VIM-CPE carrier tends to support this hypothesis. Another hypothesis is the presence of other bacteria in wastewater drains, such as *Pseudomonas aeruginosa* or *Acinetobacter baumannii*, which would be able to produce VIM carbapenemase. Actually, *P. aeruginosa* was isolated on selective plates from 8 wastewater drains. However, immunochromatography tests and PCR assays were negative for all of these isolates. Because active screening is only implemented in the ICUs, some CPE-positive patients may not have been identified in the preceding years. By considering the impossibility of screening all hospitalized patients, the presence of bla_{VIM} in wastewater drains indicate the hidden circulation of VIM-CPE in the hospital setting. If this hypothesis were confirmed by additional studies, periodic campaigns of random sampling of wastewater drains could be undertaken to record this potential indicator as a surveillance measure.

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