

bla_{VIM}-producing *Enterobacter cloacae* in Ontario, Canada: Links between Sewage, Surface Water, and Human Isolates

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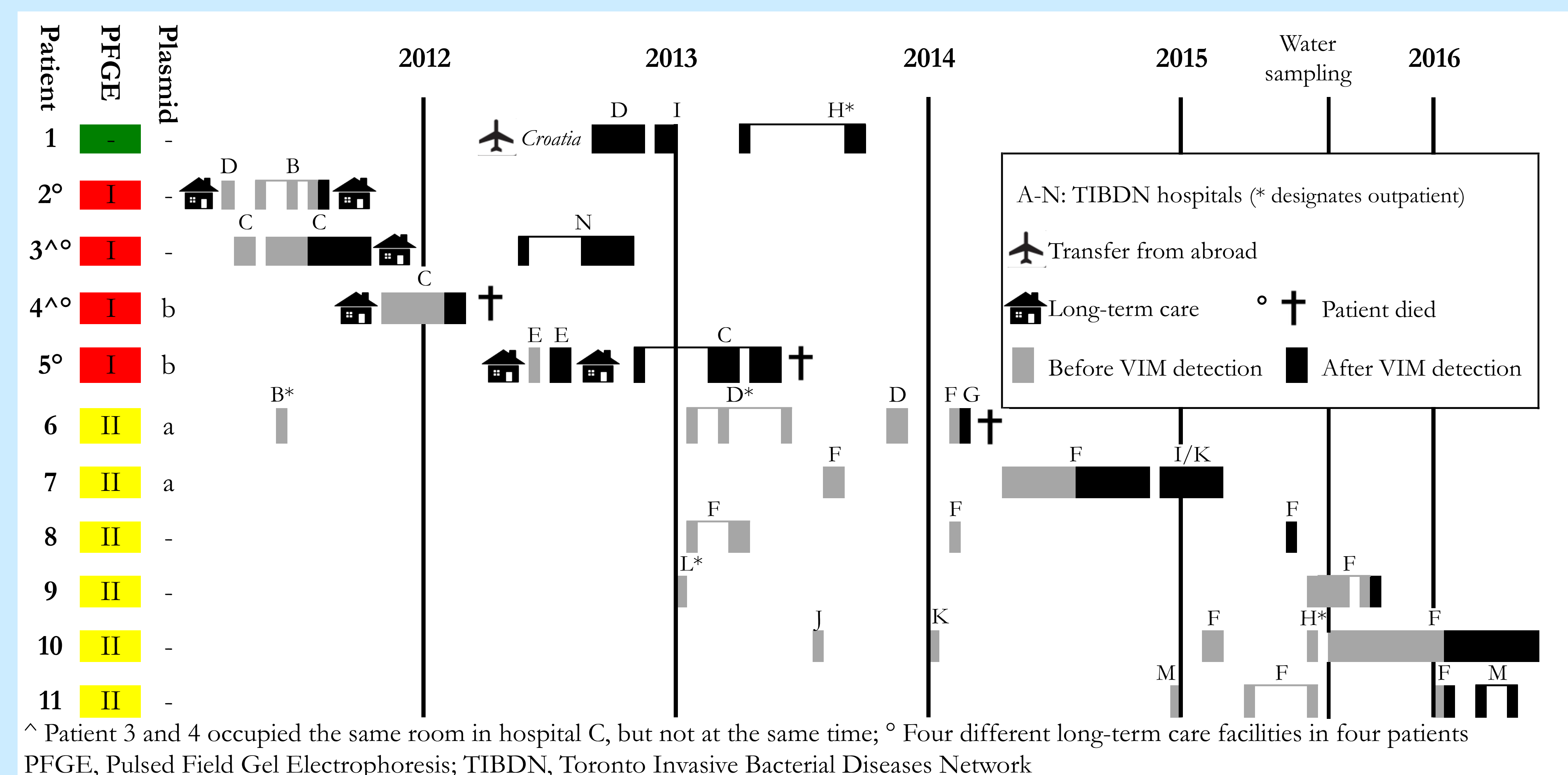
Background

- In Canada, carbapenemase-producing *Enterobacteriaceae* (CPE) are rare and usually imported from CPE-endemic countries.
- We report two patient clusters – none with hospitalizations abroad – of Verona integron-encoded metallo-β-lactamase producing *Enterobacter cloacae* (VIM-EC) linked to isolates from water in Ontario, Canada.

Methods

- We analyzed population-based data from Toronto Invasive Bacterial Diseases Network (TIBDN) surveillance from first identified CPE in 2007 until March 2016 to identify VIM-EC colonized or infected patients.
- Sewage treatment plants (STP) and surface water from one watershed (WS) in the population area were sampled in 2015. Pulsed-field gel electrophoresis (PFGE) and plasmid sequencing (PS) were performed on all patients and water samples.
- All VIM-positive patients were screened for hospital admissions or outpatient visits within the TIBDN between 2011 and 2016 to identify epidemiological links between patients. Hospital admissions abroad were also registered.

Figure 1. Inpatient and outpatient healthcare contacts in the TIBDN surveillance area as well as hospital admissions abroad of patients with VIM-producing *Enterobacter cloacae*, 2011-2016



Results

- We identified 11 patients with VIM-EC; median age 76.5y; median Charlson score 2. Five developed an urinary tract infection; one a blood stream infection (BSI). In-hospital mortality was 18% (2/11, whereof one with VIM-BSI).
- Ten patients comprised 2 PFGE clusters: Cluster I (in red) linked 4 patients to a WS sample (with different plasmids). Three of 4 patients came from different long-term care facilities. Two patients shared the same room in hospital C, but not at the same time.
- Cluster II (in yellow) linked 6 patients to a STP sample (same plasmid between patient and water samples). All six patients were linked to hospitals F and G (Fig 1; Fig 2).
- Although all patients had significant healthcare exposure before VIM detection, none of the 10 patients linked to a cluster had been hospitalized abroad. The patient with a unique PFGE isolate (patient 1, in green) had been hospitalized in Croatia in the same city and time as a reported VIM-*E. cloacae* outbreak (Fig 3).

Figure 2. Map of south central Ontario indicating locations of environmental and patient samples positive for VIM-producing *Enterobacter cloacae*. Clustering based on PFGE, letters indicate results of plasmid sequencing.

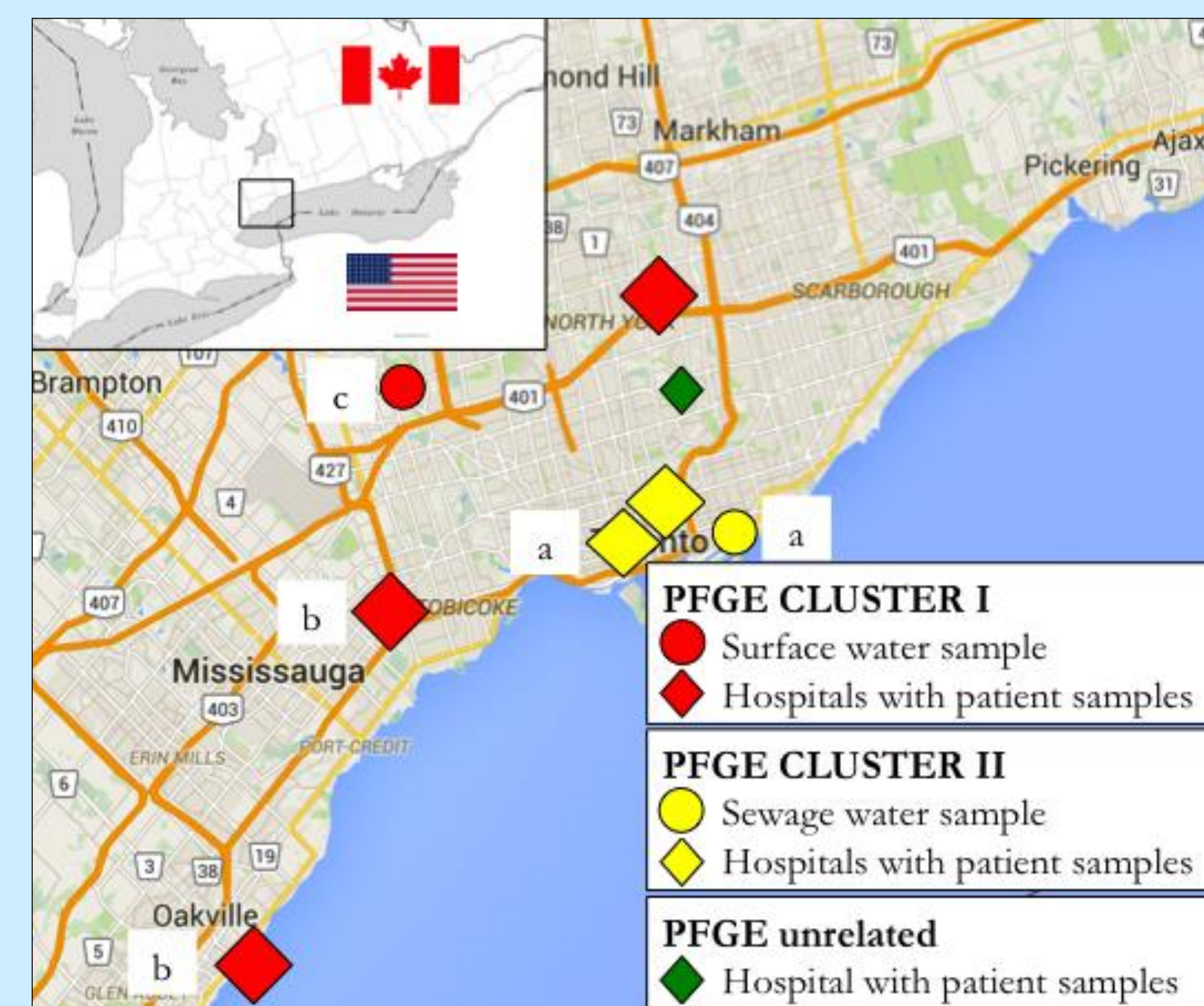
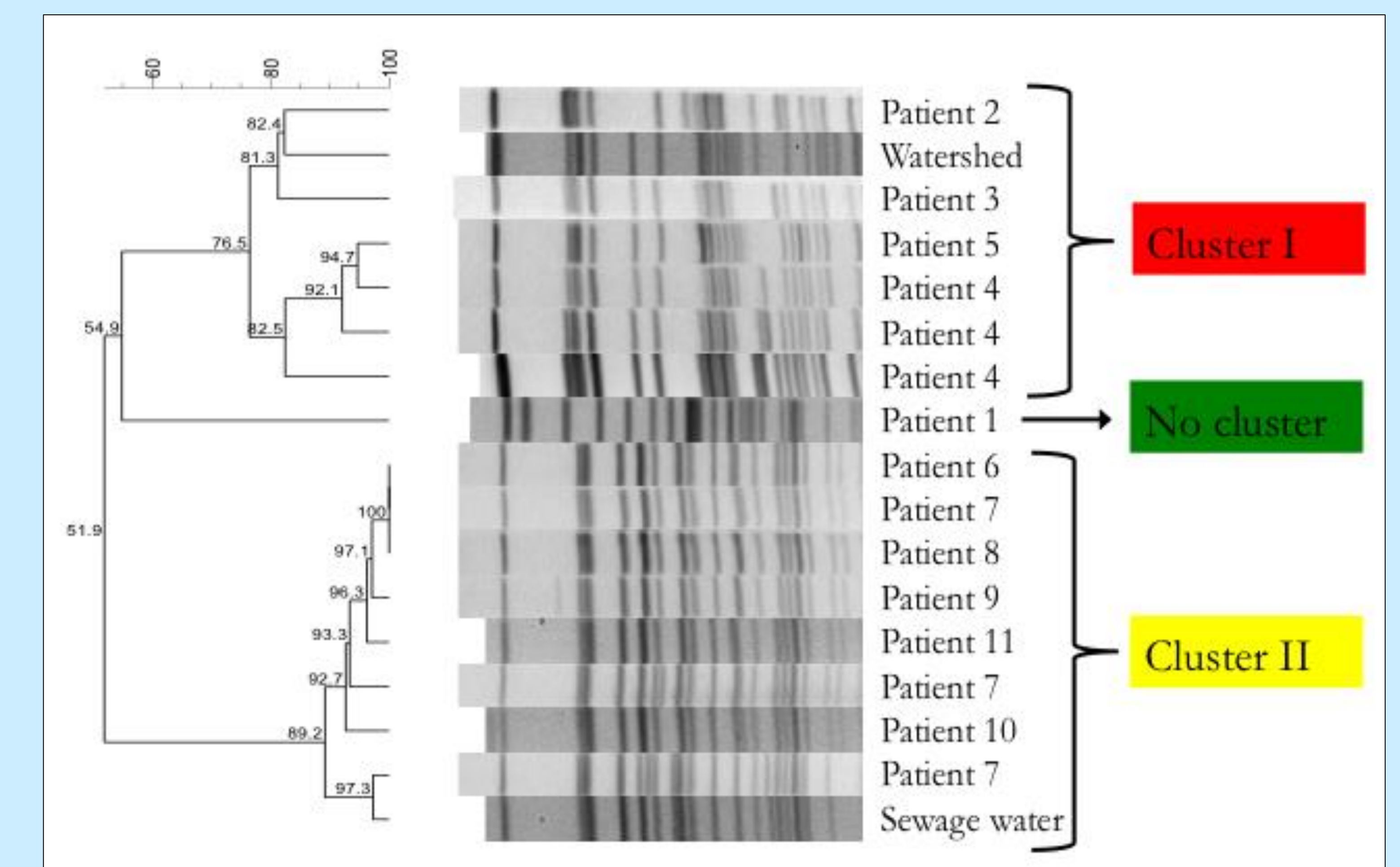


Figure 3. PFGE of 11 patient and 2 water samples with VIM-producing *Enterobacter cloacae* (patient 11 was colonized with an *E. hormaechei* strain)



Conclusions

- Most VIM-EC in Ontario seem to be autochthonous given the lack of hospital admissions abroad for most patients.
- Not all patients among PFGE clusters can be linked despite thorough epidemiological work-up. Positive water samples involving the same strains and plasmids as found in patient samples suggest that water may be an important reservoir.
- More work is urgently needed to identify environmental CPE reservoirs and to investigate potential risks in long-term care facilities.