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## Brief Report

# *Serratia marcescens* outbreak in a COVID-19 intensive care unit – Are there any factors specific to COVID-19 units that facilitate bacterial cross-contamination between COVID-19 patients?

Joao Costa Mendes MD<sup>1,2,\*</sup>, André Casado MD<sup>1</sup><sup>1</sup> Hospital da Luz Lisboa, Lisbon, Portugal<sup>2</sup> NOVA Medical School, Universidade Nova de Lisboa, Lisbon, Portugal

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## S U M M A R Y

COVID-19 dedicated units were created early in the pandemic. Despite their need, factors specific to these units can possibly increase the risk of bacterial cross-contamination between COVID-19 patients. We report a *Serratia marcescens* outbreak in a COVID-19 intensive care unit, later discussing factors specific to COVID-19 units that may facilitate bacterial cross-contamination in such units, and raising awareness for such an issue.

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## REPORT

Since COVID-19 was first reported, the scientific community has worked hard to battle COVID-19. In the last months, vaccination rates increased and hospital admissions, mainly in developed countries, are decreasing. However, COVID-19 dedicated units are still commonplace and, to our knowledge, published reports on inpatient bacterial cross-contamination between COVID-19 patients are limited. We report a *Serratia marcescens* outbreak which occurred in a 16-bed intensive care unit (ICU) in Portugal during a period of high COVID-19 incidence (February 2021), later discussing the role of some factors, specific to COVID-19 units, that may facilitate bacterial outbreaks in COVID-19 units, and raising awareness for such outbreaks.

This outbreak started on February 2, 2021. Patient A had been admitted to the ICU due to COVID-19 pneumonia 4 days before. On mechanical ventilation for 3 days, further respiratory compromise, increased inflammatory parameters, and worsened septic shock

\* Address correspondence to Joao Costa Mendes, MD, Hospital da Luz Lisboa, Portugal, NOVA Medical School, Universidade Nova de Lisboa, Lisbon, Portugal.

E-mail address: [joaorcostamendes@gmail.com](mailto:joaorcostamendes@gmail.com) (J.C. Mendes).

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ensued. He was started on piperacillin-tazobactam and tracheobronchial cultures were collected. These were positive for *Serratia marcescens* that was resistant to amoxicillin-clavulanate and sensitive to piperacillin-tazobactam, meropenem, and gentamicin. Four days later, on February 6, 2021, a second patient (patient B) also tested positive for a *Serratia marcescens* with the same antibiotic susceptibility test. He was on day 2 of meropenem, which was maintained for 14 days. The same happened during the next weeks to 5 more patients: on February 9, 2021, patient C also tested positive for *S. marcescens*. He lied in the room next to that of patient A. Later, on February 20, 2021, patient D became positive. Patient E *S. marcescens* was identified on February 27, 2021, patient F on March 3, 2021, and, finally, on March 7, 2021, *S. marcescens* was identified one last time, in the tracheobronchial secretions of patient G, a patient that had undergone tracheostomy 10 days before. Overall, 7 patients tested positive for *S. marcescens* during a 33-day period, during which 32 patients were cared for in this ICU, meaning that 21.9% of the patients treated in this ICU during this period became superinfected with *S. marcescens*. Of these, 6 were diagnosed with ventilator-associated pneumonia caused by *Serratia marcescens* (3 with associated septic shock), and 1 was diagnosed with *Serratia marcescens* bacteraemia. All isolates had the same profile of antibiotic susceptibility. Patients' clinical courses and information regarding *S. marcescens* infection are further detailed in Table 1.

There are several published reports of *Serratia marcescens* hospital outbreaks.<sup>1</sup> However, in COVID-19 dedicated units, this is, to our

**Table 1**  
Patients' clinical course, *S. marcescens* infection information, and clinical outcomes

Patient	Sex	Age	Day of COVID-19 diagnosis	Day of hospital admission	Day of ICU admission	Date of specimen collection	Type of specimen where the <i>Serratia marcescens</i> was identified	Clinical course of the patient associated with <i>Serratia marcescens</i> identification	Treatment	Day of ICU discharge	Day of hospital discharge	Outcome
A	Male	76	Jan 28, 2021	Jan 28, 2021	Jan 28, 2021	Feb 2, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia and septic shock	Piperacillin-tazobactam	Apr 26, 2021	Jun 6, 2021	Death in the ward
B	Male	84	Jan 24, 2021	Jan 29, 2021	Jan 29, 2021	Feb 6, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia and sepsis	Meropenem	Mar 31, 2021	Jun 28, 2021	Discharged home
C	Male	71	Jan 24, 2021	Jan 24, 2021	Jan 26, 2021	Feb 9, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia and septic shock	Meropenem	Mar 10, 2021	-	Death in the ICU
D	Male	69	Jan 25, 2021	Feb 2, 2021	Feb 7, 2021	Feb 20, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia	Piperacillin-tazobactam	Apr 1, 2021	Apr 9, 2021	Discharged home
E	Female	75	Jan 28, 2021	Feb 2, 2021	Feb 9, 2021	Feb 27, 2021	Blood cultures	Bacteraemia	Piperacillin-tazobactam	Mar 7, 2021	Apr 7, 2021	Discharged home
F	Female	77	Feb 16, 2021	Feb 16, 2021	Feb 19, 2021	Mar 3, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia and septic shock	Piperacillin-tazobactam	-	-	Discharged to another ICU on Mar 23, 2021
G	Female	67	Jan 22, 2021	Jan 24, 2021	Jan 25, 2021	Mar 7, 2021	Tracheobronchial secretions	Ventilator-associated pneumonia	Piperacillin-tazobactam	Mar 15, 2021	Mar 19, 2021	Discharged home

knowledge, only the second *Serratia marcescens* outbreak reported, after the report by Amarsy *et al* in 2020, early in the pandemic.<sup>2</sup> We believe that this outbreak negatively impacted on our patients' outcomes. It increased antibiotic exposure and was probably associated with increased morbidity, more days on mechanical ventilation and longer ICU and hospital lengths of stay. This in accordance with previous studies, which show that superinfection of COVID-19 patients is associated with worse clinical outcomes.<sup>3</sup>

On the factors leading to such outbreaks, we do believe some factors, specific for COVID-19 units, can play an important role. One of them relates to how personal protective equipment (PPE) is used in COVID-19 units. As recommended, health care professionals (HCPs) should protect themselves at all times.<sup>4</sup> This is usually achieved by donning and doffing at the beginning and end of the shift, meaning that the HCP will contact different patients with the same PPE, possibly carrying pathogens around the unit and cross-infecting some of them. Changing or disinfecting PPEs in between patients, as well as using a second layer of protective equipment for each patient, such as a second surgical gown, apron and gloves, which are donned before every contact and disposed of after caring for that patient have been advocated. This is what happened in our institution. Patients positive for *S. marcescens* were isolated and precautions using a second layer of PPE were instituted. However, some PPEs (masks, goggles, face shields) are still not amenable to such practices. This can help explain the spread of *S. marcescens* in our unit. Moreover, PPE shortages, despite having been more common early in the pandemic, do continue to occur in many countries, preventing the use of a second layer every time a patient is handled.

A second factor we believe may be a promotor of bacterial cross-contamination in COVID-19 units is the fact that all patients are infected with the same pathogen. This precludes caring for cross-contamination of SARS-CoV-2, giving HCPs the false perception that cross-contamination is not an issue in such a ward. This is of course not true. SARS-CoV-2 infected patients are, as any other patients, at risk for infection by other microorganisms during the course of their COVID-19 pneumonia. Actually, pulmonary bacterial co-infections in COVID-19 hospitalized patients have been reported to have an incidence of at least 7% (14% in ICUs), being associated with worse clinical outcomes.<sup>5</sup>

Other factors that may have explained an increased likelihood of bacterial cross-contamination in COVID-19 units in the past, are now, we believe, less likely to have a role. Such is the case of the increased workload imposed on HCPs during the past year, with higher patient-HCP ratios and higher HCP burnout rates, which are associated with increased rates of health care associated infections.<sup>6,7</sup> Another relates to the unprecedented need to repurpose hospital wards and spaces which were not used to care for infected patients, which may lack the structure and logistics to properly prevent cross-contamination, and to reallocate HCPs outside their area of expertise, which could have further promoted cross-contamination. Finally, infection prevention and control teams, which usually provide support to units in terms of outbreak containment, probably were not able to provide such support during the pandemic. They planned for hospital reorganization during the pandemic, implemented diverse protocols on SARS-coV-2 and reviewed them on a regular basis as SARS-coV-2 knowledge expanded. These issues may still play an important role during future pandemic waves or if new SARS-CoV-2 vaccine-evading variants emerge.

Therefore, as observed by this *Serratia marcescens* outbreak, bacterial outbreaks in COVID-19 ICUs and wards can happen, negatively impacting on COVID-19 patients' outcomes. Some factors specific to COVID-19 wards can increase cross-contamination in COVID-19 inpatient cohorts. Raising awareness for this topic and implementing proper and further strategies to prevent cross-contamination in COVID-19 units is, therefore, paramount.

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