



Marcelo Petean Amaro, Lucas Mira Gon, André Canettieri Rubez, Caio Di Donato Ribeiro, Antônio Luis Eiras Falcão, Cássio Luís Zanettini Riccetto

Division of Urology, Department of Surgery, Hospital das Clínicas, School of Medical Sciences, State University of Campinas

Introduction and Objectives

Bacterial coinfections have been reported in 7% of hospitalized coronavirus disease (COVID-19) patients and in up to 14% of COVID-19 patients in intensive care units (ICUs), (1) The lungs, bloodstream, and urinary tract are among the most common sites of coinfection.

In 2020, Haocheg et al. reported bacterial lung infections (55%) as the most common coinfection among 38 critically ill hospitalized patients with COVID-19, followed by sepsis (34%) and urinary tract infection (UTI) (7.8%). (2) Although UTIs play an important role in coinfections, it is unclear whether there is a relation between UTI and COVID-19. There is still a lack of evidence of epidemiological data, microbiological profiles, and risk factors for the possible association.

Therefore, the objective of this study was to identify the main risk factors for UTI in hospitalized COVID-19 patients and to find the most common etiological agents.

Methods

This retrospective study analyzed the data of patients admitted to a regional hospital between March 2020 and August 2021. As a reference center, most wards and ICUs were reassigned to treat COVID-19 patients during that period. The study included all patients who had SARS-CoV-2 infection confirmed by polymerase chain reaction (PCR) testing and at least one urine culture sample available.

UTI was diagnosed if 100,000 or more colony-forming units were detected in the urine culture. Only samples collected by sterile catheterization or mid-stream urine samples after disinfection were considered.

The variables studied as possible risk factors for UTI in COVID-19 patients were age, sex, leukopenia (defined as a white blood cell count below 4,000 leukocytes/ μ L (3), comorbidities [such as diabetes mellitus (DM) and obesity], ICU admission, orotracheal intubation (OTI), indwelling urinary catheter (IUC) use, and length of hospital stay.

	Table 1:	General descriptive	analysis.				
		Variables		. 00	Data (n = 447)		
		Ages (years)		min max.	19 - 96.00		
		(per microliter)	nt	min - max	0.30 - 30.00		
		Hospital stays (day	ys)	average ± SD min - max	26.5 ± 29.62 1.00 - 348.00		
		Gender		Female Male	186 (41.6%) 261 (58.4%)		
		Hospitalization sit	te	Ward Intensive Care Unit (ICU)	185 (41.4%) 262 (58.6%)		
		Urine culture		Positive Negative	185 (41.4%) 262 (58.6%)		
		Death		Yes	143 (32.1%) 303 (67.9%)		
		Diabetes Mellitus (D	DM	Yes No	172 (38.5%) 275 (01.5%)		
		Obesity		Yes	108 (23.8%) 340 (78.2%)		
		DM and Obesity		none	226 (50.7%) 58 (13.0%)		
		Leukopenia		Yes	37 (8.3%)		
	Indwell	ing Urinary Catheteria	zation (IUC)	Yes	280 (62.9%)		
	c	rotracheal Intubation	(OTI)	No Yes	165 (37.1%) 238 (53.2%)		
		ILC or OTI		No	209 (46.8%)		
				Both	228 (51.2%)		
		> ou years old		No	231 (51.7%)		
		Hospital stay > 7 da	ays	Yes No	383 (81.2%) 84 (18.8%)		
Table 2: Description of COVID-19 patie	nts with or without Uri	inary Tract Infection (U	ITI)	Pathogens		Frequency (n=185)	Percentaj
variacies	No (n=262)	(n=185)	P value	Candida albicans		54	29.2%
Age (average ± SD)	55.41±18.13	61.38±13.91	0.0002	Klebsiella pneumoniae		33	17.8%
White Blood Cells (average± SD)	9.40 ± 4.97	10.47 ± 5.32	0.0279	Enterococcus faecalis		28	15.1%
White Blood Cells (average± SD) Hospital Stay (average ± SD)	9.40 ± 4.97 18.72 ± 21.94	10.47 ± 5.32 37.51 ± 35.15	0.0279 <.0001	Enterococcus faecalis Candida tropicalis		28 28	15.1% 14.1%
White Blood Cells (average± SD) Hospital Stay (average ± SD) Female Male	9.40 ± 4.97 18.72 ± 21.94 90 (34.4%) 172 (85.8%)	10.47 ± 5.32 37.51 ± 35.15 98 (51.9%) 89 (48.1%)	0.0279 <.0001 0.0002	Enterococcus faecalis Candida tropicalis Candida glabrata		28 28 25	15.1% 14.1% 13.5%
White Blood Cells (average± SD) Hospital Stay (average ± SD) Female Male Ward Intensive Care Unit (ICU)	9.40 ± 4.97 18.72 ± 21.94 90 (34.4%) 172 (65.6%) 135 (51.7%) 126 (48.3%)	10.47 ± 5.32 37.51 ± 35.15 98 (51.9%) 89 (48.1%) 48 (25.3%) 138 (74.7%)	0.0279 <.0001 0.0002 <.0001	Enterococcus faecalis Candida tropicalis Candida glabrata Escherichia coli Providenzes aenuciones		28 28 25 22 20	15.1% 14.1% 13.5% 11.9%
Vihite Blood Cells (average± SD) Hospital Stay (average ± SD) Female Male Vlard Intensive Care Unit (ICU) Death No Death Yes	9.40 ± 4.97 18.72 ± 21.94 90 (34.4%) 172 (85.8%) 135 (51.7%) 128 (48.3%) 200 (78.8%) 81 (23.4%)	10.47 ± 5.32 37.51 ± 35.15 89 (48.1%) 46 (25.3%) 138 (74.7%) 82 (44.3%)	0.0279 <.0001 0.0002 <.0001 <.0001	Enterococcus faecalis Candida tropicalis Candida glabrata Escherichia coli Pseudomonas aeruginosa Candida gargasijosis,		28 25 22 20 9	15.1% 14.1% 13.5% 11.9% 10.8% 4.9%
White Blood Cells (average: SD) Hospital Stay (average: SD) Male Ward Intensive Care Unit (ICU) Death No Death Yes DMf Yes	9.40 ± 4.97 18.72 ± 21.94 90 (34.4%) 172 (65.6%) 135 (61.7%) 126 (48.3%) 200 (76.6%) 61 (23.4%) 181 (60.1%) 181 (60.1%)	10.47 ± 5.32 37.51 ± 35.15 89 (51.9%) 89 (48.1%) 48 (25.3%) 138 (74.7%) 103 (55.7%) 82 (44.3%) 94 (50.8%) 94 (50.8%)	0.0279 <0001 0.0002 <0001 <0001 <0001	Enterococcus faecalis Candida tropicalis Candida glabrata Escherichia coli Pseudomonas aeruginosa Candida <u>garansilosia</u> Enterococcus faecium		28 25 22 20 9 9	15.1% 14.1% 13.5% 11.9% 10.8% 4.9%
White Blood Cells (average 450) Hospital Stay (average 450) Fernale Ward Intensive Care Unit (ICU) Death No Death Yes DM ⁴ No Onacity No	9.40 ± 4.97 18.72 ± 21.94 60 (34.4%) 172 (65.6%) 135 (51.7%) 126 (45.3%) 200 (76.6%) 61 (23.4%) 181 (69.1%) 81 (30.9%) 204 (78.2%)	10.47 ± 5.32 37.51 ± 35.15 90 (51.0%) 89 (48.1%) 46 (25.3%) 103 (55.7%) 82 (44.3%) 94 (50.8%) 94 (50.8%) 91 (49.2%) 138 (75.5%)	0.0279 <0001 0.0002 <.0001 <.0001 <.0001	Enterococus fecelis Cendida tropicalis Cendida glabrata Escherichia coli Pseudomonas aeruginosa Cendida gargositosio Enterococus fectum Trichosocon asahii		28 28 25 22 20 9 9 8 6	15.1% 14.1% 13.5% 11.9% 4.9% 4.9% 3.2%
White Blood Cells (average SD) Hospital Stay (average ± SD) Female Ward Intensive Care Unit (ICU) Death No Death Yes DM" No Obesity No Obesity Yes	9.40 ± 4.97 18.72 ± 21.94 60 (34.4%) 135 (61.7%) 135 (61.7%) 128 (46.3%) 61 (23.4%) 181 (60.1%) 81 (30.9%) 204 (76.2%) 204 (76.2%)	10.47 ± 6.32 37.51 ± 35.15 90 (51.9%) 80 (48.1%) 138 (26.3%) 138 (26.3%) 138 (26.3%) 138 (24.3%) 94 (50.8%) 94 (60.8%) 91 (49.2%) 91 (49.2%) 138 (73.5%)	0.0279 <0001 0.0002 <0001 <0001 <0001 0.2559	Enterococus feecalis Candida tropicalis Candida glabrata Escherichia coli Pseudomonas aeruginosa Candida garganilosis Enterococous feeclum Jinchosococo asebii Proteus mirabilis		28 25 22 20 9 9 8 5	15.1% 14.1% 13.5% 11.9% 4.9% 4.9% 3.2% 2.7%
White Bood Calls (averages SD) Hospital Stay (average ± SD) Fernale Male Ward (Intensive Care Unit (ICU) Death Yes Daff Yes Daff Yes Daff Yes Daff Yes Daff Yes Daff and Deaty (non) DM and Deaty (both)	9.40 ± 4.97 18.72 ± 21.94 90 (34.4%) 172 (85.8%) 135 (61.7%) 136 (48.3%) 200 (78.8%) 81 (301.9%) 204 (78.2%) 87 (21.8%) 148 (55.9%) 23 (8.3%)	10.47 ± 5.32 37.51 ± 35.15 90 (51.9%) 80 (48.1%) 40 (25.3%) 138 (74.7%) 103 (55.7%) 82 (44.3%) 94 (50.3%) 138 (73.5%) 40 (25.5%) 40 (25.5%) 80 (43.2%) 35 (18.9%)	0.0279 <0001 0.0002 <0001 <0001 <0001 0.2559 0.0023	Enterococus feecalis Candida ropicalis Candida ropicalis Escherichia coli Pseudomonas aeruginosa Candida garasolisais Enterococus feedum <u>Lichosococ esabii</u> Proteus mirabilis diahelobacter baumanii .		28 28 25 22 20 9 9 6 5 4	15.1% 14.1% 13.5% 13.5% 10.8% 4.9% 4.9% 3.2% 2.7% 2.2%
White Bood Calls (averages SD) Hospital Stay (average ± SD) Fernale Male Ward Intensive Care Unit (ICU) Death Yes DM*Yes DM*Yes DM*Yes DM*And Deathy foot Deathy Yes DM*and Deathy foot Leukopania Yes	9.40 ± 4.97 18.72 ± 21.94 90 (24.4%) 172 (85.6%) 135 (61.7%) 126 (48.3%) 200 (76.8%) 61 (23.4%) 181 (90.1%) 81 (30.6%) 204 (78.2%) 87 (21.8%) 146 (55.9%) 23 (8.8%) 23 (8.8%) 23 (8.8%) 23 (8.8%)	10.47 ± 5.32 37.51 ± 35.15 90 (51.9%) 88 (48.1%) 40 (25.3%) 138 (74.7%) 103 (55.7%) 82 (44.3%) 94 (60.8%) 91 (40.2%) 138 (73.5%) 46 (25.5%) 80 (44.2%) 138 (73.5%) 80 (44.2%) 136 (73.5%) 80 (44.2%) 10 (5.4%)	0.0279 <.0001 0.0002 <.0001 <.0001 0.2559 0.0023 0.0841	Enterococus feecalis Candida tropicais Candida glatinata Escherichia coli Pseudomonas aeruginosa Candida gerapsilosis, Enterococus feecium Jichocacono asabis Proteus minabis Acinetabacter baumaoni. Sentala marcercocans		28 29 25 20 9 9 8 5 4 4 4	15.1% 14.1% 13.5% 11.9% 4.9% 3.2% 2.7% 2.2% 2.2%
Where Bood Calls (evenages 50) Hospital Stay (evenage 50) Male Wand Intensive Care buth (CU) Death Yos Death Yos Dea	9.40 ± 4.97 18.72 ± 21.94 90 (24.4%) 172 (65.6%) 135 (61.7%) 126 (48.3%) 61 (23.4%) 81 (20.4%) 204 (78.2%) 67 (21.6%) 77 (10.3%) 123 (69.7%) 235 (69.7%) 123 (69.7%) 124 (69.7%) 125 (69.7%) 125 (69.7%) 125 (69.	10.47 ± 5.32 37.51 ± 35.15 96 (51.9%) 86 (48.1%) 46 (25.3%) 138 (74.7%) 103 (55.7%) 82 (44.3%) 94 (50.3%) 94 (50.3%) 94 (50.3%) 94 (50.3%) 138 (73.5%) 49 (20.5%) 36 (18.9%) 35 (18.9%) 10 (54%) 32 (17.5%) 32 (17.5%) 33 (17.5%) 34 (17.5%) 35 (17.5%) 36 (17.5%) 37 (17.5%) 37 (17.5%) 37 (17.5%) 38 (17.5%) 39 (17.5%) 39 (17.5%) 39 (17.5%) 30 (17.5%)	0.0279 <.0001 0.0002 <.0001 <.0001 0.2559 0.0023 0.00541 <.0001	Enterococcus feecalis Cancida tropicalis Cancida propicalis Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida generalistica Cancida concus generalistica Stephytococcus generalisti Calculatorico cus generalisti Calculatori Calculatori Calculatori Calculatori Calc		28 29 25 20 9 9 6 5 4 4 4 3 3	15.1% 14.1% 13.5% 10.8% 4.9% 3.2% 2.7% 2.2% 2.2% 1.8%
White Bood Calls (evenages 50) Hospital Stay (evenage Maile Intensive Care Unit (CU) Death Yes DM* No Death Yes DM* No Death Yes DM* and Death (non) DM* and DM* and DM* And	9.40 ± 497 18.72 ± 21.94 00 (24.4%) 172 (65.0%) 135 (61.7%) 136 (64.7%) 161 (26.4%) 161 (26.4%) 161 (26.4%) 161 (26.4%) 260 (76.5%) 261 (26.5%) 235 (66.7%) 235 (66.7%) 235 (66.7%) 129 (46.2%)	$\begin{array}{c} 10.47\pm5.32\\ 37.51\pm35.15\\ 80(61.0%)\\ 80(68.1%)\\ 130(74.7%)\\ 130(74.7%)\\ 103(55.7%)\\ 20(44.3%)\\ 20(45.7%)\\ 100(55.7%)\\ 100(55.7%)\\ 100(54.5\%)\\ 100(54.5\%)\\ 10$	0.0279 <.0001 0.0002 <.0001 <.0001 0.2559 0.0023 0.00841 <.0001	Enterocour feesile Candide stropisile Candide stropisile Candide stropisile Escherchie coli Pesciences esterile Candide gesensibilité Enterocours destini Zichosoone sesti Protest minolité Adordalacté bastroanes Stephylococours epidemidis (Mahalle valoria)		28 29 25 22 20 9 9 8 5 4 4 3 3 3	15.1% 14.1% 13.5% 11.9% 4.9% 4.9% 3.2% 2.2% 2.2% 2.2% 1.8% 1.8%
White Bood Calls (evenages 50) Hospital Stay (evenages 50) Male Wate Wate Unit (CU) Death Yes DM* No Death NO Leakoperia Yes OT* No OT* No	9:40 ± 497 18:72 ± 21:94 00 (24.4%) 172 (65.0%) 135 (61.7%) 120 (76.5%) 200 (76.5%) 121 (24.4%) 121 (24.4%) 121 (24.4%) 121 (24.4%) 235 (66.7%) 235 (66.7%) 129 (42.5%) 129 (42.5%)	10.47 ± 5.32 37.51 ± 33.15 06 (61 5%) 86 (48.7%) 103 (65.7%) 103 (65.7%) 103 (65.7%) 103 (65.7%) 104 (26.5%) 104 (26.5%) 105 (62.5%) 105 (0.0279 <.0001 0.0002 <.0001 <.0001 0.2559 0.0023 0.00541 <.0001	Enterococco feesile Cancide opticale Cancide opticales Cancide opticales Escherichte col Peudomones exergionse Cancide espessible Cancide espessible Techeroccos feesile Proteur minobile Acientadeard baumania Staphylococcos espiormidis Vedesiles realizes Enterobacter dossee		28 29 25 22 20 9 9 6 5 4 4 3 3 3 3 3 3 3 3	15.1% 14.1% 13.5% 11.9% 10.8% 4.9% 3.2% 2.7% 2.2% 2.2% 1.8% 1.8% 1.8%
Whe Bood Calls (evenages 50) Hespital Stay (evenages 50) Male Wath Wath Used Care Unit (CU) Death Yes DMT Yes DMT Yes DMT Yes DMT Yes DMT And Checkly (work) Leakopena Yes Loch Yes UC" NS O(T" Yes DMT Yes	9:40 ± 4:97 18:72 ± 21:94 00 (34:4%) 172 (05:5%) 128 (48:3%) 200 (78:2%) 128 (48:3%) 200 (78:2%) 128 (48:3%) 200 (76:2%) 128 (48:3%) 200 (76:2%) 200 (10,47 ± 5.32 37,51 ± 35,15 (6) (6) 15%) 18 (48,7%) 19 (7,7%) 19 (74,7%) 19 (74,7%) 19 (74,7%) 19 (74,7%) 19 (74,7%) 19 (74,5%) 10 (44,7%) 10 (4	0.0279 <.0001 0.0002 <.0001 <.0001 0.0259 0.0023 0.0841 <.0001 <.0001	Enterococcar feesals Cancido epociela Cancido gebarisa Eschericha col Paesdomonas seruginosa Cancido sessancialos Enterococcars feesium Proteus mixebilis Cancidoscarb baseancii Cancidoscarb baseancii Cancid		28 29 22 20 9 8 5 4 4 3 3 3 3 3 2	15.1% 14.1% 13.8% 11.9% 4.9% 4.9% 3.2% 2.2% 2.2% 2.2% 1.8% 1.8% 1.8% 1.8%
Whe Bood Calls (evenage 50) Hespital Stay (evenage 50) Male Ward Nate Ward Intensive Care Unit (CU) Death Yes DM* No Death Yes DM* and Death Yo Cossity Yo	9:40 ± 4:67 18:72 ± 21:94 00 (34:4%) 172 (65:5%) 126 (45:3%) 126 (10.47 ± 5.32 37.51 ± 35.15 (6) (51.5%) 18 (46.1%) 19 (26.1%) 19 (27.5%) 19 (27.5%) 19 (27.5%) 19 (27.5%) 19 (27.5%) 10 (45.5%) 10 (45.5%)	0.0279 <.0001 0.0002 <.0001 <.0001 0.2559 0.0023 0.00941 <.0001 <.0001 <.0001	Enternocous feesils Candis probaits Candis probaits Candis probaits Description Pesudomonas seruptosa Candis carastitutas Candis carastitutas Enternocous feesium Proteus misolis Catologicas probaits Catologicas probaits	5	28 29 22 20 9 8 5 4 4 3 3 3 3 3 3 2 2 2	15.1% 14.1% 13.5% 11.9% 4.9% 3.2% 2.2% 2.2% 2.2% 1.8% 1.8% 1.8% 1.8% 1.1%
White Blood Calls (averages 50) Hospital Star (averages 51) Mail Ward Intensive Care Inth (CU) Cash No Dath Yos Duff and Orseity Non Obesity Non Obesity Non Obesity Non Diff and Orseity (contr) Diff and Orseity (contr) Leakoperia Yos Cultor No UCY *NO Elderly No Elderly No	9. 40 4 407 18. 72 ± 21. 40 407 (24. 407 17. 2 (65. 5%)) 126 (65. 5%) 126 (65. 5%) 126 (64. 5%) 204 (72. 4%) 216 (62. 4%) 216 (62. 4%) 216 (62. 5%) 226 (62. 5%) 226 (62. 5%) 128 (62. 5%	$\begin{array}{c} 10, 47\pm 6.32\\ 7.51\pm 5.55\\ 69(45.5^{\circ}), 120(47.5^{\circ}), 120($	0.0279 <0001 0.0002 <0001 <0001 0.0023 0.0041 <0001 <0001 <0001 <0001	Enterocour feesies Candia projusis Candia provins Exchercha col Pasadonens senginos Candia seasolatis Enterocour feesim Trictacouro seato Trictacouro seato Trictacouro seato Adottobacto bauroani. Statylocouro seato Natosia sergens Natosia sengens Natosia sengens Natosia sengens Natosia sengens Natosia sengens Natosia Saturyouro seato Natosia Saturyouro seato Natosia Saturyouro seato Statylocouro seatonolisio Usicaseta reporta	ş	28 29 22 20 9 6 5 4 4 3 3 3 3 3 2 2 2 2	15.1% 14.1% 13.5% 10.8% 4.9% 3.2% 2.7% 2.2% 2.2% 2.2% 1.8% 1.8% 1.6% 1.1% 1.1%

Results

A total of 447 hospitalized patients with PCR-confirmed SARS-CoV-2 infection were included in the study. Their mean age was 57.8 ±16 years, 58% were male, and 81% required hospitalization for >7 days. ICU admission and ventilatory assistance with OTI were required in 58.6% and 53% of the patients, respectively. An association between UTI and COVID-19 during hospitalization was found in 41.4% of the patients. (Table 1).]

IUC use and OTI were the main risk factors for UTI (odds ratio (OR) = 4.86 and 3.51, respectively; p<0.0001). When combined, these two factors increased the risk of UTI by more than five times (OR = 5.3, p<0.001). The necessity of intensive care was associated with a three-fold higher chance of UTI development than that in patients hospitalized only in non-ICU wards (p<0.0001). Other risk factors for UTI in hospitalized COVID-19 patients were age, sex, and DM. Patients aged over 60 years were 2.8 times more likely to acquire UTI (p<0.0001). Female patients were twice as likely as male patients (p=0.0002) and patients with DM were 2.16 times more likely than those without diabetes (p=0.0001) to acquire UTI. However, obesity and leukopenia were not associated with UTI development, contrary to the expectation based on previous findings (4, 5) (Table 2).

The most prevalent microorganisms in the positive urine culture samples were Candida spp. (64.2%), Klebsiella pneumoniae (17.8%), Enterococcus faecalis (15.1%), Escherichia coli (11.9%), Pseudomonas aeruginosa (10.8%), and Enterococcus faecium (4.9%) (Table 3).

Conclusion

Hospitalized patients with moderate-to-severe pulmonary infections caused 'by SARS-CoV-2 are associated with higher incidence of UTI than previously reported; this suggests a relationship between COVID-19 and UTIs. The main associated factors of UTI in COVID- 19 patients were IUC use and mechanical ventilation, other factors such as age, female sex, and DM also contributed to a higher risk of UTI and were associated with worse clinical outcomes

The incidence of Candida spp. in our study was still higher than those in other reports from ICU (6). This finding can be related to regional characteristics or indicate a possible association with COVID-19. SARS-CoV-2 can be detected in different tissues, and its presence in urine and urothelial could be related to a higher risk of UTI.

The limitation of this study was that owing to its retrospective nature, only available data could be used. Other information, such as obesity, body mass index, sarcopenia, and weight loss during hospitalization could not be investigated because of a lack of records. Nonetheless, we found high incidence of UTIs in a large cohort, which consistently pointed toward an association of UTI with COVID-19.

References

1 - Karaba SM, Jones G, Helsel T, Smith LL, Avery R, Dzintars K, Salinas AB, Keller SC, Townsend JL, Klein E, Amoah J, Garibaldi BT, Cosgrove SE, Fabre V. Prevalence of Co-infection at the Time of Hospital Admission in COVID-19 Patients, A Multicenter Study. Open Forum Infect Dis. 2020; 8:578. 2: Zhang H, Zhang Y, Wu J, Li Y, Zhou X, Li X, et al. Risks and features of secondary infections in severe and critically ill COVID-19 patients. Emerg Microbes Infect. 2020; 9:158-1964. 3: Kneitz Y, Ata J, Binnkardt H. Zytopenie. Anämie, Leukopenie und Thrombopenie. Z Rheumatol. 2017; 76(Supt) 2:05:74.4: Jshimine N, Honda T, Yoshizawa A, Kawasaki K, Sugano M, Kobayashi Y et al. Combination of white blood cell count and left shift level real-timely reflects a course of bacterial infection. J Clin Lab Anal. 2013; 27(5):407-11.5: Saliba W, Barnett-Griness O, Rennert G. The association between obesity and urinary tract infection. Eur J Intern Med. 2013; 24:127-31.6: Aubron C, Suzuki S, Glassford NJ, Garcia-Alvarez M, Howden BP, Bellomo R. The epidemiology of bacteriuria and candiduria in critically ill patients. Epidemiol Infect. 2015; 143:653-62.