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EVALUATION OF THE APPROACHES ADOPTED BY THE INFECTIOUS DISEASES AND CLINICAL MICROBIOLOGY SPECIALISTS AND MEDICAL MICROBIOLOGY SPECIALISTS IN THE CASE OF *MYROIDES* SPP. GROWTH IN URINE CULTURE: A SURVEY STUDY

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Abstract: *Myroides* species are bacteria that, although rare, can cause a variety of serious infections, including urinary tract infections, and are often resistant to antibiotics. There are no studies on the knowledge and attitudes of specialists regarding *Myroides* spp. growth in culture in literature. In our study, the survey forms created with Google Forms (Google LLC, CA, USA) were shared in the e-mail groups of Infectious Diseases and Clinical Microbiology (IDCM) and Medical Microbiology (MM) specialties via electronic communication system. The results were evaluated statistically. 92 IDCM specialists and 75 MM specialists participated in the study. It was found that 48.9% of IDCM specialists and 20% of MM specialists have never seen *Myroides* spp. growth in a urine sample, and 32.6% of IDCM specialists and 14.9% of MM specialists still use the old name *Flavobacterium* for *Myroides* spp. (28.8% of MM specialists do not know that the name *Flavobacterium* is changed), and 45% of MM specialists who had previously seen *Myroides* spp. growth were able to recognize the *Myroides* spp. colony visually, and 53.3% of MM specialists who had previously seen *Myroides* spp. growth routinely performed antibiograms in case of *Myroides* spp. growth in urine culture, and 32.6% of IDCM specialists requested typing and sensitivity testing in case of *Myroides* spp. growth in urine culture, and 31.9% of IDCM specialists who had previously seen *Myroides* spp. growth considered *Myroides* spp. growth as a causative agent of infection in the presence of pyuria in urine, while 36.2% always considered it as colonization/contamination, and 61.7% of IDCM specialists only changed the catheter without giving antibiotics when they considered *Myroides* spp. as a causative agent of infection, while 21.3% gave antibiotics according to the antibiogram result. As a conclusion; our study is the first study in the world to investigate the knowledge and attitudes of infectious disease specialists and medical microbiologists about *Myroides* spp. growth in urine culture. The findings of our study showed particularly that approximately half of the IDCM specialists had not seen *Myroides* spp. growth in urine culture and that some of the specialists may have a low level of knowledge about *Myroides* spp.. Additionally, among the specialists participating in the study, it was shown that attitudes and approaches in the case of *Myroides* spp. growth in urine were not directly related to the hospital that they worked and their years of experience in specialty. Our findings suggest that MM and IDCM specialists need an update of their knowledge on *Myroides* spp.

Keywords: *Myroides odoratus*, *Myroides odoratitimus,* Urine culture, Infectious diseases, Medical microbiology, Survey

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1. Introduction

Myroides species are gram-negative, non-motile, non-fermentative bacilli common in nature and can be isolated predominantly from water, soil, food and sewage treatment plants. In the last two decades, an increasing number of infections caused by these microorganisms, such as urinary tract infections and skin and soft tissue infections, have been reported as case reports (Gunzer et al., 2018; Khan et al., 2023). *Myroides* species, which are commonly known to be naturally antibiotic resistant and opportunistic, can, also cause rare outbreaks. VITEK2 automated identification system identifies the isolates at *Myroides* genus level, while MALDI-TOF MS can identify two species, *Myroides odoratus* and *Myroides odoratitimus* (Hu et al., 2016)

Although rare, *Myroides* species can cause serious infections such as necrotizing fasciitis, soft tissue infections, septic arthritis, ventriculitis, pneumonia and sepsis (Crum-Cianflone et al., 2014; Gunzer et al., 2018; Beathard et al., 2021; Büyüktuna et al., 2021). Some serious cases have been reported in which *Myroides* spp. growth was detected in urine cultures and treatment was

unsuccessful in some thereof, however, other cases were reported to recover after treatment with antibiotic combinations such as rifampicin, ciprofloxacin and meropenem (Wuer et al., 2002; Li et al., 2010; Ktari et al., 2012; Khan et al., 2023). Selection of the appropriate antibiotic therapy to treat infections caused by *Myroides* species is difficult due to its natural resistance to many antibiotics (Hu et al., 2016; Gunzer et al., 2018).

To the best of our knowledge, there are no studies on the knowledge and attitudes of medical specialists regarding the approach to *Myroides* spp. growth in culture. The aim of this study was to evaluate, via survey, the knowledge and attitudes of Infectious Diseases and Clinical Microbiology (IDCM) and Medical Microbiology (MM) specialists with respect to *Myroides* spp. growth in urine culture.

2. Material and Method

2.1. Survey and Participants

The study was conducted between February 1-28, 2023 using Google Forms (Google LLC, CA, USA) based on an electronic communication system. Two surveys prepared with 11 questions for IDCM experts and 9 questions for MM experts were made available via Google survey application and the survey link was sent to all accessible infectious diseases and medical microbiology specialists across Türkiye. Those who agreed to fill out the survey were allowed to complete it by ticking a checkbox. The completed surveys were delivered back to us by clicking on the submit button at the end of the web page. In this way, a total of 167 specialists (92 IDCM specialists and 75 MM specialists) were included in the study. The physicians other than those who completed the surveys after approval and delivered them back to us were not included in the study.

2.2. Statistical Analysis

All statistical analyses in the study were performed using SPSS 25.0 software (IBM SPSS, Chicago, IL, USA). Descriptive data were given as numbers and percentages. Comparisons between groups in terms of categorical variables were made with Pearson's chi-square test. The normal distribution of continuous variables was confirmed by the Kolmogorov-Smirnov Test. Differences between groups in terms of continuous variables were evaluated by Student's t-test and mean values between multiple groups were compared by analysis of variance. The results were evaluated at 95% confidence interval and $P<0.05$ was considered significant.

3. Results

The mean years of post-specialization experience for IDCM specialists who participated in the study was 9.33±7.7 (median = 8; min-max = 0-46) years, while that of the MM specialists was 10.53±6.68 (median = 10; min-max = 0-34) years.

According to the statements of IDCM and MM specialists, 48.9% of IDCM specialists and 20% of MM specialists had never seen *Myroides* spp. growth in a urine sample, and 28.8% of MM specialists did not know the name *Flavobacterium* has changed, and 32.6% of IDCM specialists and 14.9% of MM specialists still use the old name *Flavobacterium* for *Myroides* spp., and 45% of MM specialists who had previously seen *Myroides* spp. growth were able to recognize the *Myroides* spp. colony visually, and 53.3% thereof routinely performed antibiograms in case of *Myroides* spp. growth in urine culture, and 32.6% of IDCM specialists requested typing and sensitivity testing in case of *Myroides* spp. growth in urine culture, and 31.9% of IDCM specialists who had previously seen *Myroides* spp. growth considered *Myroides* spp. growth as a causative agent of infection in the presence of pyuria in urine, while 36.2% thereof always considered it as colonization/contamination, and 61.7% of IDCM specialists only changed the catheter without giving antibiotics when they considered *Myroides* spp. as a causative agent of infection, while 21.3% thereof gave antibiotics according to the antibiogram result (Table 1).

No significant difference was found between the distribution of responses given by IDCM specialists based on the types of hospitals where they work and their academic titles ($P>0.05$ for each) (Tables 2 and 3).

No significant difference was found between the distribution of responses given by MM specialists based on the types of hospitals where they work ($P>0.05$ for each) (Table 4).

Based on the responses given by participants, the mean years of post-specialization experience values were similar ($P>0.05$ for each) (Tablo 5).

Table 1. General characteristics of the participants and distribution of their responses to some questions

	IDCM Specialists n (%)	MM Specialists n (%)
Distribution of the hospital they work		
Training and research hospital	28(30.4)	23(30.7)
State hospital	29(31.5)	33(44)
University hospital	25(27.2)	11(14.7)
City hospital	4(4.3)	7(9.3)
Private hospital	6(6.5)	1(1.3)
Distribution of academic titles		
Professor	7(7,6)	2(2.7)
Associate Professor	7(7.6)	4(5.3)
Doctoral faculty member	10(10.9)	6(8)
Chief assistant	6(6.5)	3(4)
Specialist doctor	62(67.4)	60(80)
Distribution of the prevalence of *Myroides* spp. growth in urine		
Never	45(48.9)	15(20)
1-5 / years	28(30.4)	26(34.7)
6-10 / years	9(9.8)	16(21.3)
> 10 / years	10(10.9)	18(24)
Do you still use the old name (*Flavobacterium spp*.) for *Myroides* spp.?		
No	62(67.4)	63(85.1)
Yes	30(32.6)	11(14.9)
Myroides spp. was separated from the genus *Flavobacterium* in 1996 and renamed as a new genus and contains two species, *M. odoratus* and *M. odoratimimus*, which are human pathogens. Have you heard this information before?		
No	*	21(28.8)
Yes	*	52(71.2)
When *Myroides* spp. growth is detected in urine culture, can you identify the colony visually or do you request identification?		
Cannot identify (microbiologist: requires routine identification)	*	33(55)
Can identify (microbiologist: does not require identification)	*	27(45)
Do you perform a routine antibiogram when there is *Myroides* spp. growth in urine culture?		
No, I consider it resistant and do not perform routine antibiograms	*	28(46.7)
Yes, I perform routine antibiograms for every growth detected	*	32(53.3)
In case of *Myroides* spp. growth in urine culture, do you require typing and sensitivity testing?		
No	62(67.4)	*
Yes	30(32.6)	*
Do you consider *Myroides* spp. growth in urine culture as a causative agent?		
In case of the pyuria presence, I consider it as a causative agent of infection	30(63.8)	*
I always consider it as a colonization/contamination	17(36.2)	*
What is your approach when you consider *Myroides* spp. spp. as a causative agent of urinary tract infection?		
I only have the catheter changed, I don't prescribe antibiotics	29(61.7)	*
I require an antibiogram and prescribe antibiotics based on the results	10(21.3)	*
I prescribe antibiotics even if it is resistant	2(4.2)	*
I perform a bladder irrigation	2(4.3)	*
I have the catheter changed, I prescribe antibiotics based on the results of the antibiogram	4(8.5)	*

*This question has not been asked.

Table 2. Evaluation of the responses given by IDCM specialists based on the types of their hospitals

	Training and research hospital n (%)	State hospital n (%)	University hospital n (%)	City hospital n (%)	Private hospital n (%)	P
Distribution of the prevalence of *Myroides* spp. growth in urine						
Never	12(42.9)	12(41.4)	15(60)	1(25)	5(83.3)	.496
1-5 / years	8(28.6)	11(37.9)	8(32)	1(25)	0	
6-10 / years	4(14.3)	2(6.9)	1(4)	1(25)	1(16.7)	
> 10 /years	4(14.3)	4(13.8)	1(4)	1(25)	0	
Do you still use the old name (*Flavobacterium spp*.) for *Myroides* spp.?						
No	21(75)	18(62.1)	17(68)	2(50)	4(66.7)	.808
Yes	7(25)	11(37.9)	8(32)	2(50)	2(33.3)	
In case of *Myroides* spp. growth in urine culture, do you require typing and sensitivity testing?						
No	10(62.5)	9(52.9)	3(30)	2(66.7)	1(100)	.487
Yes	6(37.5)	8(47.1)	7(70)	1(33.3)	0	
Do you consider *Myroides* spp. growth in urine culture as a causative agent?						
In case of the pyuria presence, I consider it as a causative agent of infection	11(68.8)	12(70.6)	4(40)	2(66.7)	1(100)	.507
I always consider it as a colonization/contamination	5(31.3)	5(29.4)	6(60)	1(33.3)	0	
What is your approach when you consider *Myroides* spp. spp. as a causative agent of urinary tract infection?						
I only have the catheter changed, I don't prescribe antibiotics	11(68.8)	9(52.9)	5(50)	3(100)	1(100)	.507
I require an antibiogram and prescribe antibiotics based on the results	4(25)	4(23.5)	2(20)	0	0	
I prescribe antibiotics even if it is resistant	1(6.3)	1(5.9)	0	0	0	
I perform a bladder irrigation	0	0	2(20)	0	0	
I have the catheter changed, I prescribe antibiotics based on the results of the antibiogram	0	3(17.6)	1(10)	0	0	

Table 3. Distribution of the responses given by IDCM specialists based on their academic titles

	Specialist doctor	Doctoral faculty member	Chief assistant	Associate Professor	Professor	P
Distribution of the prevalence of *Myroides* spp. growth in urine						
Never	29(46.8)	4(40)	5(83.3)	3(42.9)	4(57.1)	.774
1-5 / years	19(30.6)	4(40)	1(16.7)	3(42.9)	1(14.3)	
6-10 / years	7(11.3)	1(10)	0	1(14.3)	0	
> 10 / years	7(11.3)	1(10)	0	0	2(28.6)	
Do you still use the old name (*Flavobacterium* spp.) for *Myroides* spp.?						
No	40(64.5)	7(70)	4(66.7)	6(85.7)	5(71.4)	.861
Yes	22(35.5)	3(30)	2(33.3)	1(14.3)	2(28.6)	
In case of *Myroides* spp. growth in urine culture, do you require typing and sensitivity testing?						
No	18(54.5)	3(50)	0	1(25)	3(100)	.324
Yes	15(45.5)	3(50)	1(100)	3(75)	0	
What is your approach when you consider *Myroides* spp. spp. as a causative agent of urinary tract infection?						
In case of the pyuria presence, I consider it as a causative agent of infection	22(66.7)	2(33.3)	1(100)	4(100)	1(33.3)	.139
I always consider it as a colonization/contamination	11(33.3)	4(66.7)	0	0	2(66.7)	
What is your approach when you consider *Myroides* spp. spp. as a causative agent of urinary tract infection?						
I only have the catheter changed, I don't prescribe antibiotics	19(57.6)	5(83.3)	0	2(50)	3(100)	.678
I prescribe antibiotics based on the results of an antibiogram	7(21.2)	0	1(100)	2(50)	0	
I prescribe antibiotics even if it is resistant	2(6)	0	0		0	
I perform a bladder irrigation	1(3)	1(16.7)	0	0	0	
I have the catheter changed, I require an antibiogram and decide on the antibiotics based on the results thereof	4(12.1)	0	0	0	0	

Table 4. Distribution of the responses given by MM specialists based on their academic titles

	Specialist doctor	Doctoral faculty member	Chief assistant	Associate Professor	Professor	P
How often do you see *Myroides* spp. (*Flavobacterium*) growth in urine?						
Never	12(20)	2(33.3)	0	0	1(50)	.739
1-5 / years	18(30)	2(33.3)	2(66.7)	3(75)	1(50)	
6-10 / years	14(23.3)	1(16.7)	0	1(25)	0	
> 10 / years	16(26.7)	1(16.7)	1(33.3)	0	0	
Do you still use the old name (*Flavobacterium* spp.) for *Myroides* spp.?						
No	49(83.1)	6(100)	3(100)	4(100)	1(50)	.292
Yes	10(16.9)	0	0	0	1(50)	
Myroides spp. was separated from the genus *Flavobacterium* in 1996 and renamed as a new genus and contains two species, *M. odoratus* and *M. odoratimimus*, which are human pathogens. Have you heard this information before?						
No	19(32.2)	1(16.7)	1(33.3)	0	0	.679
Yes	40(67.8)	5(83.3)	2(66.7)	4(100)	1(100)	
When *Myroides* spp. growth is detected in urine culture, can you identify the colony visually or do you request identification?						
I cannot identify and require routine identification.	23(50)	3(60)	2(66.7)	3(75)	2(100)	.911
I can identify and do not require routine identification.	23(50)	2(40)	1(33.3)	1(25)	0	
Do you perform a routine antibiogram when there is *Myroides* spp. growth in urine culture?						
No, I consider it resistant and do not perform routine antibiograms	23(47.9)	1(25)	3(100)	1(25)	0	.237
Yes, I perform routine antibiograms for every growth detected	25(52.1)	3(75)	0	3(75)	1(100)	

Table 5. Comparison of the years of expertise in specialization of the participants based on their responses

	MM specialist		IDCM specialist	
	Mean±SD (years)	P	Mean±SD (years)	P
Do you still use the old name (*Flavobacterium* spp.) for *Myroides* spp.?				
No	10.19±6.33	.389	9.39±7.48	.914
Yes	12.09±8.71		9.20±8.33	
Myroides spp. was separated from the genus *Flavobacterium* in 1996 and renamed as a new genus and contains two species, *M. odoratus* and *M. odoratimimus*, which are human pathogens. Have you heard this information before?				
No	8.95±4.66	.293		
Yes	10.63±6.63			
When *Myroides* spp. growth is detected in urine culture, can you identify the colony visually or do you request identification?				
I cannot identify and require routine identification	11.33±7.38	.168	11.48±9.45	.069
I can identify and do not require routine identification	9.11±5.01		7.23±5.37	
Do you perform a routine antibiogram when there is *Myroides* spp. growth in urine culture?				
No, I consider it resistant and do not perform routine antibiograms	9.07±5.21	.140		
Yes, I perform routine antibiograms for every growth detected	11.41±6.65			
How often do you see *Myroides* spp. (*Flavobacterium*) growth in urine?				
Never (15)	11.40±8.87	.733	9.16±7.47	.524
1-5 / years (26)	9.58±5.74		8.11±5.31	
6-10 / years (16)	11.69±7.15		11.33±8.39	
> 10 / years (18)	10.17±5.68		11.70±12.9	
In case of *Myroides* spp. growth in urine culture, do you require typing and sensitivity testing?				
No (25)			11.48±9.45	.069
Yes (22)			7.23±5.37	
What is your approach when you consider *Myroides* spp. spp. as a causative agent of urinary tract infection?				
In case of the pyuria presence, I consider it as a causative agent of infection (30)			9.67±6.34	.843
I always consider it as a colonization/contamination (17)			9.18±10.58	

SD: Standard deviation, The number in parentheses indicates the number of physicians who responded to that question.

4. Discussion

Although *Myroides* spp. growth in urine cultures is not very common, it is a condition that should be well known to specialists as it may lead to serious infections and is difficult to treat due to the inherent resistance of *Myroides* species to many antibiotics (Hu et al., 2016; Gunzer et al., 2018; Khan et al., 2023). In our study, the knowledge and attitudes of specialists about *Myroides* spp. growth in urine culture were evaluated for the first time in the literature. In our study, the knowledge and attitudes among IDCM and MM specialists who would initially have to deal with *Myroides* spp. growth especially in urine culture were examined and it was found that there were many different opinions and attitudes both between and within the branches.

In our study, it was noted that the mean years of post-specialization experience were approximately 10 years. This finding shows that the specialists participating in our study were well experienced. When this is considered together with the number of participants, it can be suggested that the findings obtained in our study may be representative of experienced IDCM and MM specialists. In our study, the mean years of experience in specialization of the participants were also found to be similar based on the responses given. This finding also suggests that the knowledge or attitudes of the specialists participating in our study may not be directly related to the years of experience in specialization.

Cases of infection caused by *Myroides* species are rare. *Myroides* spp. growth, especially in urine cultures, is even rarer and in some cases, it is considered as colonization or contamination and not accepted as a causative agent of infection (Ktari et al., 2012; Hu et al., 2016). In our study, 48.9% of IDCM specialists indicated that they had never seen *Myroides* spp. growth in urine samples. It is very interesting to note that about half of IDCM specialists have never seen *Myroides* spp. growth in urine culture. In addition, it is an unexpected finding that 60% of infection specialists working in university hospitals, where a wide variety of cases may be encountered, and 41.4% of IDCM specialists working in training and research hospitals have never seen *Myroides* spp. growth. Moreover, in our study, only 20% of MM specialists admitted that they had not seen any *Myroides* spp. growth. The large difference between IDCM and MM specialists may be explained by the fact that the microbiologists and infectious diseases physicians participating in the study were not from the same hospital because whether a IDCM specialist may or may not observe the agent depends directly on the ability of the MM specialist working in the same hospital to identify such agent. Furthermore, the possibility that some of the MM specialists may have considered *Myroides* spp. growth in urine culture as contamination and did not report it as *Myroides* spp. in the culture result may also explain this difference. In addition, the fact that the mean years of experience in specialization and the distribution of specialists based on academic titles were similar between those who had and had not seen *Myroides* spp. growth before suggests that *Myroides* spp. experience is not directly related to years of experience in specialization or whether or not being an academic. This suggests that it may be endemic in certain regions, may be seen by physicians of all academic titles in endemic regions, and may be overlooked in sporadic regions.

The bacterial genus formerly known as *Flavobacterium* due to its fruit odor was renamed *Myroides* spp. in 1996 and two species, *M. odoratus* and *M. odoratimimus*, were identified (Yaci et al., 2000; Hu et al., 2016; Beharrysingh, 2017). In our study, 28.8% of MM specialists indicated that they did not know that the name of *Flavobacterium* had changed to *Myroides* spp. and that there are two species as human pathogens. Furthermore, knowledge of the *Myroides* spp. name change was found to be similar across all academic titles and the mean years of experience in specialization were similar between those who knew thereabout and those who did not. In our study, 32.6% of IDCM specialists and 14.9% of MM specialists indicated that they still use *Flavobacterium*, the old name for *Myroides* spp.. Given that specialists unaware of the name change would understandably not use the new name, these findings primarily suggest that some specialists are not aware that *Myroides* spp. has two human pathogenic species. Considering that the name change was made before the 2000, these findings may be indicative of a deficiency in IDCM and MM specialty training or a failure of specialists to keep abreast of some current issues. The study also found that the rate of knowledge about the *Myroides* spp. name change was similar across all hospitals or academic titles, indicating that insufficient knowledge is not related to the hospital or years of experience.

Members of the genus *Myroides* spp. are aerobic, non-motile, yellow pigmented, oxidase-positive, gram-negative, rod-shaped bacteria. Because of the flexirubin it produces, it generates a characteristic strawberry-like odor with yellow colony morphology in sheep blood growth medium (Holmes et al., 1977; Licker et al., 2018). Colonies on blood agar appear round, mucoid, yellow pigmented. Its growth characteristics and typical odor facilitate visual identification. In our study, 45% of the medical microbiologists who had previously seen *Myroides* spp. growth indicated that they could recognize the *Myroides* spp. colony visually. The study also found that the years of experience in specialization were similar between those who claimed to be able to identify *Myroides* spp. colony and those who claimed not. This finding may indicate that the ability to identify *Myroides* spp. colony is not directly related to the experience in the specialization.

To date, several studies have reported outbreaks of Myroides-associated urinary tract infections in hospitals, some of which involved urinary tract stones or cancer, catheterization or surgery (Yaci et al., 2000; Ktari et al., 2012; Licker et al., 2018; Kutlu et al., 2020). Ahamed et al.

(Ahamed et al., 2018) reported that the patient did not respond to treatment and died in a case of urinary tract infection caused by *Myroides* spp.. In our study, 63.8% of infectious disease specialists who had previously seen *Myroides* spp. growth stated that they considered it as a causative agent of infection in the presence of accompanying pyuria, while 36.2% thereof indicated that they always considered it as colonization/contamination with or without pyuria. Considering that the acceptance of *Myroides* spp. growth in urine culture as a causative agent of infection may depend on the patient's clinical presentation and the presence of pyuria, it is remarkable that approximately one third of infectious disease specialists consider *Myroides* spp. growth in urine as definite colonization/contamination regardless of the patient's clinical presentation or the presence of pyuria.

Myroides species have been reported to have multiple antibiotic resistance due to two metallo-beta lactamases intrinsically called MUS-1 and TUS-1, as well as a resistance island in the bacterial chromosome containing several resistance genes such as *tetX* (associated with tetracycline resistance), *cat* (associated with chloramphenicol) and bla-OVA-347 and bla-OXA-209 (associated with beta lactam resistance), but show variable susceptibility profiles to beta lactams, quinolones and carbapenems (Lorenzin et al., 2018; LaVergne et al., 2019). Gunzer et al. showed that the minimal inhibitory concentration (MIC) values of levofloxacin, moxifloxacin, erythromycin, azithromycin, rifampicin, ceftazidime and cefepime were low in *Myroides* isolates (Gunzer et al., 2018). Hu et al., on the other hand, reported that all of the isolates obtained from urine culture were sensitive to trimethoprim-sulfamethoxazole (Hu et al., 2016). Besides, it has been reported that *Myroides* isolates are mainly resistant to aztreonam, ceftazidime, cefepime, piperacillin-tazobactam and imipenem, while susceptibility rates to meropenem, ampicillin and ciprofloxacin are variable (Gunzer et al., 2018). O'neal et al. compiled the reported studies and reported that Myroides isolates were highly susceptible to minocycline, moxifloxacin and tigecycline (O'Neal et al., 2022). In some cases, the isolated agent was reported to be pan-resistant (Faraz et al., 2022; Kurt et al., 2022). In our study, 46.7% of MM specialists who had previously seen *Myroides* spp. growth indicated that they routinely performed antibiograms in case of *Myroides* spp. growth in urine culture. Additionally, the mean years of experience in specialization were similar between those who stated routinely performing and not performing antibiograms in case of *Myroides* spp. growth in urine. These findings suggest that MM specialists disagree by about half that *Myroides* spp. is inherently resistant to antibiotics. We think that the reason of this difference is that there is still no standardized antibiotic susceptibility test (AST) interpretation for *Myroides* spp.. Antibiotic susceptibility testing for *Myroides* spp. is performed according to CLSI (Clinical and Laboratory Standards Institute) or EUCAST (European Antimicrobial Susceptibility Testing) and evaluated according to the recommended zone diameters or MIC result criteria for *Enterobactericae* group bacteria. This leads to the fact that MM specialists do not adopt a common approach to the identification of *Myroides* spp. In the study, 32.6% of IDCM specialists indicated that they requested typing and sensitivity testing in case of *Myroides* spp. growth in urine culture, and the years of experience in specialization were found to be statistically similar between those who requested and not requested typing and antibiograms. In addition, among IDCM specialists who considered *Myroides* spp. as the causative agent of infection, 61.7% stated that they only changed the catheter without antibiotics, 21.3% gave antibiotics according to the antibiogram result, and approximately 13% made a decision that varies based on the antibiotic treatment. These findings demonstrate that even in cases where IDCM specialists considered *Myroides* spp. as the causative agent of infection, antibiotic selection was based on the antibiogram result in one out of every five cases. This represents a very low rate of 10.9% (10/92) compared to the total number of participants. However, even this low rate may imply that the decision of half of MM specialists not to perform antibiograms should be discussed. In the study, the fact that the years of experience in specialization were similar between those who considered and not considered *Myroides* spp. growth in urine as colonization/contamination suggests that this approach is not directly related to the experience in specialization. Moreover, although the distribution of the number of IDCM specialists who requested typing and antibiograms in case of *Myroides* spp. growth in urine culture did not show a statistically significant difference in terms of hospital type, the difference in the rates of requesting typing and antibiograms between those working in training and research hospitals and those working in university hospitals is noteworthy (37.5% vs. 70%). This finding may suggest that the attitude to request further testing in case of *Myroides* spp. growth may vary according to the type of hospital where the specialist works. In fact, automated identification and susceptibility systems for the typing of *Myroides* spp. are not available in all hospitals. The MALDI-TOF MS system for species-level identification is only available in some university hospitals.

There were some limitations in our study. Since the study was survey-based and it may be difficult and restrictive to question, if questioned, which of the participants work in the same hospital and/or how long they have been working together, such information was not obtained. Accordingly, the differences in knowledge and attitudes between MM specialists and IDCM specialists working in the same hospital in case of *Myroides* spp. growth in urine culture could not be evaluated.

To the best of our knowledge, this is the first study investigating the knowledge and attitudes of IDCM and MM specialists regarding *Myroides* spp. growth in urine culture. According to the findings of our study,

approximately half of the IDCM specialists have never seen *Myroides* spp. growth in urine culture, some of the specialists may have low level of knowledge about *Myroides* spp., and the approaches adopted by the specialists in case of *Myroides* spp. growth in urine are not directly related to the hospital where they work and their years of experience in specialization. Our findings suggest that medical microbiology and infectious diseases specialists should keep abreast of their knowledge on *Myroides* spp.

Author Contributions

The percentage of the author contributions is presented below. The author reviewed and approved the final version of the manuscript.

	E.M.Y.	M.B	Ö.G.
C	50	25	25
D	70	20	10
S			100
DCP	80	20	
DAI	60	20	20
L	60	40	
W	80	10	10
CR	10	10	80
SR	100		
PM	40	30	30
FA	40	30	30

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Approval/Informed Consent

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and This prospective, survey-based study was approved by the Samsun University, Clinical Research Ethics Committee (approval date: December 13, 2022 and protocol code: SÜKAEK-2022.12/13).

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