Adıyaman Üniversitesi Sağlık Bilimleri Dergisi, 2024;10(1):10-15
doi:10.30569.adiyamansaglik.1442817

E-ISSN: 2458-9176

ADIYAMAN ÜNİVERSİTESİ SAĞLIK BİLİMLERİ DERGİSİ
JOURNAL OF HEALTH SCIENCES OF ADIYAMAN UNIVERSITY

Research Article/Özgün Araştırma

# Distribution and antibiotic susceptibility of *Stenotrophomonas maltophilia* isolates isolated from various clinical specimens

# Çeşitli klinik örneklerden izole edilen *Stenotrophomonas maltophilia* izolatlarının dağılımı ve antibiyotik duyarlılıkları

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**Atıf gösterme/Cite this article as**: Solmaz M, Dağcıoğlu Y, Şay Coşkun U. Distribution and antibiotic susceptibility of Stenotrophomonas maltophilia isolates isolated from various clinical specimens. *ADYÜ Sağlık Bilimleri Derg*. 2024;10(1):10-15. doi:10.30569.adiyamansaglik.1442817

**Abstract**

**Aim:** This study was planned to contribute to epidemiological data by determining from which clinical samples *Stenotrophomonas maltophilia (S.maltophilia)* bacteria isolated in the microbiology laboratory were isolated, their distribution according to clinics and their susceptibility status.

**Materials and Methods**: The study was carried out retrospectively from clinical specimens received by the Medical Microbiology Laboratory of Tokat Gaziosmanpaşa University Medical Faculty Hospital from various outpatient clinics and wards between January 2016 and September 2019.

**Results**: Forty-five *S. maltophilia* strains isolated from clinical samples sent to the microbiology laboratory were included in the study. The highest number of bacteria were isolated from patients hospitalised in the ward. The most common comorbidity is malignancy. The most susceptible antibiotic was trimethoprim-sulfamethoxazole.

**Conclusions:** Due to increasing resistance rates, it is important to organise empirical treatment according to antibiogram results in infections in which *S.maltophilia* strains are identified as causative agents.

**Keywords:** Nonfermentative bacteria; *Stenotrophomonas maltophilia*; Antibiotic susceptibility.

**Öz**

**Amaç:** Bu çalışma, mikrobiyoloji laboratuvarında izole edilen *Stenotrophomonas maltophilia (S.maltophilia)* bakterisinin hangi klinik örneklerden izole edildiğini, kliniklere göre dağılımlarını ve duyarlılık durumlarını belirleyerek epidemiyolojik verilere katkı sağlamak amacıyla planlanmıştır.

**Gereç ve Yöntem:** Çalışma, Ocak 2016- Eylül 2019 tarihleri arasında çeşitli poliklinik ve servislerden Tokat Gaziosmanpaşa Üniversitesi Tıp Fakültesi Hastanesi Tıbbi Mikrobiyoloji Laboratuvarı'na gelen klinik örneklerden retrospektif olarak yapılmıştır.

**Bulgular:** Klinik örneklerden izole edilmiş 45 *S. maltophilia* suşu çalışmaya alınmıştır. En fazla bakteri serviste yatan hastalardan izole edilmiştir. En yüksek saptatan komorbidite malignitedir. Bu suşların en duyarlı olduğu antibiyotik trimetoprim-sulfametoksazoldur.

**Sonuç:** Artan direnç oranları nedeniyle *S.maltophilia* suşlarının etken olarak belirlendiği enfeksiyonlarda ampirik tedavinin antibiyogram sonuçlarına göre düzenlenmesi önemlidir.

**Anahtar Kelimeler:** Nonfermentatif bakteri; *Stenotrophomonas maltophilia*; Antibiyotik duyarlılığı.

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**Geliş Tarihi/Received:**25.02.2024 **Kabul Tarihi/Accepted:**25.03.2024 **Yayım Tarihi/Published online:**23.04.2024

## Introduction

Resistance to antimicrobial drugs is an increasing threat today. This resistance may occur in different ways in microorganisms. Natural resistance, acquired resistance, resistance related to environment and conditions are among these.[1] Regardless of the mechanism of resistance development, the distribution of antibiotic-resistant bacterial strains may differ between countries and even between various residential areas in the same country. It is known that antibiotic resistance develops more rapidly and is observed at a higher rate in countries where antibiotic use is unconscious. Another important issue in terms of resistance development is that bacteria develop resistance to a large number of antibiotics Pseudomonas species, especially *S.maltophilia*, are among the bacteria causing the development of multiple resistance.[2,3] The inherent resistance to susceptible antibiotics differentiates *Stenotrophomonas maltophilia* from other non-fermenting gram negative bacilli.[4]

*S.maltophilia* is a multi-drug resistant, motile, aerobic, nonfermentative, catalase positive, oxidase negative, gram negative opportunistic pathogen that can be isolated from both nature and human oropharynx.[5] Although community-acquired infections due to this microorganism can be observed, the majority of them are nosocomial and it is shown among the leading multi-drug-resistant microorganisms in hospitals by the World Health Organization.[6]

The incidence of *S. maltophilia* infections is high in patients with risk factors such as prolonged hospitalization, hospitalization in intensive care units, chronic respiratory diseases, use of broad-spectrum antimicrobial agents, malignancies, immunosuppression.[7,8] It has been reported that its ability to colonize respiratory epithelial cells and surfaces of medical devices causes infection/colonization in hospitalized patients.[7]

The fact that it is naturally resistant to many antibiotics causes difficulties in its treatment.causes difficulties in its treatment. Due to its intrinsic and acquired resistance, it can show resistance to many antimicrobial agents, including β-lactam antibiotics, cephalosporins, aminoglycosides and carbapenems.[9,10,11]

The aim of this study was to contribute to epidemiological data by determining from which clinical samples *S. maltophilia* isolates were isolated, the distribution of the isolated samples according to the clinics and their resistance status.

## Materials and Methods

In our study, the distribution and antibiotic susceptibilities of *S.maltophilia* isolates, which were isolated from various clinical specimens that came to the Medical Microbiology Laboratory of Tokat Gaziosmanpaşa University Medical Faculty Hospital between January 2016 and September 2019, were investigated retrospectively.

Sputum samples from various clinical samples sent to the Medical Microbiology Laboratory with suspicion of infection were first evaluated macroscopically and quality sputum samples were processed. After macroscopic and microscopic evaluation, 5% sheep blood agar and EMB (eosin-methylene-blue) agar were inoculated for culture. Blood culture samples were incubated in BacTAlert 3D (bioMérieux, France) automated blood culture system and the bottles with positive signal were passaged on 5% sheep blood agar and EMB agar. After incubation of sheep blood agar and EMB agar plates at 37o C for 24-48 hours, colonies were identified by conventional methods (Gram stain, catalase, oxidase, etc.) and Vitek 2 (Biomerieux, France) automated system. Antibiotic susceptibility of the strains were determined by Vitek 2 (Biomerieux, France) automated system. Antibiotic evaluated in accordance with the recommendations of the Clinical and Laboratory Standards Institute (CLSI)[12] between 2016-2017, and SXT susceptibility was evaluated in accordance with the recommendations of The European Committee on Antimicrobial Susceptibility Testing (EUCAST)[13] between 2018-2019. In cases where the same bacteria was grown for the second time from a patient, only one strain was included in the study.

In the study, the number of samples was shown as n and calculated as a percentage. SPSS (Statistical Packages of Social Sciences, SPSS for Windows, Version 25.0, Chicago, IC, USA) package program was used in the statistical analysis of the study.

To compare the annual differences, the chi-square test was used for statistical evaluation and results with $p<0.01$ were considered statistically significant.

## Ethics committee approval

Ethics committee approval for our study was received from Tokat Gaziosmanpaşa University Faculty of Medicine Non-invasive Clinical Research Ethics Committee (dated 23.03.2023, decision No. 2023/03, 23-KAEK-029).

## Results

Forty-five *S. maltophilia* strains isolated from clinical specimens sent to the microbiology laboratory were included in the study. 2 of the isolates were isolated in 2016, 5 in 2017, 17 in 2018, and 21 in 2019. A linear trend model analysis was used because the number of bacteria increased regularly over the years. As can be seen from the figure and equation, the trend is a significant increase. (Figure 1).

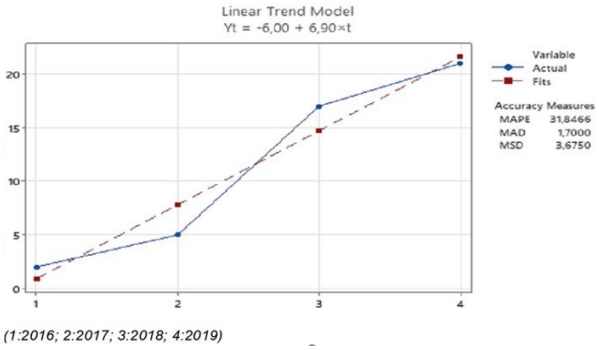


**Figure 1.** Trend analysis graph for bacteria count.

The highest number of bacteria was isolated from patients hospitalized in the ward (22; 48.88%), followed by the strains isolated from intensive care unit patients (19; 42.22%) and outpatients (4; 8.8%); (Table 1).

**Table 1.** Distribution of *S. maltophilia* strains according to the service and samples

| Sample | ICU* | Internal Service | Surgical Service | Internal Clinic | Cerrahi Clinic | Total (n/%) |
|---|---|---|---|---|---|---|
| Blood | 8 | 6 | 1 | | 1 | 16/35.6 |
| Sputum | 8 | 2 | | | | 10/22.2 |
| Wound | 3 | 4 | 2 | 2 | 1 | 12/26.7 |
| Urine | | 3 | 4 | | | 7/15.5 |
| Total | | | | | | 45/100 |

*ICU: Intensive care unit

While *S. maltophilia strains* were mostly obtained from samples such as sputum, blood and wounds, the least was produced in urine (Table 1).Antibiotic susceptibility test results of the isolates showed that trimethoprim sulfamethoxazole (TMP-SXT) (100%) was the most susceptible. Ceftazidime had a sensitivity rate of 25%, levofloxacine had a sensitivity rate of 96.7%, and minocycline had a sensitivity rate of 96.5%.

Considering the comorbid conditions of the patients, the most frequently isolated condition was malignancy (40%). This is followed by acute renal failure with a rate of 31.1%, immunodeficiency with a rate of 8.8% and hypertension with a rate of 6.6%.

In the change of results according to years; The number of bacteria arriving over the years was not evenly distributed; It increased statistically significantly (chi-square=22.467, $p<0.01$).

## Discussion

*S. maltophilia*; can be found in many environments such as spring water, tap water, soil, plants; in the hospital setting, it is one of the important pathogens that cause infections that increase mortality and morbidity.[14] Although it also causes community-acquired infections, its incidence in nosocomial infections and its importance in causing opportunistic infections is increasing. *S. maltophilia* is isolated at a rate of 0-1.6% as the causative agent of nosocomial infections[15], and the majority of infections (97%) caused by the bacteria are hospital-acquired.[2]

In recent years, the incidence of *S.maltophilia* infections has been increasing due to the increase in the number of immunosuppressive patients, long-term

hospitalization, and increased use of broad-spectrum antibiotics.[16,17] It is shown the leading multi-drug-resistant microorganisms in hospitals by the World Health Organization.[18]

Resistance to antimicrobial drugs is an increasing threat today. Its natural resistance to many antibiotics also causes difficulties in its treatment. Due to its intrinsic and acquired resistance, it can show resistance to many antimicrobial agents, including β-lactam antibiotics, cephalosporins, aminoglycosides and carbapenems.[11,19]

It is accepted that the most effective agent in the treatment of *S.maltophilia* infections is TMP-SXT. In our study, all strains were found to be sensitive to trimethoprim sulfamethoxazole. In the study of Sadic et al.[20] in 2019, trimethoprim-sulfamethoxazole resistance was determined as 8% in *S. maltophilia* strains collected between 2007-2017. Hazırolan et al.[21] determined the trimethoprim-sulfamethoxazole resistance as 11.36% in 2016. In a study by Dadashi et al. in 2023, the worldwide prevalence of TMP/SMX-resistant S. maltophilia was found to be 9.2%.[22] It is very pleasing that there is no resistance to TMP-SXT, which is recommended as the first choice in infections of this bacterium, which is difficult to treat due to its resistance to most antibiotics.

CLSI recommends studying ceftazidime from beta-lactams for testing antibiotic susceptibility. Kandemir et al. reported ceftazidime resistance as 77%.[23] In international studies, Hsueh et al.[24] 85% in Taiwan, İsmail et al.[25] found 74% in Malaysia. In our study, this rate was determined as 75%. We attribute the low rate of ceftazidime resistance to the low use in our hospital.

Although tetracycline derivatives are effective antibiotics against *S.maltophilia* infections, resistance to these agents has been reported.[26] In the tetracycline family, minocycline susceptibility has been reported to be over 95% in the treatment of *S.maltophilia* infections.[16] In vitro susceptibility was reported as 99.9% in 1289 *S. maltophilia* samples collected between 2014 and 2018. Minocycline shows minimal drug-drug interactions and can be well tolerated.[27] In our study, the most sensitive antimicrobial agent after TMP-SXT was minocycline, and its susceptibility was found to be 96.5%. Our antibiotic susceptibility rate is-compatible with the literature.

It is reported that fluoroquinolone group antibiotics are among the important treatment options especially in infections caused by nonfermentative bacteria that develop multidrug resistance such as *S. maltophilia.*[28,29] Guzelant et al.[5], the sensitivity to levofloxacin was found to be 23.7%. Bahçeci et al.[10] found levofloxacin sensivitiy to be 20% in a study they conducted in Turkey. In our study, sensitivity to levofloxacin was determined as 96.7%.

In our study, the highest comorbidity accompanying *S. maltophilia* infections was malignancy. In the meta-analysis study conducted by Lai et al. in 2023, the highest comorbidity was diabetes with 35%.[30]

In our study, blood was the most frequently isolated clinical sample with a rate of 35.5%. This was followed by respiratory and wound samples. In the meta-analysis study of Dadashi et al. the most common clinical specimen was blood with a frequency of 36.84%.[22]

Due to the high isolation of this bacteria from the blood, more attention should be paid to accurately identifying and distinguishing *S. maltophilia* from other Gram-negative bacilli in cases of bacteraemia.

## Conclusion

Treatment of *S. maltophilia* infections is difficult due to the natural resistance of the bacterium to many antibiotics. Studies conducted to determine resistance status shed light on clinicians in choosing the appropriate antimicrobial agent when starting empirical therapy. Resistance rates vary from region to region, from province to province, and even from hospital to hospital. Therefore, in the treatment of community acquired or nosocomial infections in which *S. maltophilia* strains are identified as causative agents, in vitro susceptibility tests should be performed to the extent possible, resistance status should be monitored due to changing resistance rates

to agents that can be used in treatment, empirical treatment policy should be determined according to the resistance status of each hospital and measures should be taken to prevent the spread of resistance.

## Ethics Committee Approval

Ethics committee approval for our study was received from Tokat Gaziosmanpaşa University Faculty of Medicine Non-invasive Clinical Research Ethics Committee (dated 23.03.2023, decision No. 2023/03, 23-KAEK-029).

## Author Contributions

M.S.: Design, Audit/Consultancy, Data collectıon and/or processing, Analysis and/or comment, Literature review, Writing, Critical review. Y.D.: Design, Resources, Materials. U.S.S.C.: Idea/Concept, Design, Audit/Consultancy, Resources, Materials, Data collection and/or processing,, Analysis and/or Comment, Critical review.

## Conflict of Interest

There is no conflict of interest to declare.

## Financial Disclosure

No sponsorship or funding from agencies in the commercial sectors were received for this research.

## Peer-review

Externally peer-reviewed.

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