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Frequency of inoculation enterococcus faecalis isolates from various clinical samples from patients with purulent-inflammatory diseases in a non-infectious clinic

[Nurila Rakhmetova](#)¹, [Nelya Bisenova](#)², [Aigerim Sarsenova](#)³

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* Corresponding author:

Aigerim Sarsenova,

E-mail: aikaikena638@gmail.com

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¹ Professor of the department of microbiology and virology named after Sh.I. Sarbasova, Astana Medical University, Astana, Kazakhstan

² Professor, Department of Microbiology and Virology named after Sh.I. Sarbasova, Astana Medical University, Head of Microbiology Laboratory, National Scientific Medical Center, Astana, Kazakhstan

³ Senior Lecturer at the Department of Microbiology and Virology named after Sh.I. Sarbasova, Astana Medical University, Astana, Kazakhstan

Abstract

In recent years, more and more attention around the world has been paid to the problem of antibiotic-resistant strains of bacteria, in particular *Enterococcus faecalis*, and their role in the development of purulent-inflammatory diseases in humans. This is due to the fact that evidence of a rise in infections caused by antibiotic-resistant strains of *E. faecalis* is becoming increasingly worrying. In this regard, it is relevant to study the frequency of *E. faecalis* isolates from patients hospitalized in non-infectious clinics.

Study objective. To investigate the frequency of *Enterococcus faecalis* inoculation from clinical biological samples of patients with purulent-inflammatory diseases over the period from 2018 to 2022 in a non-infectious clinics.

Methods. A retrospective analysis of five-year data from 2018 to 2022 was conducted. The data included results of bacteriological studies to identify pure cultures of *E. faecalis* in the microbiological laboratory of National Scientific Medical Center JSC, Astana.

Statistical processing of the obtained data was performed using Microsoft Excel. The mean value, standard error, and dynamic changes were determined using linear regression. Differences in means were considered statistically significant at $p < 0.05$.

Results. From 2018 to 2022, 414 isolates of *Enterococcus faecalis* were identified from various clinical materials. The highest number of strains was obtained from urine (51.9%), followed by wound samples (16.2%), throat (3.6%), and blood (2.2%).

Notably, in 2018, the proportion of strains from urine was 36.8%, while by 2022 it increased to 77.8%.

Conclusions. Based on the analysis of the dynamics of *Enterococcus faecalis* isolates inoculation from various clinical samples from patients with purulent-inflammatory diseases in a non-infectious clinic, the following conclusions can be drawn:

1. During the studied period, the highest level of *Enterococcus faecalis* inoculation was observed in 2018 (24.9%), and the lowest level of inoculation was observed in 2022 (15.2%).
2. The frequency of *Enterococcus faecalis* inoculation during the studied period, depending on the patient's biomaterial, varied as follows: it was isolated from urine in 215 cases (51.9%), from the wound - 67 (16.2%), from the pharynx - 15 (3.6%), from the blood - 9 (2.2%).

Keywords: purulent-inflammatory diseases, *Enterococcus faecalis*, antibiotic resistance, microbiological research, biological samples, urine, wound, throat, blood.

1. Introduction

Enterococci are representatives of the normal microbiota of the human intestine and urogenital tract. They can also be released from the nasopharynx, upper respiratory tract, and skin surfaces. Most infections caused by enterococci are endogenous and result from the invasion of microorganisms due to excessive colonization of mucosal and skin surfaces [1,2]. Enterococci often cause urinary tract infections in patients with long-term functioning catheters, and they are responsible for 10-20% of all bacterial endocarditis cases and 5% of bacteremias [3,4]. Despite being normal inhabitants of the human microbiota, under certain conditions, enterococci can induce the development of infectious-inflammatory processes. The clinical manifestations of enterococcal infections are diverse, ranging from localized infections (urinary tract infections, wounds) to generalized forms (bacteremia, bacterial endocarditis, meningitis) [5,6,7].

In recent years, more and more attention has been paid worldwide to the problem of antibiotic-resistant bacterial strains, particularly *Enterococcus faecalis*, and their role in the development of purulent-inflammatory diseases in humans [8,9,10,11,12,13]. This is due to the increasing concern over the rising number of infections caused by antibiotic-resistant *E. faecalis* strains.

Enterococcus faecalis is one of the most common microorganisms inhabiting the human intestine. Typically, it is a harmless bacterial symbiont, but some strains exhibit antibiotic resistance, which makes them potentially dangerous to human health [14,15,16]. Their presence can lead to infections such as appendicitis, peritonitis, sepsis, as well as inflammatory diseases of the urinary tract and skin [17,18]. Antibiotic-resistant strains of *Enterococcus faecalis* can be particularly dangerous for immunocompromised patients, such as those undergoing surgical procedures, with oncological diseases, or receiving immunosuppressive therapy [8,12,18].

Study objective: To investigate the frequency of *Enterococcus faecalis* inoculation from clinical biological samples of patients with purulent-inflammatory diseases over the period from 2018 to 2022 in a non-infectious clinics.

2. Materials and Methods

A retrospective analysis of five-year data from 2018 to 2022 was conducted. The data included results of bacteriological studies to identify pure cultures of *E. faecalis* in the microbiological laboratory of «National Scientific Medical Center» JSC, Astana.

Clinical material for bacteriological research was collected at «National Scientific Medical Center» JSC. The biological material came from patients with purulent-inflammatory diseases. The samples were collected and transported to the microbiological laboratory according to methodological guidelines.

Cultivation of Samples. The primary inoculation of clinical material was performed quantitatively on nutrient media according to regulatory documents [7]. The quantitative analysis of the material was carried out using nutrient media (blood agar, Endo agar,

enterococcal agar, Kalina agar). The inoculations were cultured for 24 hours at 37°C.

Identification of Isolates. According to methodological recommendations, the morphological and cultural properties, Gram staining, oxidase and catalase tests, and indole production tests were studied for the identification of isolates. The final identification of isolated pure cultures was conducted using the microbiological «Vitek 2 – Compact» analyzer (bioMérieux, Marcy l'Etoile, France) [8].

Statistical processing of the obtained data was performed using Microsoft Excel. The mean value, standard error, and dynamic changes were determined using linear regression. Differences in means were considered statistically significant at $p < 0.05$.

3. Results and Discussion

According to the data from the microbiological laboratory of the «National Scientific Medical Center» JSC, from 2018 to 2022, a total of 414 *Enterococcus faecalis* isolates were obtained from various clinical materials from patients with purulent-inflammatory diseases, among other pathogenic microorganisms.

In 2018, 103 *Enterococcus faecalis* strains were isolated from the 414 total isolates. Analysis of the data on the various biological materials from which enterococci were isolated during the study period showed that, in 2018, the highest frequency of *Enterococcus faecalis* isolation was from urine, accounting for 36.9% of the strains, then wounds - 22.3%, then the throat - 6.8%, sputum - 5.8%, and bronchial lavage fluids, umbilical cord, and urinary catheter - 3.9% each, from the TBD catheter and abdominal cavity - 2.9% of strains. From the central venous catheter and blood for sterility - 1.9%. Additionally, one strain was isolated from the nose, ear, tracheostomy, and episiotomy.

For 2019, data show that a total of 71 strains were isolated. The inoculation rate from urine was 49.3% of strains, from the wound - 11.3%, and from blood - a total of 5.6% of strains were isolated. From the remaining materials, a minimal amount of *Enterococcus faecalis* was isolated.

In 2020, a total of 94 *Enterococcus faecalis* strains were isolated. Data from 2020 show an increase in isolation frequency, with 49% of the strains isolated from urine, 10.6% from wounds, and 3.2% from the throat. Minimal amounts of *Enterococcus faecalis* were isolated from other materials.

In 2021, 83 *Enterococcus faecalis* strains were isolated. The highest frequency of isolation was from urine, accounting for 56.6%, followed by wounds at 24.1%. Minimal amounts of *Enterococcus faecalis* were isolated from other materials.

In 2022, a total of 63 *Enterococcus faecalis* strains were isolated. The data show a continued increase in isolation from urine, which accounted for 77.8% of the strains. Isolation from wounds decreased to 9.5%, while

isolation from the throat was 4.8%. Minimal amounts of *Enterococcus faecalis* were isolated from other materials.

The frequency of *Enterococcus faecalis* inoculation from various samples is reflected in Table 1.

Table 1 - Quantitative data on the isolation of *Enterococcus faecalis* in a non-infectious clinic from 2018 to 2022

"Research materials	Urine		Wound		Throat		Blood	
Years	n	%M±m	n	%M±m	n	%M±m	n	%M±m
2018 г.	38	36,8±7,82	23	22,3±8,68	7	6,8±9,4	2	1,9±9,6
2019 г.	35	49,3±8,45	8	11,3±11,1	1	1,4±11,74	4	5,6±11,66
2020 г.	46	49±7,37	10	10,6±10,21	3	3,2±10,00	1	1,0±9,94
2021 г.	47	56,6±7,22	20	24,1±9,54	1	1,2±10,88	1	1,2±10,88
2022 г.	49	77,8±5,94	6	9,5±11,97	3	4,8±12,34	1	1,6±12,54
Total	215	51,9±3,40	67	16,2±4,50	15	3,6±4,80	9	2,2±4,9

As shown in Table 1, the highest number of *Enterococcus faecalis* inoculations were obtained from the following materials: urine, wound, throat swab, and blood.

Thus, according to the data from the microbiological laboratory of the «National Scientific Medical Center» (NSMC), a total of 414 strains of enterococci were isolated from clinical materials with purulent-inflammatory diseases of various localizations over the period from 2018 to 2022. When analyzing the dynamics of the increase or decrease in the number of isolates by year, it can be noted that the most significant increase in the number of enterococci was observed only in samples taken from urine – 51.9% (Table 1).

The second highest frequency of *Enterococcus faecalis* isolation is observed from wounds, accounting for 16.2% of the strains. In comparison, 3.6% of strains were isolated from the throat, while only 2.2% of strains were

isolated from blood cultures for sterility. The dynamics of the increase or decrease in *Enterococcus faecalis* inoculation from various samples between 2018 and 2022 are shown in Table 1.

The diagram illustrating the dynamics of *Enterococcus faecalis* inoculation from different samples during the period of 2018-2022 is presented in Figure 1.

Analyzing the results shown in Figure 1, it can be confirmed that there is a noticeable trend of increased isolation of *Enterococcus faecalis* from urine from 2018 to 2022. In 2018, the frequency of *Enterococcus faecalis* detection was 36.8%, whereas by 2022, the frequency of isolation from urine had increased to 77.8%.

In 2018, the isolation rate from wounds was 22.3%, and by 2021, there was a significant increase to 24.1%. However, during 2019, 2020, and 2022, the isolation rates from wounds showed a decrease.

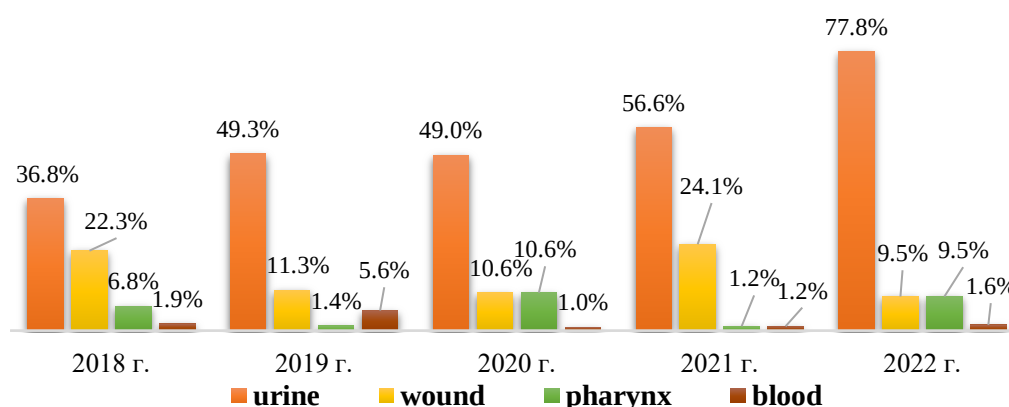


Figure 1 - Dynamics of *Enterococcus faecalis* isolation from various samples from 2018 to 2022

The results of our study on the frequency of *Enterococcus faecalis* inoculation, based on data from the National Scientific Medical Center JSC for patients with purulent-inflammatory diseases from 2018 to 2022, showed that over the past decades, the number of *Enterococcus faecalis* inoculations from urine has increased, which is consistent with findings from international authors. In the study by Polish authors - Olga Maria Rostkowska et al. (2020), it was noted that *Enterococcus faecalis* was most frequently isolated from the urine of patients in the intensive care unit, with an 8-

year study period showing a 24% isolation rate (128 strains) [19] .

According to a scientific study by Russian authors, which assessed the role of enterococci as pathogens of postoperative infectious complications, 465 strains of enterococci were isolated, with the highest number of *Enterococcus faecalis* isolated from urine (47.7%) and from the throat (24.3%), and enterococcal bacteremia was recorded in 9.7%, which corresponds to our data [20] . However, in the study, wound infections caused by enterococci accounted for only 3%, while in our study it accounted for 16.2%.

4. Conclusion

Based on the analysis of the dynamics of *Enterococcus faecalis* isolates inoculation from various clinical samples from patients with purulent-inflammatory diseases in a non-infectious clinic, the following conclusions can be drawn:

1. During the studied period, the highest level of *Enterococcus faecalis* inoculation was observed in 2018 (24.9%), and the lowest level of inoculation was observed in 2022 (15.2%).

2. The frequency of *Enterococcus faecalis* inoculation during the studied period, depending on the patient's biomaterial, varied as follows: it was isolated from urine in 215 cases (51.9%), from the wound - 67 (16.2%), from the pharynx - 15 (3.6%), from the blood - 9 (2.2%).

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Bisenova N.M. - development of study design; making a final decision on the readiness of the manuscript for publication, collection and analysis of clinical data, drafting the manuscript, interpretation of data. Sarsenova A.G. - A. - statistical processing of the material, analysis of statistical results, text editing

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Инфекциялық емес клиникадағы іріңді-қабыну ауруы бар пациенттердің әр түрлі клиникалық үлгілерінен *Enterococcus Faecalis* изоляттарының бөлініп алыну жиілігі

[Рахметова Н.Б.](#)¹, [Бисенова Н.М.](#)², [Сарсенова А.Г.](#)³

¹ Профессор, Ш.И. Сарбасова атындағы микробиология, вирусология кафедрасы,

Астана медицина университеті, Астана, Қазақстан

² Профессор, Ш.И. Сарбасова атындағы микробиология, вирусология кафедрасы, Астана медицина университеті;

Микробиологиялық зертхана жетекшісі, Ұлттық ғылыми медициналық орталық, Астана, Қазақстан

³ Аға оқытушы, Ш.И. Сарбасова атындағы микробиология, вирусология кафедрасы,

Астана медицина университеті, Астана, Қазақстан

Түйіндеме

Кіріспе. Соңғы жылдары бүкіл әлемде антибиотиктерге төзімді бактерия штамдары, әсіресе *Enterococcus faecalis*-тың антибиотиктерге төзімділігінің артуы және олардың адамның іріңді-қабыну ауруларының дамуындағы рөліне көңіл бөлу артуда. Бұл *E. faecalis*-тың антибиотикке төзімді штамдарынан туындаған инфекциялар санының алаңдатарлық өсуімен байланысты, сондықтан оларды инфекциясыз клиникаларда емделген науқастардан бөліну жиілігін зерттеу маңызды болып табылады.

Зерттеу мақсаты. 2018 жылдан 2022 жылға дейінгі кезеңде инфекциясыз клиникада іріңді-қабыну аурулары бар науқастардан алынған клиникалық биологиялық үлгілерден *Enterococcus faecalis* бактериясын бөліп алу жиілігін бағалау.

Зерттеу әдістері. 2018-2022 жылдар аралығында *Enterococcus faecalis*-тың таза культураларының бактериологиялық зерттеу деректері бойынша Ретроспективті талдау жүргізілді. Статистикалық өңдеу Microsoft Excel бағдарламасын пайдалана отырып жүргізілді, онда орташа мән, қателік және сызықтық регрессия әдісімен динамикалық өзгерістер талданды. Айырмашылықтар статистикалық тұрғыдан маңызды деп қабылданды ($p < 0,05$).

Нәтижелер. 2018-2022 жылдар аралығында әртүрлі клиникалық үлгілерден 414 *Enterococcus faecalis* изоляты алынды. Ең көп штаммдар зәрден (51,9%) алынды, содан кейін жаралардан (16,2%), жұтқыншақтан

(3,6%) және қаннан (2,2%) бөлінді. 2018 жылы зәрден штаммдар үлесі 36,8%-ды құраса, 2022 жылға қарай бұл көрсеткіш 77,8%-ға өскен.

Enterococcus faecalis изоляттарының іріңді-қабыну аурулары бар науқастардан инфекциясыз клиникада алынған әртүрлі клиникалық үлгілер бойынша бөліну динамикасын қорытындылай отырып, зерттеу кезеңі барысында ең жоғары бөліну көрсеткіші 2018 жылы (24,9%) байқалғанын, ал ең төменгі көрсеткіш 2022 жылы (15,2%) тіркелгенін атап өттік. Сонымен қатар, *Enterococcus faecalis* бөліну жиілігі пациенттің биоматериалына байланысты келесідей өзгерді: зәрден 215 рет (51,9%), жарадан 67 рет (16,2%), жұтқыншақтан 15 рет (3,6%), қаннан 9 рет (2,2%) бөлінген.

Кілт сөздер: іріңді-қабыну аурулары, *Enterococcus faecalis*, антибиотикке төзімділік, микробиологиялық зерттеулер, биоматериалдар, зәр, жара, жұтқыншақ, қан.

Частота высеваемости изолятов *Enterococcus Faecalis* из различных клинических образцов от больных с гнойно-воспалительными заболеваниями в неинфекционной клинике

[Рахметова Н.Б.](#)¹, [Бисенова Н.М.](#)², [Сарсенова А.Г.](#)³

¹ Профессор, Кафедра микробиологии и вирусологии имени Ш.И. Сарбасовой,

Медицинский университет Астана, Астана, Казахстан

² Профессор, Кафедра микробиологии и вирусологии имени Ш.И. Сарбасовой, Медицинский университет Астана,

Руководитель микробиологической лаборатории, Национальный научный медицинский центр, Астана, Казахстан

³ Старший преподаватель, Кафедра микробиологии и вирусологии имени Ш.И. Сарбасовой,

Медицинский университет Астана, Астана, Казахстан

Резюме

Введение. В последние годы во всем мире растет внимание к проблеме антибиотикорезистентных штаммов бактерий, в частности *Enterococcus faecalis*, и их роли в развитии гнойно-воспалительных заболеваний у человека. Это вызвано тревожным ростом случаев инфекций, вызванных антибиотикорезистентными штаммами *E. faecalis*, что делает актуальным изучение частоты их высеваемости у больных, госпитализированных в неинфекционные клиники.

Цель исследования. Оценить частоту высеваемости *Enterococcus faecalis* из клинических биоматериалов у больных с гнойно-воспалительными заболеваниями в неинфекционной клинике за период с 2018 по 2022 годы.

Методы исследования. Проведен ретроспективный анализ данных бактериологического исследования чистых культур *E. faecalis* в микробиологической лаборатории АО «Национальный научный медицинский центр» (г. Астана) за период с 2018 по 2022 годы. Статистическая обработка данных осуществлялась с использованием Microsoft Excel, включая определение средней величины, ошибки средней, а также анализ динамических изменений методом линейной регрессии. Различия считались статистически достоверными при $p < 0,05$.

Результаты. В период с 2018 по 2022 годы было выделено 414 изолятов *Enterococcus faecalis* из различных клинических материалов. Наибольшее количество штаммов было получено из мочи (51,9%), за ней следуют рана (16,2%), зев (3,6%) и кровь (2,2%). Примечательно, что в 2018 году доля штаммов из мочи составляла 36,8%, а к 2022 году увеличилась до 77,8%.

Выводы. На основании анализа динамики высеваемости изолятов *Enterococcus faecalis* из различных клинических образцов от больных гнойно-воспалительными заболеваниями в неинфекционной клинике можно сделать следующие выводы:

1. За изученный период исследования самый высокий уровень высеваемости *Enterococcus faecalis* отмечался в 2018 году (24,9%), а самый низкий уровень высеваемости в 2022 году (15,2%).

2. Частота высеваемости *Enterococcus faecalis* за исследуемый период в зависимости от биоматериала пациента варьировала следующим образом: из мочи выделялся в 215 случаев (51,9%), из раны 67 раз (16,2%), из зева 15 раз (3,6%), из крови – 9 (2,2%).

Ключевые слова: гнойно-воспалительные заболевания, *Enterococcus faecalis*, антибиотикорезистентность, микробиологические исследования, биоматериалы, моча, рана, зев.