

## RESEARCH ARTICLE

# Research into the knowledge levels about the medical microbiology specialization among medical students

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## ABSTRACT

**Objective:** According to our observation, despite students in medical school have taken medical microbiology course for at least one semester during their medical education, they could not have a clear knowledge about this field when they graduate and start to work in the clinics. In this study, we aimed to investigate the knowledge levels of the medical students about microbiology specialist and medical microbiology specialization field at two different medical schools in our city.

**Methods:** A 16-item multiple-choice achievement test was prepared in accordance with the relevant law to be applied to the students. The test was applied face to face to 1st, 2nd and 3rd semester students in 2018-2019 academic season with the permission of both universities. The first-year students of the nursing departments of both universities were selected as control group. The students who participated in the test were asked about the definition of the medical microbiology specialist according to the relevant law, where these specialists are primarily employed, their duties/authorizations, and which tests they are responsible for in the clinical laboratories.

**Results:** A total of 507 medical students and 159 nursing students accepted to participate in the survey. Only 9 (2%) of the students answered the test about who the medical microbiology specialist is and what kind of training procedures they had for specialization. It was detected that 30% of the students gave wrong answer to this question and these students thought that a physician (medical doctor) cannot be specialist of medical microbiology. When we asked the students where the medical microbiology specialists are primarily employed, only 16 (3%) students gave exact correct answer to this question. Using another question, it was investigated whether the students actually know what the medical microbiology specialists do in the clinics. Here, 132 (26%) students answered this question correctly, but 18% of the students gave wrong answer and it was found that they did not even know that the task of the medical microbiology specialist is to diagnose infectious diseases. Regarding control group, 9 (6%) students correctly answered the question about who the medical microbiology specialist is and what kind of education is needed for this degree, 4 (3%) students gave correct answer to the question about employment, and 31 (19%) of the students gave correct answer to the question about the role of the medical microbiologist in the clinical settings. A statistically significant difference was found between the control group and the medical student groups (1st, 2nd and 3rd year) for the 11th question. When the answers given to the other questions were analyzed, no significant difference was determined between the groups.

**Conclusion:** Our study showed that the knowledge of the medical students on medical microbiology specialization field was very limited. In conclusion, it may be considered to plan medical microbiology laboratory internship as a separate internship in the clinical phase of medical education to make students better understand the effective role of medical microbiology field in the diagnosis of infectious diseases.

**Keywords:** Medical microbiology, medical school, student, medical education

## Tıp öğrencilerinin tıbbi mikrobiyoloji uzmanlık dalı hakkındaki bilgi düzeylerinin araştırılması

### ÖZET

**Amaç:** Her ne kadar tıp fakültelerinde okuyan öğrenciler tıbbi mikrobiyoloji dersini eğitim hayatları boyunca en az bir dönem almış olsalar da mezun olup klinikte çalışmaya başladıklarında bu ihtisas alanı hakkında net bir bilgiye sahip değildiler. Bu çalışmada, ilimizde bulunan iki tıp fakültesi 1., 2. ve 3. sınıf öğrencilerinin, tıbbi mikrobiyoloji uzmanlığı ve tıbbi mikrobiyoloji uzmanının görev, yetkileri hakkında bilgi düzeylerini ölçmek amaçlanmıştır.

**Yöntem:** Öğrencilere uygulanmak üzere ilgili kanuna uygun olarak on altı soruluk çoktan seçmeli bir test hazırlanmıştır. Bu test 2018-2019 eğitim-öğretim yılı içerisinde, her iki üniversitenin izni ile 1., 2. ve 3. sınıf öğrencilerine yüz yüze uygulanmıştır. Kontrol grubu olarak her iki üniversitenin hemşirelik bölümü 1. Sınıf öğrencileri seçilmiştir. Teste katılan öğrencilere, tıbbi mikrobiyoloji uzmanının ilgili kanuna göre tanımı, asıl olarak nerelerde istihdam edildiği, görev ve yetkileri, laboratuvarında hangi testlerden sorumlu olduğu ile ilgili sorular sorulmuştur.

**Bulgular:** Toplam 507 tıp fakültesi öğrencisi ve 159 hemşirelik fakültesi öğrencisi teste katılmayı kabul etmiştir. Tıbbi mikrobiyoloji uzmanının kim olduğu ve nasıl bir eğitimle uzman olduğu ile ilgili test sorusuna tıp fakültesi öğrencilerden sadece 9'u (%2) tam doğru cevap vermiştir. Bu soru ile tıp öğrencilerinin %30'unun tıbbi mikrobiyoloji uzmanının hekim olamayacağını düşündükleri saptanmıştır. Tıbbi mikrobiyoloji uzmanlarının asıl olarak nerelerde istihdam edildiği ile ilgili soruya sadece 16 (%3) tıp öğrencisi tam olarak doğru cevap vermiştir. Tıbbi mikrobiyoloji uzmanlarının asıl olarak klinikte ne iş yaptığı ile ilgili soruya ise 132 (%26) tıp öğrencisi doğru cevap verirken, öğrencilerin %18'i yanlış cevap vermiştir. Mikrobiyoloji uzmanının görevinin, enfeksiyon hastalıklarına tanı koymak olduğunun bilinmemesi oldukça dikkat çekmektedir. Kontrol grubunda, tıbbi mikrobiyoloji uzmanının kim olduğu ve nasıl bir eğitimle uzman olduğuyla ilgili soruya 9 (%6) öğrenci doğru cevap vermiş, istihdam ile ilgili soruya 4 (%3) öğrenci doğru cevap vermiş ve tıbbi mikrobiyoloji uzmanının klinikteki görevi ile ilgili soruya ise hemşirelik öğrencilerinin 31'i (%19) doğru cevap vermiştir. Yapılan istatistiksel incelemede, 11. soru için, kontrol grubu ile tıp öğrencisi grupları (1., 2. ve 3. yıl) arasında anlamlı bir fark tespit edilmiş, diğer sorulara verilen cevaplar karşılaştırıldığında ise arada anlamlı bir fark olmadığı tespit edilmiştir.

**Sonuç:** Çalışmamız, öğrencilerin tıbbi mikrobiyoloji uzmanlık branşı hakkındaki bilgilerinin çok sınırlı olduğunu göstermiştir. Sonuç olarak, tıbbi mikrobiyoloji uzmanlık dalının, hastanelerde verdiği laboratuvar hizmetleri ile hastalıkların tanısında etkin rolünün daha iyi anlaşılabilmesi için, özellikle tıp eğitiminde klinik stajlar içerisinde, tıbbi mikrobiyoloji laboratuvar stajının da ayrı bir staj olarak planlanması düşünülebilir.

**Anahtar kelimeler:** Tıbbi mikrobiyoloji, tıp fakültesi, öğrenci, tıp eğitimi

## INTRODUCTION

Medical microbiology specialists play roles in creating a scientific approach to diagnosis of diseases caused by microorganisms, perform appropriate diagnostic tests, ensure provision of suitable treatment and also in the prevention, control and epidemiologic assessment of infectious diseases [1, 2]. Medical microbiology field is recognized as a specific medical specialization branch by the European Union of Medical Specialists (UEMS) whose structure consists of a council responsible for 43 specialist sections and their European boards, addressing training in their respective specialty and incorporating representatives from the academia. UEMS represents over 1.6 million medical specialists in all the different specialties having links and relations with European Commission and European Parliament [3]. Due to the development of a patient-centered and evidence-based approach in provision of health services in recent times, the medical microbiology scientific branch is a laboratory discipline with importance increasing day-by-day. Currently, medical microbiology specialists are primarily employed in state hospitals, university hospitals, public health laboratories and provincial health administrations in Turkey [4]. Additionally, similar to other clinicians, they may be employed in private hospitals, central sterilization units, blood transfusion and tissue typing centers [1]. In Turkey, medical school graduates can apply for a specialization education in medical microbiology field, however, according to the currently valid legislation, veterinary clinicians can also apply for student positions in very limited numbers [5, 6].

The basic aim of medical education is lifelong training to raise 'good doctors'. This feature appears to have three separate stages of undergraduate medical education (basic medical education), postgraduate medical education (specialization training in medicine) and continuous medical training (continuous professional development). As a result, changes and developments in medical training should consider all three areas together [7]. It is necessary to open a new page in the historical development of medical education with the 'Flexner Report'. An educator called Flexner prepared the report by visiting all medical faculties in the USA and Canada in 1910 and revealed the importance of training in basic sciences before clinical training [7]. Observations identified that the medical faculty students entering clinics had mostly forgotten what they had learned in the first years and in fact have not conceptualized that the knowledge obtained in the first three years of basic science could be used to solve problems encountered in clinical practice [8]. Today, integration between basic, clinical and social sciences in the medical training models is one of the very important items paid great attention. Skills training is an indistinguishable part of medical training [9]. The approach accepted for teaching of skills is an educational environment structured

around areas and levels of competence ensuring active participation of learners in the process. The process defined in skills education first develops skills to a certain level in laboratory/simulation environments and then in the clinical environment in the second stage with consolidation of experiences gained with real patients and in real situations with skills [9]. During medical education, students learn basic knowledge and are expected to know the specialization branch in which they will receive education. During our teaching experience, we observed that most of the medical students do not know there is a microbiology laboratory in our university hospital and they do not know that doctors could work as microbiologist in these laboratory settings. In this study, we aimed to research the knowledge levels about the description of a medical microbiology specialist, the duties and authority of these specialists and about the medical microbiology specialization area among students in 1st, 2nd and 3rd year of two medical faculties (three programs) in our province.

## MATERIALS and METHODS

A test form with 16 questions was prepared in accordance with relevant legislation to apply to students. This test was applied during the 2018-2019 academic year to medical faculty students in one foundation (private) and one state university located in Gaziantep province. The state university included medical students from both Turkish-language and English-language medical education programs. However, due to the language problem among the foreign students in English medicine program, the test was only administered to medical students who were citizens of the Republic of Turkey. The test was applied to all 1st, 2nd and 3rd year students who agreed to participate during class breaks and face-to-face. First-year nursing students of the two universities were taken to the study as control group.

On the test, students were asked multiple choice questions about who a medical microbiology specialist is/what training is required for specialization according to the relevant legislation, where they work/are employed, the duties-authority of these specialists and tests performed in medical microbiology laboratories. Students were requested to mark at most three choices in response to each question. As questions were multiple choice, when only correct choice(s) were marked it was evaluated as fully right, when correct choice(s) were marked along with incorrect choice(s) it was accepted as partly right and when only incorrect choice(s) were marked it was assessed as wrong. In this study, questions 11, 12 and 13 were organized to reveal the knowledge level of students about this field (Table 1). The obtained data were input into MS Excel program and descriptive statistics as percentage and number were calculated. The chi-square test and Fisher's exact test was used for comparisons.

Table 1. Questions no.11, 12 and 13 on test study.

Question no. 11	Question no. 12	Question no. 13
According to the relevant legislation, who is a <u>medical microbiology specialist</u> ? * (MARK THREE CHOICES AT MOST.)	Where are medical microbiology specialists employed/where do they work primarily? ** (MARK THREE CHOICES AT MOST.)	Which of the following do medical microbiology specialists do as a job? (MARK THREE CHOICES AT MOST.)
<ol style="list-style-type: none"> <li>1. A person who has completed a microbiology associate degree program in a vocational health school.</li> <li>2. A person who has completed a microbiology undergraduate program in university</li> <li>3. A person who has completed an undergraduate degree in the health sciences or biology fields with a master's degree in microbiology</li> <li>4. A person who has finished university in any field with a master's degree in microbiology</li> <li>5. A person with a master's degree in the field of health sciences or biology who has completed a master's degree in microbiology.</li> <li>6. A person with an undergraduate degree in the field of health sciences or biology who has completed a doctorate in microbiology</li> <li>7. A person who has graduated from a medical faculty with a doctorate in microbiology</li> <li>8. <u>A person who has finished the veterinary faculty and received 4 years microbiology specialization education after passing the Medical Specialization Exam</u></li> <li>9. <u>A person who has graduated from a medical faculty and received 4 years microbiology specialization education after passing the Medical Specialization Exam</u></li> </ol>	<ol style="list-style-type: none"> <li>1. They work as lecture staff in microbiology departments in universities</li> <li>2. They work and are responsible for waste/hygiene in factories and environmental organizations</li> <li>3. They work in food analysis laboratories belonging to the private sector and state</li> <li>4. <u>They work and are responsible for medical microbiology laboratories in state hospitals and university hospitals and linked organizations</u></li> <li>5. They work as teachers in the Ministry of National Education</li> <li>6. They work as secondary laboratory technicians in hospital laboratories</li> <li>7. They work and are responsible for hygiene in slaughter houses and markets</li> <li>8. They work and are responsible for antibiotic products in drug companies</li> </ol>	<ol style="list-style-type: none"> <li>1. Diagnose genetic diseases</li> <li>2. Diagnose metabolic diseases</li> <li>3. Diagnose cancers</li> <li>4. Diagnose surgical diseases</li> <li>5. <u>Diagnose infectious diseases</u></li> <li>6. Check hygiene in food production centers</li> <li>7. Check factory waste</li> <li>8. Teach in vocational health high schools</li> <li>9. Work as biologists in drug/bio-medical companies</li> <li>10. All of the above</li> </ol>

\*According to The Law of Practicing Medical And Specialization Arts with Number: 1219 and according to The Law of Bacteriology and Chemistry Laboratories, Which is for The Public, Where Diagnosis and Investigations are Performed with Number: 992. \*\*According to the Official Directive on Turkish Ministry of Health, Provincial Organization Staff Standards and Working Procedures and Principles. \*\*\*The underlined answers are the correct answers.

### Ethical approval

Our study received ethics committee permission from the Clinical Research Ethics Committee numbered 2018/09 KN:01.

### RESULTS

A total of 507 medical students agreed to participate in the study. Of these students 342 (67%) were attending a state university medical faculty and 165 (33%) were in a foundation university medical faculty. Of students, 158 (31%) were Turkish students studying medicine through English and 349 (69%) were studying medicine through Turkish. Of students, 171 (34%) were in 1st year, 150 (30%) were in 2nd year

and 185 (36%) were in 3rd year. The control group were composed of the first-year nursing students of the two university (n=159). Of nursing students, 137 were studying in state university while 23 were studying in foundation university.

When responses given to the test by medical students were analyzed, only 9 students (2%) answered the question about who a medical microbiology specialist was and the training required to receive the title specialist according to the relevant legislation (graduate and specialty education) correctly (question number: 11). In the state university, 51 students studying through Turkish and 48 studying through English and

Table 2. The rate of medical students to accurately answer the questions about the definition, employment and the task of the medical microbiology specialist.

	Who is a medical microbiology specialist?*(Question no. 11)	Where are medical microbiology specialists employed/where do they work primarily?**(Question no. 12)	Which of the following do medical microbiology specialists do as a job?(Question no. 13)
1st year	6/172 (3%)	5/172 (3%)	27/172 (16%)
2nd year	2/150 (1%)	3/150 (2%)	30/150 (20%)
3rd year	1/185 (0.5%)	8/185 (4%)	75/185 (40%)
Total	9/507 (2%)	16/507 (3%)	132/507 (26%)
Control	9/159 (6%)	4/159 (3%)	31/159 (19%)

\*At the statistical analyses, no significant difference was found between control, 1st, 2nd and 3rd year for the question 12 ( $p>0.05$ ). There was a significant difference identified between 1st and 2nd year students compared with 3rd year students for question 13 ( $p<0.001$ ). A significant difference was identified between control group and medical student groups (1st, 2nd and 3rd years) for the question 11. When 1st year and 3rd year, and 2nd year and 3rd year are separately compared, there was a significant difference found ( $p<0.017$ ; alpha,  $\alpha$  with Bonferroni correction was accepted as 0.017). \*\*According to The Law of Practicing Medical And Specialization Arts with Number: 1219 and according to The Law of Bacteriology and Chemistry Laboratories, Which Is for The Public, Where Diagnosis and Investigations Are Performed with Number: 992. \*\*According to the Official Directive on Turkish Ministry of Health, Provincial Organization Staff Standards and Working Procedures and Principles.

in the foundation university 55 students gave incorrect answers to this question and did not mark the box indicating graduation from a medical faculty. As a result, 154 students (30%) answered this question incorrectly and stated they did not think that medical doctors could be medical microbiology specialists. Question 12 asked students where medical microbiology specialists were primarily employed. This question was answered incorrectly by 64 Turkish language and 73 English language medical students in the state university and 54 medical students in the foundation university. In total 191 (38%) of students did not think that medical microbiology specialists could work in state hospitals, public health laboratories or in Ministry of Health positions. Only 16 (3%) students answered the question fully correctly (Table 2).

The 13th question asked students about the primary duties and what jobs were performed by medical microbiology specialists. Here, 29 Turkish-language and 32 English-language medical students in the state university and 29 students in the foundation university answered this question wrong. Of students, 90

(18%) did not know that the duty of medical microbiology specialists included diagnosis of infectious diseases. Only 132 students (26%) answered this question correctly (only one correct answer had been planned to this question). All data are summarized in Table 2 and Figure 1.

At the statistical analyses, no significant difference was found between control, 1st, 2nd and 3rd year for the question 12 ( $p>0.05$ ). However, there was a significant difference identified between 1st and 2nd year students compared with 3rd year students for question 13 about the duties and jobs of medical microbiology specialists ( $p<0.001$ ). In addition, a significant difference was identified between control group and medical student groups (1st, 2nd and 3rd years) for the question 11. When 1st year and 3rd year, and 2nd year and 3rd year are separately compared, there was a significant difference found ( $p<0.017$ ; alpha,  $\alpha$  with Bonferroni correction was accepted as 0.017).

The same form asked students questions about the laboratory tests in the medical/clinical microbiology field. Unfortunately, most of the students left these questions blank ( $>90\%$ ) so the responses to these questions were excluded from the analysis.

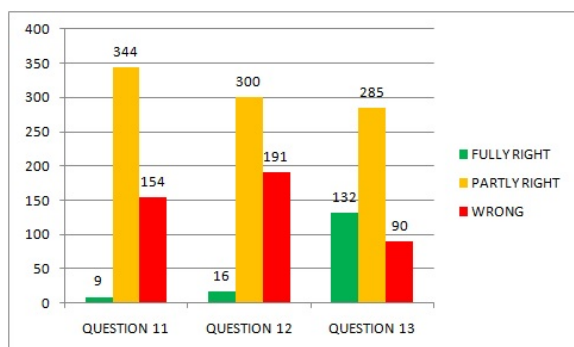


Figure 1. Distribution of the students according to the answers.

## DISCUSSION

In our study, some data come to the fore. For example, a large majority of students (98%) did not fully know what authority medical microbiology specialists obtained at the end of what training. Again, 30% of students did not think that medical doctors could be medical microbiology specialists. Our test found the highest correct answer on a year basis (at 40% level) was provided by 3rd year students in answer to the question of 'which of the following do medical microbiologists do?'. However, considering that these students will not receive medical microbiology lessons, the reality that 60% of the 3rd year students did not know the duties of a medical microbiology

specialist is worrying for the future. This situation shows that students working in clinics in the future may experience problems with medical microbiology specialists when monitoring laboratory results, and during selection of tests and consultation processes. Our study shows how limited the knowledge of students is about the medical microbiology specialization branch. When the literature is researched, there is no similar study researching the medical student knowledge levels about the authority, duties and working area of medical microbiology specialists, though there are a variety of studies indicating that restructuring microbiology lessons/exams may increase the success/knowledge/approval status among students [10, 11]. The only similar study in this field was the investigation of the gamification methods in microbiology education which were reported to have a positive effect on learning [12]. A survey study by Maral et al. [13] stated that 73.2% of students thought that infectious diseases were the diseases they would encounter most in society after graduation. In this situation, in our opinion it is a significant and sad deficiency in terms of medical education that the area of medical microbiology specialization, playing a very important role in infectious disease diagnosis, is not sufficiently known by medical students and that clinician candidates do not know who they will receive help from for diagnosis of infectious diseases after graduation.

A significant difference was found between the control group and the medical students for only for the question 11 which analyzes the knowledge about how the degree of medical microbiology specialist is gained. Interestingly, nursing students answered more correctly than the medical students. This could be due to the fact that nursing students of both two universities learnt microbiology lectures from medical doctors who are specialist of medical microbiology while medical students learnt this lecture from a mixed group of professors holding different scientific degrees.

Diagnosing and treating infectious diseases, knowing the protective methods against them and as a result protecting public health are the main duties of clinicians. The basics related to infectious diseases are explained in medical microbiology lessons [10]. Medical microbiology specialists provide protective contributions to epidemiologic and infection control with sample analysis, synthesis and presentation of diagnostic results and therapeutic and clinical consultation for the science of medicine and public health [2, 14]. A diagnostic medical specialization and an inseparable part of clinical medicine, in the medical microbiology field students should be included in real diagnostic processes with real patient samples in real hospital environments as recommended by skills education. During medical microbiology education, training that ignores aspects involving practical and real diagnostic processes will leave students with limited knowledge levels about topics like why they are

doing what, why they are evaluating this smear, what the importance of blood culture is, and how clinical diagnostic processes operate. In medical microbiology lessons, though diagnostic/medical microbiology is explained in detail, the majority of students assimilates the knowledge only theoretically and perceives this lesson as a morphologic lesson describing microbes. As a result, students do not fully know the working definition and authority of microbiology experts and experience problems related to laboratory processes when working in hospitals and clinics in future periods after graduation.

As a result, revisions to the medical microbiology education syllabus like increasing clinical practice and providing more information about clinical laboratory services and providing more detailed information about clinical test applications in theoretical lessons may provide students with more knowledge about this specialization branch. For the effective role of medical microbiology specialists in diagnosis of diseases and laboratory services in hospitals to be better understood, it will be appropriate to plan a separate medical microbiology clinical internship among mandatory clinical internships (after the 4th year). Though medical microbiology lectures are given as clinical internships in some medical faculties, generally it is an elective internship and most students cannot reach this training [15, 16]. If medical microbiology is included in the mandatory internship program, students will consolidate the knowledge obtained in basic science, it will ease approaches to infectious disease after graduation and at the same time ensure better understanding of medical microbiology specialization. Well-planned clinical microbiology internship training will make students more aware, reduce the requests for unnecessary tests in the future, train clinician candidates about which test can be requested from which laboratory and how many days for the results of tests early which will reduce time and energy loss caused by some clinicians keeping laboratories unnecessarily busy. In this way, it will be possible to achieve more effective use of medical microbiology laboratories and reduce time, labor and economic losses in the future. A limitation of our study is that only the preclinical students who are familiar with microbiology were included in the study while 4th, 5th and 6th year students of the medical school were excluded from the study. In the following years, if a research can be planned to include medical faculty students at the clinical years or medical doctors, new data can be gathered about when physicians become conscious and knowledgeable about the field of medical microbiology.

In the literature, there is one study researching the sufficiency of education conditions, theoretical and skills efficacy about branches for medical specialization students receiving education in the fields of basic science in Turkey [17]. However, there is no study similar to our research about medical or specialization students specific to medical microbiology. Our

educational research is probably the first study in Turkey and the world investigating knowledge of medical students about the medical microbiology specialization field. A limitation of our research is that our study included two universities in our city providing medical education at three medical faculty programs and did not include other cities or faculties. In spite of this fact, we think the data obtained in our study will be beneficial for planning the education of medical students. To better understand the importance and clinical application of the medical microbiology branch during the medical education process, we think it will be beneficial for this lesson to be planned as a clinical internship or some practical applications

to be completed in real hospital environments. We believe our study will be a guide to interrogating new ideas like this.

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