Infectious diseases and clinical microbiology consultations in the emergency department: A cross-sectional study at a tertiary-care hospital

Muammer Çelik[1,A–F], Adnan Karabacak[1,B,E,F], Tuğçe Açıkgöz[2,B,D–F], Feyzullah Yavuz Atabay[1,B,E,F], Gamze Helvacı[1,B,D–F], Ahmad Nejat Ghaffari[1,B,E,F], Çağlar Irmak[1,B,E,F], Hacer Ceylan Çimendağ[1,B,E,F], Figen Coşkun[2,A,D–F], Vildan Avkan-Oğuz[1,A,C–F]

[1] Department of Infectious Diseases and Clinical Microbiology, Faculty of Medicine, Dokuz Eylül Üniversity, Izmir, Turkey
[2] Department of Emergency Medicine, Faculty of Medicine, Dokuz Eylül Üniversity, Izmir, Turkey

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

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Address for correspondence
Muammer Çelik
E-mail: muammer4677@yahoo.com

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Abstract

Background. Although there is limited data about the role of infectious diseases and clinical microbiology (IDCM) consultations in the Emergency Department (ED), they have a key role in deciding on hospitalization and appropriate use of antibiotics.

Objectives. To evaluate demographic and clinical characteristics of patients who visited the ED of our hospital and underwent an IDCM consultation.

Materials and methods. In this cross-sectional study, we reviewed the medical records of adult patients who visited the ED of our hospital between May and August 2021 and needed IDCM consultation. The demographic data, the date and time of admission and consultation, the departments that were consulted before IDCM, laboratory results, diagnosis, and outcome were recorded.

Results. Out of 42,116 ED visits, 1,007 (2.4%) IDCM consultations were requested. The median time between admission and IDCM consultation was 239 min (150.0–373.5). Before 56.9% of IDCM consultations, pre-consultations were requested from other departments, and the time interval was significantly longer. The median age of patients was 68 years (51–77 years). Infections were confirmed by the IDCM physician in 79.6% of the consultations. The most diagnosed infections were urinary tract infections (32.4%), skin-soft tissue infections (16.9%) and lower respiratory tract infections (10.3%), whereas 9.3% of the consultations resulted in hospitalization to the infection ward, 25.1% to other wards, and 5% to the intensive care unit (ICU).

Conclusions. Two of 3 consultations resulted in hospitalization in other wards, and this shows that IDCM consultations are beneficial for managing patients with infectious diseases hospitalized in other departments. Communication between IDCM specialists and ED colleagues is important, especially in the management of elderly patients who require a multidisciplinary approach.

Key words: consultation, emergency department, infectious diseases and clinical microbiology, tertiary-care hospital

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Background

Infectious diseases and clinical microbiology (IDCM) consultations are vital for improving the clinical management of patients with suspected infectious diseases and increasing the rational usage of antibiotics.[1–4] Due to the unavailability of culture results, antimicrobial susceptibility tests, and other serological or molecular diagnostic tests in the Emergency Department (ED), most decisions are based on clinical symptoms and findings resulting in empirical therapy. Moreover, it is difficult to diagnose infectious diseases in the ED because of the heavy workload, heterogeneous presentation of infections, and varying host characteristics (elderly patients, children and/or immunosuppressed patients). The absence of typical infection signs and symptoms, and the presence of comorbid diseases, such as malignancy, make it difficult to interpret the clinical picture, especially in elderly patients.[5] In the elderly patients, the prevalence of bacterial colonization risk factors, including frequent hospitalization, antibiotic use, invasive devices such as urinary catheters, and residency in long-term care facilities, make the differential diagnosis of infectious diseases more challenging.[6,7]

Although there is limited data on the role of IDCM consultations in the ED, they are critical when deciding on hospitalization and the appropriate use of antibiotics. The implementation of IDCM consultations for the early management of patients with severe sepsis/septic shock in the ED reduces mortality.[8] In a Canadian study, automatic IDCM consultations for patients admitted to the ED with cellulitis were beneficial for differential diagnosis, reducing recurrence and preventing hospital admissions.[9]

Objectives

This study aimed to evaluate the contribution of IDCM consultations by determining the demographic and clinical characteristics of patients who were consulted in the ED.

Materials and methods

Study design and population

The study was designed as a retrospective, cross-sectional study. Dokuz Eylül University Hospital in Izmir, Turkey, is a tertiary care reference hospital with a 1,100-bed capacity. The ED of our hospital has 45 beds and receives approx. 120,000 admissions annually. After triage, the patient is examined by the resident physician of the ED and evaluated alongside the senior assistant or emergency medicine specialist. If necessary, a consultation is requested from the relevant departments. Infectious diseases and clinical microbiology consultation is requested for ED patients suspected of having infectious diseases and who require an expert opinion.

The inpatient service of the IDCM Department has 14 beds and was not accepting patients other than those with coronavirus disease 2019 (COVID-19) between March 2020 and May 2021 due to the heavy workload and staff shortages caused by the pandemic. After the necessary conditions were met, non-COVID-19 patients were accepted from May 1, 2021. The IDCM consultations are evaluated by a designated consultant during working hours, while IDCM residents and specialists are on duty outside working hours.

All patients older than 18 years who presented to the ED between May 1 and August 31, 2021, and required IDCM consultation, were included in this study.

Data collection and analysis

Data on patients and consultations were accessed through the computerized hospital management system. The first consultations requested on the patient's admission to the ED were considered new admissions. Those who revisited the ED at least 72 h after being discharged and were consulted were also considered new admissions. If the patient had repeated consultations during their stay in the ED or revisited within 72 h of discharge from the ED, the requested consultations were considered a re-consultation. Consultations requested from other departments before IDCM were defined as pre-consultations.

Since some patients had more than 1 admission at different times, demographic data were evaluated on the number of patients and other clinical or laboratory data on the number of admissions. The demographic data of each patient were recorded. The admission and consultation time, reason for admission, departments for which pre-consultation was requested, laboratory data, diagnosis, recommendations, and results were recorded for each application. Infectious disease was diagnosed based on symptoms such as fever, nausea, vomiting, cough, dysuria, abdominal pain, physical examination findings, laboratory results (high C-reactive protein (CRP) and/or procalcitonin, leukocytosis/leukopenia, the presence of pyuria), and/or radiological findings (system-specific findings such as pneumonic infiltration) compatible with an infection. A diagnosis of infection was excluded based on patients having no symptoms, physical examination findings, supportive laboratory and/or radiological findings compatible with an infection, and another acute condition that would explain their clinical situation.

Statistical analyses

Statistical analysis employed IBM SPSS v. 24.0 (IBM Corp., Armonk, USA). Categorical variables are presented as numbers and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test and

histograms. The homogeneity of variance was evaluated with the Levene's test. The results of assumption verification for test applications are given in the Supplementary Table (https://doi.org/10.5281/zenodo.8410371). Based on the results of the normality tests, non-parametric statistical tests were utilized. Numerical data were summarized using median values and interquartile range (IQR), which was defined as the 1st quartile (Q1) to the 3rd quartile (Q3). The Mann–Whitney U test compared differences between 2 independent groups, while the Kruskal–Wallis test assessed significant differences in a continuous dependent variable of a categorical independent variable (with 3 or more groups), followed by Dunn's post-hoc test. The statistical significance limit was accepted as 0.05 (p-value).

Ethics statement

The Non-Interventional Research Ethics Committee of the Dokuz Eylül Üniversity (Izmir, Turkey) approved the study on November 24, 2021 (No. 2021/34-06). Necessary permissions were obtained from the hospital management and the Department of Emergency Medicine of the Dokuz Eylül Üniversity.

Results

Between May 1 and August 31, 2021, there were 42,116 admissions to the ED of our hospital, and 1,007 (2.4%) consultations were requested from the Department of IDCM for 808 patients. Of the consultations, 853 (84.7%) were new admissions, and 154 (15.3%) were re-consultations. Forty-four (5.4%) patients had multiple admissions to the ED at different times. During the study period, at least 1 consultation was requested from the ED every day except for 2 days. The median number of daily consultations was 8 (6–10), with the distribution of consultations based on hourly intervals during the day given in Fig. 1.

In 56.9% (485/853) of the admissions, a pre-consultation was requested from other departments before IDCM, and the median number of pre-consultations per admission was 1 (0–2). Pre-consultations were primarily requested from the following departments: Nephrology (13.5%, n = 115), Pulmonology (9.6%, n = 82), Oncology (8%, n = 68), Gastroenterology (6.6%, n = 56), Cardiology (6%, n = 51), Orthopedics and Traumatology (5.7%, n = 50), and Neurology (4.1%, n = 35).

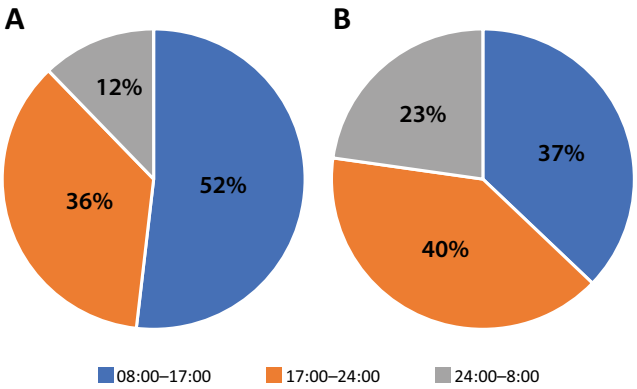

Fig. 1. A. Percentage of admissions to the Emergency Department (ED) according to working hours; B. Percentage of Department of Infectious Diseases and Clinical Microbiology (IDCM) consultations according to working hours

The median time between admission to the ED and IDCM consultation was 239 min (150.0–373.5; 3 h and 59 min), ranging between 6 and 4718 min (78 h and 38 min). The median time was 287 min (183.0–444.5; 4 h 47 min) for those with pre-consultation and 185 min (122.0–269.5; 3 h and 5 min) for those without pre-consultation ($p < 0.001$; $U = 53719.5$). As the number of departments requested for pre-consultation increased, the time until the IDCM consultation increased ($p < 0.001$; Kruskal–Wallis test) (Table 1,2). The median response time of the IDCM to the consultation was 96 min (64.0–138.5).

The median age of the patients was 68 years (51–77), and 53.25% of patients were 65 and older. Distribution of the patients according to age group is given in Fig. 2. Of the patients, 50.7% (n = 410) were men. The most common symptom on admission was fever (21.5%, n = 183), with the other symptoms given in Table 3. After evaluation by an IDCM physician, infections were diagnosed in 79.6% (n = 679) of the consultations. The diagnoses of infectious diseases are given in Table 4.

Sampling for blood cultures was done in 50.9% (434/835) of ED admissions, with no growth in 61.1% (265/434) of the blood cultures. Of the blood culture results, 19.4% (84/434) were compatible with contamination (most commonly coagulase-negative staphylococci), and 19.5%

Table 1. The time interval between the patient's arrival at the emergency department and the infectious diseases consultation based on the number of pre-consultations

Number of pre-consultations	n	Time [min] (median, IQR)	Kruskal–Wallis H test	df	p-value
0	368	184.5 (122.0–269.5)	133.515	2	<0.001
1	360	258.5 (158.7–402.0)			
≥2	125	403 (269.5–635.5)			
Total	853	239 (150.0–373.50)			

IQR – interquartile range; Kruskal–Wallis test was used; n – number; df – degrees of freedom.

Table 2. The p-values of post hoc comparisons for variables between the groups

Pairwise comparisons	p-value
0 vs 1 pre-consultation	<0.001
0 vs ≥2 pre-consultations	<0.001
1 vs ≥2 pre-consultations	<0.001

The Kruskal–Wallis test and the Dunn's post hoc test were used.

Table 3. Symptoms of the patients at presentation

Symptom	n (%)
Fever	183 (21.5)
Cutaneous symptoms (erythema, edema, swollen, tenderness, infected wound/ulcer, rash, etc.)	167 (19.6)
General systemic symptoms (weakness, fatigue, loss of appetite, myalgia, confusion, headache, etc.)	130 (15.2)
Gastrointestinal symptoms (abdominal pain, nausea, vomiting, diarrhea, etc.)	109 (12.8)
Genitourinary symptoms (dysuria, frequency, urgency, cloudy urine, flank pain, penile/vaginal discharge, etc.)	94 (11.0)
Pulmonary symptoms (coughing, sputum, shortness of breath, chest pain)	90 (10.5)
Others (joint pain, seizure, altered mental status, behavioral changes, postvaccination reaction, etc.)	80 (9.4)
Total	853 (100.0)

n – number.

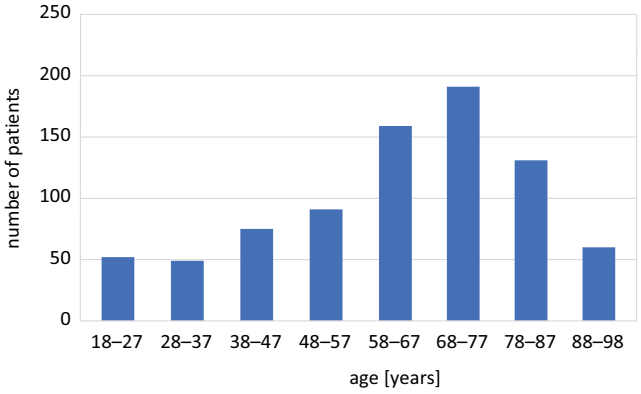

Fig. 2. The distribution of patients across different age groups

(85/434) were accepted as an infectious agent. The most frequently isolated microorganisms in blood cultures were *Escherichia coli* (41.2%, 35/85), *Staphylococcus aureus* (13.0%, 11/85) and *Klebsiella pneumoniae* (8.2%, 7/85).

Urine cultures were obtained from patients in 52.4% (447/853) of the ED admissions, with no growth in 40.0% (179/447). In 16.5% (74/447) of urine cultures, more than 3 microorganisms were isolated, which were considered contamination. The most common agents isolated in urine cultures were *E. coli* (21.0%, 94/447), *K. pneumoniae* (10.5%, 47/447) and *Pseudomonas aeruginosa* (3.8%, 17/447).

Of all consultations, 9.2% (n = 78) resulted in admission to the IDCM ward. The most common diagnoses for hospitalization were urinary tract infection (43.6%,

Table 4. Diagnosis of infectious diseases

Diagnosis, n (%)	n (%)
UTI upper UTI lower UTI	220 (32.4) 176 (25.9) 44 (6.5)
SSTI cellulitis complicated SSTI abscesses	115 (16.9) 72 (10.6) 32 (4.7) 11 (1.6)
LRTI pneumonia empyema COVID-19	70 (10.3) 46 (6.8) 2 (0.3) 22 (3.2)
Bloodstream infection bacteremia central line-associated bloodstream infection endocarditis	24 (3.5) 12 (1.8) 9 (1.3) 3 (0.4)
Central nervous system infection	7 (1.0)
Gastrointestinal system infection acute gastroenteritis cholecystitis – cholangitis peritonitis intra-abdominal infection esophagitis	61 (9.0) 33 (4.9) 11 (1.6) 8 (1.2) 8 (1.2) 1 (0.1)
Musculoskeletal system infection diabetic foot infection septic arthritis/arthritis prosthesis infection osteomyelitis	49 (7.2) 24 (3.5) 17 (2.5) 7 (1.1) 1 (0.1)
Fever fever of unknown origin neutropenic fever	67 (10.0) 43 (6.3) 24 (3.5)
Sepsis of unknown origin	28 (4.1)
Other*	38 (5.6)
Total	679 (100.0)

*Herpes zoster, HIV, Orf, infectious mononucleosis, lymphadenitis, malaria, tetanus, Crimean-Kongo hemorrhagic fever, sexually transmitted diseases.
UTI – urinary tract infection; LRTI – lower respiratory tract infection; SSTI – skin-soft tissue infection; COVID-19 – coronavirus disease 2019..

n = 34), skin-soft tissue infection (23.1%, n = 18), central nervous system infection (7.7%, n = 6), bloodstream infection (7.7%, n = 6), acute gastroenteritis (6.4%, n = 5), herpes zoster (3.8%, n = 3), and other (7.7%, n = 6), such as diabetic foot infection, fever of unknown origin, human immunodeficiency virus (HIV) infection, malaria, tetanus, and Crimean-Kongo hemorrhagic fever.

Of all ED visits, 25.1% (n = 214) of patients were admitted to other services, and 80.8% (n = 173) had accompanying infectious diseases. Of the ED visits, 5% (n = 43) resulted in hospitalization to the intensive care unit (ICU), and 3.2% (n = 27) of patients died during their ED stay (Table 5). In total, 39.3% of the consultations resulted in hospitalization (9.2% to IDCM ward, 25.1% to other wards, and 5% to the ICU). More than half (57.5%) of the patients were discharged from the ED and 39.3% were hospitalized. Between the patients being hospitalized or discharged, the median number of pre-consultations (1 [0–1] compared to 0 [0–1]; $p < 0.001$; U = 62291.5) and the time interval between

Table 5. The result of the infectious diseases and clinical microbiology (IDCM) consultations

Result	n (%)
Discharged from the ED	491 (57.5)
prescribed oral antibiotics	319 (37.4)
prescribed parenteral antibiotics	14 (1,6)
referred to the outpatient IDCM clinic	37 (4.3)
other*	121 (14.1)
Hospitalization	335 (39.3)
admission to the IDCM ward	78 (9.3)
admission to other wards	214 (25.1)
admission to the ICU	43 (5.0)
Mortality in the ED	27 (3.2)
Total	853 (100.0)

* The patients with no infection were discharged from the ED by an ED physician or left the ED voluntarily. IDCM – infectious diseases and clinical microbiology; ED – emergency department; ICU – intensive care unit.

admission and IDCM consultation (249 min (152–389) compared to 221 min (143–344), p = 0.017; U = 74177.0) were significantly different.

Discussion

In this study, 2.4% of ED patients required an IDCM consultation, of which 79.6% resulted in the diagnosis of an infectious disease. Time is needed for the initial patient examination in the ED and the results of laboratory tests and radiological imaging. For our hospital, this time is approx. 4 h, and the IDCM consultation concludes within 1.5 h. More than half of ED visits require a multidisciplinary approach, and IDCM consultation is delayed if other departments request a pre-consultation. However, an infectious disease diagnosis in 4 out of 5 patients indicates that consultations were requested with the correct indication. Additionally, the hospitalization of 2 out of 3 patients in other wards supports the importance of a multidisciplinary approach. Of the patients admitted to the other departments, 80.8% had an accompanying infectious disease.

More than half of the patients admitted to the ED of our hospital were older than 65 years. In our country, society is growing older, and the elderly population aged 65 and over has increased by 21.9% in the last 5 years.[10] As the elderly population continues to grow, there will be a gradual increase in the number of such patients seeking access to healthcare. According to studies conducted in Turkey, elderly patients accounted for 10.1–13.8% of all ED visits.[11–13] In a population-based national study conducted in the USA, more than 3 million of elderly patients attended the ED in 2012, and 18.5% of these admissions were infection-related.[14] In a single-center study conducted at a university hospital in Thailand, 18% of the annual 50,000 admissions to the ED were elderly patients, and 14.5% of the admissions were infection-related.[15] In our study, the population differed from previous research as it exclusively included patients requiring an IDCM consultation. As a result, the proportion of elderly patients was higher. Younger patients with mild or moderate infections are discharged from the ED to the IDCM outpatient clinic after being examined by the emergency physician. In older patients, infections may be more severe, and hospitalization is often required. This supports the fact that the need for IDCM consultation is higher, especially for people over 65 years of age.

According to the results of our study, a diagnosis of infection was excluded in 20% of the consultations. Diagnosing infections in the ED is challenging because of the heavy workload and diagnostic limitations. Culture results have a limited role in the diagnosis of infections in the ED because significant growth was detected in only 1 patient out of 5 for blood cultures and 2 patients out of 5 for urine cultures. This can result in either failure to recognize an infection in the ED (under-diagnosis) or attributing other diseases to an infection (over-diagnosis). Under-diagnosis may lead to delays in prescribing antibiotics, and over-diagnosis may result in the unnecessary use of antibiotics.[16,17] In a study by Caterino et al., the diagnoses of bacterial infections by ED physicians were compared with those made by 2 other experts (one board-certified in infectious disease and one board-certified in emergency medicine and internal medicine with expertise in geriatrics), and both under-diagnosis and over-diagnosis were common.[18] Infectious diseases and clinical microbiology consultations are critical for infection diagnosis and management in the ED.

The most common infections in our study were urinary tract infections (32.4%), skin-soft tissue infections (16.9%) and lower respiratory tract infections (10.3%). In the study by Ittisanyakorn et al., the most common infections were pneumonia (32.6%), pyelonephritis (23.1%) and intestinal infections (11.4%).[15] Meanwhile, Goto et al. reported lower respiratory tract infections (26.2%), urinary tract infections (25.3%) and sepsis (18.9%), and Caterino et al. reported gastrointestinal (28.6%), urinary tract (24.7%) and lower respiratory tract (23.4%) infections.[14,18] In these studies, all patients with bacterial infections admitted to the ED were evaluated. We included only patients who required IDCM consultations. In our center, patients with suspected pneumonia are consulted by the pulmonary medicine consultants working in the ED. For this reason, unlike other studies, the most common diagnosis made by the IDCM consultant was urinary tract infection instead of pneumonia. There are differences in the distribution of infectious diseases in the ED according to the sociodemographic characteristics of the region, structural characteristics of the center and patient profile. More studies should be conducted to understand the characteristics of the patients admitted to the ED and create an action plan.

Limitations

The study was conducted in a single center, and the consultations were retrospectively evaluated. There may have been a selection bias since only patients who consulted

with an IDCM were included in the study. For this reason, patients with mild-to-moderate infectious disease who were examined and discharged by the ED physician were not evaluated. On the other hand, we could not compare the outcomes of patients with and without an IDCM consultation because the study group did not include patients who did not require an IDCM consultation. The impact of IDCM consultations on the timing of antibiotic treatment or patients' outcomes could not be evaluated in the study because patients could not be followed up after they were discharged from the ED or admitted to other services.

The pneumonia rate was low in our study because pulmonary disease consultation was requested for patients with suspected pneumonia. Likewise, patients with mild COVID-19 were not included in the study because they were evaluated in the pandemic outpatient clinic, and patients with moderate-to-severe COVID-19 admitted to the ED were evaluated by a pulmonologist.

Conclusions

Despite accounting for only 2.4% of total ED visits, IDCM consultations are valuable for the diagnosis and management of infections, especially in older patients requiring a multidisciplinary approach and pre-consultation. Timely and appropriately indicated IDCM consultations have proven to be effective in achieving their intended objectives. The consultations provided by IDCM specialists confirmed infection in 4 out of 5 patients. While $^1/_3$ of the hospitalized patients were admitted to the IDCM ward, the rest were admitted to other services. Thus, IDCM consultations in the ED play a crucial role not only in the management of IDCM service patients but also in effectively managing infections for patients hospitalized in other departments. Promoting collaborative relationships between IDCM specialists and ED colleagues will be beneficial in diagnosing, managing and preventing infectious diseases in the ED.

Supplementary data

The Supplementary materials are available at https://doi.org/10.5281/zenodo.8410371. The package consists of the following file:

Supplementary Table 1. Results of verifying the assumptions for the application of the tests (dataset).

ORCID IDs

Muammer Çelik https://orcid.org/0000-0001-6190-5370
Adnan Karabacak https://orcid.org/0000-0002-7252-3885
Tuğçe Açıkgöz https://orcid.org/0000-0002-1131-6719
Feyzullah Yavuz Atabay https://orcid.org/0000-0001-6741-1216
Gamze Helvacı https://orcid.org/0000-0002-4973-9602
Ahmad Nejat Ghaffari https://orcid.org/0000-0002-7188-8268
Çağlar Irmak https://orcid.org/0000-0002-7901-3757
Hacer Ceylan Çimendağ https://orcid.org/0000-0003-2235-7767
Figen Coşkun https://orcid.org/0000-0002-7027-8169
Vildan Avkan-Oğuz https://orcid.org/0000-0001-7648-7730

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