Senaryoya Dayalı Bir Sanal Hasta Programının Hekimlerin Diyabetik Ayak Enfeksiyonu ve Komplike İntraabdominal Enfeksiyon için Mevcut Kılavuzlara Uyumlarını Artırmaya Yönelik Kullanımı

Oguz KARABAY[1], Mehmet GURLEK[2]

Öz

Diyabetik ayak enfeksiyonu (DAE) ve komplike intraabdominal enfeksiyon (KIE) hedefli sanal bir hasta programına katılım sağlayan hekimlerin tanı ve tedavi pratiklerinin değerlendirilmesi amaçlanmıştır. Bu çalışma DAE (n=210) ve KIE (n=42) hedefli sanal bir hasta programına katılım sağlayan 252 hekim ile gönüllülük esasına göre yürütüldü. Hekimlerin bilgisayar grafik teknolojileri temelinde geliştirilen program dahilinde yaptıkları aşamalı hasta değerlendirilmesi verileri (hasta özellikleri, hastalık özellikleri, fizik muayene, laboratuvar ve radyolojik bulgular) kaydedildi. KIE Olgu Senaryosunda, tanı; hekimlerin %75,0'i tarafından doğrulanırken, cerrahi girişim ve seftriakson + metronidazol (37,6%) veya ertapenem (34,1%) en sık yapılan tedavi seçimi idi. DAE Olgu Senaryosunda tanı, hekimlerin %98,0'i tarafından doğrulanırken, hekimlerin %71,0'i en sık ertapenem (%55,0) olmak üzere antibiyotik tedavisi başlanmasını uygun buldu. Sonuç olarak, bulgularımız "senaryoya dayalı" sanal hasta programlarının sağladığı hızlı ve güncel geri bildirim ve öğrenim çıktılarının bireysel takibi yoluyla hekimlerin KIE ve DAE klinik karar alma becerilerinin gelişimine katkıda bulunabileceğini göstermektedir. Dolayısıyla, bulgularımız hekimlerin KIE için tedavi uygulamalarının özellikle ampirik antibiyotik seçimi konusunda, DAE tanı ve tedavi uygulamalarının ise enfeksiyon riskinin daha dikkatli değerlendirilerek daha uygun ampirik antibiyotik tedavi seçimi yapılması açısından iyileştirilmesi gerektiğine işaret etmektedir.

Anahtar Kelimeler: Komplike intraabdominal enfeksiyon, diyabetik ayak enfeksiyonu, tanı, tedavi uygulamaları, senaryoya dayalı sanal hasta programı

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Oguz KARABAY
Department of Infectious Diseases, Sakarya University Faculty of Medicine,
54050 Adapazari, Sakarya, Turkey
Tel: +90 264 2956630
e-Mail: okarabay@sakarya.edu.tr

A Scenario-Based Virtual Patient Program To İmprove Adherence To Guidelines for Diabetic Foot İnfection and Complicated İntra-Abdominal İnfection among Physicians

Oguz KARABAY[1], Mehmet GURLEK[2]

Abstract

In the study it was aimed to evaluate diagnostic and practice patterns of physicians who participated for scenario-based virtual patient programs on complicated intra-abdominal infection (IAI) and diabetic foot infection (DFI). This study was conducted with 252 physicians who participated on a voluntary basis in two scenario-based virtual patient programs relating to complicated IAI (n=210) and DFI (n=42) which provide data on stepwise evaluation of patient (patient characteristics, disease characteristics, physical examination, laboratory and radiological findings) as requested by the physician and were developed using computer graphics technology. For IAI Case Scenario, the diagnosis was confirmed by 75.0% of physicians, while surgical intervention with ceftriaxone + metronidazole (37.6%) or with ertapenem (34.1%) was the most commonly selected treatment modalities. For DFI Case Scenario, the diagnosis was confirmed by 98.0% of physicians, and 71.0% of physicians considered initiation of antibiotic treatment and mostly with ertapenem (55.0%). In conclusion, our findings revealed that use of "scenario-based" virtual patient programs provided rapid and up-to-date feedback and self-monitoring of learning outcomes to improve clinical reasoning skills of physicians on IAI and DFI. Accordingly, our findings indicate practice pattern of physicians for complicated IAI should be improved in terms of more appropriate selection of empirical antibiotherapy, while diagnostic and practice patterns for DFI should also be improved in terms of more careful assessment of risk factors for infection and appropriate selection of empirical antibiotherapy.

Keywords: Intraabdominal enfeksiyon, diyabetik ayak enfeksiyonu, tanı, tedavi uygulamaları, senaryoya dayalı sanal hasta programı

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Corresponding Author

Oguz KARABAY
Department of Infectious Diseases, Sakarya University Faculty of Medicine,
54050 Adapazari, Sakarya, Turkey
Tel: +90 264 2956630
e-Mail: okarabay@sakarya.edu.tr

[1]Sakarya University Faculty of Medicine, Sakarya, Turkey
[2]Merck Sharp & Dohme Limited, Istanbul, Turkey

INTRODUCTION

Intra-abdominal infections (IAIs), a wide spectrum of entities ranging from uncomplicated appendicitis to fecal peritonitis, are the second most common cause of infectious mortality in intensive care units.[1-5]

Appropriate management of IAIs has improved considerably in virtue of advances in diagnostic imaging, supportive intensive care, minimally invasive intervention and antimicrobial therapy.[5] However, due to development of resistance by many responsible pathogens to standard antibiotics, treatment options become limited,[6-8] while the requirement for intervention in most cases alongside the controversies regarding type of the procedure adds further complexity to the management of these patients.[5]

Diabetic foot infections (DFIs) usually arise in a skin ulceration that occurs as a consequence of progressive neuropathy or occasionally as cellulitis or post-traumatic wound infections.[9,10] DFIs become an increasingly common problem, while associated with potentially serious sequelae including neurological problems, arterial insufficiency and immunological disturbances.[9-12] Despite the curability of most cases if properly managed, developing a DFI continues to be the most common diabetes-related reason for hospitalization and lower extremity amputation especially when wound infection or osteomyelitis are involved, because of improper diagnostic and therapeutic approaches.[10,11,13]

Use of technology in health professions education is associated with provision of rapid and up-to-date feedback, while providing educators with ability to monitor learning activities and outcomes and learners with flexibility and interactivity.[14-16] Use of "scenario-based" virtual patient programs is considered to be effective to meet strategic rather than procedural learning goals,[16] while virtual patient programs in medical education was shown to be associated with increase in knowledge and clinical reasoning skills by allowing learners to gain experience on complex problems in a safe environment.[16-19]

This study was designed to evaluate diagnosis and practice patterns of physicians for complicated IAI and DFI via scenario-based virtual patient programs.

MATERIALS AND METHODS

Participants

Data on diagnostic and treatment patterns applied by 252 physicians who participated on a voluntary basis in two scenario-based virtual patient programs relating to complicated IAI (n=210) and DFI (n=42) were analyzed in this study. Virtual patient scenarios providing data

on stepwise evaluation of patient (patient characteristics, disease characteristics, physical examination, laboratory and radiological findings) as requested by the physician were developed using computer graphics technology.

Each case-scenario was individually examined by participants using their iPads to make final diagnosis and select the treatment strategy. After completion of virtual examination by all participants, a group meeting was chaired by expert physicians to give feedback participants regarding the adherence to guidelines in terms of their selections on diagnostic and therapeutic patterns in each case-scenario, based on overall data collected during procedure.

Case Scenarios

Case Scenario 1 regarding complicated IAI was presented as "A 65-year old male patient was admitted to emergency department with complaints of acute onset severe abdominal pain, loss of appetite, nausea/vomiting and fever".

Case Scenario 2 regarding DFI was presented as **"**A 69-year old male diabetic patient was admitted to hospital with complaint of progressively worse foot wound appeared initially as a mild skin rash on the callus around the great toe nail two months ago, not responded to treatments applied to date and thus eventually become black and malodorous, along with cold feet and toes"

In each case, following initial definition, physicians were free to choice any questions regarding anamnesis, physical examination, laboratory findings and radiological imaging to complete virtual examination of the patient and asked to make a diagnosis and determine the therapeutic strategy based on the data presented to their inquiries. Additionally, each participant was also asked to complete a questionnaire with items on their opinion on management of IAI [potential causative agent, type of infection (hospital or community acquired; complicated or uncomplicated), need for stool and blood culture, need for fluid replacement therapy, coverage of enterococci and candida species in the empirical treatment and use of quinolones] and DFI [initiation of antibiotic treatment, likelihood of osteomyelitis, prescription of antibiotic treatment in uninfected ulcers, use of topical antibiotics and coverage of *Pseudomonas, Enterococci and Methicillin-resistant Staphylococcus aureus (MRSA)* in the empirical treatment].

Statistical analysis

Descriptive statistics were used to summarize data, expressed as n (%).

RESULTS

Evaluation of patient – Complicated IAI case scenario

Abdominal pain as typical manifestation was questioned by characteristics (87.0%) and

onset (97.0%) of the current complaint by majority of physicians. Palpation and auscultation of abdomen were performed by 50.0% to 70.0% of physicians, while vital signs were checked by less than 20% of physicians (Table 1).

Systemic infection signs including leukocytosis and neutrophilia were questioned by 58.0%, liver function tests by 40-40%, renal functions by half of physicians and thyroid functions by 30%. Culture tests included urine culture and antibiotic sensitivity test (9.0%), automatized blood culture (7.0%), stool culture and antibiotic sensitivity test (7.0%) and Gram staining microscopy (7.0%) (Table 1).

Direct abdominal X-ray (62.0%), total abdominal ultrasonography (USG; 58.0%), postero-anterior chest XR (30.0%), upper abdominal computed tomography (CT; 24.0%) and abdominal CT in the standing position (23.0%) were the most commonly selected imaging methods (Table 1).

Diagnosis and treatment-Complicated IAI case scenario

The diagnosis was confirmed to be complicated IAI secondary to spontaneous intestinal perforation by 75.0% of physicians, while uncomplicated IAI secondary to spontaneous intestinal perforation (21.0%) and complicated IAI secondary to acute cholecystitis (10.0%) were the following common diagnoses. Infection was considered to be community acquired by 84.3% of physicians and to be complicated by 77.5% of physicians with available data. *Escherichia coli* (*E. coli;* 48.0%), *Bacteroides fragilis* (*B. fragilis*; 30.0%) and *Klebsiella spp. (*18.0%) were considered as the most probable pathogens by physicians. Stool culture and blood culture were considered not necessary by 69.2% and 31.1% of physicians who provided data, respectively (Table 2).

Ceftriaxone + metronidazole+ surgical intervention was the treatment modality selected by 37.6%, ertapenem + surgical intervention by 34.1% and piperacillin/tazobactam + surgical intervention by 2.4% of physicians who provided data. Only 17.0% of physicians were against the statement that empirical treatment of community-acquired infections should include enterococci and candida species, and only 33.3% were against the statement that quinolones can be used everywhere in our country and confirmed that if quinolone-resistant E. coli ratio is below 10%, quinolones should not be included in the treatment (Table 2).

Evaluation of patient – DFI case scenario

Considering evaluation of patient as a whole; co-morbid disorders (86.0%) and concomitant medications (88.0%) were the most commonly questioned items, as followed by smoking status (71.0%), recent diseases (69.0%) and family history (60.0%). Glycemic control was

evaluated by half of physicians, while psychological status (7.0%) was the least commonly questioned item (Table 3).

Considering evaluation of the affected foot; current complaint (86.0%), onset of current complaints (90.0%) and frequency of complaints (74.0%) were questioned by majority of physicians, while inspection and palpation of foot by 55.0% and 33.0%, respectively (Table 3).

Considering evaluation of the wound infection; classical signs of inflammation were questioned by less than 20.0% of physicians and skin discoloration was questioned by 10.0%. For the factors that increase the risk for DFI, onset of open wound (ulceration) and previous treatments were questioned by majority of physicians (by 95.0% and 90.0%, respectively), while previous vascular thrombosis was questioned by 45% and renal functions by 40% to 60% of physicians. Selected culture tests included deep tissue (50.0%), wound smear (48.0%) and bone biopsy (24.0%) culture, while the most commonly selected imaging tests were foot plain radiograph (86.0%), followed by lower extremity arterial (62.0%) and venous (55.0%) system Doppler USG (Table 3).

Considering systemic signs of infection, fever was questioned by 98.0% of physicians, WBC by 74.0%, CRP by 48.0% and procalcitonin by 33.0%, while sedimentation rate was questioned by none of physicians (Table 3).

Diagnosis and treatment – DFI case scenario

DFI was confirmed by 98.0% of physicians, while 83.0% considered the likelihood of osteomyelitis. Overall 71.0% of physicians considered initiation of antibiotic treatment mostly with ertapenem (55.0%) as followed by levofloxacin (7.0%), while 57.0% identified that it was not appropriate to use topical antibiotics in this patient. Most of physicians were against the prescription of antibiotics when ulcer is not yet infected (86.0%) and treatment of all moderate to severe DFIs to cover Pseudomonas (67.0%), Enterococci (67.0%) or MRSA (52.0%) organisms (Table 4).

DISCUSSION

Case Scenario 1-Complicated IAI

A 65-year old male patient admitted to emergency department with acute onset severe abdominal pain, loss of appetite, nausea/ vomiting and fever complaints.

As questioned by majority of physicians, diffuse abdominal pain was reported to start 24 hours ago, accompanied with sweating and right shoulder pain, loss of appetite, nausea and vomiting leading to current emergency admission.

Palpation and auscultation of abdominal quadrants were selected by 50-70% of physicians for physical examination leading to positive findings for widespread abdominal tenderness, defense, rebound, generalized

abdominal rigidity and absence of bowel sounds in all four quadrants. Systemic infection signs questioned by 58% of physicians were presence of leukocytosis and neutrophilia. Abdominal USG was chosen by 58.0% of physicians revealing intraabdominal free fluid findings, while abdominal CT by 23.0% of physicians revealed free air in upper abdomen, diffuse free intraabdominal fluid and dense fecal mass in colon.

Patients with IAI typically present with rapid-onset abdominal pain and symptoms of gastrointestinal dysfunction with or without signs of inflammation.[5] The diagnosis was confirmed to be complicated IAI secondary to spontaneous intestinal perforation by 75.0% of physicians, emphasizing the significant role of clinical impression in diagnosing IAI.

In fact, a careful history, physical examination, and laboratory investigation are considered to identify most patients with suspected IAI with no need for further diagnostic imaging in patients with obvious signs of diffuse peritonitis necessitating immediate surgical intervention.[5] In adult patients not undergoing immediate laparotomy, CT scan is considered the imaging modality of choice to determine the presence and source of an IAI.[5]

Blood cultures are not routinely recommended in community-acquired IAI since they do not provide additional clinically relevant information; and no information likely to alter outcome is obtained upon routine Gram staining of the infected material.[5] Routine aerobic and anaerobic cultures are considered optional in lower-risk patients with community-acquired infection.[5] Accordingly, urine culture, automatized blood culture, stool culture and Gram staining microscopy were performed by less than 10.0% of participant physicians.

However, although implementation of diagnostic work-up related to culture tests seems in accordance with guidelines, it should be noted that only 31.0% identified that blood culture is not mandatory in this patient.

The major pathogens in community-acquired IAI are coliforms (*Enterobacteriaceae,* especially *E. coli*) and anaerobes (especially *B. fragilis*) showing moderate or heavy growth on primary isolation plates.[5] Data from the multinational CIAOW study (Complicated IAIs worldwide observational study) revealed that *Enterobacteriaceae, Streptococcus* species, and certain anaerobes (particularly *B. fragilis*) are the major pathogens involved in community-acquired IAIs, while extended-spectrum β-lactamase (ESBL)-producing *Enterobacteriaceae* are the main resistance threat in community-acquired infections.[4,20] Accordingly, *E. coli* (48.0%), *B. fragilis* (30.0%) and *Klebsiella spp*.(18.0%) were considered as the most probable pathogens by physicians in the present study.

Guidelines indicate that antibiotics used for empiric treatment of community acquired IAI

should be active against enteric gram-negative aerobic and facultative bacilli and enteric gram-positive streptococci. Coverage for obligate anaerobic bacilli should be provided for distal small bowel, appendix, and colon-derived infection and for more proximal gastrointestinal perforations in the presence of obstruction or paralytic ileus. For adult patients with mild-to-moderate community acquired infection including those with perforated or abscessed appendicitis, the use of ticarcillin-clavulanate, cefoxitin, ertapenem, moxifloxacin, or tigecycline as single-agent therapy or combinations of metronidazole with cefazolin, cefuroxime, ceftriaxone, cefotaxime, levofloxacin, or ciprofloxacin are recommended regimens.[5] Hence, ceftriaxone + metronidazole+ surgical intervention was selected by 37.6%, ertapenem + surgical intervention by 34.1% and piperacillin/tazobactam + surgical intervention by 2.4% of physicians in the present study. Nonetheless it should be noted that broad use of ertapenem is considered likely to hasten the appearance of carbapenem-resistant *Enterobacteriaceae*, *Pseudomonas*, and *Acinetobacter* species.[5]

Recognition of local changes in resistance is important in optimal selection of antimicrobial agents for both definitive treatment and oral step-down therapy. Hence consideration of increasing resistance to selected antibiotics among community-acquired strains of gram-negative organisms in many locations, such as the widespread prevalence of ampicillin/sulbactam-resistant *E. coli* worldwide, the high penetration of fluoroquinolone-resistant *E. coli* in Latin America and East Asia, locations with a high prevalence of ESBL–producing strains of *Klebsiella* species and *E. coli* as well as a relatively high prevalence of more-resistant non-enteric gram-negative organisms like *Pseudomonas aeruginosa* populations, is important in selection of empirical antibiotic therapy in patients with community-acquired IAI.[5,21-24]

Empiric coverage of enterococcus is not necessary and empiric antifungal therapy for *Candida* is not recommended for patients with community acquired IAE in the guidelines.[5] Notably, enterococci was considered probable pathogen by 12.0% of physicians in the present study and only 17.0% were against the statement that empirical treatment of community-acquired infections should include enterococci and candida species.

Given the increased prevalence of quinolone-resistant *E. coli* in some communities, guidelines recommend that quinolones should not be used unless hospital surveys indicate >90% susceptibility of *E. coli* to quinolone.[5] However, only 33.3% were against the statement that quinolones can be used everywhere in our country and confirmed that if quinolone-resistant E. coli ratio is below

10%, quinolones should not be included in the treatment.

Our findings indicate that practice pattern of physicians for complicated IAI should be improved in terms of appropriate selection of empirical antibiotic treatment in accordance with local resistance profile. This seems important given the increased risk for therapeutic failure and mortality in case of failure to provide adequate antimicrobial therapy in these patients.[25,26]

Case Scenario 2- DFI

A 69-year old male diabetic patient admitted to hospital with progressively worsening foot wound appeared initially as mild skin rash on the callus around the great toe nail two months ago, not responded to treatments applied to date and thus eventually became black and malodorous, along with cold feet and toes.

Occurring at three consecutive steps including evaluation of the patient as a whole, the affected foot and limb, and finally the wound; diagnostic work-up in DFI aims to determine the extension and microbial etiology of infection, pathogenesis of wound and presence of any contributing biomechanical, vascular, or neurological abnormalities as well as patient's social and psychological situation to consider his/her ability to comply with recommendations.[10,27]

Majority of physicians questioned co-morbid disorders and concomitant medications, family history and smoking status to evaluate the patient as a whole. However glycemic control was assessed by half, marital and educational status by less than 25% and psychological status by 7.0% of the physicians. This seems notable given the 12-year diabetes duration, chronicity of skin ulceration and failure of previous treatment in the presented scenario, since long duration of diabetes, sustained uncontrolled hyperglycemia, diabetes related complications, impaired wound healing and maladaptive behaviors are considered amongst the risk factors for development of DFI.[10,11,28,29]

Diagnostic criteria for foot infection include the presence of at least 2 classic symptoms or signs of inflammation or purulent secretions, but may also include additional or secondary signs (non-purulent secretions, friable or discolored granulation tissue, undermining of wound edges, foul odor).[10] Considering evaluation of the wound infection; classical signs of inflammation were questioned by less than 20.0% of physicians, while skin discoloration was questioned only by 10.0% of physicians as the secondary sign of inflammation.

Awareness and evaluation of factors that increase the risk for DFI such as positive probe-to-bone (PTB) test, presence of an ulceration for >30 days, a history of recurrent foot ulcers, a traumatic foot wound, the presence of peripheral vascular disease in the affected limb, a previous lower extremity

amputation, loss of protective sensation and the presence of renal insufficiency is considered critical in diagnosing DFI.[10] Accordingly, onset of open wound and previous treatments were questioned by majority, previous vascular thrombosis by 45% and renal functions by 40-60% of physicians, while PBT was not assessed by any of physicians in the present study.

Presence of any systemic symptoms and signs of infection and laboratory markers are recommended to be investigated in DFI.[10] Besides, elevated procalcitonin levels has also been suggested to be adjunct to making diagnosis, and to correlate more accurately with clinical evidence of infection than WBC, erythrocyte sedimentation rate (ESR), or C-reactive protein (CRP).[10,30] Increased CRP and procalcitonin levels were reported to accurately distinguish clinically uninfected ulcers from those with mild or moderate infections.[31] Accordingly, considering systemic signs of infection, fever was questioned by 98.0% of physicians, WBC by 74.0%, CRP by 48.0% and procalcitonin by 33.0%, and ESR by none of physicians. Leukocytosis and fever was evident, elevated procalcitonin levels were noted, while CRP and ESR were in the normal ranges in the present case. Indeed, not necessarily excluding a potentially serious infection; lack of fever, leukocytosis, or leftward shift in the WBC differential or markedly elevated acute phase serum markers is frequently noted among patients with deep foot infections. Given that worsened glycemic control is often the only systemic evidence of a serious infection in this setting,[10,32-34] evaluation of glycemic control only by half of physicians seems notable.

Considering evaluation of affected foot and limb, inspection and palpation were performed by 55.0% and 33.0% of physicians. Careful inspection of foot for proximal spread of infection and deformities is considered important in evaluation of DFI as is the palpation of the plantar arch for the presence of pain or fullness which may indicate a deep plantar space abscess.[10]

All patients presenting with a new DFI are recommended to have plain radiographs of the affected foot to assess bony abnormalities (deformity, destruction) as well as for soft tissue gas and radio-opaque foreign bodies.[10] According to our findings, the most commonly selected imaging test by physicians was foot plain radiograph (86.0%) that revealed focal soft tissue swelling, demineralization in periarticular region and periosteal reaction in distal interphalangeal joint of the great toe. Lower extremity arterial (62.0%) and venous (55.0%) system Doppler USG were the second-most common radio-imaging modalities selected by physician to exclude presence of peripheral vascular disease in the affected limb, while revealed normal findings. This seems notable given that assessing the

vascular supply is considered crucial among patients with DFI, since edema due to venous insufficiency may impede wound healing, while PAD may exist in up to 40% of cases with DFI, despite presence of normal femoral, popliteal, and pedal pulses.[10,35]

While collecting a specimen for culture is not recommended for clinically uninfected wounds, properly obtained wound cultures prior to starting empiric antibiotic therapy are useful for guiding antibiotic therapy in DFI, particularly in patients with a chronic infection or who have recently been treated with antibiotics. Collecting deep tissue culture specimens via biopsy or curettage is recommended after the wound has been cleansed and debrided, while guidelines suggest avoiding swab specimens, especially of inadequately debrided wounds, as they provide less accurate results.[10]

Accordingly, consistent with presence of infection with failure of previous antibiotic therapy, deep tissue culture was selected by 50.0% of physicians and revealed >100.000 CFU/ml *Klebsiella pneumoniae* (ESBL +), while wound smear culture was chosen by 48.0% and revealed >100.000 CFU/ml *P. aeruginosa* and >100.000 CFU/ml *Staphylococcus epidermidis* in the present case.

Although the presence of a local ulceration (toe or metatarsophalangeal joint) or a "sausage toe" (swollen, erythematous, and lacking normal contours) is suggestive of the diagnosis, there is no specific clinical finding of diabetic foot osteomyelitis.[10,36] Hence, clinicians are recommended to consider osteomyelitis as a potential complication of any infected, deep, or large foot ulcer, especially chronic one that does not heal at least 6 weeks of treatment or overlies a bony prominence.[10,37] Also, in the presence of changes suggestive of osteomyelitis such as cortical erosion, active periosteal reaction, mixed lucency and sclerosis on the plain radiograph, treatment for presumptive osteomyelitis is recommended, preferably after obtaining appropriate specimens for culture with consideration of bone biopsy, if available.[10]

Accordingly, 83.0% of physicians considered the possibility of osteomyelitis in the present virtual patient scenario, while bone biopsy culture as chosen by 24.0% of physicians revealed normal findings, consistent with the lack of strong evidence to suggest that historical features strongly predict active osteomyelitis due to likelihood of false positive and false negative results.[10]

Among currently available imaging modalities, magnetic resonance imaging (MRI) is considered to provide the greatest accuracy for the detection of bone infection in the diabetic foot, while it is not available, indicated, or easy to justify in every case and not always necessary for diagnosing or

managing DFO.[10,38] Accordingly, while the likelihood of osteomyelitis was considered by majority of physicians in the presented case, none of them selected MRI for further imaging to clarify the diagnosis of osteomyelitis.

Unlike clinically uninfected wounds, prescribing antibiotic therapy is recommended for all infected wounds combined with appropriate wound care.[10,39,40] DFI was diagnosed accurately by 98.0% of physicians; most of physicians were against antibiotics prescriptions when ulcer is not yet infected, while only 71.0% considered the initiation of antibiotics.

Albeit no single drug or combination of agents appears to be superior to any others, since publication of the 2004 DFI guidelines, the FDA has approved 3 antibiotics (ertapenem, linezolid, and piperacillin-tazobactam) specifically for the treatment of complicated skin and skin structure infections including DFI.[10]

Isolation of antibiotic-resistant organisms, particularly *MRSA*, but also ESBL-producing gram-negative bacilli and highly resistant *P. aeruginosa* is considered an increasing problem with DFI in most settings.[10] Although the infection with these organisms requires specifically targeted antibiotic therapy, empiric coverage in all cases is considered to be not prudent, supported by demonstration of clinical resolution of DFIs from which *MRSA* or *P. aeruginosa* are cultured despite the regimen not covering these organisms.[10] Accordingly, more than half of physicians in this study confirmed that it is not mandatory that treatment of all moderate to severe DFIs to cover *Pseudomonas* (67.0%), *Enterococci* (67.0%) or *MRSA* (52.0%).

Both ertapenem and levofloxacin are recommended for moderate or severe infections with *MSSA, Streptococcus spp., Enterobacteriaceae* and obligate anaerobes as probable pathogens.[10] Hence given the production of ESBL producing *K. pneumoniae* in deep tissue culture samples and *P. aeruginosa* in wound smear culture samples, ertapenem or levofloxacin seems appropriate regimens for starting broad-spectrum empiric antibiotic therapy, pending culture results and antibiotic susceptibility data in the present case scenario, while this approach was selected only by 62.0% of overall physicians.

Accordingly, our findings indicate that practice pattern of physicians for DFI should be improved in terms of more careful assessment of evidences for infection such as glycemic control, diabetes related complications, impaired wound healing as well as maladaptive behaviors as well as more appropriate selection of empirical antibiotic treatment in accordance with the inessentiality for the empiric coverage of highly resistant organisms such as *MRSA* and *P. aeruginosa* in all cases

The major limitation of the present study is the low response rates for questions regarding infection type, appropriate culture tests, principles of empiric antibiotherapy and treatment modalities, leading to large amount of missing data, particularly for the IAI case scenario. This seems to emphasize the importance of using a software program for virtual patient scenario studies that do not allow participants to proceed to the next step in the scenario presentation without completing the previous steps.

Conclusion

Our findings indicate adherence to guidelines among physicians for selections regarding diagnostic work-up in complicated IAI, particularly considering the role of typical manifestations of disease and clinical relevance of laboratory investigations, while practice pattern of physicians for complicated IAI should be improved in terms of appropriate selection of empirical antibiotic treatment in accordance with local resistance profile. Considering DFI, adherence to guidelines among physicians should also be improved in terms of more careful assessment of risk factors for infection such as poor glycemic control, diabetes related complications, impaired wound healing as well as maladaptive behaviors and appropriate selection of empirical antibiotic treatment considering the necessity for coverage of highly resistant organisms. Given the provision of feedback by experts on the adherence to guidelines in terms of selected diagnostic and therapeutic patterns in each case-scenario, our findings emphasize the potential benefit of scenario-base virtual patient programs to improve practice patterns and to help clinicians to transfer clinical reasoning skills gained in virtual settings into everyday clinical practice.

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REFERENCES

1. Menichetti F, Sganga G. Definition and classification of intra-abdominal infections. J Chemother. 2009;21(Suppl 1):3-4.
2. Armstrong C. Updated guideline on diagnosis and treatment of intra-abdominal infections. Am Fam Phys. 2010;82:694-709.
3. Brun-Buisson C, Doyon F, Carlet J, et al. Incidence, risk factors, and outcome

of severe sepsis and septic shock in adults: a multicenter prospective study in intensive care units. French ICU Group for Severe Sepsis. JAMA. 1995;274:968-974.

4. Sartelli M, Catena F, Ansaloni L, et al. Complicated intra-abdominal infections worldwide: the definitive data of the CIAOW Study. World J Emerg Surg. 2014;9:37.
5. Solomkin JS, Mazuski JE, Bradley JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. Clin Infect Dis. 2010;50:133-164.
6. Nordmann P, Poirel L, Walsh TR, Livermore DM. The emerging NDM carbapenemases. Trends Microbiol. 2011;19:588-595.
7. Perez F, Van Duin D. Carbapenem-resistant Enterobacteriaceae: a menace to our most vulnerable patients. Cleve Clin J Med. 2013;80:225-233.
8. Mazuski JE, Gasink LB, Armstrong J, et al. Efficacy and Safety of Ceftazidime-Avibactam Plus Metronidazole Versus Meropenem in the Treatment of Complicated Intra-abdominal Infection: Results From a Randomized, Controlled, Double-Blind, Phase 3 Program. Clin Infect Dis. 2016;62:1380-1389.
9. Uçkay I, Aragón-Sánchez J, Lew D, Lipsky BA. Diabetic foot infections: what have we learned in the last 30 years? Int J Infect Dis. 2015;40:81-91.
10. Lipsky BA, Berendt AR, Cornia PB, et al.; Infectious Diseases Society of America. 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. Clin Infect Dis. 2012;54:132-173.
11. Amin N, Doupis J. Diabetic foot disease: From the evaluation of the "foot at risk" to the novel diabetic ulcer treatment modalities. World J Diabetes. 2016;7:153-164.
12. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet. 1998; 352: 837-853.
13. Zingg M, Nicodeme JD, Uckay I, Ray A, Suva D. Lower limb amputation: indication, preoperative workup and complications. Rev Med Suisse. 2014;17:2409-2413.
14. McKimm J, Jollie C, Cantillon P. ABC of learning and teaching: Web based learning. BMJ. 2003;326:870-873.

15. Maxwell S, Mucklow J. E-Learning initiatives to support prescribing. Br J Clin Pharmacol. 2012; 74: 621-631.
16. Zlotos L, Power A, Hill D, Chapman P. A Scenario-Based Virtual Patient Program to Support Substance Misuse Education. Am J Pharm Educ. 2016;80:48.
17. Cook DA, Erwin PJ, Triola MM. Computerized virtual patients in health professions education: a systematic review and meta-analysis. Acad Med. 2010;85:1589-1602.
18. Makransky G, Bonde MT, Wulff JS, et al. Simulation based virtual learning environment in medical genetics counseling: an example of bridging the gap between theory and practice in medical education. BMC Med Educ. 2016;16:98.
19. Benedict N. Virtual patients and problem-based learning in advanced therapeutics. Am J Pharm Educ. 2010;74:143.
20. Hawser SP, Bouchillon SK, Hoban DJ, Badal RE, Cantón R, Baquero F. Incidence and antimicrobial susceptibility of Escherichia coli and Klebsiella pneumoniae with extended-spectrum beta-lactamases in community- and hospital-associated intra-abdominal infections in Europe: results of the 2008 Study for Monitoring Antimicrobial Resistance Trends (SMART). Antimicrob Agents Chemother. 2010;54:3043-3046.
21. Paterson DL, Rossi F, Baquero F, et al. In vitro susceptibilities of aerobic and facultative Gram-negative bacilli isolated from patients with intraabdominal infections worldwide: the 2003 Study for Monitoring Antimicrobial Resistance Trends (SMART). J Antimicrob Chemother. 2005;55:965-973.
22. Yellin AE, Heseltine PN, Berne TV, et al. The role of Pseudomonas species in patients treated with ampicillin and sulbactam for gangrenous and perforated appendicitis. Surg Gynecol Obstet. 1985;161:303-307.
23. Bradley JS, Behrendt CE, Arrieta AC, et al. Convalescent phase outpatient parenteral antiinfective therapy for children with complicated appendicitis. Pediatr Infect Dis J. 2001;20:19-24.
24. Lin WJ, Lo WT, Chu CC, Chu ML, Wang CC. Bacteriology and antibiotic susceptibility of community-acquired intra-abdominal infection in children. J Microbiol Immunol Infect. 2006;39:249-254.
25. Mosdell DM, Morris DM, Voltura A, et al. Antibiotic treatment for surgical peritonitis. Ann Surg. 1991;214:543-549.

26. Montravers P, Gauzit R, Muller C, Marmuse JP, Fichelle A, Desmonts JM. Emergence of antibiotic-resistant bacteria in cases of peritonitis after intraabdominal surgery affects the efficacy of empirical antimicrobial therapy. Clin Infect Dis. 1996;23:486-494.
27. Schaper NC, Apelqvist J, Bakker K. The international consensus and practical guidelines on the management and prevention of the diabetic foot. Curr Diab Rep. 2003; 3: 475-479.
28. Frykberg RG. Diabetic foot ulcers: pathogenesis and management. Am Fam Physician. 2002;66:1655-1662.
29. Lipsky BA, Berendt AR, Deery HG, et al; Infectious Diseases Society of America. Diagnosis and treatment of diabetic foot infections. Clin Infect Dis. 2004;39:885-910.
30. Uzun G, Solmazgul E, Curuksulu H, et al. Procalcitonin as a diagnostic aid in diabetic foot infections. Tohoku J Exp Med. 2007;213:305-312.
31. Jeandrot A, Richard JL, Combescure C, et al. Serum procalcitonin and C-reactive protein concentrations to distinguish mildly infected from non-infected diabetic foot ulcers: a pilot study. Diabetologia. 2008;51:347-352.
32. Armstrong DG, Lavery LA, Sariaya M, Ashry H. Leukocytosis is a poor indicator of acute osteomyelitis of the foot in diabetes mellitus. J Foot Ankle Surg. 1996;35:280-283.
33. Eneroth M, Larsson J, Apelqvist J. Deep foot infections in patients with diabetes and foot ulcer: an entity with different characteristics, treatments, and prognosis. J Diabetes Complications. 1999;13:254-263.
34. Frykberg RG. An evidence-based approach to diabetic foot infections. Am J Surg. 2003;186:44-54.
35. Prompers L, Schaper N, Apelqvist J, et al. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODIALE Study. Diabetologia. 2008;51:747-755.
36. Rajbhandari SM, Sutton M, Davies C, Tesfaye S, Ward JD. 'Sausage toe': a reliable sign of underlying osteomyelitis. Diabet Med. 2000;17:74-77.
37. Newman LG, Waller J, Palestro CJ, et al. Unsuspected osteomyelitis in diabetic foot ulcers. Diagnosis and monitoring by leukocyte scanning with indium in 111 oxyquinoline. JAMA. 1991;266:1246-1251.
38. Kapoor A, Page S, Lavalley M, Gale DR, Felson DT. Magnetic resonance imaging for diagnosing foot

osteomyelitis: a meta-analysis. Arch Intern Med. 2007;167:125-132.

39. Rao N, Lipsky BA. Optimising antimicrobial therapy in diabetic foot infections. Drugs. 2007;67:195-214.
40. Lipsky BA, Aragón-Sánchez J, Diggle M, et al; International Working Group on the Diabetic Foot. IWGDF guidance on the diagnosis and management of foot infections in persons with diabetes. Diabetes Metab Res Rev. 2016;32(Suppl 1):45-74.

Table 1. Evaluation of patient and diagnostic work-up – "Complicated Intra-abdominal Infection Case Scenario"

	Selected by physicians		Case Scenario findings
BACKGROUND	n	%	
Educational level	61	29.0	High school graduate
Job	142	68.0	Musician
Marital status	73	35.0	Married
Smoking status	92	44.0	Active smoker (20 packs-year)
Alcohol or substance use	109	52.0	Alcohol, occasionally
Family history	135	64.0	Father died of lung cancer, HT+DM in mother
Co-morbid disorders	180	86.0	Congenital visual impairment, total thyroidectomy (20 years ago), hypothyroidism with irregular levotiron use, HT for the last 6 years.
Concomitant medications	149	71.0	NSAIDs (last 6 months), Amlodipine (for 2 y), Levotiron (for 20 y
High blood pressure	41	20.0	Yes
Varices	22	10.0	Yes
Thyroid dysfunction	23	11.0	Yes
Alteration in hair or nails	9	4.0	Hair loss, thinning eyebrows
Cold or heat intolerance	21	10.0	Cold intolerant
Sleep problem	9	4.0	Difficulty in waking up, daytime sleepiness
Medications during the febrile period	210	100.0	No medications, bed-rest for at least 2 weeks due to fatigue
Previous abdominal pain	164	78.0	Frequent abdominal pain due to constipation
History of recent disease(s)	156	74.0	Sore throat and fever, one month ago
Previous jaundice	80	38.0	Yes, hepatitis B carrier
Previous hepatitis	56	27.0	Yes, HbsAg positivity for years
Prior surgery	136	65.0	None
Previous blood transfusion	131	62.0	None
TYPICAL MANIFESTATIONS	n	%	
Current complaint(s)	183	87.0	Abdominal pain, loss of appetite, N/V and fever
Most painful region	13	6.0	Abdomen and thighs
Onset of current complaints	204	97.0	Previous admission to outpatient clinic with complaints of inability to defecate for 10 days, abdominal pain and abdominal distension and treated with manual evacuation of feces upon failure of enema. No complaints since 10 days until initiation of diffuse abdominal pain, loss of appetite, N/V 24 hours ago, leading to current emergency admission.
Current abdominal pain	77	37.0	Frequent abdominal pain due to constipation. Prior admission with long-term constipation 10 days ago. Abdominal pain on current admission was diffuse and very severe at onset, while severity decreased gradually, while accompanied with sweating and right shoulder pain. Pain even during breathing, reluctance to move abdominal region and palpation of abdomen
Frequency of complaints	173	82.0	Continuous
Factors affecting abdominal pain	79	38.0	Pain increases with movement, dizziness on standing up
Nausea	77	37.0	Yes
Alteration in appetite	76	36.0	Loss of appetite since abdominal pain
Change in bowel habits	90	43.0	Constipation for a long time
Palpitation	42	20.0	Rarely
PHYSICAL EXAMINATION	n	%	
Palpation- abdomen left	146	70.0	Widespread abdominal tenderness, defense+ rebound + GAR
Auscultation-abdomen	143	68.0	Absent bowel sounds in all four quadrants
Palpation- abdomen right	114	54.0	
Palpation- abdomen right lower quadrant	108	51.0	Widespread abdominal tenderness, defense+ rebound+GAR
Palpation- abdomen left lower quadrant	106	50.0	
Inspection- chest	88	42.0	Increased respiration rate
Inspection-face	78	37.0	Red face, pain expression
Inspection-tongue	68	32.0	Extreme dryness
Percussion- abdomen right lower quadrant	67	32.0	Tympanic sound
Percussion- abdomen right	66	31.0	
Percussion- abdomen left	65	31.0	
Functional- shoulder	63	30.0	Pain radiating to right shoulder
Percussion-abdomen left lower quadrant	62	30.0	Tympanic sound
Inspection-eye	59	28.0	Congenital vision impairment
Palpation- face	45	21.0	Red face, pain expression.
Palpation-rectal	10	5.0	Tender on palpation, fecal contamination, no blood or mass
Vitals-Pulse	39	19.0	105/min
Vitals-Blood pressure	39	19.0	90/60 mmHg
Vitals-body temperature	38	18.0	39.2°C
Vitals-respiration	34	16.0	25/min
Vitals-body weight	22	10.0	71 kg
Vitals-waist circumference	16	8.0	83 cm
Vitals-body mass index	15	7.0	24 kg/m²
LABORATORY FINDINGS	n	%	

Systemic infection signs			
Hemoglobin |11.7-16.1 g/dl |	121	58.0	10.6
Hematocrit |35-47%|	121	58.0	33
WBC |4.5-11 mm^3|	121	58.0	17.100
Neutrophils |41-73%|	121	58.0	89
Peripheral smear	81	39.0	Toxic granulation
CRP	84	40.0	230
Procalcitonin	43	20.0	24
Liver function tests			
ALT |0 – 35 U/L |	144	69.0	59
Amylase |60-180 U/L|	136	65.0	120
AST |0 – 35 U/L|	121	58.0	52
ALP |90-150 U/L |	102	49.0	240
GGT	84	40.0	Normal
Direct bilirubin |0.0 – 0.2 mg/dL|	56	27.0	0.3
Total bilirubin |0.3 – 1.2 mg/dL|	40	19.0	1.4
LDH| 0 – 248 U/L |	39	19.0	300
Renal function tests			
BUN |7.9 – 21 | mg/dL	106	50.0	22
Creatinine |0.81 – 1.44 | mg/dL	97	46.0	2.0
Albumin	78	37.0	Normal
Urine analysis	69	33.0	Normal
Endocrine functions			
TSH |0.34 – 5.6 mU/L|	62	30.0	5.4
Glucose| 75 – 106 mg/dL|	46	22.0	94
HbA1c |<6.0 |	29	14.0	9.9
OGTT -30 min	9	4.0	Normal
OGTT -60 min	8	4.0	Normal
OGTT -120 min |<200 mg/dL|	4	2.0	240
Culture tests			
Urine culture and antibiotic sensitivity test	18	9.0	100.000 CFU/ml Klebsiella pneumoniae (ESBL +)
Automatized blood culture	15	7.0	Klebsiella pneumoniae (ESBL+) on each of 3samples
Stool culture and antibiotic sensitivity test	14	7.0	Normal
Gram staining microscopy	14	7.0	High leukocyte and erythrocyte count, abundance of gram (-) bacilli
Abscess culture and antibiotic sensitivity test	11	5.0	Normal
Respiratory secretions quantitative culture (ETA+NTA+BAL)	8	4.0	Normal
Wound, discharge culture and antibiotic sensitivity test	7	3.0	Normal
Serology[1]	13.0	6.0	Negative
Drug levels[2]	6	3.0	Normal
DIAGNOSTIC IMAGING	n	%	
Direct abdominal X-ray	131	62.0	Bilateral free gas under the diaphragm
Total abdominal USG	121	58.0	Intraabdominal free fluid
Posteroanterior chest XR	64	30.0	Gas
Upper abdominal CT	50	24.0	Free air in upper abdomen and diffuse free intraabdominal fluid
Abdominal CT in the standing position	49	23.0	Free air in abdomen, dense fecal mass in colon
Hepatobiliary USG	32	15.0	Normal
Renal USG	16	8.0	Normal
Lung perfusion scintigraphy	14	7.0	Normal
Urinary system USG	13	6.0	Normal
Foot XR	13	6.0	Normal
Upper abdominal USG	12	6.0	Intraabdominal free fluid

[1]Anti-HBc IgM, Anti-Adenovirus IgM, Anti-HBs, VDRL-RPR, Anti-HBc, Anti-Hbe, Anti- HAV IgM, Anti-CMV IgG, EBV-VCA IgM, Anti-HIV, Anti- HAV IgG, Anti-CMV IgM, Anti-HEV, Anti-HCV, HbsAg

[2]Phenytoin, phenobarbital, gentamycin, carbamazepine, lithium, methotrexate, salicylic acid, cyclosporine, tacrolimus, theophylline, valproic acid, vancomycin, EBL: extended-spectrum β-lactamase, DM: diabetes mellitus, GAR: Generalized abdominal rigidity, N/V: Nausea/ vomiting, HT: Hypertension. Positive findings for Case Scenario are written in italics

Table 2. Diagnosis and treatment- "Complicated Intra-abdominal Infection Case Scenario"

Final diagnosis	**n**	**%**	
Complicated intraabdominal infection secondary to spontaneous intestinal perforation	157	75.0	
Uncomplicated intraabdominal infection secondary to spontaneous intestinal perforation	45	21.0	
Complicated intraabdominal infection secondary to acute cholecystitis	22	10.0	
Intestinal perforation	16	8.0	
Pyelonephritis	7	3.0	
Acute appendicitis	5	2.0	
Gastrointestinal bleeding	4	2.0	
Uncomplicated intraabdominal infection secondary to acute appendicitis	4	2.0	
Treatments selected by physicians	**n**	**%[a]**	**%[b]**
Ceftriaxone + Metronidazole+ Surgical intervention	32	37.6	15.0
Ertapenem + Surgical intervention	29	34.1	14.0
Ertapenem	9	10.6	4.0
Meropenem+ Surgical intervention	7	8.2	3.0
Ceftriaxone + Vancomycin+ Surgical intervention	3	3.5	1.0
Piperacillin/Tazobactam + Surgical intervention	2	2.4	1.0
Ceftriaxone	2	2.4	1.0
Ciprofloxacin + Amikacin + Surgical intervention	1	1.1	0.5
Missing data	125		
Potential causative agent	**n**	**%**	
Escherichia coli	101	48.0	
Bacteroides fragilis	62	30.0	
Klebsiella spp.	37	18.0	
Enterococci	26	12.0	
Proteus spp.	21	10.0	
Bacteroides spp.	17	8.0	
Pseudomonas spp.	9	4.0	
Streptococci	8	4.0	
Clostridium spp.	5	2.0	
Peptostreptococcus spp.	4	2.0	
Fusobacterium spp.	3	1.0	
Candida spp.	2	1.0	
Is this a hospital-acquired infection?	**n**	**%[a]**	**%[b]**
No	75	84.3	36.0
Yes	14	15.7	7.0
Missing data	121		
Is it complicated?	**n**	**%[a]**	**%[b]**
Complicated	86	77.5	41.0
Uncomplicated	25	22.5	12.0
Missing data	99		
Is stool culture necessary in this patient ?	**n**	**%[a]**	**%[b]**
No	54	69.2	26.0
Yes	24	30.8	11.0
Missing data	132		
Is blood culture is mandatory in this patient?	**n**	**%[a]**	**%[b]**
Yes	71	68.9	34.0
No	32	31.1	15.0
Missing data	107		
Empirical treatment of community-acquired infections should include enterococci (A-I) and candida species (B-II).	**n**	**%[a]**	**%[b]**
Yes	39	83.0	19.0
No	8	17.0	4.0
Missing data	163		
Can quinolones be used everywhere in our country?	**n**	**%[a]**	**%[b]**
Yes	36	66.7	17.0
No, if quinolone-resistant E. coli ratio is below 10%, quinolones should not be included in the treatment (AII).	18	33.3	9.0
Missing data		56	

[a]excluding missing data, [b]in the overall population; Items appropriate for the present case or in accordance with guidelines are written in italics

Table 3. Evaluation of patient and diagnostic work-up- "Diabetic Foot Infection Case Scenario"

	Selected by physicians		Case Scenario findings
PATIENT AS A WHOLE	n	%	
Job	25	60.0	Grocer
Marital status	10	24.0	Married
Children	9	21.0	Four children
Educational status	13	31.0	Primary school graduate
Alcohol or substance use	24	57.0	Former alcohol use (for 15 years)
Smoking status	30	71.0	Active smoker (20 packs-year) since 20 years
Co-morbid disorders	36	86.0	Diabetes mellitus (for 12 years, Prostate disease, HT
Concomitant medications	37	88.0	Amlodipine (5 mg/day, for the last 5 years) Diabetic diet + irregular use of OADs (for the first 4 years) Regular use of OADs (for the last 8 years) Doxazosin (2-4 mg/day)
Glycemic control	22	52.0	Uncontrolled
Family history	25	60.0	Father died of heart failure, HT+DM in mother, DM in uncle
Recent diseases	29	69.0	Visual impairment, laser treatment twice
Psychological problems	3	7.0	Feeling unwell, preoccupied with death and diseases
HbA1c |<6.0% |	20	48.0	12.2
Glucose |75 – 106 mg/dL|	21	50.0	244
LDL-cholesterol |0 – 248 U/L|	5	12.0	300
AFFECTED FOOT	n	%	
Current complaint	36	86.0	Progressively worse foot wound
Frequency of complaints	31	74.0	Sensation of tingling and cold in right foot for the last 2-3 y
Onset of current complaints	38	90.0	Callus on the right great toe for a year. Two months ago, mild skin rash appeared on the callus around the great toe nail, causing discomfort when wearing shoes along with cold feet and toes.
Inspection- foot	23	55.0	Significant wound
Palpation- foot	14	33.0	Significant wound
Functional-ankle	11	26.0	Red and tender
Foot plain radiograph	36	86.0	Focal soft tissue swelling, demineralization in periarticular region and periosteal reaction in distal IPJ of the great toe
Lower extremity arterial system Doppler USG	26	62.0	Normal
Lower extremity venous system Doppler USG	23	55.0	Normal
WOUND INFECTION	n	%	
Classic signs of inflammation			
Swelling in skin	6	14.0	Around the wound
Sensitive skin	6	14.0	Cold feet
Skin rash/redness	8	19.0	On foot
Additional or secondary signs			
Skin discoloration	4	10.0	Great toe
Factors that increase the risk for DFI			
Onset of open wound (ulceration)	40	95.0	Following simple unnoticed skin rash on right great toe, 1cm wide open wound occurred two months ago
Previous treatment	38	90.0	No significant benefit from previous medications (clarithromycin 2x1 + rifocin drops+ mupirocin ointment) Finally, wound started become black and malodorous
Frequency of complaints	31	74.0	Sensation of tingling and cold in right foot for the last 2-3 y
Limping on walks	16	38.0	Yes
Leg cramps	15	36.0	Yes
Edema	5	12.0	Leg edema
Previous vascular thrombosis	19	45.0	No
Stroke	3	7.0	No
Varices	13	31.0	Yes
Laboratory findings			
Deep tissue culture/ antibiotic sensitivity test	21	50.0	>100.000 CFU/ml Klebsiella pneumoniae (ESBL +)
Wound smear culture/antibiotic sensitivity test	20	48.0	>100.000 CFU/ml Pseudomonas aeruginosa and >100.000 CFU/ml Staphylococcus epidermidis
Bone biopsy culture	10	24.0	Normal
SYSTEMIC SIGNS OF INFECTION	n	%	
Concomitant fever	41	98.0	Yes, for the last two days
WBC | 4.5-11 mm^3 |	31	74.0	15.200
Hemoglobin |11.7-16.1 g/dL |	31	74.0	12.6
Hematocrit | 35-47%|	31	74.0	33
Neutrophils |41-73%|	31	74.0	89
CRP	20	48.0	Normal
Procalcitonin	14	33.0	Normal
Sedimentation rate (mm/h)	0	0.0	89
Creatinine	26	62.0	Normal
BUN | 7.9 – 21 mg/dL|	15	36.0	24
Urinalysis	17	40.0	Microalbuminuria

Uric acid	6	14.0	Normal
Sodium	10	24.0	Normal
Potassium	9	21.0	Normal
Phosphorus	2	5.0	Normal
Calcium	2	5.0	Normal
Chloride	2	5.0	Normal
Magnesium	2	5.0	Normal

Positive findings for Case Scenario are written in italics. DM: diabetes mellitus, HT: Hypertension, IPJ: Distal interphalangeal joint

Table 4. Diagnosis and treatment – "Diabetic Foot Infection Case Scenario"

Final diagnosis	**n**	**%**
Diabetic foot infection	41	98.0
Erysipelas	1	2.0
Treatments selected by physicians	**n**	**%**
Ertapenem	23	55.0
Levofloxacin	3	7.0
Missing data/other treatments	16	
Dou you consider initiation of antibiotic treatment?	**n**	**%**
Yes	30	71.0
No	5	12.0
Missing data	7	
Is osteomyelitis possible in this patient?	**n**	**%**
Yes	35	83.0
No	5	12.0
Missing data	2	
Do you prescribe antibiotic treatment when ulcer is not yet infected?	**n**	**%**
No	36	86.0
Yes	7	17.0
Should treatment of all moderate to severe diabetic foot infections include/target Pseudomonas?	**n**	**%**
No	28	67.0
Yes	11	26.0
Missing data	3	
Should treatment of all moderate to severe diabetic foot infections include/target Enterococci?	**n**	**%**
No	28	67.0
Yes	15	36.0
Should treatment of all moderate to severe diabetic foot infections include/target MRSA?	**n**	**%**
No	22	52.0
Yes	12	29.0
Missing data	8	
Is it appropriate to use topical antibiotics in this patient?	**n**	**%**
No	24	57.0
Yes, antibiotic ointments other than mupirocin	6	14.0
Yes, antiseptic solution	2	5.0
Missing data	10	

MRSA: Methicillin-resistant Staphylococcus aureus. Items appropriate for the present case or in accordance with guidelines are written in italics