

Assessment of physicians' and senior medical students' knowledge in treatment of patients with community-acquired pneumonia: Current results of the KNOCAP project

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Abstract

Introduction. Community-acquired pneumonia (CAP) remains one of the most acute problems of bronchopulmonary pathology being the 4th in the mortality structure (after cardiovascular, cerebrovascular diseases and malignant neoplasms) and the 1st among all fatalities from infectious diseases. Thanks to the scientific progress achieved in the antibiotic therapy and vaccine prophylaxis, the death toll has decreased four times compared to its rate during the "pre-antibiotic era". However, nowadays there is a steadily increasing trend in the pneumonia mortality rate in Russia. The only possible way to increase efficacy of CAP treatment is timely initiated rational antibiotic therapy, considering the possible etiologies, risk factors and the severity of the patient's condition.

Materials and methods. The article represents the results of anonymous prospective surveys within the framework of the KNOCAP multi-centered research project aimed at accessing the knowledge on the fundamental issues in diagnosis and treatment of community-acquired pneumonia. The survey involved 222 students in their fifth- and sixth years in medical institute from Belgorod, Dnepr (Dnipro), Voronezh, Kiev (Kyiv) and Saratov and 110 physicians from Krasnodar, Saratov, Belgorod and Dnepr.

Results and discussion. According to the results of the survey, such levels of correct answers were given by doctors and students, respectively: the inadmissibility of antimicrobial therapy (AMT) delay in CAP - 82% and 59%; the main criterion for withholding AMT - 56% and 37%; "sequential therapy" - 61% and 59%. At the same time, only 24% of the students and 23% of the physicians surveyed correctly reported typical mistakes in the treatment of a non-severe CAP with 50% or more accuracy; and in case of initial treatment, the number of correct responses was less than 28% for students and 45% for doctors.

Conclusion. The survey showed that both senior medical students majoring in Medical Care and general practitioners had a low level of knowledge in CAP treatment. Hence, curricula need to be adjusted both in medical universities and in health institutions for practitioners in order to inform them and, thus, improve the quality of their knowledge in this field.

Keywords

community-acquired pneumonia, medical students, physicians, antibacterial therapy, education.

Introduction

In Russia, more than 1.5 million people get sick with CAP every year (Chuchalin et al. 2010, Blumenthal 2011). The average indicators of incidences of CAP are 10-15%, in young and middle-aged people - 1-11.6%, increasing to 25-51% in the older age group (Kruglyakova and Naryshkina 2014). Despite the impressive results achieved in the treatment of pneumonia, there is an acute problem of a significant decrease in the sensitivity of microorganisms to antibacterial drugs. The revealed triggers of microorganisms' resistance to antibiotics should be tackled, first, by raising the level of medical personnel's awareness of the issues of AMT of infectious diseases (Bontsevich et al. 2015). For a timely diagnosis, rational administration of antimicrobial drugs and, therefore, effective therapy for CAP, the sound professional training of both practitioners and senior students is of great importance. For this purpose, doctors should constantly strive to improve their professional activities; and in higher medical educational institutions across the country, the core units of pharmacology and clinical pharmacology should be introduced into the curriculum.

The aim of the study: to assess the level of senior medical students' and general physicians' basic knowledge in CAP treatment by using the method of anonymous questioning.

Materials and methods

The survey was conducted within the KNOCAP multicenter research project, which started in 2014 (the acronym of the project "The assessment of students' (physicians') knowledge of community-acquired pneumonia basics") (Bontsevich et al. 2015, Bontsevich et al. 2017). So far, the results of the survey conducted in five centers have been obtained and analyzed. The survey involved 222 Medical Care majors in their fifth-sixth years from five cities of Russia and Ukraine (42% from Belgorod, 34% from Voronezh, 14% from Dnepr, 5% from Kiev and

5% from Saratov), as well as 110 physicians (23% from Krasnodar, 14% from Saratov, 46% from Belgorod and 17% from Dnepr). We have also started the research in Chelyabinsk, Ufa, Kazan and Vladivostok and are currently accumulating data for the further analysis.

The method of anonymous questioning was used in this study, for which an original questionnaire was developed on the basis of current clinical recommendations (Chuchalin et al. 2010). In the questionnaire, the student was asked to enter his/her year of studies and major, indicating whether s/he is taking the questionnaire for the first or second time, after which, s/he is supposed to complete the questionnaire. The physicians were additionally asked to specify their specialty, category and years of service in their specialty. The questions concerning the therapy for CAP are presented below (they are given without variants of answers):

1. Specify the regulatory documents that the respondent uses in the treatment of CAP.
2. Choose the reasons to suspend the onset of antimicrobial therapy for CAP.
3. Indicate the main criterion to terminate antimicrobial therapy.
4. Choose the correct definition of the concept of "sequential therapy" in the treatment of pneumonia.
5. Indicate the typical errors in the initial therapy for a non-severe CAP.
6. Enter the drug/treatment regimen for a non-severe CAP in a patient in the absence of risk factors and/or concomitant diseases, indicating the mode of administration, frequency and dose.
7. Enter the drug/treatment regimen for a non-severe CAP in the patient when there are some risk factors and/or concomitant diseases, indicating the mode of administration, frequency and dose.
8. Identify if there is a subjective need for educational activities on adequate therapy for CAP.

The respondent was awarded 1 point for each correct answer, from 0.25 to 0.75 – for an incomplete answer,

depending on the completeness of the answer and 0 points for the wrong answer. Thus, with all correct answers, the maximum average score was 1.0.

The following averages were assessed in the study: the average score of each respondent, the average for individual questions, the average score for the centers (cities) and the average score for the entire questionnaire. The average completeness rate for the correct, partially correct and wrong answers was defined as the average level of response completeness (ARC), which is an equivalent for the average level of correct answers. Also, the patterns of answers to individual questions were analyzed. Since the questions related to the onset of CAP treatment (questions No.6 and No.7) require a mandatory “written” response, when none was provided, 0 points were assigned. All the information entered into the questionnaires was then entered to an electronic database and processed using Microsoft Excel applications. Statistical data were processed through the analysis of arbitrary contingency tables using the Pearson’s chi-square (χ^2) test.

This questionnaire, as part of the above mentioned KNOCAP project, was held in 2016–2017 on the bases of Belgorod State National Research University (Belgorod), Voronezh State Medical University named after N.N. Burdenko (Voronezh), Dnepropetrovsk State Medical Academy (Dnepr), Saratov State Medical University named after V.I. Razumovsky (Saratov), and Kiev State Medical University named after A.A. Bogomolets (Kiev). It should be noted that the students were trained in the main therapeutic majors, as well as in Pharmacology and Clinical Pharmacology. It is necessary to emphasize that this method of knowledge evaluation is relative, being specially developed for this study, and cannot fully reflect the general level of education quality in the university. Partial primary and intermediate results of this study were presented at the IACMAC-2015 (Bontsevich et al. 2015) and ERS-2017 (Bontsevich et al. 2017) congresses.

Results and discussion

In the first question of the questionnaire, it was required to specify the regulatory document (one or several) that the respondent used when studying the issues of managing patients with CAP. The following list of answers was proposed: standard, order, guidelines, I prescribe treatment basing on my practical experience, I find it difficult to answer. It should be noted that the respondents could provide their own answer option or expand the one from the list. Most doctors (32%) use 2 or more normative documents simultaneously and 28% prefer the standard. Most students (30%) had difficulty in answering this question, which, according to the authors, is due to their lack of practical experience; 14% of the physicians use guidelines. A significant part of the students (7%) chose the option “other” (Fig. 1).

The second question required to indicate the possible reasons for delaying the onset of AMT with a confirmed

diagnosis of CAP. The ARC for this question is 84% in the group of doctors and 60% in the group of students (Fig. 2). Despite the importance of obtaining a laboratory material (blood, sputum) prior to the administration of antibiotics, microbiological examination should not be the reason for the delay of AMT (Chuchalin et al. 2010, Chuchalin et al. 2017, Yakovlev et al. 2016). Most doctors (82%) and a great many of students (59%) answered the question correctly ($p < 0.001$).

A stable normalization of body temperature over a period of 48–72 hours, combined with a positive clinical picture, is a key criterion for terminating AMT for a non-severe CAP (Chuchalin et al. 2010). ARC for the question about an adequate duration of AMT is 42% in the group of students and 60% in the group of doctors (Fig. 3). About 56% of doctors and 37% of students answered correctly ($p < 0.01$).

The next question was aimed at assessing the respondents’ knowledge of “sequential therapy” in managing patients with CAP. The main idea of the sequential mode of antimicrobial drugs (AMD) administration is to reduce the duration of parenteral AMT by transferring patients to tableted drugs. In practice, the transition to the oral route of AMD administration takes place on average 2–3 days after the start of treatment (Avdeev 2004). Regardless of the importance of this treatment tactics, only 59% of students and 61% of doctors managed to answer correctly ($p > 0.05$), with the ARCs for doctors and students being 63% and 61%, respectively (Fig. 4).

In the next question of the questionnaire, it was necessary to point out the typical mistakes when beginning antibiotic therapy for a non-severe CAP in patients without risk factors. The following AMD options were offered to the respondent: ampicilline+oxacilline (Ampiox); ciprofloxacin; ceftazidime; ampicillin per os; and respiratory fluoroquinolones. According to the clinical guide (Chuchalin et al. 2010), the use of ampicillin per os is accompanied with a low bioavailability of the drug (40%) compared with amoxicillin (75–93%); ceftazidime has a low activity against pneumococci, as well as lack of clinically significant activity against *H. influenzae*; ciprofloxacin is inactive against *S. pneumoniae* and *M. pneumoniae*; it is inappropriate to prescribe respiratory fluoroquinolones as a drug of choice in patients without risk factors; Ampiox should not be used in medical practice because of irrational combination of antibiotics (Yakovlev et al. 2016). Less than 1% of the students and 2% of the doctors ($p > 0.05$) know that the proposed AMD are inadvisable because of their ineffectiveness. Since the majority of the respondents (90% of students and 84% of doctors) gave an incomplete correct answer, the results were divided into two groups: respondents with 50–75% level of correct answers and those with a 25% rate. The results were as follows: 66% of the physicians and 67.3% of the students gave an incomplete correct answer, referring the correct answer group by 25%; 20.8% of doctors and 23.6% of students were referred to the incomplete correct answer by 50–75% ($p > 0.05$). The ARC for the question about the

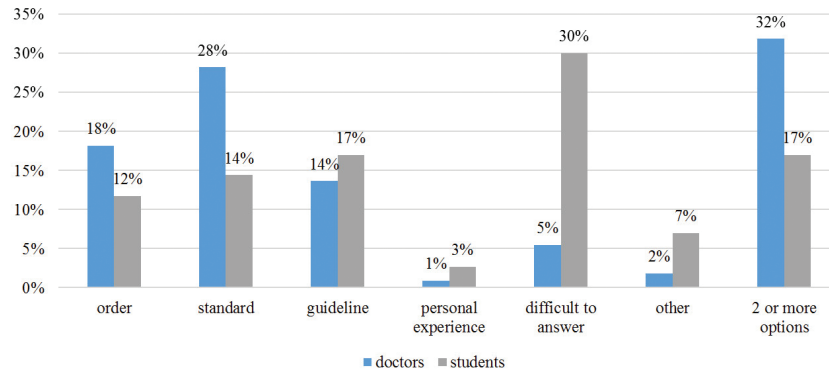


Figure 1. Preferred choice of regulatory documents for the treatment of CAP patients

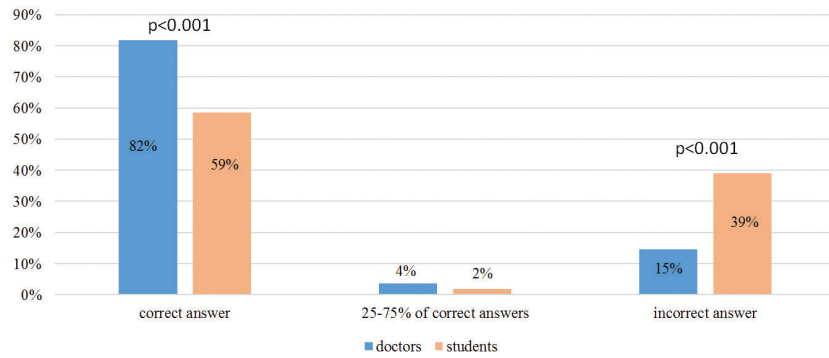


Figure 2. Responses to the question about reasons for a delayed onset of AMT in patients with a confirmed diagnosis of CAP

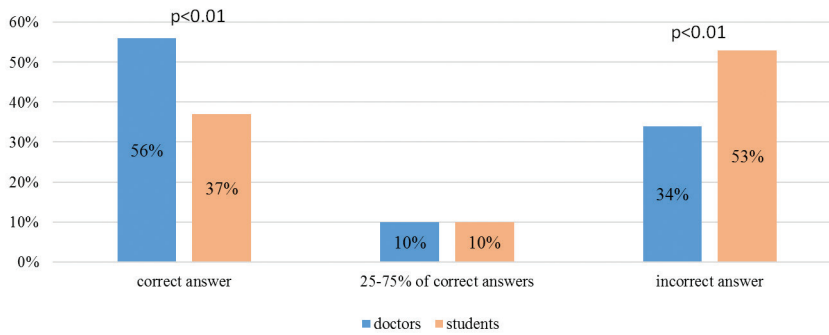


Figure 3. Responses to the question about the main criterion for termination antimicrobial therapy

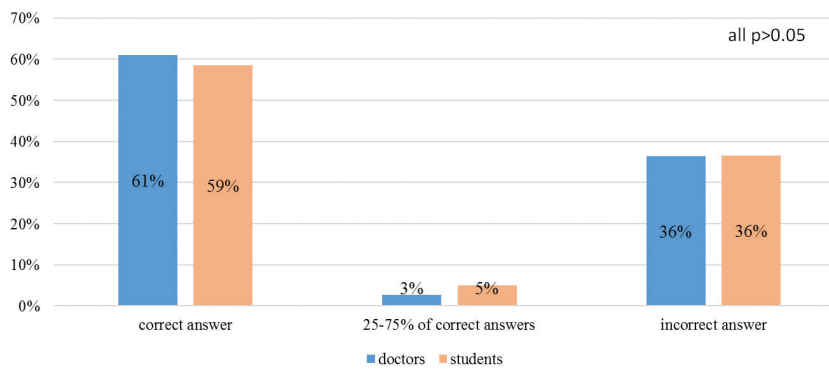


Figure 4. Responses to the question about sequential therapy for CAP

typical mistakes in the initial antibacterial therapy for a non-severe CAP is 29.5% in the group of students and 31% in the group of doctors (Fig. 5).

The last questions served to determine the level of knowledge when choosing the initial AMT to manage patients with a non-severe CAP. The respondent had to independently fill in a blank field with a drug name or a regimen of treatment with indicating the dose, frequency and administration mode.

When answering the question requesting to indicate an optimal initial therapy for a non-severe CAP in patients with neither risk factors nor concomitant diseases, the respondents were supposed to enter amoxicillin or macrolides as a drug of choice, according to the clinical recommendations. Though *in vitro* aminopenicillins do not cover the entire spectrum of potential pathogens, clinical trials did not reveal any differences in the efficacy of these antibiotics. Macrolides should be preferred at suspicion on "atypical" etiology of the disease (*S. pneumoniae* and *M. pneumoniae*) (Chuchalin et al. 2010, Nie et al. 2018). It should be emphasized that the positive dynamics can be achieved in patients of this group with oral forms of AMD administration.

ARC for the question of treatment tactics in this group of patients is 20.5% in the group of students and 28% in the group of doctors. The correct answer was given by 5.5% of doctors and 4.1% of students ($p > 0.05$). However, the physicians gave an incomplete correct answer (50-75%) significantly more often ($p < 0.001$) (Fig. 6). Therefore, a considerable number of the respondents made mistakes in selecting the initial therapy: 62% of the respondents in the group of students chose an AMD inconsistent with the clinical recommendations (26% of them indicated cephalosporins, 36% - protected penicillins, 16% - respiratory fluoroquinolones and 22% - AMD from other groups), 4% of students, though choosing the correct drugs for therapy, indicated an incorrect treatment regimen, 43% of the respondents gave an incomplete correct answer (that is, they indicated one true drug, among which amoxicillin was mentioned in 65% and macrolide in 35% answers), 21% of the respondents left the blank empty and 12% indicated another treatment option; in the group of doctors: 56% of the respondents chose an AMD inconsistent with the clinical recommendations (28% selecting cephalosporins, 59% - protected penicillins, 7% - respiratory fluoroquinolones, 6% - other types of AMD), 1% of the respondents indicated an incorrect treatment regimen, 49% of doctors gave an incomplete correct answer (amoxicillin - 74%, macrolide - 26%), 12% of the respondents left the blank empty (Figs. 6, 7).

The next question required a respondent to indicate an optimal initial therapy for a non-severe CAP in patients with risk factors and/or concomitant diseases (diabetes mellitus, COPD, congestive heart failure, chronic renal failure, drug addiction, chronic alcoholism, malnutrition, cirrhosis) and/or those who had taken system AMD for 2 or more days over the last 3 months. When managing these patients, tableted forms of AMD are also

recommended, but the tactics of AMT for such patients is different, as the etiological role of Gram-negative flora is likely to increase (Chuchalin et al. 2010, McLaughlin et al. 2018, Lee et al. 2018, Cilli et al. 2018). The use of the following combined AMD is recommended in the initial therapy: amoxicillin+clavulanic acid. When there are risk factors for "atypical" microflora, a combination of β -lactam and macrolide may be possible. An alternative to a combination therapy may be the administration of respiratory fluoroquinolone (levofloxacin, moxifloxacin, hemifloxacin) (Marston et al. 1997, Valenza et al. 2016, Chuchalin et al. 2017, Cillóniz et al. 2018). The local practice of administration of aminoglycosides (gentamicin, etc.), cefazolin and ciprofloxacin for CAP treatment should be considered erroneous, as they are not active against the key pathogens of CAP (Chuchalin et al. 2010).

ARC totaled 14% in the group of students and 23% in the group of doctors. Completely correct answers were given by less than 3% of the respondents. However, the doctors gave an incomplete correct answer (50-75%) significantly more often ($p < 0.001$). At the same time, fairly large number of the respondents (63.8% of doctors and 85.5% of students, $p < 0.05$) suggested an incorrect scheme of managing patients with a non-severe CAP when there were some risk factors and/or concomitant diseases. (Fig. 8). The major mistakes among the students were: 33% of the respondents chose an AMD inconsistent with the clinical guidelines (70% of the respondents chose cephalosporins, 8% - protected penicillins, 22% - other types of AMD), 1% of students indicated a wrong treatment regimen, 49% gave an incomplete correct answer (that is, they indicated at least one correct drug, among which 7% of students indicated a combination of protected penicillins and respiratory fluoroquinolones, 27% - protected penicillins, 15% - a combination of protected penicillins and macrolide and 51% - respiratory fluoroquinolones), 33% of the respondents left the blank empty and 10% indicated another treatment option; in the group of doctors: 35% of the respondents chose an AMD inconsistent with the clinical recommendations (74% of them indicated cephalosporins, 18% - protected penicillins, 8% - other types of AMD), 1% of the respondents, though they made the correct choice of the drug, indicated an incorrect treatment regimen, 65% of the doctors gave an incomplete correct answer (32% of the respondents indicated only protected penicillins, 31% - a combination of protected penicillins and macrolide and 37% - respiratory fluoroquinolones), 18% of the respondents left the blank empty.

Thus, at the decision-making stage concerning an initial AMT for patients with a non-severe CAP, both students and doctors made a significant number of errors: the AMD indicated by the respondents do not always meet the clinical guidelines (high frequency of administering the 3d generation cephalosporins against the drugs of choice) and had poor knowledge of the administration schedule (route of administration, frequency and dose).

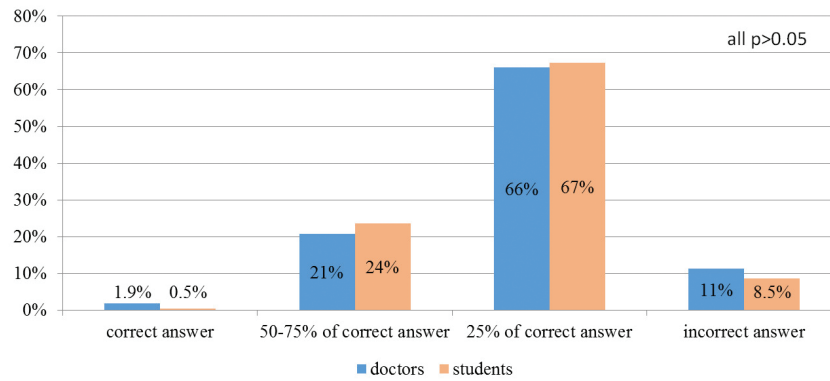


Figure 5. Responses to the question about typical mistakes in CAP treatment

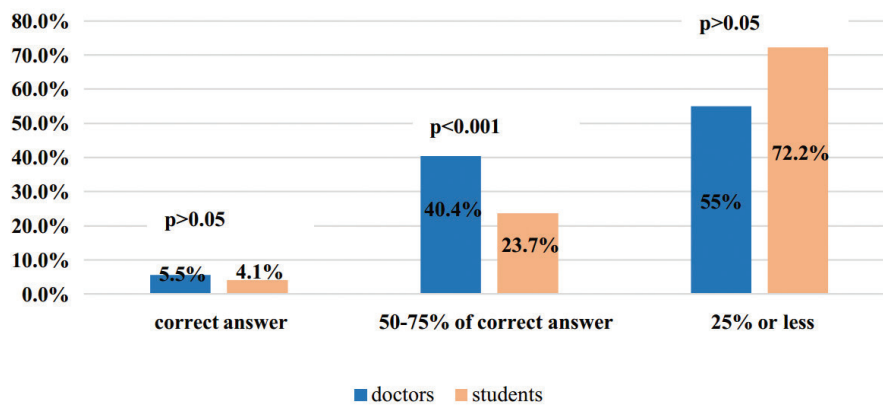


Figure 6. Distribution of answers concerning the choice of optimal initial therapy for a non-severe CAP in patients with neither risk factors nor concomitant diseases

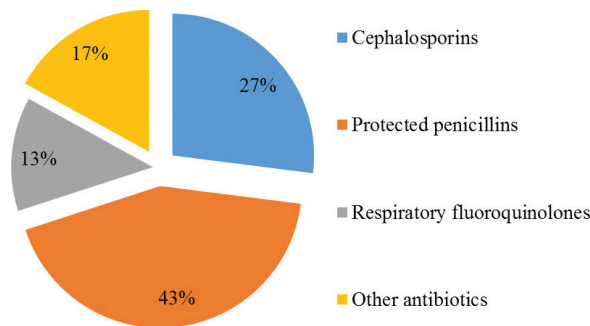


Figure 7. The main mistakes in the groups of students and doctors (both groups together) when selecting an initial therapy for a non-severe CAP in patients with neither risk factors nor concomitant diseases

In the last question of the questionnaire, it was required to indicate whether there was a subjective need for educational programs on managing CAP patients. A considerable number of the respondents (64% of doctors and 63% of students) expressed the need for such kind of activities.

Conclusions

The conducted survey indicated that both senior Medical Care majors and general practitioners showed a low level of knowledge of CAP treatment. The greatest difficulties, both for students and practitioners, appeared when answering the questions about "sequential therapy" as well as the questions requiring a "written" response – a recommended initial treatment regimen for a non-severe CAP. It should be admitted that the doctors coped better with the majority of the tasks as compared to the students' results, which may be due to lack of practical experience in the latter (Fig. 10). However, this fact does not justify the low level of theoretical competence of the students, though they had already studied pharmacology and clinical pharmacology.

In the authors' view, the number of practical lessons on CAP remains insufficient for better understanding and, as a result, mastering the topic by the students. It is likely that more hours should be allocated to the questions about the treatment of major infectious diseases when teaching students of the fifth and sixth years of study. In addition, special training programs should be introduced to inform

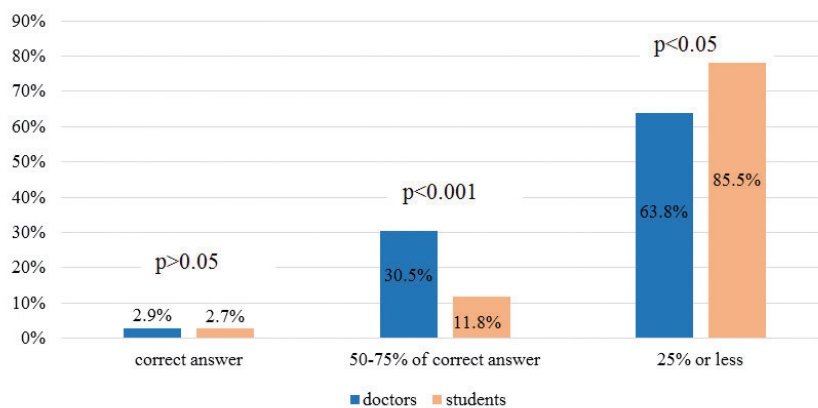


Figure 8. Responses to the questions about an initial therapy for a non-severe CAP in patients with risk factors and/or concomitant diseases

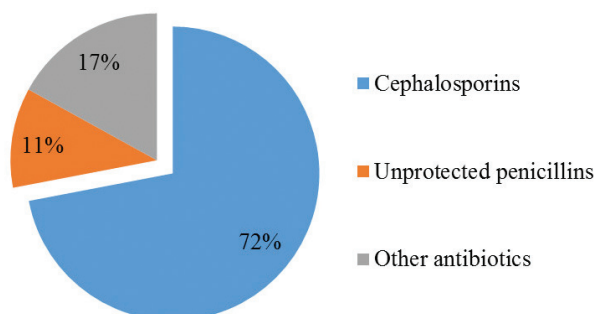


Figure 9. The main mistakes in the groups of students and doctors (both groups together) when selecting an initial therapy for a non-severe CAP in patients with risk factors and/or concomitant diseases

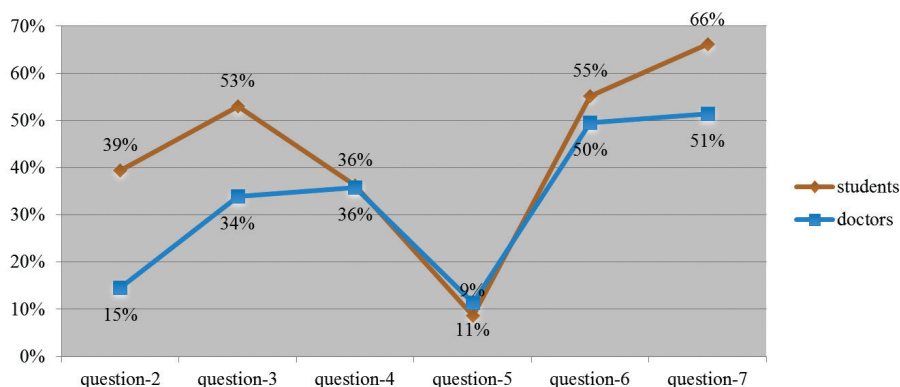


Figure 10. Distribution of incorrect answers to all questions in groups of doctors and students

doctors in this field and improve their knowledge of the issue. Thus, future and currently practicing doctors, familiar with CAP treatment, will be able to provide timely and proper medical care.

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References

- Avdeev SN (2004) Treatment of community-acquired pneumonia. *Russian Medical Journal [Russkiy meditsinskiy zhurnal]* 12(2): 70–73. [in Russian]
- Blumenthal IY (2011) Extrahospital pneumonia: an actual problem or a routine pathology? *The Bulletin of Contemporary Clinical Medicine [Vestnik sovremennoy klinicheskoy meditsiny]* 4(1): 52–55. [in Russian] [https://doi.org/10.20969/VSKM.2011.4\(1\).52-55](https://doi.org/10.20969/VSKM.2011.4(1).52-55)
- Bontsevich R, Shchurovskaya K, Gashynova K, Pokrovsky M, Pokrovskaya T (2017) Assessment of senior medical students' knowledge in treatment of patients with community-acquired pneumonia (KNOCAP project). *European Respiratory Journal* 50(61): PA2767. <https://doi.org/10.1183/1393003.congress-2017.PA2767>
- Bontsevich RA, Shchurovskaya KV, Pokrovskaya TG, Goryainova LY (2015) Assessment of senior dental students and dental residents in matters of antimicrobial chemotherapy. *Research Result: Pharmacology and Clinical Pharmacology* 1(1): 51–57.
- Bontsevich RA, Shchurovskaya KV, Pokrovskaya TG, Kompaniets OG, Ponomareva AI (2015) Assessment of the knowledge of therapists in the management of patients with community-acquired pneumonia. *Clinical Microbiology and Antimicrobial Chemotherapy [Klinicheskaya mikrobiologiya i antimikrobnaya himioterapiya]* 17(2): 20. [in Russian]
- Chuchalin AG, et al. (2017) *Respiratory Medicine: Manual*. Litterra, Moscow, Vol. 2, 544 pp. [in Russian]
- Chuchalin AG, Sinopalnikov AI, Kozlov RS, Tyurin IE, Rachina SA (2010) Community-acquired pneumonia in adults: practical recommendations for diagnosis, treatment and prevention. *Clinical Microbiology and Antimicrobial Chemotherapy [Klinicheskaya Mikrobiologiya i Antimikrobnaya Himioterapiya]*. 12(3): 186–225. [in Russian]
- Çilli A, Sayiner A, Çelenk B, Şakar Coşkun A, Kılınc O, Hazar A, Aktaş Samur A, Taşbakan S, Waterer GW, Havlucu Y, Kılıç Ö, Tokgöz F, Bilge U (2018) Antibiotic treatment outcomes in community-acquired pneumonia. *Turkish Journal of Medical Sciences* 48(4): 730–736. <https://doi.org/10.3906/sag-1709-144> [PubMed]
- Cillóniz C, Rodríguez-Hurtado D, Nicolini A, Torres A (2018) Clinical approach to community-acquired pneumonia. *Journal of Thoracic Imaging* 33(5): 273–281. <https://doi.org/10.1097/RTI.0000000000000343> [PubMed]
- Kruglyakova LV, Naryshkina SV (2014) Modern approaches to the treatment of community-acquired pneumonia (review). *The Bulletin of Contemporary Clinical Medicine [Byulleten' fiziologii i patologii dyhaniya]* 52: 110–120. [in Russian]
- Lee MS, Oh JY, Kang CI, Kim ES, Park S, Rhee CK, Jung JY, Jo KW, Heo EY, Park DA, Suh GY, Kiem S (2018) Guideline for antibiotic use in adults with community-acquired pneumonia. *Infection and Chemotherapy* 50(2): 160–198. <https://doi.org/10.3947/ic.2018.50.2.160> [PubMed]
- Marston BJ, Plouffe JF, File TM Jr, Hackman BA, Salstrom SJ, Lipman HB, Kolczak MS, Breiman RF (1997) Incidence of community-acquired pneumonia requiring hospitalization. Results of a population-based active surveillance Study in Ohio. The Community-Based Pneumonia Incidence Study Group. *Archives of Internal Medicine* 157(15): 1709–1718. <https://doi.org/10.1001/archinte.1997.00440360129015> [PubMed]
- McLaughlin J, Jiang Q, Isturiz R, Sings H, Swerdlow D, Gessner B, Carrico RM, Peyrani P, Wiemken TL, Mattingly WA, Ramirez JA, Jodar L (2018) Effectiveness of 13-valent pneumococcal conjugate vaccine against hospitalization for community-acquired pneumonia in older US adults: a test-negative design. *Clinical Infectious Diseases*. <https://doi.org/10.1093/cid/ciy312> [PubMed]
- Nie XM, Li YS, Yang ZW, Wang H, Jin SY, Jiao Y, Metersky ML, Huang Y (2018) Initial empiric antibiotic therapy for community-acquired pneumonia in Chinese hospitals. *Clinical Microbiology and Infection* 24(6): 658.e1–658.e6. <https://doi.org/10.1016/j.cmi.2017.09.014> [PubMed]
- Valenza MC, Torres-Sanchez I, Núñez-Flores TDC, Gómez de Aranda JA, Rios-Sanchez A, Torres JR (2016) Effectiveness of a physical therapy intervention in patients hospitalized due to community acquired pneumonia. *European Respiratory Journal* 48: PA4424. <https://doi.org/10.1183/13993003.congress-2016.PA4424>
- Yakovlev SV, Sidorenko SV, Rafalsky VV, Spichak TV (2016) Strategy and tactics of adequate use of antimicrobial agents in outpatient practice: *Eurasian Clinical Recommendations*. Moscow, Pre100 Print, 144 pp. [in Russian]

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