Distribution of Pathogens Involved in Infections in Oncological Patients and their Antibiotic Resistance Profile

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Cancer is the second leading cause of death in Romania and worldwide. Cancer patients are at increasing risk of acquiring bacterial infection with multi-resistant germs, including multidrug-resistant (MDR) strains of Gram-negative bacteria involved in nosocomial infection. Romania is one of the South-Eastern European countries with one of the highest prevalence rates of MDR pathogens. To determine the resistance pattern of bacterial profile and antibiotic resistance pattern in cancer patients admitted at the County Emergency Clinical Hospital Craiova, Romania. A retrospective study of bacterial pathogens was carried out on 90 adult cancer patients admitted from January to December 2018. The analysis of the resistance patterns for the action of the appropriate antibiotics was performed using Vitek 2 Compact system and diffusion method. In this study there were analysed 92 samples from 90 oncological patients (37-86 years). A total of 157 bacterial isolates were obtained, of which 37 strains of Staphylococcus aureus *(23.56%), followed by Streptococcus pneumoniae (23-14.64%), Klebsiella spp. and Escherichia coli (22 - 14,01%). The most common isolates were from respiratory tract (86 isolates – 54.77%). High rates of MDR were found for E. coli (63.63%), MRSA (61,11%) and Klebsiella spp. (54,54%), while one third of the isolated strains of Pseudomonas aeruginosa, Acinetobacter spp. and Proteus spp. were MDR. The findings of this study may be the basis for further more extensive studies highlighting the germs involved in the infectious pathology of cancer patients, in order to determine the antimicrobial resistance and to improve the methods of prophylaxis and treatment.*

Keywords: multidrug resistance (MDR), cancer patients, bacterial pathogen

Cancer is the second leading cause of death in Romania and worldwide. The most common causes of cancer death in the world are lung, liver, colorectal, stomach, breast cancer, and leukemia. [1- 5]. Due to the severe immuno-suppression associated with the underlying disease, cancer patients are at increasing risk of acquiring bacterial infection with multi-resistant germs, including multidrug-resistant (MDR) strains of Gram-negative bacteria involved in nosocomial infection.

Antimicrobial resistance is a threat to all branches of medical and public health practice, the emergence and spread of antimicrobial resistance (AMR) being now considered a global public health threat. [6- 9].

According to the European Antimicrobial Resistance Surveillance Network (EARS-Net), Improving Patient Safety in Europe (IPSE) and ECDC data, Romania is one of the South-Eastern European countries with one of the highest prevalence rates of MDR pathogens. [10]. A worrying phenomenon in Romania is also the existence of the MDR-TB and XDR-TB cases in socio-economic conditions (malnutrition, agglomeration, stress), with the doubling of number of cases of XDR-TB in the last years [11, 12], including the cases of extrapulmonary tuberculosis which originates from the hematogenous metastatic affects developed during the prime TB infection period [13- 15]. This condition associated with the underlying disease may contribute to the increased immunosuppression of cancer patients and can reduce the chances of a favorable evolution.

The aim of the present study were to identify the microbial spectrum of bacteria isolated from infection in hospitalized cancer patients and their resistance profiles, to help developing an adequate policy of using antibiotics to treat oncological patients and for limiting nosocomial infections.

Experimental part

Materials and methods

The research is a retrospective study, which includes the determination of pathogens involved in infections of adult cancer patients (between 37 and 86 years), admitted from January to December 2018 to the oncology clinic of Craiova Emergency Clinical County Hospital, Romania, a county hospital with 1518 beds which provides specialized healthcare to patients from Dolj county and Oltenia region. Demographic and clinical data (patient hospital number (ID number),

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gender, date of test, ward of isolation and source of specimen) were collected from the clinical pathology databases of the hospital. Samples included urine, sputum/tracheal aspirate (respiratory secretion), pus/wound swabs, exudates, ear discharge, vaginal discharge. There were included in the study only those samples which were positive by culture.

The identification of the isolated strains on the clinical specimens received from oncological patients was carried out in the Hospital's Laboratory of Microbiology. The analyse of the resistance patterns for the action of the appropriate antibiotics was performed using Vitek 2 Compact system and diffusion method.

Antibiotics agents employed for susceptibility testing were amoxicillin-clavulanic acid (20/10 μg), amikacin (30 μg), cefazolin (30 μg), cefuroxime (30 μg), ceftriaxone (30 μg), cefotaxime (30 μg) ceftazidime (30 μg), cefepime (30 μg), ciprofloxacin (5 μg), moxifloxacin (5 μg) tetracycline (30 μg), piperacillin-tazobactam (30 μg), imipenem (10 μg), meropenem (10 μg), ertapenem (10 μg), linezolid (30 μg), tetracycline (30 μg) penicillin (10 μg), erythromycin (15 μg), clindamycin (2 μg), clarithromycin (15 μg), doxycycline (30 μg) and rifampicin (5 μg). Interpretation was done according to Clinical Laboratory Standard Institute (CLSI) guidelines [16].

Information about gender and age of the patients, site of infection and antimicrobial resistance pattern were collected from Hospital's Information System and from the available hospital records. Data were entered and analysed using Microsoft Excel. Continuous variables like age are expressed as mean±STDEV. The pattern of micro-organisms and gender/sites of infections were analysed and expressed as percentages.

Results and discussions

From January to December 2018, there were analysed 92 samples from 90 cancer patients aged over 35 years, included in the study. The mean age of the patients was 62.44±11.00 years. 29 were females (32.22%) and 61 (67.77%) were males. Samples included urine, sputum/tracheal aspirate (respiratory secretion), pus/wound swabs, exudates, ear discharge, vaginal discharge. There were included in the study only positive samples by culture. It is a retrospective study and the patients signed the informed consent for analysis and treatment.

Distribution of subjects by age group reflects that more than half (56.66%) were under 65 years (between 35-64 years). From all the cancer cases, lung cancer (21 – 23.33%) was the highest, followed by larynx cancer (13 – 14.44%) and cervical cancer (7 – 7.77%). There were registered 3 cases of bone cancer, 3 of bladder cancer and 3 of liver cancer (including cirrhosis, the final stage of fibrosis, with portal fibrosis extended to the central area) [15]. In women first place was occupied by cervical cancer, followed by breast and ovarian cancer. 80,95% from the lung cancer cases (17) and all the cases of larynx cancer were recorded in male patients (table 1).

Table 1
DISTRIBUTION OF ISOLATES AMONG SAMPLES FROM CANCER PATIENTS AT THE COUNTY EMERGENCY CLINICAL HOSPITAL CRAIOVA, ROMANIA, 2018

Sample	Number of bacterial strains	%
Exudates	2	1.27
Vaginal discharge	7	4.45
Pus/wound swabs	36	22.93
Sputum/tracheal aspirate	86	54.77
Urine	22	14.01
Ear discharge	4	2.54
Total	157	100

Only one case of lymphoma and one of colorectal carcinoma were registered in male patients and one case of colon cancer in a female patient, in the conditions in which there are places in Romania (Bucharest and Timis region) with similar incidence and mortality levels as in Central and Northern Europe [18].

A total of 157 bacterial isolates were obtained, excluding cases where it was more than one isolate of the same pathogen from the same patient. In 42 specimens was recovered polymicrobial growth.

85 isolates (54.14%) were Gram negative and 72 isolates (45.85%) were Gram positive bacteria. The most common isolate of the Gram negative pathogens were *Klebsiella* spp. (14.01%) and *E. coli* (14.01%), followed by *Proteus* spp (7.64%), *Pseudomonas* spp. (6.36%) and *Acinetobacter* spp. (5.73%). *Streptococcus pneumoniae* and *Staphylococcus aureus* were the first and second predominant Gram positive bacteria, accounting for 26.74% from all isolates.

The majority of the isolates were from respiratory tract (86 isolates – 54.77%), pus/wound swabs (36 isolates – 22.93%) and urine (22 isolates – 14.01%), with a low frequency of the isolates from vaginal discharge (7 isolates – 4.45%), ear discharge (4 isolates – 2.54%) and exudates (2 isolates – 1.27%). (table 2).

The overall predominant bacterial isolates were *Staphylococcus aureus* (37- 23.56%), followed by *Streptococcus pneumoniae* (23 – 14.64%), and, very closely, in equal proportion, by *Klebsiella* spp. and *E. coli* (22 – 14.01%). From the *Staphylococcus aureus* strains 11.46% (18 strains) were *MRSA* - Methicillin-Resistant Staphylococcus Aureus and 12.10% (19 strains) were *MSSA*- Methicillin-Sensitive Staphylococcus Aureus.

Referring to the total number of samples collected by gender, isolation rates indicates a higher value for male patients, germs like *Coagulase-negative Staphylococci* (CoNS) and Glucose-nonfermenting Gram-negative bacilli (*NFB*) being found only in men. (table 3).

Table 2
CLINICAL CHARACTERISTICS OF CANCER PATIENTS AT THE COUNTY EMERGENCY CLINICAL HOSPITAL CRAIOVA, ROMANIA, 2018

Specific type of cancer	Females		Males		Total	
	n	%	n	%	n	%
Breast cancer	6	100	0	0	6	6.66
Lymphoma	0	0	1	100	1	1.11
Ovarian cancer	5	100	0	0	5	5.55
Cervical cancer	7	100	0	0	7	7.77
Colon cancer	1	100	0	0	1	1.11
Lung cancer	4	19.04	17	80.95	21	23.33
Pancreatic cancer	0	0	1	100	1	1.11
Brain cancer	1	50	1	50	2	2.22
Colorectal cancer	0	0	1	100	1	1.11
Larynx cancer	0	0	13	100	13	14.44
Oral cavity cancer	0	0	6	100	6	6.66
Skin cancer (including melanoma)	0	0	3	100	3	3.33
Other	5	21.74	18	78.26	23	25.55
Total	29	32.22	61	67.77	90	100

Table 3
DISTRIBUTION BY GENDER OF THE MICRO-ORGANISMS ISOLATED FROM SAMPLES FROM CANCER PATIENTS AT COUNTY EMERGENCY CLINICAL HOSPITAL CRAIOVA, ROMANIA, 2018

Micro-organism	Females		Males		Total	
	n	%	n	%	n	%
S. aureus	7	36.84	12	63.15	19	100
MRSA	2	11.11	16	88.88	18	100
E.coli	8	36.36	14	63.63	22	100
Klebsiella	9	40.91	13	59.09	22	100
Proteus	6	50	6	50	12	100
Pseudomonas	3	30	7	70	10	100
Acinetobacter	1	11.11	8	88.88	9	100
NFB	0	0	4	100	4	100
Citrobacter	1	50	1	50	2	100
Enterobacter	0	0	2	100	2	100
CoNS	0	0	7	100	7	100
S. aureus	7	36.84	12	63.15	19	100
MRSA	2	11.11	16	88.88	18	100
Streptococcus pneumoniae	4	17.39	19	82.60	23	100
Streptococcus spp.	1	50	1	50	2	
Enterococcus	1	33.33	2	66.66	3	100
Stenotrophomonas maltophilia	0	0	1	100	1	100
Providencia spp.	0	0	1	100	1	100
Total	43	27.38	114	72.61	157	100

NFB- Glucose-nonfermenting Gram-negative bacilli; *CoNS* -- Coagulase-negative staphylococci;
MRSA - Methicillin-Resistant Staphylococcus Aureus

The most frequently harvested samples originated from sputum/tracheal aspirate (54.77%) and *Streptococcus pneumoniae* was the most common isolated pathogen from these samples (26.74%). (table 4).

From urine, *E. coli* was the most frequently isolated organism (59.09%), while *MRSA* occupied the first place among isolated pathogens from pus/wound swabs (16.66%), followed at a very short distance, with an equal percentage (13.88%), by *Acinetobacter* spp. and *Proteus* spp.

In our study we have analysed the percentage of multidrug-resistant (MDR) strains among the clinical isolates from the oncologic patients, by taking into consideration resistance to at least three different antibiotic groups: aminoglycosides, cephalosporins, carbapenems, tetracyclines and fluoroquinolones. High rates of MDR were found for *E. coli* (63.63%), *MRSA* (61,11%) and *Klebsiella* spp. (54.54%), while one third of the isolated strains of *Pseudomonas aeruginosa*, *Acinetobacter* spp. and *Proteus* spp. were MDR.

The antimicrobial resistance patterns of bacterial pathogens isolated in cancer patients are presented in tables 5-7**.** The combined resistance to multiple antimicrobial groups observed for *Klebsiella* spp. is consistent with European

Centre for Disease Prevention and control (ECDC). The majority of infections caused by *K. pneumoniae* are healthcare-associated and the most common resistance phenotype was combined resistance to three key antimicrobial groups: fluoroquinolones, third-generation cephalosporins and aminoglycosides [19].

Arround 60% from the *Klebsiella* spp. strains isolated in our study were resistant to second and fourth-generation cephalosporins and half to third-generation. More than half of the *Klebsiella* spp. strains were sensitive to carbapenems (meropenem and ertapenem) and over 60% to ciprofloxacin. Almost 80% of the strains were resistant to amoxicillin/clavulanic acid. All the tested *Klebsiella* spp. strains (10 from 22), were sensitive to colistin and over 60% (14 strains) were sensitive to aztreonam, a monobactam antibiotic with antimicrobial activity against gram-negative bacilli.

Table 4
PATTERN OF PATHOGENS ISOLATED FROM DIFFERENT SPECIMEN TYPES IN CANCER PATIENTS

Species	**Sample**					
	Sputum /tracheal aspirate	Urine	Pus/wound swabs	Vaginal discharge	Exudate	Ear discharge
Acinetobacter	4	-	5	-	-	-
NFB	3	-	1	-	-	-
Citrobacter	-	-	2	-	-	-
Enterobacter	--	-	2	-	-	-
E.coli	7	13	-	-	-	2
Enterococcus	-	-	1	-	-	-
Klebsiella	14	4	3	1	-	-
Proteus	5	1	5	1	-	-
Pseudomonas	5	2	2	-	1	-
CoNS	3	-	4	-	-	-
S. aureus	9	-	3	4	1	2
MRSA	12	-	6	-	-	-
Streptococcus pneumoniae	23	-	-	-	-	-
Providencia spp.	-	-	1	-	-	-
Streptococcus spp.	-	-	1	1	-	-
Stenotrophonas maltophila	1	-	-	-	-	-
Total	86	22	36	7	2	4

Table 5
ANTIMICROBIAL RESISTANCE PATTERN OF ENTEROBACTERIACEAE GNB (NUMBER AND PERCENTAGE)

Antimicrobial agent	Klebsiella (22)	E.coli (22)	Proteus (12)
Amikacin	7 (31.81%)	11 (50%)	3 (25%)
Amoxicillin/clavulanic acid	17 (77.27%)	19 (86.36%)	5 (41.66%)
Aztreonam	7 (31.81%)	6 (27.27%)	2 (16.66%)
Ceftazidime	13 (59.09%)	11 (50%)	4 (33.33%)
Ceftriaxone	12 (54.54%)	9 (40.91%)	4 (33.33%)
Cefotaxime	2 (9.09%)	-	2 (16.66%)
Cefuroxime	6 (27.27%)	13 (59.09%)	4 (33.33%)
Cefazolin	11 (50%)	7 (31.81%)	3 (13.63%)
Cefepime	13 (59.09%)	8 (36.36%)	5 (41.66%)
Imipenem	1 (4.54%)	4 (18.18%)	2 (16.66%)
Ciprofloxacin	8 (36.36%)	13 (59.09%)	4 (33.33%)
Meropenem	3 (13.63%)	2 (9.09%)	-
Piperacillin/tazobactam	5 (22.72%)	7 (31.81%)	-
Ertapenem	1 (4.54%)	1 (4.54%)	1 (4.54%)

*-not tested

Table 6
ANTIMICROBIAL RESISTANCE PATTERN OF GRAM POSITIVE COCI
(NUMBER AND PERCENTAGE)

Antimicrobial agent	MRSA (18)	S. aureus (19)	CoNS (7)	Streptococcus pneumoniae (23)
Ciprofloxacin	12 (66.66%)	8 (42.10%)	7 (100%)	-
Chloramphenicol	10 (55.55%)	6 (26.31%)	4 (57.14%)	-
Clindamycin	15 (83.33%)	15 (78.94%)	5 (71.42%)	7 (30.43%)
Clarithromycin	9 (50%)	9 (47.36%)	4 (57.14%)	-
Doxycycline	5 (27.77%)	4 (21.05%)	2 (28.57%)	10 (43.47%)
Erythromycin	14 (77.77%)	15 (78.94%)	4 (57.14%)	15 (65.21%)
Linezolid	0 (0%)	0 (0%)	0 (0 %)	-
Penicillin	18 (100%)	16 (84.21%)	7 (100%)	17 (73.91%)
Rifampicin	10 (55.55%)	6 (31.57%)	5 (71.42%)	-
Tetracycline	15 (83.33%)	9 (47.36%)	6 (85.71%)	13 (56.52%)
Oxacillin	17 (94.44%)	2 (10.52%)	7 (100%)	8 (34.78%)
Meropenem	-	-	-	3 (13.04%)
Moxifloxacin	11 (61.11%)	5 (26.31%)	6 (85.71%)	3 (13.04%)

* — not tested

Table 7
ANTIMICROBIAL RESISTANCE PATTERN OF NON-FERMENTING GNB
(NUMBER AND PERCENTAGE)

Antimicrobial agent	Acinetobacter spp. (9)	Pseudomonas spp. (10)
Amoxicillin/clavulanic acid	2 (22.22%)	6 (60%)
Amikacin	3 (33.33%)	4 (40%)
Ceftazidime	4 (44.44%)	7 (70%)
Ceftriaxone	4 (44.44%)	4 (40%)
Cefotaxime	3 (33.33%)	-
Cefuroxime	2 (22.22%)	5 (50%)
Cefazolin	2 (22.22%)	-
Cefepime	5 (55.55%)	5 (50%)
Ertapenem	2 (22.22%)	-
Imipenem	1 (11.11%)	2 (20%)
Ciprofloxacin	1 (11.11%)	4 (40%)
Meropenem	5 (55.55%)	1 (10%)
Piperacillin/tazobactam	-	1 (10%)
Tetracycline	2 (22.22%)	-

* —not tested

E. coli showed a higher resistance rate to second and third-generation cephalosporins (60%, respectively 50%), to amoxicillin/clavulanic acid (86.36%), consistent with other studies [18,19]. Almost 60% of the strains were resistant to fluoroquinolone (ciprofloxacin). Low resistance rate to carbapenems (less than 20%) and to aztreonam (27.27%) was observed in *E. coli* strains. More than 30% of the strains were resistant to first and fourth-generation cephalosporins.

According to our study, more than half of the *Acinetobacter* strains were resistant to meropenem, fourth-generation cephalosporins (cefepime) and to piperacillin-tazobactam.

In 33.33% of the *Proteus* strains was observed resistance to second (cefuroxime) and third-generation cephalosporins (ceftazidime, ceftriaxone) and also to fluoroquinolone (ciprofloxacin).

A high resistance to the cephalosporins (between 50-70%), has been highlighted in the case of *Pseudomonas aeruginosa* strains. 60% of them were sensitive to meropenem, ciprofloxacin and colistin.

In the Gram-positive group, 37 strains of *Staphylococcus aureus* were identified in our research, from which 18 were *MRSA.* MDR *MRSA* strains represented 61.11% (11), in the conditions in which this pathogen has been the most important cause of antimicrobial-resistant healthcare-associated infections worldwide, with higher percentages in the southern and south-eastern parts of Europe [19].

All of the MRSA strains were resistant to penicillin and a higher degree of resistance was found to be against clindamycin (83.33%), erythromycin (77.77%), tetracycline (83.33%), oxacillin (94.44%) and ciprofloxacin (66.66%). Almost all MRSA strains (16 – 88.88%), were susceptible to linezolid (table 4).

A high resistance was observed in the case of *Staphylococcus aureus* strains for clindamycin (79.94%), erythromycin (78.94%) and penicillin (84.21%). All the tested strains (18) were sensitive to linezolid.

All of the isolated strains of *coagulase-negative staphylococci* (CoNS) were resistant to penicillin, ciprofloxacin and oxacillin, around 70% to clindamycin and rifampicin and 85% to tetracycline and moxifloxacin. All the strains were susceptible to linezolid (table 4).

Three (13.04%) of the *Streptococcus pneumoniae* were MDR isolates. Almost 75% of the strains were found resistant to penicillin and 65% to erythromycin and had shown low resistance to cephalosporins (ceftriaxone, cefotaxime and cefepime), carbapenems (meropenem) and fluoroquinolone (moxifloxacin).

Our study included cancer patients hospitalized in oncology clinic, over 35 years, with the aim of highlighting the MDR strains which can cause infections with severe evolution in immunocompromised cancer patients.

The research revealed that the most common isolated pathogen was *Staphylococcus aureus*, followed by *Streptococcus pneumonia, Klebsiella* spp. and *E. coli*. *Staphylococcus aureus* and *E. coli* were the most common bacterial pathogens isolated from cancer patients also in researchers' studies [1,20 - 23].

Antimicrobial resistance (AMR) is a serious threat to public health and patient safety in Europe, leading to mounting healthcare costs, patient treatment failure, and deaths. [19, 24]. The conditions that affect patient`s immunity, like cancer, lung and gastrointestinal diseases, increase the risk of MDR, contributing to the spread of MDR isolates [25-29]. The empirical, indiscriminate, prolonged, or incorrect usage of antibiotics contributes significantly to the selection of MDR strains [30, 31].

Our study revealed that over half of the strains of *Klebsiella* spp. (54.54%) are MDR, in the conditions in which, according to the European Antimicrobial Resistance Surveillance Network (EARS-Net), more than one third (34.5%) of the *Klebsiella pneumoniae* isolates reported in 2016 were resistant to at least one of the antimicrobial groups under regular surveillance (fluoroquinolones, third generation cephalosporins, aminoglycosides and carbapenems) [32].

Almost the same percentage of resistance was found in their study by Eldomany et al. [16]. Also a high percentage of resistance to cephalosporins (cefotaxime, ceftazidime) was found in other studies for *E. coli*, *Klebsiella* spp. and *Pseudomonas* spp. isolates [16, 33, 34].

In the research conducted by Vahedian-Arkadani [20], *Klebsiella* isolates were susceptible to all third- generation cephalosporins and carbapenems.

A small percentage of *E. coli* strains have been carbapenem resistant, consistent with EARS-Net. The results are consistent with analyses from the European Centre for Disease Prevention and Control [19].

For preventing transmission of resistant enterobacteriaceae the screening for carriers with subsequent isolation of those identified is effective. Infection prevention and control relies on the consistent application of some measures as hand hygiene, appropriate use of personal protective equipment, and ensuring a clean and well-maintained care environment [35].

More than 60% *MRSA* strains have been MDR. This percentage has been highlighted both in other researches that I conducted [36-38], as well as in a prospective study performed also in Romania by Licker at al. [39]. The results are consistent also with other findings [34, 40], while *MRSA* remains a major cause of healthcare-associated infections worldwide, with higher percentages in the southern and south-eastern parts of Europe [32].

In our research, both *Coagulase-negative Staphylococci* (CoNS) and *MRSA* showed resistance to penicillin in almost all patients, similar to the results obtained by us and other researchers [35-37,41].

In our 60% of the *Pseudomonas* strains were sensitive to carbapenems and fluoroquinolones, consistent with the finding of a significant decreases of the mean percentages for fluoroquinolone resistance, aminoglycoside resistance and carbapenem resistance [32] between 2013-2016.

More than half of the *Acinetobacter* strains were found resistant to carbapenems, fourth-generation cephalosporins and piperacillin-tazobactam, consistent with the results from other studies [36- 38, 40, 42- 44]. Due to the limited possibilities of treatment and control of the infections with *Acinetobacter* spp., the existence of resistant strains represents a public health concern [32].

In Romania, the percentage of *Streptococcus pneumoniae* strains non-susceptible to penicillins and macrolides raised from 21.4% in 2013 to 30.4% in 2016, in the conditions in which majority of the EU countries reported this phenotype for less than 10% of the tested isolates [32]. In our study around 13% of the *Streptococcus pneumoniae* strains were MDR and 65-75% were resistant to penicillin and erythromycin.

In some EU countries, adult high-risk groups such as elderly and immunocompromised are targeted with polysaccharide vaccine, which can have an impact to the epidemiology of non-susceptible *Streptococcus pneumoniae* in Europe [32].

The limits of the study are related to the fact that in the oncology clinic of the hospital are hospitalized especially patients in advanced stage of the basic disease, severe impairment of the immune system and with high risk of acquiring HCAIs, with highly resistant bacterial pathogens. Also, not all of the identified strains have been tested to all antibiotics, which leads to the assumption that their resistance is higher than that detected after the study.

However, the study may be the basis for further more extensive studies highlighting the germs involved in the infectious pathology of cancer patients, in order to determine the antimicrobial resistance and to improve the methods of prophylaxis and treatment.

Conclusions

The most common bacterial isolates from cancer patients were *S. aureus*, *Streptococcus pneumoniae*, *Klebsiella* spp. and *E. coli*. High rates of MDR were found for *E. coli* (63.63%), *MRSA* (61.11%) and *Klebsiella* spp. (54.54%). One third of the isolated strains of *Pseudomonas aeruginosa*, *Acinetobacter* spp. and *Proteus* spp. were MDR.

The results of the current study call for a more extensive study with a larger isolate number to better understand the resistance pattern of the common bacterial isolates and advise policymakers to develop guideline.

Acknowledgements: Authors have equally contributed to the paper and they should be regarded as main authors.

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Manuscript received: 18.11.2019

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