

SURVEY OF ANTIBIOTIC RESISTANCE OF ISOLATED BACTERIAL STRAINS AT NINH THUAN PROVINCE GENERAL HOSPITAL IN 2023

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Objectives: Distribution of the proportion of bacterial isolates and their antibiotic resistance rate at Ninh Thuan Provincial General Hospital (NTPGH).

Subjects and methods: All bacterial isolates from various types of clinical specimens from a departments of NTPGH from October 1, 2022 to September 30, 2023.

Methods: Cross-sectional description.

Results and conclusions: Of the 993 samples designated for culture, 988 cultured samples contained pathogenic bacteria, accounting for 99.5%. Pus specimens account for the highest rate of 32.1%; Gram-negative bacteria account for 76% while *Escherichia coli* was found in 324 samples, accounting for 32.8%, the highest proportion. *Escherichia coli* resists ampicillin, bactrim, and tetracycline at 95.4%, 90.5%, and 75.8%, respectively. *Staphylococcus aureus* resists penicillin, azithromycin, erythromycin, clindamycin, oxacillin, and bactrim at 96.5%, 93.5%, 93.2%, 93.2%, 81.9%, and 75.0 %, correspondingly. *Acinetobacter* spp. resists cefotaxime at 100%, ceftriaxone (100%), bactrim (92.3%), ceftazidime (90.9%), cefepime (87.8%), tetracycline (84.7%), gentamycin (81.4%), ciprofloxacin (80.0%), levofloxacin (78.9%), and piperacillin-tazobactam (76.9%). *Klebsiella* spp. resists ampicillin, and bactrim at 99.1%, and (86.7%), respectively. *Enterococcus* spp. resists tetracycline at 85.7%. *Proteus* spp. resists tetracycline, bactrim, and ampicillin at 94.9%, (86.8%), and (78.3%), correspondingly. *Pseudomonas aeruginosae* resists ampicillin-sulbactam, and ceftriaxone at 100%, and 75%, respectively.

Keywords: Harmful bacteria, antibiotic resistance.

INTRODUCTION

Statistics indicate that the rate of hospital-acquired infections is about 5-10%, and up to 25% in developed countries, and in some developing countries, respectively⁷. Hospital-acquired infections also increase hospital mortality rates. In the European community, the death rate due to hospital infections is 37,000 cases/year⁶, while in the US this rate is up to 99,000 cases/year⁸. Levels of antibiotic resistance relating to hospital-acquired infections are higher than those of community-caused infections. At the

same time, hospital-acquired infections have a longer average hospital stay, from 7 - 14 days. Therefore, the cost of hospital-acquired infections often increases 2 - 4 times compared to cases without hospital-acquired infections. The costs incurred due to hospital-acquired infections in the UK are about 1 billion dollars⁷, while in the US it is 28 - 45 billion dollars⁸.

Ninh Thuan Provincial General Hospital is a class I provincial hospital with 1,000 beds. This is the place to receive many patients from lower level hospitals or even from higher level hospitals. Although in recent times, Ninh Thuan Provincial General Hospital has conducted research on the situation of drug-resistant bacteria of agents commonly isolated at the hospital, but the situation of antibiotic-resistant bacteria is increasingly common, then researching the situation of antibiotic resistance is necessary, thereby contributing to

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helping doctors working in hospitals easily choose antibiotics that are still effective for patients with infections. Therefore, we conducted this project for the purpose of: Surveying antibiotic resistance of bacterial strains isolated at Ninh Thuan Provincial General Hospital in 2023.

MATERIAL AND METHOD

Research Method: Cross-sectional retrospective description

Subjects: All positive bacterial results were isolated from specimens taken from infections of patients treated in departments of the Provincial General Hospital.

Inclusion criteria: Only select bacteria isolated from valuable specimens (for example: sputum specimens: white blood cells > 25, epithelial cells < 10 on a field x 100; urine specimens when there are bacteria > 10⁵ CFU/ml. The bacteria were subjected to antibiograms with existing antibiotics in the conditions of Ninh Thuan Provincial General Hospital.

Exclusion criteri: For contaminated specimens, cases without antibiogram results.

Place and duration of study: At the Department of Biochemistry - Microbiology, Ninh Thuan

Provincial General Hospital from October 1, 2022 to September 30, 2023.

Sample size and sampling methods

- Take all positive bacterial culture results from departments and send them to the Department of Biochemistry - Microbiology of Ninh Thuan Provincial General Hospital.

- Follow the laboratory's routine for each type of specimen, take it into a sterile bottle or cotton swab, conduct it in the clinical departments and bring it to the Department of Biochemistry and Microbiology, Ninh Thuan Provincial General Hospital.

Specimens: All positive bacterial results were isolated from specimens taken from infections of patients treated at departments in the Ninh Thuan Provincial General Hospital.

Test technique: According to Kirby-Bauer technique or on BD Phoenix 100 bacterial identification and antibiogram machine.

Data processing and analysis

- Data collection: Data were entered using Epidata 3.1 software

- Data analysis: Using Stata 14.0 software and descriptive statistical methods.

RESULTS AND DISCUSSIONS

Table 1. Percentage of samples with pathogenic bacteria isolated

Model number	n	Ratio (%)
Positive	988	99.5
Negative	05	0.5
Total	993	

Comment: During the research period, there were 993 specimens designated for culture, of which the number of positive and negative samples were 988 (99.5%), and 05 (0.5%), respectively.

Table 2. Distribution of pathogenic bacteria isolated from various specimens

Specimens	n	Ratio (%)
Pus	317	32.1
Phlegm	234	23.7
Urine	249	25.2

Specimens	n	Ratio (%)
Blood	88	8.9
Pandemic	100	10.1
Total	988	

Comment: Through the research process, the number of pus specimens was 317, accounting for the highest rate of 32,1%, urine (25.2%), blood (23.7%), fluid (10.1%), blood (8.9%).

Our research results are similar to studies by authors Pham Hoang Yen at Hanoi French-Vietnamese Hospital from November 2014 to October 2016, when bacterial specimens were tested for antibiotics. Pus samples account for 10%, urine accounts for 30%, vaginal fluid accounts for 33%, stool accounts for 11%, Ear, Hat and Throat accounts for 8%, other specimens are 8%¹¹; Nguyen Si Tuan from December 2011 to May 2013 at Thong Nhat Dong Nai General Hospital isolated 1,978 specimens positive for bacteria (accounting for 38.36%) compared to the total number of samples sent for culture of 5.156 samples. Pus and sputum are the two types of specimens with the highest positive culture rate among the types of specimens isolated⁹.

Table 3. Total number of bacteria isolated

Bacteria	n	Ratio (%)
Gram-negative bacteria	751	76.0
Gram-positive bacteria	237	24.0
Total	988	100

The number of Gram-negative bacteria bacteria accounts for 76%, Gram-positive bacteria accounts for 24%.

Our research results are similar to those of Chu Thi Hai Yen in 2014 at Trung Vuong Emergency Hospital, where 2,475 samples of bacterial identification and antibiogram results were collected from 1.165 patients. Survey, in which gram-negative bacteria are 3.3 times more than gram-positive bacteria¹⁰.

Thus, the number of gram-negative bacteria in clinical specimens that cause disease in patients is the majority.

Table 4. Percentage of bacteria isolated from clinical specimens

Bacteria	n	Ratio (%)
<i>Escherichia coli</i>	324	32.8
<i>Staphylococcus aureus</i>	157	15.9
<i>Acinetobacter</i> spp.	98	9.9
<i>Klebsiella</i> spp.	177	17.9
<i>Enterococcus</i> spp.	29	2.9
<i>Proteus</i> spp.	70	7.1
<i>Pseudomonas aeruginosae</i>	79	8.0
<i>Enterobacter</i> spp.	3	0.3
<i>Streptococcus pneumoniae</i>	7	0.7
<i>Staphylococcus coagulase negative</i>	44	4.5
Total	988	



Among all types of isolated specimens, *Escherichia coli* bacteria numbered 324, accounting for the highest proportion of 32,8%, *Klebsiella spp.* (17.9%), *Staphylococcus aureus* (15.9%), *Acinetobacter spp.* (9.9%), *Pseudomonas aeruginosae* (8.0%), *Proteus spp.* (7.1%), *Staphylococcus coagulase negative* (4.5%), *Enterococcus spp.* (2.9%), *Streptococcus pneumoniae* (0.7%), *Enterobacter spp.* (0.3%).

Our research results are similar to the research results of Pham Hoang Yen at Hanoi French-Vietnamese Hospital from November 2014 to October 2016, the proportion of bacteria isolated from all types Specimens: *Escherichia coli* isolated 711 strains, accounting for 33%, *Streptococcus* group B was 476 strains, accounting for 22.1%, *Staphylococcus aureus* was 261 strains (12.1%), *Streptococcus* group D was 185 strains (8.6%), *E. Cloacae* is 113 strains (5.2%), *H. influenzae* is 74 strains (3.4%), others are 337 strains (15.6%)¹¹.

As analyzed above, it proves that *Escherichia coli* strains account for the highest proportion among bacterial strains isolated from all types of clinical specimens.

Table 5. Antibiotic resistance rate of *Escherichia coli*

Antibiotic	n	R	Ratio (%)
Ampicilin	219	209	95.4
Bactrim	168	152	90.5
Tetracycline	260	197	75.8
Ciprofloxacin	77	48	62.3
Cefuroxime	91	69	75.8
Levofloxacin	257	153	59.5
Ceftriaxone	156	94	60.3
Cefotaxim	236	155	65.7
Ceftazidime	210	130	61.9
Tobramycin	182	77	42.3
Gentamycin	218	91	41.7
Cefepime	192	95	49.5
Ampicilin-Sulbactam	198	30	15.2
Piperracillin-Tazobactam	233	11	4.7
Amikacin	211	13	6.2
Imipenem	242	0	0.0

Escherichia coli bacteria are resistant to ampicillin (95.4%), bactrim (90.5%), tetracycline (75.8%), cefotaxime (65.7%), ciprofloxacin (62.3%), ceftazidime (61, 9%), ceftriaxone (60.3%), levofloxacin (59.5%), cefepime (49.5%), tobramycin (42.3%), gentamycin (41.7%), ampicillin-sulbactam (15.2%), amikacin (6.2%), piperracillin-tazobactam (4.7%).

Our research results are similar to the research results of authors Van Bich and colleagues in 2008, a total of 106 *E. coli* strains were studied, including 75 strains from feces and 31 strains from diseases. other products such as urine, bile, and blood. As a result, the majority of *Escherichia coli* has a high resistance rate to commonly used antibiotics, only remaining sensitive to amikacine, netilmicine, imienem and piperatazobactam³; Nguyen Si Tuan and colleagues (2013), at Dong Nai General Hospital, *Escherichia coli* showed resistance to carbapenem (1 - 6%). Antibiotics that are still sensitive to over 90%: aminoglycoside, piperacilline/tazobactam and cephalperazone/sulbactam, carbapenem⁹.

Table 6. Antibiotic resistance rate of *Staphylococcus aureus*

Antibiotic	n	R	Ratio (%)
Penicillin	115	111	96.5
Erythromycin	118	110	93.2
Clindamycin	117	109	93.2
Azithromycin	93	87	93.5
Bactrim	92	69	75.0
Cefoxitin	44	28	63.6
Oxacillin	116	95	81.9
Tetracycline	89	47	52.8
Tobramycin	1	0	0.0
Gentamycin	90	44	48.9
Doxycycline	108	26	24.1
Ciprofloxacin	109	30	27.5
Levofloxacin	90	23	25.6
Teicoplanin	117	14	12.0
Linezolid	114	4	3.5
Vancomycin*	114	0	0.0

Staphylococcus aureus bacteria are resistant to penicillin (96.5%), azithromycin (93.5%), erythromycin (93.2%), clindamycin (93.2%), oxacillin (81.9%), bactrim (75.0%), cefoxitin (63.6%), tetracycline (52.8%), gentamycin (48.9%), ciprofloxacin (27.5%), levofloxacin (25.6%), teicoplanin (12.0%), linezolid (3.5%).

Our research results are similar to the research results of authors Nguyen Huu An, a study with 143 *S. aureus* strains on the antibiotic resistance rate of *S. aureus* in 4,299 clinical specimens, isolated in Vietnam. Department of Microbiology, LAM Department of Pasteur Institute of Ho Chi Minh City, results show that the resistance rate of *S. aureus* to antibiotics is 93.7% with penicilline G, 65.0% with erythromycine, 60.8% with kanamycine, 58% with clindamycine. The rate of MRSA is 39.2% and MSSA is 60.8%¹; Pham Hoang Yen (2014), at Hanoi French-Vietnamese Hospital, *Staphylococcus aureus* was well sensitive to most tested antibiotics, except erythromycin and clindamycin, which were highly resistant (71.5% and 55%)¹¹.

Table 7. The antibiotic resistance rate of *Acinetobacter spp.*

Antibiotic	n	R	Ratio (%)
Bactrim	39	36	92.3
Cefotaxime	33	33	100.0
Ceftriaxone	11	11	100.0
Ceftazidime	55	50	90.9
Imipenem	62	39	62.9
Ciprofloxacin	65	52	80.0



Antibiotic	n	R	Ratio (%)
Gentamycin	59	48	81.4
Levofloxacin	71	56	78.9
Cefepime	49	43	87.8
Tetracycline	72	61	84.7
Ampicilin-Sulbactam	49	12	24.5
Piperracillin-Tazobactam	65	50	76.9
Amikacin	54	38	70.4
Doxycycline	60	38	63.3

Bacteria *Acinetobacter spp.* resistant to cefotaxime (100%), ceftriaxone (100%), bactrim (92.3%), ceftazidime (90.9%), cefepime (87.8%), tetracycline (84.7%), gentamycin (81.4%), ciprofloxacin (80.0%), levofloxacin (78.9%), piperracillin-tazobactam (76.9%), amikacin (70.4%), doxycycline (63.3%), ampicillin-sulbactam (24.5%).

Our research results are similar to the research results of authors Chu Thi Hai Yen (2014), at Trung Vuong emergency hospital, *Acinetobacter baumannii* had the highest level of antibiotic resistance and with the majority of antibiotic resistance. Often used by birth. Imipenem has a resistance rate of 78%, only cefoperazone + sulbactam has a low resistance rate of 16%. There were no results of this bacteria's resistance to Colistin¹⁰; Nguyen Si Tuan (2013), at Dong Thong General Hospital, *Acinetobacter baumannii* is resistant to over 50% of most circulating antibiotics, except: lipopeptide group (0.63%); beta-lactam/sulbactam group (about 15 - 30%, ampicillin/sulbactam, cephaloperazone/sulbactam)⁹.

Acinetobacter spp. is resistant to most antibiotics currently used in hospitals.

Table 8. The antibiotic resistance rate of *Klebsiella spp.*

Antibiotic	n	R	Ratio (%)
Ampicilin	116	115	99.1
Bactrim	83	72	86.7
Tetracycline	143	95	66.4
Cefuroxime	64	40	62.5
Ceftriaxone	73	35	47.9
Cefotaxim	127	64	50.4
Ceftazidime	115	58	50.4
Levofloxacin	134	54	40.3
Ciprofloxacin	45	22	48.9
Tobramycin	96	44	45.8
Ampicilin-Sulbactam	98	55	56.1
Gentamycin	114	42	36.8
Cefepime	107	43	40.2
Piperracillin-Tazobactam	120	43	35.8

Antibiotic	n	R	Ratio (%)
Amikacin	111	25	22.5
Imipenem	130	23	17.7

The bacteria *Klebsiella spp.* resistant to ampicillin (99.1%), bactrim (86.7%), tetracycline (66.4%), cefuroxime (62.5%), ampicillin-sulbactam (56.1%), cefotaxime (50.4 %), ceftazidime (50.4%), ciprofloxacin (48.9%), ceftriaxone (47.9%), tobramycin (45.8%), levofloxacin (40.3%), cefepime (40.2%), gentamycin (36.8%), piperracillin-tazobactam (35.8%), amikacin (22.5%), imipenem (17.7%).

Our research results are similar to the research results of authors Nguyen Si Tuan (2013), at Dong Nai Thong Nhat General Hospital, *Klebsiella pneumoniae* appeared resistant to carbapenem (10 - 15%). Antibiotics are still susceptible from over 70% such as cefepime, piperacilline/tazobactam, cephaloperazone/sulbactam, carbapenem⁹; Pham Thi Hoai An (2014), *Klebsiella pneumoniae* was isolated on clinical specimens at the Pasteur Institute in Ho Chi Minh City. *Klebsiella pneumoniae* has resistance to most antibiotics, especially antibiotics of the penicillin group (AM: 94.29%), cephalosporins (CN: 62.86%, CAZ: 51.43%), carbarpenems (IMP: 2.86%; MEM: 2.86%)².

Table 9. The antibiotic resistance rate of *Enterococcus spp.*

Antibiotic	n	R	Ratio (%)
Tetracycline	14	12	85.7
Ciprofloxacin	13	6	46.2
Levofloxacin	13	5	38.5
Penicillin G	13	0	0.0
Ampicillin	14	2	14.3
Vancomycin	14	0	0.0
Linezolid	14	0	0.0
Teicoplanin	14	3	21.4

Bacteria *Enterococcus spp.* resistant to tetracycline (85.7%), ciprofloxacin (46.2%), levofloxacin (38.5%), teicoplanin (21.4%), ampicillin (14.3%).

Our research results are similar to the research results of authors Nguyen Si Tuan (2012), at Dong Nai Thong Nhat General Hospital, 72.23% of *Enterococcus spp.* strains are resistant to PEF and Gentamicin 120µg. 16.67% of *Enterococcus spp.* strains appear to be resistant to vancomycin⁹; Vu Ngoc Hieu at Bach Mai Hospital, the rate of *Enterococcus spp.* resistant and intermediate to gentamicin and chloamphenicol is quite high (both 57.1%)⁵.

Table 10. The antibiotic resistance rate of *Proteus spp.*

Antibiotic	n	R	Ratio (%)
Ampicilin	46	36	78.3
Bactrim	38	33	86.8
Tetracycline	59	56	94.9
Tobramycin	43	24	55.8



Antibiotic	n	R	Ratio (%)
Gentamycin	52	29	55.8
Ciprofloxacin	16	9	56.3
Levofloxacin	59	28	47.5
Cefotaxim	50	12	24.0
Ampicilin-Sulbactam	43	9	20.9
Cefuroxime	20	9	45.0
Ceftriaxone	37	7	18.9
Ceftazidime	48	13	27.1
Cefepime	43	9	20.9
Imipenem	55	3	5.5
Piperracillin-Tazobactam	55	3	5.5
Amikacin	45	5	11.1

Bacteria *Proteus spp.* resistant to tetracycline (94.9%), bactrim (86.8%), ampicillin (78.3%), ciprofloxacin (56.3%), tobramycin (55.8%), gentamycin (55.8%), levofloxacin (47.5%), cefuroxime (45.0%), ceftazidime (27.1%), cefotaxime (24.0%), ampicillin-sulbactam (20.9%), cefepime (20.9%), ceftriaxone (18.9%), amikacin (11.1%), imipenem (5.5%), piperracillin-tazobactam (5.5%).

Our research results are similar to the research results of author Dang My Huong (2010), at Thong Nhat Hospital in Ho Chi Minh City, *Proteus spp.*: for the fluoroquinolone group, the resistance rate (44% - 63%) higher than the cephalosporine group (8.53 - 31.82%), for the aminoglycoside group: amikacin is 18.18% more resistant to *E.coli* (12.08%) and *Klebsiella* (15.58%) strains. Good sensitivity to imipenem and meropenem⁴.

Table 11. Antibiotic resistance rate of *Pseudomonas aeruginosa*

Antibiotic	n	R	Ratio (%)
Ampicilin-Sulbactam	6	6	100.0
Cefotaxime	2	1	50.0
Ceftriaxone	4	3	75.0
Levofloxacin	45	14	31.1
Ciprofloxacin	49	17	34.7
Imipenem	44	14	31.8
Cefepime	44	19	43.2
Gentamycin	40	14	35.0
Ceftazidime	43	18	41.9
Amikacin	40	13	32.5
Piperracillin-Tazobactam	44	12	27.3

Pseudomonas aeruginosae bacteria are resistant to ampicillin-sulbactam (100%), ceftriaxone (75%), cefotaxime (50.0%), cefepime (43.2%), ceftazidime (41.9%), gentamycin (35.0%), ciprofloxacin (34.7%), amikacin (32.5%), imipenem (31.8%), levofloxacin (31.1%), piperracillin-tazobactam (27.3%).

Our research results are similar to the research results of authors Nguyen Si Tuan (2013), at Dong Thong General Hospital, *Pseudomonas aeruginosa* is resistant to over 40% of most circulating antibiotics. Except for the lipopeptide group (4.6%), piperacilline/tazobactam and cephaperazone/sulbactam (about 15 - 30%)⁹; Tran Minh Giang (2016), the rate of multiresistant *Pseudomonas aeruginosa* is 60%. Rate of *Pseudomonas aeruginosa* resistant to amikacin: 65.5%, ceftazidime: 72.4%, cefepime: 61.9%, ciprofloxacin: 80%, levofloxacin: 78.6%, piperacilin - tazobactam: 32.1%, imipenem: 79.3%, meropenem: 86.2%, cefoperazone - sulbactam: 60%. No case of colistin-resistant *Pseudomonas aeruginosa* has been recorded⁴.

CONCLUSIONS

The antibiotic sensitivity rate in departments in Ninh Thuan Provincial General Hospital is low and sensitivity tends to decrease during this period. Regarding antibiotic resistance characteristics, bacteria are highly resistant to many commonly used antibiotics. Especially, *Acinertobacter spp.* is the bacteria with the lowest antibiotic sensitivity rate among seven common bacterial strains at Ninh Thuan Provincial General Hospital.

RECOMMENDATION

We would like to maintain research on the antibiotic resistance situation of common bacteria in all clinical departments based on antimicrobial susceptibility testing to have the latest updated data to serve doctors who prescribe appropriate and effective antibiotics.

Towards research on methods to combat antibiotic resistance in pathogenic bacteria: Infection control measures, antibiotics with nanoparticles attached,... to increasingly meet the needs of treating infectious diseases. caused by drug-resistant bacteria.

REFERENCES

1. Nguyen Huu An, Tran Thi Tuyet Nga, Cao Huu Nghia, Vu Le Ngoc Lan (2013), Antibiotic resistance rate of *Staphylococcus aureus* in clinical samples at Pasteur Institute, City. Ho Chi Minh.

2. Pham Thi Hoai An, Vu Le Ngoc Lan, Uong Nguyen Duc Minh, Phan Ngoc Thao, Cao Huu Nghia (2014), Survey on antibiotic resistance of *Klebsiella Pneumoniae* on specimens isolated at the Pasteur Institute, Ho Chi Minh City .

3. Van Bich, Nguyen Su Minh Tuyet, Vo Thi Tra An, Nguyen Thanh Tung (2008), Survey on antibiotic resistance of *Escherichia Coli* at Gia Dinh People's Hospital.

4. Tran Minh Giang, Tran Van Ngoc (2015), Determining the antibiotic resistance rate of *Pseudomonas aeruginosa* causing ventilator-associated pneumonia and risk factors at Gia Dinh People's Hospital.

5. Vu Ngoc Hieu, Pham Hong Nhung (2017), Antibiotic resistance levels of some common bacteria causing skin and soft tissue infections in patients with isolated diabetes at Bach Mai Hospital.

6. Cao Minh Nga, Nguyen Thi Yen Chi, Vu Bao Chau & Nguyen Thanh Bao (2013), "Antibiotic resistance of *Klebsiella spp.* and ESBL-producing *E. coli* isolated at hospital 175", Medical Journal Ho Chi Minh City,17 (1)279-285.

7. Nguyen Hoang Thu Trang (2011), Characteristics of genes encoding extended-spectrum β -lactamase in some gram-negative bacteria and the risk of transmission via plasmids, Master's thesis in genetics, Ho Chi Minh City University of Natural Sciences Chi Minh.

8. Hanoi Medical University (2012), Clinical Pharmacology, Medical Publishing House, Hanoi.

9. Nguyen Si Tuan, Luu Tran Linh Da, Pham Van Dung, Nguyen Thuy Huong (2012), Research on antibiotic resistance models of pathogenic bacteria at Thong Nhat Dong Nai General Hospital.

10. Chu Thi Hai Yen, Pham Thi Huynh Giao, Nguyen Thi Hieu Hoa, Tran Ngoc Thao, Ho Thi Hoa (2014), Survey on antibiotic resistance rate of bacteria isolated at Trung Vuong Emergency Hospital.

11. Pham Hoang Yen, Ngo Thi Thi, Do Thi Minh Huyen, laboratory team of Vietnamese-French Hospital Hanoi (2016), Antibiotic resistance situation of common pathogenic bacterial strains isolated from patients came for examination and treatment at Hanoi French-Vietnamese Hospital from 11/2014 to 10/2016.