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Phenotypic Identification and Antibiotic Profile of *Proteus, Morganella* and *Providencia* Species Group (PMP) From Clinical Sources in Mosul/Iraq

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Abstract

THE *Proteus*, *Morganella* and *Providencia* (PMP) group is a distinct set of bacteria within the Enterobacteriaceae family. Out of (380) isolates from different clinical sources, isolation of PMP bacterial group depending on API 20E confirmatory test, Vitek-2 GN. Disc diffusion method & VITEK-2 compact system used to evaluate antibiotic susceptibility.The number of *Proteus mirabilis* which isolated from urine samples was(5.5% n=21), then from burn samples (2.3% n=9), pus &wound swabs was(1% n=4),stool (0.78 % n=3). *Proteus mirabilis* was the most commonly isolated species in PMP group at (9.7%) , while *Morganella morganii* was isolated from urine only at (2.1% n=8), *Providence stuartii* was isolated from stool and pus samples only at (0.5% n=2).. *Proteus mirabilis* exhibited resistance toward Ceftazidime (83.7%) Cefuroximea axetil, Nitrofurantion (81%,) Cefazolin, Trimethoprim-sulfamethoxazole (78%) Cefuroxime (75%,) Amoxicillin-Clavulanic acid, Ceftriaxone (70%) gentamicin Ciprofloxacin, (64,62%) Cefepime (59%), while sensitive toward Ertapime, Imipenem Meropenem, Amikacin, Erythromycin (71%, 65%, 60%,65% and 55%). While *Morganella morganii* shows resistance Amoxicillin-Clavulanic acid, Cefazolin, Cefuroxime, Cefuroxime axetil, Nitrofurantion at(100%), ceftazidime, Cefepime, (87%), Ceftriaxone, Ciprofloxacin(62.5%) and sensitive toward Ertapime, Amikacin Piperacillin-Tazobactam Erythromycin at (100%), Imipenem (62.5%), gentamcin(75%), Trimethoprim-sulfamethoxazole (62%) gentamicin (87%) . *Providence stuartii* shows high resistance to most antibiotic using in this study This resistance is may be due to its acquisition of resistance genes. The prevalence of infection in the PMP group due to longer hospital stays. Drug resistance was also more common in the PMP group.

Keywords: Enterobacteriaceae, *Proteus spp., Morganella spp.,* and *Providence spp.* antibiotic susceptibility.

Introduction

The Enterobacteriaceae are the most frequently encountered bacterial isolates from clinical specimens. soil, water, and plants [1].

This family are including many genera that have a clinical perspective. The three genera *Proteus, Morganella and Providence* presently comprise a total of ten species, all are gram-negative rods, motile, with peritrichous flagella and are assigned to this family on the basis on shared biochemical characteristics [2]. The genus Proteus is currently consists of five named species *P. mirabilis, P. penneri, P. vulgaris, P. myxofaciens, and P. hauseri* [3].

P. mirabilis is a common causative agent of a diversity of clinical infections such as Urinary Tract Infections (UTIs), wounds, burns, prostatitis, meningitis, otitis media, and rarely respiratory tract infections [4] It affects patients with anatomical abnormalities, immunodeficiency and urinary catheterization [5]. They are pleomorphic gram-negative bacilli, facultatively anaerobic, motile with swarming motility, have urease activity, do not usually ferment lactose, non-spore-forming, non-capsulated oxidase-negative, but catalase and

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nitrate are positive. *Proteus spp*. cause UTI, skin, and soft tissues due to their ability to create a variety of extracellular enzymes such as urease and phenylalanine deaminase. The genus *Morganella* belongs to the tribe Proteae of the same family and contains one species, *Morganella morganii*, with two subspecies, *morganii and sibonii*. They are facultative anaerobic Gram-negative enteric rod-shaped, commonly found in the environment and the intestinal tracts of humans, mammals and reptiles as normal flora. Despite its wide distribution, it is an uncommon cause of community-acquired infection and is most often encountered in postoperative, catheter - associated bacteria and other nosocomial settings [6]. *M. morganii* is urease and indole- positive, without swarming, citrate negative [7]. *Providencia* s*pp*., a widespread type of Gram-negative bacteria within the Enterobacteriaceae family, is often a harmful pathogen that can cause diarrhea and urinary tract infections in people. In some cases, they have also been found in severe infections like meningitis [8]. These bacteria are a natural part of the human gut bacteria, and some strains have had their genetic sequence analyzed as part of the Human Microbiome Project [9].

Providencia is a facultative anaerobic , with peritrichous flagella , *Providenca stuartii and P. rettger*i, are the most commonly associated with hospitalized infections [10] . The *Providencia* genus originally had six species, but is now known to have nine species including *P. alcalifaciens, P. rustigianii, P. stuartii, P. rettgeri, P. friedericiana, P. heimbachae, P. vermicola, P. sneebia, and P. thailandensis. Providencia* bacilli do not ferment lactose, but they are positive for methyl red and phenyl pyruvic acid tests. They are also positive for the phenylalanine deaminase test, but negative for lysine decarboxylase, ornithine decarboxylase, and arginine dihydrolase tests [11]. One common characteristic of *Providencia* species is their fruity smell. The existence of antibiotic resistance amongst *P. mirabilis* is isolated from patients in particular from the classes of β-lactam antibiotics and fluoroquinolones [12]. The bacteria have evolved ways to resist antibiotics by creating new genes that can be transferred through plasmids and other mobile genetic elements like transposons [13]. They use various methods to become resistant to multiple drugs, including altering the target sites of antibiotics, deactivating antibiotics with enzymes, expelling drugs through efflux mechanisms, and increasing mutation rates in response to stress [14]. *Morganella morganii* is often difficult to treat because it is naturally resistant to several antibiotics including glycopeptide, fusidic acid, macrolides, lincosamides, streptogramins, rifampicin, daptomycin, tetracyclines, colistin, and nitrofurantoin. Additionally, there is an increasing presence of extended-spectrum beta-lactamases, carbapenemase, and plasmid-mediated quinolone-resistance [15]. In this species, making the selection of antibiotics even more complicated . *Providencia spp*. resistant to multiple antimicrobials and exhibit Multi- Drug Resistance (MDR). Both *P. stuartii and P. rettger*i have shown resistance to a range of antimicrobial drugs, including gentamicin, Imipenem, polymyxin, tetracycline, nitrofurantoin, vancomycin, bacitracin, erythromycin, Novobiocin, and rifampin. These species are also capable of acquiring genes that confer resistance, such as aminoglycoside-modifying enzymes (AMEs), Extended Spectrum β-lactamases (ESBLs), and carbapenemase enzymes [16].

The current study aimed to isolate *Proteus spp., Morganella spp. and Providencia spp*. from clinically sources and identification according to essential Biochemical screening tests and confirmed to species level by API-20, Vitek-2 system and indicate their resistance to specific antibiotics in which were used in the treatment of PMP group..

Material and Methods

Study Population

Three hundred and eighty (380) specimens were collected urine (179) pus and swab wound (52), burns (91), stool (37), cerebrospinal fluid (10), Sputum (8), and Bone marrow (3) from Recumbent patients and out-patients who visited Ibn Sena hospital Mosul General Hospital, AL-Jamhoree hospital, Al-Salam teaching hospital, AL-Mosul center for burns and plastic surgery hospital in Mosul city/Iraq from 23th March to 30th September 2023. The majority of samples yielding non lactose fermentative Gram- negative bacteria (NLF -GNB), the isolates belonged to patients aged from (1–80) years. The samples were taken to the laboratory to isolate the PMP bacterial group using sterile equipment and media. They were streaked on selective media such as MacConkey's agar, blood agar, XLD agar, and Cetrimide agar for the identification of *Pseudomonas aeruginosa,* a bacterial species different from other NLF-GNB. The plates were then incubated at 37^{o} C for 24 hours, and the isolates were identified based on their Microscopical features using Gram stain to detect their response to stain, shape, and arrangement [17]. Morphological features on culture media, such as swarming on blood agar, non-lactose fermented growth on MacConkey's agar, and colorless growth on XLD agar, were also used to identify the PMP group. Additionally, several biochemical tests, including catalase, oxidase tests, Indole, MR-VP test, citrate utilization tests, Urea test, Motility test, gelatin liquefaction test, and Triple Sugar Iron agar test, were used for further identification of the PMP group.

phenylalanine deaminase test (PDA), Isolates other than PMP Group from various clinical samples were excluded from the study according to the diagnostic procedures [18]. and the diagnosis of bacterial samples has been enhanced according to API 20E [19] confirmatory test and Vitek GNI [20].

Antibiotic Susceptibility Testing (AST):

The Kirby Bauer disc method is used to assess antibiotic susceptibility on Muller Hinton Agar (MHA). Fresh bacterial cultures were prepared in MHA, and the concentration of bacterial cells was adjusting to (1×10^8) CFU/ml) compared with the first tube of McFarland. By using, the bacterial inoculum which was streaked on plates containing MHA the following antibiotic discs were used :AMC(30µg), CZA (30 µg) ,FEP (30 µg), CRO(30 µg), CFX(30 µg) ,CFXAxetil (30 µg), ETP(10 µg), MEM(10 µg), PTZ(100 µg/10 µg), AK(30 µg), CiP (10µg) CZ(30 µg), CN(10 µg), IMP(10 mg),), F(100µg),ATM(30 µg),SXT(25µg) **(**purchased from (Himedia, Mumbai, India, Bioanalyse, Turkey) discs were fixed on the plates and then incubated at37℃ for 24h, the results were recorded by the appearance of inhibition zones around the discs . The Clinical and Laboratory Standards Institute (CLSI) guidelines were interpreted the result (CLSI, 2023). Also isolates for drug susceptibility were analyzed using the Vitek-2 system(BioMerieux, France),(21).In this study we use disc diffusion classical and conventional phenotypic method still widely practiced as gold-standard**.**

Results

Bacterial isolation and Identification

A out of (380) clinical samples were collected from different clinical sources including urine (179), burn (91), wound & pus swabs (52), stool (37), C.S.F(10), sputum (8), bone marrow (3). The primary isolation and identification of different bacterial genera were done by growing on blood agar and MacConkey's agar to obtain bacterial species belonging to the PMP group, which all PMP groups were positive for Phenylalanine deaminase test (PDA). And can used to differentiate *Proteus spp., Providencia spp., and Morganella morganii from* other Enterobacteriaceae that have great importance in the taxonomy *of Proteus spp., Morganella morganii, and Providencia spp* The biochemical tests of the PMP group as shown in Table (1).

A total of (380), isolates belonging to the PMP group according to API20E, the VITEK 2 automated system (bioMerieux,France) were identified, *P. mirabilis* from urine was 21(5.52%), burn 9(2.36), pus& wound swab 4(1%), stool 3 (0.78%). was the most common pathogen, followed by *M. Morganii* from urine 8(2.1%) and *Providencia stuartii* from Pus& wound Swabs & stool 2(0.52%) as shown in Table 2). The majority of the isolates. were recovered from urine (16.20 %; n=179), followed by burn (9.8%; n=91) as shown in Table (2).

Antibiotics sensitivity test:

The results of antibiotic susceptibility showed that all isolates varied in their sensitivity as shown in Table (3) the high resistance rates were to Ceftazidime (83.7%), Cefuroxime axetil, Nitrofurantion (81%) Cefazolin and Trimethoprim (78%) Cefuroxime75%, Amoxicillin-Clavulanic acid, Ceftriaxone (70%), Gentamicin(62%) Ciprofloxacin, (64,62%). while sensitive toward Ertapime, Imipenem , Amikacin, Meropenem, Erythromycin, Piperacillin-Tazobactam, Cefepime, and (71%, 65%,65%,60%55%,84.6%), respectively were observed amongst *P. mirabilis* isolates as shown in table (3), whereas the *M. Morganii* show least resistance toAmoxicillin-Clavulanic acid, Cefazolin, Cefuroxime Cefuroxime axetil Nitrofurantion, (100%). Ceftazidime and Cefepime (87%), Ceftriaxone , Ciprofloxacin (62.5%) and show sensitive toward Ertapime, Amikacin Piperacillin-Tazobactam Erythromycin, Meropenem (100%), Cefepime (87%) , Imipenem (62.5%) ,Gentamicin (75%) , Trimethoprim-sulfamethoxazole (62%) as shown in table (5) and *Providence stuartii* shows high resistance to antibiotic Amoxicillin-Clavulanic acid, Cefazolin, gentamicin, Nitrofurantoin (100%) and less resistance Ceftriaxone, Imipenem Ciprofloxacin, Trimethoprim-sulfamethoxazole Erythromycin and sensitive to Ertapenem, Amikacin, Meropenem, Piperacillin-Tazobactam, Erythromycin(100%), Cefuroxime Axetil Ceftazidime Cefuroxime, Cefepime Amikacin as show in the Table (7).

Discussion

Members of the PMP group are inclusive, and great interest like other Enterobacteriaceae in the listing of gram-negative bacteria responsible for nosocomial infections especially from clinical specimens. They are opportunistic and may cause morbidity and motility [22]. In this study PMP bacterial group accounted for 47/380(12.36%) of all isolates.

The highest frequency of the PMP group was from urine samples with dominant of *P. mirabilis and M. morganii* followed by burn samples highlighting the clinical relevance of the PMP group as causative agents for UTIs. Proteae are more severe and have an increased risk of recurrence, complications, and pyelonephritis, especially for UTIs [23]. *Proteus mirabilis* has emerged as a significant cause of complicated urinary tract infections (UTIs) because of its ability to produce the enzyme urealyticum

biomineralization, which leads to the formation of alkaline urine and crystalline deposits. A study by [24] found that *P. mirabilis* was most commonly isolated from urine compared to other clinical samples, likely due to the bacteria's possession of virulence factors that contribute to UTI development, such as adherence capability, urease production, and flagella. The high percentage of local strains could be attributed to the broad capability of the *Proteus spp*. genus to invade tissues and surfaces of instruments. This, coupled with the indiscriminate use of antibiotics, has led to a rise in *Proteus spp*. infections and contamination of urinary catheters and other devices used in the area [25]. *Morganella morganii* was isolated from the urine a similar finding of (26) Out of 625 patients diagnosed with urinary tract infections (UTIs), only 11 cases tested positive for *M. morganii* in clean-catch midstream urine cultures. *M. morganii* was commonly identified as a cause of UTIs in adults. A study conducted in Turkey in 2020 found 11 cases of community-acquired UTIs caused by *M. Morganii* in urine cultures [27] . The reason why this bacteria, *M. morganii*, is less common in causing UTIs compared to other bacteria like *P. mirabilis* is primarily because *M. morganii* grows slowly and its urease cannot be stimulated to progress, which slows down its growth. (28). . Isolates of *Proteus mirabilis* from burns and wounds were in low percentage [29], that Bacteria rapidly colonize open skin wounds after burn Injuries can come from microorganisms that naturally exist on a patient's skin, in their gastrointestinal system, and in their respiratory system. *Proteus* spp. were found to be most dominant Gram-negative isolates in diabetic wounds. The lack of both presurgical prophylactic measures and education on the principles of asepsis for wound care may explain colonizing *Proteus* in wounds. These microorganisms can also be spread to a patient's skin by touching contaminated surfaces, water, objects, air, and the dirty hands of healthcare providers [15].

The present study also suggests that *P. mirabilis* was prevalently etiological agent for wounds and on the pus specimen's infections [30]. This study indicates that *P. mirabilis* was commonly responsible for wound and pus infections [29]. The prevalence of *P. mirabilis* infections was 2%, with the bacteria being predominantly found in 84.29% of pus samples. Pus is collected from infected wounds and can contain dead white blood cells and harmful bacteria [31]. The study by [11] identified *Providencia stuartii* isolates in samples taken from stool, pus, and wound swabs. The research specifically examined the presence of these opportunistic bacteria in patients with diarrhea, particularly children, as well as those with wound infections [32].

Antibiotics Sensitivity Test:

In the existing study, high rates of resistance were to Ceftazidime, CefuroximeAxetil, Nitrofurantoin, Cefazolin, Trimethoprim-sulfamethoxazole, Cefuroxime, Ceftriaxone Amoxicillin-Clavulanic acid, Gentamicin, Ciprofloxacin similar to the rates reported from [23]. This finding could be related to the indiscriminate use of these antibiotics for treatment of community-acquired UTIs. The resistant proportion toward Trimethoprim and Resistance antibiotics are mediated through barrier permeability exhibited by isolated strains [33] as resistance toward Amoxicillin/ Clavulanic acid due to the elevated level of -lactamase production as directly proportional to an increase in the resistance menace and frequent prescribing of this drug by physicians [34]. *P. mirabilis* displayed resistance to ertapenem and Imipenem [28]and in the present study it gave highest sensitivity rate against amikacin, Cefepime. which showed that aminoglycosides commonly used in the treatment of infections caused by *P. mirabilis* isolates also are still effective. In the current study, susceptibility tests showed that *M. morganii* isolates were highly susceptible to Aztreonam, piperacillin/Tazobactam, ertapenem, Meropenem, and Amikacin at 100%, and Trimethoprim-sulfamethoxazole at 62.5%. % [26], who found the same rate of sensitivity and high resistance toward Amoxicillin-Clavulanic acid, Cefazolin, Cefuroxime Cefuroxime Axetil Nitrofurantion, (100%). Ceftazidime and Cefepime (87%), Ceftriaxone , Ciprofloxacin 62.5% [35]. Discovered (36) that two *M. morganii* strains resistant to multiple drugs used to treat urinary tract infections were only susceptible to carbapenems, amikacin, and tigecycline. Additionally, they found that *M. morganii* showed resistance to most β-lactam antibiotics. Typically, *M. morganii* is susceptible to Aztreonam, aminoglycosides, third- and fourth-generation cephalosporins, carbapenems, quinolones, and trimethoprim / sulfamethoxazole.

Conclusion

The antibiotic pattern of *Providence stuartii* in the current study shows high resistance to antibiotic Amoxicillin-Clavulanic\acid, Cefazolin, Gentamcin, Nitrofurantoin (100%) Ceftriaxone, Imipenem Ciprofloxacin, Trimethoprim-sulfamethoxazole Erythromycin and sensitive to Ertapenem, Amikacin, Meropenem, Piperacillin-Tazobactam, Erythromycin Cefepime (100%),. This agrees with [32] that the majority of strains were Carbapenem-resistant *Providencia spp*. other studies find similar results. *P. stuartii* naturally produces AmpC beta-lactamase, making it resistant to penicillin and generation cephalosporins. In recent years, there has been a growing concern about *P. stuartii* as ESBL-producing and

Carbapenem-resistant strains have become more common [37]. While *P. stuartii* strains were susceptible to Cefepime and Imipenem [38], non-carbapenemase mechanisms often lead to Carbapenem resistance through increased production of AmpC, changes in outer membrane proteins, efflux pumps, and penicillin-binding proteins [39].

The prevalence of PMP group infections could be attributed to prolonged hospital stays and overcrowding. Drug resistance was also becoming more common in the PMP group. Merely relying on screening tests may not be enough to detect antibiotic resistance, so a dependable confirmatory test to identify resistance in this group is necessary if possible.

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TABLE 1. Conventional Biochemical Tests for Identification of PMP Group

Bacterial Species / Biochemical tests	*Proteus mirabilis*	*Morganella morganii*	*Providencia stuartii*
Indole	-	+	+
Methyl red test	+	+	+
Vogues Proskauer	-	-	-
Citrate utilization	**V**	-	+
Urease	+	+	-
H2S production	+	-	-
Phenylalanine deaminase	+	+	+
Gelatinase	-	-	-
Catalase	+	+	+
Oxidase	-	-	-
Lactose fermentation	-	-	-
sucrose fermentation	-	-	-
Glucose fermentation	+	+	+
D-mannitol fermentation	-	-	-
TSI test	**A/K gas +**	**A/K gas-**	**A/K gas-**
Nitrate Reduction	+	+	+

TABLE 2. Numbers and Percentages of PMP Bacterial Species

Bacterial Species	Number of bacteria	Source of isolation	Percentages of bacterial isolate%
Proteus mirabilis	21	Urine	5.52
Proteus mirabilis	9	Burns	2.36
Proteus mirabilis	4	Pus & wound swab	1
Proteus mirabilis	3	Stool	0.78
Providencia stuartii	2	Pus& wound Swabs &stool	0.52
Morganella morganii	8	Urine	2.1

TABLE 3. Number and Percentage of Resistance or Sensitivity of *Proteus mirabilis* by Kirby-Bauer Disc Diffusion Method

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of sensitive
1	**Amoxicillin-Clavulanic Acid**	26	70	11	30
2	**Piperacillin-Tazobactam**	17	45	20	55
3	**Cefazolin**	29	78	8	22
4	**Cefuroxime**	28	75	9	25
5	**CefuroximeAxetil**	30	81	7	19
6	**Ceftazidime**	31	83.7	16	16.3
7	**Ceftriaxone**	26	70	11	30

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of sensitive
8	**Cefepime**	19	51.3	18	48.6
9	**Ertapenem**	12	29	25	71
10	**Imipenem**	13	35	24	65
11	**Meropenem**	15	40	22	60
12	**Amikacin**	16	43	21	65.75
13	**Gentamicin**	23	62	14	38
14	**Ciprofloxacin**	24	64	13	36
15	**Nitrofurantoin**	30	81	7	19
16	**Trimethoprim-sulfamethoxazole**	29	78	8	22
17	**Erythromycin**	17	45	20	55

TABLE 4. Number and Percentage of Resistance or Sensitivity of *Proteus mirabilis* by Vitek-2

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of Sensitive
1	**Amoxicillin-Clavulanic Acid**	16	43	21	56.7
2	**Piperacillin-Tazobactam**	17	45	20	55
3	**Cefazolin**	29	78	6	22
4	**Cefuroxime**	28	75	7	25
5	**CefuroximeAxetil**	30	81	7	19
6	**Ceftazidime**	26	70	11	30
7	**Ceftriaxone**	26	70	11	30
8	**Cefepime**	19	51	18	49
9	**Ertapenem**	10	29	27	71
10	**Imipenem**	10	27	27	73
11	**Meropenem**	12	32	25	68
12	**Amikacin**	15	40	22	60
13	**Gentamicin**	18	48	19	52
14	**Ciprofloxacin**	24	64.5	13	35.5
15	**Nitrofurantoin**	31	83	6	17
16	**Trimethoprim-sulfamethoxazole**	31	81	6	19
17	**Erythromycin**	17	45	20	55

TABLE 5. Number and Percentage of Resistance or Sensitivity of *Morganella morganii* by Kirby-Bauer disc diffusion method

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of Sensitive
1	**Amoxicillin-Clavulanic Acid**	8	100	Zero	Zero
2	**Piperacillin-Tazobactam**	Zero	Zero	8	100
3	**Cefazolin**	8	100	Zero	Zero
4	**Cefuroxime**	8	100	Zero	Zero
5	**CefuroximeAxetil**	8	100	Zero	Zero
6	**Ceftazidime**	6	87.5	1	12.5
7	**Ceftriaxone**	5	62.5	3	37.5
8	**Cefepime**	1	12.5	7	87.5
9	**Erttapime**	Zero	Zero	8	100
10	**Imipenem**	3	37.5	5	62.5
11	**Meropenem**	1	12.5	7	87.5
12	**Amikacin**	Zero	Zero	8	100
13	**Gentamicin**	2	25	6	75
14	**Ciprofloxacin**	5	62.5	3	37.5
15	**Nitrofurantoin**	4	50	4	50
16	**Trimethoprim-sulfamethoxazole**	3	37.5	5	62.5
17	**Erythromycin**	Zero	Zero	8	100

TABLE 6. Number and Percentage of Resistance or Sensitivity of *Morganella morganii* by Vtek-2.

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of Sensitive
1	**Amoxicillin-Clavulanic Acid**	8	100	Zero	Zero
2	**Piperacillin-Tazobactam**	Zero	Zero	8	100
3	**Cefazolin**	8	100	Zero	Zero
4	**Cefuroxime**	8	100	Zero	Zero
5	**CefuroximeAxetil**	8	100	Zero	Zero
6	**Ceftazidime**	6	75	2	25
7	**Ceftriaxone**	5	62.5	3	37.5
8	**Cefepime**	1	12.5	7	87.5
9	**Erttapime**	1	12.5	7	87.5
10	**Imipenem**	7	87.5	1	12.5
11	**Meropenem**	Zero	Zero	8	100
12	**Amikacin**	Zero	Zero	8	100
13	**Gentamicin**	3	37.5	5	62.5
14	**Ciprofloxacin**	2	25	1	75
15	**Nitrofurantoin**	8	100	Zero	Zero
16	**Trimethoprim-sulfamethoxazole**	2	25	5	75
17	**Erythromycin**	Zero	Zero	8	100

TABLE 7. Number and Percentage of Resistance or Sensitivity of *Providencia stuartii* by Kirby-Bauer Disc Diffusion Method and by Vtek-2.

NO.	Antibiotics	Isolates of resistance	Percentage of resistance	Isolates of Sensitive	Percentage of Sensitive
1	**Amoxicillin-Clavulanic Acid**	2	100	Zero	Zero
2	**Piperacillin-Tazobactam**	Zero	Zero	2	100
3	**Cefazolin**	2	100	Zero	Zero
4	**Cefuroxime**	Zero	Zero	2	100
5	**CefuroximeAxetil**	Zero	Zero	2	100
6	**Ceftazidime**	Zero	Zero	2	100
7	**Ceftriaxone**	1	50	1	50
8	**Cefepime**	Zero	Zero	2	100
9	**Erttapime**	Zero	Zero	2	100
10	**Imipenem**	1	50	1	50
11	**Meropenem**	Zero	Zero	2	100
12	**Amikacin**	Zero	Zero	2	100
13	**Gentamicin**	2	100	Zero	Zero
14	**Ciprofloxacin**	1	50	1	50
15	**Nitrofurantoin**	2	100	Zero	Zero
16	**Trimethoprim-sulfamethoxazole**	1	50	1	50
17	**Erythromycin**	1	50	1	50

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التصنيف المظهري لمجموعة أنواع البروتيوس والمورغانيلا وبروفيدينسيا (PMP) من المصادر السريرية في الموصل-العراق

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الملخص

مجموعة Proteus و Morganellaو Providencia (PMP)هي مجموعة متميزة من البكتيريا الموجودة داخل عائلة البكتيريا المعوية. وهي مسبب شائع للعدوى المكتسبة من المستشفيات .من بين (380) عزلة من مصادر سريرية مختلفة بلغ عدد البروتيوس ميرابيليس التي عزلت من عينات البول (5.5%) ومن عينات الحروق (2.3%) ومسحات القيح والجروح. كانت (1%)، البراز (0.78%). كانت Proteus mirabilis أكثر الأنواع المعزولة شيوعاً في مجموعة PMP بنسبة (9.7%)، في حين تم عزل Morganella morganii من البول بنسبة (2.1%) فقط، وتم عزل Providence sturatii من عينات البراز والقيح بنسبة (0.5%) فقط.. Proteus mirabilis أظهرت مقاومة تجاه سيفتازيديم (83.7%) سيفوروكسيم أكسيتيل، نيتروفورانتيون (81%)، سيفازولين، تريميثوبريم-سلفاميثوكسازول (78%)، سيفوروكسيم (75%)، أموكسيسيلين-كلافولانيك أسيد، سيفترياكسون (70%) جنتامسين سيبروفلوكساسين، (62،64%). سيفيبيم (59%) بينما حساس تجاه إرتابيم وإيميبينيم وميروبينيم وأميكاسين وإريثرومايسين (71% و65% و60% و65% و55%). بينما تظهر المورغانيلا المورغانية مقاومة أموكسيسيلين- كلافولانيك أسيد، سيفازولين، سيفوروكسيم، سيفوروكسيم أكسيتيل، نيتروفورانتيون بنسبة (100%)، سيفتازيديم، سيفيبيم، (87%)، سيفترياكسون، سيبروفلوكساسين (62.5%) وحساسة للإرتابيم، أميكاسين بيبيراسيلين- تازوباكتام إريثروميسين عند (100%)، إيميبينيم (62.5%)، جنتامسين (75%)، تريميثوبريم- سلفاميثوكسازول (62%) جنتامسين (87%). يُظهر بروفيدنس ستوارتي مقاومة عالية لمعظم المضادات الحيوية المستخدمة في هذه الدراسة. قد تكون هذه المقاومة بسبب اكتسابه لجينات المقاومة. يمكن أن يعزى انتشار عدوى مجموعة PMP إلى الإقامة الطويلة في المستشفى. كما أصبحت مقاومة الأدوية أكثر شيوعًا في مجموعة PMP.

الكلمات المفتاحية: Enterobacteriaceae، Proteus spp.، Morganella spp.، Providence spp. حساسية المضادات.