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The prevalence of antibiotic resistance in hospital Tengku Ampuan Afzan

Sinan Mohammed Abdullah Al-Mahmood[1], Nur Hartikah Hidayah Abd.Rahim[2]
[1]Pharmacy college, Tikrit University, Salahuddin, Tikrit, 34001, Iraq
[2]Kulliyyah of Nursing, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

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*Corresponding author:
sinanpharmacy@tu.edu.iq

ABSTRACT

Background: Antibiotic resistance is seriously threatening hospitals and the community. Improper antibiotic usage might increase the possibility of antibiotic resistance occurring and be more challenging to treat. The prevalence of antibiotic resistance needs to be reviewed so; a better plan can be made to tackle the issue. However, the factors associated with it need to be explored to tackle the issues. Hopefully, this study's outcome could give healthcare providers some input to control the problems and understand antibiotic usage properly. **Objective:** This study aimed to identify the prevalence of antibiotic resistance in HTAA. Thus, identify common antibiotic-resistant bacteria and antibiotic resistance among them. **Methods:** The retrospective cohort study design was used to determine the prevalence of antibiotic resistance in HTAA. This study was conducted at the pathology laboratory of HTAA. All antibiotic-sensitive tests for 3707 patients were used and analysed using Microsoft Excel. **Results:** 3707 patients were infected, which are Klebsiella pneumonia (19.3%), Staphylococcus aureus (18.4%), Pseudomonas aeruginosa (16.3%), Streptococcus Group B (15.8%), Escherichia coli (15.2%), Staphylococcus coagulase negative (13.5%), and others. **Conclusion:** Findings of the study present that Penicillin has a higher resistance rate against Staphylococcus aureus, Klebsiella pneumonia, Escherichia coli, Staphylococcus coagulase-negative and Enterobacter aerogenes. Pseudomonas aeruginosa shows lower susceptibility against Carbapenem. Tetracycline has a high resistance rate to Streptococcus Group B and Enterococcus sp. Acinetobacter baumannii presents a higher resistance rate against most antibiotics except Polymixin B, but it has lower susceptibility against Proteus mirabilis.

INTRODUCTION

Infection commonly happens to anyone, but the causes of infection vary from viruses, parasites, bacteria or other microorganisms. However, to treat infection, it must come from the sources of infection. Antibiotics cannot be treated if the infection comes from viruses. The antibiotic is a treatment for bacterial infection only. Antibiotic resistance is possible if antibiotics are unnecessary (WHO, 2014). Over the years, the prevalence of antibiotic resistance dramatically increased (Laxminarayan, Duse, Wattal, Zaidi, Wertheim, Sumpradit, Vlieghe, Hara, Gould, Goossens, Greko, So, Bigdeli, Tomson, Woodhouse, Ombaka, Peralta, Qamar, Mir, Kariuki, Bhutta, Coates, Bergstrom, Wright, Brown & Cars, 2013). It is becoming a serious threat to the hospital, the community, and the country (Prasad & Smith, 2013). Antibiotic resistance is more difficult to treat, and their treatment is limited. Antibiotics used for that are more toxic and have severe side effects (Frieden, 2010). In addition, the percentages of mobility and mortality caused by antibiotic resistance have increased over the years (Dyar, Hoa, Trung, Phuc, Larsson, Chuc & Lundborg 2012). Thus, increasing the cost of the health care system and becoming a burden to them (Sikarwar & Batra, 2011). Common gram-negative antibiotic-resistant bacteria present at Gulf Corporation Council Country are Staphylococcus aureus, Enterococci, and Clostridium difficile, for gram-positive bacteria. However, Acinetobacter, Klebsiella pneumoniae, Pseudomonas aeruginosa and Escherichia coli were more dominant for gram-negative bacteria. (Aly & Balkhy, 2012). However, in Sanandaj, Iran, Serratia marcescens, Escherichia coli, Klebsiella pneumoniae, and Acinetobacter were more dominant for gram-negative bacteria (Soltani, Poorabbas, Miri & Mardaneh, 2016). Demographics for each state are different and affect each bacteria's survival rate. Then, the common bacteria found were different in every state or country. This affects the prevalence of antibiotic resistance. In addition, bacteria cannot only be resistant to one antibiotic, but some bacteria can be resistant to various antibiotics (Sikarwar & Batra, 2011). Many factors promote antibiotic resistance. Antibiotic resistance usually occurs by inappropriate or improper usage of antibiotics (Frieden, 2010). Inappropriate use of antibiotics can be caused antibiotics to be resistant, causing bacteria to change to adapt to the presence of antibiotics so that they can survive (Prasad & Smith, 2013). Another factor is the overuse of antibiotics. Overuse of antibiotics cannot help to treat infection, but worse, it can make the patients suffer from the side effects of antibiotics (European Centre for Disease Prevention and Control, 2014). Moreover, a lack of infection control practices can make the transmission of this microorganism easily affect other people (Aly & Balkhy, 2012). Hygiene plays an important role in reducing the transmission of these bacteria to other people. Improper hygiene care between health care providers and patients might increase the prevalence of transmitted antibiotic-resistant bacteria among them (Laxminarayan et al., 2013). The study on the majority of antibiotic resistance in this country is limited. So, the prevalence of antibiotic resistance needs to be reviewed; a better plan can be made to reduce the prevalence of antibiotic resistance and improve antibiotic usage. Therefore, the outcome of this study could give some input to healthcare providers, particularly to those nurses and physicians who get in touch with patients to control or reduce the prevalence of antibiotic resistance. Thus, they can optimise and correctly use antibiotics in effective ways. Moreover, nurses can also

provide health education to patients, either outpatients or inpatients, regarding the critical of using antibiotics correctly and getting antibiotics prescribed by physicians, not over the counter, to reduce the prevalence of antibiotic resistance. Hopefully, the government and healthcare providers can make strategies for improving antibiotic resistance plans. This study was conducted to identify the prevalence of antibiotic resistance among hospital settings, focusing on Hospital Tengku Ampuan Afzan (HTAA), Kuantan Pahang. Then, this study determined the common antibiotic-resistant bacteria in HTAA. Thus, identify the antibiotic resistance among common antibiotic-resistant bacteria in HTAA.

METHODS

Data source

The retrospective cohort study design was used throughout this study to determine the prevalence of antibiotic resistance. It was conducted at the main laboratory of Hospital Tengku Ampuan Afzan (HTAA), Kuantan Pahang. All antibiotic-sensitive tests were taken from the pathology lab records from HTAA and used in this study.

Study sample

This study used the universal sampling method. 3707 patients were identified as being infected by various types of bacteria. The research had been approved by Kulliyyah of the Nursing Research Committee (KNRC) and the International Islamic University Malaysia Research Ethics Committee (IREC). In addition, this research had been registered using National Medical Research Registration (NMRR) and has been approved by the Clinical Research Centre (CRC), Medical Research and Ethical Consideration (MREC) and Head of Pathology Laboratory of HTAA. The other ethical consideration considered in this study to protect patient confidentiality and privacy is that the data obtained from this study will be published only for knowledge purposes, and no personal information of the subject is taken and allowed. All data from the hospital are kept in Research Community Room (under lock and key) at International University Malaysia, and it will be destroyed after 3 years of study.

Statistical analysis

Microsoft Excel Worksheet 15 was used for data management and analysis throughout this research. The data was loaded on Microsoft Excel Worksheet 15 for descriptive statistics.

RESULTS

3707 patients were identified as infected by various types of bacterial infection. Table 1 presents the prevalence of patients infected by various kinds of bacteria among 3707 patients in HTAA. Patients commonly infected by Klebsiella pneumonia (714, 19.3%), Staphylococcus aureus (682, 18.4%), Pseudomonas aeruginosa (603, 16.3%), Streptococcus Group B (584, 15.8%), Escherichia coli (562, 15.2%), Staphylococcus coagulase negative (502, 13.5%), Acinetobacter baumannii (359, 9.7%), Enterococcus sp. (133, 3.6%), Enterobacter aerogenes (117, 3.2%) and Proteus mirabilis (99, 2.7%). Each bacteria undergoes an antibiotic-sensitive test to determine antibiotic resistance among them.

Table (1): Prevalence of antibiotic resistance bacteria (N=4355).

	Frequency (n)	Percentage (%)
Bacteria		
Staphylococcus aureus	682	15.7
Klebsiella pneumonia	714	16.4
Pseudomonas aeruginosa	603	13.9
Staphylococcus coagulase negative	502	11.5
Escherichia coli	562	12.9
Streptococcus Group B	584	13.4
Acinetobacter baumannii	359	8.2
Enterococcus sp.	133	3
Enterobacter aerogenes	117	2.7
Proteus mirabilis	99	2.3

Tables 2(a) and 2(b) present the resistance rate of antibiotics among common bacteria in HTAA. Staphylococcus aureus presents with the highest resistance rate against Penicillin (82.6%) and Ampicillin with 82.4%. However, Staphylococcus aureus shows a low resistant rate to Nitrofurantoin (0.3%), Rifampin (1.1%), Trimethoprim/Sulfamethoxazole (5.2%) and Gentamicin with 6.8%. In contrast, no resistance against Vancomycin can be seen. Klebsiella pneumonia presents with a high rate of resistance to Ampicillin (98.9%), Piperacillin (46.2%), followed by Cefuroxime (39%), Cefotaxime (38%), Ceftazidime (37.2%) and Trimethoprim/ Sulfamethoxazole with 37%. However, a low resistant rate was found against Polymixin B (1.7%), Imipenem (4.4%) and Meropenem (4.5%). Pseudomonas aeroginosa resistance was shown at a high rate against Meropenem (12.5%) and Imipenem (10.6%). However, the low resistant rate can be seen in Polymixin (0.6%), Amikacin (2.5%), Ciprofloxacin (3%) and Gentamicin (3.7%). Staphylococcus coagulase negative presents a high resistant rate against Ampicillin (83.2%), Penicillin G (83.1%), Oxacillin (65.9%), Erythromycin (57%) and Fusidic acid (52.1%). However, there is a low resistance rate against Vancomycin (0.3%) and Nitrofurantoin (3.8%). The resistance rate of Escherichia coli was found to be high against Ampicillin (69.4%), Piperacillin (60.7%), and Trimethoprim/Sulfamethoxazole (39.1%). However, low resistance rates were found for Polymixin B (0.2%), Ertapenem (0.6%), Amikacin (0.7%) and Piperacillin/Tazobactam (2.2%). There is no resistance of Escherichia coli shown to Imipenem and Meropenem. Streptococcus Group B was present resistant against

Tetracycline (65.5%), Clindamycin (6.4%), Erythromycin (5.8%), Ceftriaxone (0.9%), and Cefotaxime and Penicillin G with each rate is 0.2%. Most antibiotics tested present with a higher resistance rate against Acinetobacter baumannii, more than 55% of which are Chloramphenicol (96.3%), Cefotaxime (93.3%), Piperacillin (82.8%), Ceftazidime (78.3%), Meropenem (78.2%), Cefepime (78.1%), Ciprofloxacin (77.8%), Imipenem (77.8%), Piperacillin/Tazobactam (77.8%), Gentamicin (72.7%), Cefoperazone/ Sulbactam (71.9%), Amikacin (70.8%), and lastly, Trimethoprim/ Sulfamethoxazole (55.3%). However, Polymixin B is the only antibiotic with a lower resistance rate (0.2%). Enterococcus sp. were shown to be resistant to Linezolid (1.2%), Vancomycin (5.9%), Nitrofurantoin (10%), Gentamicin High (18.8%), Ampicillin (28.7%), Ciprofloxacin (56%) and lastly Tetracycline with 83.3%. Enterobacter aerogenes present a high resistance rate against Ampicillin (92.2%), Amoxicillin/ Clavulanic acid (90.2%) and Ampicillin/Sulbactam (46.1%). However, a low resistance rate can be seen against Polymixin B (0.8%), Imipenem and Ciprofloxacin with each antibiotic 1.4%, Amikacin (2.1%), Ertapenem (3.5%), Gentamicin (4.2%) and Cefepime (5.5%). Noresistance to Meropenem was present. Proteus mirabilis presents with a high resistance rate to Polymixin B (93.8%), Trimethoprim/ Sulfamethoxazole (57%), Chloramphenicol (55.7%) and Ampicillin (53.3%). However, a low resistance rate can be found against Amikacin and Ertapenem, with each of them is 0.8%, Meropenem at 2.5%. In addition, no resistance against Piperacillin/Tazobactam can be found.

Table 2(a): Antibiotic resistance prevalence of most frequently detected bacteria in HTAA.

Antibiotics	Antibiotic Resistance Bacteria												
	Staphylococcus aureus			*Klebsiella pneumoniae*			*Pseudomonas aeruginosa*			*Staph. coagulase-negative*			*E coli*	
	n	%R		n	%R		n	%R		n	%R		n	%R
Amikacin				1001	5.3		849	2.5					667	0.7
Amoxicillin/ Clavulanic acid				1001	33.5								667	24.0
Ampicillin	1013	82.4		996	98.9					680	83.2		661	69.4
Ampicillin/ Sulbactam													412	21.6
Cefepime							848	4.6					410	12.9
Cefoperazone/ Sulbactam							821	6.2					185	4.3
Cefotaxime				1000	38.0								666	27.6
Ceftazidime				1001	37.2		849	6.7					665	20.0
Cefuroxime				997	39.0								666	27.9
Chloramphenicol				840	15.6					37	16.2		409	19.1
Ciprofloxacin				998	24.7		836	3.0		38	34.2		666	24.0
Clindamycin	1022	12.5								697	42.5			
Ertapenem				986	5.7								663	0.6
Erythromycin	1022	15.6								698	57.0			
Fusidic Acid	1025	11.2								698	52.1			
Gentamicin	1025	6.8		1001	27.8		849	3.7		698	34.1		666	17.0
Imipenem				1001	4.4		848	10.6					666	0.0
Meropenem				1000	4.5		849	12.5					662	0.0
Nitrofurantoin	928	0.3								608	3.8			
Oxacillin	1024	13.8								698	65.9			
Penicillin G	1023	82.6								698	83.1			
Piperacillin				824	46.2								407	60.7
Piperecillin/ Tazobactam				843	21.0		848	5.2					413	2.2
Polymixin B				816	1.7		822	0.6					401	0.2
Rifampin	1023	1.1								697	17.5			
Trimethoprim/ Sulfamethoxazole	1023	5.2		1000	37.0					697	33.6		665	39.1
Vancomycin	1024	0.0								698	0.3			

Table 2(b): Antibiotic resistance prevalence of most frequently detected bacteria in HTAA.

ANTIBIOTICS	Antibiotic Resistance Bacteria												
	Streptococcus Group B			***Acinetobacter baumannii***			***Enterococcus sp.***			***Enterobacter aerogenes***			***Proteus mirabilis***	
	n	%R		n	%R		n	%R		n	%R		n	%R
Amikacin				479	70.8					143	2.1		121	0.8
Amoxicillin/ Clavulanic acid										143	90.2		121	23.1
Ampicillin							171	28.7		141	92.2		120	53.3
Ampicillin/ Sulbactam										128	46.1		97	20.6
Cefepime				479	78.1					127	5.5		97	4.1
Cefoperazone/ Sulbactam				469	71.9									
Cefotaxime	638	0.2		448	93.3					143	25.9		121	19
Ceftazidime				479	78.3					143	23.1		121	8.3
Ceftriaxone	637	0.9												
Cefuroxime										143	28		121	23.1
Chloramphenicol				428	96.3					128	15.6		97	55.7
Ciprofloxacin				477	77.8		50	56		143	1.4		121	17.4
Clindamycin	638	6.4												
Ertapenem										143	3.5		121	0.8
Erythromycin	638	5.8												
Gentamicin				479	72.7					143	4.2		121	18.2
Gentamicin High							170	18.8						
Imipenem				477	77.8					143	1.4		121	10.7
Linezolid							168	1.2						
Meropenem				478	78.2					143	0.0		121	2.5
Nitrofurantoin							50	10.0						
Penicillin G	637	0.2												
Piperacillin				476	82.8					128	27.3		92	16.3
Piperecillin/ Tazobactam				478	77.8					128	10.9		98	0.0
Polymixin B				466	0.2					123	0.8		97	93.8
Tetracycline	631	65.5					48	83.3						
Trimethoperin/ Sulfamethoxazole				447	55.3					142	14.8		121	57.0
Vancomycin							170	5.9						

DISCUSSION

The study was conducted at HTAA, one of Pahang's general and government hospitals. The common dominant antibiotic-resistant bacteria present were Klebsiella pneumoniae (19.3%), Staphylococcus aureus (18.4%), Pseudomonas aeruginosa (16.3%), and others. However, Enterococcus sp. were more dominant in US hospitals, followed by Staphylococcus aureus and others (Edelsberg, Weycker, Barron, Li, Wu, Oster, Badre, Langeberg & Weber. 2014). Escherichia coli was more dominant in Gulf Corporation Council countries, followed by Klebsiella pneumoniae and Pseudomonas aureus. (Aly & Balkhy,

2012). Demographics for each state are different and thus effected the survival rate of each bacteria. Thus, make the rate of bacteria was different in every place. Penicillin resistance presents a high rate (13.5%-82.6%) against Staphylococcus aureus. The same pattern can be seen in Turkey (Koziol-Montewka, Szczepanik, Baranowicz, Jozwiak, Ksiazek & Kaczor, 2006). Methicillin-resistant against Staphylococcus aureus is common in hospitals (Raghunath, 2008). So, it is unsurprising that the resistance rate against penicillins is higher. The combination antibiotic, Trimethoprim/ Sulfamethoxazole, used to treat Staphylococcus aureus demonstrated a low resistance rate (5.2%) in this study and in US hospitals worldwide, 3.1%-3.6% (Edelsberg, 2014). The effectiveness is still relevant. However, no resistance was seen in Vancomycin. In some countries, Vancomycin resistance is low. However, the scenario can alter when antibiotics are misused (Raghunath, 2008). So, it is recommended to use it for infection caused by multidrug-resistant Staphylococcus aureus as a last resort (Koziol-Montewka et al., 2006). The lack of an infection control program and the ineffectiveness of antibiotic usage are possible reasons for increasing antibiotic resistance. This opinion remains relevant (Udobi, Obajuluwa & Onaolapo, 2013). Klebsiella pneumonia presents with higher resistance against Penicillins. Raghunath (2008) mentions that Beta-lactam antibiotics, mostly penicillin, develop resistance against gram-negative bacteria. So, it is not surprising that the resistance rate is higher. It is becoming a healthcare provider concern regarding the increasing resistance rate of Beta-lactam antibiotics. Cephalosporin resistance in this study is higher than in US hospitals (Edelsberg et al., 2014). This study is consistent in India (Raghunath, 2008). Cephalosporin has been used widely for the treatment of Klebsiella infection. Sikarwar & Batra (2011) mention that Quinolones, Amikacin, and Gentamicin were highly susceptibilities against Klebsiella pneumonia. However, Quinolones and Gentamicin present a higher resistance rate in this study. The effectiveness against Klebsiella pneumoniae is reducing. In contrast, Carbapenem presents high susceptibility (>95%) against Klebsiella pneumonia. The same pattern was present in US hospitals (Edelsberg et al., 2014). The treatment of Klebsiella pneumoniae infection using Carbapenems is still effective. Pseudomonas aeroginosa presents a high resistance rate against Carbapenem antibiotics (10.6%-12.5%). However, Carbapenam, one of the Beta-lactam antibiotics still an effective treatment (Yayan, Ghebremedhin & Rasche. 2015). Aminoglycoside antibiotics (Gentamicin, 3.7% and Amikacin, 2.5%) still present in low resistance to Pseudomonas aeroginosa compared to others except for Polymixin B in present and other studies (Edelsberg et al., 2014). Polymixin B is highly susceptible (>99%) to treating infection caused by Pseudomonas aeroginosa. Moreover, in other research, Polymixin B is the only antibiotic that showed no resistance. However, Polymixin B can only be used as the last treatment due to its nephrotoxicity. Because of that, susceptibility testing should be indicated if the Polymixin B usage is considered (Hamzeh, Najjar & Mahfoud. 2012). Although the susceptibility of all tested antibiotics was high (>87%), the development of resistance still occurs. So, it is important to measure antibiotic use properly to control the rise of the resistance rate among Pseudomonas aeroginosa. Staphylococcus coagulase-negative bacteria are becoming a major concern because they can adapt easily to antibiotic stress in a short time (Koksal, Yasar & Samasti, 2006). Antibiotic use in treating Staphylococcus coagulase negative is almost the same as Staphylococcus aureus. Penicillin presents with high resistance to Staphylococcus coagulase negative. The same pattern can be seen in Staphylococcus aureus (Raghunath, 2008). It is not surprising that methicillin-resistant strains develop. In some cases, Methicillin resistance was

accompanied by a high resistance rate among other classes of antibiotics (Koziol-Montewka et al., 2006). Trimethoprim/Sulfamethoxazole is one of the alternative treatments against Staphylococcus coagulase-negative, and the resistance rate was high. It is becoming a healthcare concern (Koksal, Yasar & Samasti, 2009). Vancomycin presents with the highest susceptibility to Staphylococcus negative. The pattern can be changed if antibiotic usage and infection control policies are not followed appropriately. However, Vancomycin has been considered an antibiotic of last resort for multidrug-resistant staphylococci infections (Koziol-Montewka et al., 2006). It is not recommended to use if not necessary. Penicillin resistance presents at higher rates than other antibiotics in treating infections caused by Escherichia coli. Furthermore, the rate is consistent with worldwide rates of ampicillin-resistant (Bryce, Hay, Lane, Thornton, Wootton & Costelloe. 2016). The same pattern can be seen in Cephalosporins. Raghunath (2008) stated that Beta-lactam resistance is widespread, and most hospitals face it, especially in Escherichia coli and Klebsiella. Ciprofloxacin resistance presents at a high rate compared with the rate among children in Vietnam (Dyar et al., 2012). Surprisingly, Carbapenem, one of the beta-lactam antibiotics, presents with high susceptibility (>99%) against Escherichia coli. The effectiveness is higher compared with other antibiotics tested. In addition, Polymixin B also presents with high susceptibility. However, using it against Escherichia coli is less recommended due to the side effect of nephrotoxicity (Hamzeh, Najjar & Mahfoud, 2012). Tetracycline shows a high resistant rate against Streptococcus Group B. Cephalosporins and Penicillin present with high susceptibility (>99%), and they are an effective treatment for Streptococcus Group B. However, only some patients will proceed to treatment if an allergic reaction does not develop. Clindamycin and Erythromycin present 2nd and 3rd of highest resistance among Streptococcus Group B. show increasing in resistance rate for both antibiotics from 2000 until 2010 (Centers for Disease Control and Prevention, 2013). However, Clindamycin is recommended if the patient is allergic to penicillin. In contrast, Vancomycin is used to penicillin-allergic patients if the patient develops resistance to Clindamycin and Erythromycin (Capanna, Emonet, Cherkaoui, Irion, Schrenzel, Tejada, 2013). Acinetobacter baumannii presents a high resistance rate to most antibiotics tested compared to other bacteria. Beta-lactam antibiotics present a high resistant rate (>77.8%) among Acinetobacter baumannii. The resistance rate was different, which can be seen as high compared with the Edelsberg et al. (2014) study. Surprisingly, non-Beta-lactam antibiotic presents low susceptibility (<45%) against Acinetobacter baumannii. The same pattern for resistance can be seen in Hamzeh, Najjar, & Mahfoud's (2012) study. The improper use of antibiotics is becoming a pandemic in some countries, leading to an increasing resistance rate of antibiotics in the community. However, Polymixin B has a higher susceptibility (>99%) in treating infection caused by Acinetobacter baumannii. However, Polymixin B only can be used as the last treatment due to its nephrotoxicity and preserve resort (Hamzeh, Najjar & Mahfoud, 2012). The limitation and caution before using Polymixin B should be considered to preserve it. Enterococcus sp. presents with a high resistant rate against Tetracycline. It is consistent with the hospital in Algeria (Djahmi, Boutet-Dubois, Nedjai, Dekhil, Sotto & Lavigne, 2012). It presents that Tetracycline has less effectiveness against Enterococcus sp. In Algeria hospitals, penicillin is less effective against Enterococcus sp. and is consistent with HTAA (Djahmi et al., 2012). However, Vancomycin presents a low resistant rate against Enterococcus sp., contrasting it in Algeria and US hospitals (Edelsberg et al., 2014). It shows that Vancomycin is still effective against Enterococcus sp. in

HTAA. However, the prescription of Vancomycin needs to monitor to reduce the possibility of increasing the resistance rate against Enterococcus sp. (Raghunath, 2008). Linezolid shows high susceptibility against Enterococcus sp. The effectiveness of Linezolid is consistent in Algeria. (Djahmi et. al., 2012). Penicillins and Cephalosporins present with a high resistant rate against Enterobacter aerogenes. The Beta-lactam resistance occurred in Enterobacter sp due to its ability to develop a resistant mechanism (cited in Davin-Regli & Pagès, 2015). The same pattern can be seen in US hospitals. In contrast, Carbapenem shows high susceptibility (>98%) against Enterobacter aerogenes. This is consistent with US hospitals (Edelsberg et al., 2014). However, Carbapenem is one of the Beta-lactam antibiotics, resistant and occurs at a low rate. It shows that Carbapenems are an effective treatment against Enterobacter aerogenes (Davin-Regli & Pagès, 2015). Aminoglycoside, Polymixin B, and Quinolone are highly susceptible to treating infection caused by Enterobacter aerogenes. However, due to Polymixin B present with nephrotoxicity, it is least recommended to prescribe for infection caused by Enterobacter aerogenes (Hamzeh, Najjar & Mahfoud. 2012). Proteus mirabilis present high resistant rate to Polymixin B. It contrasts with other bacteria with a low resistance to Polymixin B (Hamzeh, Najjar, & Mahfoud, 2012). Thus, effectiveness is decreasing. No resistance rate shows in Piperacillin/Tazobactam against this bacteria and its effectiveness for treatment. Carbapenems present a lower resistance rate (0.8%-10.7%) against Proteus mirabilis. It describes that Carbapenems are still effective against Proteus Mirabilis. Cephalosporins show different rate when Taiwan present with higher susceptibility compared to this study. It contrasts with Gentamicin which describes lower resistance rates than Taiwan (Wang, Chen, Chang, Shiau, Wang, Lai, Huang, Tan, Lauderdale, & TSAR Hospitals, 2014). It might be due to the consumption status of certain antibiotics within that year.

CONCLUSION

This study found that Penicillin presents a higher resistance rate against Staphylococcus aureus, Klebsiella pneumonia, Escherichia coli, Staphylococcus coagulase-negative and Enterobacter aerogenes. This is becoming our concern because Penicillin is one of the antibiotics used for treatment against Gram-positive and negative bacteria. In addition, Pseudomonas aeruginosa presents lower susceptibility against Carbapenem, which is in the same class as Penicillin and beta-lactam antibiotics. Tetracycline resistance presents a high rate among Streptococcus Group B and Enterococcus sp. Acinetobacter baumannii infection might cause problems because most antibiotic use has a higher resistance rate except for Polymixin B. However, Polymixin B shows lower susceptibility against Proteus mirabilis. This study found that each bacteria has a different antibiotic resistance rate. The data provide information on antibiotic resistance patterns in one of the general hospitals at Pahang. The antibiotic usage plan and infection control policies must be enhanced, improved and followed in tackling the issue. Moreover, knowledge on the proper use of antibiotics among the public must be given to increase awareness of antibiotic resistance and thus control it. However, this study only focused on antibiotic resistance among 10 common bacterial infections. Other bacterial infections that cause antibiotic resistance were not stated. This study was conducted at one of the general hospitals in Pahang. The result only represents part of the hospital setting in a district or state in Pahang and Malaysia. In addition, the demographic data were not included in this study. So, the prevalence of antibiotic resistance based on gender and age is unknown.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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