Original Research Article

PREVALENCE OF MULTI-DRUG RESISTANT ORGANISMS IN PRIMARY HEALTH CARE PHCC, HEALTH CENTERS IN QATAR (2019-2021)

ABSTRACT

Inappropriate use of anti-microbials is the most contributive factor to the development of multi-resistant organisms among the public. Additionally, the health care facilities are prominently infectious environment that can significantly contribute to a substantial number of morbidities and mortalities when compared to other industries.

This descriptive retrospective study sampled 1,522 laboratory confirmed cases of Multi-Drug Resistant Organism (MDRO) which were obtained from the total culture in the 28 Health Centers of Primary Health Care Corporation (PHCC) from 2019 to 2021. Ethical approval was gotten from the Research department and Ethical committee of the Primary Health Care Corporation prior to commencement of the study. Data obtained were cleaned, verified, and analyzed using Microsoft excel software.
The prevalence of MDRO in this study is 1.35% with an incident rate of 99 cases per 100,000 population. ESBL is the most occurring organism representing 87.5% of the sample. The rate of resistant organisms was highest among adults 25-59 years with 77.5% of the total sample. Females were more affected than men (F, 87% : M, 13%). The burden was higher among educated professionals with 611 cases covering about (40%) of the total sample. Cases with chronic kidney disease, Diabetes and chronic lung diseases were most affected by MDROs.

There was a significance prevalence of Multi-Drug Resistant Organism among the PHCC served population with a high percentage among adults vising the health centers. This study identified ESBL of which is mostly E.coli and MRSA to be the most prevalent organisms causing resistant to the population sampled. Chronic kidney disease and diabetes were also identified to be mostly affected. These findings call for the prompt necessity in developing and evaluation of nationwide antibiotic policy and guidelines, monitoring and evaluation of these guidelines, public health awareness which is essential in this time due to the increasing resistance patterns.

In addition, it calls for developing and routine update of the National antibiogram database which will improve the knowledge of antimicrobial resistance patterns in Qatar, identify new resistant patter and will also help to improve treatment strategies based on unit-specific data.

Keywords: *Antimicrobials, co-morbidities, prevalence, MDRO, Community-acquired infections.*

1. INTRODUCTION

1.1. Background of Study

Certain infectious organisms have developed resistant to one or more prescribed treatment regimen and is posing an elevated risk among the HCW and the public also. These organisms which has developed resistant to one or more antimicrobial is termed “Multi-Drug Resistant Organisms” (MDROs).

Inappropriate use of anti-microbials is the most contributive factor to the development of multi-resistant organisms among the public. Additionally, the health care facilities are prominently infectious environment that can significantly contribute to a substantial number of morbidities and mortalities when compared to other industries.

Based on increased urbanization and modernization, health care sector has continuously experienced expansion and has boomed with activities including surgical procedures, vaccination programs, physiotherapy, and rehabilitation services etc. Health Care Workers are however key players in any given health care sector because they are critically involved in prevention and treatment services. (Ajai, 2015).

Due to the increased demand on health care due to various disease outbreak and re-emergence of various diseases, there is increased burden in the health care sector which has contributed to an increase in Hospital Acquired infections, specifically the spread of microbial agent. Factors that lead to the development of Anti-Microbial Resistance among the populace include misuse of antimicrobial and exposure to nosocomial infections due to poor adherence to standard precautions and, poor disinfection of medical equipment.

Similarly, with the recent outbreak of severe acute respiratory syndrome across the globe, the rate of hospitalization increased drastically, and this has placed huge burden among the health care workers, reducing their care coverage abilities as there is higher number of patients requiring attention. Such situation gives rise to neglect or forgetfulness in the appropriate use of personal protective equipment and the application proper hand hygiene by the health care workers; this can lead to the spread of infections from the HCW to the patient, from the HCW to the environment , from the environment to the patient and from the patient to the HCW subsequently (Al-Tonbary, 2011)

1.2. Statement of Problem

The wide use of antibiotics in community and healthcare setting has led to the emergence of resistant pathogens (Spellberg, 2008; Heuer, 2009). For infections caused by multidrug-resistant organisms (MDROs), effective treatment is often limited, and this is associated with additional morbidity and mortality and increased medical costs (Founou, 2017). Patients colonized by MDRO are not only at substantial risk of infectious death but are also a threat to other patients, if not identified early.

Drug-resistant strains initially appeared in hospitals, where most antibiotics were being used,Sulfonamide-resistant Streptococcus pyogenes emerged in military hospitals in the 1930s, Penicillin-resistant Staphylococcus aureus confronted London civilian hospitals very soon after the introduction of penicillin in the 1940s, and similarly, Mycobacterium tuberculosis with resistance to streptomycin emerged in the community soon after the discovery of this antibiotic (Levy, S.B,1998).

The misuse of antibiotics has contributed to the growing problem of antibiotic resistance, which has become one of the most serious and growing threats to public health (CDC, 2017).

1.3 Study Justification

In Taiwan, the multicentred surveillance programs for MDROs observation in the hospitals had shown an increase in the prevalence of vancomycin-resistant enterococci (VRE) and carbapenem-resistant Gram-negative bacteria (Tseng, 2011). Prior studies reported that the colonization rate of methicillin-resistant Staphylococcus aureus (MRSA) was 3.8% and 7.8% among Taiwanese adults and children in the community, respectively (Wang, 2009; Chen, 2011).
Another study surveyed Escherichia coli from various sources in the community setting and found that the prevalence of extended-spectrum β-lactamases (ESBL)-producers increased from 4.0 to 10.7% within 8 years (Wang, 2015).
From the 382 articles in a registered systematic review in nine countries in the Arabian Peninsula, more than 50% (n = 453) of multidrug-resistant, microbe-associated mortality (n = 871) was due to MDR Acinetobacter baumannii, Mycobacterium tuberculosis and Staphylococcus aureus infection
In Qatar, researchers have done diverse studies to find a specific resistant organism circulating in Qatar and in different hospital settings, but this study has not given the general picture of the resistant organisms present among the community.
A search on Pub Med for 'multi drug resistant prevalence Qatar' resulted in nineteen articles. Eight studies were focused on different countries, 1 provided no access, 7 focused on secondary care or private institutions and 3 studied detailed MDRO cases in animals. Of the secondary care studies, 2 focused on specific diseases. Baiou, (2021) analyzed MDROs from clinically ill patients with COVID-19 whereby the most frequent species was stenotrophomas maltophial (24.5%).

It is evident that the majority of MDRO research were conducted in secondary or tertiary care facilities globally, with a lack of primary care involvement (Rodriguez-Vilodres, 2021; Burnham, Olsen and Kollef, 2019; Lancet, 2019).

Globally and locally, different studies have been done on the prevalence and pattern of Multi-Resistant Organisms in hospital setting. However, it is vital and paramount that we study the prevalence of these multi-drug resistant organisms in the Primary Health Care setting, as to ascertain and characterize the pattern of MDRO prevalent in the health centers.

This study will give us a clear and specific knowledge about the predominant and non-predominant resistant organisms obtainable in the community, bearing in mind that the Primary Health Care Centers are the first point of contact for Qatar population (expatriates and Qataris) and is therefore a representation of the whole community seeking health care in the country. The Primary Healthcare Centers serve as an important interface between community and secondary hospital care; the microbial ecology is often a combination of community and healthcare-associated organisms.

This study is critical to ascertain the prevalence of multi-Drug resistance organisms among PHCC served population receiving care in the PHCC healthcare centers from January 2019 to December 2021. To identify the most implicated organisms prevalent among the PHCC served population across the health centers, and in devising the most effective preventive measures and antimicrobial awareness

to maximize patient outcomes. Moreover, the impact and prevalence of antimicrobial drug resistance in Qatar Primary health care settings is uncertain.

1.4 Statement of Objectives

1.4.1 General Objective

To ascertain the prevalence of MDRO among PHCC served population receiving care in the PHCC health centers which can be used to create an intervention towards the prevention and reduction of MDRO prevalence.

1.4.2 Specific Objectives

1. To determine the prevalence of MDROs in PHCC health centers.
2. To identify the most occurring organisms among the PHCC served population in the health centers.
3. To ascertain factors associated with prevalence of MDROs PHCC facilities.
4. To identify the geographical trend of the MDRO by representing Health Centers.

2. LITERATURE REVIEW:

Resistance to multiple drugs was first detected among enteric bacteria—namely, Escherichia coli, Shigella and Salmonella—in the late 1950s to early 1960s (Crofton, J, 1984). Such strains posed severe clinical problems and cost lives, particularly in developing countries.

A retrospective case-controlled study in Australia evaluated the risk factors for the development of these bacterial infections. They determined that the greatest predictors of ESBL production were length of stay (LOS) prior to infection ($p < 0.0001$), exposure to antibiotics within the last six weeks ($p < 0.001$), recent return from travel abroad (particularly in Asia) ($p < 0.03$), admission to the ICU ($p < 0.001$), and finally, residence in a long-term care facility ($p > 0.001$) (Kiddee, 2019). These findings are consistent with similar literature. Research in a French ICU to determine predictive factors for the development of ESBL Gram-negative pathogens (GSB) infections during hospitalization additionally found male sex, age >75 years old, exposure to a third-generation cephalosporin or β-lactam in the prior three months, and colonization pressure of the unit were risk factors.

Finally, a one-year, prospective surveillance study of MDR GNB blood stream infections also identified male sex, older age (>60), and co-morbidity (Charlson score) to be independent risk factors for resistance. They additionally determined that some pathogens were more likely to develop resistance than others such as *Enterobacteriaceae* spp., which were positively associated with multi-drug resistance.

3.0 METHODOLOGY

3.1 Study Area

We conducted this study in the twenty-eight health Centers of the Primary Health Care Corporation PHCC Qatar as of 2021. The state of Qatar is a country in Western Asia. It occupies the Qatar Peninsula on the north-eastern coast of the Arabian Peninsula in the Middle East; it shares its sole land border with Saudi Arabia to the south, with the rest of its territory surrounded by the Persian Gulf. The Gulf of Bahrain, an inlet of the Persian Gulf, separates Qatar from nearby Bahrain. The capital is Doha, home to over 80% of the country's inhabitants, and the language is Arabic.

The State of Qatar took its first steps in establishing a primary health care system and started to provide healthcare services through a range of clinics as early as 1954. In 1978 the Ministry of Health developed a comprehensive scheme for building a primary health care system which was submitted to

the Council of Ministers and the scheme included the launching of primary health care services through 9 health centers, covering different parts of the country, and capable of providing basic and essential health and medical services (preventive and curative).

3.2 Study Design

This is a retrospective study which employed a descriptive, cross sectional study design.

3.3 Study Population

Male and female patients, who were assessed in the health center from January 2019 to December 2021.

3.3.1 Inclusion Criteria:

a) Registered patients at the PHCC health center.
b) Patient whose data are recorded in the medical records file via Cerner system.
c) All patients who were assessed in PHCC health centers.
d) Male and female at all ages

3.3.2 Exclusion Criteria:

a) Patients who have bacterial infection from food borne diseases.
b) Patients diagnosed with other bacterial infections which are not MDROs.

3.4 Sampling Method

- This study employed electronic data collection, where data was obtained from the health information Management unit of PHCC.
- This study will focus on the prevalent of laboratory confirmed resistant organisms identified by laboratory confirmation in PHCC from January 2019- December 2021.
- Variables relevant to the objectives were sent to HIM and these variables were filled and forwarded back to the research data analyst.
  To calculate the prevalence (x).

- We will obtain the total population of active registered patients per health center within the specified study period. (≠)
- We select data of all the patient whose samples were collected for the laboratory testing of microbials from January 2019 – December 2021 (μ)
- We then filter and select the number of confirmed isolates which are resistant to one or more classes of antimicrobial agents within the specified period of study. (π).

$$Prevalence\ (x) = \frac{Total\ No\ of\ MDROs\ during\ the\ study\ time\ (\pi)}{Total\ No\ active\ registered\ patient\ in\ PHCC\ during\ the\ study\ time(\neq)}$$

3.5 Instrument for Data Collection

An internet connected computer was utilized in the collection of data. A secured official email was used to transmit information between the research team and the health information managers.
There were certain variables designed and forwarded to the data management team.
These variables include demographic data of laboratory confirmed cases as recorded in the Cerner system.
The Cerner is a central health information system used in the state of Qatar for the collection of health data by various health sectors, including PHCC.

3.6 Data Analysis: Collected data was entered into MS Excel and analysis was done using pivot program. Data presentation was done using simple tables. Descriptive statistics used include frequencies and percentage.

3.7 Validity: To ensure accuracy of data, the data was cleaned and verified by the investigators, including the removal of any duplicate data before analyses.

To ensure the data collected is reliable, the data was checked by all researchers involved, twice and a pretest analysis and interpretation of data was done. Any data that does not meet our inclusion criteria was removed.

3.8 Ethical Considerations: Before undertaking this study, ethical clearance was gotten from the Research Department of the Primary Health Care Corporation and a copy of the ethical approval has been attached. There was no live participant enrolled for this study and so, no participant consent was required.

4.0 RESULTS

4.1 Presentation of Findings/Interpretation

This result is based on the data collected from the laboratory surveillance. A total of 112,813 cultures were requested for the 3-year period, and 1,522 cases of Multi-Drug Resistant Organism (MDRO) were obtained from the total culture in the 28 Health Centers of Primary Health Care Corporation (PHCC), from 2019 to 2021. With (547) MDRO cases occurring in 2019, and (444) cases in 2020, and additional (531) cases in 2021.

4.2 Socio-Demographic Characteristics of the Sample Population

Chart 1 Representation of Study Population by Gender 2019-2021 in PHCC

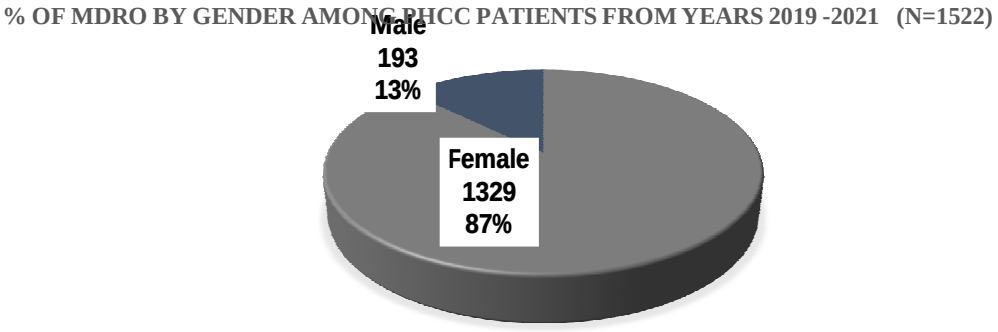

Chart 1 represents the gender of the population used for this study. Majority of cases with Multi-Drug Resistant Organisms were found among the female population with a proportion of 87% and lesser proportion among the male, with about 13%.

Chart 2 Distribution of MDRO by Gender from 2019-2021 (N=1522)

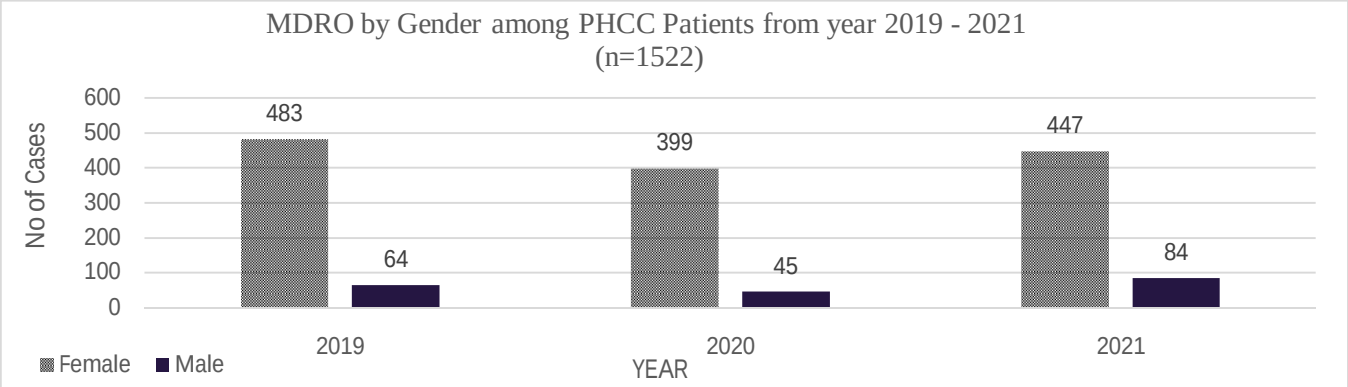

Chart 2 shows a major occurrence of MDROs among the female population more than the male for 3 consecutive years. The prevalence rate among females is 1.2% against males with 0.2%.

Table 1. Distribution of MDRO by Age from 2019-2021 (N=1522)

	2019		2020		2021		Grand Total	
Age (Years)	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
0-4	10	1.83%	7	1.58%	7	1.32%	24	1.58%
5-9	20	3.66%	9	2.03%	18	3.39%	47	3.09%
10-14	12	2.19%	9	2.03%	13	2.45%	34	2.23%
15-19	9	1.65%	7	1.58%	7	1.32%	23	1.51%
20-24	31	5.67%	15	3.38%	27	5.08%	73	4.80%
25-29	74	13.53%	49	11.04%	68	12.81%	191	12.55%
30-34	102	18.65%	79	17.79%	111	20.90%	292	19.19%
35-39	85	15.54%	67	15.09%	69	12.99%	221	14.52%
40-44	64	11.70%	30	6.76%	37	6.97%	131	8.61%
45-49	27	4.94%	25	5.63%	30	5.65%	82	5.39%
50-54	24	4.39%	16	3.60%	21	3.95%	61	4.01%
55-59	17	3.11%	24	5.41%	28	5.27%	69	4.53%
60 & above	72	13.16%	107	24.10%	95	17.89%	274	18.00%
Grand Total	**547**	**100%**	**444**	**100%**	**531**	**100%**	**1522**	**100%**

Table 1 above represent the age group of the studied population. MDRO affected 128 children covering (8.4%), young adults covered (51%), while adults and elderly covered a percent6age of 22.5% and 18% of the cases, respectively.

Table 2. Distribution of Occupation of the population (N=1522)

OCCUPATION	ESBL	MDRO	MRSA	N (%)	(%)
Clerical Support Workers	2		1	3	(0.2%)
Craft and Related Trades Workers	9		3	12	(0.8%)
Elementary Occupations	65		12	77	(5.1%)
Managers / Supervisors	32		3	35	(2.3%)
Plant and Machine Operators and Assemblers	86		19	105	(6.9%)
Professional	541	7	63	611	(40.1%)
Service and Sales workers	141		25	166	(10.9%)
Skilled Agriculture, Forestry and Fishery Workers	1		2	3	(0.2%)
Technicians and Associate Professionals	19		7	26	(1.7%)
Not assigned	66		7	73	(4.8%)
Wives, children, & students	369	6	36	411	(27.0%)
Grand Total	**1331**	**13**	**178**	**1522**	**(100%)**

ESBL-Extended-spectrum beta-lactamase; MDR – Multi-drug resistant; MRSA- Methicillin Resistant Staphylococcus aureus

Table 2 covers occupational history of the population being studied; The classification of the occupation category was based and coined from the International standard Classification of Occupation ICSO professional classification. This study was not able to obtain the complete details about the occupationcategorysince the system di notcapture these variable.A total of 1,449 occupations associated with MDRO cases were obtained for this study, with 73 missing occupation data for the population being study.The burden of MDRO can be seen among the professionals with 611 cases (40%), followed by Wives, children, and students with 411 cases (27%), Services and Sales workers with 166 cases (11%), Plant and machine operators with 105 cases (7%).

Table 3: The Distribution of MDROs By Region from 2019-2021 in PHCC (N=1522)

	Year 2019	Year 2020	Year 2021	Total (%)
Central Region	173 (31.63%)	177 (39.86%)	182 (34.27%)	**532 (35%)**
Northern Region	160 (29.25%)	107 (24.10%)	150 (28.25%)	**417 (27%)**
Western Region	214 (39.12%)	160 (36.04%)	199 (37.48%)	**573 (38%)**

Table 3 shows that Western Region has the highest number of MDROs with 573 laboratory confirmed cases representing about 38% of the total cases.

Table 4 Distribution of MDRO by Classifications (N=1522)

CLASSIFICATION	N	(%)
ESBL	1331	87.5
MRSA	178	11.7
MDR	13	0.9
Grand Total	**1522**	**100.0**

ESBL organisms recorded a greater distribution of 1331 (87.5%) out of the total 1,522 MDRO cases obtained. The frequency of occurrence of the organisms within the ESBL classification are more than half of the total cases being studied. Majority of the ESBL cases include Escherichia coli with 1,022 cases (77%), Klebsiella Pneumonia 195 cases (15%), and MRSA with 178 cases (1%).Currently, there are 28 health Centers under PHCC at the period of this study. The highest frequency of MDROs can be observed in Abubaker Siddiq Health Center with 113 cases (7.4%), followed by Al Thumamah Health Center 110(7.2%),

Leabaib Health Center 99(6.5%), Al Rayyan Health Center 99 cases (6.5%), Airport Health Center 81 cases (5.3%).

Chart 3 Proportion of MDROs Classifications (N=1522)

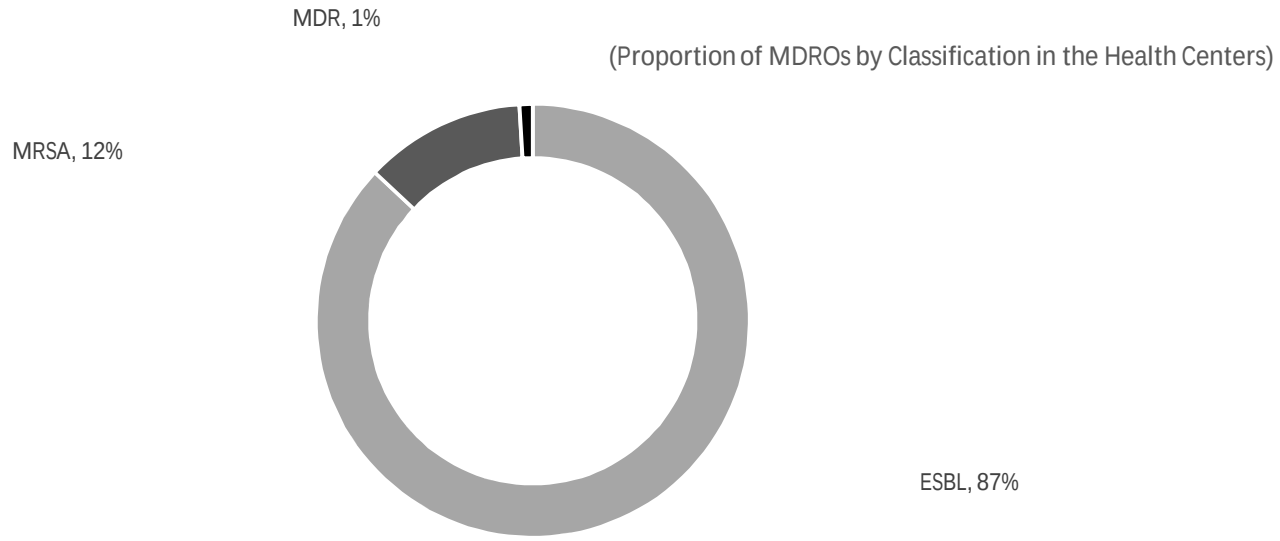

Chart 3 describes the distribution of isolated organisms by their classification. The highest occurrence can be found among the ESBL group representing about 87% of the total isolated organisms in the is study. This is followed by MRSA with 12% and 1% of other MDRO cases consisting of other organisms that are not classified in any of the group as per the classification of the antibiotic groups. These groups of MDROs which are not elsewhere classified are resistant to multiple antibiotics but are not producers of Beta-Lactamase.

Table 5 Distribution by Isolates and MDRO Classification (N=1522)

ESBL (EXTENDED SPECTRUM BETA LACTAMASE0	N	(%)
Escherichia coli-ESBL	1022	76.8
Klebsiella pneumoniae-ESBL	224	16.8
Escherichia coli-ESBL/Klebsiella pneumoniae-ESBL	26	2.0
Escherichia coli-ESBL /Streptococcus agalactiae	11	0.8
Pseudomonas aeruginosa-ESBL/Klebsiella pneumoniae-ESBL	5	0.4
Enterobacter cloacae-ESBL	5	0.4
Proteus mirabilis-ESBL	4	0.3
Klebsiella ozaenae-ESBL	3	0.2
Klebsiella pneumoniae-ESBL/Streptococcus agalactiae	3	0.2
Citrobacter koseri-ESBL	3	0.2
Escherichia coli-ESBL/Enterococcus faecalis	3	0.2
Klebsiella aerogenes-ESBL	2	0.2
Klebsiella pneumoniae/ESBL Enterococcus faecalis	2	0.2
Klebsiella pneumoniae-ESBL/Streptococcus agalactiae	2	0.2
Citrobacter freundii-ESBL	2	0.2
Escherichia coli-ESBL/Enterobacter cloacae	2	0.2

Escherichia coli-ESBL/Morganella morganii	2	0.2
Escherichia coli-ESBL/Staphylococcus aureus	2	0.2
Salmonella species, Group C1-ESBL	1	0.1
Serratia marcescens-ESBL/Klebsiella pneumoniae	1	0.1
Shigella boydii-ESBL	1	0.1
Shigella flexneri-ESBL	1	0.1
Shigella sonnei-ESBL	1	0.1
Citrobacter braakii-ESBL/Klebsiella pneumoniae	1	0.1
Citrobacter farmeri-ESBL	1	0.1
Citrobacter youngae-ESBL	1	0.1
Grant Total	**1331**	**100**

Isolates by MRSA Classification

MRSA (METHYCILLIN RESISTANT STAPHYLOCOCCUS AUREUS)	**N**	**(%)**
Staphylococcus aureus-MRSA/Achromobacter xylosoxidans	163	91.6
Staphylococcus aureus-MRSA/Pseudomonas aeruginosa	3	1.7
Staphylococcus aureus-MRSA/Aspergillus niger	2	1.1
Staphylococcus aureus-MRSA/Streptococcus agalactiae	2	1.1
Staphylococcus aureus-MRSA/Candida albicans	1	0.6
Staphylococcus aureus-MRSA	1	0.6
Staphylococcus aureus-MRSA /Candida parapsilosis	1	0.6
Staphylococcus aureus-MRSA /Escherichia coli	1	0.6
Staphylococcus aureus-MRSA /Stenotrophomonas maltophilia	1	0.6
Staphylococcus aureus-MRSA/Streptococcus pneumoniae /Pseudomonas mendocina Candida species	1	0.6
Staphylococcus aureus-MRSA/Streptococcus anginosus	1	0.6
Staphylococcus aureus-MRSA/Streptococcus pyogenes	1	0.6
Grand Total	**178**	**100**

The table 5 showsa high frequency of E-coli ESBl1,022 cases (76.8%), Klebsiella pneumoniae-ESBL224 cases (16.8%). This study has identified Staphylococcus aureus to be the predominant organism in the MRSA classification.

Table 6. Isolates that are not elsewhere Classified.

MDRO	**N**	**(%)**
Pseudomonas aeruginosa-MDRO	8	61.5
Escherichia coli-MDRO	3	23.1
Enterococcus faecalis Pseudomonas aeruginosa-MDRO	1	7.7
Morganella morganii-MDRO	1	7.7
Grand Total	**13**	**100**

For other Multi-Drug Resistant organisms which could not be attributed or classified into any of the MDRO classification, we termed them MDRO. This organisms are resistance to one or more antibiotics, but do not produce Beta-lactamase. They include pseudomonas aeruginosa (8), E-coli (3), enterococcus faecalis and pseudomonas aeruginosa (1), and Morganella morganii (1) cases.

Chart 4: Isolated Organism and Comorbidities (N=1522)

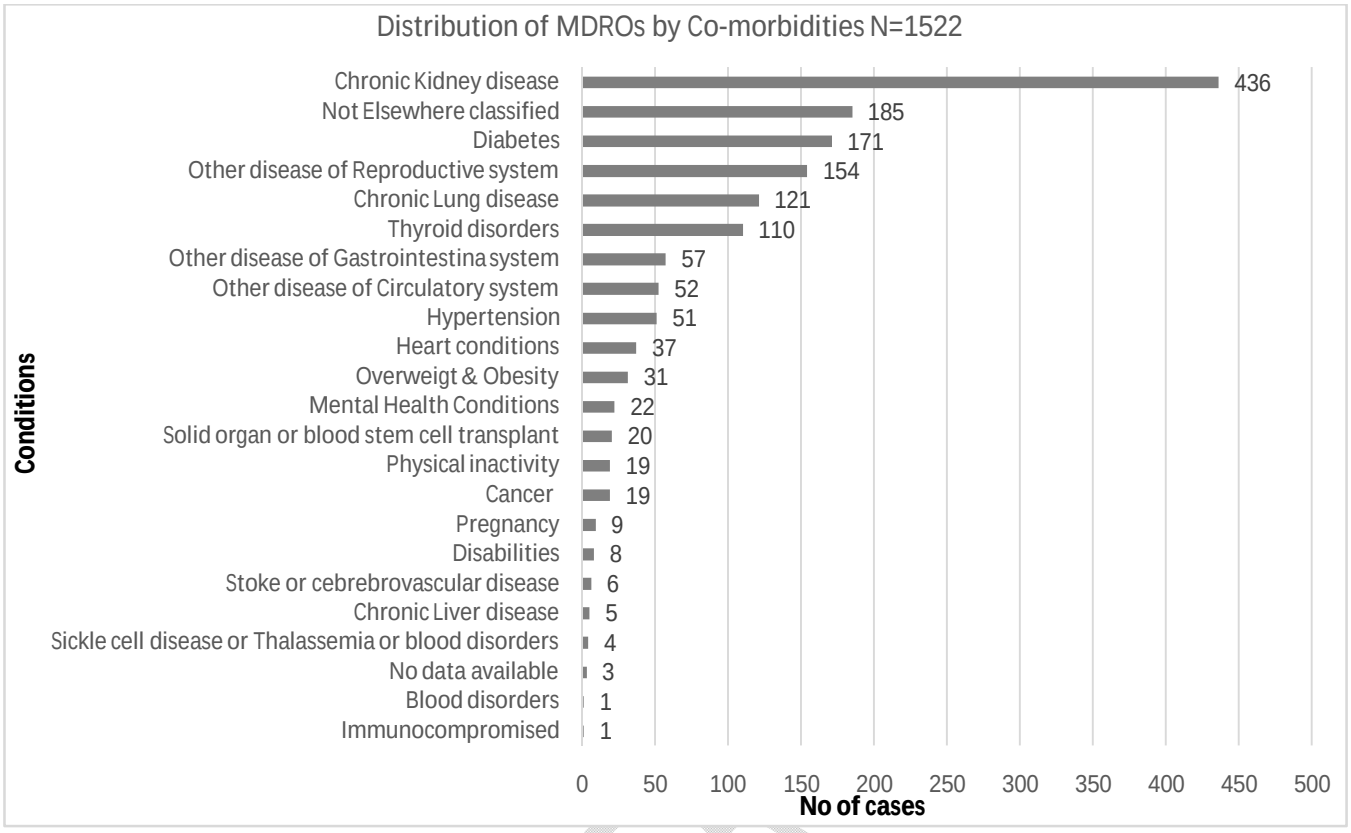

Chart 4 shows that majority 436 (28.6%) cases have chronic kidney disease, followed by 171(11.2%) Diabetes cases, 154 (10.1%) cases of reproductive system disease, chronic lung disease 121(8%) and thyroid diseases. This result agrees with the study done in Saudi Arabia by Alaa F. Alshemi in 2023, where MDRO infection was studied among patient admitted in a tertiary hospital. The study carried out in Saudi tertiary hospital showed that the most significant comorbidities were diabetes and hypertension.

About 88% of the cases had an underlying illness or co-morbidity which can be classified, while 12% of the cases were recorded without any disease description, they include Ear, eye, mouth, Musculoskeletal, respiratory, skin, and urinary diseases.

Table 7: Distribution of MDRO Group by Type and Source of Sample from 2019-2021 in PHCC

	MDRO CLASSIFICATION						
Type/Source of sample taken	**ESBL**	**(%)**	**MRSA**	**(%)**	**MDRO**	**(%)**	**Total**
Urine culture	1315	86.4	49	3.2	12	0.8	1376
Wound Culture	6	0.4	46	3.0	0	0.0	52
Stool Culture	4	0.3	0	0.0	0	0.0	4
Pus Culture	3	0.2	40	2.6	0	0.0	43
Eye Culture	1	0.1	1	0.1	0	0.0	2
Genital Culture	1	0.1	2	0.1	0	0.0	3
Sputum Culture	1	0.1	0	0.0	0	0.0	1
Body Fluid Culture	0	0.0	3	0.2	0	0.0	3
Ear Culture	0	0.0	14	0.9	1	0.1	15
MRSA Culture	0	0.0	21	1.4	0	0.0	21

Upper Respiratory Tract Culture	0	0.0	2	0.1	0	0.0	2
Grand Total	**1331**	**87.5**	**178**	**11.7**	**13**	**0.85**	**1522**

Table 7 above displays the type and source of sample taken for isolation of different MDRO group.
In ESBL cases, urine sample was more utilized with 1,315 cultures (86.4%), wound sample 6 (0.4%), stool sample 4 (0.3%) and pus sample 3 (0.2). this shows that for the isolation of organisms in the ESBL group, urine culture is the predominant test, followed by wound culture and stool culture.

For MRSA, urine sample (3.2%) and wound sample (0.4%) were the most utilized form of specimen used for the confirmation of the presence of MRSA organisms in this study. Other source of sample includes pus culture (2.6%), MRSA culture (1.4%), genital and upper respiratory tract culture were (0.1%) respectively.

5.0 DISCUSSION

This study looked at the prevalence of Multi-Drug Resistant organisms in the PHCC health Centers. Patient who come into the health Center through walk-in, referral or by emergency are diagnosed and examined by the health Center physicians. PHCC health Center takes laboratory samples from patients according to the order of the physician and sends them to the laboratory.
There are so many test done in PHCC for investigation, confirmation, and treatment purposes. This study focuses on the number of isolated organisms which are resistant to one or more prescribed antimicrobials in PHCC.

The prevalence rate of MDROs for this study is 1.35%, with an incidence rate of 99 cases per 100,000 population.By the end of 2021, a total of 1,522 cases of laboratory confirmed Multi-Drug Resistant Organisms had been obtained in the PHCC health Centers, and of those, (547) cases were reported in 2019, and (444) cases reported in 2020, while (531) were reported in 2021.The calculation of prevalence for this study employed the total number of laboratory confirmed isolates which showed resistant to one or more antibiotics divided by the total culture ordered by PHCC physicians for the same period.

This studied identified ESBL which is mostly E.coli as the most implicated organism associated with the occurrence of MDROs for the duration of study, and this is followed by MRSA. This finding aligns with the study conducted in Oman by Abdulla Balkhair in 2012 and Al-Muharrmi in2005, where they evaluated extended-spectrum *β*-lactamase (ESBL) isolates in a pediatric population. For over 12-month period of observation, the authors found that 13.3% of *E. coli* and 6.6% of *Klebsiella pneumoniae* isolated were ESBL producers. The study concluded that ESBL-producing organisms are becoming a major problem in Omani children. These observed percentages were also higher than those previously reported from other countries such as Guinea-Bissau (ESBL *E. coli* 47.7% and *K. pneumoniae* 15.8%), Madagascar (ESBL *E. coli* and *K. pneumoniae* 36.9% respectively), Lebanon (ESBL *Enterobacteriaceae* 24.9%), and Thailand (ESBL *E. coli* 67.5% and *K. pneumoniae* 19.4%) (Isendahl, 2012; Hijai, 2016; Andiatahina, 2010; Kidee A, 2019).

The burden of MDROs among the PHCC served population falls on the age group 20-39 years, followed by age group 40-59 years, while children (1-18 years) had the lowest prevalence of MDRO. Qatar's population has mostly young adult/adult population within the age 25-59 years which represents the workforce group. However, this finding is in contrast with the study done in Pakistan by Sonia Qureshi in 2021 which found an increase in MDRO among children 1-18 years, this can be attributed to

the age criteria employed by Sonia Qureshi, which studied the prevalence and risk factors associated with MDROs carriage among pediatric patients.

Majority of the cases have chronic kidney disease, followed by diabetes. This result agrees with the study done in Saudi Arabia by Alaa F. Alshemi in 2023, where MDRO infection was studied among patient admitted in a tertiary hospital. The study showed that The most significant comorbidities were diabetes, hypertension and antibiotic use prior to hospitalization.

Females had the highest burden of MDROs compared to males. This can be due to certain factorslike antenatal care, female's higher level of health seeking behaviour leading to more female encounters (Ashley E., 2016). This finding is in contrast with the study done in Pakistan, Italy, United Kingdom, and Ireland. The risk of MDRO colonization was higher in males (60%) than in females (40%) across these studies done by (Kohler P Kohler P., 199; Nucleo E., 2018; Jans B, 2013).An Italian point-prevalence study of 340 residents in four LTCF found male sex to be an independent risk factor for MRSA colonization with an OR of 2.31 (95% CI 1.16–4.59); however, male sex was not found to be an independent risk factor for ESBL colonization in this study (Nucleo E., 2018).

The burden of MDRO can be seen among educated professionals. One would question why we have a higher incidence of MDROs among professionals who are presumed to be educated and knowledgeable. Firstly, we would like to mention that most of the Qatari population are the young working groups and older adults between the age of 25-45 years migrating to the country forwork, leisure, medical tourism,and business (*Planning and statistics authority, 2023*). Also, with much education comes independence and self-making decision abilities. This group of people can make decisions to utilize the same antimicrobial previously prescribed by a physician to treat related symptoms. While antimicrobial resistance can occur naturally in bacteria, misuse of antibiotics can worsen it and create multiple resistant organisms in the body. School aged childrencovered a 27% proportion of the cases.Many children at this age do not have sufficient knowledge and self-will to practice proper hand hygiene and infection prevention and control protocols. This school-aged population needs proper education, awareness, and guidance to ensure good hand hygiene as to prevent or mitigate then possibility of acquiring infectious organisms.School aged children could acquire this disease from the community, home, school, play area and hospital. There have been studies around parents' knowledge and practice of antibiotics administration, and the result showed that most patient administer the same antibiotics prescribed for one child to another child, without proper medical consultation and laboratory testing. (Esposito S., 2007).

Most patient with MDRO visited the Abubaker Siddiq and Al Thumamah Health centre. These health Centers with the highest occurrence of MDROs are located at the most populated area of the country. Therefore, the influx of patient is higher in these health Centers, with a higher chance of detecting patients with Multi-Drug Resistant Organisms. Also, the health Centers with fewer frequencies of MDROs like Al Karaana Health Center, Al Ruwais Health Center and Lebaib Health Center are situated in the region of the country having less population and fewer number of patient influx in these health Centers.

6.0 RECOMMENDATION

This study demonstrated a significant trend of MDRO in PHCC health Centers in Qatar, with a range of organisms that are related to those reported in nearby countries. These findings call for the prompt necessity in developing and evaluation of nationwide antibiotic policy and guidelines, monitoring and

evaluation of these guidelines, public health awareness which is essential in this time due to the increasing resistance patterns.

In addition, it calls for developing and routine update of the National antibiogram database which will improve the knowledge of antimicrobial resistance patterns in Qatar, identify new resistant patter and will also help to improve treatment strategies based on unit-specific data. Collaboration with other sectors and countries who has reduced the incidence of MDROs.

Our findings suggest that interventions optimizing awareness should be a priority to prevent MDRO infections.Currently, PHCC have an Antimicrobial Stewardship. Hopefully, this will reduce the number and impact of Multi-Drug Resistance Organisms in the community.

6.1 LIMITATIONS

Our study is not without limitations. There was limited data about the subject's previous antibiotic usage, this can be due to re-call bias. So, this study was not able to relate the previous antibiotic use and onset of MDRO. Again, most of the samples were gotten from the women in this study.

Also, we lacked information on possible post-hospital admission status of the subjects, which could direct us on determining if the MDRO cases were hospital or community acquired infections. We cannot make any assertions about the role this situation might play on the outcome of colonization. The hospital admission history however is a crucial factor to analyze in future studies.Nevertheless, those findings emphasize that more focus should be placed on enhancing the awareness of improper antibiotic prescription and use among health care professionals and the general public to mitigate the spread of antibiotic resistance. This study reveals an increasing trend of MDRO infections, implying that recognizing the risk factors for MDRO infections and appropriate administration of antibiotics may help prevent high patient mortality.

7.0 REFERENCES

1. Al Muharrmi Z, Rafay AM, Balkhair A, Al-Tamemi S, Al Mawali A, Al Sadiri H, 2008. Extended-spectrum β-lactamase (ESBL) in Omani children: study of prevalence, risk factors and clinical outcomes at Sultan Qaboos University Hospital, Sultanate of Oman. Sultan Qaboos University Medical Journal.;8(2):171–177. [PMC free article] [PubMed] [Google Scholar].
2. Al-Muharrmi Z, Rafay A, Balkhair A, Jabri AA, 2008. Antibiotic combination as empirical therapy for extended spectrum beta-lactamase. Oman Medical Journal. ;23(2):78–81. [PMC free article] [PubMed] [Google Scholar].
3. Al-Tonbary YA, Soliman OE, Sarhan MM, et al, 2011. Nosocomial infections and fever of unknown origin in pediatric hematology/oncology unit: a retrospective annual study. World Journal of Pediatrics. ;7(1):60–64. [PubMed] [Google Scholar].
4. Alumran A, Hou XY, 2013. Hurst assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scale) Health and Quality of Life Outcomes.;11, article 39 [PMC free article] [PubMed] [Google Scholar].
5. Aly M, Balkhy HH, 2012. The prevalence of antimicrobial resistance in clinical isolates from Gulf Corporation Council countries. Antimicrobial Resistance and Infection Control. ;1(1, article 26) [PMC free article] [PubMed] [Google Scholar].

6. Andriatahina T, Randrianirina F, Hariniana ER, Talarmin A, Buisson Y, et al, 2010. High prevalence of fecal carriage of extended-spectrum beta-lactamase-producing Escherichia coli and Klebsiella pneumoniae in a pediatric unit in Madagascar. BMC Infect Dis.;10(1):204. https://doi.org/10.1186/1471-2334-10-204.
7. Arias CA, Murray BE, 2009. Antibiotic-resistant bugs in the 21st century: a clinical super-challenge. The New England Journal of Medicine.;360(5):439–443. [PubMed] [Google Scholar].
8. Ashley E. Thompson, Yvonne Anisimowicz, Baukje Miedema, William Hogg, Walter P. Wodchis & Kris Aubrey-Bassler, 2016. The Influence of gender and other patient characteristics on health care-seeking behaviour. (BMC Family Practice). https://doi.org/10.1186/s12875-016-0440-0.
9. Balkhy HH, Bawazeer MS, Kattan RF, et al, 2012. Epidemiology of Acinetobacter spp.-associated healthcare infections and colonization among children at a tertiary-care hospital in Saudi Arabia: a 6-year retrospective cohort study. European Journal of Clinical Microbiology and Infectious Diseases. ;31(10):2645–2651. [PubMed] [Google Scholar].
10. Bearman G, Rosato AE, Duane TM, et al, 2010. Trial of universal gloving with emollient-impregnated gloves to promote skin health and prevent the transmission of multidrug-resistant organisms in a surgical intensive care unit. Infection Control and Hospital Epidemiology. ;31(5):491–497. [PubMed] [Google Scholar].
11. Centers for Disease Control and Prevention 2013. Vital signs: carbapenem-resistant Enterobacteriaceae. Morbidity and Mortality Weekly Report(MMWR).
12. Coates ARM, Hu Y,2007. Novel approaches to developing new antibiotics for bacterial infections. British Journal of Pharmacology. ;152(8):1147–1154. [PMC free article] [PubMed] [Google Scholar].
13. Cohen ML 2000. Changing patterns of infectious disease. Nature. ;406(6797):762–767.
14. Devasahayam G, Scheld WM, Hoffman PS, 2010. Newer antibacterial drugs for a new century. Expert Opinion on Investigational Drugs. ;19(2):215–234. [PMC free article] [PubMed] [Google Scholar].
15. Echols RM, 2012. A long and winding road, evolution of antimicrobial drug development: crisis management. Expert Review of Anti-Infective Therapy. ;10(11):1311–1319. [PubMed] [Google Scholar].
16. El-Saed A, Balkhy HH, Al-Dorzi HM, Khan R, Rishu AH, Arabi YM, 2013. Acinetobacter is the most common pathogen associated with late-onset and recurrent ventilator-associated pneumonia in an adult intensive care unit in Saudi Arabia. International Journal of Infectious Diseases. ;17(9):e696–e701. [PubMed] [Google Scholar].
17. Esposito S, Leone S, 2007. Antimicrobial treatment for intensive care unit (ICU) infections including the role of the infectious disease specialist. International Journal of Antimicrobial Agents. ;29(5):494–500. [PubMed] [Google Scholar].
18. Fukuta Y, Muder RR, Agha ME, et al, 2013. Risk factors for acquisition of multidrug-resistant Acinetobacter baumannii among cancer patients. American Journal of Infection Control. ;41(12):1249–1252. [PubMed] [Google Scholar].
19. Hijazi SM, Fawzi MA, Ali FM, Abd El Galil KH, 2016. Multidrug-resistant ESBL-producing Enterobacteriaceae and associated risk factors in community infants in Lebanon. J Infect Dev Ctries.;10(9):947–55. https://doi.org/10.3855/jidc.7593.
20. Hsueh P-R, Teng L-J, Yang P-C, Ho S-W, Luh K-T, 2002. Emergence of nosocomial candidemia at a teaching hospital in Taiwan from 1981 to 2000: increased susceptibility of Candida species to fluconazole. Microbial Drug Resistance. ;8(4):311–319. [PubMed] [Google Scholar].

21. Kiddee A, Assawatheptawee K, Na-Udom A, Boonsawang P, Treebupachatsakul P, Walsh TR, et, 2019al. Risk factors for extended-Spectrum beta-lactamase-producing Enterobacteriaceae carriage in patients admitted to intensive care unit in a tertiary Care Hospital in Thailand. Microb Drug Resist.;25(8):1182–90. https://doi.org/10.1089/mdr.2018.0318.
22. Kohler P., Fulchini R., Albrich W.C., Egli A., Balmelli C., Harbarth S., Héquet D., Kahlert C.R., Kuster S.P., Petignat C., et al, 2018. Antibiotic resistance in Swiss nursing homes: Analysis of National Surveillance Data over an 11-year period between 2007 and 2017. Antimicrobe. Resist. Infect. Control. ;7:88. doi: 10.1186/s13756-018-0378-1.
23. Magiorakos A-P, Srinivasan A, Carey RB, et al, 2012. Multidrug-resistant, extensively drug-resistant, and pan drug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clinical Microbiology and Infection. ;18(3):268–281. [PubMed] [Google Scholar].
24. Mahler H, 2000. The meaning of “health for all by the year” World Health Forum. 1981;2(1):5–22. [Google Scholar].
25. Matsuzaki S, Rashel M, Uchiyama J, et al, 2005. Bacteriophage therapy: a revitalized therapy against bacterial infectious diseases. Journal of Infection and Chemotherapy.;11(5):211–219. [PubMed] [Google Scholar].
26. Morales E, Cots F, Sala M, et al, 2012. Hospital costs of nosocomial multi-drug resistant Pseudomonas aeruginosa acquisition. BMC Health Services Research;12, article 122 [PMC free article] [PubMed] [Google Scholar]
27. Nillius D., Von Müller L., Wagenpfeil S., Klein R., Herrmann M, 2016. Methicillin-Resistant Staphylococcus aureus in Saarland, Germany: The Long-Term Care Facility Study. PLoS ONE. ;11:e0153030. doi: 10.1371/journal.pone.0153030. [PMC free article] [PubMed] [Cross Ref] [Google Scholar].
28. Nucleo E., Caltagirone M., Marchetti V.M., D’Angelo R., Fogato E., Confalonieri M., Reboli C., March A., Sleghel F., Soelva G., et al, 2018. Colonization of long-term care facility residents in three Italian Provinces by multidrug-resistant bacteria. Antimicrobe. Resist. Infect. Control. ;7:33. doi: 10.1186/s13756-018-0326-0. [PMC free article] [PubMed] [Cross Ref] [Google Scholar].
29. Qatar Planning and Statistics Authority 2023, https://www.psa.gov.qa/en/statistics1/StatisticsSite/pages/population.aspx.
30. Reusken C, Haagmans BL, üller MA M, et al, 2013. Middle East respiratory syndrome coronavirus neutralising serum antibodies in dromedary camels: a comparative serological study. The Lancet Infectious Diseases. ;13(10):859–866. [PMC free article] [PubMed] [Google Scholar].
31. Rodríguez-Créixems M, Alcalá L, Muñoz P, Cercenado E, Vicente T. Bouza, 2008. Bloodstream infections: evolution and trends in the microbiology workload, incidence, and etiology, 1985–2006. Medicine. ;87(4):234–249. [PubMed] [Google Scholar].
32. Rolain JM, 2013. Food and human gut as reservoirs of transferable antibiotic resistance encoding genes. Frontiers in Microbiology. ;4, article 173 [PMC free article] [PubMed] [Google Scholar].
33. Rosenberger LH, Hranjec T, Politano AD, et al, 2011. Effective cohorting and “super isolation” in a single intensive care unit in response to an outbreak of diverse multi-drug-resistant organisms. Surgical Infections;12(5):345–350. [PMC free article] [PubMed] [Google Scholar].
34. Saeed NK, Kambal AM, El-Khizzi NA, 2010. Antimicrobial-resistant bacteria in a general intensive care unit in Saudi Arabia. Saudi Medical Journal. ;31(12):1341–1349. [PubMed] [Google Scholar].
35. Scott DR, 2009. The Direct Medical Costs of Healthcare-Associated Infections in U.S.Hospitals and the Benefits of Prevention, , http://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf.

36. Shlaes DM, Spellberg B, 2012. Overcoming the challenges to developing new antibiotics. Current Opinion in Pharmacology. ;12(5):522–526. [PubMed] [Google Scholar].
37. Somily AM, 2010. Comparison of E-test and disc diffusion methods for the in vitro evaluation of the antimicrobial activity of colistin in multi-drug resistant gram-negative bacilli. Saudi Medical Journal. ;31(5):507–511. [PubMed] [Google Scholar].
38. Somily AM, Al-Khattaf AS, Kambal AM, 2010. Antimicrobial activity of tigecycline against bacterial isolates from intensive care units in a teaching hospital in Central Saudi Arabia. Saudi Medical Journal. ;31(1):18–24. [PubMed] [Google Scholar].
39. Spellberg B, Bartlett JG, Gilbert DN, 2013. The future of antibiotics and resistance. The New England Journal of Medicine. ;368(4):299–302. [PMC free article] [PubMed] [Google Scholar].