Original Research Article

ANTIMICROBIAL RESISTANCE IN PRIMARY HEALTH CARE SETTING: THE PREVALENCE OF MULTI-DRUG RESISTANT ORGANISMS IN HEALTH CENTERS UNDER THE PRIMARY HEALTH CARECORPORATION PHCC,QATAR

ABSTRACT

Wrong utilization of antimicrobial agents is the greatestcauseof developing antibiotics resistance organisms in the human system. Also, hospital acquired infections are known to contribute to illness and earth that can arise from the resistance of organisms towards antimicrobials designed to kill these organism.

Our study looked at samples (n=1,522) which were confirmed in the laboratory to be resistance to one or more antimicrobials between year 2019-2021. The research team obtained an ethical approval from the ethics committee before the commencement of this research. The data extracted was carefully cleaned and verified by multiple research team members to ensure accurate data is utilized for the study.

The result of this study has revealed a prevalence of (1.35%) with the most implicated organism being the E.coli(87.5%) mostly resistance to the ESBL antibiotics group. Majority of the MDRO cases could be seen in adults between the age of 25 years to 29 years. Moreso, the females had the burden of MDROs when compared to the males visiting the same medical facilities(Female:87% : Male:13%).

With a significance prevalence of organisms' resistance to one or more antibiotics group has been found in people receiving care at the PHCC health centers. There is need to evaluate and enhance the existing policies and guidelines surrounding the antibiotic prescription and administration. Additionally, the enhancement of the public health awareness regarding this condition should be intensified to reach the populations from the grassroot to the top. This strategies will give the community a good understanding of the cause and preventative measures against this rising trend and to avert the consequences that come with it.

Keywords: *Antibiotics, resistance, prevalence, public awareness*

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1. INTRODUCTION

1.1. Study Background

Previously, some bacterial infections can be treated successfully within few weeks with an appropriately prescribed antibiotics from a licensed and trained health care providers if the medication was taken according to the dosages and timings. But recently, severalinfectivebacteria have establisheda resistant attribute against different types of antimicrobials that were successfully used in the treatment of bacterial infection among the populace. Also, hospital visits and admissions has increasingly led to the acquiring of resistant bacteria when appropriate infection prevention measures were overlooked or not applied by the personnels providing health care services to the patient. The health care facilities are loaded with different forms of infectious agents following the influx of people with various illness seeking care. With this, medical facilities or settings can be said to contribute to the risk of acquiring these organism when compared to other industries (Ajai et al, 2015).

Likewise, following the recent global epidemic of Covid-19, the degree of hospitalization witnessed a huge spike placing a big burden on the shoulders of the healthcare workers HCW. This situation led to burnout of HCW and a decline in the practice of good hand hygiene and precautions recommended for the prevention of pathogen transmission between the HCW and the patient, the health care environment, and the patient, and between patients to health care workers. With a reduction in the appropriate practice, the risk of hospital-acquired infection increases among the community (Al-Tonbary, 2011)

1.2. Problem Statement

The increased inappropriateutilization of antibiotics has steered towards arise of resistant pathogens (Spellberg,2008: Heuer,2009). For diseasestriggered by multidrug-resistant organisms (MDROs), successful treatment is usuallyreduced thereby causing furtherillness,death and evena huge rise in medical expenses (Founou, 2017). Patients who are colonized by these resistance organisms are not only at risk of death, but they are also a huge risk to other patients and HCW if notidentified on time and isolated or decolonized before they spread these microbes.

These resistant strains initially surfaced in hospitals where these antibiotics were majorly used; Sulfonamide-resistant Streppyogenes appeared in the army hospitals around 1930s, Penicillin-resistant Staph disturbed the civilian hospital then in the city of London immediately after the penicillin antibiotics was introduced in the 1940s. likewise an organisms termed the Mycobacterium TB was identified to be resistant to streptomycin among the public who consumed them following the discovery and manufacture of this antibiotics (Levy et al, 1998_).

The wrong prescription and utilization of antibiotics has added to the mounting problem of antimicrobial-resistance, which has now become one of the utmostdangerous and rising threats to public health (CDC, 2017).

1.3 Justification

Previousresearch done in Taiwan has demonstrated that the rate of MRSA colonization among adults and children was 3.8% and 7.8% each respectively (Wang, 2009; Chen, 2011).Another study reported

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E. coli from diverse sources in the public setting and discovered that the prevalence of ESBL-producers escalated from 4.0%to 10.7% within a space of 8-years (Wang, 2015).

A systematic review of 382 articles from 9 countries within the Arabian Peninsula revealed that 50% of deaths related to antimicrobial resistance was because of the resistant Acinetobacter baumannii organism, Mycobacterium TB, and Staphylococcus infectious organisms.
A web search on the PubMed database for antimicrobial resistance in Qatar produced 19 articles. 8 studies were focused on different countries, 1 study couldn't provide an access to the article, 7 studies looked at the secondary and private healthcare institutions and the other 3 research studied the incidence of MDROs in animals. Baiou and his research team looked at the secondary care aspect of the antimicrobial resistant-organisms in 2021, where theyanalysed MDROs from symptomatic patients with COVID-19 and found that the most occurring species was the stenotrophomas maltophial. Evidently, most of the studies found were carried out in tertiary and private care facilities with a lack of study done in the Primary care settings (Rodriguez-Vilodres, 2021; Burnham, Olsen and Kollef, 2019; Lancet, 2019).

This study will provide a strong and direct knowledge about the major and minor resistant organisms found in the community, noting that the Primary Health Care Centers are the first place of contact for the Qatar populace (expatriates and locals), and thus is a goodillustration of the entire community looking for healthcare in the country. The Primary care facilitiesfunction as a criticalcrossing point between community and secondary care institutions; the microbial environment is habitually a mix of community and healthcare-associated organisms.

This study is important in ascertaining the prevalence of drug resistance organisms among patients who sought for care in the Primary healthcare facilities from January 2019 - December 2021 by identifying the most involvedorganismdominantamongst the PHCC population. Also, this will assist in devising the best andefficientpreventative measures to boost patient outcomes. The impact and trend of antimicrobial drug resistance in Qatar Primary health care settings is uncertain and needs to be put up in knowledge for reference and academic purposes as well.

1.4 Statement 0f 0bjectives

1.4.1 General Objective

To determine the prevalence of Multi-Drug Resistance 0rganismsamongstpatient who received care in The Primary Health Care centers between year 2019 to year 2021.

1.4.2 Specific 0bjectives

1. To establish the prevalence of MDROs in health centers of the PHCC.
2. To detect the majorlyoccurring organisms inhealth centers of the PHCC.
3. To detect the geographicpattern of the resistance 0rganisms per Health Centers.

2. LITERATURE REVIEW:

Resistance to more than oneantibiotics was initiallydiscoveredamongstthe enteric bacteria such as the E-coli, Shigella and Salmonellain the late 1950s to early 1960s (Crofton, J, 1984). these strains of bacteria causedmore serious clinical complications and loss of lives, especially in developing countries.
In Australia, a study was done to evaluate certain risk factors that leads top the development of bacterial infections. This study found that the major predators of Extended Spectrum Betta Lactamase

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ESBL were due to length/duration of stay LOS before infection, exposure to antimicrobials that occurred within last six weeks before the sample collection, recent travel history mostly from those returning from the Asia part of the world, ICU admission and stay in a long term care homes or facilities where all significant factor in the development of antimicrobial-resistant organisms(Kiddee, 20I9). Another research in a French coordinated ICU was done to ascertain factors which can be predictive for acquiring the ESBL infection during hospitalization. This study discovered that gender, age, and disposition to 3rd generation cephalosporin or Beta-lactam in the past 3 months were also risk factors predisposing patients to the development of antimicrobial-resistance organisms.

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.

3.0 METHODS

3.1 Area of Study

We conducted this study in the 28 health centers ran by the Primary Healthcare Corporation (PHCC). Qatar is a small country that lies in a peninsula within the Western Asia and only shares land border with the Kingdom of Saudi-Arabia. The health centers are saddled with the responsibility of providing preventive care to families and communities within the state of Qatar. They also provide treatments and diagnosis for the patients.

3.2 Study-Design

This study employed a retrospective cross-sectional study design.

3.3 Study Population

We utilized the data for all male and female patient who were diagnosed by the PHCC physicians in the health centers.

3.3.1. Inclusion Criteria

a) All patient who are formally registered in the PHCC centers with a valid health card number.
b) All patients whose medical and demographic data was found in the health data base.
c) Any patient who was attended to by the physicians in the health centers.
d) All gender at all ages.

3.3.2 Exclusion Criteria:

a) Patients whose infection was due to the injection of contaminated food.
b) Any patient whose laboratory result did not indicate antimicrobial resistant pattern.
c) Any patient with incomplete data.

3.4 Method of Sampling

- We utilized electronic data of patients as recorded in the health database.
- The study was based on laboratory confirmation.
- Required parameters were sent to the Health Information Management Department.
- The required parameters were met and sent to the research team in a protected Excel sheet.

Calculating the prevalence which is represented as(x).

- First, we acquired the total registered patient for the study period, this became our denominator (≠)
- Then, we filtered and collected data for all patient whose sample was taken for bacterial testing (µ)

- Lastly, we selected all the laboratory confirmed organisms which were determined to be resistance to one or more antimicrobials using the susceptibility testing. (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 Used for Data Collection

Data was collected using the HIM data base which provided all the required variables meeting the set objectives. This data was collected in a secured MS Excel sheet accessible to the research team alone.

3.6 Analyzing Data: This data collected was analyzed using the latest Microsoft Excel software and presentation of data was done by bar charts, pie charts, frequency-tables, and line carts.

3.7 Data Validity: To guaranteecorrectness of data, we repeatedly cleaned and verified the data, and this was done by different investigators, duplicated data and incorrect data was removed before analyzing and reporting data.

4.0 RESULTS

4.1 Findings and Interpretation

A total of 112813 samples were ordered for the 3-year period, and a total of 1522 isolates of Multi-Drug Resistant Organisms(MDROs.) were gotten. MDRO cases seen in year 2019(547), year 2020(444cases) and 531cases in 2021.

4.2 Demographic Attributes of the Study Population

Chart 1 Illustration of Study Population According to Gender

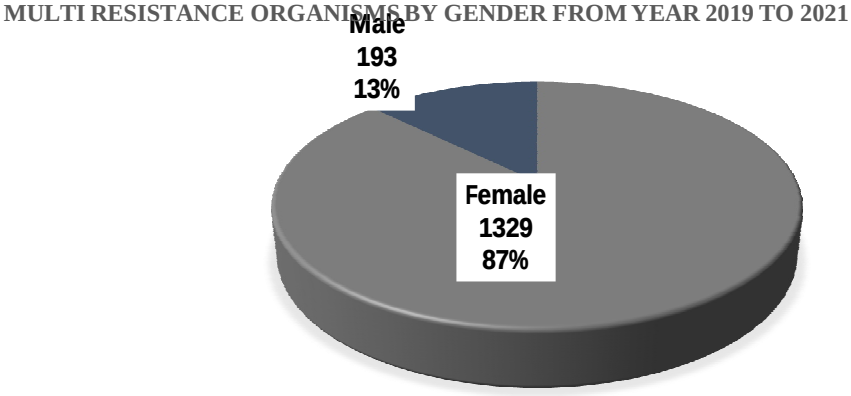

Chart1 denotes the sexual characteristics of the population in this study. Most Resistant Organisms were seen mostly among the female populacewith(87%) and lesser in malescovering about(13%).

Chart2 Showing MDRO by Gender in Years (N=1522)

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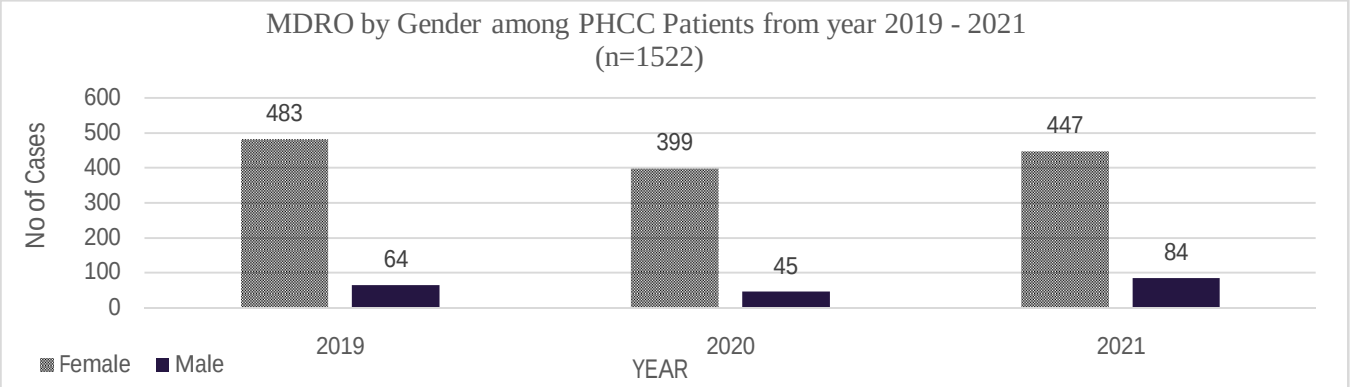

There is a major incidence of resistance organisms in females when compared to the males across the years. The prevalence rate between both gender is females(1.2%) and males(0.2%).

Table 1. Table depicting MDROs by Age Across the Years (N=1,522)

	Year2019		Year2020		Year2021		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%)**	**(1,522)**	**(100%)**

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MDROsoccurred in 128 children(8.4%), young adults(51%), then older adults and elderly covered a proportion of(22.5.%) and (18.%)each respectively.

Table 2. Showing Occupation of the Study population (N=1,522)

OCCUPATION	ESBL	MDRO	MRSA	N (%)
Clerical-Support Workers	2.0		1.0	3(0.2%)
Craft/Related Traders	9.0		3.0	12(0.8%)
Elementary jobs	65.0		12.0	77(5.1%)
Managers/Supervisors	32.0		3.0	35(2.3%)
Plant/Machine Operators/Assemblers	86..0		19.0	105(6.9%)
Professionals	541.0	7.0	63.0	611(40.1%)
Service/Sales workers	141.0		25.0	166(10.9%)
Skilled - Agriculture, Forestry &Fishery	1.0		2.0	3(0.2%)
Technicians &Associate-Professionals	19.0		7.0	26(1.7%)
Not assigned elsewhere	66.0		7.0	73(4.8%)
Housewives, children, and students	369.0	6.0	36.0	411(27.0%)
Grand-Total	**1331**	**13**	**178**	**1522(100%)**

ESB;-Extended-spectrum beta-lactamase; MD; Multi-drug resistant; MRSA ;Methicillin-Resistant Staph aureus

Table 2describeswork-relatedattributes of the people being studied; The job classification was derived from the International-standard Classification of Occupation(ICSO) professional classification. There are occupations that couldn't be classified due to the deficiency of the data available 73 job details of the population were missing.

Table 3: Geographical Trend of MDROs According to Regional distribution(N=1,522)

	Year2019	Year2020	Year2021	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%)**

Western part of the country has the highest burden with 573(38%)antimicrobial resistantcases.

Table 4 Representing MDROs by Antibiotics Classifications (N=1,522)

ANTIBIOTICS CLASSIFICATION	N(%)
Extended Spectrum Beta- Lactamase-ESBL	1331(87.5%)
Methicillin resistance staph aureus-MRSA	178(11.7%)
Multi drug Resistant-MDR(not classified)	13(1.0%)
Grand Total	**1522(100%)**

The most resistant organism to the antimicrobial is the E.coli mostly resistant to (ESBL classification).

Chart 3 Pie Chart Illustration of MDROs Classifications (N=1,522)

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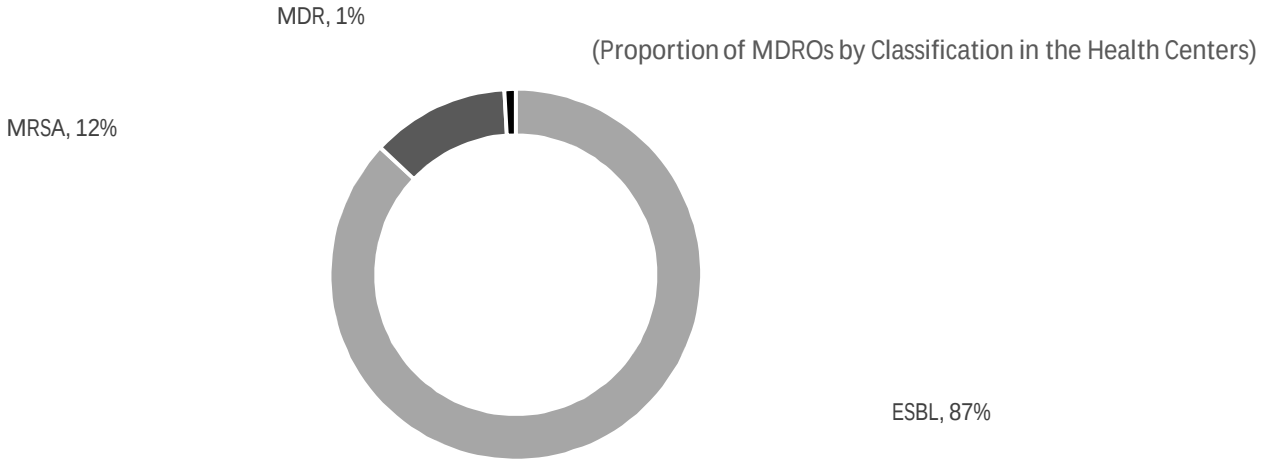

A high incidenceis seen in the ESBL group with 87% of the entire isolates, MRSA 12% and 1% from other MDR cases. These groups of MDR which are not somewhere elsegrouped are resistant to multiple-antibiotics but do not produce Beta-Lactamase.

Table 5. Isolates which are not classified elsewhere (MDR)(n=13)

MDR	**N(%)**
Pseudomonas-aeruginosa	8.0(61.5%)
Escherichia-coli	3.0(23.1%)
Enterococcus-faecalis/Pseudomonas aeruginosa	1.0(7.7%)
Morganella-morganii	1.0(7.7%)
Grand Total	**13.0(100%)**

These organisms have developed resistance to 1 or multiple antibiotics, but they don't produce Beta-lactamase.

Chart 4: Antimicrobial-Resistant Organism and Comorbidities (N=1,522)

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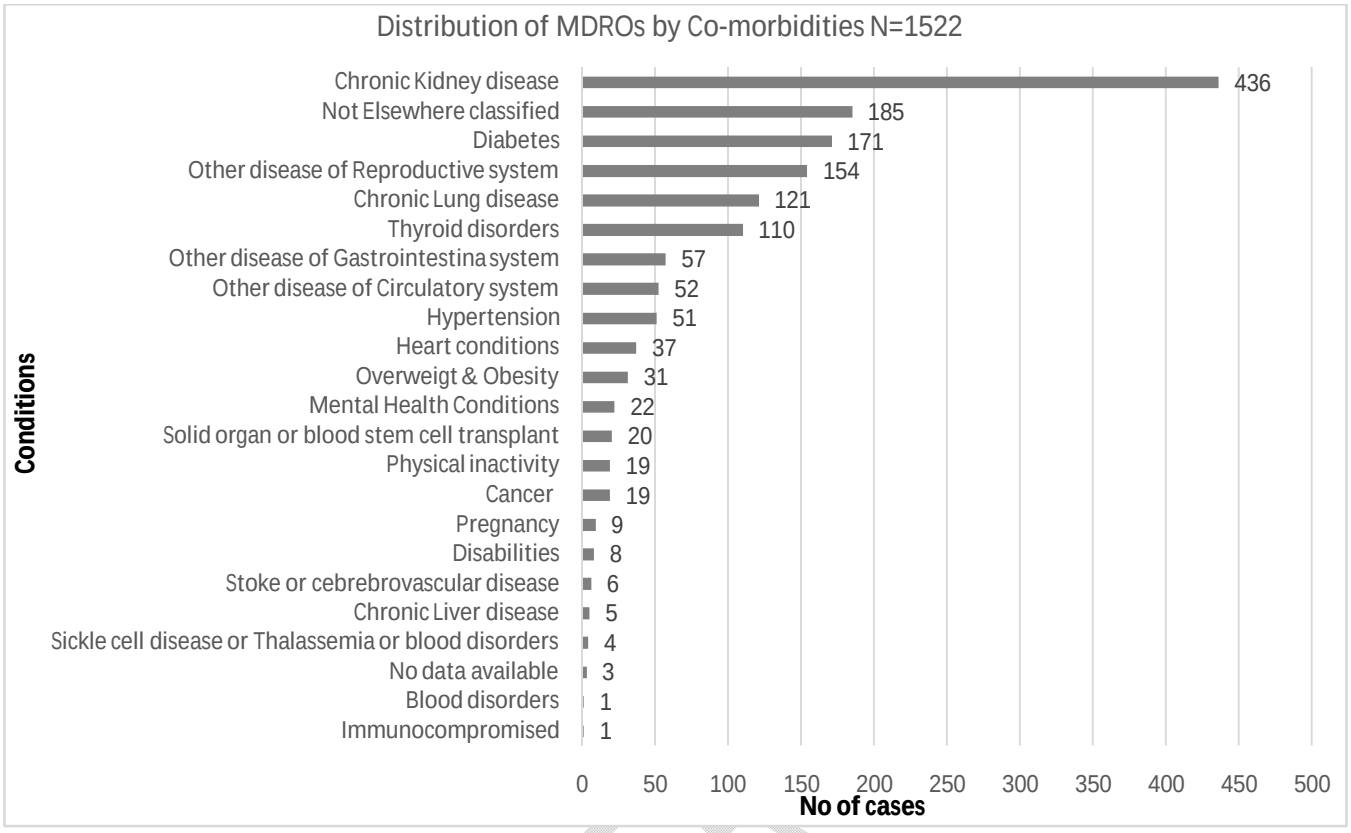

Most of them haschronic kidney disease, Diabetes, disease of reproductive system, chronic lung disease and thyroid diseases. Around 88% haveotherdisease conditions, while 12% of the cases were documented with no disease narration, theseinclude ear disease, eye conditions, mouth disease, Musculoskeletal disorder, respiratory, skin dis-order, and urinary diseases.

Table 6: MDRO Group According toOrder Type and Source of Sample

	MDRO CLASSIFICATION						
Type/Source of sample taken	**ESBL**	**(%)**	**MRSA**	**(%)**	**MDRO**	**(%)**	**Total**
Urine-culture order	1,315	86.4	49.0	3.20	12.0	0.80	1376
Wound-Culture order	6.0	0.40	46.0	3.00	0.0	0.00	52.0
Stool-Culture order	4.0	0.30	0.0	0.00	0.0	0.00	4.0
Pus-Culture order	3.0	0.20	40.0	2.60	0.0	0.00	43.0
Eye-Culture order	1.0	0.10	1.0	0.10	0.0	0.00	2.0
Genital-Culture order	1.0	0.10	2.0	0.10	0.0	0.00	3.0
Sputum-Culture order	1.0	0.10	0.0	0.00	0.0	0.00	1.0
Body-Fluid Culture order	0.0	0.00	3.0	0.20	0.0	0.00	3.0
Ear-Culture order	0.0	0.00	14.0	0.90	1.0	0.10	15.0
MRSA-Culture order	0.0	0.00	21.0	1.40	0.0	0.00	21.0
Upper-Respiratory Tract Culture order	0.0	0.00	2.0	0.10	0.0	0.00	2.0
Grand Total	**1331.0**	**87.50**	**178.0**	**11.70**	**13.0**	**0.850**	**1522.0**

This table is showcasing the type and sources of sample collected for isolatingthese organisms.

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5.0 DISCUSSION

In this study, we worked with the health center data to ascertain the prevalence and trend of organisms which have developed resistance to one or multi antibiotics which were previously successfully utilized in the elimination of these organisms, termed “MDROs”. The health center is often the first point of contact between the patient, families, and the family physicians. Often time, the patients are diagnosed in the primary care centers before the referral or contact with the secondary and tertiary care. The primary care is responsible for preventive and curative services to the community. Patients who visit the health centers to receive care are often diagnosed according to the case definition, medical history is taken, and laboratory samples are obtained for the testing of the suspected illness or disease.
Since our health care workers are usually faced with multiple disease conditions ranging from infectious to non-infectious chronic diseases, it is paramount to establish the pattern and trend of these diseases, such as the infectious diseases which has develop resistance to treatment regimen. This will support and inform decision making and policy to safeguard the health care workers, as well as the patient and communities. This is one of the public health goals.

A prevalence of (1.35%) was obtained, and an incidence rate of (99 MDRO cases per 100,000 population). The most implicated resistant organism in this study is the E.coli which is mostly resistant to the ESBL antibiotic-group. And the this has been followed by the MRSA. This finding agrees with the Oman study in 2012 and 2005 which assessed ESBL isolates in children. The result of the Oman study showed that E.coli and Klebsiella pneumonia was the most occurring organism isolated in that study. Similarly in Guinea-Bissau, Madagascar and Lebanon, studies done on the antimicrobial resistance also showed an increasing trend in the incidence of E.coli(47.7%) and Pneumonia(15.8%);Madagascar (ESBL-*E.coli* & Klebsiella-*Pneumonia* 36.9%); Lebanon(ESBL-*Enterobacteriaceae* 24.90%); (Isendahl et al, 2012; Hijai et al, 2016; Andiatahina, 2010; Kidee A, 2019).

The burden of resistant organisms can be greatly witnessed among young adults within the age group(20 to 39 years). This is the followed by older adults within the age range of(40 to 59 years), while pediatric age group (1-18 years) experience the minimal prevalence of MDRO. Young adults and adults make up a greater percentage of the Qatar population representing a greater workforce category.
However, this result does not agree with the study conducted in Pakistan which showed that an increasing burden of antimicrobial resistance among the pediatric population. The reason for the different could be due to the inclusion criteria sampling only the pediatric patients for the risk factors linked to the development of MDROs in children admitted to the secondary care (Sonia Qureshi et al, 2021).

The most frequent co-morbidity or condition exhibited by the population studied ischronic kidney disease and Diabetes mellitus. This result corresponds with the study conducted in The Kingdom of Saudi-Arabia in 2023, in which the most occurring co-morbidities are diabetes, high blood pressure and the use of antibiotics before hospitalization (Balkhy et al, 2012).

Females showed the most burden of drug resistant organisms when matched to the males. This can be due to various reasons such as the routine urine test during antenatal care, the tendency for the females to exhibit more level of health seeking behaviour preceding to more female encounters (Ashley E., 2016). However, this result does not agree with the study carried out in Pakistan, Italy, United

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Kingdom, and Ireland. The burden of MDRO was greater in males 60% than in females 40%. (Kohler P Kohler P., 199; Nucleo E., 2018; Jans B, 2013).
An Italian point-prevalence studyexplored340 residence and discovered 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 linked as a risk for ESBL colonization (Nucleo E., 2018).

There is a great burden of growing resistance organisms among educated professionals. This raises a question of how and why? It is presumed that the more educated one is, the more aware and enlightened one will be, and so, the rate of health literacy, disease prevention awareness, and appropriated antibiotics usage knowledge should be positive in this category. Let's take note that with education comes prowess to make decision increases. The educated professionals are a better position to make right and decisive decision which is not replicated in this study. Just like in other areas of preventive health, like in vaccination. We could see the high rate of vaccine hesitancy among learned people because they source for information any where and are able to argue on the safety and potency of any vaccine. The information gotten from non-scientific sources are usually biased, wrong, and not evidence based. This sounds familiar with the wrong and inappropriate utilization of antibiotics. One can read a medication leaflet and understand different, without consultinga trained and licensed physician, or without following the right prescription, a risk of drug resistance can emanate from the misuse of antimicrobials. While antimicrobial resistance can happen naturally in bacteria, wrong use of antibiotics can greatly induce the development of resistant organisms.
Also, students were significantly affected in this study. Lots of children at this stage does not have the ability to make the right choices of drug administration, and if left unattended, they could consume antibiotics wrongly and even share with their friends. The level of proper hand hygiene in this stage is low and thus, they are predisposed to contamination and infection by bacterial. This is why the importance of continuous awareness and health education at this age cannot be over emphasized. This step is crucial to mitigate and minimize the spread and impact of these multi resistance organisms in the community.
Several studies have been done regarding parent's knowledge, attitude and practice regarding antibiotics administration, the results have shown poor knowledge and practice regarding the use of antibiotic by the parents, where a previously prescribed antimicrobial for "child A" is used for "child B" who develops similar symptom to "child A" without medical diagnosis and consultation (Esposito S., 2007).

6.0 RECOMMENDATION

This study exhibited a substantialrate of antimicrobial-resistancetrend in PHCC-health Centers, with similar organisms being reported in the nearby countries.These findings call for the swiftrequirement in assessment of countrywide antibiotic policy and guidelines, monitoring and assessment, public health alertnessand enlightenment which is crucialthis period due to the rising resistance patterns.
Additionally, thisbeckons for collaboration with other sectors and countries who has reduced the incidence of MDROs, routine update of the Country's antibiogram database thereby supporting and improving knowledge antimicrobial-resistance patterns in Qatar, to identify new resistant pattern and aidin the improvement of treatment approaches based on unit-specific data.

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Our findings recommend that interventions enhancing awareness should be prioritized to inhibit MDRO infections.Presently, there is a national Antimicrobial Stewardship Committee,hopefully, this will reduce the number and impact of Multi-Drug Resistance Organisms in the community.

6.1 LIMITATIONS

Our study has few limitations which do not hugely impact the authenticity of this research. First, we had limited data regarding the patient's previous use of antibiotics as this was not captured in the health data base, since different patient have insurance and can choose to visit other private clinics, which the history of that visit Is not captured in the data base accessible to us. So, this study was not able to link prior antibiotics usage to the recent development of the multi drug resistant organisms.

Also, we do not have information on likelihood of post-hospital admission status of the patients before diagnoses. This couldlead us to determine if the cases where community of hospital acquired in this case. Therefore, due to this circumstance, we would not be able to make assertions the role this situation might play on the result of colonization. The hospital-admission history however is a critical factor to consider in future studies.Nonetheless, those findings highlights that more attention should be targeted on boosting the awareness of inappropriate antibiotic prescription and usage among HCW and the general public to prevent and reduce the spread of antibiotic resistance. This study reveals a rising trend multidrug resistant organisms, indicating that understanding the risk factors for MDRO infections and appropriate administration of antibiotics can help avoid high patient mortality.

Ethical Approval: As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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