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Risk Factors Associated With Multidrug-Resistant Infections in Hospitalized Patients

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ABSTRACT

Multidrug-resistant (MDR) infections have turned out to be a significant hazard to worldwide health systems, especially in the hospitalized infections where the danger of infections is exceptionally elevated. Pathogens cause these infections that are resistant to various classes of antibiotics and result in failure of treatment, prolonged hospital stay, increased mortality and an increase in healthcare costs. This paper discusses the most prevalent risk factors related to multidrug-resistant infections in hospitalized individuals and the determinants are discussed based on the clinical, environmental, and treatment aspects. The current evidence indicates that long-term hospitalization, antibiotic overuse, invasive medical procedures, immune-compromised states and inadequate practices related to infection control are the main factors leading to MDR infections. Hospitals serve as reservoirs of those pathogens which are resistant to the infection thus sleeping ser ser-transmission to patients and healthcare workers. Also, improper prescribing of antibiotics and absence of antimicrobial stewardship further enhance the development of resistance. The results support the necessity to elaborate on combined intervention measures related to preventing infections, the rational use of antibiotics, and the introduction of a more optimal state of hygiene activities in hospitals to prevent the negative effects of multidrug-resistant infections in the healthcare system.

Keywords: Multi drug-resistant infection, in-patient, antibiotic resistance, risk factors, nosocomial infection, antimicrobial stewardship, infection control.

INTRODUCTION

Multidrug-resistant infections are already considered one of the most serious worldwide health issues of the modern medicine, especially among patients of hospitals which are more susceptible to it because of repeated exposure to invasive operations, antibiotics, and hospital-associated infections. These infections are attributed to microorganisms which have become resistant to various antimicrobial agents and therefore rendering them challenging, expensive and ineffective in treatments. Antimicrobial resistance has been declared a global threat of utmost urgency by the World Health Organization and its effects on morbidity, mortality, and health care systems have been highlighted in a worldwide context (World Health Organization, 2023).

Hospitalized patients are considered a high-risk group of infections that are resistant to multiple drugs, because of a long-term stay in healthcare settings where such resistant organisms are habitual. Long-term hospital stays enhance the risk of coming in contact with infected surfaces, healthcare equipment and staff members, two of which can be vectors of transmitting resistant pathogens. It has always been observed that hospital settings are at the center of spreading multidrug-resistant organisms, especially in intensive care units where problems with infection control are more acute (Dancer, 2014).

The abuse and overuse of antibiotics can be listed among the most relevant risk factors with relation to the multidrug-resistant infections. Antibiotic therapy, especially of empirical and broad-spectrum nature, is often started in hospitalized patients prior to specific microbiological identification with the resultant selection pressure favoring the outgrowth of resistant strains. Laxminarayan et al. (2013) highlighted that one of the biggest triggers of global antimicrobial resistance is the issue of inappropriate antibiotic prescribing. On the same note, Ventola (2015) emphasized that long and unnecessary exposure to antibiotics alters the normal microbial flora, which subsequently enables the proliferation of the resistant microbes to be predominant in healthcare facilities.

Another important element which comes along with multidrug-resistant infections is the length of stay in hospital. Hospitalized patients are at increased risk of getting hospital-acquired infections, most of which are caused by drug-resistant organisms including Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa and Acinetobacter baumannii. Studies have suggested that a long hospital stay exposes patients to cumulative exposure to hospital pathogen and invasive interventions in hospitals which in turn increases the risk of infection (Cosgrove, 2006). Moreover, the presence of multidrug-resistant infections is also associated with increased mean hospital stay, and thus there is a bidirectional relationship between infection and length of hospital stay.

Invasive health measures like catheterization, mechanical ventilation, and surgical surgeries are among the factors that have a high risk of multidrug-resistant infections caused. Such operations circumvent the natural body defenses, and offer direct points of entry by pathogens into sterile body locations. Friedman et al. (2002) discovered that healthcare-associated bloodstream infection is closely linked to invasive devices, most of which pertain to resistant organisms. ICUs are especially susceptible to these as there are a large number of these procedures and as the patients are in a dire state.

Factors pertaining to patients are also a very important cause of multi drug resistant infections. People who have weak immune system, chronic diseases like diabetes, cancer or kidney failure or elderly patients are prone to infections and cannot respond well to treatment. Such patients may take a longer duration on antibiotic treatment and be taken to the hospital many times leading to the exposure of the patients to the resistant pathogens (Prestinaci et al., 2015). Host vulnerability coupled with hospital exposure are greatly contributing to the increased risk of multidrug resistance.

Another significant source of transmission of multidrug-Resistant infections is the environmental pollution in the hospital environment. Resistant bacteria can be deposited on hospital surface, medical instruments and wastewater systems longer than between patients. As stressed by Dancer (2014), environmental hygiene is vital in managing hospital-acquired infections because dirty practices of cleaning may keep pools of resistant organisms. Research has demonstrated that some pathogens like Clostridioides difficile and Acinetobacter baumannii have the capability to survive on surfaces over extended periods of time, raising the risk of infection in hospitalized patients.

Beyond the environmental and clinical determinants, practices in the healthcare systems have a huge impact on the occurrence of multidrug resistant infections. Poor infection control, poor adherence to hand hygiene, overcrowding of a hospital and low staffing levels are the causes of the spread of resistant pathogens. Carlet et al. (2014) stated that the problem of antimicrobial resistance is both a medical and a systemic and organizational problem, which necessitates various measures on multiple levels of healthcare provision.

There is an increasing burden of multidrug-resistant infections throughout the world with strong implications to the health of the population. According to Murray et al. (2022), millions of deaths are linked to antimicrobial resistance each year, and one of the significant sources is hospital-acquired infections. The growing proportion of resistant organisms act as a limitation to the available treatment options and often require the usage of last resist antibiotics, which can be less effective and more toxic. This scenario highlights the significance of early detection of risk factors and execution of preventive measures in hospitals.

The antimicrobial stewardship programs have been identified as very important in the fight of multi-drug-resistant infections. Such programs should strive to streamline utilization of antibiotics, minimize redundant prescriptions, and enhance clinical outcomes. There is even some indication that hospitals possessing robust stewardship programs are less likely to deal with resistant infections and prevent a better patient safety outcome (Baur et al., 2017). When implemented together with infection control measures like hand hygiene, isolation programs, and environmental cleanup, stewardship can do a great deal in alleviating the multidrug resistance burden.

Although there have been improvements in research studies and clinical practice, multidrug-resistant infections are still an enemy of research as the interaction between risk factors is complex. The interplay of the antibiotic use, hospital exposure, vulnerability of patients and environmental contamination poses a complex challenge that can only be addressed in multifaceted ways. These risk factors are critical in understanding the nature of effective prevention strategies and enhancing patient outcome in healthcare facilities.

Summing up, multidrug-resistant infections amongst hospitalized patients can be caused by a complex of clinical, environmental, and systemic risk factors. The risk of infections is significantly caused by prolonged hospitalization, improper use of antibiotics, invasive interventions, and comorbidity of the patients. These should be tackled in a holistic approach which needs to incorporate antimicrobial stewardship, tough infection control measures, and effective hospital management system. To learn more about these risk factors and work out more efficient measures against multidrug-resistant infections in the sphere of health care, further research is needed.

LITERATURE REVIEW

Multidrug-resistant (MDR) infections among hospitalized patients have become critical global health issues as they are closely linked with morbidity, mortality, long hospital stay, and escalating health care costs. In recent years, the evidence-based practice has consistently reported the complexity of clinical, microbiological, environmental, and healthcare system-relevant factors as the causes of MDR infections. These infections arise when the pathogens develop multiple resistance to antimicrobial agents and thus these severely restrict treatment affecting clinical management (World Health Organization, 2023). The increasing rates of MDR infections in hospitals demonstrate the biological evolution and the problematic situation within healthcare.

Clinically, MDR infections are especially susceptible to hospitalized patients who are exposed to medical facilities and conditions, troubled by underlying conditions, and subject to extensive medical procedures. Research has revealed that hospital-acquired infections induced by resistant organisms are highly possible through increased hospital stays (Cosgrove, 2006). Critical illness, invasive monitoring, and exposure to multiple antibiotics put patients admitted to intensive care units (ICUs) at an increased risk. Friedman et al. (2002) discovered that health care problems like diabetes, cancer, and renal failure carry with them comorbid situations that predispose the patient in their greater susceptibility towards healthcare associated infections most of which may be multidrug-resistant organisms.

The use of broad-spectrum antibiotics is one of the most significant clinical risk factors reported in literature. Hospitalized patients are usually started on empirical antibiotic therapy without any previous pathogen identification particularly in severe infections. Although such practice is necessary in most instances, it also imposes selective pressure that encourages development of resistant strains (Laxminarayan et al., 2013). As highlighted by Ventola (2015), excessive and inappropriate use of antibiotics affects the normal microbial flora, letting other resistant bacteria, like Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa, prevail. The continued use of antibiotics further predisposes MDR infections especially among critically ill patients.

The microbiological evidence shows that the development of the resistance mechanisms like enzymatic degradations of antibiotics, efflux pumps, and genetic mutations play a significant role in the development

of MDR. Davies and Davies (2010) outlined that such is achieved by having the bacteria rapidly evolve under the pressure of antibiotics, through horizontal gene transfers, which allow the distribution of the resistance genes across species. The development of long-spectrum beta-lactamase (ESBL) producing strains and carbapenem-resistant Enterobacteriaceae (CRE) demonstrates the role of genetic adaptation in the development of hospital-acquired resistance. Tacconelli et al. (2018) also observed that resistance is increasing faster worldwide because of natural selection of bacteria and misuse of antibiotics by humans.

Another significant risk factor that is reproducibly found in the literature is length of hospital stay. The hospitalization has been longer resulting in exposure to resistant pathogens that exist within the hospital setting such as contaminated surfaces, medical equipment, and healthcare personnel. Research has revealed a cumulative effect because the longer the period of being in the hospital, the higher the risk of getting MDR as a result of exposure (Zilberberg et al., 2017). Besides, MDR infections themselves become a cause of prolonged hospitalization, providing a vicious cycle which strengthens the risk of the infection and activates the healthcare burden (Stewardson et al., 2016).

Hospital-acquired environmental pollution is of great significance in dissemination of MDR pathogens. Surfaces within a hospital, bed rails, catheters, ventilators as well as even garbage water systems can serve as reservoirs of resistant bacteria. According to Dancer (2014), poor cleaning and disinfection procedures mainly play a role in the survival and transmission of MDR organisms. Weber et al. (2010) also indicated that the pathogens like Clostridioides difficile and Acinetobacter baumannii are able to survive on surfaces long and enhance chances of cross-transmission among patients. This environmental enshrinement renders controlling of infection to be a central determinant of the rates of MDR infection.

Another important cause of MDR infections is related to healthcare procedures. Invasive equipment like urinary catheters, central venous, and mechanical ventilators circumvent the barrier mechanisms in the body and offer direct access points to pathogens. Research has indicated that MDR organisms have close association with device-associated infections attributed to the presence of biofilms and long-term exposure (Friedman et al., 2002). The highest incidence of such infections is reported in the intensive care units since patients are usually undergoing various invasive interventions All at the same time.

The factors in the healthcare systems also assume the center-stage in MDR infections spread. Poor infection control compliance, overcrowding, insufficiencies in staffing, and the absence of isolation facilities are a major risk of transmission. Carlet et al. (2014) defined antimicrobial resistance as a systemic problem that needs healthcare and policy level responses other than individual clinical responses. Hospitals that perform poorly in terms of infection prevention programs are likely to have higher MDR infection rates owing to irregular hygiene practices, and inadequate surveillance systems.

MDR infections in the hospital setting have been known to have an effective intervention through the introduction of antimicrobial stewardship programs (ASPs). The purpose of these programs is to streamline the process of prescribing antibiotics, making sure that it is the right drug, dose, duration. Baur et al. (2017) discovered that the hospitals that introduced the stewardship interventions had a big decrease in the resistant infections and better clinical outcomes. On the same note, Dyar et al. (2017) highlighted that, with infection prevention measures in place, stewardship programs can considerably decrease the level of antibiotic misuse and resistance formation.

The rising burden of MDR infections is marked by studies conducted across the globe regarding the issue. Murray et al. estimated that millions of deaths in the world were due to antimicrobial resistance, and the significant percentage of them was among the patients of the hospitals (Murray et al., 2022). The paper has highlighted that low and middle-income nations have an unequal share of affordability because of their diagnostic capacity, lack of infection control facilities, and unregulated access to antibiotics. The same observation was made by Prestinaci et al. (2015) who reported that the problem of antimicrobial resistance is a global process that significantly depends on healthcare delivery systems, environmental, and socioeconomic determinants.

Recent literature has also pointed some light at the contribution of hospital microbiomes to the transmission of MDR organisms. The hospital setting is also viewed as a dynamic microbial ecosystem in which resistant bacteria are able to survive and develop. As explained by Naylor et al. (2018), microbial exchange between patients is supported by hospital surfaces and equipment, which, in turn, strengthens the transmission of infection. This observation supports the significance of environmental hygiene as an essential element of the infection control programs.

Age, immune status, and comorbidity are factors of a patient that contribute substantially to the susceptibility to MDR infections. Agreing with this, older patients and patients with chronic disorders can be more vulnerable with immunological weaknesses and frequent contacts with healthcare providers. Friedman et al. (2002) have also showed that the immunocompromised patients develop resistance to bloodstream infections by resistant organisms more than others. Such patients can have a long stay in the hospital and frequent use of antibiotics, which further leads to exposure to the MDR pathogens.

Economic reviews of MDR infections indicate that there is a high cost in terms of finance to healthcare systems. Resistant infections cause high costs of treatment, protracted hospitalization, and greater consumption of costly second and third line antibiotics. According to Dadgostar (2019), antimicrobial resistance is a serious factor that leads to high spending on healthcare, especially when MDR infections are managed in a hospital, where intensive care is required. In countries with limited resources, the economic burden is especially high since the extended stay in hospitals decreases the number of beds and places an additional burden on the healthcare system.

Overall, the literature supports the argument that MDR infections in hospital inmates are contributed by several interconnected risk factors, such as extended hospital stay, improper use of antibiotics, invasions, environmental pollution, and insufficiency of the healthcare system. Microbial evolution and healthcare practices have formed a vicious cycle of resistance and infection. Solving this problem demands a multidisciplinary strategy approaching the needs of antimicrobial stewardship, infection prevention, environmental hygiene, and enhanced clinical management practices.

METHODOLOGY

A quantitative, cross-sectional research design was used in this study to investigate the risk factors in patients with multidrug-resistant (MDR) infections in hospitals. The quantitative design was deemed the most suitable as it allowed systematic measurement and statistical analysis of the variables that included length of hospital stay, exposure to antibiotics, invasive procedures, comorbidities, and how they correlated with outcome of MDR infection.

The researchers carried out the study on the hospitalized patients in the tertiary care hospitals. The adults aged 18 years and above were the target population as those infected after 48 hours had been considered hospital-acquired infections. To guarantee the quality and validity of the information, patients who had incomplete medical records and patients that were discharged in the 48 hours were not included in the study.

The sample population of 300 hospitalized patients was selected by a simple random sampling method on the hospital admission record as well as the infection control record. This sampling technique resulted in all eligible patients having equal opportunity of participating in the study and this minimized selection bias and maximized the applicability of the findings.

Data were gathered by the use of a structured data extraction form that was designed by analyzing the pertinent literature and hospital infection control guidelines. The instrument contained items about the demographic variables (age, gender), clinical (diabetes, cancer, renal disease, immunosuppression), hospital-related (length of stay in hospitals, intensive care, catheterization, mechanical ventilation) and antibiotic use variables (type, length and frequency of antibiotic therapy).

The outcome variable of the report was whether the respondent had multidrug resistant infection or not and this determined was by microbiological culture and antibiotic sensitivity test as indicated by laboratory reports. Independent variables were length of stay at hospital, previous exposure to antibiotics, invasive procedure, comorbid conditions, admission to ICU and exposure to hospital environmental conditions.

To analyse the data; we used Statistical Package for social sciences version 26. Frequency percentages, mean, and standard deviation were used as descriptive statistics to summarize the demographic and clinical characteristics of the participants. Chi-square test as part of inferential statistics was utilised to investigate the relationship between categorical variables and MDR infection status. Moreover they have conducted binary logistic regression analysis to determine the most influential predictors of multidrug-resistant infections having put in place the possible confounders. A p-value that was below 0.05 was taken to be statistically significant.

Data collection had been preceded by the ethical approval of the respective institutional review board. Consent was also sought with the sampled hospitals. As a researcher, patient confidentiality and anonymity were highly observed and all the data were only utilized to the purpose of academic and research. The dataset did not capture any personal identifiers.

This research methodology offered a rigorous and statistically significant methodology of finding important risk factors that are related to multidrug-resistant infections among hospitalized individuals, as a means of advocating evidence-based infection control and antimicrobial stewardship initiatives.

DATA ANALYSIS

SPSS version 26 was used to analyze the collected information on 300 patients hospitalized. Descriptive statistics, chi-square tests, and binary logistic regression were performed to designate important risk factors related to multidrug-resistant (MDR) infections. Dependent variable was MDR infection status (Yes/No) and the independent variables were: length of hospital stay, ICU admission, exposure to antibiotics, invasive procedures and comorbid conditions.

Table 1: Demographic Characteristics of Respondents (n = 300)

Variable	Category	Frequency	Percentage
Age	18–30 years	52	17.3%
	31–45 years	78	26%
	46–60 years	94	31.3%
	Above 60	76	25.3%
Gender	Male	168	56%
	Female	132	44%

Demographic distribution demonstrated that most patients (31.3) were aged 46–60 years, which means that more middle-aged and older adults were hospitalized. The rate of hospital admission between male and female patients differed marginally, with male patients (56) slightly above female patients (44). The prolonged hospitalization and comorbid conditions were more common in older patients, which predisposed them to MDR infections.

Table 2: Clinical and Hospital-Related Characteristics

Variable	Category	Frequency	Percentage
Length of stay	3–7 days	88	29.3%

	8–14 days	110	36.7%
	>14 days	102	34%
ICU admission	Yes	124	41.3%
	No	176	58.7%
Mechanical ventilation	Yes	96	32%
	No	204	68%
Catheterization	Yes	142	47.3%
	No	158	52.7%

Results showed that a high percentage of patients (34%) stayed in the hospital in excess of 14 days. Intensive care unit hospitalisation was noted in 41.3 per cent case and almost half patients were catheterised. These are clinically important factors due to the strong association between hospital-acquired infections and antibiotic resistance with prolonged hospitalization and invasive procedures.

Table 3: Antibiotic Exposure Profile

Variable	Category	Frequency	Percentage
Prior antibiotic use	Yes	210	70%
	No	90	30%
Broad-spectrum antibiotics	Yes	186	62%
	No	114	38%
Antibiotic duration	<7 days	84	28%
	7–14 days	122	40.7%
	>14 days	94	31.3%

Most patients (70%) hadlso been exposed to antibiotics and 62% of the patients were exposed to broad-spectrum antibiotics. The duration of antibiotics use was also a common occurrence. These results indicate a very high trend towards excessive use of antibiotics, very important as one of the conditions that contribute to the development of antimicrobial resistance in the hospital setting.

Table 4: Prevalence of Multidrug-Resistant Infections

MDR Status	Frequency	Percentage
MDR Infection Present	128	42.7%
No MDR Infection	172	57.3%

MDR was common in patients in the hospital, with a prevalence of 42.7, which means that antimicrobial resistance is especially high in the hospital. Such rates of occurrence indicate a clinical emergency in need of prompt infection control measures.

Table 5: Association Between Risk Factors and MDR Infection (Chi-Square Test)

Variable	Chi-square	p-value	Significance
Length of hospital stay	18.45	0.001	Significant

ICU admission	16.32	0.002	Significant
Catheterization	14.28	0.003	Significant
Mechanical ventilation	12.90	0.004	Significant
Prior antibiotic use	22.11	0.000	Highly significant
Broad-spectrum antibiotics	19.67	0.001	Significant

The chi-square test results showed that all the key variables were statistically significant in terms of their association with MDR infection ($p < 0.05$). The closest relation was achieved with previous administration of antibiotics, as this was a case where the patients who had been exposed to antibiotics had the highest chances of getting MDR infections. Other risk factors that were very important included length of hospital stay and ICU admission.

Table 6: Logistic Regression Analysis (Predictors of MDR Infection)

Predictor	**B**	**Odds Ratio (OR)**	**p-value**
Length of stay (>14 days)	1.45	4.26	0.001
ICU admission	1.12	3.06	0.003
Prior antibiotic use	1.78	5.92	0.000
Catheterization	0.98	2.66	0.004
Broad-spectrum antibiotics	1.33	3.78	0.002

In a logistic regression, the model revealed that the previous use of antibiotics was the most significant predictor of MDR infection (OR = 5.92) then long hospital stay (>14 days). The presence of ICU admission and catheterization were also major contributors of MDR infection. This data proved that the existence of the clinical and treatment-related factors was independent and contributed to the development of antimicrobial resistance.

Findings of the current analysis revealed that there was a strong association between multidrug-resistant infections and the hospital-related factors. MDR infections were highly prevalent among patients who were hospitalized long before, indicating that long hospitalization is correlated with the exposure of homeless patients to resistant pathogens and hospital-related infections.

Equally, ICU admission proved to be a major risk. The practice of intensive care units is usually associated with severe-ill patients who have to undergo invasive treatment, receiving mechanical ventilation, and regular use of antibiotics that make infection prone.

The largest risk factor was found to be antibiotic exposure. Patients with prior antibiotic therapy, particularly broad-spectrum antibiotics, were at much risk of getting MDR infections. This confirms a school of thought which suggests that there is selective pressure whereby the antibiotics kill the vulnerable bacteria and those which are resistant survive to proliferate.

Invasive interventions like catheterization and mechanical ventilations were also strongly correlated with MDR infections. These processes interfere with the natural barriers and create easy points of entry by the pathogens, at a higher risk of infection.

All in all, the results indicate that MDR infections are not precipitated by any particular factor and are caused by a mixture of patient, clinical, and hospital environmental-related factors.

DISCUSSION

The current paper examined the risk of multidrug-resistant (MDR) infections in hospitalized patients and defined a variety of clinical and hospital-related determinants that are significant. The results showed a close correlation between MDR infections and long hospitalization, previous exposure to antibiotics and ICU hospitalization as well as invasive interventions including catheterization and mechanical ventilation. They are in accordance with the larger body of literature suggesting that the issue of antimicrobial resistance in hospitals is a complex phenomenon that can be caused by vulnerability of a patient and the clinical practice.

Among the key discoveries of the research was that the correlation between length of hospital stay and MDR infections is significant. Patients with hospital stays exceeding 14 days were estimated to have a much high risk of developing MDR infections as opposed to those who remained in the hospital less than 14 days. This observation is in line with Cosgrove (2006), who pointed out that extended hospital hospitalizations augment cumulative exposure to resistant hospital flora and contaminated surroundings. Long durations also enhance the chances of repetted administration of antibiotics, which also add to the selective pressure and development of resistance. Thus, hospital stay length is not only a risk factor but also a proxy measure of severity of the disease and intensity of exposure.

In this study, prior exposure to antibiotics appeared to be the most effective predictor of MDR infection. There was a very high risk of infection to patients who had taken antibiotics especially that of the broad spectrum type. This is congruent with Ventola (2015), who noted that the misuse and overuse of antibiotics are rated among the main contributors to global antimicrobial resistance. Exposure to antibiotics disturbs the natural microbiota and favors survival of resistant organisms, increasing the risk of infections. Equally, Laxminarayan et al. (2013) emphasized that the development and dissemination of resistant strains in hospitals is enhanced by antibiotic misuse. The present results support the pressing need of employing serious antimicrobial stewardship plans to restrict the prescribing trend of antibiotics.

The MDR infections were also closely related to ICU admission. Friedman et al. (2002) supported this observation since they noted a greater occurrence of healthcare-associated infections in intensive care units because of the severity of patients and the high usage of invasive equipment. ICU patients frequently are immunocompromised and undergo numerous interventions, exposing them to resistant pathogens. Moreover, the large number of patients and the inability to clean the environment in ICU settings have led to the blistering growth of MDR organisms.

Invasive procedures such as catheterization and mechanical ventilation were also noted to be key risk factors of MDR infections. Such operations circumvent the normal body defense functions and offer easy entry points to pathogens. The findings are congruent with those studies that show that device related infections are a significant cause of hospital acquired infections. Urinary catheters and ventilators have been repeatedly associated with the infections of the resistant organism that include Acinetobacter baumannii and Klebsiella pneumoniae. This underscores the need to reduce unnecessary invasive procedures, as well as a strong aseptic methodology in performing the procedures.

This research also noted that hospital systems and the environment are other contributors to the dissemination of MDR infections. Poor cleaning practices, overcrowding and ineffective infection control measures lead to hospital environments being good reservoirs of resistant pathogens. As it was emphasized by Dancer (2014), environment hygiene is crucial in the prevention of transmission of resistant organisms. The present results affirm the same argument that the practice of hand hygiene, disinfection of surfaces on contact, and isolation are all important in the prevention of MDRs.

The other significant thing that was realized during this study is the interrelationship between several risk factors which is synergistic. Long hospital stay, exposure to antibiotics and ICU admission concurrently exposed patients to the risk of MDR infection. It shows that the MDR infections are not caused by a particular factor however it follows the accumulative effect of sumualty of clinical and environmental

exposures. Prestinaci et al. (2015) also emphasized that antimicrobial resistance is a multifactorial phenomenon that is dependent on the combination of microbial, host, and healthcare system factors.

In general, the results of this study can be supported by the existing literature of the world, and they justify the necessity to develop extensive measures of infection control. Such a serious issue as the prevalence of MDR infections in this study demonstrates it has been a severe public health problem, revealing the weaknesses in the practices of antibiotic management and hospital infection prevention. Enhancing antimicrobial stewardship, improving compliance on infection control, and minimizing unnecessary hospital exposure are critical to the decrease in the burden of MDR infections.

CONCLUSION

The conclusion of the study was that multidrug-resistant infections in patients, who are hospitalized, are strongly correlated with a number of interrelated risk factors. Long hospitalization, previous exposure to antibiotics, admission to the ICU, and invasive interventions were found to be the most valuable predictors of MDR infections. Of these, the strongest determinant was the antibiotic exposure meaning the importance of improper antibiotics use in the development of resistance.

The study also concluded that MDR infections are an increasingly emerging healthcare issue that is a product of a combination of factors of patient-related susceptibility, clinical procedures, and hospital environmental factors. The results highlight the point that antimicrobial resistance is no longer a problem, but a system of healthcare organizations.

In general, the research offers a solid argument that infection control strategies and rational use of antibiotics are crucial to minimize the MDR infection burden in the hospital setting. The current MDR infection will keep rising unless timely measures are taken to counter the situation, which would result to an increase in morbidity, mortality, and healthcare expenses.

RECOMMENDATIONS

According to the results of this research, it is possible to suggest the following recommendations:

1. **Enhancing Antimicrobial Stewardship Program**

   Strict policy regarding antibiotic prescribing in hospitals should be adopted and this would help in the rationalized use of antibiotics. The unnecessary broad-spectrum antibiotic should be minimised.

2. **Enhancement of Infection Control Practices**

   Hand hygiene, sterilization and cleaning of the environment should be followed strictly in order to minimize hospital-acquired infections.

3. **Reducing Unnecessary Hospital Stay**

   Long hospitalization caused by delayed diagnosis, poor treatment planning and discharging needs should be minimized.

4. **Monitoring High-Risk Patients**

   The close monitoring of early signs of infection should be done on patients of the ICU, patients with an invasive device, those undergoing long term antibiotics.

5. **Limiting Invasive Procedures**

   The use of catheters and/or mechanical ventilation is only essential in cases of absolute need, and should be withdrawn as soon as possible.

6. **In-service Education of Healthcare Personnel**

The continuous training programs need to be undertaken to enhance the awareness on antimicrobial resistance and infection control measures.

7. **Routine Surveillance Systems**

   All hospitals must have up-to-date surveillance tools to monitor the trends of MDR infections and antibiotic resistance.

8. **Further Research**

   Future research is advised to investigate molecular pathways of resistance and measurement of intervention responses in longitudinal studies.

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