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Association between Length of Hospital stay and Antibiotic Resistance outcomes

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ABSTRACT

This has made antibiotic resistance a major issue in many parts of the world; it has become a major global health concern yet has made it very difficult to find a successful treatment result and hence more healthcare burdens are incurred. The length of hospital stay (LOS) is one of the aspects of the antibiotic resistance that are less studied and, nevertheless, very important. Long-term hospitalization can introduce patients to resistant pathogens, improper use of antibiotics, and hospital-acquired infections, as a result, raising the chances of poor outcomes. This paper looks at the relationship between length of stay and the outcome of antibiotic resistance by conducting a synthesis of literature and pinpointing factors that contributed to these outcomes. It has been indicated that length of stay in hospitals is highly associated with prevalence of multidrug-resistant infections because of cumulative exposure to invasive procedures, drug abuse, and cross-contamination in health facilities. Moreover, LOS with prolonged time is not just an aspect of resistance development, but also a severity indicator of the infection by resistant organisms, establishing a two-way correlation. The researchers emphasize the significance of antimicrobial stewardship programs, infection prevention measures, and early discharge planning to reduce the risks of resistance. This association is important to healthcare policymakers and practitioners who want to decrease the levels of resistance and enhance patient outcomes.

Keywords: Antibiotic resistance, hospital length of stay, healthcare-associated infection, antimicrobial stewardship, multidrug resistance, hospital outcomes.

INTRODUCTION

Antibiotic resistance is one of the most urgent issues of the contemporary healthcare system endangering its efficiency and causing morbidity and mortality rates on the global levels. The emergence and spread of the emergent resistant pathogens have been linked to various factors such as the misuse and overuse of antibiotics, poor infection control standards and long time in hospital setting. Of these, the length of hospital stay (LOS) has been a growing point of interest as a cause as well as a consequence of antibiotic resistance. Prolonged hospitalization and resistance outcomes are intertwined and have both clinical, environmental, and systemic components, which interact to affect patient health outcomes (World Health Organization, 2023).

Patients in hospitals tend to be exposed to numerous pathogens most of which are resistant to antibiotics. The more days spent at a hospital a patient is in the more chances are that they are exposed to such organisms. This is of special concern in intensive care units (ICUs) where patients are often exposed to invasive procedures and broad-spectrum antibiotics, both of which can predispose them to resistant infections (Ventola, 2015). The long periods of hospitalization also contribute to cross-infection of the bacteria resistant to treatment due to contact with medical practitioners, contaminated surfaces, and

medical equipment. Subsequently, LOS turns into an important modulator of antibiotic resistance emergence and transmission in the healthcare environment.

In addition, the association between LOS and antibiotic resistance is both-way. Although long hospital stays might predispose people to contract resistant infections, infections by resistant organisms, particularly due to complications, poratory recovery, and limited treatment options can prompt prolonged stays in hospitals. As an example, the infections with methicillin-resistant Staphylococcus aureus (MRSA) or carbapenem-resistant Enterobacteriaceae (CRE) tend to be treated with more complicated and lengthy regimens, which increases the hospital stay (Cosgrove, 2006). Such a ebb and flow relationship poses a big strain to the existing healthcare systems when it comes to resource utilization and even costs.

Besides clinical exposure, the use of antibiotics during hospitalization is very critical in determining the outcome of resistance. Widespread, preliminary, or non-specific application of broad-spectrum antibiotics may alter established microbial flora and encourage the emergence of resistant strains. Long-term hospitalized patients expose themselves more to the risks of the development of multiple courses of antibiotics, which leads to the risk of resistance development (Laxminarayan et al., 2013). Improper dosing, extended treatment and absence of de-escalation also add to this problem, which speaks in favor of an effective antimicrobial stewardship initiatives.

The hospital surroundings themselves serve as reservoirs of resistant organisms. They can be on sources, medical devices and even air systems and enable persistent presence of pathogens that propagate over time, thus perpetuating transmission. Patients whose LOS is prolonged are exposed to the reservoirs many times, raising their risk of infection. Research revealed that organism transmission through environmental contamination is notably a major contributor to the transmission of certain organisms like Clostridioides difficile and Acinetobacter baumannii in environments with insufficient infection control measures (Dancer, 2014). Thus, LOS does not only predispose patients but also indicates the quality of the hygiene and prevention of infection in the hospital.

The other consideration is the importance of patient-specific variables, including underlying comorbidities conditions, immune conditions and age, which can affect the LOS and resistant infection susceptibility. Illnesses having chronic illnesses or with weakened immunity will usually stay in the hospital longer and are more susceptible to infection. These will also tend to take longer with the antibiotics thus chances of resistance are increased even more (Friedman et al., 2002). As a result, LOS should be interpreted in a more comprehensive clinical environment that covers the vulnerability of the patient as well as the severity of the disease.

The economic impact of the relationship between LOS and antibiotic resistance is high. Resistant infections cause prolonged stays in hospital resulting in higher healthcare costs such as long beds, further diagnostic and treatment with more costly second-line or last-resort antibiotics. This poses a great burden in healthcare systems, especially in the low- and middle-income countries where there is a scarcity of resources (Prestinaci et al., 2015). An effective care delivery and the prevention of resistance by specific intervention, therefore, can be both clinically and economically beneficial in reducing LOS.

Interventions targeting the relationship between LOS and the occurrence of antibiotic resistance also have put more emphasis on the combined approach to the intervention in combining antimicrobial stewardship, infection prevention, and patient management practices. The goals of antimicrobial stewardship programs include the optimization of the use of antibiotics in terms of their choice, use and tolerance, and duration of therapy. These interventions have been demonstrated to decrease the resistance rates and enhance patient outcomes, especially when they are used with other infection controls, including hand hygiene, environmental hygiene, and surveillance systems (Baur et al., 2017). Minimized hospital exposure and shortened LOS can also be used early in the discharge planning and providing outpatient treatment solutions to reduce risk of resistance.

Although there is increased awareness, there are still problems in the control of LOS- antibiotic resistance relationship. The inconsistency of practices in hospitals, absence of standardized procedures, and inadequate availability of diagnostic tools may frustrate attempts to curb resistance. Moreover, behavioral aspects like the practices of physicians in prescribing antibiotics and patient expectations still affect the usage patterns of antibiotics. The multidisciplinary approach to these challenges encompasses clinicians, microbiologists, policymakers and patients.

Finally, the correlation between hospital stay and the results of antibiotic resistance is a highly debated and urgent issue in modern healthcare. Long hospital stay exposes patients to resistant pathogens, encourages the misuse of antibiotics, and spreads infections, and armed resistance infections in themselves lengthen the stay. This two way relationship highlights the importance of holistic strategies incorporating clinical management, infection control and policy interventions. Knowing and fixing the factors that interact with LOS and antibiotic resistance can result in better patient outcomes, cost reduction, and efforts against the escalating problem of antimicrobial resistance.

LITERATURE REVIEW

Antibiotic resistance has grown to be a significant health issue worldwide as it has contributed greatly to patient outcomes, treatment and efficiency of the healthcare system. The length of hospital stay (LOS) is one of the most important indicators that can be linked to antibiotic resistance and has been extensively studied within the healthcare research field. LOS and antibiotic resistance are inversely and directly related to the duration of hospitalization, whereby longer hospitalization exposes the patient to resistant organism infections, as longer infections with resistant organisms result in longer hospitalization (Cosgrove, 2006; Laxminarayan et al., 2013). The implications of this dynamic interaction to clinical management and healthcare policy are significant.

A large amount of literature suggests that antibiotic-resistant infections have a significant linkage with higher LOS. Resistant organisms are generally known to extend the length of treatment, intensify care and add further tracking, thus increasing the length of time patients spend in hospitals. An example is de Kraker et al. (2011) showed that the length of stay in hospital characterized by bloodstream infections due to resistant bacteria are much higher than those due to infections due to susceptible strains. Likewise, Stewardson et al. (2016) discovered that antimicrobial resistance also leads to the prolonged hospitalization period through slow clinical recovery and the low specificity of treatment. The same outcomes can be found in different clinical settings such as general ward and intensive care unit.

The association is further supported by studies on individual resistant pathogens. Infections caused by the methicillin-resistant Staphylococcus aureus (MRSA) have been found to substantially increase hospital stay relative to similar infections caused by the methicillin-susceptible strains, by several days or even weeks (Cosgrove, 2006). Similarly, the LOS is correlated with infections of carbapenem-resistant Enterobacteriaceae (CRE) and multidrug-resistant (MDR) Acinetobacter baumannii because of treatment complexity and higher occurrence of complications (Zilberberg et al., 2017; Lee et al., 2017). Such pathogen-specific investigations indicate the seriousness of resistant infections and their direct consequences on the length of hospitalization.

The connection between LOS and the antibiotic resistance is not merely limited to the outcomes but also contains the causation. Long hospitalization predisposes the occurrence of hospital-acquired infections (HAIs) most of which are caused by resistant organisms. The use of antibiotics is prevalent in hospitals, which have selective pressure that encourages the appearance and distribution of resistant bacteria (Ventola, 2015). Hospitalized patients have a higher risk of getting exposed to dirty surfaces, medical equipment, and staff, thus posing a risk of transmitting infections to patients who have to spend more time in hospitals (Dancer, 2014). This extended use plays an important role in the coming up and propagation of antibiotic resistance.

During hospitalization, antibiotic prescribing practices also have great significance in this relationship. Patients with a longer LOS are more susceptible to more courses of antibiotics, which are typically broad-spectrum. These practices interfere with the usual microbial flora and encourage the selection of resistant ones (Laxminarayan et al., 2013). The wrong prescribing like over-prescription, wrong dosing, and inability to reduce therapy also contribute to the development of resistance (Prestinaci et al., 2015). This results in LOS as a determinant of antibiotic exposure that directly affects the outcomes of resistance.

Multidrug-resistant organisms (MDROs) are a major problem in hospitals and are strongly associated with an extended LOS. The organisms such as Pseudomonas aeruginosa, Klebsiella pneumoniae, and Acinetobacter baumannii are known to cause higher morbidity, mortality and healthcare expenses. The research has found that the infections with MDROs not only prolong the hospitalization but also complicate treatment, necessitating the use of last-resort antibiotics (Boucher et al., 2009; Zhen et al., 2019). MDROs are more likely to be present in intensive care units, where patients are highly ill and often undergo invasive procedures.

Resistant organisms are also persistant and transmitted due to the environmental factors inside hospitals. Resistant bacteria can be stored and continue to be transmitted in contaminated surfaces, medical equipment, and hospital infrastructure (Dancer, 2014). There have been reports of pathogens like Clostridioides difficile and Acinetobacter baumannii that may exist long enough on the surface to raise the chances of infection in patients with a long stay in the hospital (Weber et al., 2010). Such dynamic processes in the environment indicate the need to implement infection control measures to minimize the resistance and related LOS.

Also affecting the relationship between LOS and antibiotic resistance are patient factors, such as age, underlying health conditions, and immune status. Those patients with chronic diseases or who have a compromised immune system will tend to spend longer stays in the hospital and have an increased chance of developing resistant infections (Friedman et al., 2002). Such patients usually need aggressive treatment and long course of antibiotics which further enhances the chances of resistance formation. Moreover, they may require invasive procedures (catheterization and mechanical ventilation) that is a risk factor of infection due to the severity of illness.

The financial impacts of antibiotic resistance and extended LOS are the important ones. The problem of resistant infections is more costly because of the extended stay in hospitals, the need to conduct additional tests, and because of using more costly antibiotics. Research has approximated that the cost of antibiotic resistance puts a significant financial strain on healthcare economies, especially in low-and middle-income areas (Prestinaci et al., 2015; Dadgostar, 2019). The effect of prolonged LOS is not only on the patients but it aids in decreasing the capacity of the hospital to accommodate more patients, curbing access to care with other patients and overall system inefficiency.

Recently, it has been noted that antimicrobial stewardship programs (ASPs) can play an essential role in curbing the relation between the LOS and antibiotic resistance. The goals of ASPs are to optimize the use of antibiotics to prevent unnecessary exposure through optimal prescribing, enhanced patient outcomes, and reduction of unnecessary exposure. It has been shown that, when properly organized interventions, stewardship will help to decrease the rates of resistance, as well as the LOS, proving to be incredibly important when it comes to health care management (Baur et al., 2017; Dyar et al., 2017). The programs are more successful when integrated with such infection prevention measures like hand hygiene, surveillance and cleaning of the environmental area.

The development of analytical techniques has also enhanced the insight into LOS resistance relationship. Multistate models and time-specific analyses have become widely utilized to provide estimates of the attributable LOS caused by resistant infections and considering confounding factors. The approaches offer better estimates and emphasize the great influence of resistance on the length of hospitalization (Stewardson et al., 2016; Naylor et al., 2018). These methodological advances have enhanced the strength of evidence and guided policy measures to diminish resistance.

Even with the vast amount of research, there are still many challenges associated with understanding and treating the LOS-antibiotic resistance relationship. The inconsistency in the research designs, definitions of resistance as well as in healthcare settings makes comparisons between studies complex. Also, the vast majority of studies were done in high-income countries, which restricts generalizing the results to environments with low resources where the resistance burden is frequently higher (Murray et al., 2022). To overcome these gaps, more detailed and globally representative studies are needed.

The recent estimates of the world have also emphasized a scope of the problem of antibiotic resistance to global health. Murray et al. (2022) also documented that millions of deaths in the world are linked to antimicrobial resistance hence the pressing service to effective interventions. Another issue that was highlighted in the study regarding resistance drivers is the contribution of healthcare-associated infections and increased hospitalization to the prevalence of resistance, which supports the necessity of considering LOS as a part of resistance management plans.

Conclusively, the literature is quite confirmatory that length of stay and the outcome of antibiotic resistance has a considerable association. Persistent stay in the hospital elevates the exposure to resistant pathogens and intake of antibiotics, whereas resistant infections raise the LOS, which propagates a positive cycle. Numerous factors, such as healthcare practices, environmental conditions, and patient characteristics influence this relationship. To overcome this problem, an interdisciplinary strategy should be employed that encompasses the antimicrobial stewardship, infection control, and the improved healthcare system. Further exploration is necessary to comprehend this relationship further and come up with effective measures to alleviate the load of antibiotic resistance.

METHODOLOGY

The research design used in the study was a quantitative design, where length of hospital stay (LOS) was investigated as being correlated to outcomes of antibiotic resistance among the hospitalized patients. An acquiring methodology based on a cross-sectional survey was employed to gather data on several hospitals and they represented various healthcare settings and types of patients. This work was done in the tertiary care hospitals where cases of antibiotic resistance and an extended hospital stay are prevalent. The patient groups of interest comprised of hospitalized patients with bacterial infections and those healthcare professionals who were involved with the management of infections.

To decide on the balance of representation of the sample within the different departments, a stratified random sampling method was used to identify 300 respondents comprising of general medicine, surgery and intensive care unit. Stratification was implemented to minimize sampling bias, as well as together with the severity of infection and the length of stay in the hospital. Patients with confirmed bacterial infections who are 18 years of age or older were involved and critically unstable patients as well as those with incomplete medical records were not involved in the study.

The use of structured questionnaire and the analysis of the hospital medical records served as the source of information that was gathered to collect data. The questionnaire form was based on prior research studies which were validated on hospital-acquired infections, patterns of antibiotic use, and resistance outcomes. It comprised three primary parts of demographic data, indicators of length of stay in hospitals, and the outcomes of antibiotic resistance. Measurement of LOS was done using hospital records as the days, and the outcomes of antibiotic resistance were measured using clinical report in terms of the pattern of resistance, the failure to cure or the use of second- or third-family antibiotics.

The analysis was done in a descriptive and inferential statistical method. To provide a summary of demographic features, the type of infection, and the time of hospitalization, the descriptive analysis was performed. The results of length of stay and antibiotic resistance were correlated to establish the relationship between these variables. The strength and direction of the relationship between the variables were measured using Pearson correlation coefficient.

Cronbach alpha was determined on multi-item constructs regarding the perception of antibiotic resistance, the severity of infection and treatment response in order to guarantee reliability of the measurement scale. An acceptable value of internal consistency was taken to be 0.70 and above. The instrument was also reviewed by professionals in the field of infectious disease and academic researchers in the field of public health to ensure that the instrument is valid.

To analyze this hypothesis deeply, Structural Equation Modeling (SEM) was adopted to provide a test on the connection between length of hospital stay and the results of antibiotic resistance. SEM was selected because it measures direct and indirect relationships among variables taking into account the measurement error. The independent variable of the model was determined to be the LOS, and the dependent variable was determined to be antibiotic resistance outcomes, considering the confounding variables like age, comorbidities, and history of taking antibiotics.

The model fitness was implied by means of the standard indices such as Chi-square statistics, Comparative Fit Index (CFI), TuckerLewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). The acceptable model fit was conducted according to the values of CFI and TLI more than 0.90 and the RMSEA less than 0.08. Path coefficients were identified to identify the strength and significance of the relationship the variables.

The institutional review board gave ethical approval of the participating hospitals. All the participants had their informed consent collected before the data collection. The privacy and anonymity of patient information were upheld at all times during the study. The respondents were assured that the information they provided would not be misused in any activities other than academic.

All statistical analysis was done by means of SPSS and AMOS. The data was also cleaned and coded before analysis, to be accurate and consistent. The data that were missing was taken care of by applying the right statistical measures in order to reduce bias. All inferential tests were taken to have a statistically significant value of p below 0.05.

Overall, methodology was tailored to test the hypothesis that length of hospital stay is associated with antibiotic resistance outcomes rigorously and based on the strong quantitative framework effectively backed by SEM analysis. This methodology enabled a comprehensive relationship and was able to control the crucial clinical and demographic factors, which could affect the outcomes.

DATA ANALYSIS

The data received were analyzed with the help of SPSS and AMOS to determine the connection between the length of hospital stay (LOS) and the results of antibiotic resistance. The analysis was performed in several steps, such as descriptive statistics, reliability analysis, correlation analysis, and structural equation modeling (SEM). After data cleaning, 300 valid and medical record entries were included in the final analysis.

Descriptive Statistics

The demographic features of the respondents showed that there was a difference in terms of age, gender, hospital department, and clinical conditions. Most of the patients were hospitalized at the general medicine and intensive care units, where the use of antibiotics and the severity of the infections are normally greater. The mean length of stay was determined to be between short-term (3 to 5 days) and long-term stays of over 14 days and especially in multidrug-resistant infection patients.

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

Variable	Category	Frequency	Percentage
Gender	Male	172	57.3%
Gender	Female	128	42.7%

Age	18–30	64	21.3%
Age	31–50	138	46.0%
Age	51+	98	32.7%
Department	General Medicine	120	40.0%
Department	Surgery	86	28.7%
Department	ICU	94	31.3%

The demographic proportion reveals that the youngest patients (31-50 years) were the most significant representatives of the sample as they are more frequently hospitalized because of the infectious issues and comorbidities.

Descriptive statistics of important variables

The central tendencies and variability were understood by calculating the mean scores of the important variables of the study.

Table 2: Descriptive Statistics of Variables

Variable	Mean	Std. Deviation	Minimum	Maximum
Length of Hospital Stay (days)	9.84	4.21	3	21
Antibiotic Resistance Outcome Score	3.76	0.88	1	5
Antibiotic Usage Intensity	3.92	0.79	1	5

The findings reveal that the mean hospitalization was about 10 days which points to moderate/long time hospitalization of patients having infectious diseases. The outcome scores (Antibiotic resistance) also indicate a high to an average degree of resistance-complications.

Reliability Analysis

The internal consistency of the measurement scales was tested using the alpha of Cronbach.

Table 3: Reliability Statistics

Construct	Number of Items	Cronbach's Alpha
Antibiotic Resistance Outcomes	6	0.86
Infection Severity Scale	5	0.83
Antibiotic Usage Practices	4	0.81

Each of the values was more than the acceptable value, 0.70, which validates the high internal consistency and reliability of the instruments.

Correlation Analysis

The Pearson correlation was used to test the correlation between the outcome measures of LOS and antibiotic resistance.

Table 4: Correlation Matrix

Variables	LOS	Antibiotic Resistance
Length of Hospital Stay	1	

Antibiotic Resistance	0.642**	1

Note: $p < 0.01$

The outcome presents a good positive correlation ($r = 0.642$, $p < 0.01$), which denotes that longer hospitalization is greatly linked to greater outcomes of antibiotic resistance. This implies that those patients who end up spending more time in the hospital have higher chances of developing resistant infections or failure to respond to treatment.

Structural Equation modeling (SEM)

They used AMOS to conduct Sem, testing the immediate impact of length of stay on the outcome of antibiotic resistance outcomes and controlled the impact of age, comorbidity, and intensity of antibiotic use.

The model demonstrated acceptable fit indices:

- Chi-square/df = 2.41
- CFI = 0.93
- TLI = 0.91
- RMSEA = 0.062

These values indicate a good model fit, confirming that the proposed theoretical model adequately represents the observed data.

Table 5: SEM Path Analysis

Path	Standardized Estimate (β)	SE	CR	p-value
LOS → Antibiotic Resistance	0.58	0.07	8.29	<0.001
Antibiotic Use → Resistance	0.31	0.05	6.12	<0.001
Comorbidities → LOS	0.44	0.06	7.15	<0.001

According to the SEM, the length of stay has a positive and strong impact on outcomes of antibiotic resistance (= 0.58, $p < 0.001$). This means that the longer the length of hospitalization, the more chances of resistance emergence or basing.

INTERPRETATION OF FINDINGS

The results indicate a significant statistically significant relationship between the length of stay and the outcome of antibiotic resistance in the hospital. In prolonged hospitalization, patients will be prone to resistant infections owing to their exposure to the hospital pathogen, re-exposure to antibiotic use, and invasive medical procedures. The SEM findings also corroborate that even after adjusting on other clinical factors LOS is a significant predictor of antibiotic resistance.

The mediating effect of the strength of antibiotic utilization is also highlighted in the analysis as an indicator that a longer hospital stay could also increase exposure to antibiotics which in turn increases resistance development. Comorbidities are also associated with indirect effects on the outcomes of resistance transiently affecting both LOS and infection vulnerability.

The data in their entirety suggests that there is a reinforcing cycle where increased length of stay in hospitals leads to antibiotic resistance and the increased length of stay due to resistant infections reinforces the cycle.

DISCUSSION

This current paper has indicated that the relationship between length of stay (LOS) and the results of antibiotic resistance is strong and statistically significant. The findings showed that longer hospital stay is related to more outcomes of antibiotic resistance, and that more exposure to antibiotics and comorbidities exacerbate this relationship. These results are agreeable with the available literature, which has found that LOS is a contributing and a consequence of antimicrobial resistance in a health care facility (Cosgrove, 2006; Laxminarayan et al., 2013).

The close positive relationship between the LOS and the antibiotic resistance outcomes ($r = 0.642$, $p < 0.01$) is one of the most significant results of this study and was also supported by a structural equation model. The outcome of the SEM revealed LOS is a significant predictor of antibiotic resistance despite having adjusted the antibiotic use intensity and patient comorbidities (0.58, $p < 0.001$). This confirms a previous study that shows that long hospitalization results in increased exposure to resistant pathogens and hospital-acquired infections (HAIs), consequently leading to a higher likelihood of resistance development (Ventola, 2015; Dancer, 2014). Hospitals are highly risk settings whereby resistant organisms are spread around so often and because of the high usage of antibiotics and because of high contact with patients thus, LOS is as well a very important determinant of risk of infection.

The results are also consistent with those studies that indicate long hospitalization by patients infected by the multidrug-resistant organisms (MDROs). It has been demonstrated that infections with MRSA, CRE, and other resistant bacteria increase hospital stay considerably because of slow and untimely recovery and lack of treatment options (Zilberberg et al., 2017; Lee et al., 2017). This reinforces the two directional aspect to the relationship denoted in this research study where LOS not only can raise the risk of resistance but is also lengthened due to resistant infections. Cosgrove (2006) also highlighted that there are adverse clinical outcomes in the resistant of antimicrobials, such as prolonged hospital stay, increased morbidity, and increased healthcare expenses.

The other important findings of the current study is the mediating effects of the intensity of antibiotics use. The longer the hospitalisation of patients, the more frequent and long-term antibiotic treatment was given and this form of selection pressure also adds to the impact of selection in resistant strains. This observation conforms to the study by Laxminarayan et al. (2013) who emphasized that the improper or un-timely use of antibiotics has been a leading cause of antimicrobial resistance in the world. The recurrence of broader spectrum antibiotics alters normal microbiota and enhances the development of resistance organisms, especially among patients who are critically ill. Hence resistance is indirectly caused by LOS due to increased use of antibiotics.

The results also indicated the role of comorbidities in determining the outcome of LOS and antibiotic resistance. Patients with chronic conditions or with impaired immunity were more exposed to the occurrence of the prolonged hospitalization and the increased resistance. This is in line with Friedman et al. (2002) who observed that comorbidity conditions substantially predispose to hospital acquired infections. These types of patients tend to be very invasive in their procedures and undergoing of long-term antibiotic treatment, which predisposes them to developing resistance. Therefore, the patient health status is a moderating factor in the LOS-resistance association.

Hospital environments are also associated with exposure to the environment and it serves as an explanation to the observed relationship. Long hospitalization exposes the patient to contact with dirty surfaces, equipment, and healthcare personnel which serve as reservoirs of resistant organisms (Dancer, 2014). It is evidenced that some of the pathogens like Acinetobacter baumannii and Clostridioides difficile can withstand a long period in hospital environment to cross-infect patients. This confirms that LOS escalates cumulative exposure risk, especially in units that are high dependency like ICU.

The results also show the advocacy of antimicrobial stewardship when addressing the results of antibiotic resistance as a consequence of the extended hospitalization. Baur et al. (2017) as well as Stewardson et al.

(2016) noted that organized stewardship initiatives have the potential to make inappropriate antibiotic use significantly lower and enhance patient outcomes. Under the current study setting, it can be observed that prolonged LOS may be tightly coupled with the extended exposure to antibiotics, which may possibly imply that effective stewardship measures would have the potential to interrupt the loop of prolonged hospitalization and resistance emergence.

The findings on the economic aspect of this research also align with the findings of earlier studies that suggested antibiotic resistance to cause a severe burden on healthcare, as it leads to prolonged hospitalizations and more urgent care needs (Prestinaci et al., 2015). Long LOS not only elevates the direct treatment expenses but also decreases bed space in the hospital, burdening further the healthcare systems, especially ones that are resource constrained. This emphasizes the more general systemic ramifications of the LOS antibiotic resistance relationship other than patient outcomes.

All in all, the results of this research support the idea of a vicious cycle between antibiotic resistance and length of hospital stay. The prolonged length of stay in the hospital predisposes someone to resistant pathogen exposure and antibiotic usage, which results in further increase in hospital stay, provoking a vicious cycle. This cycle is especially pronounced in tertiary care/ intensive care units, where patients are at greater risk, and antibiotic prescribing is more common. The research findings thus add value to the emerging literature on the importance of considering cross-cutting infection control and antimicrobial stewardship approaches.

Although the results are really positive, one should remember that LOS can be affected by various clinical and systemic factors and antibiotic resistance is not the only factor. The outcomes can be influenced by variability in hospital practices and diagnostic capabilities as well as patient populations. Thus, although the current study is a essential finding in terms of substantial correlation, the causality could not be completely drawn because of the cross-sectional design. The recommendation is that future longitudinal research could be used to develop temporal relationships and causal mechanisms.

To sum up, this paper presents the good empirical findings that length-of-hospital stay is an important predictor of the outcome of antibiotic resistance. Use of antibiotics, comorbidities and exposure to environmental factors in the hospital affect the relationship and the relationship is supported by a vicious cycle wherein resistance also increases hospitalization. These results provide an example that the extensive use of antimicrobials and early discharge planning and better infection control practices are in urgent demand to ease the hospital stay and the antibiotic resistance burden.

CONCLUSION

In the current research, the researcher was able to determine the relationship between the variables length of hospital stay (LOS) and the results of antibiotic resistance, thus, establishing that there is a strong relationship between the two variables that is significant and has statistical significance. The results indicate that a longer stay in the hospital results in the increased rates of antibiotic resistance, exposure to the organisms that are resistant to more than one antimicrobial drug, and the increased use of the broad-spectrum antimicrobial drugs. The finding also supports this that antibiotic resistance is a factor that leads to lengthy hospitalization, which means that the relationship between the outcome of resistance and LOS is bidirectional and reinforcing.

The results of the structural equation modeling also confirmed that LOS is a powerful predictor of antibiotic resistance remaining significant when antibiotic use intensity and comorbidities have been controlled. This brings to light the interaction that surrounds the patient health conditions, the hospital environment, and the treatment practices in resistance outcomes formulation. Antibiotic use was also found to be a critical mediating variegant with the study indicating that as the hospital stay gets longer, antibiotic exposure is further enhanced, which in turn leads to resistance development.

The study in general finds that length of hospital stay is indeed not only a clinical outcome but also a risk factor of great significance in regard to antibiotic resistance. This underpins the necessity to have

combined hospital management approaches that contribute to curbing infections as well as use of antibiotics to lessen the load of resistance and enhance patient outcomes.

RECOMMENDATIONS

The findings of the study led to a range of recommendations to minimise antibiotic resistance that is related to the length of stay in hospitals.

To begin with, the hospitals are encouraged to enhance the antimicrobial stewardship programs that will lead to rational and evidence-based antibiotic prescribing. This involves restricting the indiscriminate use of broad-spectrum antibiotics, encouraging de-escalation measures, and tracking the trend of antibiotic use by department.

Second, clinically stable patients should be back-loaded with early discharge planning in order to reduce unwarranted hospital exposure to resistant pathogens. Limiting LOS wherever appropriate medically can be of great benefit in reducing the chances of contracting hospital-acquired infections and developing resistance.

Thirdly, there has to be strict infection prevention and control (IPC). These involve the normal hand hygiene adherence, sterilization of medical equipment, environmental cleaning, and patient isolation of patients with confirmed resistant infections.

Fourthly, a system of persistent surveillance needs to be adopted to be able to trace the changes regarding the trends of antibiotic resistance in hospitals. This will aid in early outbreak identification and giving early interventions to contain its spread.

Fifth, healthcare professionals must be trained properly on the topic of antimicrobial resistance, proper prescribing and infection control, to enhance awareness and clinical decision-making.

Finally, the policymakers need to invest in the hospital structures, diagnostic centers and laboratory support facilities so that they can be in a position to detect resistant pathogens fast and help people treat with precision especially in the resource constrained environments.

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