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Misuse of Antibiotics and Potential Economic Loss in Bangladesh

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Abstract
Misuse of antibiotics is a global phenomenon. It is an increasingly serious threat to global public health that requires action across all government sectors and society. This study is an attempt to determine the rate of inappropriate use or misuse of antibiotics and understand potential economic loss in Bangladesh. This study uses simulated patients and they behaved like ordinary patients when they visited the doctors and collected prescriptions from them. The study finds that of total, 71.2% prescriptions contained antibiotic drug. The more the male doctors the higher the prescription of antibiotics. Doctors in sub-district level prescribe more antibiotics than the doctors in Dhaka urban periphery and public hospitals. This misuse of antibiotics has serious potential economic loss as it will lead to the development of antibacterial resistance coinciding with the increase in drug-resistant organisms which may result in the use of more toxic drugs. It will impose unnecessary costs on the patients and obviously reduce productivity of labor which is a very important factor of economic growth thus economic development.
Keywords: Misuse, Antibiotics, Side effects, Economic growth.

1. Introduction

As in all other sectors, the health sector of Bangladesh has also registered a significant improvement since the independence of the country in 1971. Life expectancy at birth is one of three indicators of human development. In 1972 life expectancy at birth was only 46.88 years which has increased to 70.65 years in 1914 (Chowdhury 2015), a remarkable improvement indeed. In Bangladesh demand for medical services among cross section of population has increased significantly due to increased income and enhanced awareness about the importance of a healthy life. On the supply side too there has been a very significant improvement in the access of the general people to medical services both in urban and rural areas. There are now more public and private hospitals and clinics. The sales promotion officers of the different pharmaceutical industries are reaching medicines to pharmacies at different locations of the country.

Both demand and supply side factors have increased people's knowledge about health problems and medical services. There is a lot of room for improving the provision of medical services in the country. One area which needs special attention is the misuse of antibiotics because it creates serious health hazards involves substantial costs. It imposes unnecessary costs on the patients because treatment expenditures increases and raises the costs of overall health care services system. Inappropriate use of antibiotics leads to the development of antibacterial resistance coinciding with the increase in drug-resistant organisms which may result in the use of more toxic drugs. The patients infected with drug-resistant organisms may require hospitalization with longer hospital stay and ultimately die (Currie, Lin and Zhang, 2011). It obviously reduces productivity of labor which is very important factor of economic growth thus economic development. Antibiotics are being prescribed to treat viral infections in many countries though they are supposed to be used for treating bacterial infections (Stephens, 2016).

There are some reasons behind antibiotic abuse. One of the reasons is of demand side and blames the consumer. The argument is that patients think antibiotics as a panacea and demand them even when those are not inevitable (Cars and Hakansson, 1995). Patients often claim newer antibiotics, considering those to be more effective (Bi et al., 2000). When patients demand antibiotics, doctors think it easier to prescribe antibiotics than to explain to the patients why it is not necessary (Schwartz et al., 1998). It is a common practice for patients to request antibiotics from physicians, take newer ones if their conditions do not improve within a few days, and then change the dosage at their own discretion (Li, 2005). Due to consumer misuse, bacteria have become much more resistant to older antibiotics in China than in western countries (Hu, 2008). This further exacerbates antibiotic use and results in a vicious circle of continuous abuse. Alumran et al. (2011) revealed that most parents expect physicians to prescribe antibiotics for their children even when presenting with viral infections. Almost one third of the respondents (adult patients and guardians) presented at the family practice center particularly to obtain antibiotics.

On the supply side, doctors may prescribe more antibiotics because they have lack of appropriate knowledge about proper antibiotic usage (Yao and Yang, 2008), because they expect to prevent potential infections (Dar-Odeh et al., 2010), simply because they believe that is what patients want (Bennett et al., 2010), or hospitals and physicians have substantial monetary incentives to prescribe medications (Currie, Lin and Zhang, 2011). Misuse of antibiotics may cause side effects and drug reactions like adverse gastrointestinal effects (Currie, Lin and Zhang, 2011). The most serious concern now-a-days is that wide spread misuse of antibiotics may contribute to the rise of superbugs that will be resistant to most or all forms of antibiotics and will threaten global health. Misuse of antibiotic is a global phenomenon and it has been widely studied in some countries like China and the USA. In China, rate of misuse of antibiotics is 60%. In USA, the rate is 50% and in Australia, it is 70%.

There is a controversy on whether knowledge of patients on medication options can increase a patient's power over a range of decisions of treatment choice or not. Paluck, et al., (2001) showed that almost all physicians (93.5%) in Canada believed that educating parents about antibiotics and their implications would reduce expectations for antibiotics and minimize the irrational use of antibiotics. Kravitz et al. (2005) found that physicians were significantly more likely to prescribe antidepressants for standardized patients with depression if they made a request for a specific drug. This practice has the potential to both avert underuse and promote overuse. While physicians seem to be responsible for such antibiotic abuse, patients can exert a positive effect on excessive antibiotic prescribing with a show of knowledge about the drug. If patients have more knowledge on antibiotics, it can help reduce the moral hazard brought about by self-interested incentives for physicians (Currie, Lin and Zhang, 2011). Hollon et al. (2003) found that women familiar with osteoporosis drugs had nine times the odds of having bone densitometry performed on them as compared with matched control groups. However, Weissman et al. (2003) showed that, if patients had more knowledge on medical drugs, physicians were more likely to identify new conditions which were often underdiagnosed or undertreated in the general public.

However in Bangladesh the issue, it appears, has not received enough attention from the research community and so adequate number of studies covering key various aspects the issue have not carried out as yet. This study tries to determine the rate of inappropriate uses or misuse of antibiotics and understand potential economic loss in Bangladesh.

2. Methodology

2.1 Study Methods

The study uses both primary and secondary data. Primary data have been collected using simulated student-patients. The study follows two methods to determine misuse of antibiotics: non-experimental method and experimental method. In the non-experimental method, the simulated patients pretended not to know about the side effects of antibiotics, in other words they did not have any knowledge of the adverse effects of antibiotics. They behaved like ordinary patients when they visited the doctors and collected prescriptions from them.

In the experimental method, the idea was to see if knowledge of side effects of antibiotics made any difference in the rate of prescription of antibiotics by doctors. To achieve this objective a pair of two simulated student patients – one without the knowledge of side effects of antibiotics and the other with knowledge of adverse impacts of wrong use of antibiotics visited the same doctor in an interval of around an hour. The one with the knowledge of side effects told the doctor that he was aware of the problems associated wrong use of antibiotics, and one without knowledge did not say anything except registering his health complaints. The experiment was conducted only at Dhaka urban periphery levels.

2.2 Sampling Method and Sample Size

In this study, public hospitals, sub-districts and Dhaka urban peripheries were purposively selected. Prescriptions were collected from doctors. The doctors were selected using simple random sampling method. 428 prescriptions were collected from doctors who were selected using simple random sampling method. The prescriptions were collected through doctors' visits by simulated-student patients: 320 prescriptions under non-experimental method and 108 under experimental method.

2.3 Doctors' Visit and Prescription Collection

For doctors' visit and prescription collection, the undergraduate students of Department of Economics, Southeast University, Dhaka were used as simulated patients. The students were in the age group of 18-22 years. They were healthy and did not suffer from any diseases, they pretended being sick. Information was collected by simulated patients about the doctors using a predesigned questionnaire. The simulated patients did not interview the doctors using the questionnaire; they filled in the questionnaire immediately after visiting the doctors based on their interaction with the doctors and their observation on the behavior of doctors. As a simulated patient visited a doctor, he informed the doctor about his health complaints in the way (Currie, Lin and Zhang, 2011): "For the last two days, I've been feeling fatigued. I have a light fever, slight dizziness, a sore throat, and a poor appetite. This morning, the symptoms worsened, so I took my body temperature. It was 99◦F." The simulated patients were also given the instruction that if the doctor asks about the following symptoms: dizziness, fever, throat-ache and poor appetite, patients should answer "yes"; if the doctor asks about a cough, simulated patients should answer "a little bit". This idea of taking

Very minor symptoms as mentioned above were purposely chosen so that it would be difficult for physicians to determine if the infections were viral or bacterial without further tests. Since antibiotics are only effective in treating infections caused by a bacterium, doctors faced with these vague symptoms would not prescribe antibiotics. Any antibiotic prescription for patients not having bacterial infections represents is a case of misuse or abuse of antibiotics.

2.4 Statistical Tools and Models

The information collected have been analyzed and presented by using simple descriptive statistics. To identify the determinants of prescription of antibiotics two separate regression functions – one under non-experimental method and the other under experimental method- have been estimated. The specifications of the functions are as follows:

Function under non-experimental method:

$Y = \beta_0 + \beta_1 TCP + \beta_2 D_{gen} + \beta_3 D_{age} + \beta_4 E + \beta_5 I + \beta_6 L + \mu$

Where,

Y = Whether antibiotic prescribed, Yes = 1, No = 0, TCP = Total cost of prescription (in Taka), D_{gen} = Gender of doctors (categorical variable), D_{age} = Age of doctors (categorical variable), E = Doctor's education (categorical variable), I = Doctor's interruption (categorical variable), L = Doctor's location (categorical variable), β_0 = Constant, μ = Error term.

Function under experimental method:

$Y = \beta_0 + \beta_1 TCP + \beta_2 D_{gen} + \beta_3 E + \beta_4 K + \mu$

Where, K = Patient's intervention (categorical variable)

Both qualitative and quantitative data have been used in the functions. Dependent variable is qualitative in the functions. Logit model is used in this study. The data of dichotomous variables have been used on the basis of two values, say, 1 if the event occurs and 0 if the event does not occur. The coefficients of regressors show log of the odds ratio where odds ratio refers to the ratio of the probability that the event will occur to the probability that the event will not occur.

3. Definition of Terms

Simulated Patient: A simulated patient is a person who is not actually sick but acts as a patient for an audit study.

Antibiotics: Antibiotics are a type of antimicrobial used specially against bacteria, and are often used in medical treatment of bacterial infections.

Misuse of Antibiotics: Misuse of antibiotics is the use of antibiotics generally for curing viral infections rather than for bacterial infections. It may also mean inappropriate and inadequate doses and use of incorrect type of antibiotics.

Dhaka Urban Peripheries: The areas of Dhaka city outside the central Dhaka where physicians provide outdoor medical services at their chamber at drug stores.

Sub-district: Upazilas are third tier government administrative units. They are also a kind of growth centers facilitating trade and commerce in the area of their jurisdiction. Average size of population in an upazila is around 0.32 million.

Public Hospitals: These are funded and managed by the government. All public hospitals are attached to government medical colleges.

4. Findings and Discussion

4.1 Age, gender and educational qualification of Doctors

As can be seen in Table-1, close to 55.90% of the 320 doctors visited by our simulated patients are relatively young belonging to age group 20 to 40 years. Only 10.6% are over age of 50 years.

Table-1: Age, gender and educational qualification of Doctors

Age of physician, Years	Gender of the physician			Education of Physicians		
	Female	Male	Total	MBBS	MBBS plus postgraduate degree/fellowship	Total
20-30	1 (0.30)	19 (5.90)	20 (6.20)	20 (6.25)	0 (0.00)	20 (6.25)
31-40	16 (5.00)	143 (44.70)	159 (49.70)	140 (43.75)	19 (5.94)	159 (49.69)
41-50	4 (1.20)	105 (32.80)	109 (34.10)	79 (24.69)	30 (9.38)	109 (34.06)
>50	0 (0.00)	32 (10.00)	32 (10.00)	0 (0.00)	32 (10.00)	32 (10.00)
Total	21 (6.60)	299 (93.40)	320 (100)	239 (74.69)	81 (25.31)	320 (100)

Note: Figures in parenthesis show percentages

Overwhelming majority of doctors are male being 93.4% which reveals that the practicing doctors are predominantly male. Among the doctors visited, 74.69% are with MBBS degree while 25.31% have MBBS plus postgraduate degree/fellowship. This indicates that the majority of doctors do not have specialized degrees.

4.2 Rate of Antibiotic Prescription

As Table-2 reveals that of the 320 prescriptions collected by our simulated patients, 71.2% contained antibiotics drug. The rate indeed is very high especially when we consider the fact that the patients were simulated ones with good health. They just pretended being sick. Among the three locations, the incidence of antibiotics prescriptions appears highest, being 91.2% at sub-district level followed by Dhaka urban area being 74.5%. The rate of antibiotics prescription appears lowest at public hospitals being 32.7%. None of our simulated patients asked for antibiotics nor they had any symptoms of bacterial infections. Doctors themselves prescribed antibiotics. The doctors at public hospitals levels appear less influenced by supply side factors to prescribe antibiotics than those at Dhaka urban area and sub-district levels. In fact, public hospital doctors generally do not have the usual incentives for prescribing antibiotics- they use public hospital offices as their chambers, drugs including antibiotics are supplied free of costs to patients.

Table-2: Rate of antibiotics prescriptions

Locations	Did not prescribe	Prescribed	Total
Public hospitals	35	17	52
	(67.3)	(32.7)	(100)
Sub-district	6	62	68
	(8.8)	(91.2)	(100)
Dhaka urban area	51	149	200
	(25.5)	(74.5)	(100)
Total	92	228	320
	(28.8)	(71.2)	(100)

Note: Figures in parenthesis show percentages.

The supply side factors seem to work very strongly at sub-district level where doctors work in more relaxed environment and treat generally the less informed and less aware patients. At the Dhaka urban area level too, supply side factor appears to influence the doctors' decision to prescribe antibiotics to patients.

4.3 Knowledge intervention and prescriptions of antibiotics

The results, as presented in the table-3, show that the patients' knowledge about the side effects of antibiotics has reduced the rate of prescription of antibiotics but not to the extent as one might expect. The rate of antibiotic prescription for with knowledge patients was 75.9%, while for without knowledge the rate was 85.2%. It appears that the supply side factors had stronger influence on the prescription of antibiotics than the knowledge of patients about the side effects of antibiotics.

Table-3: Knowledge intervention and prescriptions of antibiotics

Knowledge intervention	Prescriptions of antibiotics		
	Did not prescribe	Prescribed	Total
Without knowledge	8 (14.8)	46 (85.2)	54 (100)
With knowledge	13 (24.1)	41 (75.9)	54 (100)
Total	21 (19.4)	87 (80.6)	108 (100)

Note: Figures in parenthesis show percentages.

4.4 Generation of Antibiotics Prescribed in Bangladesh

As resistance to antibiotics grows, more and more powerful antibiotics are produced and used. In Bangladesh, the production and use of 4th generation of more powerful and more expensive antibiotics have been started. The study finds that the doctors in public hospitals in Dhaka prescribed mostly 2nd generation of antibiotics, rarely of 3rd generation and none of 1st generation of antibiotics. The rate of prescription of 3rd generation of antibiotics has been found to be higher in Dhaka urban peripheries than that at sub-district level.

4.5 Antibiotics Cost Per Prescription

Antibiotics generally are more expensive than other medicines. The present study made an attempt to find the cost of antibiotics per prescription. As table-4 shows, cost of antibiotics is highest at sub-district level being TK. 276.8 and lowest at Dhaka urban periphery being TK. 182.20. In public hospital the cost is TK. 229.75 which appears higher than one would expect.

Table-4: Per prescription antibiotic costs

Locations	Range (tk.)	Average cost (tk.)
Public hospitals	70 – 700	229.75
Sub-district	35 – 980	276.81
Dhaka urban periphery	10 – 700	182.20

4.6 Determinants of Antibiotics Misuse: Econometric Analysis

A logistic model is supposed to fit data in a more statistically meaningful way if it demonstrates an improvement over the intercept – only model- the model but predictor. Such an improvement is statistically examined by various inferential statistics that includes the Likelihood ratio, and Wald tests. The Likelihood Ratio test is a test based on the difference in deviancies: the deviance without any predictor in the model (or the intercept-only model) minus the deviance with all predictors in the model. The Wald test is obtained from a vector-matrix calculation that involves the parameter vector, its transpose, and inverse of its variance matrix (Hosmer and Lemeshow, 2000 cited in Peng and So, 2002).

4.6.1 Non-experimental model

In case of 'non-experimental model', regression results show that chi square has 9 degrees of freedom, a value of 73.625 and a probability of $p < 0.000$. Thus, the indication is that the model has a good fit.

Table-5: Estimation of Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	73.625	9	.000
	Block	73.625	9	.000
	Model	73.625	9	.000

Table-6: Summary of non-experimental model

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	310.310[a]	.206	.294

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The value of -2 Log likelihood ratio is 310.310. It is very high and it indicates that the model has fitted the predictors adequately. Nagelkerke's R square is normally higher than the Cox and Snell measure. In non-experimental model it is 0.294 which indicates that the relationship between the predictors and the prediction is 29 percent.

Table-7: Estimation of Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	16.990	8	.030

In case of goodness-of-fit, Hosmer and Lemeshow Chi-square Test value is 16.99 with probability of $p < 0.030$ which indicates the good fit of the model.

Table-8: Statistical estimation of Wald chi-square test

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 0	Constant	.908	.124	53.991	1	.000	2.478

In this model (Table-8), the value of Wald Chi-square test is 53.99 which is statistically highly significant with p value of 0.000, which means that the null hypothesis that the constant equals to zero should be rejected. The following table shows how the values of the categorical variables are handled.

Table-9: Categorical variables-non-experimental model

Variables		Frequency	Parameter coding		
			(1)	(2)	(3)
Age of doctors	<30	20	.000	.000	.000
	30-40	158	1.000	.000	.000
	41-50	108	.000	1.000	.000
	>50	34	.000	.000	1.000
Doctors' location at three different levels	Public hospitals	52	.000	.000	
	Upazila	68	1.000	.000	
	Dhaka urban periphery	200	.000	1.000	
Interrupted by the doctors	No	239	.000		
	Yes	81	1.000		
Doctor's education	MBBS	239	.000		
	MBBS plus Postgraduate degree/Fellowship	81	1.000		
Gender of doctors	Female	21	.000		
	Male	299	1.000		

The following table-10 shows that the total cost of prescription is statistically significant at 1% level. If total cost of prescription increases by 1 taka, prescribing antibiotics increases by log odds of 0.002 remaining other variables constant. It means that the relationship between total cost of prescription and rate of antibiotics prescription is positive. In case of gender, if the doctor is male rather than female, prescribing antibiotics increases by log odds of 0.850. The more the male doctors the higher the prescription of antibiotics.

Table-10: Non-experimental Logistic model of prescribing antibiotic rate

Variables	B	S.E.	Wald	Sig.	Exp(B)
Total cost of prescription	.002	.001	8.004	.005	1.002
Gender of Doctors(1)	.850	.502	2.876	.090	2.341
Age			5.305	.151	
Age(1)	1.243	.567	4.797	.029	3.465
Age(2)	1.162	.594	3.832	.050	3.196
Age(3)	1.480	.743	3.963	.047	4.393
Doctors' education(1)	-.410	.339	1.463	.226	.663
Doctors' interruption(1)	-.325	.318	1.041	.308	.723
Doctors' location			23.179	.000	
Doctors' location(1)	2.434	.573	18.072	.000	11.404
Doctors' location(2)	1.656	.390	18.024	.000	5.239
Constant	-2.864	.783	13.394	.000	.057
Dependent variable: Prescription of antibiotics					

Though the results show that overall categorical dummy variable of doctor's age is not statistically significant but individually different categories are found statistically significant at 5% level.

If doctors are in the age group of 30-40 years versus the doctors of age < 30 years, prescribing antibiotics increases by log odds of 1.243. If doctors are of age 41-50 years old versus the doctors of age < 30 years, prescribing antibiotics increases by log odds of 1.162. If doctors are of age 51-60 years old versus the doctors of age < 30 years, prescribing antibiotics increases by log odds of 1.480. The estimation indicates that there is positive relationship between doctors' age and prescription of antibiotics. Although doctors' education is not statistically significant in prescribing antibiotics, but a negative association is revealed between education and antibiotics prescriptions. If the doctors are with higher than MBBS degree relative to those with only MBBS degree, prescribing antibiotics decreases by log odds of .410. This finding may mean that higher education increases the diagnosis capability of doctors. Moreover, higher education, on one hand, adds social values, and on the other hand, increases economic benefits to the doctor. A doctor with higher education usually charges higher for the first and consecutive visits than a doctor with only MBBS degree. So, the supply side factors may have less influence in cases of the doctors with higher education.

If the doctors interrupt during the registration of chief complaints by the simulated patients, prescribing antibiotics decreases by log odds of .325 relative to when doctors do not interrupt. The finding indicates that interruption works as a tool of diagnosis. The interrupted simulated patients are scrutinized relatively more than the uninterrupted patients which may reduce the rate of antibiotic prescription. Overall locations of doctors are highly significant at 1% level. If doctors are in sub-district level versus in public hospitals, prescribing antibiotics increases by log odds of 2.434 and if doctors are in Dhaka urban periphery versus in public hospitals, prescribing antibiotics increases by log odds of 1.656.

4.6.2 Experimental model

In case of 'experimental model' regression results show that chi square has 4 degrees of freedom, a value of 55.016 and a probability of $p < 0.000$. Thus, the indication is that the model has a good fit.

Table-11: Estimation of Omnibus Tests of Model Coefficients

	Chi-square	Df	Sig.
Step	55.016	4	.000
Block	55.016	4	.000
Model	55.016	4	.000

The value of -2 Log likelihood ratio is 51.387 which is high and indicates that the model has a good fit. Nagelkerke's R-square is normally higher than the Cox and Snell measure. Nagelkerke's R-square is the most reported of the R-squared estimates. In experimental model it is 0.637 which indicates that the relationship between the predictors and the prediction is 64 percent.

Table-12: Summary of experimental model

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	51.387[a]	.399	.637
a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.			

In case of goodness-of-fit, Hosmer and Lemeshow Chi-square Test value is 9.325 with probability of $p < 0.316$. The justification of the overall goodness-of –fit of econometric model should not be based on only the value of Chi-square test (Bhattacharya and Dey, 2014).

In this model, however, the Hosmer and Lemeshow Chi-square Test is found statistically non-significant (Table-13), but from classification table-14 it is found that 92.6 percent cases were correctly classified and thus the estimation of the experimental model is acceptable.

Table-13: Estimation of Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	9.326	8	.316

The value of Wald Chi-square test is 34.177 (Table-14) which is statistically highly significant with p value of 0.000.

Table-14: Statistical estimation of Wald chi-square test

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 0	Constant	1.421	.243	34.177	1	.000	4.143

The table-15 shows how the values of the categorical variables for experimental model are handled.

Table-15: Categorical Variables- experimental model

		Frequency	Parameter coding
			(1)
Knowledge intervention	Without knowledge	54	.000
	With knowledge	54	1.000
Gender of doctors	Female	6	.000
	Male	102	1.000
Doctor's education	MBBS	59	.000
	MBBS plus Postgraduate degree/Fellowship	49	1.000

Table-16 shows that when the simulated patients intervene with knowledge on the negative consequences of antibiotics, prescribing antibiotics decreases by the log odds of only 0.717 relative to when patients do not intervene.

Table-16: Experimental Logistic model of prescribing antibiotics rate

Variables	B	S.E.	Wald	Sig.	Exp(B)
Total cost of prescription	.018	.004	18.318	.000	1.018
Gender of doctors(1)	6.013	2.493	5.817	.016	408.884
Doctors' education(1)	-.492	.755	.424	.515	.611
Knowledge intervention by simulated patients(1)	-.717	.740	.939	.332	.488
Constant	-7.973	3.003	7.052	.008	.000
Dependent variable: Prescription of antibiotics					

Knowledge intervention is not statistically significant but its expected negative association means that supply side factors are more dominating than the demand side factors in prescribing antibiotics.

4.7 Potential Economic Loss Due to Misuse of Antibiotics

The problems associated with such misuse of antibiotics, among other things, include the following:

a) It imposes unnecessary costs on the patients because treatment expenditures increases and raises the costs of overall health care services system which ultimately decreases living standard of people.
b) Misuse of antibiotics causes side effects and drug reactions like adverse gastrointestinal effects. In China, it was estimated that between 2001 and 2005 there were 14,738000 incidents of moderate to severe antibiotic adverse drug reactions yearly and 1,50,000 patients died (Currie, Lin and Zhang, 2011). Treating these reactions cost 0.43 to 2.04 billion US$.
c) Inappropriate use of antibiotics leads to the development of antibacterial resistance coinciding with the increase in drug-resistant organisms which may result in the use of more toxic drugs. The patients infected with drug-resistant organisms may require hospitalization with longer hospital stay and may ultimately die. A list of the antibiotic resistant pathogens and the corresponding diseases in Bangladesh are listed below:

Table-17: Antibiotic resistant pathogens in Bangladesh

SL	Pathogens	Diseases
1	Salmonella typhi	Typhoid
2	Styphimurium	
3	Shigella dysenterae type	Diarrhoea
4	Neisseria gonorrhea	Gonorrhoea
5	Staphylococcus species	Abscess
6	Enterococcus species	Meningitis
7	Mycobacterium tuberculosis	Tuberculosis
8	Streptococcus pneumonia	Pneumonia
9	Plasmodium species	Diarrhoea
10	Nosocomial pathogens	Hospitalized Infection
11	Pseudomonas spp	Skin and trachea Infection
12	Acinetobacter spp	Respiratory diseases (Bronchitis and asthma)
13	Klebsiella spp	Diarrhoea

d) The most serious concern now-a-days is that wide spread misuse of antibiotics may contribute to the rise of superbugs that will be resistant to most or all forms of antibiotics and will threaten whole health care system in Bangladesh. It will impose unnecessary costs on the patients and obviously reduce productivity of labor which is a very important factor of economic growth thus economic development.

5. Conclusion

Based on the above findings and the discussions made earlier, the study concludes that there exists a high rate of antibiotics misuse in Bangladesh- patients' knowledge intervention although has some positive influence on the rate of antibiotics misuse; the influence is not very significant. The supply side factors appear to have dominated the high rate of antibiotics misuse in the country. This misuse of antibiotics has serious potential economic loss as it will lead to the development of antibacterial resistance coinciding with the increase in drug-resistant organisms which may result in the use of more toxic drugs. It will impose unnecessary costs on the patients and obviously reduce productivity of labor which is a very important factor of economic growth thus economic development. If this misuse rate is not reduced substantially on an urgent basis, it is going to affect personal health of citizens and jeopardize the county's public health system, thus economic growth and development.

Recommendations

Bangladesh should prepare a comprehensive policy containing detailed guidelines for producers of antibiotics, hospitals, doctors and users of antibiotics; and start vigorous educational and motivational campaigns among producers, physicians and general public about the dreadful consequences of misuse of antibiotics.

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