

Extent of Medication Wastage and Cost among Female Students in a University Setting

S. E. Ali and M. I. M. Ibrahim*

Social & Administrative Pharmacy Discipline, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800 Minden, Penang, Malaysia

Abstract

Medicine wastage poses a significant health problem. Unused medication endangers human life and health, results in non-optimal utilization of resources and causes considerable loss of money. Due to these issues, a study was conducted to identify the extent of medicine wastage in a university campus, the cost and to examine the behaviours of the students as drugs consumers that contribute to such wastage. A prospective descriptive, cross-sectional survey was conducted from February to June 2005 in the Universiti Sains Malaysia main campus among female students (undergraduates and postgraduates). A total of 481 single female respondents were targeted for a questionnaire-based survey on randomly sampled students. Data was analyzed by using descriptive and non-parametric statistics. Results showed that the total number of medicines found was 1724 different types of medicines. The average number of medicines found per student was 4 medicines with an estimated average cost of RM23.94 per student. The total cost of all left over medicines found was estimated to be RM11,515.40, while the original cost of all medicines supplied based on pharmacy retail price was RM24, 294.84, hence an estimated of 47.41% cost of supplied medicines were wasted. It was revealed that vitamins & minerals (24.8%) were of the highest number and costs followed by gastrointestinal tract drugs (17.3%) and analgesic & antipyretics (17.0%). Common reason for unused medicine was 'just stop taking medicines' (89.8%). In conclusion, the study found that female students in USM main campus kept a total of RM11,515.4 worth of medication that were not consumed. The study proposed that education and awareness programs should be implemented among university students.

Key words: Social-behavioural, survey, female students, Universiti Sains Malaysia (USM), medicine wastage, medicine cost

INTRODUCTION

A sizeable percentage of total health care costs are explained by the increase expenditures on drug prescriptions. The rise in the cost of medicines is often linked to factors such as higher medical service utilization rates, irrational medicine use as well as consumer behavioural aspects that lead to wastage. Globally more than 50% of all medicines are prescribed, dispensed or sold inappropriately, while 50% of patients failed to take them correctly¹. Irrational

medicine use is a major public health problem worldwide, with extensive economic implications². Thus, improving medicine use would have important financial and public health benefits³⁻⁶. Medicine wastage is defined as "any drug product, either dispensed by prescription or purchased over the counter (OTC), that is never fully consumed"⁷. This definition explicitly pertains to partially or totally unused medicines as well as expired medicines.

*Corresponding author: Social & Administrative Pharmacy Discipline, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800 Minden, Penang, Malaysia. E-mail: mohamedizham@yahoo.com

Medication wastage is major burden on the fiscally restrained health care system even in a university setting such as the Universiti Sains Malaysia (USM). Thus, appropriate medication use and prescription is needed to decrease costs attributable to such waste. There are many factors contribute to medication wastage. They include excessive and irrational prescribing, consumers' attitudes and behaviours towards prescribed medicines like poor compliance to prescriptions, storage of medicine and other patterns of self-medication practice^{8,9,7,10}. As such, many responsible parties are seeking ways to reduce the amount of unnecessary medicine consumption. These, include clamping down on the irrational use of medicines and influencing public behaviour towards medicine use.

The total number of patients with specific diseases who visited the USM Health Centre during 2002 had increased by approximately 11% from 2001. The estimated total cost of medicines in Malaysian Ringgit spent for the treatment of different pharmacological cases amount to RM360,606.82. In the period from January 2001 to March 2003, the amount of money expended on medicines by the Health Centre and its pharmacy for students totalled RM70,931.16. There exists a pattern of escalating medicine expenditure despite diminishing income in the USM Health Centre. For instance, in 2002, medicine expenditure increased by 47.5%, health care fees collected from students only increased by 1.8%. In fact, a detailed comparison between fees collected and medicine expenditures for the years 2001 and 2002 revealed an increase in expenditure of approximately 201% and 301%, respectively. It is clear from the above data that there has been a substantial increase in medicine expenditure and clinical visits during the last few years with students counting for the largest share. This would eventually lead to budgetary shortfalls as expenditure outstrips income.

Based on these preliminary findings, a study was designed with the intent of using socio-economic description to identify the extent of medication wastage in USM main campus and to assist in reducing the

high expenditure incurred due to non-optimal medicine consumption patterns by USM students. The study was designed to help policy makers in USM to stem this escalating cost. A survey was conducted and it was aimed to examine medicine use behaviour patterns among USM students who, to some extent, are representative of the general public in terms of race, culture and behavioural pattern. The survey also describes the types and extent of medication wastage in USM and analyzes this wastage economically. Information obtained from this study will help in the identification of target groups and types of medicines implicated in medicine wastage. This information can then be used to develop interventions and educational programs.

MATERIALS AND METHODS

Study design

A non experimental, descriptive and cross-sectional study design was chosen as the means to investigate the type and extent of medicine wastage among students in the USM main campus. The data collected basically focussed upon out-patient drug prescriptions issued by the USM Health Centre, USM panel of private clinics and pharmacies, the Penang Government Hospital and to a lesser extent those issued by other private sources. Data were collected by visiting the students in their rooms and through face-to-face interview.

Study location

USM is one of the four universities in Malaysia that have been earmarked as research-intensive universities. In 2005 about 30,000 students were enrolled in USM. The total number of students in the main campus in the same year is about 23,269 students with male students accounted totally to about 8,894 students and female students amounting up to 14,375 students. The main health care services are provided by the USM Health Centre.

Study population and sampling

The target population in this study was female students. This population was

chosen due to the increase number of female students in the main campus nowadays. Moreover, in an attempt to control for data collection variations and medicine investigation mistakes, the data collection and interviews were done solely by the researcher (the researcher is a female). Thus, researcher primary prepared lists of female student's addresses (room numbers) that have medicines with them to facilitate the interview visits. The study was conducted from February to June in 2005 in the USM main campus. The estimation of the sample size necessary for this study was done utilising specific sample size equation and the researcher assumed a higher prevalence (0.80) of medicine wastage among the students. The total number of subjects estimated by the equation was 512 and data was estimated to be 95% accurate with an 80% power for generalising the findings. A two stage cluster random sampling sample technique was used. Stage 1 involved the selection of the relevant hostels through simple random sampling and stage 2 involved the selection of female student respondents from within these selected hostels through simple random sampling technique.

Study instruments

A letter explaining the purpose of the study, a pre- tested questionnaire (pilot tested in 30 female students), a 2-pages data-collection form to detail information about the medication taken and plastic bags to collect unused (left-over) medicines were distributed to the selected female students. The questionnaire addressed aspects of medicine wastage, students' behaviours and attitudes, the direct total cost and reasons of medication wastage.

First section of the questionnaire was intended to profile the demographic background of female students. Second section evaluates medicine consumption and the economic implications of medicine use and wastage. The data was compiled utilising a specially designed (pre-tested) data- collection form which was modified from one used in a previous study. The form recorded information about the types of medicine found in the respondents

premises, the reasons for their presence, the type of and the information on the medicine packages (labels). The information recorded for each medicine collected comprised of its name, code, class, strength, dosage form, source, manufacturer, original number of units (tablets, capsules, etc.) or volumes (ml), amount remaining unused (partially used), cost of unused portion, totally unused medicine, cost of totally unused medicine, reasons for unused medicine, medicine label, manufacturing date, expiration date, total cost of expired medicines, total number of medicines per student, total cost of medicines (original) and total cost of all unused medications.

The study was approved by the USM School of Pharmaceutical Sciences Postgraduate Studies Board and top management of the university.

Variables under study

In addition to demographic data, the study examined many medicine wastage variables like direct medicine costs of unused medicine (partially used, totally unused or expired medicines) plus types of drug classes that involved in medicine wastage and reasons that mentioned by students for not fully consuming their medications. Besides, some other variables describing student's general health conditions and health services that provided to the students by USM clinics. In addition to other variables that were assumed to have a direct impact on medicine consumption and wastage. These variables comprised behavioural patterns e.g. self-medication practices, medication storage by students, medicine discontinuation pattern and student's non-compliance to medicine which are not fully presented in this article. The direct adjusted medicines costs were estimated and adopted from the sources of the prices which are: Health Center medicine price list, panel clinics medicine price list, Penang Government Hospital medicine price list and an average medicine price list of 4 panel community pharmacies adjacent to USM main campus. All direct costs are only descriptive and are approximately or an estimation of costs attributable to medication

unused. The expiration of medicine was decided based on the expiration date recorded in the package.

Data analysis

The collated data was processed using the Statistical Package for Social Science (SPSS®) software program for Windows® version 12.0. The sorting of student's medications or pharmaceutical products into therapeutic classes was done using the Microsoft® Excel program. The different pharmaceutical products obtained by prescription from USM clinics were categorized under 14 major therapeutic and pharmacological classes according to the classification of drugs procedure outlined in the Malaysia Index of Medical Specialists (2004). Quantitative data was processed and analysed using the appropriate descriptive statistics such as frequencies, means, standard deviation (sd), medians and cross-tables. Apart from this, appropriate non-parametric statistical tools were utilised for data that were not normally distributed (skewed), where applicable. Data normality was tested by using probability plot (P-P plot). The statistical significance level (α) was 0.05 with confidence interval of 95%.

category while 8.7% (n=42) were aged between 25-30 years old. The remaining 2.1% (n=10) were aged between 31-54 years. The mean \pm sd age was 22.1 ± 3.3 . In terms of ethnic background, 54.7% (n=263) of the respondents were of Malay, while 30.8% (n=148) of Chinese origin and Indians constituted 9.8% (n=47).

Among the undergraduate students, 24.5% (n=118) were from the first year cohort while 23.5% (n=113) were from the second year cohort. The remaining 21.8% (n=105) were from the third year and 16.6% (n=80) were from the fourth year cohort. Out of 65 postgraduate students, 58 were MSc students and 7 PhD students.

Data in Table 1 shows that the total number of medicines found with single female students in different years of study were significantly different ($p=0.028$).

The total number of medicines found unused was 1724 drug products. Of them, 82.4% (n=1421) of the medications prescribed were of brand names. Only 17.2% (n=297) of the medicines found were of generic names while 0.4% (n=6) of the medicines were unlabelled. In addition to 6.2% of the whole medicines found were traditional herbal medicines. Table 2 shows the total number of medicines found and their estimated costs.

Table 1. Comparing between single female student's years of study and total number of medicines found (n= 481)

Year of study	Total number of medicines			p value*
	Number of students	Median	Mean \pm SD	
First year	118	3.00	3.87 \pm 3.38	0.028
Second year	113	3.00	3.46 \pm 2.70	
Third year	105	3.00	3.26 \pm 2.50	
Forth year	80	3.00	3.60 \pm 2.80	
Postgraduates	65	3.00	3.78 \pm 2.17	
Total	481	3.00	3.58 \pm 2.80	

*Kruskal- Wallis test at $\alpha = 0.05$

RESULTS

The number of undergraduate (n=416) plus single postgraduate (n=65) female students surveyed totalled 481 respondents (response rate approximately 94.0%). Respondent ages varied from 19 to 54 years old. 89.2% (n=429) of the students were categorised in the 19-24 years age

The percentage cost of all medicines collected was 47.4% from the original amount, while the percentage cost of medicines which are totally unused was 7.8%. The percentage cost of expired medicine was 1.2% and the number of medicines found unused per student were 3.60 medicines (approximately 4 medicines) and their cost was RM23.94.

Table 2. Extent of medication wastage and costs (n=1724 medicines)

Item	Total number of medicines (%)	Estimated costs in RM*
1. Number of partially used medicines	1435 (83.2)	RM9,325.52
2. Number of totally unused medicines (from their original amount)	249 (14.5)	RM1,898.91
3. Number of expired medicines	40 (2.3)	RM290.97
4. Total number of all medicines found with the students	1,724 (100.0)	RM11,515.40
5. Total cost of all prescribed medicines in original amount (n=1724)		RM24,294.84

*All values in (RM) Malaysian Ringgit (US\$1=RM3.37 in year 2005).

Table 3 shows the types and estimated costs of the 8 therapeutic classes of medicines found with the students. These classes of medicines constituted 1623 items out of the total of 1724 medicines (94.1%). The most commonly medicines found with the students (around 60%) were vitamins & minerals, gastrointestinal drugs, and analgesic & antipyretics.

In terms of dosage forms, 68.5% (n=1181) of the medications were in the form of tablets and pills while capsules constituted 14.6% (n=252) of the overall amount. Five percent (n=87) of the medicines were in the form of syrups and suspensions while 4.9% (n=84) were creams and ointments. Less than 1.0% (n=5) consisted of inhalers, with suppositories accounting for 0.2% (n=4) of the overall total. Table 4 shows the different sources of medicine found and their costs.

In term of medicine label information, medicines concentrations were provided in 52.8% (n=910) of the medicines found while medicines concentrations were not mentioned in the remaining 47.2% (n=814). Original prescription units or volumes were clearly written in 96.5% (n=1663) of the medicines found. In addition, the expiry dates were not stated in 79.2% (n=1366) of the medicines found. 98.9% (n=1705) of the medications were inadequately or incompletely labelled with only 1.1% (n=19) being fully and comprehensively labelled.

Table 5 illustrates the main reasons single female students mentioned for not completing their medications and their average costs. Nearly 90% of the students mentioned 'medicines just discontinued/stopped' as reason for not completing their medications. It costs more than ten thousand ringgit for approximately one thousand five hundred items.

Table 3. Costs of 8 therapeutic classes of medicines (Total number of medicines, n=1724 medicines)

Therapeutic class **	Total no. of medicines (%)	Cost of medicines found with the students (RM [*])	Cost of the whole medicines based on the retail pharmacy price (RM [*])
Vitamins & minerals	427 (24.8)	3,480.30	7,880.47
Gastrointestinal drugs	298 (17.3)	1,861.79	3,995.33
Analgesic & antipyretics	293 (17.0)	1,627.10	3,300.71
Antibiotics	174 (10.0)	1,156.30	2,497.31
Ear, nose & throat drugs	159 (9.2)	960.62	1,760.51
Respiratory drugs	106 (6.3)	569.42	1,547.19
Dermatological products	97 (5.6)	981.18	1,374.20
Anti-rheumatic & anti-inflammatory	69 (4.0)	312.68	716.22
Others (CNS drugs, endocrine & metabolic drugs, cardiovascular drugs, genito-urinary drugs, and others	101 (5.8)	566.01	1,222.90
Total	1,724 (100.0)	11,515.40	24,294.84

**Classification is according to Malaysia Index of Medical Specialities (MIMS)

*RM=Malaysian Ringgit

Table 4. Medicine sources and average costs (n=1724 medicines)

Medicine source	Total number of medicines (%)	Average cost (RM)
1. USM Health Centre	1,231 (71.4)	8,820.40
2. Panel clinics	465 (27.0)	2,322.00
3. Panel pharmacies	23 (1.3)	373.00
4. Un-identified source	5 (0.3)	NA [*]
Total	1,724 (100.0)	11,515.40
5. Other private pharmacies	399 (64.1)	3,192.35
6. Shops	179 (28.7)	NA [*]
7. Penang Government hospital	45 (7.2)	297.00
Total	623 (100.0)	3,489.35

*NA= the prices not available

Table 5. Reasons for disuse of medications and average costs (n=1724 medicines)

Reason mentioned	Number of Medicines (%)	Average cost (RM)
1. Medicines just discontinued/stopped	1,548 (89.8)	10,340.64
2. Medicine not needed any more (patient cured)	67 (3.9)	447.56
3. Medicines increased or decreased by the prescriber	45 (2.6)	300.60
4. Medicine changed by the prescriber	33 (1.9)	220.44
5. Medicine expired	29 (1.7)	192.80
6. Patient (student) transferred to hospital	2 (0.1)	13.36
Total	1,724 (100.0)	11,515.40

DISCUSSION

This study focuses on the most common problem of inappropriate medicine use by consumers namely unused medications and wastage. As mentioned above medicine wastage is defined as “any drug product, either dispensed by prescription or purchased over the counter (OTC), that is never fully consumed”⁷. The wide availability and accessibility of medications and their prescription in all USM related clinics and pharmacies may contribute to increased risk of medicine wastage.

The reason for the selection of more female respondents was due to the fact that the total number of female students in the university was nearly double the number of male students. In addition, several studies have reported that young women are more likely to use prescription medications than young men^{11,12}. Besides, different studies reported that despite the high consumption of medications by women than men, mounting evidence shows that they respond differently from men to certain medications (e.g. the effect of their hormonal levels)¹³. Therefore, the study of their knowledge, attitudes and behaviours about medicine usage is essential.

Among the therapeutic classes of medicines found, vitamins & minerals costing RM3480.30 constituted the largest proportion. This finding can be attributable to the free prescription of these medicines to students and also due to the perception that the respondents needed these types of

energetic medicines for overall health and effective study. Through discussion with students, the authors were told that this medication is widely used during examination week. A similar perception was found in other studies¹⁴⁻¹⁷. This finding is also similar to other study reported that nutritional supplements (e.g. vitamins & minerals) usage was more prevalent among women than in men (42% vs. 30%) especially in the 20-29 years age groups¹⁸. GIT-drugs and analgesic & antipyretics were the second most prescribed medicines and they cost RM1861.79 and RM1627.10, respectively. In a study conducted in 2001, it was found that analgesics were the most commonly returned and higher than predicted¹⁹. This was the case in our study as female students stocked and uses excessively analgesics mainly for headache and their monthly pain (menstrual pain). A similar finding was found in Finland, where the use of analgesics by female conscripts (15-24 years of age) was 44.5%²⁰. Furthermore, cross-sectional survey conducted in 2003 across 28 countries found that more girls than boys used medicine for pain²¹. Antibiotics and other anti-infections constituted 10% of the unused prescribed medicines and cost RM1156.30. This finding is significant as the non-utilisation of antibiotics due to social and behavioural factors is one cause of antibiotic resistance in developing countries^{15,22-26,30}. It is clear from the data that the four categories, vitamins& minerals, GIT-drugs, analgesic & antipyretics and antibiotics collectively represent approximately

70% of the total cost of wasted medication. Finally, the data also revealed that multivitamins, vitamin C, vitamin B-complex, antacid tablets and suspension, paracetamol and mefenamic acid tablets as well as cephalexin and amoxicillin capsules were the common types of medications wasted.

In term of preparations, tablets and pills dosage forms were the most predominant medicine type found with single female students, followed by capsule dosage forms and syrups and suspension dosage forms. Creams & ointments constituted a small percentage. A community study in USA revealed some similarity in the result of type dosage forms of the returned unused medicine²⁷. Tablets, pills and capsules are more common among students because they are easy to storage and in their opinion that these dosage forms can last long.

The study noted that the top four major medicine sources were the USM Health Centre probably due to its proximity to the respondents followed by panel clinics due to their accessibility after office hours and during emergencies. Next, private community pharmacies were the source of a considerable proportion of medicine found due to the students' tendency of purchasing prescription only medicines or OTC medicines without a prescription or without the advice of qualified pharmacists. Another interesting finding was that shops were sources of some medicines found. This is significant as the purchase of medications from these sources without expert advice have potentially serious health consequences^{28,29}. Medicine that students purchased from shops included analgesics, vitamins & minerals, nutritional supplements, skin products, herbal tonics (e.g. Ginseng containing products) and some herbal pain killers. This type of self-medication practice by purchasing medicines from community general shops and other in-formal sources are common in developing countries⁹.

The premature discontinuance of medicine use attributable to neglect involved a total of 1548 medicines (89.8% of the overall total). This is a major problem leading to medicines wastage as reported in USA in 2005 that "29% of Americans stop taking their medicine before it runs out while 22% took less medication than prescribed on the

label"³¹. Among the other reasons for premature discontinuation cited were full recovery and medicines not being needed any more due to full recovery, changes in dosage prescriptions, changes in the type of medicine prescribed due to the lack in the efficacy of the original medication, and expiry of the prescribed medicines.

The health policy of the university during the study period allows the students to visit the health centers and panel of private clinics without limits. Such policy will create unlimited access, unnecessary visits to the health institutions and promotes irrational use of medicines. Medicines wastage can be avoided if such policy be relooked and strengthened. When the medicines are at the hand of the individuals, wastages can be reduced through health education and creating health awareness.

Study Limitation

The study limitations though not pervasive did pose a problem in data collation as they pertained to issues such as language, information bias and sampling restrictions. Lack of fluency in English among respondents, harboured a risk of information bias. Second limitation pertained to the information bias as their awareness of the objectives of the study led certain segments of the respondents to deliberately underestimate their actual amount of unused medicines in order to avoid negative implications. Thirdly, the sampling of only female students made it impossible to generalize the results to the whole student population in the campus.

Recommendations

The study attributed the wasted medicine to inappropriate medicine usage which in turn is attributed to the lack of medicine information knowledge and to unrestricted availability of medicines. Thus, policy makers in USM should initiate targeted, problem-based educational programmes conducted by professionals, particularly for female students in the early years of study. They should also conduct regular continuing education programs in order to disseminate adequate information about medications and their use. As stated in the findings that

one of the main source of medicines is the university clinic, therefore it is recommended that doctor and pharmacist should prescribed and dispensed amount of medicines appropriately according to the severity of the illness; not excessively. The pharmacy or dispensary unit in all health institutions can also print the cost of the medicines dispensed on the package so that this will create awareness among patients on the actual cost of medicines dispensed to them. It will make them appreciate the amount and cost of medicines actually consumed by them.

CONCLUSIONS

The results clearly indicate that in the USM main campus, medicines wasted by female students was a significant issue. Approximately RM11,515.40 worth of medicines were wasted. The large number of drug products found with USM female students clearly manifested this trend. Most of the medicines were vitamin and minerals, obtained mainly from USM Health Center, and in tablets and pills dosage forms.

ACKNOWLEDGEMENT

The authors would like to thank to all respondents who have agreed to participate in this study and to the management of Universiti Sains Malaysia who has allowed us to conduct this study in the campus.

CONFLICT OF INTEREST

The researchers would like to declare that there is no conflict of interest in this study.

REFERENCES

1. World Health Organization (WHO). Promoting rational use of medicines: core components. WHO Policy Perspectives on Medicines. Geneva: World Health Organization; 2002. p.1-6.
2. Ambwani S, Mathur AK. Rational Drug Use. *Health Administrator* 2007; 19(1):5-7.
3. Tepper CD, Lied TR. Trends in Medicaid prescribed drug expenditures and utilization. Health Care Financing Review San Francisco: Look Smart, Find Articles (FindArticles™); 2004. p. 69-78.
4. Fairman KA. The effect of new and continuing prescription drug use on cost: A longitudinal analysis of chronic and seasonal utilization. *Clin Ther* 2000; 22(5):641-652.
5. Morgan SG. Quantifying Components of Drug Expenditure Inflation: The British Columbia Seniors' Drug Benefit Plan. *Health Services Research (HSR)* 2002; 37(5):1243-1266.
6. Hart RJ, Marshall FSV. Wastage of Pharmaceuticals. *Lancet* 1976; 308(7997): 1239-1240.
7. Abou-Auda HS. An economic assessment of the extent of medication use and wastage among families in Saudi Arabia and Arabian Gulf countries. *Clin Ther* 2003; 25(4):1276.
8. Grand AI, Hogerzeil HY, Haaijer-Ruskamp FM. Intervention research in rational use of drugs: a review *Health Policy Plan* 1999; 14(2):89-102.
9. Hardon A, Hodgkin C, Fresle D. How to investigate the use of medicines by consumers. Amsterdam: WHO; 2004.
10. Abahussain E, Matowe L, Nicholla PI. Self-Reported Medication Use among Adolescents in Kuwait. *Med Princ Pract* 2005; 14(3):161-164.
11. Roe Cm, Mcnamara Am, Motheral Br. Gender-and age-related prescription drug use patterns. *Ann Pharmacother* 2002; 36(1):30-39.
12. Caces MF, Harford TC, Aitken SS. Prescription and non-prescription drug use: A longitudinal study. *J Subst Abuse* 1998; 10(2):115- 126.
13. Correa-De-Araujo R. It's Your Health: Use Your Medications Safely. *J Womens Health* 2005; 14(1):16-18.
14. O'dea JA. Consumption of nutritional supplements among adolescent: usage and perceived benefits. *Health Education Research (Theory & Practice)* 2003; 18(1): 98-107.
15. Kim SH, Han JH, Keen CI. Vitamin and mineral supplement use by healthy Teenagers in Korea: motivating factors and dietary consequences. *Nutr* 2001; 17(5):373-380.
16. Ayranci U, Son N, Son O. Prevalence of nonvitamin, nonmineral supplement usage among students in a Turkish university. *BMC Public Health* 2005; 5(1):47.
17. Neuhouser MI. Dietary Supplement Use by American Women: Challenges in Assessing Patterns of Use, Motives and Costs. *J Nutr (JN)*. 2003; 133(6):1992S-1996S.

18. Dickinson A. Who uses vitamin and mineral supplements? people seeking A healthier lifestyle. The benefits of nutritional supplements 2002 [cited 2004. 2nd March 2004]; Available from: http://www.crnusa.org/benpdfs/CRN011benefits_whovms.pdf
19. Cromarty E, Dawnie G. Drug Wastage-What is Acceptable? *The Pharmaceutical Journal (PJ)* 2001 200; 267(7167):424.
20. Linden K. A pharmacoepidemiological Study of Medicine Use Among Finnish Conscripts. Helsinki: Association of Military Medicine in Finland and Research Institute of Military Medicine in Finland; 2005.
21. Hansen EH, Holstein BE, Due P, et al. International Survey of Self-Reported Medicine Use Among Adolescents. *DICP* 2003; 37(3):361-366.
22. Hasan MY, Das M, Mourad F. Drug utilization and antibiotic use in the primary health care centres in Sharjah. *Eastern Mediterranean Health Journal* 1997; 03(03):444- 451.
23. Kapil A. The challenge of antibiotic resistance: Need to contemplate. *Indian J Med Res* 2005; 121 (2):83-91.
24. Datta A. Drug resistant bacteria, killer at large. The Hindu- online edition of India's National Newspaper 2001 [cited 2006. 2nd May 2006]; Available from: <http://www.hinduonnet.com/2001/07/26/stories/08260008.htm>.
25. Okeke IN, Lamikanra A, Edelman R. Socioeconomic and Behavioral Factors Leading to Acquired Bacterial Resistance to Antibiotics in Developing Countries. *Emerg Infect Dis* 1999; 5 (01):18-27.
26. Salvatierra-González R, Guzmán-Blanco M. Pan American Conference on Antimicrobial Resistance in the Americas *Epidemiol Bull* 1999; 20(2):6-7.
27. Garey KW, Johle MI, Behrman K, et al. Economic Consequences of Unused Medications in Houston, Texas. *Ann Pharmacother* 2004; 38(7):1165-1168.
28. Smith F. Community pharmacy in Ghana: enhancing the contribution to primary health care. *Health Policy Plan* 2004; 19 (4):234- 241.
29. Dengeler R, Roberts H. Adolescents' use of prescribed drugs and over- the-counter preparations. *J Public Health Med* 1996; 18(4):437-442.
30. Levy SB. The Challenge of Antibiotic Resistance. *Scientific American Magazine* 1998 [cited 2004. 4 June 2004]; Available from: http://arizona.edu/Courses/Ecol409_509/levy.pdf
31. Murphy RT. Taking Your Medicine Can Reduce Health Care Costs. Murphy. House.gov/UploadedFiles/HealthCareFYI_25.pdf 2005 [cited 2006. 5 December 2006]; Available from: <http://murphy.house.gov/News/DocumentSingle.aspx?DocumentD=35114>.