MEDICAL GRAND ROUNDS

Parkland Memorial Hospital

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REVIEW OF ANTIBIOTIC UTILIZATION

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Trends in the rational utilization of antimicrobial agents have been highlighted by a number of events and publications. Soon after the introduction of antibiotics, pharmaceutical companies and the journal Antibiotic Medicine and Clinical Therapeutics heralded the "new antibiotic era" as they promoted the "fixed dose" combinations of antibiotics (1). Dr. Max Finland, joined by other investigators, attacked this irrational concept in an editorial in 1957 entitled "The New Antibiotic Era: for better or for worse?" (2). Following this editorial and congressional investigations, the FDA changed the manner of licensing new antimicrobial agents and investigators changed the manner in which they presented reports on evaluations of new antibiotics. The next stage of development was the attempt to bring order out of the chaos of a long list of antimicrobial agents and a multiple of infections for which these agents might be indicated. Such program was initiated locally by presentations at previous Grand Rounds by Dr. Sanford which culminated in the first edition of the Guide to Antimicrobial Therapy published in 1970. Recently, programs have been devised which examine the use of antibiotics, such as detailed by Drs. Kunin and Craig in Use of Antibiotics and by Simmons and Stolley in an article entitled This is Medical Progress? (3,4). Interest in the rational utilization of antibiotics has received further stimulus from the Federal government which wishes to achieve a more economical use of its drug expenditures. Recent HEW regulations just issued state that only generic drugs will be reimbursed for medicare patients and that Peer Review boards be established which would include an examination of utilization of antibiotics.

Questions have been raised about antibiotic usage:

1) What are the trends of antibiotic usage?
2) To what degree has the use of antibiotics contributed to the increased cost of medical care?
3) Are antibiotics used without obtaining proper bacterial cultures?
4) To what extent have antibiotic agents been prescribed that are unwarranted on the basis of expense or of toxicity?
5) Are antibiotics used excessively in prophylactic situations?
6) Has the ecology of hospital-acquired infections changed because of antibiotic usage?

1) Trends in Antibiotic Usage

Although antibiotics have been available for greater than 25 years, evidence indicates that their usage has increased rapidly within the past 10 years. Data indicated that the use of antibiotics is increasing more rapidly than the growth of the U.S. population or of patient's visits to Doctors' offices (4). Sufficient quantities of antibiotics are produced annually in the United States to treat each person for two illnesses per year (5). The greatest increase in prescriptions has been for the broad and medium spectrum antibiotics, which includes ampicillin and the cephalosporins. Presently, up to 1/3 of hospital pharmacy budgets represent antibiotics, and the cephalosporins and aminoglycoside antibiotics account for 2/3 of the total cost of antibiotics in hospitals (3).

Does such prescribing of antibiotics represent overuse? Evidence which indicates that indeed antibiotics are over-prescribed include studies which

reveal that many patients visiting physicians' offices for the treatment of the common cold receive antibiotics (Table 1) and a majority of patients receiving antibiotics in hospitals have no evidence of infection (6,7). These studies have also indicated that antibiotics are frequently administered without taking a culture or prescribed by telephone without examining the patient. Situations in which antibiotics are utilized with no evidence of infections include prophylactic therapy for surgical procedures such as tonsillectomies, hernia repair, vasectomies, and other similar surgical procedures. (Table 2).

Table 1 (Ref.4)

—Treatment of the Common Cold in the Physicians' Offices, January 1972-December 1972*

Type of Drug	% Patients† Visiting a Physician and Receiving a Prescription or Drug
Broad- or medium-spectrum antibiotic	28
Oral cold preparation (antihistamine and decongestant)	33
Penicillin	21
Cough preparations	12
Cold and cough preparations	16
Nonnarcotic analgesics	7
Topical nasal and ophthalmic preparations	6
Sulfonamides	2
Antihistamines	6
All others	12

Table 2 (Ref.4)

—Operations and Antibiotic Treatment, 1972*

	Total No. of Operations	% of Patients Given Antibiotics
Appendectomy (with no perforation)	331,000	46
Cholesystectomy	396,000	45
Hysterectomy		
Abdominal	470,000	47
Vaginal	204,000	57
Inguinal hernia repair (nonrecurrent)	476,000	16
Tooth extractions	48,000	38
Tonsillectomy and adenoidectomy	692,000	26

2) Adverse effects of antibiotics

The change in the ecology of hospital infections with the emergence of of the gram-negative organisms which are resistant to multiple antibiotics has been documented extensively (8-11). It is presumed that the major factor responsible for the changing ecology is the selective pressure of antibiotics. Documentation of the influence of antibiotics on this ecology is illustrated by the study by English investigators who demonstrated a significant increase in antibiotic-resistant gram-negative bacilli in sewage recovered from hospitals compared to that obtained from the community at large (12). In addition, numerous epidemics have occurred in hospitals with organisms resistant to a single or multiple antibiotics and the epidemics have been stopped by removing the principal antibiotic in question from use in the hospital (13-17). The major fear in our hospital presently is that a significant number of gram-negative organisms will appear with resistance to gentamicin.

Patients can expect more adverse reactions with over-utilization of antibiotics. Up to 5% of hospitalized patients treated with antimicrobial agents experience a reaction (18). Rates were particularly high with ampicillin and furadantin (19-20). A major problem that existed in the past was the severe and often fatal complications following the administration of

chloramphenicol (21-22). Although this reaction was a rare event, occurring in 21,000 administrations (22), the widespread use of the drug frequently for non-indicated situations increased the total number of complications. An example today of a potential complication which would increase if the drug were over-utilized is the development of renal failure following the administration of gentamicin. This has been shown by Dr. Ed Goodman in a prospective study to occur in of 25% of those receiving the drug (23).

3) Criteria for Appropriate Antibiotic

In order to assess prescribing practices for antimicrobial agents at the Dallas V.A. Hospital (DVAH), we established the following criteria for the appropriate use of antibiotics.

a) Appropriate cultures must be obtained for the patient's clinical problem. This means obtaining appropriate cultures prior to the administration of antibiotics.

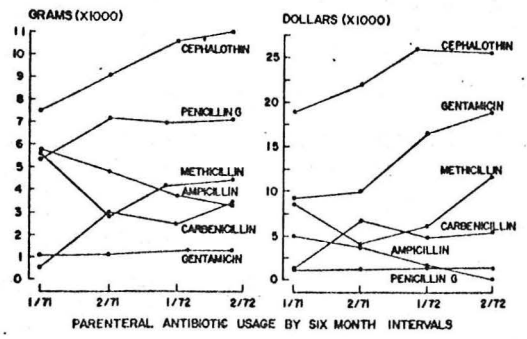
b) Choose the appropriate antibiotic. The Guide to Antimicrobial Therapy has detailed lists of the antibiotics for the appropriate clinical condition. Criteria for the appropriate agents must consider risks to patient in choosing the most effective antibiotic. For example, one would choose gentamicin for a person presenting with possible gram-negative sepsis, but would not choose it for the treatment of asymptmatic bacteriuria. In addition, one should consider the expense to the patient and the toxicity of the agents. Also, antimicrobial agents should only be utilized for very specific indications for which they are indicated.

c) Administer the antibiotic properly. This includes choosing the correct dosage for that agent and choosing the correct interval for the infection.

4) How Can Utilization Be Evaluated?

In designing a program to encourage better antimicrobial usage, concepts may be borrowed from older epidemiologic programs such as those for the prevention of nosocomial infections. Two fundamental concepts used in these programs are the principles of surveillance and control. There are two potential methods for the surveillance of antibiotic usage: 1) quantitive and 2) qualitative. The former one simply measures amounts and/or cost of antibiotics used and may be handled quite easily with modern data processing. Figure 1 depicts the results of a study such as this (3).

Fig. 1



PARENTERAL ANTIBIOTIC USAGE BY SIX MONTH INTERVALS

Table 3

Qualitative Surveillance of Antibiotic Utilization

Reference	Type of Hospital	Antibiotics	Duration Months	Number Patients	Number Orders	Personnel	Results	
							% Quality	Cost
6	Community (Seven)	All	19	1608	2094	Physicians (Center for Disease Control)	62% of patients had no evidence of infection (range 25-75%)	--------
7	Community	All	1	340	--	Pharmacists Physicians	13% rational 21% questionable 66% irrational	Total: $18,224 Rational:$1,677 Questionable:$2,578 Irrational:$13,989
3	University	All	3	500	227	Physicians	49% appropriate 52% inappropriate	--------
24	Pediatric	penicillin ampicillin cephalosporins	2	167	177	Pharmacists	32% rational 49% questionable 19% irrational	--------
25	Community	gentamicin	?	100	--	Physicians	29% for specific culture result 4% prophylactic 67% empiric (23% without cultures)	--------

Problem areas may be identified when utilization patterns vary from local or national standards. In addition, trends affected by control measures may be followed. Qualitiative studies measure not only the amount of antibiotics being used, but also how they are being used. These studies are demanding, requiring extensive data collection and analysis. Only a few have been reported (Table 3). The results are remarkably similar although conducted at different types of hospitals by different investigators using different criteria and methods. It appears that the majority of inpatient antibiotic orders are unnecessary or improper. Because we were somewhat dubious that these results applied to our institution, we decided to evaluate local antibiotic usage.

5) Surveillance of Antibiotic Utilization at Dallas V.A. Hospital

A six-week survey was conducted at the Dallas V.A. Hospital. Primary data collection and evaluation was performed by residents in hospital pharmacy using specially designed data collection forms. These forms contained sections for recording information about 1) general patient information, 2) classification of infection, 3) antibiotics and their dose, route, freeuency and duration, 4) surgical procedures, 5) graphic temperature chart, 6) laboratory results and 7) an abstract of the progress notes.

A physician and then a Ph.D. clinical pharmacist independently evaluated the collected data. Each course of antibiotics was placed in one of eight categories:

Categories
of Antibiotic Utilization

I - Appropriate
II - Probably appropriate
III - Inappropriate,
more effective drug recommended
IV - Inappropriate,
less expensive/toxic drug recommended
V - Inappropriate,
improper dosage
VI - Unjustified,
length of treatment incorrect
VII - Unjustified,
the use of any antimicrobial is not indicated
VIII - Records insufficient for categorization

In the Antibiotic Utilization study at the Dallas V.A. Hospital, only 40% of the orders were appropriately administered (Categories I and II) - Table 4. A majority of orders on Medicine service were appropriate, but appropriate orders varied on surgery specialties from 0 to 45%. A total of 33% of the orders were considered unjustified (Categories VI and VII) or an excess cost of $3,982 (Table 5 and 6) for the 6 week period. The next most common error was the imappropriate choice of antibiotic, either on basis

TABLE 4

Utilization of Antibiotics at DVAH by Service

Service	Total Orders	Categories I %*	II %	III %	IV %	V %	VI %	VII %	VIII %	Category Total
Medicine	95	60	1	3	13	10	0	12	2	95
Surgery Specialties										
General	133	32	13	17	11	6	13	12	2	140
Ortho	58	31	2	2	17	14	14	22	2	60
Plastic	30	0	0	0	20	27	20	57	0	37
Thoracic	32	16	9	0	19	0	9	50	0	33
ENT	29	7	0	7	3	10	24	38	0	32
Oral	8	12	25	0	0	12	25	25	0	8
Surg-Subtotal	290	26	8	9	13	10	15	26	1	310
% of Total		34	6	8	13	10	11	22	1	
TOTAL	385	132	24	29	49	37	43	86	5	405

* % refers to % of orders in that category of total categorizations.

TABLE 5

COST OF INAPPROPRIATELY ADMINISTERED ANTIBIOTICS BY SERVICE

Service	Category			
	IV	VI	VII	VI,VII
Medicine	$634	0	87	87
Surgery, General	431	403	599	1002
Ortho	212	188	247	435
Plastic	114	133	199	332
Thoracic	151	23	469	492
ENT	2	475	152	627
Oral	0	1	6	7
Surgery Total	910	1224	1671	2895
TOTAL	$1544	$1224	$1758	$2982
% of Total Antibiotic ($7646)	20%	16%	23%	39%

TABLE 6

COST OF ANTIBIOTICS BY INAPPROPRIATE CATEGORY AT DVAH

$ per category (Total Cost=$7646)

	IV	VI	VII	Total VI,VII	% Unjustified Cost
Penicillin	$91	$38	$20	$20	<1%
Cephalosporins	$984	$380	$1245	$1625	57%
Macrolides	$203	$627	$406	$1033	34%
Other	$265	$190	$89	$279	9%

TABLE 7

Utilization of Individual Antibiotic at DVAH

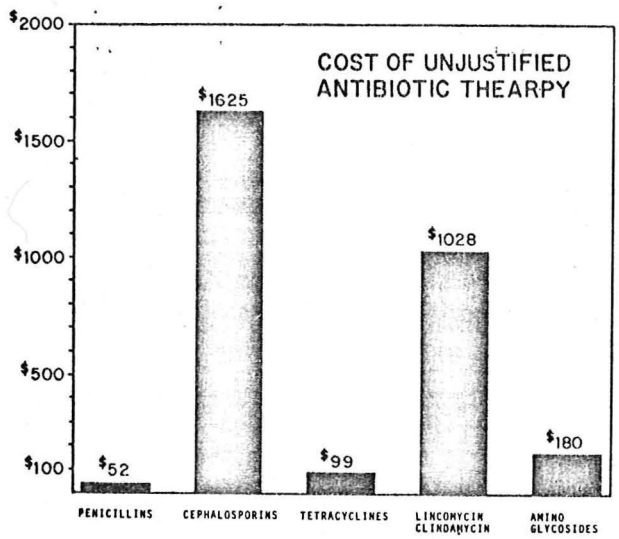
Antibiotic	Total	Categories I %	II %	III %	IV %	V %	VI %	VII %	VIII %
Penicillin G	51	65	18	4	0	4	10	0	0
Penicillin V	14	21	0	0	0	29	14	36	0
Methicillin	24	71	0	21	4	0	0	4	0
Cloxacillin	20	50	0	5	10	20	15	0	0
Ampicillin	16	56	0	6	6	13	6	6	6
Cephalexin	85	11	3	0	25	20	18	22	1
Cephalothin	51	18	0	0	18	0	6	59	
Lincomycin	24	21	0	4	4	0	12	58	
Clindamycin	14	14	0	0	14	0	14	36	8
Erythromycin	8	25	0	25	12	0	12	12	0
Tetracycline	49	14	0	35	8	8	8	10	2
Gentamicin	36	56	0	0	16	6	11	8	3
Other	13	46	0	0	8	1	0	16	0
% of Total # of Orders=385		34	6	8	13	10	11	22	1
TOTAL	405	132	24	29	49	37	43	86	5

of effectiveness (III) or expense and/or toxicity (IV). The cost of the inappropriate choice of a more expensive agent added $1544 to the hospital cost for this period.

Considerable variation occurred in the proper utilization of individual antibiotics (Table 6, 7). Antibiotics frequently used appropriately include penicllin G, methicillin, ampicillin, and gentamicin (Table 7). On the other hand, antibiotics which were utilized inappropriately included cephalothin, cephalexin, lincomycin, clindamycin, and tetracycline. The unjustified use of cephalexin, cephalothin, and lincomycin accounted for the bulk of the excess cost of antibiotics during this period of study (Table 6, Fig. 2).

Analysis of utilization of antibiotics by anatomic site of infection indicated that systemic infections and infections of the chest had appropriate administration of antibiotics used frequently. In infections of the skin and of wounds, poor choice in selection of antibiotics was made frequently. Administration of prophylactic antibiotics accounted for most of the unjustified orders.

Fig. 2



An analysis of the individual categories in which antibiotics were used or were unjustified follows on page 11.

TABLE 8

Utilization of Antibiotics at DVAH by Anatomic Site of Infection

Site	# of Orders	*% in Category I	II	III	IV	V	VI	VII	VIII	Categorizations
Systemic	22	91	0	0	9	0	0	0	0	22
Wound	34	38	0	12	23	21	6	6	6	38
Head, Neck, Oral	33	30	6	9	27	12	24	0	0	34
Chest	37	65	3	3	8	14	0	8	0	37
Gastrointestinal	27	22	26	19	3	7	22	0	0	27
GU Tract	33	42	0	6	12	9	6	21	6	34
Musculo-Skeletal	70	46	6	17	16	7	9	4	0	73
Skin	25	28	4	8	40	12	4	8	0	26
None/prophylaxis	104	6	9	0	3	8	17	66	1	114
% of Total	34	6	8	13	10	11	22	1		
Total #	385	132	24	29	49	37	43	86	5	405

* Expressed as % of orders for infections in the site.

Category III

Antibiotic Indicated; Inappropriate use: more effective drug recommended.

Total	No.	% Total Orders
Service	29	8
Medicine	3	3
Surgery, General	23	17
Surgery, Specialty	3	2

Antibiotic Commonly used: tetracycline

Clinical Situations: Surgical patient with significant infection in which an aerobic or anerobic gram-negative infection likely

Preferred alternative:
Musculo skeletal - methicillin or gentamicin (particularly in Diabetic)
Gastrointestinal - chloramphenicol or clindamycin

TABLE 9

Other situations in which antibiotics are not equivalent:

Infections with Organism	Antibiotic Acceptable	Antibiotic Not Acceptable
Neisseria meningitidis (26) and gonorrhea (27) Anaerobic Streptococcus (28)	Penicillin G	Penicillin V Cephalothin
Hemophilus	Ampicillin Chloramphenicol	Penicillin V Cephalothin
Enterococcus (29,30)	Penicillin G+ or Ampicillin+	Cephalothin+
Shigella (31,32,33)	Ampicillin	Amoxicillin Cephalothin
Salmonella	Chloramphenicol Ampicillin Amoxicillin	Cephalothin Tetracycline

Clinical Situation	Antibiotic Indicated	Antibiotic Not Indicated
Meningitis in Penicillin-Sensitive Person (27)	Chloramphenicol	Cephalothin
Hospital-Acquired Gram-Negative Infection	Gentamicin	Ampicillin Cephalothin

Category IV

Antibiotic Indicated; Inappropriate Antibiotic Use: Less expensive or less toxic drug recommended.

	No.	% Total Orders	Cost	% Total Cost
Total	49	13	1544	20
Service				
Medicine	12	13		
Surgery, General	14	10		
Surgery, Specialty	23	15		

Antibiotics Frequently Used (% of orders for that drug):

Cephalexin (25%), Cephalothin (18%), Gentamicin (17%)

Clinical Situations:

Infection at site suspected to be due to organism suspectible penicillin or proven to be suspectible to drug less toxic than gentamicin.

TOXIC EFFECTS OF PARTICULAR ANTIBIOTICS

Antibiotic	Toxicity	Prevalence
Ampicillin (19)	Skin Rash	9%
Nafcillin (IV)	Phlebitis	(High)
Cephalothin (IV)	Phlebitis	50%
Lincomycin (oral)	Diarrhea	5-10%
Clindamycin (oral)	Colitis	<1% (?)
Tetracycline (40)	Thrush	10-50%
Chloramphenicol (21-22)	Aplastic Anemia	1:21,000
Macrodantin (20)	Gastro-intestinal	5%

TABLE 10

Cost to Patient of 10 Day Course of Antimicrobial Agents

Drug	Size	No. for Days	Hospitals			Pharmacy	
			DVAH	PMH	Other	North Dallas	South Oak Cliff
			(Cost in Dollars $)				
Penicillin G	250 mg	40					
generic			.60	3.75	6.00	1.20	1.30
Trade name			-	-	10.00	-	6.79
Phenoxymethyl	250 mg	40					
generic			.80	-	6.00		
Tradename			3.60	-	6.00	3.60	4.99
Ampicillin	250 mg	40					
generic			3.20	10.75	12.00	2.00	-
Tradename			4.80	-	12.00	-	8.08
Amoxicillin	250 mg	40	13.00	-	28.00	-	16.18
Oxacillin	250 mg	40	6.10	-	16.00	6.00	11.24
Cloxacillin	250 mg	40	5.10	12.75	12.00	6.00	11.14
Dicloxacillin	250 mg	40	8.00	-	22.00	-	14.09
Nafcillin	250 mg	40	6.00	-	24.00	-	-
Cephalexin	250 mg	40	12.50	31.00	28.00	12.00	14.53
Lincomycin	250 mg	40	6.10	-	16.00	-	10.59
Clindamycin	150 mg	40	8.70	19.00	22.00	9.60	14.09
Erythromycin	250 mg	40					
Generic			-	16.00	12.00	-	7.32
Trade name			6.00	-	14.00	4.00	8.08
Ilosone			8.00	-	16.00	7.20	10.81
Tetracycline	250 mg	40	1.00	4.25	6.00	2.40	2.80
Oxytetracycline	250 mg	40	1.40	-	16.00		-
Minocycline	100 mg	20	7.40	-	18.00	8.40	12.34
Doxycycline	100 mg	20	8.50	-	30.00	-	18.71
Chloramphenicol	250 mg	40	1.60 (12.80)	20.00	24.00	10.40	15.85
Macrodantin	100 mg	20	5.00	8.75	10.00	9.00	7.97
Sulfamethoxazole / Trimethoprim		40	5.00	19.25	16.00	8.00	11.24

Category V

Antibiotic Use Appropriate: Improper Administration due to improper dosing or interval of administration

	No.	% Total Orders
TOTAL	37	10
Service		
Medicine	9	10
Surgery, General	8	6
Surgery, Specialty	20	13

Antibiotics Frequently Improperly Administered:

Cephalexin, Penicillin V, (Given QID - (9-1-5-9), Cloxacillin, (Given after meals)

TABLE 11

Factors which effect absorption of antibiotics:

Factor	Effect
Food Intake	Decreased Absorption: Penicillin G, Cloxacillin Erythromycin, Tetracycline and derivatives (35-37)
Drugs	Decreased Absorption: Antacids, Iron - Tetracycline (38,39) Diet Soda - Lincomycin Kaolin - Lincomycin, erythromycin and tetracycline (all drugs)
Age	Elderly & Newborn - Prolonged half-life (40)
Achlorhydria	Increased Absorption (40)
Diarrhea	Decreased Absorption (41-43)
Diabetes	Decreased Levels following IM Administration compared to IV (40)

Category VI

Inappropriate Use of Antibiotics: Excessive Duration

	No.	% Total Orders	Cost	% Total Cost
TOTAL	43	11	1224	16
Service				
Medicine	0	0		
Surgery, General	17	12		
Surgery, Specialty	26	16		

Antibiotics Frequently Inappropriately Administered: Cephalexin (18%)*

Clinical Situations:
Antibiotic administered appropriately for prophylactic purposes during surgery, but continued for period exceeding 2 days.

Category VII

Inappropriate Use of Antibiotics: No indication

	No.	% Total Orders	Cost	% Total Cost
TOTAL	86	22	1758	23
Service				
Medicine	11	11		
Surgery, General	16	12		
Surgery, Specialty	59	38		

Antibiotics Frequently Used Inappropriately:

Cephalexin, (22%)*, Cephalothin, (60%), Lincomycin, (60%)

Clinical Situations: Prophylactic use of antibiotics for clean surgical procedures

* % of Antibiotic Orders

TABLE 12

A. Antibiotic Prophylaxis of Proven Value	
1. Medical	
a. Rheumatic Fever (44,45)	Penicillin, Benzathine
b. Meningocaccal carrier state (46)	Rifampin, Minocycline
c. Lymphangitis (47)	Penicillin V,G
d. Labor where membranes ruptured over 24 hours	Tetracycline
e. Incubating syphilis (48)	Penicillin, Benzathine
2. Surgical (49-52)	
a. Dental extraction with cardiac lesion (53)	Penicillin G
b. Mandibular fractures (54)	Penicillin
c. Penetrating abdominal wound (55-57)	Pen/tetra, Clind/kana
d. High risk biliary tract surgery (58)	Cephaloridine
e. Hysterectomy (59)	Cephaloridine
f. Animal bite (60-61)	Penicillin G

B. Antibiotic Prophylaxis of No Value
1. Medical
   a. Common cold
   b. Comatose Patient (62)
   c. Premature infants
2. Surgical
   a. Clean surgical and obstetrical procedures (63-64)
   b. Acute pancreatitis

C. Antibiotic Prophylaxis of Debatable Value
1. Medical
   a. Chronic bronchitis (65)
   b. Cystic fibrosis
   c. Hepatic coma
   d. Gonorrhea exposure
   e. Staphylococcal infection in nurseries
   f. E. coli diarrhea (Turista) - (66-67)
   g. Leukemia Chemotherapy (68)
   h. Post streptococcal glomerulonephritis (69)
   i. Urinary tract infection (70-72)
2. Surgical
   a. Preoperative bowel prep (73-75)
   b. Burn prophylaxis
   c. Basilar skull fracture (79)
   d. Cardiac catheterization (76)
   e. Open heart surgery (77)
   f. Hip Prosthesis (78-78a)
   g. Open Fractures
   h. Tornado-associated wounds (80)
   i. Peripheral vascular surgery
   j. Caesarean section (81)

Figure 3

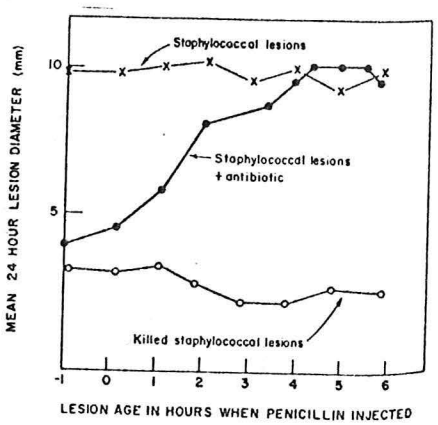
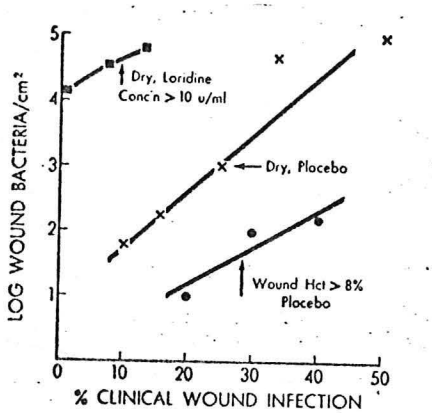


Figure 4



The above studies graphically depict the rationale for prophylactic antibiotics. In Figure 3, Burke shows that antibiotics must be administered 1 hour prior to and not later than 1 hour after organisms begin growth to prevent infection (51). The development of wound infection (Figure 4) relates to 1) Number of bacteria in wound, 2) presence of blood, and 3) presence of antibiotic in tissue (64).

6) How Can Better Utilization Be Developed?

The second thrust of an effective program to encourage better antimicrobial usage is the development of control measures. Continuing the analogy with nosocomical infection control, where standards have been set for aseptic techniques and restrictions placed upon the use of medical devices, an effective program will probably use both direct institutional controls and education.

One manner in which antibiotic usage can be modified is through institional control: either indirect or direct. Indirect controls are common practice at non-private hospitals. By their omission from the hospital formulary, certain antibiotics just won't be used, e.g., penicillin V at Parkland and carbenicillin indanyl sodium both at Parkland and the V.A. Hospital. Another means of limiting usage is by omitting the drug from the antibiotic-susceptibility testing battery in the clinical laboratory. This is the current practice for trimethoprim/sulfmethoxazole at the V.A. Hospital.

On the other hand, direct control measures are used in some institutions (Table 13, and figures 4 and 5). A global restriction of the use of all antibiotics or of selected antibiotics was justified because of their inordinate cost or toxicity (3, 82,83). These programs are effective, but require a great deal of thoughtful consultation between expert and physician.

Table 13

Control of Antibiotic Utilization

Reference	Hospital	Antibiotic	Method	Results
3	V.A.	cephalexin	Required Consultation	"Marked fall" in usage of cephalexin
82	Community	All	Required Written Justification on prescription and record	50% ↓ in use of cephalothin 70% ↓ in use of carbenicillin
83	University	"Selected"	Required Consultation	ampicillin restricted 7,126 gm/yr. unrestricted 62,613 gm/yr. - despite ↓ in hospital admissions during unrestricted period

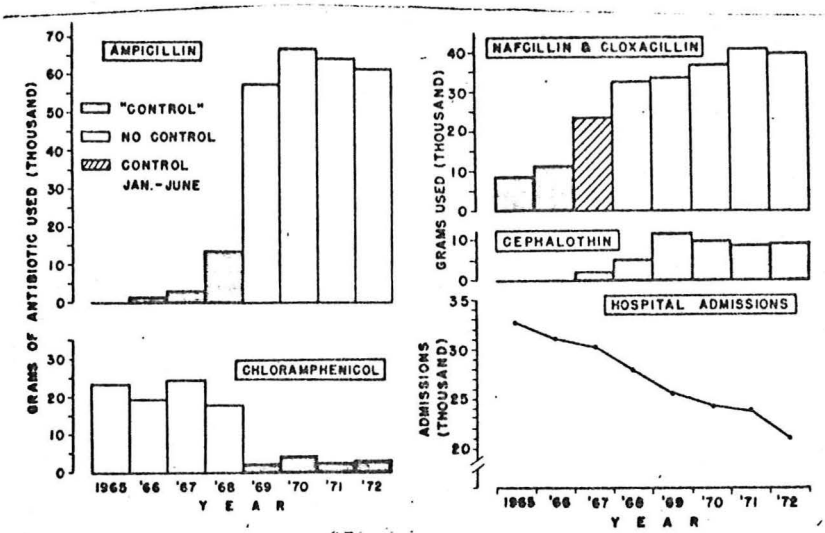


Figure 5

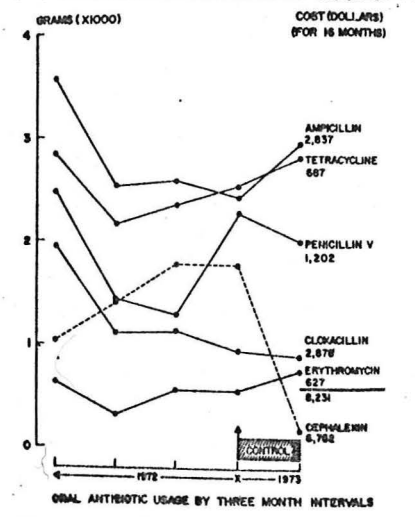


Figure 6

Another method to improve antibiotic usage is by education. The education of physicians in the proper use of antibiotics is what this presentation is all about. In an area so rapidly altered by changes in bacterial susceptability to drugs and by the persistent introduction of new antimicrobials, whether needed or not, it is obvious that physician education must be continuous from medical school to senesence. The educational programs most effective, it would seem to us, would be those based upon the problems of the practitioners and not the problems of the academic educator or the pharmaceutical manufacturers representative. No study of which we are aware of documents the effects of a problem-oriented educational program such as suggested by Bjorn and Cross, (84), i.e., the periodic monitoring of medical care, as reflected by patient records, by "experts" with face to face evaluations and suggestions. Such a peer review could be a part of a hospital effort and we intend to implement this at the Dallas V.A. Hospital.

Aphorisms on Antibiotics (AoA)

The public has, of course, come to believe over the last two decades that antibiotics are truly miracle drugs devoid of limitations, Anon. (85).

* * *

"To satisfy the wants of the public", it is high time an Official Antibiotic Capsule was launched: Antibiotic Capsules Forte (Fancimycin imaginate 300 mg.) Caution: do not exceed the stated dose, Anon., (86).

* * *

It is on record that a girl who had been given oral penicillin for earache (Twice), for a pain in the knee, and for toothache and then went into severe shock after the last dose, was under the impression that penicillin is an analgesic, Garrod (87).

* * *

Vague general prophylaxis is dangerous, and especially so when conducted to counter the ill-effects of inadequate operating-theatres, overcrowded understaffed wards and poor techniques, Anon. (88).

* * *

One thing is clear, however, the unwarranted use of antibiotics and particularly broad-spectrum antibiotics in a mistaken prophylactic attempt is a sin, Anon. (49)

* * *

One of the most flagrant misuses of the antibiotics is the treatment of patients with respiratory disease by telephone. Any patient who deserves chemotherapy certainly deserves an adequate examination first, Lepper, (89).

* * *

Hospital utilization review committees have executed a significant beneficial effect on efficiency in bed utilization. Similar physician groups could contribute toward reducing the use of unnecessary antibiotics,Howell, Editorial Board, JAMA, (90).

* * *

I suspect that ampicillin, which I facetiously termed today's "decerebrate antibiotic", will soon be replaced by cephalexin, Austrian, (91).

* * *

It is apparent from the above that, based on scientific and microbiologic grounds, all the existing, clinically available cephalosporins can be relegated to the class of second-line drugs, Hamilton-Miller and Brumfitt, (92).

* * *

Lincomycin versus erythromycin: A choice or an echo?, Sanders (93).

* * *

Studies of the factors that appear to influence the results of treatment with anti-infective compounds indicate very clearly that the patient is a most important determinant of their effects, Weinstein (40).

* * *

Physicians with patterns of higher appropriateness ratings and lower chloramphenicol use were found to (have)... more post graduate training and activity outside their practices, ... they more often consulted their colleagues on matters concerning therapeutics, ... they saw more patients, but wrote fewer prescriptions. Becker, et al. (94).

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