Editorial

The New Prospective Payment System and Antibiotic Utilization

The cost of health care in the United States has increased at three times the inflation rate. The political promise of quality medical care for all has turned out to be a promise that is larger than the public purse can meet. To reduce the rate of growth in health care costs, a prospective payment system was devised to replace the cost reimbursement system. The system, known as Diagnosis Related Groups (DRG), is the clinical basis for determining payment.[1-5] DRG is an acronym which is becoming as familiar as FBI or IRS.

Hospital managers will attempt to maximize revenues and minimize costs in order to survive. While pursuing overutilization of hospital services, we will have to guard against underutilization that impairs the care a patient receives—*primum non nocere*.[1,4]

Since more than 50% of the pharmacy's budget in most acute care facilities is spent on antibiotics, appropriate utilization of antibiotics will be a major target of concern. There are several obvious areas where we can direct our attention to control these costs. Other areas are also fertile for clinical investigation.[6,7]

One initial step involves streamlining the pharmacy's formulary. The number of "me-two" or three antibiotics should be reduced. For example, it is not necessary to stock three parenteral anti-staphylococcal drugs: oxacillin, methicillin and nafcillin. Secondly, less expensive but equally effective drugs should be selected when possible. Cefazolin, for instance, is a less costly substitute for cephalothin, and cefazolin is as effective except, perhaps, in the case of *Staphylococcus aureus* endocarditis. Thirdly, physicians can also play a vital role. For penicillin-sensitive staphylococci—they still do exist—oxacillin or related drugs can be replaced by penicillin. When aminoglycosides are given, the less expensive one—gentamicin—can replace tobramycin in most younger patients with normal renal function.[8] Gentamicin is one-fourth the cost.

The pharmacy also can assist by controlling the contact between pharmaceutical representatives and staff physicians.[6] In addition the pharmacy can increase the use of bid prices, reduce its inventory, educate physicians on relative costs of antibiotics, and review the use of expensive antibiotics.

The use of antibiotics for prophylaxis should clearly be distinguished from therapeutic usage. Goldmann has been able to encourage the physician to declare in advance whether the antibiotic he orders will be for prophylactic or therapeutic purposes.[9] By making this declaration on the order sheet, unnecessarily prolonged administration of antibiotics can be avoided. Previously, the proper duration of prophylactic antibiotics for surgical procedures was 72 hours. However, that time period was too long. Currently, 24 hours is considered appropriate. In the future, the period may be further reduced to the few hours following one dose.[10]

As the duration of prophylaxis shortens, the likelihood of using one dose of an antibiotic increases. This likelihood will be even greater when the second generation cephalosporins—with a longer half-life—are commercially available. For example, cefonicid has a half-life of 4.4 hours compared to 1.8 hours for cefazolin.[11,12]

A fourth step would be to use drugs with a longer half-life for therapeutic indications. Among the second generation cephalosporins, cefonicid, ceforanide and cefuroxime can be given less frequently than cefamandole.[14] Which one of the three newer agents is selected, however, will depend on the clinical situation and relative costs. Among the third generation cephalosporins, ceftriaxone has an extremely long half-life and can be given once or twice a day.[13] Fewer daily doses will reduce costs of drug preparation and administration.[7]

Another area will focus on the development of a list of costly antibiotics which should require approval before

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they are dispensed by the pharmacy. Candidates for this list are the second and third generation cephalosporins, the anti-pseudomonas penicillins, or ureidopenicillins (eg, piperacillin, mezlocillin, azlocillin), clindamycin, metronidazole and vancomycin. It is difficult to list all the drugs because there is too much work required to regulate usage. Another facet of the problem concerns who should enforce the usage of these drugs. Will it be the pharmacist, infectious disease fellow, quality assurance committee, or a designated attending physician in each clinical department?

A sixth area which is often overlooked is the cost of monitoring patients for drug side effects. The most obvious example is the aminoglycosides. The frequent ordering of renal function tests, antibiotic blood levels and audiograms may cost more than the antibiotic.

The methylthiotetrazole ring in cefamandole, cefaperazone, cefmetazole, cefotetan, moxalactam and cefmenoxime may cause prolongation of the prothrombin time.[14] Monitoring for and treating hypothrombinemia becomes a hidden cost of using these antibiotics.

Certain infections require several weeks of parenteral antibiotics. Yet some do not require continuous hospitalization. After a week or more, some patients may be discharged and continue to receive the parenteral antibiotic at home.[15] The patient can begin to learn self-administration of the drug during the hospital stay. Alternatively, home health care agencies sponsored by a hospital or a commercial enterprise can be responsible for parenteral drug administration in the home. Chronic osteomyelitis and viridans streptococcal endocarditis have both been successfully managed in this manner.

Another area for cost control in the hospital as well as the community is recurrent urinary tract infections. Asymptomatic bacteriuria usually requires no antibiotic therapy.[16] Dissemination and acceptance of this concept is just beginning.

Many microbiology laboratories now use a method of antimicrobial susceptibility testing that could reduce the cost of administered antibiotics. These systems report minimum inhibitory concentrations (MICs) for each antibiotic. For drugs with low MICs, the dose of antibiotic can be less than for drugs with higher MICs. The precise relationship between MIC and dose is still unclear. Some investigators suggest that the serum antibiotic level should be four to eight times the MIC. The dose, then, is determined by knowing the expected blood level for different doses. For example, the dose of carbenicillin for *Morganella morganii* is usually one-fourth that required for *Pseudomonas aeruginosa*.[17]

As a corollary to the above approach we should look at the minimum effective dose for the more expensive antibiotics, such as the newer cephalosporins and the ureidopenicillins. We certainly cannot go on indiscriminantly using large doses of these agents and assume if a little is good, then more is better. Although we should proceed with caution to answer this question, our direction is clear.

In addition to the minimum effective dose, what is the minimum effective duration of therapy? Ironically, after 50 years of clinical antibiotic research, we can answer this question for only a few clinical situations. Chronic osteomyelitis in the adult requires three to four weeks of parenteral antibiotics to minimize the chance of recurrence; streptococcal pharyngitis requires ten days of oral therapy to avoid the non-suppurative complications of acute rheumatic fever and glomerulonephritis, and enterococcal endocarditis requires six weeks of parenteral therapy with a penicillin and an aminoglycoside. But even some of these tenets of therapy are being questioned.

Lastly, we consider education. Despite the intuitive appeal, attempts to change physician behavior by educational newsletters and conferences have not been uniformly successful.

Our goal, then, is to select the least toxic, least expensive, and narrowest spectrum antibiotic. Next, we should strive to administer this antibiotic in an adequate dose and for an adequate period of time to cure the infection if possible or, if not, to modify it. Our goal, unfortunately, will often appear to be like Sir Gallahad searching for the Holy Grail. But pursue it we must.

A joint effort of the infection control practitioner, attending and resident physicians, medical executive board, quality assurance committee, administration, pharmacy, and laboratory will be necessary to accomplish our goal.

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