agents. I strongly suggest examining the thyroid prior to using contrast agents, to identify patients with goiter who are at greater risk of developing iodine-induced thyrotoxicosis.

TREATMENT ISSUES

What to do about subclinical thyrotoxicosis

Subclinical thyrotoxicosis—in which the TSH level is low but the T_4 and T_3 levels are normal—poses a dilemma for the clinician. The prevalence is about 1.5% in elderly patients, and most have a multinodular goiter. Such patients are at two to three times greater risk of atrial fibrillation than those with normal serum TSH values, but it is not clear whether to give them antithyroid therapy to prevent atrial fibrillation. The most common cause of subclinical thyrotoxicosis is excess administration of levothyroxine for hypothyroidism.

Treatment of Graves' disease

Treatment of Graves' disease is not standardized. I recommend radioactive iodine therapy in older patients, or antithyroid drugs in younger patients. Patients with extremely large goiters may require surgery. I prefer methimazole to propylthiouracil because the former can be given once daily, compared with two to three times a day for the latter, assuring better patient compliance.

Patients must be made euthyroid before thyroid surgery. A regimen that can accomplish this in 5 to 7 days when urgent surgery is necessary is dexamethasone (1 mg every 12 hours), iopanoic acid (0.5 g every 12 hours), propranolol (120 mg daily), and large doses of propylthiouracil (600 mg daily) or methimazole (40 mg daily).

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SUGGESTED READING

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CONTEMPORARY ISSUES IN COST-EFFECTIVE DRUG THERAPY

MANY FACTORS influence a physician's decision to prescribe a particular drug. Now, in addition to considering the efficacy of the drug therapy they prescribe, physicians are increasingly being asked to consider its cost-effectiveness.

Although cost is a factor in selecting drugs, it should not be the deciding factor. Efforts to control pharmacy costs involve preventing medication errors (which lead to preventable hospitalizations), using the least-expensive drug that is appropriate, and using the most cost-effective drug to reduce overall health care costs.

PREVENTING DRUG ERRORS

Pharmacists and physicians can collaborate to reduce health care costs by minimizing adverse drug effects, which are common and costly. By one estimate, each adverse drug event costs an average of $2000, excluding legal repercussions.[1] Extended stays due to inappropriate antibiotic use cost an average of $5300. Overall, adverse drug events cost the US health care system an estimated $76 billion per year.[2]

Statistics vary, but according to one study, adverse drug events are responsible for 11% of all hospital admissions (28% to 35% of these admissions are of patients older than age 65), and 28% of hospitalized patients experience an adverse drug event.[3] Another study found an incidence of 6.5 adverse drug events per 100 admissions, of which 1% were fatal, 12% were life-threatening, and 30% were serious.[4] The investigators considered 28% of all the drug events preventable, as were 42% of the life-threatening and serious events. Of the preventable events (ie, errors), 56% occurred during ordering, 34% occurred during administration, 6% occurred during transcription, and 4% occurred during dispensing.

The latter study points out the need to provide physicians more information when they prescribe, perhaps in the form of computer systems or information pharmacists. At one hospital, use of such a computer system resulted in a decrease in antibiotic use, a decrease in costs per treated patient, fewer adverse events, and a lower mortality rate.[5]

TABLE
COSTS OF VARIOUS DRUGS

Drug and dosage	Wholesale cost ($)
Parenteral fluids for volume expansion, one dose	
Normal saline 1 L	0.66
Hetastarch 500 mL	28.00
Albumin 500 mL	79.00
Antibiotics for urinary tract infections due to *Escherichia coli*, 7 days	
Amoxicillin 250 mg three times a day	1.40
Trimethoprim/sulfamethoxazole DS (generic) twice a day	0.84
Ciprofloxacin 250 mg twice a day	32.62
Antibiotics for pseudomembranous colitis due to *Clostridium difficile*, 10 days	
Metronidazole 250 mg three times a day	1.20
Vancomycin 125 mg four times a day	157.60
Sedatives for use in intensive care, 1 day	
Lorazepam 0.06 mg/kg/hour	85.20
Midazolam 0.24 mg/kg/hour*	485.85
Propofol 2.3 mg/kg/hour*	203.36
Loop diuretics, one intravenous dose	
Furosemide 200 mg	0.74
Bumetanide 5 mg	11.80
Antiemetics in patients not receiving highly emetogenic chemotherapy	
Prochlorperazine 10 mg intravenously	0.54
Dexamethasone 10 mg intravenously	1.28
Droperidol 2.5 mg intravenously	0.20
Ondansetron 8 mg intravenously	34.10
Metoclopramide 10 mg by mouth	0.02

*Approved for short-term sedation only

REDUCING DRUG COSTS

Besides helping physicians avoid drug errors, pharmacists can work with physicians to control drug costs by making them aware of the costs of drugs, suggesting equally effective but less expensive alternatives, and suggesting appropriate dosing and administration.

Using cost-effective drug therapy

In many instances, different drugs are equivalent in their efficacy and safety profiles but vary greatly in cost. For example, in many situations, amoxicillin is as effective as clarithromycin for treating acute sinusitis, but costs much less ($2 vs $35 for 1 week's worth, wholesale). Drugs for treating simple cystitis may also vary widely in cost (see *Table*). Avoiding more-expensive, newer, broad-spectrum antibiotics may also help to circumvent the problem of emerging microbial resistance in the hospital and the community. Additional examples of drug costs within specific drug categories are listed in the *Table*. Drugs within each category are often (but not always) interchangeable.

Using the lowest dose needed

In some situations, a lower dosage of a given drug can be used effectively. For instance, in autologous bone marrow transplantation, 5 μg/kg/day of granulocyte colony stimulating factor (G-CSF) has been demonstrated to be as effective as 10 μg/kg/day or 16 μg/kg/day (unpublished data). Utilizing the lower dose regimen resulted in a cost savings of $3600 per patient. Other strategies are to give drugs orally rather than intravenously, if possible, and to order fewer laboratory tests, such as vancomycin levels (which lack data regarding their clinical relevance, and may need to be done only in specific situations such as meningitis, endocarditis, persistent bacteremia, and renal dysfunction).

USING EXPENSIVE DRUGS TO REDUCE OVERALL COSTS

Although there are many times when a less costly drug is as effective as a more expensive one, an expensive drug may well be cost-effective if it leads to a better outcome and reduces the overall cost of care.

For example, colony-stimulating factors are relatively expensive agents, but for bone-marrow transplant recipients they decrease length of stay, duration of neutropenia, neutropenic fever, and the need for additional medication. More research is needed in this area, in order to adequately assess the effect drugs have on length of stay and quality of life.

FUTURE ISSUES

Trends to control pharmaceutical costs will accelerate. The pressure to contain costs will increase as new, expensive drugs are introduced, and many hospital and health care network pharmacy and therapeutic committees are forced to make difficult decisions.

Already many managed care organizations scrutinize individual physician prescribing patterns for commonly used drugs, comparing how often different physicians prescribe specific agents. Inpatient and outpatient formularies will be tighter and stricter. There will be more guidelines on the indications for many new drugs, and in some cases their use will be

restricted to certain services (such as intravenous amiodarone, which at the Cleveland Clinic can only by used by the electrophysiology staff). And outcomes research will more carefully scrutinize how drugs can be used most cost-effectively.

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