That the early feeding of egg white favors the development of sensitization is widely accepted. Some pediatricians—myself included—feel that the too early introduction of other solid foods also favors the development of allergy.

The matter of adenoid-tonsillectomy in the allergic child is one of frequent concern. Some physicians feel that this operation should not be done in allergic children, or in children of allergic parents, during the height of the pollen season, as pollen sensitization is then more likely to occur. This may be a valid precaution, especially in areas where the pollen count rises to great heights. Not valid, in my opinion, is the avoidance of needed adenoid-tonsillectomy simply because the child is allergic—on the theory the allergy may be flared up—or the performance of the operation routinely in allergic children. I believe the indications for operation are the same in allergic and non-allergic children; the retention of obstructing adenoid tissue is no more logical in an allergic child than in one who is nonallergic.

Finally, I would like to venture the view that just as the retention of obstructive adenoid tissue is not logical, retention of a pet to which a patient is sensitive is equally illogical. There is no question, in my mind, that by condoning such an arrangement we physicians have permitted a great deal of asthma to persist in our patients. I have seen much more harm done in this way than is done psychologically by the removal of the dog or cat from the homes of asthmatic children. Our patients and their parents are like ourselves in wanting to have their cake and eat it, too. They would like to get rid of asthma, while keeping the cause of it. The attempt to do so is no more successful in this situation than it is in others like it. As physicians, it behooves us not to become party to this type of self-deception.

A discussion of this type would not be complete without mentioning the potential danger of giving horse serum or other serum to sensitized patients. Such sensitization may have been induced by previous administration of serum or may have occurred naturally, as in the case of a horse-sensitive asthmatic. It is, therefore, necessary to question the recipient about known sensitivity to horses, as well as previous administration of serum. Intradermal testing of such patients will reveal those in whom serum administration may be dangerous. Foremost among these is the horse-sensitive asthmatic whose skin test is markedly positive. Ordinary delayed serum sickness in a previously untreated patient following therapeutic doses of diphtheria or tetanus antitoxin is an example of justifiably induced iatrogenic disease.

ANTIBIOTICS AND IATROGENIC DISEASE

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The association of the term “iatrogenic disease” with the clinical use of antibiotics poses many problems. Physicians generally are familiar with most of the untoward reactions that may follow the use of antibiotics, and many excellent reviews of the subject are to be found in the literature.¹⁻⁴

One cannot divorce the undesirable effects of antibiotics from the beneficial ones and, in this light, therapy becomes a calculated risk. If the probable discomforts or
dangers outweigh the probable advantages, the cure may be worse than the disease, and one is then dealing with true iatrogenic disease.

Probabilities of this kind cannot be assessed easily with antibiotics because reactions vary so much with type of drug, dose, course, method of giving and in different patients. Certain reports may be biased one way or the other because of personal prejudices or unusual series. Some ill effects are undoubtedly related to unwise, improper or careless use of the drug; others are not. So true incidences are not accurately known. Reactions where antibiotics are being used needlessly for trivial infections or for unnecessary prophylaxis are particularly deplorable while risks are justified when dealing with severe infections known to respond. Evaluation is difficult with infections of borderline severity and those prone to exceptionally severe secondary bacterial complications.

Reactions may be mild or severe; none is negligible. Oxytetracycline, for example, is considered to be relatively harmless. Still, Jackson and his colleagues reported that 58% of patients with pneumonia showed untoward effects attributable to this antibiotic. Most reactions were mild, but the antibiotic was believed to have contributed in large measure to the fatal outcome in five of the seven patients who died in the 91 cases.

Tissue irritation and pain from injected drug is often regarded as warranted temporary inconvenience to the patient. The intensity of these reactions is usually less with the soluble preparations such as potassium penicillin and streptomycin than with repository forms such as procaine penicillin, benzathine penicillin G and suspension of chloramphenicol. The pain from some, notably bacitracin and polymyxin B, is disguised by mixing with procaine. There is often neglect of the deleterious mental and physical effects that pain might have on sick individuals particularly if long courses of therapy are given.

Not all local irritant reactions are so easily disregarded. Residual areas of degeneration and fibrosis in muscles have been seen, but are seldom looked for. Sterile abscesses have followed the injection of preparations in oil. One report suggests, maybe wrongly, that metastasizing fibrosarcomas arose in two patients at the sites of intramuscular injections of penicillin in sesame oil because of a carcinogenic effect from the oil. Four papers describe severe neuritis in 15 infants and adults where sensory losses and/or disabling motor paralyses followed intramuscular injections of penicillin, streptomycin or tetracycline. The disabilities persisted for months in some cases and in a few seemed permanent. The sciatic nerve was involved most frequently, following intragluteal injections, but the deltoid region was affected in five cases. In some patients the immediate onset of symptoms suggested a more or less mechanical type of injury; in others, notably after injection of penicillin, the symptoms appeared only after several days, leading to a belief that the effect was related to the known toxicity of penicillin for nerve tissue. We are aware of several unreported cases. This complication is admittedly of infrequent occurrence, but the consequences are disastrous.

Toxicity to the central nervous system evidenced by spasms, convulsions and coma and by persisting paralyses in survivors, has followed intrathecal injections of penicillin where the dose greatly exceeded 5,000 to 10,000 units. Somewhat similar reactions have resulted from excessive intrathecal doses of streptomycin. Fever reactions with pleocytosis in the spinal fluid are often seen with usual intrathecal doses.

Most antibiotics can be given orally, thus avoiding painful and other tissue reactions, but with certain drugs this unfortunately results in a higher incidence of various gastrointestinal complications that are more troublesome and significant than those after parenteral use. The so-called "broad spectrum" drugs are the chief offenders, though others may be involved, and these side effects are not always controllable by adjustments of dosage. The mechanisms under-
ing these complications are poorly understood. Some of the effects are related to a change in the normal bacterial flora of the tract; others are not. Some may be due to a direct irritation of the gut or to an upset in the absorption or utilization of certain of the vitamin B components.

Nausea or nausea and vomiting may be very upsetting, occurring in 15% of Jackson’s series with oxytetracycline. Various forms of glossitis and stomatitis are seen; these occurred in 2% in Jackson’s series.

But far more troublesome, persistent and sometimes serious are the disturbances of the lower intestinal tract. The incidence of anorectal-colonic side effects has been estimated as about 20% in those taking broad spectrum antibiotics, though much less with other drugs. In Turell’s experience, about 57% of those showing upsets of the lower gastrointestinal tract have perianal pruritis alone, about 27% have diarrhea and 16% have both pruritis and diarrhea.

Perianal pruritis is common, even early in ambulatory patients, and though not fatal some sufferers almost wish it were. It usually disappears within 1 or 2 weeks after discontinuing the drug, but recovery may be slow in as many as 30%. A few may remain problems for several months despite active treatment with topical cortisone or other therapies.

Diarrheal upsets vary from bothersome, loose, frequent stools to severe, toxic, dysenteric-like diseases. The mild upsets, seen often with trivial treatment for trivial infections, may appear early and persist for weeks after discontinuing the drug; the severe types may be rapidly fatal. Dearing and Heilman recorded 7 deaths in 29 such severely affected patients; 4 in the 12 receiving antibiotics for preoperative preparation of the intestine and 3 in the 17 being treated for various diseases. The fulminating, disastrous reactions are usually accompanied by partial or complete replacement of the intestinal flora by staphylococci. Most such cases of enterocolitis will respond promptly if a suitable antibiotic capable of suppressing the staphylococcus is given early, but minor disability may persist for a long time. Quick tentative confirmation of the diagnosis of staphylococcal enterocolitis is best made by a direct microscopic examination of a stained film of the feces. Replacement of the intestinal flora by staphylococci can occur without giving rise to the disease.

Toxicities directed systematically at specific organs are seen. Infrequently occurring, miscellaneous, sometimes fatal reactions have been reported for most antibiotics, such as damage to the liver by excessive administration of chlorotetracycline intravenously or by novobiocin. These are often difficult to assess because factors related to dose or to the abnormal physiologic state of the patient may contribute greatly to the effects in each individual. Maybe the action of chloramphenicol on the hematopoetic system should be mentioned here even though further experience suggests that the dangers from this drug are not as great as was once thought.

Some toxic manifestations, however, almost constantly accompany the parenteral use of certain antibiotics. Included here are the nephrotoxicity of neomycin, the transient nephrotoxicity from bacitracin, and the less marked renal effects from polymyxin B. These drugs should not be used or cautiously used in patients with impaired renal function. The ill-defined paresthesias, vasomotor and psychic upsets accompanying systemic administration of polymyxin B are examples of neurotoxicities, but the best known of the neurotoxic effects are the vestibular and auditory disturbances after administration of streptomycin and dihydrostreptomycin.

The ill effects of the streptomycins vary with the dose, the duration of therapy and the ability of the kidney to excrete the drug. From 44 to 96% of patients receiving a 4-week course of streptomycin may show vestibular disturbances depending on whether 1 gm or 2 gm are given daily. This is largely reversible, but residual defects may remain in 50% of affected subjects. With dihydrostreptomycin, auditory dis-
turbances become more prominent than vestibular ones, and while these are slower to appear they tend to be more irreversible. The drug, neomycin, is particularly prone to give irreversible nerve deafness if given parenterally, and many patients may remain "stone" deaf. These dangers from streptomycin are disturbing when one considers how frequently fixed combinations of streptomycin and penicillin are given to infants and how hard it is to recognize early impairment of the eighth nerve in the very young.

Drug fever due to antibiotics is probably common, although seldom recognized as such. Its significance may be that it is often responsible for undue prolongation of a course of therapy.

Reactions to antibiotics attributable to allergic or hypersensitivity mechanisms are distinct hazards. They are, perhaps, related more closely to iatrogenic disease than most toxic manifestations of antibiotics because they may follow the first dose of the drug, even in individuals who are receiving such therapy for trivial reasons. These reactions may take many forms: various rapid or delayed skin manifestations running the gamut from simple erythemas through eczematoid and urticarial eruptions to exfoliative dermatitis; miscellaneous reactions; and anaphylactoid shock that is often fatal. The risks involved are estimated variously by different reporters, but the incidences are highest with penicillin, much lower with streptomycin and very low with the others. Novobiocin has produced a high incidence of skin rashes, possibly allergic in nature.

After an injection of penicillin, it has been said that some reaction may be expected in 2.5% of children, in 5% of non-allergic adults and in 15% of individuals with an allergic diathesis. The risk from oral administration is less, estimated at about 0.2%. Reaction rates are said to be increasing by 1% each year, possibly because of prior sensitizing doses of penicillin. Reactions occur, however, in individuals not known to have received penicillin previously.

Anaphylactoid shock has been reported most frequently after the use of penicillin; all types of preparations have been involved including the crystalline potassium salt. Von Oettingen, from the literature published prior to 1953, lists 127 such penicillin reactions; 46 were fatal. Seventy-two of these reactions with 24 fatalities were related to procaine penicillin. There was little to implicate the procaine part of the molecule, but one might ask how often this relatively insoluble salt might have been injected inadvertently into a vein, a danger that has been shown by Kagan to exist experimentally. Almost all anaphylactoid reactions occur after injection of penicillin, but death has followed oral administration, and severe reactions have resulted from skin contact.

Estimates of the incidence of hypersensitivity reactions to streptomycin have varied from 0.4 to 5%. The commonest type is that reported by the British Ministry of Health where skin reactions occurred in 3.5% of nurses who were handling streptomycin. Von Oettingen lists seven anaphylactoid reactions to injected streptomycin with two fatalities. There was one nonfatal reaction to chlortetracycline.

There are many other untoward effects of antibiotics that come about somewhat indirectly but which may nevertheless be classified properly as iatrogenic disease. These are the so-called replacement infections or superinfections. Most are related to disturbances in the normal flora of the body that follow antibiotic therapy. On occasions these added infections are of endogenous source, but more frequently their source is exogenous, and here another factor enters the picture of iatrogenic disease. This factor is our inability to protect hospitalized patients from the bacterial environment of the hospital, an environment which, because of the very nature of hospitals, abounds in microorganisms of selected virulence and of selected patterns of resistance to antibiotics. Cross infection, the widespread, often indiscriminate use of antibiotics, the emergence of antibiotic-resist-
ant bacteria are all interrelated phenomena that lead to the greater prevalence of super-infections in hospitalized patients than in those outside hospitals. The chief offenders in these infections are staphylococci, but many other microorganisms including Candida albicans may be involved.

The true incidence of new infections developing during antibiotic therapy and as a more or less direct result of that therapy is not known. Weinstein and colleagues, in a careful study of 3,095 patients, estimated the frequency as 2.19%. These occurred most commonly in children and usually after giving broad spectrum antibiotics. They often arose within a few days of starting therapy.

Antibiotics are often given for prophylaxis, the view being taken that this could benefit the patient without having harmful effects. This prophylaxis may be justified where one is dealing with specific infections such as those caused by hemolytic streptococi, or those due to meningococci, gonococci and a few others. There is little justification for antibiotic prophylaxis against the bacterial world at large. There is almost no evidence to support antibiotic prophylaxis during most of the common viral infections, including the common cold, atypical pneumonia, measles or poliomyelitis, nor during bacterial infections such as pertussis, or in clean elective surgery or where indwelling catheters or drainage tubes are used. Weinstein's studies indicate that such prophylaxis may in fact be harmful. Of 130 patients with measles receiving antibiotics prophylactically, 30.4% developed superimposed bacterial infections whereas this occurred in only 14.9% of 298 cases not receiving antibiotic. Complicating infections developed in only 16% of 165 cases of bulbar poliomyelitis not receiving drug, but in 53% of 63 similar cases who were given antibiotics. This unwise prophylaxis does little more than insure that the superimposed infections will be resistant to the antibiotics used.

The needless prescribing of antibiotics is wasteful; it is dangerous because reactions may occur or the patient may become specifically sensitized. At the army post in the village of Igloo, South Dakota, two enterprising doctors, Nolen and Dille, tried to determine if an abuse had been made of antibiotics among the residents of the village. There were 763 civilians who had lived in Igloo for a full 5 years, who had been employed at the army post. Of these, only 7.9% had never received antibiotics during the 5-year period. Among those who had taken antibiotics, the average number of occasions each individual had been so treated was 3.9 times. Fortunately the medical records of this group were available to decide if antibiotic use had been warranted. The two doctors were most gentlemanly, even allowing a 1° rise above normal in temperature to be a valid reason for treatment. Despite their generosity, they concluded that antibiotic therapy had not been indicated on 52.5% of occasions.

We don’t know how much good or how much harm was done in Igloo, South Dakota, but we suspect that there was dishonest thinking, albeit not conscious dishonesty. There may be a moral to be drawn from Igloo, but there is no need to spell it out here.

These then are some of the highlights of the topic, "Antibiotics and Iatrogenic Disease." The dangers and discomforts attending antibiotic use are many and varied—sensitization and hypersensitivity reactions, pain and other local effects, systemic toxic effects, the hazards of superinfections and replacement infections, and others. These are real hazards that should be stressed as well as the benefits. Because they are real, the giving of antibiotics is always a calculated risk and they should be used only when there are definite and valid indications.

REFERENCES
2. Kagan, B. M., and Faller, L.: Symposium on clinical advances in medicine; unto-

SOME COMPLICATIONS OF TRANSFUSION, ENDOCRINE THERAPY AND OXYGEN ADMINISTRATION

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COMPLICATIONS OF TRANSFUSION

In no field has medical opinion reversed itself so completely as in that of blood letting versus blood replacement.

A short time ago while visiting the reconstructed colonial town of Williamsburg, one saw the tools of the old barber surgeons. A copy of a manuscript on the wall stated that George Washington was bled on several occasions during his terminal illness, without seeming benefit.

In this paper, I would like to emphasize some of the ills of blood replacement rather than withdrawal.

Due to the impetus given by life-saving transfusions during the war, blood transfusion has become universally available in all parts of the country. This has not proved an unmixed blessing, however, for the dangers associated with blood transfusion have also been greatly multiplied thereby.

The factors which give rise to these dangers are as follows: 1) those associated with donor; 2) those associated with stored blood; 3) those associated with act of transfusion; 4) those associated with recipient.

1. Factors Associated with Donor
   1. Homologous serum jaundice.
   2. Allergic reactions.

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