



“Start thinking now about what our roles should be 5–20 years from now.”

== **WARREN E. McCONNELL** ==
(1983)

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A 20–20 Vision: Alternative Futures for Hospital Pharmacy

Since the future is the realm of infinite possibilities, we can never know all the things that might come to pass within its domain; all we can do is to make a few forays into that awesomely vast and incomparably fascinating territory.

Edward Cornish, 1999—*The World of Tomorrow*

Several months ago, I happened upon a review of a book entitled *The Post-Physician Era: Medicine in the Twenty-First Century*, by Jerrold S. Maxmen.¹ The title itself was enough to capture my attention, but reading the review really sparked my interest. The author of the book is a physician. This fact seemed particularly important. Here was a physician speculating that medical doctors will

become virtually extinct in another 50 years! This started me thinking: If there will no longer be any doctors around in another 40 or 50 years, what about pharmacists? With no doctors, what will we be doing in 2025? So, when I learned last February that I was to give this address, the first topic that came to mind was hospital pharmacy's future.

Since this is ASHP's 40th anniversary year, I thought it would be interesting to look 40 years into the future, when ASHP would be twice its present age, and speculate what the status of hospital pharmacy would be then. It was not just coincidence that 40 years from now is just about the time that Maxmen predicts the obsolescence of all physicians.

A word about the title of this address. Some simple arithmetic will quickly tell you that 40 years takes us to the year 2023. You will forgive, I hope, the liberty I took in choosing to title my talk "A 20–20 Vision," but to call it "A 20–23 Vision" just didn't seem to get the point across.

Perhaps you are wondering why we should bother to examine what might happen 40 years from now when we cannot even predict with any known degree of accuracy what will happen 10 years from now, or five years, or even one year. Is not studying the future just a waste of time? Maxmen² observed that:

Exploring the future can be interesting because we and our children are going to spend the rest of our lives in it By focusing upon specific future developments, one can begin to evaluate their relative desirability [By] anticipating the potential consequences of a projected development, one is afforded the opportunity to assess its desirability thoroughly before the event occurs. Consequently, individuals or society can be better equipped to adopt constructive policies and to avert potential difficulties. Because we are too often unprepared to cope with the consequences of scientific innovations we hastily make decisions that we learn to regret. Studying the future can help to minimize this problem.

Of all the allied health professions, I believe pharmacy has less control over its destiny than perhaps any of the others. This is even more true for hospital pharmacy than for other branches of the profession. Hospital pharmacists provide their services at the pleasure of—and sometimes at the displeasure of—consumers, physicians, nurses, hospital administrators, pharmaceutical manufacturers, and occasionally other health professionals. Thus, if we are to examine realistically the future of hospital pharmacy, we cannot do so in isolation. We must look at it in the context of the entire health care system and the world around us. And we cannot simply extrapolate our past and present knowledge and experiences to arrive at a forecast for the future. We must wade into unknown waters.

The most difficult aspect of futures research is the impossibility of accounting for all the variables affecting the issue under study, not to mention predicting what changes may occur in the important ones we can identify and how they will interact. The only way around this difficulty is to establish certain premises beforehand. In exploring alternative futures for hospital pharmacy, I have made the following assumptions:

- ▶ There will be no world catastrophe, such as nuclear war or an ecological disaster.
- ▶ The population of the developed countries will continue to have adequate food and housing.
- ▶ The world economy will stabilize at no worse than its present level.
- ▶ There will be no major cultural upheavals in the developed countries.
- ▶ Natural resources will be sufficient to sustain technological growth.

Although these conditions may not hold, I shall not speculate on the results of their failure to do so.

To set the stage for projecting hospital pharmacy's future, I shall first take a look at some of the major trends that affect society today and will most likely affect the health care system. I shall then examine trends in the health care system in this country that will have an impact on hospital pharmacy practice. And, finally, I shall describe two scenarios for future health care systems and speculate how hospital pharmacy will fare in them.

Few developments have had as great an impact on the lives of people in our generation as television and computers. Automation or electronic communications play a role in almost every activity in which we are involved, whether at work, at home, or at play. And we hear from all sides that we are only on the threshold of what we can expect in the future.

Clement Bezold,³ Director of the Institute for Alternative Futures, which is located in Washington, says we are in a communications revolution and dates it from about 1950 when home television receivers first became relatively affordable. John Naisbitt,⁴ author of the recent book *Megatrends*, explains that we have moved from an industrial society to an information society. A recent article by Dwight Tousignaut⁵ describing automated literature-retrieval techniques brings this point home most vividly.

In the next 20–40 years, we can expect to see technological developments in the applications of computers and microelectronics that will dwarf, by comparison, developments up to this time. In the health care field, obtaining a medical history will not require the intervention of a physician.⁶ Instead, the patient will use an interactive computer terminal programmed to elicit the desired information. The patient will enter information into the computer by keyboard, by use of a light pen, or through a touch-sensitive screen. Alternatively, the patient may provide the same information from home using a Touch-Tone telephone as an interactive “terminal” instead of a keyboard. He will indicate his answers to questions generated orally from a central computer by keying responses using the phone buttons and a predetermined code. It will be possible for the computer to modify its clinical interview in response to various nonverbal signals, such as pulse, blood pressure, or response latency.⁷

Eventually, interaction between the patient and computer may be entirely by voice

(speech recognition) without the need for a keyboard or phone set. The patient's medical history, as a part of the medical record, will be permanently stored in a central computer file accessible to authorized persons from anywhere in the country—or the world, if need be. Maxmen⁸ calls this computer file a national medical data bank (NMDB). A person's record will be created at birth and updated each time he interfaces with the health system. It will also be reviewed systematically and periodically to purge inaccurate, irrelevant, or outdated information.⁹

We can also expect that most diagnostic procedures, such as complete blood counts, urinalyses, various functional tests, roentgenograms, ECGs, and EEGs, will be ordered, performed, and interpreted by computers without the physician even entering the picture.¹⁰ Wireless sensing devices will be used for remote transmission of ECGs, EEGs, vital signs, and so on. Videophones will be used to transmit visual images of roentgenograms, ECGs, and the like between health facilities or health personnel.¹¹ Interactive television will permit "face-to-face" communication between a patient and a remotely located health professional, or between health professionals themselves for consultation purposes. Eventually, by using interactive television or videophone or by pushing the appropriate buttons on his Touch-Tone telephone, a patient's medical requirements will be met in many circumstances without his ever leaving his home.¹²

It has already been demonstrated that computers can outperform physicians in diagnosing a wide range of illnesses. In the 21st century, all diagnoses will be performed by computer.¹³ Treatment decisions, likewise, will be made by the computer, and, following drug therapy, patient-monitoring functions will be computer controlled.¹⁴ The final disease-oriented function of the physician—rendering a prognosis—is simply a matter of probabilities and readily adaptable to computer programming.¹⁵

We may expect that automated methods will also be applied in so-called preventive-health activities (wellness programs). This has already been demonstrated in several automated multiphasic screening programs around the country. Computers will also prescribe prophylactic treatments in wellness programs and will be used in conjunction with interactive television as the primary medium in health education for the public.

Since the health care industry exists because of illness, our attention naturally focuses on technological developments in medical diagnosis and treatment. Even though these scientific advancements do save lives, the impact on the overall health status of the population of the United States is negligible. For example, the U.S. Surgeon General's Office estimated that for the year 1976 more than two thirds of the U.S. mortality was attributed to unhealthful lifestyle and environmental factors. Less than a third was because of human biological factors and inadequacies in health care.¹⁶

There has been a decided shift in the last decade or two in the average American's lifestyle and values away from institutional help to self-help.^{17,18} Changing attitudes towards health are reflected in the increased number of people who, for example, regularly exercised, changed dietary habits, reduced use of tobacco, and shifted from drinking hard liquor to wine. In addition, more and more businesses and corporations, including hospitals, are implementing employee fitness and wellness programs. Several companies and a few hospitals are providing health-hazard appraisal services

for their employees.¹⁹ In a health-hazard appraisal, individuals answer a battery of 300–400 questions about their living habits and health history. The answers are compared with computerized statistical tables that assess the health risks and benefits associated with the person's particular lifestyle and history. The objective of the appraisal is to use statistical methods and epidemiological data to motivate an individual to change his lifestyle to achieve a gain in life expectancy.

The self-help trend in the health field is further exemplified by the dramatic growth in sales to the public of such items as do-it-yourself pregnancy test kits, sphygmomanometers, stethoscopes, otoscopes, specialized convalescent devices, and so forth. An increasing number of women are opting for natural childbirth, home deliveries, and deliveries by nurse midwives instead of by obstetricians. More families are choosing hospices over hospitals so family members with terminal illnesses may live out their final days in a home-like atmosphere. In general, individuals are assuming more responsibility for their own health, reducing the number of visits to the doctor, cutting short their hospital stays, or choosing alternatives to use of the hospital.²⁰

The holistic-health movement, which focuses on health maintenance rather than illness care, represents a growing popular challenge to established health policies and practices. The holistic-health movement stresses the necessity of restructuring the social environment to achieve and maintain health effectively.²¹ Spokesmen for the movement argue for establishment of a "healthy public policy" to replace our "public health policy."^{22, 23}

The trend in changing personal attitudes and lifestyles is already having an effect on the health care industry. Clement Bezold,²⁴ in his book *The Future of Pharmaceuticals*, cites the trend as a factor to be considered by pharmaceutical manufacturers in their long-range research and development planning. Jeff Goldsmith,²⁵ President of Health Futures, Inc., points out the possible future effect of this trend on the consumption of health services, particularly the potential decrease in hospital usage.

If the self-help trend continues, and if individuals continue to assume greater responsibility for their own well-being, we can expect a decrease in the use of drugs in general. At the same time, there will be increased demand by the public for health education to make it more self-reliant in health matters. Hospital pharmacists, therefore, will find their roles gradually shifting to assume this public education responsibility. As the home computer and interactive television become more common, however, health education will be provided through these media and the educational role of the pharmacist may then diminish.

In 1900 the leading causes of death in the United States were influenza and pneumonia, tuberculosis, gastroenteritis, and heart disease.²⁶ Today they are heart disease, cancer, stroke, and accidents.²⁷ The change reflects several factors, including the discovery of antibiotics and advances in nutrition and environmental conditions. As life expectancy has advanced because of these and other developments, the incidence of the disorders of the elderly, such as cancer, stroke, and heart disease, has increased.

Over the next 40 years, the number of so-called acute organic diseases will diminish substantially.²⁸ Although infectious diseases will not be eradicated entirely, they will have been largely controlled through new antibiotic therapy, diminished trans-

mission resulting from lower disease incidence, and discovery of new prophylactic immunization measures. The problem of resistant organisms will probably have been solved.

Cardiovascular and cerebrovascular problems will probably still plague us unless hereditary factors, psychosocial stresses, and dietary traits can be better controlled; however, many cardiac dysfunctions will be effectively treated with new therapeutic agents. Allergies will increase because of the proliferation of new biologic substances, synthetics, and additives encountered in foods, water, pharmaceuticals, clothing, and other materials. Environmental pollutants—biochemical, radioactive, and sound—may pose some of the most troublesome health problems in the future unless more effective means can be found for their control.

By the turn of the century, vehicular and industrial accidents as leading health problems should be yielding to control. Accounting for this will be automated vehicular and traffic control systems and computer-controlled (cybernated^a) manufacturing systems replacing humans in the production lines.

Psychogenic illness will constitute one of the greatest, if not the greatest, health problems as we move into the 21st century. The “future shock” syndrome—Toffler’s²⁹ “disease of change”—will be the primary causative factor. Stresses arising from the individual’s attempts to cope with rapidly changing needs, values, and goals will be responsible.³⁰ Most difficulties will be traceable to group maladaptations and rejections as our society becomes less individualistic and more group oriented. Changing family structures and male-female relationships will be important factors. Too many choices and lack of choices will be sources of stress and frustration. Automation and cybernation in the workplace will result in large increases in leisure time for a vast majority of the population, and this will be particularly stressful to many.

Bezold³¹ lists the increasing proportion of elderly as one of five major trends and issues that will shape the future of health care. According to official projections, the number of Americans 65 and older, now about 25 million, will rise to more than 55 million by 2035. Unless the birth rate increases substantially, elderly persons will compose nearly 20% of the total population, compared with 11% today.³² The “old old” (age 75 and over)—the group with the most illness and disability—will outnumber today’s 65 and over by the year 2040. The growth in the elderly population probably will mean increasing demand for hospital services, since elderly individuals consume almost four times as much hospital care per capita as the national average. This demand will be determined, in part, by tradeoffs with aftercare alternatives to hospitalization forced by strained federal budgets and the changing health status of this segment of the population.³³

As medical advances prolong life, chronic illness will become a greater problem. Undoubtedly, some elderly Americans will require nursing home care, but some will be cared for at home with the aid of electronic monitoring devices and telecommunication hookups with central health facilities. Hospitals are likely to broaden their service offerings to elderly persons by providing for day hospitalization (daycare) for geriatric patients and by providing home health care services. Smaller hospitals may open “swing beds,” which can be converted from acute care to long-term care as needed.

Much ongoing research today focuses on the action of individual cells in an effort to discover more about the basic functioning of the human body. Because immunotherapy promises to be useful for such a wide range of diseases, much current research is targeted on the human immune system. Current studies include continuing investigations of the interferons, the immune system's role in tissue rejection in organ transplantation, immunologic prevention of tooth decay, the relationship between the immune system and the aging process, and the development of vaccines for prophylaxis against parasitic diseases.³⁴

Research on neurotransmitters—molecules that mediate brain activity—may result in major breakthroughs. About two dozen neuropeptides have already been discovered, and there are perhaps hundreds more.

In the area of birth control, it is claimed there is so much research going on that by the year 2000 there will be a large selection of safe pharmacologic techniques from which to choose.³⁵

We are only beginning to scratch the surface in our research on genetics. Protein synthesis is the goal of most current genetic engineering efforts, but future possibilities for development of new therapies and preventive measures for disease are almost limitless.³⁶

Discovery and refinement of the technique for producing monoclonal antibodies promise to bring about revolutionary changes in the understanding and treatment of diseases. They are already being used with success in research on cancer, heart disease, multiple sclerosis, viral diseases, and disorders of the human immunological defense system. They may also be used as drug conveyers in organ-targeted therapy, as drug-carrying vehicles to neutralize overdoses of drugs or to desensitize patients with allergy, or as a monitoring system to trace drug effects. Highly specific antibodies may also be used for preparing improved vaccines for use against specific types of cancer, such as malignant melanoma.³⁷

We can expect to see development of new and unique drug-delivery systems. Controlled-release technology is likely to be made much more sophisticated and reliable. Alternatives to drugs, such as electrical stimulation, are being studied. Nuclear magnetic resonance (NMR) as a diagnostic alternative to conventional roentgenograms and the computerized axial tomographic (CAT) scanner will soon be in common use.³⁸

As the patterns of illness are modified by the medical, social, and technological developments we have described, the patterns of treatment will also change. The trend towards greater self-reliance of the individual in health matters, the shift of the health care system from illness care to health maintenance (wellness), the improved health and physical condition of the public in general, the reduced incidence of disease, the availability of more effective drugs for a broader spectrum of illness, and the technological developments that will permit patients to be treated at home will mean that many fewer people will be hospitalized and that ambulatory care will greatly increase.

The runaway escalation of health care costs in the last few years has put hospitals under tremendous pressure to reduce their expenses. William Smith,³⁹ in his Whitney address last December, described the situation facing hospitals and some of the implications for hospital pharmacy. Goldsmith,⁴⁰ in his book *Can Hospitals Survive?*, states:

The health care industry in the United States is undergoing profound structural changes which will alter the role the hospital and the physician play in rendering medical care. As this structure broadens and diversifies, alternatives to acute care hospitalization will become increasingly attractive economically. The more rapidly hospital costs escalate, the more rapidly these trade-offs will be forced by health insurers. . . [T]he rising price of hospital care will encourage growth of ambulatory services, alternative delivery systems, and aftercare for the nation's elderly. As costs increase, competitive pressures within the hospital industry will intensify to the point where many hospitals, perhaps hundreds, may be forced to close, and as many as several thousand others may be absorbed by large hospital management firms. . . .

The impact of this trend on hospital pharmacy—and hospital pharmacists—may be substantial indeed, especially in hospitals forced to close and those taken over by management firms.

Now that I have reviewed the major trends shaping the future health care system, we should have a better image of the context within which the system will metamorphose. I shall now examine future hospital pharmacy practice in the context of this changing health care system.

In subscribing to the concept of clinical pharmacy, hospital pharmacy has cast its lot with the health care team; therefore, the future of hospital pharmacy practice may be determined in large measure by whatever happens with the health care team, particularly with respect to the clinical aspects of our practice.

The current concept of the health care team identifies the physician as, if not captain of the team, then certainly its dean. So the future of the physician and his role on the health care team should give some inkling of what the future has in store for the hospital pharmacist.

Two incisive expositions on medicine and the health care system in the 21st century are Maxmen's *The Post-Physician Era*, which I cited earlier, and a book entitled *The Future of the Health Sciences: Anticipating Tomorrow*,⁴¹ by Stanley Lesse, a physician who is editor-in-chief of the *American Journal of Psychotherapy* and currently on the faculty of neurology of the College of Physicians and Surgeons at Columbia University. The two books were published in 1976 and 1981, respectively.

These books are not science fiction; they are serious dissertations with substantial documentation from the literature to back them up. In the preface to his book, Lesse states that he has “. . . attempted to develop a future health science model that will be a reflection of the interrelated social, demographic, and technologic forces that will mold it.” Maxmen stated as his objective in writing *The Post-Physician Era*: “By proposing the eventual replacement of a physician-centered model by a medic-computer model, I hope to present an innovative, viable and desirable alternative solution to the American health care crisis.” The future health systems proposed by Maxmen and Lesse are strikingly similar. Both are based on highly sophisticated automated and cybernated (computerized) systems that will perform more efficiently most of the functions of the contemporary physician. Both proposals emphasize health maintenance rather than illness care. Both authors predict the demise of the physician within the next 40 or 50 years.

The two physician authors suggest that private medical practice will disappear during the first decade of the 21st century. By the turn of the century, the vast majority of physicians we train today, they say, will become what Maxmen calls “medics” and what Lesse calls “health technical experts.” These medics will work as assistants to sophisticated automated devices that will take over many, if not most, of the tasks now carried on by today’s highly specialized physicians. There will be generalist medics and specialist medics. The latter would require further training to learn about such things as psychotherapy, delivering babies, setting fractures, and so forth. Some medics will be diagnosticians; some will be trained as therapists. The medic–computer team will replace the general practitioner and the clinical specialist of today. In combination with the automated systems, the medics will interpret and apply procedures that are suggested and planned by higher level health professionals.

Lesse and Maxmen see the need for one or two higher levels of health manpower that will have overall conceptual and operational responsibility for the health system. They will be generalists, not specialists. They will supervise the programming of the automated diagnostic-treatment system and the health record-memory banks and have responsibility for their attending medics. They will be humanistically oriented cyberneticists. They will be programmers, consultants, teachers, and researchers, but of a different order from what we now associate with these terms. They will *not* be comparable to today’s physicians and their education will be vastly different from present-day medical education.

Charging that today’s mammoth medical centers are one of the greatest deterrents to the future progress of American medicine, Lesse and Maxmen propose that the formal physical structure of future health practice be greatly simplified. Since the primary focus of the future health system will be prophylaxis and health maintenance, design of facilities will put heavy emphasis on automated diagnostic and health maintenance technology.

The types of facilities and numbers of each will be planned to take into account the emphasis on health maintenance and self-care, lower incidence of acute illness and injuries, new therapeutic developments, increased elderly population, and other factors I have already described. With no need to accommodate the requirements of doctors, the facilities can be planned and operated at much lower cost and greater efficiency.

Maxmen’s concept of how the transition from a health-team model to a medic–computer model will occur is particularly interesting. He believes the public’s experience with nurse-practitioners, nurse-clinicians, and physician’s assistants (and we could add clinical pharmacists) will influence the likelihood of future patients accepting the “medic.” He thinks that, as physicians continue to withdraw from active patient care under a health-team model, the public will become less dependent on physicians’ services; furthermore, as paraprofessionals increasingly use computers in providing clinical services, patients will become accustomed to receiving treatment from machine-assisted allied health personnel. He believes also that physicians will actually facilitate their own obsolescence because they are not suited by temperament to perform tasks that can be delivered more readily and more effectively by a medic or by a computer. Because physicians are not going to *want* to do something that a

medic-computer symbiosis can do better, they may actually facilitate the development of a medic-computer model.

What can we say now about hospital pharmacy practice 40 years in the future?

Let us assume for the moment that Lesse and Maxmen are correct and that by the year 2025 automation has progressed to the level of sophistication they forecast and that physicians have become extinct, replaced by the health personnel they describe.

What will happen to the clinical functions performed by today's institutional pharmacists? Of the 10 activities listed in the *ASHP Statement on Clinical Functions in Institutional Pharmacy Practice*,⁴² I suggest that all but one will have been automated or turned over to medics. Such functions as taking medication histories, drug-therapy monitoring, patient education, and drug prescribing have already been described in our discussion of future trends. It requires no stretch of the imagination to envision similar automation and delegation of other functions, such as pharmacokinetics consultations, medication administration control, detection and reporting of adverse drug reactions, conducting drug-use reviews, and so on. The only function for which a higher level person might be required is initiation and participation in research, which would remain a responsibility of the clinical pharmacist or a similarly qualified person.

Since there will be no physicians, what will happen to the health care team with which clinical pharmacists identify today? It appears that the only one of today's health professionals in the hospital who will still be needed 40 years from now is the technical (bedside) nurse—the licensed practical nurse. The professional nurse will disappear along with the physician. So, too, will the physician's assistant. Maxmen suggests that during the transition period from the health-team model to the medic-computer model, nurses who wish to perform clinical services could become medics. Physician's assistants, on the other hand, might be in a natural position to help in the confusion, after which there would be no place for them. So, the health care team, as we know it today, has disappeared along with the physician, the professional nurse, and the physician's assistant.

What will happen to the nonclinical functions of the hospital pharmacist? In my opinion, these will disappear long before the clinical functions. Most of the technical functions related to compounding and dispensing have already been automated or turned over to technicians. The administrative functions, such as record keeping, purchasing, and inventory control, can be performed by nonpharmacists and computers, as well as by pharmacists. Management activities likewise do not require pharmacists' unique knowledge and expertise.

Drug information service activities, which some may call clinical functions but which in my opinion are largely technical, will probably be completely automated before the end of this decade. With the departure of the physician and with automation of medical diagnosis and treatment, the clinical function of the drug information pharmacist—interpretation of the literature—will be in slight demand. The only consumers of this service will be medical researchers and "health academicians" involved in programming the automated systems, and they will either do their own literature interpretations or obtain the needed information online from national or internation-

al “literature interpretation centers.”

Earl Joseph,⁴³ editor of *Future Trends*, which is published by the Minnesota Futurists, identifies five basic periods of the future:

1. Now and the immediate future: up to 1 year from now.
2. The near-term future: 1–5 years from now.
3. The middle-range future: 5–20 years from now.
4. The long-range future: 20–50 years from now.
5. The far future: 50 years or more hence.

Joseph makes two points he believes are important in long-range planning: (1) the world that we shall experience in 5–20 years is being shaped by decisions made now, and (2) almost anything can be done in 20 years. To illustrate the latter point, Joseph reminds us that, once the decisions were made, only 4 years were needed to build the first atomic bomb and only 8 years to put man on the moon.

We need to start thinking now about what our roles should be 5–20 years from now, not by extrapolating from the past and present but by looking 20–50 years into the future and then working back from there. Our objective should be to think of what we as health professionals can contribute to the needs of the future health system as we think it will be.

The kind of thinking and planning we must do will not be easy. And it may be quite stressful. We will have to consider the possibility that, if we wish to have a meaningful role in the future system, we may not even be called pharmacists or clinical pharmacists. Educational requirements for our future role may be entirely different from today’s pharmaceutical education. There may not be any pharmacy colleges.

The planning needed cannot be done in isolation by pharmacy alone. It must be a joint effort involving all the health disciplines and those outside the health disciplines as well. It will call for uncommon statesmanship—of a kind not often witnessed. It will be a lengthy process; in fact, it must be a continuing process. Plans must be perpetually updated as new knowledge or evidence comes to light.

If, as Earl Joseph claims, there is little we can do now to change the course of things during the next 5 years, we can shape our future beyond that time if, beginning now, we commit our creative energies to participating in planning for change. American hospital pharmacy has never lacked forward-thinking leaders. The man in whose honor this award was established, Harvey A. K. Whitney, was one of these. Dr. Arthur Purdum was another. And Dr. Don Francke. I am confident that we hospital pharmacists can meet the challenges that lie before us.

(For the complete list of references cited, please see page 1322 of the *American Journal of Hospital Pharmacy*, Aug. 1983.)

Harvey A. K. Whitney Award Lectures (1950–2005)

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