

# **5. Medical Technology in Japan**

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## JAPAN: COUNTRY DESCRIPTION

Civilization in the Japanese Archipelago began several thousand years ago in the neolithic age (17). Japan is made up of 4 main islands and more than 3,000 smaller islands, covering a land mass of over 377,000km<sup>2</sup>. Over 111 million persons reside on less than 3 percent of the land. Nearly 70 percent of the land is covered by mountains and forests, and 27 percent is used for farming and industry.

The Meiji Restoration in the mid-1800's marked the beginning of the modernization of Japan. At that time, Japan opened its doors to the rest of the world and took steps to modify and update its industries, political institutions, and the pattern of society. Today, the government is a parliamentary system with three branches: legislative (the Diet), executive (Prime Minister and Cabinet), and judicial. National policies are administered at the local level by governments in each of the country's 47 Prefectures (States).

Buddhism, introduced to Japan from China and Korea, and Shinto, a religion native to Japan, are the primary religions. Japan has a rich cultural history ranging from the theatrical arts, including Noh and Kabuki, to significant literature and poetry. Other forms of art and music from the past still hold a prominent place in today's society.

Japan is essentially ethnically homogeneous and has one language. In order to be able to read the daily newspaper, one must have a working knowledge of three different alphabets,

the principal alphabet (Kanji), which is made up of several thousand characters; and two other alphabets (Hiragana and Katakana), each of which has 46 letters. The literacy level in Japan is extremely high and education is an important societal goal.

The economy of the past was labor intensive and had many, many small industries. Japan, of necessity, entered into international trade because of the lack of raw materials needed in manufacturing processes. Much of Japan's rapid economic progress has occurred in the post-World War II recovery period, after the country and its productive capacity had become almost totally inoperative. Accomplished primarily because of a focused effort, the country's achievement has been rather remarkable.

In recent years, there has been a massive shift to high technology. Industries in Japan, through the guidance and support of government agencies, have concentrated on developing high levels of productivity for a limited number of manufactured products. Marketing methods for the distribution and sale of these products, furthermore, have helped make these industries highly competitive in world markets.

The tradition of lifetime employment security has played no small part in the success of Japanese industry. In addition, Japan has a rather elaborate social security system. This system, which provides for medical, annuity, industrial accident, and unemployment insurance, has undoubtedly had an impact on the lifestyle of the Japanese people.

## THE HEALTH CARE SYSTEM

The days of acknowledgment that "illness was God's punishment" went out to sea when Western medicine was introduced to Japan in the 1740's by Dutch and German physicians (20). Isei, the medical law, was adopted during the Meiji Restoration in 1873 and established medical schools for the education of physicians. Japanese physicians were and are today primarily concerned with ". . . affairs to protect people's health, to cure their illnesses, and to foster medical science." Japan's Constitution states that "in order that all the people may lead a healthy and decent life worthy of man, the right to life and the pursuit of happiness shall be respected" (20).

A series of questions come to mind when one wishes to explore and understand the medical care system within the milieu of a country like Japan. What is the state of the art in Japan with respect to health and medical care? What kind of financing system is there? Who administers and plans for the health sector? Finally, what problems seem to be emerging and how are programs evaluated? Answering these questions in brief will provide at least an overview of a health and medical care system that is both "alive and dynamic."

At the outset, it is important to realize that Japan ranks as a modern postindustrial society and has an advanced medical care system. Most observers in the United States turn to the East—that is, to Western Europe—for information about their medical experience, but rarely go West—to the Orient—to learn from centuries of experience. When seeking to add to the body of knowledge for future decisionmaking, observations in all directions might be more appropriate.

Japan scores high in the health indicator arena, with an infant mortality rate of 8.9 infant deaths per 1,000 live births for 1977 (12). At the other end of the lifecycle, Japan boasts about its life expectancy achievements, namely, 77.95 years for females and 72.69 years for males (12). With the newly developing health promotion centers, the use of selective health screening pro-

grams, emphasis on physical fitness, and the use of feet and bicycles for transportation, these measures will probably continue to move in the same positive direction.

### General Organization of the System

Medical care in Japan has been, and continues to be, dominated by solo general practitioners in clinic (office) settings. There are 1.18 physicians per 1,000 population, but the distribution of physicians varies markedly by Prefecture, from a high of 1.8 to a low of 0.5 physicians per 1,000 persons (4). Operating parallel with, but separate from, clinic practice is a "closed-staff" hospital system. Clinic physicians rarely have hospital privileges and hospital specialists seldom conduct part-time private practices. A situation in which hospital specialists are salaried at substantially lower incomes than clinic physicians, who practice on a fee-for-service basis, has caused some abandonment of hospital specialty practice for lucrative solo general practice.

Nearly 43 percent of the solo practitioner clinics possess 1 to 20 short-term (72 hours or less) holding beds. These units, although not officially classified or regulated as hospitals, account for 18.7 percent of the short-term beds in Japan. In 1975, Japan had 8,294 hospitals with 1,164,098 beds, or 10.4 beds per 1,000 population (4). When the clinic and specialty beds are added to this complement, the bed/population ratio is estimated to be 12.8 beds per 1,000 population, or 70 percent higher than the ratio in the United States (4).

Hospitals are owned and managed under many auspices throughout Japan. Some are owned by private physicians, whereas others are owned and administered by insurance plans, unions, industries, churches, and various levels of government. The private sector owns between 70 and 75 percent of the general hospitals (50 percent of the beds) and 95 percent of the psychiatric hospitals (9,27). Private ownership has had a definite impact on use patterns and expenditures for medical care, as evidenced by the

reported 33-day average length of stay in the short-term general hospitals (9). This length of stay has been explained in two ways. First, because of limited housing space and a paucity of nursing homes, patients have nowhere other than hospitals to convalesce. Second, the average cost per day in the hospital is rather low, and a significant portion of this cost is covered by sickness insurance.

Traditional public health and environmental health programs (i.e., institutional inspections, food and water supply inspections, etc.) are administered by the 852 Prefectural and local health centers (4). These health centers also provide preventive services to the population as a whole. Preventive services, which are not included as covered benefits in the insurance program but are provided on a large scale through these centers, include screening (early detection) programs for selected conditions (e.g., hypertension, stomach cancer, diabetes), immunizations and physical exams for infants and school age children, plus special categorical programs for maternal health, hypertension, etc. It is obvious from visiting the health centers that persons from all socioeconomic strata frequent them. These facilities truly function as public centers.

## Financing

Nearly the entire Japanese population possesses health insurance coverage which has

evolved over the 40-year period since passage of the basic Health Insurance Act of 1922. The original Act was a broad law covering the working population. By compelling employers to offer health insurance to their employees, this statute set the stage for the development of various health insurance plans. Amendments added subsequently required the plans to provide coverage to dependents of workers, the poor, and the aged. Most recently, benefits were added to provide special coverage for persons with high-cost (catastrophic) illnesses.

Six health insurance plans have developed since passage of the 1922 Act, and these plans collectively cover the entire population: Seikan Kempo, which is government-managed; Kyosai Kumiai, which is administered by the Ministry of Finance; Kokuho, which is administered by Prefectural and local governments; and three other plans which function independently. (See table 1.) All six plans have been set up as non-profit organizations.

The compulsory health insurance system in Japan has been financed by two methods: 1) employer-employee contributions, and 2) subsidies derived from general tax revenues. Employer-employee contributions are in actuality insurance premiums derived from a specified percent (8.3 percent) of the employee's basic salary. The employer, by law, contributes at least 50 percent of the premium and the employee pays the remainder.

Table 1.—Japanese Health Insurance Plans, Beneficiaries, and Enrollments<sup>a</sup>

Plan and year established	Beneficiaries	Number of persons insured	Percent of all insured persons
Seikan Kempo, 1926	Employees of firms having 5 to 1,000 persons	27,721,000	25.1 %
Kumiai Kempo, 1926	Employees of firms having more than 1,000 persons	25,573,000	23.1
Hiyatoi Kempo, 1953	Day laborers	752,000	0.7
Senin Hoken, 1940	Seamen	753,000	0.7
Kyosai Kumiai, 1962	National and local government employees; public corporations; private school teachers and staff	11,969,000	10.8
Kokuho, 1938	Employees of firms having fewer than 5 persons; persons who are self-employed, retired, aged, and others not covered by employees insurance	43,853,000	39.6
Total		110,631,000	100.0%

<sup>a</sup>Over 99 percent of the population in Japan is covered by one of the six insurance plans; the remainder is covered under special categorical programs. The distribution is as follows:

Total population	—	Total insured persons	=	Persons covered by special programs
111,275,000	—	110,621,000	=	654,000
100 percent	—	99.4 percent	=	0.6 percent

SOURCE: National Federation of Health Insurance Societies (Kemporan), *Health Insurance and Health Insurance Societies in Japan* (Tokyo, September 1977) (16).

Over the past several years, the Government of Japan has been called on to subsidize five of the six health insurance plans to cover unexpected, and in some cases continuing, deficits. Only one of the plans (Kumiai Kempo) has consistently shown a surplus, and surplus funds are passed on to the enrollees in various forms (i.e., premium reduction, extra benefits, recreation facilities, hospital facilities).

On the consumer side, in addition to the insurance premium paid to their respective insurance plan, insured persons (workers) pay a small, fixed amount out of pocket for care, whereas their dependents (family) pay 30 percent out of pocket up to a 39,000 yen (\$108) maximum liability during a calendar month (2).<sup>2</sup> In late 1973, an amendment (Kogaku Ryo-yohi) was added to the basic insurance law as a means to meet high-cost illness (catastrophic) expenses for dependents beyond the 39,000 yen threshold. This program, administered by each insurance plan, was designed to prevent economic catastrophes that heretofore had resulted from high-cost illness. Patients in Japan have the right to seek care from any provider, and the provider in turn is able to bill any of the appropriate health insurance plans for the services rendered.

### Reimbursement

Physicians, dentists, other health providers, and medical care institutions are reimbursed for care by the insurance plans under a standardized set of fee schedules. Lists of fees for each item of service (consultation, teaching, lab by test, drug by generic class, specific surgical procedure, X-ray by type, etc.) are published, and all claims for reimbursement must be submitted by medical care providers on standard forms. Clinics and hospitals have a choice (annually) to elect the use of "fee-for-(each) service" or an "all-inclusive rate." In general, hospitals select the "all-inclusive rate" scheme, and solo practitioners choose the "fee-for-service" method.

<sup>2</sup>For conversion of Japanese yen to U.S. dollars, the exchange rate used throughout this paper was ¥360 = \$1.00 (U.S.).

<sup>3</sup>For the legally poor and the elderly (persons over 70 years old), no copayment is required.

Fees for each service that is provided in a medical care settings are negotiated on an annual basis. The Bureau of Insurance of the Ministry of Health and Welfare is charged with the development of a fee reimbursement scheme proposal for the providers and medical facilities (14). Under a system adopted in 1943, each item of medical service is assigned a certain number of points, depending on such things as the item's relative complexity. The actual medical fee for a particular item is then calculated by multiplying the respective points by a certain unit cost, which was set at 10 yen (\$0.027) per point in 1977. Proposed changes in fees are presented, debated, and negotiated within the Central Social Insurance Medical Council, an advisory body to the Ministry of Health and Welfare that is made up of representatives from medicine, dentistry, the insurance plans, and so forth. The specific tariff schedule for drugs, for example, is reviewed annually and in recent years has also been revised annually. The strongest body in the policymaking process of fee-schedule development is probably the Japanese Medical Association.

### Administration and Planning

The Ministry of Health and Welfare has the primary responsibility for the regulation, administration, and conduct of public health programs. This Ministry regulates the health insurance plans, but generally delegates the responsibility for day-to-day administration to each plan. For insurance plans that are government-sponsored, however, the Ministry retains this administrative responsibility.

Health planning has traditionally been from the bottom up (local to national) through committee consensus. In the past, national health planning was categorical in nature. Early in the 1960's, the concept of comprehensive planning became more practical, particularly since there had been rapid socioeconomic changes in the country as a whole (4). Today, it has been noted, the Ministry of Health, on an ad hoc basis, calls on and utilizes input from various institutes and university experts on substantive planning issues, and also solicits citizen participation (the latter having become rather popular in re-

cent times). In this manner, it develops both short- and long-range health plans and updates these as changes are needed.

As part of the Ministry's medical manpower development plan, the policy of establishing new medical schools (one per Prefecture) has been implemented since 1970. This effort will be terminated in a few years. The Ministry is planning to improve postgraduate medical education in primary care by training doctors for education technology or sending trainees to the United States.

## POLICIES TOWARD MEDICAL TECHNOLOGY

The introduction and adoption of a significant volume of new forms of medical technology in Japan is similar to that in other well-developed industrialized countries. Over the past two decades, vast amounts of sophisticated new medical technologies have been developed and used to augment the provision of medical care in hospitals, as well as in private solo practitioners' clinics. The function of these technologies is to prevent, detect, or treat illnesses once thought to be the cause of "unnecessary disease, disability and untimely death" (21).

The devices industry has grown rapidly in Japan. In 1974, receipts totaled 254.3 billion yen (\$706 million), an increase of 26 percent over the year before (14). Electronic equipment in general has shown very rapid growth, rising from 21.6 billion yen (\$60 million) in 1971 to 35.7 billion yen (\$99 million) in 1974 (14). Patient monitoring and diagnostic equipment sales increased from 1.9 billion yen (\$5.4 million) in 1971 to 5.5 billion yen (\$15 million) in 1974 (14). Drugs account for annual sales for the industry of 2,161 billion yen (\$6 billion), a figure that rose about 15 percent from 1975 to 1976 (14).

Because of the rapid development and dissemination of new medical technology in Japan, the evaluation phase in many cases has been ignored or set aside for future action. Today, particularly with the ever increasing costs of the

The Ministry of Health and Welfare recently became actively involved in a newly formed World Health Organization/Pan American Health Organization (WHO/PAHO) health planning consortium that will serve as a continuing forum for the exchange of methodologies and program experience in health planning. Some WHO-collaborating health planning centers have been established. In addition, the Ministry has a plan to establish an International Medical Care Cooperation Center to promote medical care cooperation, particularly with developing countries.

delivery of health and medical care in Japan, there is not only a consciousness of increased costs, but a concerted effort to carefully allocate scarce funds and resources. It may be that this effort will provide some impetus to a more thorough evaluation of medical technology.

### Research and Development

The Japanese Medical Association functions prominently in the promotion, development, and support of research, and in the introduction of new technology (25). This has been particularly true in the past for historical reasons. Prior to 1955, the vast majority of physicians continued their training 6 to 10 years beyond the Doctor of Medicine degree to attain the higher Doctor of Medical Science degree (Igaku-Hakase) (4,26). In 1955, postgraduate training was reconstructed into a 4-year program in research, completion of which resulted in the granting of the same higher degree. Some of the physicians who completed their training in these programs became and continue to be the nucleus of the technological innovators in Japan. In 1968, a number of medical students challenged the new process, reportedly because they believed that too much emphasis was being placed on research and not enough on clinical medicine (25). The immediate impact of the change that resulted was a decrease in clinical research and widespread inability of medical schools to attract new faculty interested in and/or with ex-

expertise in research. Currently, the impact of this turn of events is being tempered by government and private foundation sponsorship of research fellowship programs abroad. The long-range effects of the change are not yet being felt.

The development and introduction of new medical technologies in Japan—whether these be in the form of instrumentation, procedures for patient management, or drugs—follows a common pathway. In general, a new technology is developed by researchers and clinicians from the leading medical schools, sometimes with the aid of technical specialists from industry. The quasi-governmental Science and Technology Agency often provides grants-in-aid to support the research, as do the Ministry of Health and Welfare and the Ministry of International Trade and Technology (MITI).

In recent years, the major focus for the development of medical technology in Japan has been to find the means to change the tide of the three leading causes of death: 1) cerebrovascular disease (stroke), 2) cancer, particularly stomach cancer, and 3) heart and other vascular diseases, with special emphasis on chronic renal disease (12). Basic scientific research on cerebrovascular disease is currently being carried out at the Japan Stroke Prevention Center, Institute of Health Science in Shimane, in cooperation with the U.S. National Institutes of Health. Animal model studies, which it is hoped are transferable to man, have been concentrated on the development of stroke-resistant strains of rats and on the means of the treatment of persons who have been found to be stroke-prone (5,28).

Also being carried out are clinical studies with scanning devices to detect persons with vascular changes. A limited number of experimental stroke intensive care units, some with hyperbaric chambers, have been set up by private hospitals in an effort to reduce mortality of persons who have had cerebral hemorrhages. Other modalities for the prevention and treatment of stroke, including diet modification, drugs for the treatment of hypertensive disease, and neurosurgical procedures, are being explored. None of these modalities, however, have been introduced on a broad scale; nor have any of them been fully evaluated or received

sufficient endorsement from the medical community to warrant general use.

Much more technology has been developed for the early detection of cancer, particularly stomach cancer, than for detection of cerebrovascular disease. A great deal of research is currently underway in Japan to increase the speed of diagnosis with the so-called automated cytology process using optical scanning technology. Research for this and a series of related projects has been supported for several years by funds from the Ministry of Health and Welfare and MITI. Before there is any diffusion and dissemination of the new technology, however, researchers want to perfect it to the level at which there will be no sacrifice of accuracy for speed.

### **Evaluation of Medical Technology**

The use of a new medical technology in Japan is dependent on its introduction by an eminent professor or clinician and its subsequent endorsement by peers or professional groups. The process of peer evaluation applies to all forms of medical technologies—drugs, devices, and procedures—whether they are developed within Japan or are imported.

Once the original investigator's coworkers and peers feel the technology has promise, the investigator usually publishes the findings in technical scientific or medical journals. If and when the investigator's peers recognize the potential and value of the technology, they replicate the work and often make improvements on the basic idea. Subsequent publication of their findings is recognized as a positive sign to the original investigator, who then with his peers formally introduces the technology for review and approval by the Pharmaceutical Affairs Bureau of the Ministry of Health and Welfare.

### **Regulation of Drugs and Medical Devices**

Drugs and medical devices are currently regulated in Japan under the Pharmaceutical Affairs Law (15), which passed the Japanese Diet



on August 10, 1960. Products intended for use in humans are controlled by the Ministry of Health and Welfare, through its Bureau of Pharmaceutical Affairs. The Bureau of Pharmaceutical Affairs is assisted in implementing the Pharmaceutical Affairs Law by the Pharmaceutical Affairs Council, an advisory group with 13 committees and 55 subcommittees. The committees and subcommittees of the Pharmaceutical Affairs Council deal with such matters as the approval of manufacture and import of new drugs (Committee on Drugs), the establishment of quality standards for medical devices (Committee on Medical Devices), measures to assure the safety of drugs (Committee on Safety of Drugs), and review of drugs already on the market for effectiveness and safety (Committee on Drug Efficacy Re-Evaluation).

Whenever a new drug is proposed for marketing, data concerning its safety and efficacy must be submitted to the Bureau of Pharmaceutical Affairs. The Committee on Drugs of the Pharmaceutical Affairs Council reviews the data and makes a recommendation, but the final decision on market approval is made by the Bureau of Pharmaceutical Affairs. Of interest is the fact that drugs already marketed in other countries apparently are approved more readily than totally new drugs.

Once the drug is approved, it is entered in the Japanese Pharmacopoeia and may be marketed. In addition, the Bureau of Pharmaceutical Affairs requires good manufacturing practices to assure quality products. Because of their exposure to a series of manmade tragedies resulting from environmental contaminants, the Japanese are especially sensitive to the issue of safety. A national drug monitoring system of 465 hospitals that report adverse drug reactions is administered by the Bureau of Pharmaceutical Affairs (14). A surveillance system is also operated by the Bureau of Insurance through its Division of Medical Affairs.

Although medical devices are regulated under the pharmaceutical affairs law, any medical device that is in conformance with standards promulgated under the industrial standard law, may be manufactured or imported without a product license. Regulation under the industrial

standard law focuses on safety, in particular, the safety of electrical instruments and apparatus. Performance standards have been established for 140 devices, including electrocardiographs, gastroscopes, and blood pressure meters. The law also requires manufacturers to register their products.

### Reimbursement and Medical Technology

As was mentioned earlier, when a new service is proposed for a fee in Japan, it must first be debated by the Central Social Insurance Council. In its informal evaluation, the Council considers what is known about the benefits and risks of the proposed technology at that time. The fee established is intended to cover the price of the service. Thus, for example, the fee for a drug should be the actual purchase price. In practice, however, these purchase prices vary considerably in different institutions and different parts of the country, so the Minister of Health and Welfare establishes one fee.

The fees for drugs have been consistently lowered in recent years, reflecting market prices. The lowering of fees discouraged excessive drug use in the early 1970's, and the reduction of market prices probably results from competition in the Japanese drug industry. In 1974, a new free medical treatment system for the aged "brought about a tendency to excessive dependence on drug therapy and eventually resulted in great increase in drug consumption" (14).

### Cost-Containment Efforts

A rather dramatic increase in medical care demands following the introduction of new technology has been documented by the ongoing Medical Care Survey for Social Insurance (Shakai Iryo Chosa) (19) of the Ministry of Health and Welfare's Information and Statistics Department. In the period from 1964-74, for example, it was observed that new technology increased the frequency of visits 2.4 times and the level of expenditures 6.9 times (19). These increases have been attributed, in part, to the increase in the variety of available laboratory tests and the increased testing capacity of laboratories resulting from automation.

In general, it is thought that the new technology has contributed to better diagnostic ability and therapy, and subsequently has had a positive influence by the improvement of the quality of care (19). Some people, however, feel that at least part of the observed increases in use of the technology maybe due to provider incentives in the fee-for-service payment system, which may result in duplication and possible abuse or excess service (19). Although the increases them-

selves have been documented through the Medical Care Survey, their causes remain to be demonstrated empirically before any attempts are made to modify public policy. Because there is now a great deal of concern about the rising costs of medical care, the Ministry has been conducting a variety of studies to pinpoint the underlying causes and is attempting to develop methods to contain medical care costs.

## SPECIFIC TECHNOLOGIES

The use in Japan of medical technologies like radioisotopes, radiotherapy, computed tomography (CT) scanners, renal dialysis, premature incubators, and drug therapy has shown rapid growth in recent years. Specific technologies are discussed below.

### CT Scanners

CT scanners were first introduced in Japan in 1975. At that time, the device used was the EMI scan imported from England. Since then, similar devices have been developed and manufactured in Japan for domestic use. Initially, the CT scanner was used primarily as a diagnostic instrument, but over time it has come to serve also as an adjunct and guide for radiation therapy for cancer.

In 1978, a survey was conducted to determine the number and type of CT scanners that were in place in a number of industrialized countries. In this inventory, Japan, with 180 head scanners and 112 body scanners, ranked second out of 8 industrialized countries (10). There were 2.6 scanners per 1 million persons in the population (10). As of April 1979, Japan had an estimated 516 (304 head, 212 body) scanners in operation, or approximately 4.6 per 1 million persons (23,24).

Japanese researchers and clinicians have continued to develop and evaluate scanners since the introduction of this new technology. In particular, Japanese researchers have compared CT scanners with other forms of diagnostic methodologies, e.g., radionuclide imaging and angiog-

raphy (11). Conclusions from some of their studies (11) indicate that the medical profession in Japan has not fully accepted the CT scanner as a single, foolproof diagnostic tool. The use by some practitioners of both CT scanning and its diagnostic predecessors, however, may be duplicative, resulting in an unnecessary added expenditure in the delivery of medical care. Any unnecessary expenditure is being absorbed by society through the health insurance premium-reimbursement system.

### Renal Dialysis

The introduction of hemodialysis in Japan, almost 25 years ago in 1955, marked the beginning of an era for the treatment of persons with acute renal failure (8). Therapy for those with chronic renal failure was made available about 10 years later.

For the first 10 to 15 years, the diffusion and distribution of renal dialysis units in Japan were rather limited. In 1972, however, this form of therapy was introduced as a reimbursable benefit through all of the six major health insurance plans that collectively cover the entire Japanese population. From December of 1966 to mid-1978, the number of hemodialysis units in Japan reportedly increased from 48 to 11,671 (8). Table 2 illustrates a nearly 50-percent increase in the number of units from 1976 to 1978.

The number of patients receiving dialysis has been increasing annually at a rather rapid rate. There are now over 200 renal dialysis cases per 1 million population now receiving dialysis in

**Table 2.—Number of Hemodialysis Units in Japan (1976-78)**

Dialyser	June 30, 1976	June 30, 1977	Dec. 31, 1977	June 30, 1978
Coil . . . . .	—	4,720	5,228	5,514
Patient stations . . . . .	—	4,728	5,317	6,157
Total . . . . .	7,822	9,448	10,545	11,671

SOURCES: T. Inou and M. Odaka, "The Situation of Dialysis in Japan," *Proceedings of the Seventh International Congress of Nephrology*, Montreal, Canada, 1978 (8); T. Inou, "Current Status of Artificial Organs in Japan," *Artificial Organs (Japan)* 1(1):19, 1977 (6); and T. Inou, "Current Status of Artificial Organs in Japan," *Artificial Organs (Japan)* 2(Suppl.):1, 1978 (7).

Japan, which is probably the highest rate in the world (8). This is not to say that the prevalence of kidney disease in Japan is necessarily higher than is reported in other countries, but that dialysis therapy is quite accessible and available. Health insurance is probably a rather significant "enabling factor" in this context.

As of July 1978, 99 percent of patients requiring renal dialysis in Japan received their treatment in the hospital or at specialized hospital-affiliated centers; less than 1 percent of Japanese patients who require dialysis had home dialysis, which is used more commonly in other countries (1,3,6,7,8,17). (See tables 3 and 4.) There are several reasons for the lack of use of home dialysis in Japan. First of all, the vast majority of the families live in one- or two-room apartments. The installation of a dialysis unit would crowd the already limited quarters and might require special plumbing facilities. Secondly, the administration of dialysis is considered by physicians to be a medical treatment which, because of its specialized nature, can be provided

**Table 4.—Percent of Chronic Renal Disease Patients Receiving Home Dialysis in Selected Countries and Areas**

Country (or area)	Percent of patients receiving home dialysis
Japan (1976) . . . . .	0.6%
United States (1976) . . . . .	23.7
Washington State . . . . .	75.0
Indiana . . . . .	60.0
Northeast United States . . . . .	15.0
United Kingdom (1977) . . . . .	66.0

SOURCES: E. Friedman, et al., "Pragmatic Realities in Uremia Therapy," *N. Engl. J. Med.* 298(7):368, 1978 (3); and C Blagg, "Incidence and Prevalence of Home Dialysis," *Journal of Dialysis* 1:475, 1977 (1)

only in a medical care setting by physicians. Lastly, Japanese health insurance plans pay the physicians higher fees for dialysis in the hospital and clinical settings than in home settings. By exerting a stronger influence on the physicians' choice of treatment site, this last reason probably overshadows the others.

Along with the number of patients, the costs for the provision of renal dialysis treatment have been rapidly escalating. The equipment in 1976 dollars averages about \$5,000 for the apparatus (coil type \$5,120, plate type \$4,200, and hollow fiber type \$6,420) and \$70 per treatment for the disposable parts (8). Each treatment costs \$200 in the outpatient setting, or \$31,200 per year per patient (8). The cost across the nation for Japan for the year 1976-77 for 20,000 patients was estimated at \$624 million (8).

A number of promising avenues (e.g., the development of reusable filters) to stem the cost tide are being approached and explored by universities. In addition, concerted efforts are being

**Table 3.—Number and Percent of Chronic Renal Disease Patients Receiving Different Types of Hemodialysis in Japan (1976-78)**

Type and location of treatment	June 30, 1976	Dec. 31, 1976	June 30, 1977	Dec. 31, 1977	June 30, 1978
		Number/percent	Number/percent	Number/percent	Number/percent
Hospital in the daytime . . . . .	—	13,864/77.0%	16,037/75.9%	17,317/76.7%	19,184/76.0%
Hospital at night . . . . .	—	3,721/20.6	4,693/22.2	4,847/21.5	5,766/22.8
Home dialysis . . . . .	—	103/0.6	111/0.5	156/0.7	115/0.5
Peritoneal dialysis . . . . .	—	322/1.8	299/1.4	259/1.0	185/0.7
Total . . . . .	15,675	18,010/100.0%	21,140/100.0%	21,140/100.0%	25,250/100.0%
Cases per million population . . . . .	140	160.9	188.9	199.4	222 <sup>a</sup>

<sup>a</sup>Estimate.

SOURCES: T. Inou and M. Odaka, "The Situation of Dialysis in Japan," *Proceedings of the Seventh International Congress of Nephrology*, Montreal, Canada, 1978 (8); T. Inou, "Current Status of Artificial Organs in Japan," *Artificial Organs (Japan)* 1(1):19, 1977 (6); T. Inou, "Current Status of Artificial Organs in Japan," *Artificial Organs (Japan)* 2(Suppl.):1, 1978 (7); and M. Odaka, "Current Status of Dialysis Patients in Japan," *Artificial Organs (Japan)* 2(Suppl.):7, 1978 (17).

made by physicians to increase patients' survival rates, and just as importantly, to improve the quality of their survival. When appropriate, for example, kidney transplantation is being recommended to more candidates. Today, fewer than 200 kidney transplantations are performed in Japan per year (8). It has been reported that 8 to 10 percent of the kidneys are obtained from cadaver donors and that the remaining 90 percent are obtained from related donors (8). There is also a drive to promote night hospital dialysis and home dialysis. Finally, basic research projects supported by the government and foundations are well underway to develop an effective low-cost artificial kidney.

### Radiation Therapy

Radiation therapy or teletherapy for cancer in Japan has taken, and continues to take, several forms. Initially, the treatment of choice was with X-radiation referred to as orthovoltage. During the past two decades, other forms of radiation therapy have been added to the cancer treatment armamentarium. A more potent treatment source that followed X-radiation was cesium ( $^{137}\text{Cs}$ ), and this source was then super-

seded by the "super-voltage" modality cobalt ( $^{60}\text{Co}$ ). More recently, Japan has developed even more advanced technology to augment cobalt therapy, by the introduction of electronically generated therapeutic impulses, with cyclotrons, betatrons, and linear accelerators. These new radiation methods, along with cobalt therapy, are often combined with surgery, chemotherapy, immunotherapy, and hyperbaric oxygen.

The predominant source of teletherapy used in Japan today is cobalt therapy. The other "super-voltage" sources are limited in number, and in many cases still under development. Cobalt units that emit over the 1,000-curie range have been shown to be most effective and are more commonly found in hospital teletherapy units. (See table 5.) A 1978 survey conducted by the Science and Technology Agency's Bureau of Nuclear Safety indicated that there were 589 cobalt and 10 cesium units in use in Japan (22). These units ranged in power from less than 100 to over 5,000 curies. Almost half (48.1 percent) of the cobalt units and 70 percent of the cesium units are in the over 2,000-curie class, which appears to be the treatment of choice (22,29).

**Table 5.—Number and Distribution of Teletherapeutic Apparatus in Use in Japanese Hospitals and Clinics (March 1978)**

Power of apparatus (in curies) <sup>c</sup>	Number of hospitals with apparatus in use	Cobalt units <sup>a</sup>		Cesium units <sup>b</sup>	
		Number	Percent distribution	Number	Percent distribution
Less than 100 Ci . . . . .	60	75	12.7%	1	10.0%
100 Ci to less than 200 Ci . . . . .	10	12	2.0	—	—
200 Ci to less than 500 Ci . . . . .	47	48	8.1	—	—
500 Ci to less than 1,000 Ci . . . . .	60	60	10.2	—	—
1,000 Ci to less than 2,000 . . . . .	110	111	18.8	2	20.0
2,000 Ci to less than 3,000 Ci . . . . .	123	124	21.1	6	60.0
3,000 Ci to less than 5,000 Ci . . . . .	152	152	25.8	—	—
5,000 Ci and over . . . . .	7	7	1.2	1	10.0
Total . . . . .	569	589	100.0%	10	100.0%

<sup>a</sup>Cobalt =  $^{60}\text{Co}$ .

<sup>b</sup>Cesium =  $^{137}\text{Cs}$ .

<sup>c</sup>Curies (Ci) = a unit of radioactivity equal to  $3.7 \times 10^{10}$  disintegrations per second.

SOURCE: Science and Technology Agency (Japan), Nuclear Safety Bureau, "Statistics on the Use of Radiation in Japan" (Tokyo, 1979) (22).

## CONCLUDING REMARKS

No country, including Japan, has been able to provide a problem-free health care program to its people. Japan's major problem now is dealing with chronic disease. Once a country conquers its basic communicable disease and sanitation problems, it enters an era in which the challenges come from chronic illness, environmental and industrial hazards, and other similar threats to mankind. The leading causes of death shift from infectious diseases like tuberculosis, typhus, and smallpox to cerebrovascular disease, cancer, and other similar conditions. As inflation, recession, and unemployment affect the general economy, they also affect the health sector—and their impact makes the combating of these chronic conditions of postindustrial society especially difficult.

A second area of concern in Japan is the rising costs of medical care. National medical care expenditures (NMCE) have risen over 20 percent per year for the past several years (e.g., from 1970 to 1975, NMCE increased by a total of 154 percent, from 2,553 billion yen (\$7,091,667) in 1970 to 6,478 billion yen (\$17,994,444) in 1975) (4). At the present time, approaches to modify the insurance program are under serious discussion. In June of 1978, the Ministry of Health and Welfare submitted to the Diet a proposal to reform the health insurance program (i.e., to increase the premium, increase the out-of-pocket payment for outpatient drugs, equalize insurer and dependent out-of-pocket liability, etc.). This proposal, primarily a cost-containment measure, was introduced at the end of the legislative session of the Diet and was tabled for further study. Since that time, elements of the proposal have been debated by organized medicine, industry, unions, and the general public. The debate and exchange of ideas is a healthy sign, but unless action on this measure is taken soon, the Ministry of Finance will be unable to continue to cope with the deficits of the health insurance plans.

A third problem that is being anticipated in Japan is the potential impact of the country's increased life expectancy achievement. It is estimated that by the year 2025, more than 18 percent of the population will be over the age of 65 (13). This important segment of the population will require special health services, health facilities, housing, income maintenance, and other specialized services. These services must be planned for and financed by today's working population for a period of 40 years hence in order to avert future problems. The emphasis, therefore, has been on planning and program development for the aged population to prevent future problems. If this activity proceeds at its projected pace, there will be few if any problems. Only time and experience will reveal the success of this preventive action.

The fourth and final set of problems pertain to medical manpower distribution and health care technology. A visit to a physician's clinic will reveal a well-trained physician who probably has specialty training. Unfortunately, some of the physician's skills are underutilized because of the closed-staff hospital system. Relaxation of this barrier would alleviate at least part of the problem. In the clinic setting, it is clear that medical technology permeates the air. One will probably find a rather large variety of sophisticated diagnostic and therapeutic equipment. That is, technology can be observed as the rule rather than the exception. Technology assessment, on the other hand, has not kept pace with the introduction of new modalities. Because of the recent recognition of the need for cost savings and cost-containment measures to stem the tide of spending during these inflationary times, however, it is anticipated that more assessment will be done in the future to determine the use, benefits, risks, and costs of technology to society.

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