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HEALTH MANPOWER IN A DEVELOPING ECONOMY

TAIWAN, A CASE STUDY IN PLANNING

BY TIMOTHY D. BAKER
AND MARK PERLMAN

THE JOHNS HOPKINS MONOGRAPHS
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Health Manpower in a Developing Economy
Baker and Perlman
Johns Hopkins

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PREFACE

IN 1704 a book called *An Historical and Geographical Description of Formosa, an Island Subject to the Emperor of Japan*, was written by George Psalmanaazaar, "a native of the said island, now in London." Although Psalmanaazaar was supported by the Church of England and respected by Samuel Johnson, who said of him, "I should as soon think of contradicting a Bishop," the book was pure humbug. Even the title was false, for at that time Formosa was subject to the Emperor of China. Not only was Psalmanaazaar not "a native of said island," *he had never been there*. This study of ours may likewise be subject to errors; but at least we have been there.

This volume is the result of two and a half years of collaboration between the Division of International Health of The Johns Hopkins University, the Health Division of the Joint Commission for Rural Reconstruction of the Republic of China, and the Provincial Health Department of Taiwan. The major source of financing was a grant from the Agency for International Development to The Johns Hopkins University. The study is the first in a series of four Johns Hopkins' health manpower surveys; the others are being carried out in Turkey, Peru, and Nigeria.

These studies developed from our conviction that planning for human resources in the health field is essential for adequate health services in newly developing nations. This book was designed to serve a dual purpose—to assist the government of Taiwan in its planning for the next twenty years, and to develop methods of health manpower analysis. Lessons learned in this study may be applied to professional manpower planning in other developing nations.

In the fall of 1961 we learned of the interest of the government of Taiwan in a joint research project. In March, 1962, after a series of conferences, an agreement was reached to carry out this research project in Taiwan. Preliminary plans were developed during the next three months. Field work was initiated in Taiwan in June of 1962.

Our research consisted of five substudies: (1) a complete census of all health workers on the island; (2) a random sample survey of twelve thousand households to determine medical care demands; (3) an analysis of the results of the joint entrance examinations of the past five years; (4) a survey of the medical training institutions of the island; and (5) a student-attitude survey in the colleges of medicine, nursing, dentistry, and pharmacy.

We would like to thank a number of persons and agencies who contributed significantly to the success of our study. The Joint Commission for Rural Reconstruction gave us office space, administrative services and, above all, the assistance of Dr. S. C. Hsu, Dr. K. K. Chang, and Dr. L. P. Chow of their Rural Health Division. Dr. Chang was instrumental in the administration of the project during our absence; without his assistance, we would have very little solid data. Dr. Chow worked full-time with us on the design of several of the substudies. He is the author of Appendix II, The Sampling Frame. Dr. Hsu was always available for consultation and help in solving our problems. Commissioner C. H. Yen, and Commissioner T. C. Hsu of the Provincial Health Department not only gave us ideas and good advice but provided office space, transportation, and staff during the first months of the study. The deans and directors of the medical and nursing schools were most generous in giving us ideas and information. Dean Wei, Dean Tu, General Yang, General Loo, General Peng, Miss Hsu, and Miss Li were particularly helpful. The staff of the Agency for International Development (AID) Mission in China facilitated our work in many ways.

Dr. Ronald Freedman of the Michigan Population Studies Center, who was working in Taiwan, was most generous in advice on the initiation of our project. His assistant, Dr. John Takeshita, was invaluable in the development of our Institute for Interviewers. Dr. William Reinke, Biostatistician for the Division of International Health, deserves full credit for our multivariable analysis, a basic component of our projection method. He is the author of Appendix I, dealing with multivariable analysis.

We thank Dr. Abel Wolman, Dr. Carl Taylor, Dr. S. C. Hsu, Dr. L. P. Chow, Dr. Harald Frederiksen, Dr. Oliver McCoy, Mr. J. G. Goellner, Mr. Ralph Berry, Miss A. C. Hsu, and the other readers of our manuscript who made many helpful suggestions. We were able to incorporate many of their suggestions into our revised draft.

In conclusion, we would like to express our gratitude to the thirty-five public health nurses of Taiwan who served faithfully and well under extremely arduous working conditions. Without them there would have been no study.

We hope that readers concerned with the development of health services in Taiwan will be able to use this document to good advantage. We hope that those interested in the fields of health planning and manpower planning will find the methods and ideas presented in this book both useful and interesting.

NOTE

Taiwan refers to Taiwan Province of the Republic of China. Taiwanese refers to all persons living in the province of Taiwan, regardless of province of birth. In a few instances mainland-born Chinese citizens are differentiated from Taiwan-born Chinese citizens. "Overseas Chinese" refers to persons of Chinese origin who come from Hong Kong, Malaya, etc.

CONTENTS

Health Manpower in a Developing Economy: Taiwan, a Case Study in Planning

CHAPTER 1

WHY HEALTH MANPOWER? WHY TAIWAN?

"The health of the people is really the foundation upon which all their happiness and all their powers as a state depend." *Disraeli*

WHAT IS health manpower planning? In simplest terms, it is planning to provide enough doctors, nurses, and other health professionals to meet, but not exceed, future economic demands for their services.

Why is health manpower planning important? Now, when the peoples of the world aspire to the goal of better health, most nations lack the doctors, nurses, and other health workers to achieve this goal. Good health is a goal in itself; it is also a means to reach the goal of economic well-being. The wealth of a nation consists of the goods and services it produces. The sources of these goods and services are capital, raw materials, and, above all, human resources. Human resources are not simply conglomerates of humanity; rather, they are people with essential skills. Conservation of these skills is an economic necessity. If one who possesses them is kept from performing his usual labors by illness, debility, or premature death, the wealth of the nation will have been unnecessarily diminished.

The medical care and preventive services essential for improvement of a nation's health require medicines, hospital buildings, water supplies, and other material resources. Although these material resources are needed, their contribution is small in comparison to the contribution of the human resource of skilled health professionals. The health industry is a skilled, labor-intensive industry.

It is most difficult to equip a professional staff with the necessary knowledge and skills. As we have already noted, people "in the raw" are not, for our purposes, human resources. They must be trained in techniques, and they must be prepared with supervised experience so that their judgments will have validity. To teach techniques is usually more time-consuming than to provide material resources. To teach judgment in medicine is an even longer process. For these reasons, potential shortages of professional medical manpower should be anticipated at least five or, more usefully, ten years before they occur. Thus we come to another answer to our question, "Why is health manpower planning important?" The answer is *time*. Planning to meet health manpower needs must be done early. Hospitals can be built in months; it takes a decade to train a doctor.

Planning for health manpower is most urgently needed in developing nations. With their severely limited resources there is less margin for error. For example, through gross overproduction Philippine medical schools are, in effect, expending the country's scarce resources to supply doctors to the United States. India, with only half as many nurses as doctors, is unable to free highly trained, highly paid doctors from tasks better and more cheaply done by nurses. Not only is there a dearth of manpower, but frequently what *is* available is inequitably distributed socially and geographically; i.e., the rural population and the poor have less access to medical care. Throughout the world hundreds of unstaffed hospitals, unmanned sanitary posts, and deteriorating water supply systems stand as monuments to dismally inadequate health manpower planning.

But the reasons we have given are not the only ones for giving priority to medical manpower planning. What we have said of health professionals could also be said of physicists, engineers, and even teachers. What is unique about professional medical manpower is that it is essential *under all conditions* for the protection of society's investment in all other human skills. Let a good engineer, a great physicist, a wise teacher, or even a mother of small children fall ill or die, and the nation has suffered a loss in its real wealth. In developing countries many preventable deaths can usually be traced to the absence of a physician, or one of the allied professional medical personnel. Thus the final answer to our question is that medical manpower has a unique role in preserving society's investment in its future.

Careful planning is vital not only for the utilization of the existing health manpower, but for the training and placement of future manpower resources. It is essential that planning and action be based on careful studies of present health manpower. It is unfortunate that underdeveloped countries, with the least adequate resources for manpower research, have the greatest need for this research as a basis for their plans to maximize the effect of available financial resources.

How is health manpower planning done? Our research project in Taiwan was designed to help answer this question. Our major effort was in the establishing and implementing of effective methods for: (1) surveying the present supply of medical personnel and the economic demand for their services, and (2) projecting the supply and demand into the future. In making such a projection, we considered the present and anticipated age and education distribution of the population, the economic stratification, and the redistribution patterns of population concentration, assuming that each would have a unique effect on the demand for health workers within its category.

The conceptual framework of the study is in six parts: (1) *qualitative and quantitative analysis of the supply of health workers;* (2) *projection of this supply to the future;* (3) *analysis of current public and private sector demands for health services;* (by demand we mean not only a need for medical services, but an awareness of the need, and, more important, a willingness of individuals or governments to *pay for* these services); (4) *projection of these demands;* (5) *trial balance of supply and demand;* and (6) *corrective measures for any imbalances* (including changes in over-all supply, changes in the "mix" of health workers, and changes in productivity).

The first part involves measuring the current supply and qualifications of all types of health workers in some detail. It is important to define the categories of health workers, by function and by professional training. Sources of data include lists of graduates, governmental registration or licensing lists, professional specialty registers, drug company lists, and, most reliable of all, a special health professional census. The projection of this supply to target dates ten and twenty years hence involves analyzing the factors influencing fluctuation in this supply, such as increases by new graduates and losses by retirement, change of profession, migration, and death.

The analysis of current economic demand must consider both private and public sectors. The present public sector demand is simply the number of health professionals, at all levels, employed by government services. It does not include budgeted vacancies, for these indicate that the public sector is unable to meet the estimated need by providing adequate salaries. The present private sector demand is basically the number of professionals (more accurately, "full-time equivalents") supported by the private sector. The term "full-time equivalent" implies corrections for part-time and overworked professionals.

Projection of this economic demand forward to ten- and twenty-year target dates is not a simple projection of total population, with application of existing ratios of doctors to people. It should take into consideration at least five factors of social dynamics: growth of population, changes in age composition, increase in per capita income, better education, and urbanization. Two populations of identical total size with differing proportions of elderly people will have different demands for physicians. Similarly, different demands will occur when the level and distribution of wealth are not identical. The changing characteristics of a population will also influence the *categories* of health workers demanded, e.g., as the population becomes better educated, the demand for herb doctors will decrease. As the components of a population change, demands for medical services will vary, in terms of both biological need and economic utilization.

There are some changes affecting medical care demands, such as institutional change and political change, which defy successful measurement. Other changes such as technological change or variation in disease patterns cannot even be predicted. Unfortunately, the effects of these changes cannot be taken into account in health manpower planning.

As the private sector demand changes, so will the public demand. Predictions of change of government demand should be based on national health plans, if such exist. If no formal plans exist, estimates must be made of future funds available for official health services. Government policy on maintenance or improvement of present staffing standards must be determined. Ultimately, a trial balance should be made to determine what differences exist between predicted supply of health professionals and predicted demand for their services.

The final step in manpower planning is to propose practical solutions for any imbalances. With these proposals, the target aspect of the task of the health manpower planner is complete.

Why Taiwan? The requirements for carrying out a meaningful study of health manpower include: (1) free access to available data, such as general population information, economic information, governmental health services, and educational information; (2) co-operation and interest of the government and medical educational institutions; and (3) (in our case) availability of capable, interested local personnel.

When the Division of International Health of Johns Hopkins University approached the Agency for International Development (AID) for support of studies in health manpower, these funds were generously provided, but additional requirements for study sites were added. The studies were to be made in developing countries and they were to be conducted in the following areas: Africa, the Middle East, Latin America, and East Asia.

Taiwan fitted all requirements. It was a developing nation in East Asia. There was local interest in undertaking a study there. The Taiwan provincial government offered us both assistance and full co-operation. Second, local interest was backed up by the availability of excellent statistical data and the presence of trained local research assistants who were willing, even eager, to help us. (As our project progressed, we became increasingly aware of the incredibly good research opportunities existing in Taiwan.) Third, the costs of making an extensive study came within our budget. And finally, Taiwan, like Israel and Puerto Rico, was advancing so fast economically that we felt our efforts would not be in vain. Programs initiated as a result of our study could be expected to find financial support.

CHAPTER 2

ILHA FORMOSA— BEAUTIFUL ISLAND

THE role of environment in manpower planning is crucial. This chapter concentrates on the environment of Taiwan. It is divided into six sections: history, geography, education, people, economy, and government. Like any summary, it does damage to the subtleties. However, we trust that it gives a sufficiently detailed picture to make the subsequent material, relating to our study, vivid and understandable.

HISTORY

The first people of Taiwan, the aborigines, were a Malaysian people—savages, cannibals, and hunters. With the advent of the Ming dynasty (1358–1644), the world beyond began to take an interest in Taiwan. First to come were adventurers. Japanese and Chinese pirates, outlaws, and refugees took the coastal areas from the native tribes. Japanese adventurers temporarily occupied the northern tip of the island, and Chinese soldiers-of-fortune settled in the southwest.

In the early years of the sixteenth century, the Portuguese sighted Taiwan and gave it the name of Ilha Formosa, or Beautiful Island. Throughout the sixteenth and seventeenth centuries, the Portuguese, Spanish, and Dutch made abortive attempts to colonize portions of the island. The Dutch finally succeeded in establishing a trading station at Anping on the west coast in 1624. They held it for forty years. We find no evidence of Dutch influence on the development of Taiwanese medical practice.

In the last days of the Ming dynasty (1661), when the scales on the mainland were tipping in favor of the Manchus, a Ming

loyalist, Cheng Ch'engkung (Koxinga) fled with his followers to establish an overseas resistance post on Taiwan. They succeeded in ousting the Dutch a year later, in 1662.

Ming resistance to the Manchus lasted on Taiwan until 1683, when Taiwan became a part of the mainland Fukien province. From then until 1886, Taiwan was nominally ruled from the Chinese mainland. It was a period when Chinese government was in great part characterized by corruption and official indifference. Disease, particularly malaria, was so rife that the island had a reputation as a graveyard for Chinese officials. However, migration from the mainland grew throughout this period. The aborigines in Taiwan were driven further up into the mountains, where they remained mostly outside the mainstream of such development as occurred.

During these two centuries of Chinese rule, western missionaries and entrepreneurs came to the island in increasing numbers. With them they brought some of the new concepts of Western medicine. They established missionary clinics and hospitals. Yet the efforts of the missionaries and traders did not greatly affect the development of Taiwanese medicine. In fact, only about 100 persons received training certificates from these hospitals. Sir Patrick Manson, one of the founders of the London School of Tropical Medicine, served for six years as medical officer for the Chinese Imperial Maritime Customs.[19] Manson's brother, David, attempted to start a medical school in Takao in 1875, but was unsuccessful, principally because he could find no English-speaking students.

The two centuries of Chinese rule also established a Chinese herbalist tradition on Taiwan. Herbalist academies were founded, and the herbalist school of thought began to take hold on the island.

Toward the end of the nineteenth century, Japan and other seafaring nations suffered at the hands of the Taiwanese aborigines, who reportedly practiced their cannibalism on shipwrecked sailors. Japan officially complained to the Imperial Chinese government on the mainland and asked it to discipline the aborigines and set up a responsible governmental administration in the area. The Imperial government did nothing to answer these complaints; indeed, it even suggested to the Japanese that if they found the situation unbearable the Japanese government should take remedial measures.

In any event, Japan's loss of sailors was used as the rationale for

her colonial ambitions. Japan invaded and occupied Taiwan from 1887 until 1889. In 1889 she withdrew at the request of the Imperial Chinese government, which agreed to pay the costs of the Japanese occupation. Later, after the Sino-Japanese War of 1894, Taiwan was formally ceded to Japan. Taiwan remained part of the Japanese colonial system for the next fifty years.

Taiwan provided raw materials for Japanese industry, and served as a market for Japanese finished products. More important, the Japanese intended Taiwan to be a showcase for her ability as a colonial power.

The Japanese were greatly concerned with increasing Taiwan's agricultural productivity. They also built schools, railroads, and communications facilities. They established modern business institutions and developed modern commercial centers. They promoted small-scale industrialization, rebuilt major cities, and achieved some control over the principal epidemic diseases.

Japan's most important accomplishment of concern to our study was the institution of modern medicine.[30,34] Credit for this success is largely due to Dr. Yamaguchi Hidetake. Dr. Yamaguchi acted as superintendent of the first hospital founded in Taipei (1895). In 1899 he persuaded the Japanese government to found the Taiwan Government Medical School. The medical school offered a four-year course, and required grade school education for matriculation. In 1918 Taipei Medical College was established; its entrance requirements included a secondary school graduation. The original "school" was closed in 1929.

In 1919 the new Taiwanese medical college offered postgraduate courses in tropical medicine and Taiwan served as the training ground for many of the Japanese experts in tropical medicine.

A third improvement was made in 1936, with the establishment of Taihoku University Medical College. It offered a four-year course in medicine, and required students to have three years of preparatory study beyond secondary school. Taihoku University was changed to National Taiwan University after the end of World War II, and the old Taipei Medical College was closed in 1950.

In addition to the opportunities afforded them at home (in Taiwan), a number of Taiwanese students were allowed to study medicine abroad. Most went to the Japanese islands; a few went to mainland China.

While the Japanese occupation of Taiwan was efficient, it was not without its harsher aspects. All Taiwanese nationals were issued pass cards and classified by race. Entry into the professions was subject to ethnic restrictions. Chinese were assigned relatively small quotas for professional training. In Taiwanese eyes, then, those few professions that Chinese could enter came to enjoy particularly high status. Medicine was one of these professions.

The Japanese occupation also had a lasting effect on the status of nursing. At that time the Japanese treated their nurses as servants. This prejudice became part of the Taiwanese culture. The shortage of nurses and disinterest of girls in nurse training since World War II can be traced to this source.

At the end of World War II, Taiwan was returned to China and ruled from the mainland. After the occupation of the mainland by the Communists in 1947–49, President Chiang-Kai-shek withdrew with approximately two million of his followers to Taiwan. On December 8, 1949, Taipei became established as the new capital of the Republic of China.

The situation was not auspicious. What little industry had been started during the Japanese occupation had been largely destroyed in 1944–45 by Allied bombing. The island in 1949 was crowded with mainland refugees, who found themselves in an alien environment.

In less than fifteen years, with the talents and ambition of the trained personnel who came from the mainland, the capability and industriousness of the native Taiwanese, and American aid, the Republic of China had turned a war-ravaged colony into a vigorous land.

GEOGRAPHY

Taiwan is only 100 miles from the Chinese mainland. Approximately 700 miles to the north are the main Japanese islands. Two hundred and fifty miles to the south is the northernmost island of the Philippines. Taiwan is 240 miles long by 85 miles wide, with a surface area of approximately 14,000 square miles, slightly larger than the state of Maryland.

Topographically, it is an island of contrasts. The central mountain chain, which covers over two-thirds of the island, rises from steep, rugged foothills to a dozen peaks towering over 11,000 feet above sea level. The densely populated, intensively cultivated

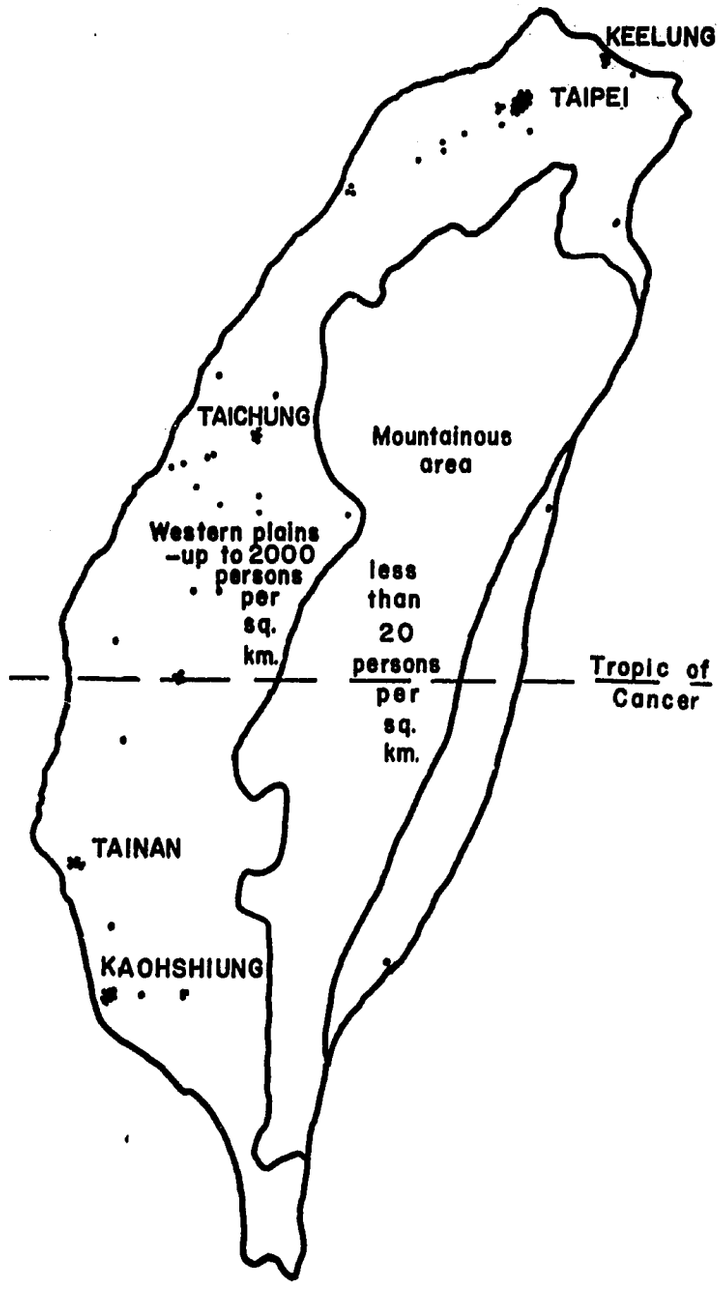

Figure 2-1. Taiwan Population Distribution (each dot equals 50,000 persons).

plain along the western coast is broken by numerous rivers carrying the runoff from heavy rains in the mountains. In the southeast there is a narrow inland plain bordered by coastal ranges. Along the northeastern coast sheer cliffs drop thousands of feet to the Pacific. The climate is subtropical. Summers are hot and humid; winters, short and moderately cool, permitting double-cropping. Situated within the Asian monsoon area, Taiwan records an annual rainfall of 50 inches on the western plains, and more than 250 inches on the exposed mountain slopes. There is a rich and varied insect fauna, including vectors of malaria, filariasis, and Japanese B encephalitis. There are many varieties of poisonous snakes in the rural areas. The island is regularly convulsed by earthquakes and battered by typhoons.

EDUCATION

The tremendous importance of free public education was a significant part of the teachings of Dr. Sun Yat-sen, philosophical father of the Republic of China. He wrote, "The school is the fountainhead of civilization. The establishment of schools is essential to the progress of local government."[13] His directives concerning the establishment of schools have been carefully and successfully carried out by his successors in the government of Free China.

Today, about 72 percent of the population in Taiwan, aged twelve and over, can read and write. Primary education is free and compulsory for children between the ages of six and twelve, and the government has succeeded in enforcing this law to the extent that in 1961, 96 percent of the children between the ages of six and eleven were actually in school. Only 51 percent of primary school graduates enrolled in junior high schools, but 80 percent of junior high graduates enrolled in high school and 76 percent of high school graduates went on to higher education.

How have these results been achieved? The answer, it seems, lies in the breadth of Taiwan's educational program. From the preschooler to the grandfather who needs retraining to be employable, there is no one on Taiwan who does not have the opportunity to receive instruction in some branch of the government's educational system. To illustrate the magnitude of this endeavor, at the end of the year 1960–61 there were said to be approximately:

1,889,000 students in 1,800 primary schools
263,000 students in 244 high schools
84,000 students in 109 vocational schools
8,000 students in 10 normal schools (high school level)
35,000 students in 27 colleges and universities.[14]

In addition, the government has set up a number of adult education classes called variously, "Social Education Centers" and "Community Supplementary Classes."

An overview of the educational system reveals that primary school in Taiwan, as in the United States, includes grades one through six. There the similarities end. The secondary school system in Taiwan seems complex. For our purposes, however, the secondary system includes the academic middle schools (like U.S. junior-senior high schools), the vocational schools, and the normal schools (for teacher-training). Students pay tuition in the academic middle schools and in the vocational schools; only the normal schools are free.

Secondary Education

The academic middle schools offer a three-year junior plus a three-year senior course. In 1950 four-year junior and two-year senior course sequences were inaugurated for the benefit of those students who must end their education at the junior high level. As economic conditions in Taiwan have improved, the proportion of eligible students attending academic middle schools has greatly increased. This boom, in turn, has spurred the building of new schools. In 1954–55 there were 137 high schools having approximately 125,000 students. In 1960–61 there were 244 high schools with approximately 265,000 students.

The vocational schools, with about 84,000 students in 1960–61, offer courses in agriculture, engineering, commerce, maritime navigation, home economics, and nursing. In fact most of the nurses in Taiwan (a mere 0.3 percent of the total number of students in secondary school in 1962) are being trained in a four-year vocational course which serves as an alternative to senior high school.

The normal schools, with an enrollment of only 7,600 in 1960–61, offer free tuition, free room and board, and free uniforms in a government effort to recruit potential teachers.

Higher Education

In 1961 Taiwan had twenty-seven institutions of higher education.[14] There were: four national universities, four provincial universities and colleges, seven private colleges and universities, and twelve junior colleges. These schools offer a variety of courses including teaching, agriculture, law, business, technology, maritime navigation, nursing, engineering, home economics, and adult education. The existence of a wide range of choice provides attractive alternatives to medicine as a career for Taiwan's brightest young men and women. In 1962 only about 8 percent of Taiwan's 38,000 college students were studying in the medical disciplines (i.e., medicine, dentistry, pharmacy, and nursing). (Discussion of instruction in the Taiwanese medical schools will be found in Chapter 4, nursing schools in Chapter 5, and pharmacy and dentistry in Chapter 6.)

Conclusions

The achievement of the academic middle schools is important to our study, because the graduates of their senior schools include potential doctors; the graduates of their junior schools, potential nurses. In 1960–61 approximately 16,000 students graduated from the academic senior schools: 69 percent male, 31 percent female. In the same year about 17,000 girls graduated from the academic junior schools. Thus, we can formulate a first conclusion relative to the medical manpower study: there is no shortage of potential students for training in the medical professions. The difficulties lie, as we shall see, in assuring that sufficient (but not excessive) numbers of students are attracted to medical and paramedical studies, that they are selected wisely, and that they receive good training.

THE PEOPLE

Taiwan's population, some twelve million, is at once her greatest asset and her greatest liability. The constant struggle in Taiwan, as elsewhere, is to increase levels of economic productivity to keep up with the growth of population. Since 1949, with the asset of a healthy, industrious population, Taiwan has made great progress in economic development. However, this achievement is jeopardized by a population growth rate that has been one of the highest in Asia.

Who are these Taiwanese people who created an "economic miracle"? Where do they live? What are they like? What are they doing to reduce their population explosion? To a limited degree, we will attempt to answer some of these questions.

In 1963 the Taiwanese midyear population was 11.7 million (6.1 million male, 5.6 million female).[12] The excess of males over females is usually attributed to two causes: (1) there were more male refugees from the mainland, and (2) most males have not reached the years of higher male mortality.[10]

By age, 46 percent of the people were under fifteen years of age (a higher percentage than in India), 52 percent were fifteen to sixty-five years of age, and 2.5 percent were sixty-five years of age, and over. More strikingly, Dr. Hsu, in his *Report on Rural Health Programs in Taiwan*, reports that 25 percent of the total population is under age six![22] In other words, the bulk of the Taiwanese population is in the young, dependent age group. Although the percentage of the population in this group has been going down in recent years, in absolute numbers the young group has been growing.[9] The aged constitute another dependent age group. Better medical care, giving rise to longer life expectancies, has been gradually increasing their numbers too.

How did the pattern of these two dependent age groups, with their high medical demand, develop? In 1952, after the bulk of the civil war migration, with a total population of approximately eight million, Taiwan had a crude birth rate of 46.6/1,000, a death rate of 9.9/1,000, and consequently an over-all natural rate of increase of 36.7/1,000. In 1963, with a population of twelve million, Taiwan still had a birth rate as high as 36.3/1,000; but the death rate had declined to 6.1/1,000, giving an over-all natural rate of increase of 30.2/1,000 (about 400,000 people annually).[8] Naturally, then, there were more young people in 1963 than ever before. If the present rate of increase persists, Taiwan's population will be doubling itself every twenty-three years, an increase which could submerge a presently healthy economy. However, this rate of increase is not likely to persist. The Family Planning Health Program, which had its origin in the euphemistically named "Pre-Pregnancy" Health Program, has as its goal the insertion of 600,000 intra-uterine contraceptive devices by 1968. This program should lower the natural increase rate from 30.2 to 18.6; an ambitious goal, but we believe it will be attained.[6,17] We believe the program will be successful for four

reasons. (1) Women wish to limit the size of their families. In a survey, the majority of women with three children said they did not want any more. Of those with six or more children, 95 percent did not want more. (2) The interest in family limitation is universal; 88 percent of the women accepting birth control devices had "primary or less" education. The programs of rural counties have been as successful as those of the cities. (3) The method is safe and effective. (4) The program in Taiwan is being carried out by an effective, dedicated group of health workers. In 1964, 47,000 devices were inserted.[16] In the first quarter of 1965, 24,000 devices were inserted.[15] Yet even if the program is completely successful the population will still increase by 50 percent, to 17.6 million, during the next twenty years.[7] The impact of this increase is a major factor in any health manpower plans.

Although Taiwan's population has increased mostly by reproduction over the past half-century, the early increases were by migration and colonization. In 1640, near the close of the Ming dynasty, the 10,000–20,000 Chinese immigrants on Formosa were outnumbered by the 100,000 aborigines. By 1660, when Koxinga came to Formosa, the Chinese population had doubled. His followers redoubled it, the total Chinese population being near two hundred thousand. Although the early Manchu rulers discouraged immigration, the restrictive policy was dropped in 1760. In the next fifty years the population increased by *tenfold* to two million. The aborigines were still less than 200,000. Contemporary writers refer to the extensive practice of abortion among the aborigines. Immigration from the mainland continued at a slightly lower rate until the end of the nineteenth century when the Japanese reinstated strong restrictions.[32] Immigration has been a negligible factor in population growth on Taiwan since the great influx of about two million mainlanders who came with President Chiang-Kai-shek in the 1949 retreat from the mainland. Since that time only an additional 150,000 Chinese have been able to make their way to Taiwan.

The largest group of immigrants to the island were the Chinese settlers from Fukien and Kwangtung provinces in South China. About one-sixth of present-day Taiwanese are Hakkas, mainly farmers and woodsmen descended from refugees from Kwangtung province. Another two-thirds of the Taiwanese are descendants of Fukienese peasants who migrated to Taiwan in the eighteenth and nineteenth centuries. The only "true" natives of Taiwan are the

200,000 Malay aborigines in the central mountains. These aborigines present interesting problems in planning for health workers to meet their needs. Aborigines who have been assimilated into the Taiwanese culture are called Ping-pu-huan and are considered as a part of the general population.

As you will recall from the section on geography, most of Taiwan's arable land is on the western coast. Most of the people are there too—it is the most densely populated area on the whole island. Taiwan continues to be primarily rural. Only about 25 percent of the population lives in cities larger than 50,000.

Population of major cities (year ending in 1962)[21]

Taipei	979,000
Keelung	249,000
Taichung	320,000
Tainan	363,000
Kaohsiung	515,000

Population of small cities

Chiayi	191,000
Hsinchu	161,000
Pingtung	131,000
Sanchung	126,000
Changhwa	106,000
Hualien	69,000
Ilan	60,000

Except for the mountain areas, Taiwan is a crowded land. Even the casual visitor cannot fail to be impressed by one thing, *people.* The density of the population of Taiwan is twice that of India!

Density of population (per sq. km.)[33]

Taiwan	336
Japan	262
India	155
United States	21

From a sociological standpoint, a significant feature of the Taiwanese is the large family—the average family includes about six persons. According to Barclay,[1] the Chinese regard the large family living under one roof as symbolic of wealth (which it certainly is) and family prestige. Why? The function of the family in traditional Chinese thinking is to perpetuate the family name—

hence size is a desirable feature—and to maintain family unity—hence the utility of all family members living under one roof. Consider the ancient text which states that the purpose of marriage in China is "to obtain a hundred sons and a thousand grandchildren to continue the family's name." In accordance with these beliefs, Taiwanese produced large families throughout the first half of this century. As noted earlier, this tendency seems to be changing. The Taiwanese family system proved to be of utmost importance to demographers. The Japanese made use of the family system in the establishment of their household registers, vital statistics registers, and civil administration. In our own study we utilized the Taiwanese familial groupings in the sample survey of private sector demand for medical care. The Taiwanese household is an excellent source of statistical data for three reasons: (1) the household is a decision-making unit; (2) all members pool their financial resources and live on a common budget; and (3) the head of the household is a responsible person capable of answering questions for members of the household.

In summary, Taiwan is a very densely populated, primarily rural province with a rapidly growing population. Although the rate of population growth will probably drop, the absolute numbers will continue to increase. The effects of complex shifts in age patterns on demand for medical care will be discussed in detail in Chapter 8.

THE ECONOMY

Principal Characteristics

In many ways Taiwan's economic development over the past ten years serves as a showpiece. It has increased its real per capita output. It has developed a capacity for generating its own capital resources; in so doing it has become less dependent upon foreign, politically inspired and even nonpolitically inspired, loans. Land reform, in several stages, has been effective.[4] Productivity per worker and per hectare has increased markedly. Workers have transferred from agriculture to manufacturing and the manufacturing sector has grown both quantitatively and qualitatively. There has also been an impressive widening and deepening of the services sector. Widening suggests that the economy is more advanced with specialization of economic function (i.e., use of bakers

rather than baking in the home), while deepening implies the greater consumption of services.

While the public sector of the Taiwan economy remains large, the marked advances in productivity have occurred in the private sector. Of course, governmental expenditures on roads, education, power, water, and sewerage, plus a monetary policy of low interest rates have provided some of the means from which private firms have benefited.

Although the per capita annual income is still low, $150 (U.S.), there is more equality of distribution of income than in most developing countries. Taiwanese economists have assured us that economic development was not causing regressive income redistribution; the rich were not getting richer, while the poor got poorer. In fact, Lorenz curves derived from studies of household income distribution in 1953 and in 1960 suggest a slight trend toward equalization of income distribution. This observation is important for our method of projecting economic demand for doctors.

Detailed Analysis

Note: The exchange rate at 40 NT$ = $1 U.S. is used in this section and throughout the book.

Growth of the total economy. June 30, 1964, marked the end of the American economic aid program in Taiwan. Over the years the United States has given over $1.5 billion (U.S.) in economic aid to the civilian sector of the economy. By that date there was a conviction among both Chinese and Americans that the Taiwan economy was viable and that it could attract what foreign capital it needed through the normal channels of private and public investment.[26] Table 2–1 shows the growth of national income in current NT$ and in the form of a constant dollar index. It shows both the total or aggregate figure and the per capita amounts (the total adjusted for the growth of population). The panels giving the indexes are of most interest. Note that the economy has doubled in twelve years and that each individual is, on the average, almost 50 percent better off in 1964 than he was in 1953. In other words, the economic strength of the community is twice what it had been and the average real income of each individual has increased by almost half. Table 2–2 shows how these increases were achieved. Each successive figure is the increase of that year's national income or per

TABLE 2–1. GENERAL INDICATORS OF THE TAIWAN ECONOMY

	Absolute amounts (current prices) nat. inc. NT$ (billions)	Per capita nat. inc. NT$ (000)	Indexes: 1953 = 100 nat. inc.	(Constant prices) per capita nat. inc.
1953	17.9	2.0	100.0	100.0
1958	32.8	3.1	132.3(?)	111.6(?)
1963	66.6	5.4	184.4	133.1
1964 est.	76.9	6.0	204.0	142.9

Source: *Industry of Free China*, XXIII (January, 1965), Table 1.

capita national income (adjusted for price changes) over the previous year's level. A 5 percent annual rise in real national income is impressive; indeed, a regular 3 percent rise in real per capita national income is accepted as a signal achievement. Taiwan has exceeded these goals! Such rates of increase cannot in all probability be maintained either in the presence of continued massive transfusions of foreign aid, or in their absence, because as the base becomes larger, the need to pull larger and larger amounts of scarce resources is blocked by the diminishing marginal supply of those resources. To date, however, the Taiwan economy has shown real viability. In our calculations for economic demand for physicians' services we anticipate a 20 percent increase in real per capita income over the next ten years. Taiwanese economists tell us repeatedly that this figure is too conservative.

TABLE 2–2. REAL GROWTH[a] OF THE TAIWAN ECONOMY; PERCENTAGE INCREASE OVER PREVIOUS YEAR

	Real net national income	Per capita national income
1954	4.0	0.4
1955	6.2	2.1
1957	6.7	3.5
1959	6.9	3.6
1961	8.0	4.7
1962	6.3	3.1
1963	6.5	3.3
1964 est.	10.6	7.3

[a] In constant dollars.
Source: *Industry of Free China*, XXIII (January, 1965), derived from Table 3.

The role of monetary inflation. Inflation, the lessened purchasing power of money, has occurred. The economic literature abounds with discussions regarding the inevitability and the desirability of inflation during early periods of economic growth and transformation. To some degree "easy" money encourages risky enterprise just as "tight" money discourages it. But price inflation is also a method of income distribution since it tends to favor productive workers at the expense of *rentiers* (bond holders and those who derive income from long-term land rents).

As a measure of Taiwan's inflation, the over-all wholesale price index for the city of Taipei rose from 100 in 1956 to 159 in 1963.[7] Inflation is not uniform throughout a country; invariably some areas are more affected than others; so, too, are some individuals within a given community more affected than others. Physicians are able to raise their fees in response to inflationary trends. Unless an adequate supply of physicians is maintained, the price index for their services may rise much faster than the general price index. Large increases in physician's fees could negate any medical benefits from increases in Taiwan's per capita income. This problem is one of the dangers of a future undersupply of doctors.

In addition to the potential for disproportionate increase in fees for physicians, increase has been noted in the price index for Chinese herbal medicine. This increase was not paralleled in the wholesale price of scientific medicine. Scientific medicine accounts for approximately 80 percent of the value of medicine sold in Taiwan.

In conclusion, we believe that inflationary trends will continue in Taiwan but that changes in the prices of medicine will not seriously limit the demand for medical services. The changes in the price of medical services, however, may well affect the demand for services, particularly if the supply of doctors drops below present ratios.

Composition of the economy. Taiwan's economy is changing very slowly from one based primarily on extractive industry (agriculture, forestry, and mining) to one diversified in effort and output. Table 2–3 shows this transformation in percentage terms.

Although agriculture's *percentage* of the gross domestic product had dropped, the absolute value had more than tripled. This increase in agricultural productivity can be traced to the governmental policies of land reform and, more than that, agricultural

TABLE 2–3. PERCENTAGE COMPOSITION OF THE TAIWAN ECONOMY
(Net Domestic Product)

Year	Agriculture	Manufacturing	Construction	Commerce	Communications (incl. transportation)	Money & banking	Government	Other
1954	34.7	16.4	5.8	17.3	4.2	1.4	12.2	8.0
1958	34.4	17.5	4.7	15.8	4.5	2.2	12.3	8.6
1962	31.9	18.8	4.3	15.0	4.7	1.8	12.4	11.1
1964 est.	27.5	25.5	3.6	16.1	4.5	1.8	11.0	10.0

Source: *Industry of Free China*, XXIII (January, 1965), derived from Table 2.

research and extension work by the Joint Commission on Rural Reconstruction.[27] The effect of improved agriculture is demonstrated by a steady rise in yield of rice per hectare, from 2.2 metric tons in 1954 to 2.7 metric tons in 1962. This rise was achieved in the face of two negative factors: possible wearing out of land, and the bringing of less suitable (less productive) land under rice cultivation.[3] The effect of improved health on improved agricultural productivity has not yet been accurately measured.

Foreign trade. As a growing region, Taiwan imports more than it exports since the imports include both capital goods and funds for capital improvements. Thus the balance of payments picture really does not give the proper perspective regarding the growth of the economy. What is interesting to us, however, is the growth of the export economy. In current dollars it increased sevenfold between 1955 and 1964. Sugar is still the major export commodity (29.6 percent of total exports). However, agricultural products have declined from 86 to 56 percent of exports. Thus there has been an impressive diversification of exports and growth of the manufacturing and processed goods sectors.

Destination of the exports has also tended to change. There has been a lessening of the export trade tie to Japan and the growth of that tie to the United States. We mention this point because trade ties offer further educational exchange opportunities.

The health sector. Knowledge of the health sector of the economy of any country is needed to understand health manpower problems.

This section presents an overview of the health sector. Details are presented in Chapters 8, 9, and 10, on the demand for medical services.

In expenditures, the private sector is by far the most important sector of the health industry. According to our household survey, five billion NT$ are spent on health and medical care by the households of Taiwan. The governmental health expenditures are less than one-tenth of private expenditures. In this respect, Taiwan's health industry is more similar to the free enterprise system of the United States than to socialized systems of medical care. Our household survey shows that health receives 7.5 percent of household expenditures. Earlier studies (1954–59) by the Bank of Taiwan showed health consumed 6 percent of household expenditures. The increase may be explained by disproportionately large increases in the cost of medicines and medical care.

It is interesting to compare expenditures on health and medical care to other major household expenditures. Food, of course, is the largest expenditure, about half of the total. Housing accounts for 20 percent of household expenditure. Rather surprisingly, marriages and funerals and entertainment are the next most important categories of expenditure. Health expenditures are fourth in importance, just ahead of clothing, and more than double the education expenditures.

It is difficult to completely separate costs of health services from costs of medicine, for doctors, herbalists, and pharmacists all dispense medicine and make one charge to cover both medication and service. However, it is quite clear that payments to physicians are the major medical expense: 2.2 billion NT$ per year, approximately one-half of all medical expenditures. Payments to pharmacists (0.5 billion NT$) and herbalists (0.4 billion NT$) are the next most important medical expenditures. Private payments to public hospitals and health centers amount to 373 million NT$, a surprisingly large amount compared to the total provincial and local health budgets of less than 200 million NT$ (exclusive of large revolving funds)[20] in 1963 (estimates by Provincial Health Department). The economic aspects of the public sector of the health industry are extremely difficult to analyze for there are *no* official figures published on central government expenditures. At the local level, budgets include village watchmen, street cleaners, and other nonhealth personnel, under the heading of health. To compound this difficulty, the figures given for total budgets in

two official sources, the Ten Year Health Plan[28] and the Statistical Abstracts,[25] are quite different. Much of the problem results from the lack of information on transfers of funds between levels of government. However, the best estimate of true health expenditure is about 5 percent of provincial expenditure, excluding transfers, and 2 percent of local expenditure. Since the central government expenditures on health, exclusive of the armed forces, are negligible, the percentage of Taiwan's over-all government expenditures on health is lower than for most countries. The Ten Year Health Plan calls for increasing, or at least maintaining, present percentages of government expenditures for health.[28] Provincial and local budgets are increasing at over 10 percent per year. This has obvious implications in terms of increased health manpower demands for the public sector. Division of public health expenditures into program areas shows that control of communicable disease, including tuberculosis, and sanitation are still very important in Taiwan. These programs account for over one-third of the total public sector health expenditures. Medical care calls for almost 20 percent of government health expenditures. Mental hospitals and family planning are the next largest programs. Administration, the general "catch-all," takes 25 percent of the governmental health budget.

This brief review of the health sector should give the reader adequate background to interpret the detailed discussion in Chapters 9 and 10, on private and public demand for medical services.

GOVERNMENT

The *de facto* Republic of China includes Taiwan and its nearby small islands, Quemoy, Matsu, and sixty-four islands in the Penghu (Pescodore) group. There are three levels of government on Taiwan: (1) the national government of the Republic of China, which represents the Republic's island holdings and (*de jure*) the Chinese mainland; (2) the Taiwan provincial government, which represents Taiwan and the Pescodores only; and (3) local governments of sixteen counties, five cities, and a small administrative area (Yangming Shan). Public health can be a responsibility of all levels of government (*Constitution*, Articles 108, 109, and 110).

The national government, based on the constitution adopted December 25, 1946, combines features of the cabinet and the

presidential forms of government. The government derives its power from the National Assembly elected by the people. The National Assembly elects the president, who is the head of state. Under the president's jurisdiction are the five chief governmental departments or yuan (executive, legislative, judicial, examination, and control). The Executive Yuan is the administrative arm of the government and contains eight ministries and two commissions. Under the Executive Yuan, the Ministry of the Interior, the Ministry of Education, and the Ministry of National Defense have the most direct influence on health planning.

The Department of Health Administration of the Ministry of the Interior licenses doctors and other health personnel, screens and keeps records on civilian medical personnel and patients applying to go abroad, and has over-all responsibility for relations with international health agencies. The health section has a small professional staff.

The Ministry of Education is, in theory, responsible for seeing that Taiwan's medical and paramedical schools meet government standards for certification. On the mainland, a high-level Ministry of Education committee of medical education experts had effectively assumed that responsibility. Since the transfer to Taiwan, however, the Ministry of Education has allowed this committee to atrophy through disuse. We concluded that the over-all development of medical education is suffering from lack of adequate encouragement and control by the Ministry of Education.

The Ministry of National Defense, on the other hand, has been highly successful in its program of medical education. The National Defense Medical College (NDMC) is ranked as one of the best medical schools on the island. In addition to functioning as an excellent training center for the armed forces, it trains physicians who will later serve the civilian population, after completion of their military service. The NDMC also trains personnel who supply medical services to a sizable number of military dependents.

On the provincial level there is an appointed governor, council, and an elected assembly. There are twelve departments plus bureaus to carry out provincial administration. The reader should have a clear concept of the political subdivisions of Taiwan to understand the sampling frame for our household survey of demands for health services. Some knowledge of the organization of the provincial and local government is necessary to appreciate the staffing problems of official health departments.

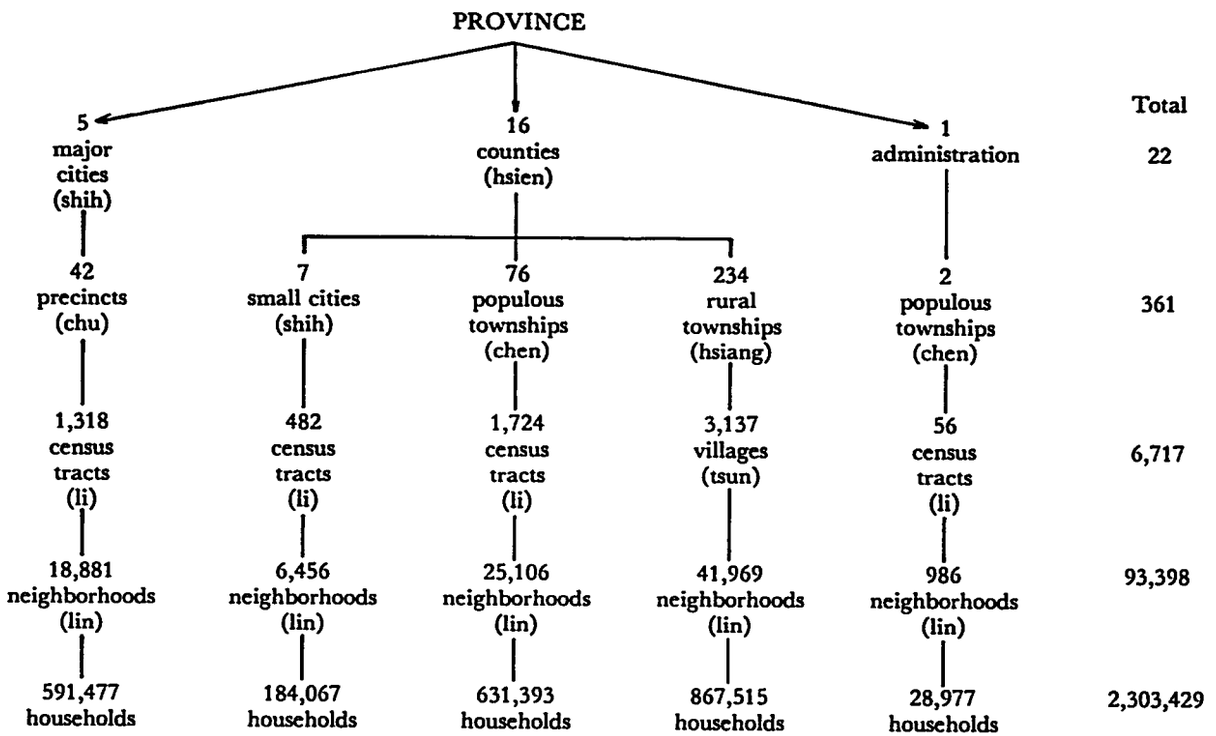

Figure 2–2. Political Subdivisions in Taiwan.[22]

Taiwan province is divided into five major cities (shih), sixteen counties (hsein), and the Yangmingshan administration. The large cities are divided into precincts (chu). The counties are divided into small cities (shih), densely populated townships (chen), and rural townships (hsiang). (Certain hsiang are designated mountain or aboriginal areas.) For registration purposes, the lowest levels of division, we have villages (tsun), and census tracts (li), and under these are the neighborhoods (lin). The lin is the smallest unit and is composed of from 10 to 100 families. There are 361 precincts, small cities, and townships; (chu, shih, chen, hsiang), 6,717 villages and census tracts; and 93,398 neighborhoods.

Described in broadest terms, the Provincial Health Department (formerly Administration) consists of a central office which indirectly controls twenty-two county and city health bureaus (the county and city governments exercise direct control). It is headed by a commissioner who is appointed by and responsible to the provincial government. The Provincial Health Department also is responsible for the provincial hospitals, the major disease prevention programs, and the provincial health programs, such as maternal and child health.

TABLE 2–4. CURRENT NUMBERS OF HEALTH WORKERS
(year end 1962 or early 1963)

	Doctors	Mid-wives	Herbal-ists	Nurses	Pharm.	Dentists	San. Engrs.
PHD–JHU[a]							
Census	5,450	2,050	1,510	1,440	1,000	760	—
PHD Register	4,902	1,990	1,630	1,600	1,000	810	—
MOI Register	7,500	3,600	2,270	2,760	1,250	1,010	60

				Unlicensed (full-time)[b]			
	Asst. Pharm.	Asst. Dentists	Lab. & X-ray tech.	Doctor	Dentist	Herb.	San. Insp.
PHD–JHU							
Census	330	210	—	1,030	540	300	—
PHD Register	460	230	420[c]	—	—	—	500±

[a] Corrected for Penghu and incomplete physician data.
[b] *Part-time*, unlicensed, practitioners, a few more than the full-time number, are not shown here.
[c] Government service only.

Local government is by elected mayors, or magistrates, and city-county councils. The city and county health departments are under the direction of the elected officials. The city health bureaus have jurisdiction over the district (chu) health stations and their mobile health units, while the county health bureaus indirectly control the township health stations and their local health rooms.

Present supply of health workers. We close this introductory chapter on Taiwan with a brief summary of the numbers of health workers.

The table above shows the best available estimates of health workers currently practicing in Taiwan. The Ministry of Interior (MOI) figures are overestimates as there is no efficient mechanism for removing retirees.

This summary table leads us to Chapters 3, 4, and 5, which give important details about the supply of doctors, nurses, and other health workers that furnish a basis for our projections of supply.

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CHAPTER 3

SIXTY-SIX THOUSAND INTERVIEWS AND OTHER SOURCES OF DATA

IN addition to statistics from official sources, we gathered data from five studies designed to fill gaps in the available information or confirm data of dubious accuracy. The techniques used in these studies may have pertinence for other health manpower studies and should give some idea of the problems involved in collecting information for health manpower planning.

THE HOUSEHOLD SURVEY

In Taiwan, as in many places, private practitioners serve a substantial part of the population. The demand for their services is controlled by "market" mechanisms. Data to provide a sound understanding of the private sector demand was essential for our study.

Unfortunately, there were few sources of islandwide data on private sector demand for medical services, and those available were of questionable value. For example, there had been no provincial health surveys to determine the patterns of morbidity, mortality data were not available by economic classes, and there were no counterparts of the United States Bureau of Labor Statistics figures on expenditures for private medical care.

We had the choice of two basic sources of information on the demand for private medical care: the practitioners (i.e., physicians, pharmacists, etc.), or their patients. Although contacting the practitioners would have been simpler because of having fewer persons to interview, two problems seemed insoluble. First, busy physicians are reluctant to grant time for extensive interviews; and, second, our Taiwanese colleagues warned us that few practitioners

would give accurate information concerning their gross incomes, fee schedules, or patient loads. In this respect, Taiwanese doctors are similar to private practitioners the world over. For obvious reasons, our decision was to interview the patients themselves.

Since the problems of design and execution of our survey may be common to other developing countries, we will give a detailed description of our sample design, questionnaire preparation, and survey execution.

Sample Design

We could only interview a sample of the total population; therefore we decided to use an islandwide-survey of a random, stratified sample of households. The sample design was prepared primarily by Dr. L. P. Chow, a physician-demographer, now Assistant Commissioner of Health for Taiwan, and Mr. L. H. Kou, a statistician at National Taiwan University. The full description is presented in Appendix I.

The initial problem, involving stratification of our sample, was to define the "extent of urbanization" for our sampling frame. Taiwan's political divisions corresponding to large cities, small cities, villages, rural areas, and "aboriginal areas," present jarring anomalies. There are rice fields within the boundaries of some large cities, and several "rural" areas are more densely populated than villages. Recognizing the existence of these anomalies, we had the choice of living with them, or of setting up our own definitions of "urban," "surbuban," "village," and "remote rural area." To set up such a system of redefinition, we would have been obliged to reclassify every one of Taiwan's 5,000 basic demographic units (corresponding to census tracts). This was obviously impractical. We decided to live with the existing classifications.

Our second problem was devising means to randomize our sample. Since complete randomness of sample would have been prohibitively expensive, we decided to set up a four-stage sampling process, to use random sampling in every stage, but to let each household selected be the index for a cluster of four adjacent households. The idea for this cluster sampling technique was taken from the United States Public Health Service National Sample Survey.[4] To us the "cluster" method seemed the ideal compromise between high costs and complete randomization.

Why use the household as the index for the cluster method?

Because it is the typical decision-making unit, and the Taiwanese government maintains continuous household registers. These household registers are a legacy from the Japanese occupation, and although some demographers question the accuracy and completeness of the Taiwanese registration figures, they are by far the best sampling framework we have seen in any developing country.

Nevertheless, these household registers are far from perfect. First, they do not include institutional populations. This is also a deficiency of our sample. This fault is mitigated somewhat by the fact that the men in military service, who do not belong to the private sector medical care group, constitute the largest "institutional" population on Taiwan. (We consider the military demands for medical personnel separately.) Second, the critics' allegation that the household registers are not up-to-date is all too true. Our spot-checks showed that, in many cases, persons listed as living in one household had moved and were then living in another. Were we to accept the *de jure* definition of household as containing those persons listed on the household register, or a *de facto* definition including only those persons actually living in the house at the time of our survey? Since gross inaccuracy would be introduced by questioning household respondents about the use of medical services by "household members" who had not been living in the household for the past month, we chose the *de facto* definition. We felt the improved accuracy of responses on the questionnaire would outweigh the small loss in number.

In determining the size of our sample, we first went through the standard procedures of estimation of sample size. However, since we could not predict the size of the various subgroups we might wish to use for analysis, we followed the dictum of Dr. Ronald Freedman (Director, Michigan Survey Center), and made our sample "as large as was practical." This was an excellent rule-of-thumb.

We decided to run the sample at monthly intervals for a period of one year. We hoped to determine seasonal disease trends and to obtain a full year's data for the entire island. As a time-saving device, we considered interviewing the same people each month. Two possible consequences deterred us. First was the increase in sample error concomitant with the smaller sample size; second we feared that respondents' reactions to previous interviews would produce biased responses on later visits.

Sampling of Aboriginal Areas

The aborigines of Taiwan have been a stable population during this century. Their growth rate has been only about 0.3 percent annually for the last thirty years. The increase of aborigines from the census of 1905 to the census of 1935 probably represented extension of Japanese control, and therefore census data from more of the mountainous areas rather than true increase in population.[1] Today the aboriginal population is 225,108, less than 2 percent of the population of Taiwan. About half of the aborigines still live in the inaccessible mountain areas where they retreated from the incursions of the early Chinese settlers. The 121,588 aborigines living in the mountainous hsiang, plus 46,000 Taiwanese settlers, made up our Stratum V, the "mountain-aboriginal" stratum.

In any study of a society, it is difficult to avoid giving too much emphasis to the more picturesque, more remote, and often less important elements of the society. The aborigines of Taiwan—those remnants of the first inhabitants of the island, the Formosan head-hunters—are such a population group. If we have given too much attention to the aborigines in this study it was because we were interested in learning the problems of studying a remote, ethnically and linguistically separate group as a part of a health manpower study. Such groups have much greater importance in many countries of the world and it is important to develop methods to study their demands for health services.

After discussions with health bureau directors and visits to the aboriginal areas, we concluded that it would be neither practical nor necessary to have a true random sampling of these areas. Instead, we selected sampling areas on a basis of geographic distribution and convenience to the public health nurse interviewer in the course of her routine travel. Thus, the interviewer would not be required to question four households in one village and then walk for three days to her next randomly selected household, but would interview all of the households where her work took her.

At the end of four months we had data on 1,972 persons from the mountain-aboriginal area, more than needed for our sample, so work was terminated. We used data from three months as an adequate representation of mountain aboriginal strata. In our over-all analysis we combined the aboriginal data with the next most rural area to simplify analytic procedures. Detailed information on health status and services for the aborigines will be presented in a later publication.

The Questionnaire

There were four principal questions we wished to answer: (1) Do increases in economic level result in increased use of physicians? (2) Will widespread public education increase the demand for physicians' services? (3) Does urbanization raise the demand for physician care? (4) Do the old and the young make more demands on physicians than middle-aged groups? In addition, we wished to answer a number of subsidiary questions on the Taiwanese demand for medical care.

The majority of questions on our sample survey dealt with these four subjects. First, we had a series of questions dealing with the household economic level. We sought estimates of the total amounts spent on medical treatment (on a monthly basis); on food (on a daily basis multiplied by thirty); on housing; and on such living cost as heat, transportation, servants, cosmetics, recreation, entertainment, and insurance (on a monthly basis). We asked for approximate expenditures for consumer semidurables such as clothing, furniture, personal items, household repairs, education, and family celebrations (on an annual basis divided by twelve). This information gave us an estimate of the monthly household expenditure pattern. Our reasons for choosing expenditure, rather than wealth or income, are given in detail in Chapter 9.

Second, we had questions on the education of all adults (over fifteen) in the household. Third, since our respondents were already classified by place of residence, no additional questions on location were asked. Fourth, the age of all persons was determined by a question on year of birth. This eliminated the difficulty of transposing from the Chinese to the Western system of age calculation. The final, essential group of questions dealt with the demand for and cost of medical services.

In addition to the four principal areas of inquiry, our subsidiary questions covered topics such as type of water supply and sewage disposal. These last questions were added at the request of the Health Commissioner, and proved helpful to the sanitary engineers in analyzing the needs of the community. Another question asked for the distance by "usual means of travel" to the nearest physician, pharmacist, hospital, etc.

We had considerable discussion on the wisdom of including questions on morbidity. We felt that if we were to put credence in such data the answers to the morbidity questions should be backed up by medical fact, i.e., physician and laboratory examinations.

However, since our interviewers were public health nurses, we decided to include one question on morbidity—"What were your illnesses this past month?" Less than 20 percent of the responses fell into the vague and nonspecific category. Of course, we cannot estimate the validity of the definitive answers. Even so, the morbidity information was helpful in interpreting our patterns of use of medical services.

Initially, we had several questions asking for the respondent's opinion of the quality of various medical facilities. These questions were dropped after the first month. We decided that the respondent's actions in choosing various types of services spoke louder than his words. Only one "opinion" question was retained; it dealt with the minimum age of which midwives would find acceptance. The answer to that question was used as a basis for recommendations on midwifery school entrance age requirements.

We also carried a series of rider, or "piggy-back" questions, which had little to do with the central purpose of the questionnaire. They took little time in the interview and were included as a favor to other researchers. These extraneous questions concerned family planning knowledge and practices. We dropped these questions after six months. Our interviewers were embarrassed by the sequence of questions, "Are you married?"; "Are you pregnant?" Obviously, reversing the sequence would not solve the problem.

Execution and Appraisal

As a result of the wholehearted co-operation of the Taiwanese Provincial Health Department and the county health departments, we were offered the use of public health nurses as interviewers on a part-time basis. They proved to be a real asset; retests showed them to be intelligent, reliable interviewers. Their reputation for tact and diligence gave us confidence in our decision to use them.

Having made the decision to use the public health nurses as interviewers, we then contacted the health directors of the various county health departments to explain our project, and to request their assistance in selecting intelligent public health nurses from their staff. We were particularly interested in nurses with interviewing experience.

We planned a special training course in Taichung, in August, 1962, for interviewer orientation. This was delayed until October

by the cholera epidemic of 1962. The faculty for this training course included Dr. K. K. Chang, a public health administrator; Dr. John Takeshita, a sociologist from the Michigan Survey Center, then working in Taiwan; Mr. L. H. Kou, a statistician; and Mr. J. F. Tsai, a psychologist from National Taiwan University.

The first goal of the course was to explain the importance of the project to the nurses so that they would become personally involved with its execution, rather than merely regarding it as another assigned duty. Considerable time was devoted to interviewing technique and methods of securing co-operation from respondents. There was opportunity for practice-interviewing in the classroom setting. The random sampling procedure was explained carefully, so that the nurses would understand why it was necessary to travel long distances to some households. The training course concluded with field practice under supervision. This also served as the final pretest of the questionnaire. The first month's survey in November was regarded as a practice month, and the November data were discarded.

We employed one full-time nurse supervisor who spent half her time in the field visiting the various interviewers. In the first months of the survey we hired additional nurse supervisors. In a few cases where interviewers had to be replaced, our supervising nurse trained the new nurses and made practice visits with them to insure their full understanding of the interviewing technique.

In December at least one of the professional staff made a field visit to each of the health areas to see if any problems were developing. The major problem at that time was interviewer morale, which we traced to supervision based more on sympathy than on encouragement. Once the supervisors were reoriented and, more important, after a bonus payment system was instituted, morale improved tremendously.

In addition to the field visits, newsletters telling about the progress of the survey were sent to girls who had raised specific questions. Our interviewers were encouraged to submit questions on any problems that arose in the course of their work. They readily complied with this suggestion.

To understand fully the rigors of conducting such a survey in Taiwan, one must have some knowledge of the nature of the land. Much of the island is characterized by rugged terrain. There are thickly settled, isolated valleys half a day's journey from the nearest public health outpost. We talked to one public health nurse, a

grandmother, who said she had traveled two hours by bus, ridden in a truck for another hour, and walked three hours to reach one cluster of households in her assignment area. Another nurse working in the aboriginal areas spent nearly one full day reaching an isolated rural village. When she finished interviewing it was almost nightfall, and she had to walk four miles down an isolated and unfamiliar forest path to the nearest village. She said she was in constant fear of stepping on a snake, but there was nothing she could do but keep going. Without the real interest and devotion of the Taiwanese public health nurses, this survey could never have been completed.

Evaluation

For the field appraisal of our work we had a series of interviews rechecked by the nurse supervisor three to five days after the original interviews. Our supervisor said this was by far her most difficult task. As the original interviews took almost an hour, the informants were loath to grant additional time for a second interview. However, by tact, diplomacy, small gifts for the children, and careful explanation of the importance of rechecking the nurse was able to complete her task. The refusal rate in our survey, both for the original interviews and rechecks, was very low.

We were amazed at the close agreement of the rechecks with the original interviews. There was an over-all discrepancy of less than 2 percent in the economic data. This over-all figure gives an exaggerated idea of the precision of our study, however, because there was a 10 percent discrepancy in the economic figures reported for the average, single household in the two interviews.

In addition to the field checks made by the public health nurse supervisor, our economist-statistician and our statistical supervisor

TABLE 3-1. SAMPLE QUALITY BY AGE

Age	PHD-JHU Survey (%)	Household Registry (%)
0–5	21.3	20.3
6–15	27.1	27.5
16–50	42.0	42.7
51–65	7.1	6.8
65+	2.3	2.5

made field checks. As a further check on our sample design, we compared our census figures with the Taiwanese household registry figures.

Our figures showed a 1.8 percent excess of females and a 0.7 percent deficit of persons in the 16–50 age group. The source of these discrepancies was persons moving away from the household and not being removed from the household registers. Primarily these would be working men who had moved into the cities. Many such workers were living in boarding houses or work barracks, where they would not have been reached by our household survey. Our survey also showed 1.5 percent more persons in the cities than were listed on household registers.

In conclusion, we felt that our survey, despite some flaws, was a useful and valid source of information on the health practices on the island of Taiwan.

HEALTH PROFESSIONS CENSUS

Determining total numbers of practicing health professionals is essential in any health manpower study. There are various sources for this information. In some countries periodic registration of health workers is supervised by government agencies. Licensing authorities usually maintain separate records as well. Some professional associations keep accurate, up-to-date records of their members. Lists of past graduates, corrected for deaths, retirement, and migration, may be used. Drug companies often know how many doctors are currently practicing. In countries where private practice is negligible, government payrolls yield information on the majority of practitioners. In a health manpower study in a province where the reliability, or even the existence, of these sources of data is not known, all possibilities should be explored. Such was our procedure in Taiwan.

We first considered using licensure data from the health section of the Ministry of the Interior. However, the health section has no up-to-date record of losses through changes in career or deaths. In addition, licensure data storage did not permit easy access or utilization. We next consulted the Taiwan Provincial Health Department register. Although this register was more up-to-date than the Ministry of Interior information, spot-checks still showed many incorrect listings. Moreover, this register, like the Ministry of Interior licensure data, was difficult to use. Registrants were

recorded *ad seriatum* in books rather than coded on cards. The Provincial Health Department would benefit by a card file system which could be kept up to date by periodic surveys. A third source of our information was the government health institution personnel list. Although any one of these sources of data would have been better than the best data from many other developing countries, we felt that with a moderate expenditure we could obtain up-to-date, accurate, detailed information on the numbers and characteristics of Taiwan's health workers. This information would not only be useful for strengthening our conclusions on Taiwanese problems, but the census techniques developed would also have relevance to health manpower studies in areas similar to Taiwan. Thus we decided to conduct an island-wide census of all health workers.

The Provincial Health Department Commissioner asked the health department directors of the five major cities and fifteen counties (the Penghu Islands were excluded throughout the study) to send their chief statisticians to an orientation meeting in Taichung. The purpose of the meeting was to explain the mechanism of the census and to distribute blank census cards. The nineteen representatives who attended the meeting were interested in the project, and suggested several improvements in census methods.

The actual census takers were, variously, nurses, sanitarians, or sometimes the chief statistician himself. The county or city health departments used the registry lists as a starting point. Then, census takers visited factories, schools, hospitals, and other institutions to identify any new, salaried health workers not yet listed in the registration records. Next, census takers went to all small villages and city subdivisions to locate new, unregistered, private practitioners, and see if any health workers had died, moved away, or retired.

We used locally printed, marginal punch cards, color-coded for eight classes of health workers. The only information requested was: age, sex, place of birth, place of education, and type of practice. Although our census was simply designed, initially we had difficulty with quality of returns from some county health departments. We had to return the cards several times for corrections and make additional visits to re-explain the census methods. Despite all of this effort, there were still 117 physicians' cards (out of 5,227) that had data missing at the conclusion of the census. These problems were, in part, the result of the cholera epidemic

that intervened between our first instruction session in July and the initial collection of census data in October. The exigencies of the anticholera campaign drove the details of the manpower census from some of the statisticians' minds.

In the cities our problem was not completeness of cards but health practitioners missed in the census. Spot-checks in the counties were satisfactory. Similar checks in the cities revealed underenumeration. We decided that the city subdivisions were too large for one census taker, and instituted a block-by-block resurvey. This resurvey resulted in a 10 percent increased yield and thus was worth the increased cost. Despite operational difficulties and delays, we obtained the basic supply information we needed.

MEDICAL AND PARAMEDICAL STUDENT-ATTITUDE SURVEY

Medical and paramedical students are potentially health manpower. Their contributions to society will depend on the quality of their training and on the extent of their dedication to their profession. It is our belief that the motives which lead students to enroll in medical schools, as well as the rewards (both tangible and intangible) which keep them in the practice of medicine are of prime importance to health manpower planning. We conducted an attitude survey to learn why young people wish to become health practitioners, what financial rewards they expect, where they intend to practice, their interests in specialization and advanced training, and their likelihood of continuing in practice. We developed a questionnaire for medical students with appropriate modifications for nursing, midwifery, dentistry, and pharmacy students. The questionnaire was pretested on a group of nursing students from the Taichung Nursing School, and revisions were made. The survey as it was finally used asked for:

1) students' family backgrounds as a basis for classification of students;
2) their motives in applying for medical or other training;
3) their intention to encourage their friends to study in this field;
4) the prestige of various medical professions as viewed by the students themselves;
5) their future plans; i.e., likelihood of further study, probable

location and field of practice, and (for nurses and midwives) their probable number of years in practice;

6) anticipated income immediately after completion of training, and after five years of practice.

We were interested not only in a cross-sectional picture of student opinion, but also in the changes that had occurred in students' attitudes as a result of their professional training; therefore, we surveyed both freshman and senior classes. Visits were made from October, 1962, through May, 1963, to the following schools: National Taiwan University—schools of medicine, dentistry, nursing, and pharmacy; Taipei College—schools of medicine, dentistry, and pharmacy; Kaohsiung College—schools of medicine, dentistry, and pharmacy; National Defense Medical Center—schools of medicine, dentistry, nursing, and pharmacy; China Medical Herbalist College; Chungshan Dental School; Taipei Nursing College; Taipei Nursing Vocational School; Taichung Nursing Vocational School; Tainan Nursing Vocational School; and Pingtung Midwifery Vocational School.

Our surveys were written in English, then translated into Chinese and finally retranslated to English to check for distortions. They were administered to groups of roughly forty students in specially scheduled, half-hour periods. The students were told that their answers would be used for statistical purposes only, and that any information they gave us would be kept confidential. For the most part, we secured adequate co-operation from those students who participated; although Mr. J. F. Tsai, the psychologist who helped design and administer the questionnaires, observed that the spirit of co-operation was inversely correlated with the student's class. Medical college seniors were occasionally disrespectful. Most classes had high response rates with only a few absentees. Where the response rate was low, the entire class was dropped rather than bias the results for that school. As expected, nursing students showed the greatest co-operation.

We were fortunate enough to consult with Dr. K. P. Chen, professor of preventive medicine at National Taiwan University, in planning our student survey. Dr. Chen later did a similar survey, with better response rates than ours. Where there were similar questions, our findings agreed substantially with those of Dr. Chen. This confirmation was reassuring, but did not completely dispel our feeling that an opinion survey is not a particu-

larly accurate predictor of students' future career activities. Some of the results of the student surveys are presented in Chapters 4, 5, and 6.

MEDICAL AND PARAMEDICAL SCHOOL SURVEY

In any manpower study it is essential to gather information on training institutions. One must know the existing teaching institutions, their past production and capacity for future increases. It is important to know the approximate cost and quality of training.

In Taiwan there were twenty-five institutions offering formal training in the various health professions. There are four medical schools, one herbalist school, seven recognized nursing schools, three missionary hospital nurses training courses, three midwife training courses, three established dental schools, and four pharmacy schools. In some cases institutions are grouped together under one university. For example, the National Taiwan University has a medical school, a collegiate nursing school, a registered nurse training course, a dental school, and a pharmacy school. Since a university complex permits sharing of facilities and faculty among the professional schools, it is difficult to compare costs and student faculty ratios between university and nonuniversity schools.

To learn as much as possible about the twenty-five institutions, we visited them for on-site observation and left a questionnaire to obtain detailed statistical information. Information requested included the total number of graduates, by year, from the beginning of the institution; the number of faculty members by rank (part-time and full-time); the budgets of the institution; the number of graduates, by year, over the past ten years by graduates' birthplace; and the number of students enrolled in each class, by year, over the past seven years. Draft questionnaires were discussed initially with Dean Wei of the National Taiwan University Medical College to evaluate availability of information and clarity of questions. After an initial pretest, the forms were delivered to all of the training institutions on the island. We had complete returns from all questionnaires. We question the data on financial expenditures, not so much from inaccurate reporting as from a lack of uniformity in reporting. It is well known that figures on the costs of medical education, even in the United States, are not uniform.[2,3,5] The administrators of the medical colleges, nursing

schools, dental schools, and pharmacy schools in Taiwan should seriously consider the discussion and establishment of uniform systems of cost accounting so that accurate, comparable costs per graduate can be determined.

The figures on the numbers of past graduates, students, and faculty can be used with confidence, whereas the figures on the costs of education should be regarded as approximate.

JOINT COLLEGE ENTRANCE EXAMINATION STUDY

Every spring in Taiwan the senior high school classes are gripped by rising tension. A group of teachers are held under lock and key while they prepare the questions that will decide the student's future. Sealed and guarded documents are sent simultaneously to all parts of the island. The time of the joint college entrance examination is at hand.

This examination is an inherent part of Taiwan's educational system. It occurred to us that analysis of its results would be extremely valuable in predicting trends of demand for higher education. We felt sure that attempts would have already been made to analyze professional trends. To our surprise, the past five years' results had been packed away with no thought of their value for research purposes. In talking with university presidents we met with enthusiastic response to our idea of analyzing the examination results. Their interest was so great that we decided not to limit our project to medical institutions, and to record information on IBM cards. These cards are now available for future analyses of other sectors of high-level technical manpower.

The sectors on which we gathered information include *medicine*, *dentistry*, *pharmacy*, *medical technology*, psychology, veterinary medicine, mathematics, physics, chemistry, geology, geography, engineering, architecture, and a few odds and ends making up the so called "Group-A" subjects. We also have information on *nursing*, zoology, botany, agriculture, home economics, and the other miscellaneous "Group-C" subjects. The "Group-B" subjects, primarily humanities, were not studied as they were not germane to our primary interests. The logic of the division of subjects into groups has never been clear to us. We fail to see why nursing is classified with agriculture rather than with the other medical sciences.

The three groups (A, B, and C) are given different examinations although there are some common questions in areas such as Chinese history. Questions are usually of the essay type. In discussing the examination system, many educators pointed out defects to us. These were not our primary concern. Research to evaluate and improve the system is desirable, but we were interested in the joint examination system as a mechanism to predict trends of preference for study of medicine, nursing, pharmacy, and dentistry.

A brief description of the mechanics of the examination system is necessary to facilitate understanding of our methods of analysis.

Before each student takes the examination he fills in his choice, in order of preference, for department and institution for collegiate study. Some students, undecided or insecure, have been known to put down as many as fifty choices! The student then answers the questions. After each student's paper has been coded with his examination number the examinations are read and graded.

The final selection works like a large-scale, nonelectronic, "intern matching plan." The examinations are arranged according to grade. Officials from all of the institutions represented in one group assemble. Starting with the top ranking students, first choices are read off. When a department reaches its enrollment capacity the responsible official announces that enrollment is closed. From then on, any student whose first choice is a filled department will be turned down and given his second choice (unless that is also filled). When the lower scoring students are reached, most of the favored departments are filled and students are perforce matched with their low priority choices, if they are matched at all. Occasionally, students listing as many as thirty or forty schools will still not be matched. At the end of the matching, there are still students unmatched and schools unfilled. These students and departments may make separate arrangements on their own initiative. Many students whose grades are not high enough for them to get their first or second choice will prepare for another year and stand for examination a second or third time. There is also a small percentage of the enrollment of some colleges accepted by recommendation of the high school teachers. In certain medical colleges the examinations system is circumvented by students who enter a less favored, low priority, department such as dentistry and transfer after one year to a more popular depart-

ment. Informed sources state that in some cases these transfers are not based exclusively on scholastic merit, but on the extent of financial support given to the school.

As noted earlier, the National Defense Medical Center does not participate in the joint examination system. Also the vocational nursing schools are excluded and have their own separate entrance procedures.

Our procedures for collecting data were fairly straightforward once we located the repository for the examinations. Responsibility for giving the examinations had rotated among the universities, and it was difficult to find anyone with a continuity of knowledge of the program. The old records were finally located in Chengchi University outside Taipei. Preliminary review of the records showed that information available included: the student's grade (from 0–515), his choices of department for future study by priority (we only used the first five), the number of previous examinations, place of origin, and sex. Information on parents was available, but not collected. We made a trial run with about 750 examinations to determine distribution for sample size, and estimated total costs. A 25 percent systematic sample was decided on—a total of about 15,000 records out of 60,000. Of these, roughly two-thirds were for Group A, the remainder Group C; they cover the years 1958–62.

The data collection was carried out by four statistics students working part-time under the direction of our study statistician. They transferred needed information from every fourth examination to code sheets that were taken to the Taiwan IBM center for punching. About 0.4 percent of the code sheets were defective or incomplete and could not be punched.

The costs of coding, punching, verifying, and tabulating all this information were surprisingly low, less than $500 (U.S.)

In summary, the joint entrance examination study offered an unusual opportunity to get information on trends in choice of careers in the health field. Although it has little direct applicability to countries outside of Taiwan, it has great value for research in other sectors of technical manpower in Taiwan. The results are reported in Chapters 4, 5, 6, and 7.

OTHER SOURCES OF DATA

We made one attempt to measure physician income directly. Most of the city and county medical societies prepare a list of

doctors by twelve income groupings. This list is furnished to the tax bureau for tax computation. We visited medical society representatives and secured copies of these income distribution listings. Spot-checks revealed so many glaring inaccuracies that we decided that the data were virtually useless. Why the tax bureaus accept such information is beyond comprehension.

In addition to our own studies we referred to official publications such as the annual Provincial Health Administration reports, reports from the Ministry of Education, school catalogues, personal communication, and journal articles.

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CHAPTER 4

PHYSICIANS, HERBALISTS, AND QUACKS

INTRODUCTION

PHYSICIANS, in Taiwan as elsewhere in the world, are essential for adequate health services. The 3,800 physicians who are in full-time private practice have 60 million visits to their offices or clinics each year. In addition, doctors take care of more than eight million patient-visits to health units and hospital out-patient departments and see over thirty thousand in-patients in government hospitals. Physicians account for 70 percent of patient-visits to all types of health workers (pharmacists, dentists, physicians, herbalists, midwives, and "quack" doctors). Every year the physicians of Taiwan render more than 2 billion NT$ ($56.6 million [U.S.]) worth of services.

In comparison with other developing regions, Taiwan is relatively well supplied with physicians. In 1963 there were 5,400, or one for every 2,100 people, compared with India's 1:5,000 and Indonesia's 1:100,000. Taiwan's ratio approximates those of Peru and Yugoslavia.

Our findings indicate that the physician is not likely to be replaced as the key person in the health industry in Taiwan, for only the older and poorly educated patients prefer the herbalist or the quack. One impact of Taiwan's massive public educational program will be to increase the importance of physicians in relation to the quasi-medical practitioners.

Study of the doctor supply in Taiwan is vital, not only because of the pivotal importance of the physician in provision of medical care but also because of the long training period required for doctors. Planning for supplying physicians is of utmost importance, for if shortages develop it will take decades to fully correct them.

For these reasons we have given detailed attention to the discussion of the supply of doctors in Taiwan.

First we will discuss the age distribution of doctors, for here we found the major surprise of the study and here we uncovered information of greatest importance to the planners in Taiwan.

Age Distribution of Taiwanese Physicians

The analysis of age information from our island-wide health worker census indicates that the present rate of training of Taiwanese doctors is not sufficient to maintain the present number, let alone meet the increased demands of a larger population with more money to pay for physician service.

The table below shows the nature of the problem.

TABLE 4–1. AGE DISTRIBUTION OF PHYSICIANS

Age	Total practicing physicians (A&B)[a]	Percent in each age	Comparable United States percentages[a]
<–35	391	7	24
35–44	2,012	38	27
45–54	1,700	33	22
55–64	820	16	14
65–74	261	5	8
76+	43	1	5
	5,227[b]	100	100

[a] See section on types of doctors, page 49, for definitions.
[b] Excludes 30 doctors from Penghu, 95 doctors with incomplete cards, and an estimated 100 doctors missed in 4 cities.

Our census figures are admittedly distorted by lower registration in the younger age groups. However, even when we allow for underenumeration of: students graduating at age 26 or older, students taking postgraduate training outside of Taiwan, and unregistered physicians just established in practice, we are still faced with the fact that there are at most only half as many physicians in the 20–34-year-old group as there are in the 35–44-year-old group. Doctors in the 20–34-year-old group would have graduated during the past ten years. There were only 825 graduates from civilian medical schools during this time. Of this number we estimate that over 150 have left Taiwan permanently.

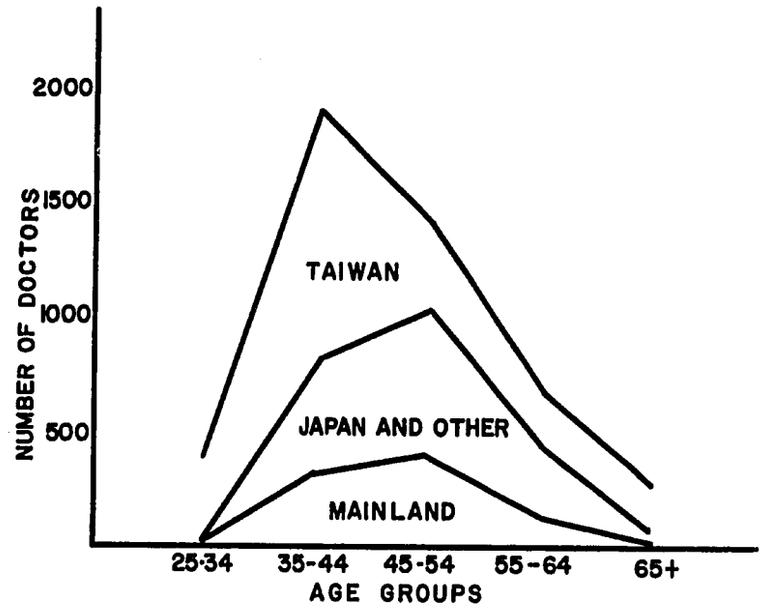

Figure 4-1. Doctors—Age and Place of Education.

There is a hidden deficit of over 1,300 doctors that will begin to show its effect in 1972 when the older doctors start retiring. Table 4-1 shows the genesis of the shortfall in younger doctors.

As we expected, almost one-fifth of the older physicians are graduates from mainland China who migrated at the time of the Communist takeover. Obviously there are essentially no mainland graduates in the younger age groups. However, we were very surprised to find that there were 538 Taiwanese graduates from Japanese schools in the 35–45 age group, and even more surprised to find that there were 678 Japanese school graduates in the 45–54 age group. There are very few Taiwanese students studying medicine in Japan today, who might serve as replacements for the older, Japanese-trained doctors who constitute about one-third of all physicians in these two age groups. Review of medical school records shows that some Japanese doctors were trained in Taiwan before the war, but far less than the number of Taiwanese trained in Japan.

The potentially dangerous gap and its antecedent reasons are evident. Possible solutions are discussed in Chapter 11, on alternatives and consequences.

Types, Numbers, and Distribution of Doctors

The average Taiwanese medical graduate of today is twenty-six years old. He has had six years of good medical college training after high school, and a year's internship. Today's graduate is not, however, typical of the bulk of Taiwan's practicing physicians. The older physicians may have had only four years of medical school without a high school background. Approximately 20 percent of physicians have had no more than secondary school, and four years of medical school. This older group is being replaced by younger, better trained physicians.

The table in the preceding section includes "Grade-A" and "Grade-B" doctors. What do these terms mean? The Grade-A doctors, 85 percent of the total, have had training ranging from four years after high school in the old Taiwan medical school to seven years after high school in the present medical colleges. The 874 Grade-B doctors also show a wide range in levels of training. They are preceptor-trained, short-trained (two years), military-trained, and, unfortunately, untrained medical practitioners. With the exception of military physicians, Grade-B doctors are no longer being trained, and, like the older Grade-A doctors, are gradually being replaced. In fact, the current training of military Grade-B doctors is indistinguishable from that of the older Grade-A physicians. The general public usually draws no distinction between the Grade-B and fully qualified doctors. For this reason we have combined them in our analysis and projection. The herbalist, a licensed health professional, and the "quack," an unlicensed yet popularly recognized purveyor of medicine, will not be included with the doctors, but will be discussed separately at the conclusion of this chapter.

How many doctors *are* there in Taiwan? The Ministry of Interior registration records showed 7,818 in 1963.[14] Surely this is an overestimate, because according to Dr. C. K. Chang, chief of the health section, there is no efficient system to remove doctors from MOI (Ministry of Interior) records when they die or retire. Provincial Health Department records showed 4,902 in 1963.[6] This is probably an underestimate as spot-checks showed that

some physicians, particularly those in government service, failed to register with the Provincial Health Department.

Our island-wide census of health professionals shows 5,450 doctors. This figure includes 95 doctors with incomplete census cards and 30 doctors (PHD [Provincial Health Department] figures) from Penghu Hsien (Pescadore Islands) where we took no census due to transportation difficulties. It also includes an estimated 100 practitioners who were missed in Kaohsiung, Taichung, Tainan, and Keelung cities. Our original census procedure was proved adequate by rechecks in the rural counties and small cities, but we were dubious of its accuracy in the five large cities. Our suspicions were confirmed in Taipei by a special block-by-block recensus of the entire city which brought in approximately 10 percent higher returns than the original census. Since there are only 969 doctors in the four cities outside of Taipei, applying the same correction factor of 10 percent would result in an increase of about 100 additional doctors. We also suspect underenumeration of the younger physicians. The reasons for this will be discussed later. We believe there is no overenumeration in our census in the form of double-counting or counting of inactive practitioners.

None of these figures includes military physicians, nor has the military population been counted when calculating physician-to-population ratios. This procedure is not strictly accurate as there are some military physicians who render medical care for members of the civilian population, e.g., military dependents. Special estimates for military physicians are given in Chapter 10, on public sector demand.

The figures from our census give a physician-to-population ratio of one physician to 2,140 people, or 46 per 100,000 population. We believe that this ratio is not sufficient to meet the existing demand in Taiwan.

As principal evidence, the average doctor's earnings are approximately twenty times that of the average laborer, twenty-five times that of the average secretary, and ten times that of the average dentist. The very high income for doctors indicates a relative shortage. In addition, our household survey showed that at least half of the persons interviewed would go to a private practitioner more often if they could afford it.

The distribution of doctors in Taiwan is far superior to that in many of the countries of the world. Our survey showed that almost

half of the households on the island were less than fifteen minutes, by the "usual means" of transportation, from a doctor's office; 84 percent less than one hour. Only 0.2 percent of the population indicated that they were "too far" from any private practitioner's office to normally utilize such services.

There are two reasons for satisfactory distribution of doctors in Taiwan. The first is the good network of roads, railroads, and bus lines in Taiwan. The second is the number of Taiwanese physicians willing to practice in the rural areas. Of physicians born in rural areas, 75 percent remained in rural practice. However, in the city-born group, less than 10 percent moved to rural areas for practice. As expected, Grade-B doctors showed a heavier concentration in the rural areas than Grade-A doctors; 75 percent of Grade-B doctors and 50 percent of Grade-A doctors practice in rural counties. However, younger physicians have tended to concentrate in cities. Data from our medical student survey indicate an increasing trend toward city practice. This trend is greater than the general urbanization trend on the island and may result in a depletion of physicians in rural areas, such as has occurred in the United States. This will be discussed further in Chapter 11.

Table 4–2 shows physician-to-population ratios for all counties. It does not give a completely accurate picture of physician distribution, as some counties have cities conveniently located for the bulk of the population.

TABLE 4–2. DISTRIBUTION OF PHYSICIANS BY COUNTY

County (hsien)	Persons/Physician	County	Persons/Physician
Taipei	2,744	Yunlin	3,600
Ilan	3,150	Chiiyi	2,670
Taoyuan	3,600	Tainan	3,810
Hsinchu	2,400	Kaohsiung	3,510
Miaoli	3,880	Pingtung	2,650
Taichung	3,380	Taitung	3,600
Changhua	3,260	Hualien	2,860
Nantou	3,200		

However, the table shows that there is no gross disproportion in distribution of doctors as occurs in some counties. The average for the big cities is one doctor for 1,200 people. This apparent disparity

is balanced by the fact that many rural people go to the cities for their medical care.

Income

The knowledge of physicians' income is vital for a health manpower study, but it is probably the most difficult information to obtain accurately. All previous estimates of physician income in Taiwan have been made on the basis of reporting by physicians. These include special studies and tax collection figures. Although Taiwan has an efficient tax bureau, its methods for determining physician income are rather unique. In the majority of governmental units the tax bureau requests the medical society to prepare a list of all doctors' income. In the opinion of every knowledgeable person we consulted the list is invariably a gross underestimate of true income. One of our Taiwanese colleagues said, "If my best friend asked me my income from private practice, I would tell him—but I would not tell him the truth."

With an almost insurmountable problem in collecting income data from the physicians directly, we decided to measure consumer, or patient, expenditure. We had reliable information on expenditures for physicians on a random sample of the total population of the island. We converted this to per capita expenditure and multiplied by the total population of the island, thus coming up with a total expenditure for physician services. We then divided the total expenditure for physicians by the number of full-time practicing physicians, and arrived at an average income figure of 33,000 NT$ gross per month (40 NT$ = $1 U.S.). In Taiwan the physician's office expenses are high, for doctors dispense more medicine in Taiwan than is customary in the more industrialized countries. This medicine is included in the cost of the visit. Our estimate of *net* physician income is 20,000 NT$ per month.

We had hoped to compare rural and urban physician incomes and incomes by individual cities and counties. However, we seemed to find inordinately high physician income in the rural areas and realized that many rural patients from our household survey had gone to city physicians rather than rural physicians in their own area. There was no way to determine from our data the extent to which rural patients go to city physicians. Some future study should make an estimate of the flow of patients from rural areas into the city, as this information would be useful for planning by the Provincial Health Administration.

We have compared the expectation of income of medical students with the average physician income figure for Taiwan and find that in general medical students underestimate their potential earnings. This has real importance in terms of future planning for any expansion of numbers of physicians trained. We will deal with this matter in greater detail in Chapter II. First-year students tend to expect a higher level of income than the last-year students. It is impossible to say whether this is the effect of six years in a medical school, talking with the underpaid faculty, or higher aspirations among current matriculants than among medical students born half a decade earlier. We also asked for estimates of income expected immediately on leaving internship. Immediate income, in contrast to long-term aspirations, was overestimated.

The net income of 20,000 NT$ for private doctors stands out in sharp contrast to the wages of the government doctor. The beginning doctor makes only 1,200 NT$. Even the director of a health station makes less than 2,000 NT$, including all allowances.[7] This marked imbalance will be discussed further in Chapter 11, on alternatives and consequences.

Prestige

There is general agreement in Taiwan that there is more prestige in the practice of medicine than in the practice of any other profession. We included questions on prestige in our questionnaire for the medical, nursing, dentistry, and pharmacy students. It would surprise no one to learn that 98 percent of the medical students believed that of all health professionals, the physician was accorded the greatest prestige by both the community and by the other health professions. (We assume that the other 2 percent misunderstood the question.) Findings in the nursing, dentistry, and pharmacy student questionnaires were similar, indicating that the physician was accorded very high prestige by both the general public and by the professions. The unusually high prestige accorded to the physician by other students has an effect on manpower planning. It leads to the practice of students quitting pharmacy or dentistry courses after several years if they find an opening in medical school.

Women in Medicine

Slightly less than 10 percent of all doctors in Taiwan are women. This sex ratio shows little change for different age groups. Medical

school enrollment statistics in Taiwan Province show that, although there has been fluctuation from year to year, the female enrollment also averages 10 percent. Thus we find little evidence of women earning a doctor's degree and then not practicing. For this reason we have not taken sex differences into account in our projection of numbers of doctors.

In the National Defense Medical Center (NDMC), as expected, there are essentially no women medical students being trained for army service. However, we were surprised to find that for the past ten years at National Taiwan University (NTU) Medical School only 3 percent of the native Taiwanese students were female, compared to 35 percent of students from mainland families. Perhaps the difference is explained by the large number of boys from mainland families going to NDMC rather than NTU.

Types of Practice

Our census of physicians in Taiwan showed that physicians are primarily engaged in private practice (71 percent fulltime). The next largest number are in hospital work (20 percent). Health centers account for 5 percent, schools and all other activities employ the remaining 4 percent. Although the Grade-B doctors have the same heavy concentration in practice (82 percent), there is an interesting shift from the next most important category of employment from hospital to health center, for the health centers employ some 15 percent of the Grade-B doctors, while hospitals employ only 1 percent. In light of the specialized nature of hospital care, this seems reasonable. The question it raises for the public health department is: How will the health centers be staffed when there are no more Grade-B doctors?

Figures from our medical student survey show that about three-fourths of those planning to stay in Taiwan plan to go into private practice; the remaining one-fourth will go to hospitals and health centers. Over 75 percent of the doctors working in government hospitals were less than forty-four years of age, while only 42 percent of the private practitioners were under forty-four. This difference is best explained by the normal working pattern of the Taiwanese physician. He initially works in the hospital for additional training and experience and gradually builds up his capital, while initiating his private practice. Then he leaves his salaried position. The higher percentage of physicians over forty-four years of age (62 percent) working in the health centers probably represents

physicians who have been unable to make private practice pay, since most health center positions are low paying, isolated, and generally undesirable to most physicians. In discussing the usual career pattern for physicians, we recognize that the physicians in government work in the hospitals and health centers are often far from full-time employees. In fact, several authorities in Taiwan have suggested that on the average we count the time as being devoted half to government and half to private practice.

Our health census did not specifically inquire about specialization, as there is no official basis for accrediting specialists in Taiwan. There are no specialty boards. Although residency training is available, there is no method of regulating or obtaining official approval for this residency training. However, there are specialists in Taiwan as in every region of the world. Although many of them are specialists only by self-proclamation, a number have received advanced training in Japan, Western Europe, and the United States (in addition to those who had specialty training in mainland China). Appropriate Taiwanese health and medical education authorities should plan for and regulate specialty practice. Specialists should have a system for accreditation which will be recognized by the profession. With planning, Taiwan can avoid the mistakes of some countries which have overproduced specialists in glamorous but limited fields such as cardiac surgery and neurosurgery.

Educational Background

The word "doctor" does not describe a truly uniform group, but rather a spectrum of individuals whose skills and training may differ widely. In the United States when we speak of doctors we sometimes include osteopaths, graduates of the now-defunct Grade-B medical schools, and even homeopaths. In Taiwan we find an even broader spectrum of persons working under the title "doctor." Eighty-five percent of the doctors of Taiwan are Grade-A doctors whose training after high school ranges from four years in the old medical "school" to seven years in the current medical "colleges," plus postgraduate training. Physicians coming from the mainland show the same variation in training. They may be graduates from the world-renowned Peking Union Medical College, or from very inferior medical schools in mainland China. Grade-B doctors (15 percent of all physicians) are mainly graduates of special short courses set up in mainland China and in Taiwan to

meet the exigencies of the Sino-Japanese War and World War II. In addition, there are a few Grade-B doctors who have had only practical experience. In recent years the National Defense Medical Center has set up an adequate four-year course for Grade-B doctors.

We did not consider it advisable to separate Grade-A and Grade-B doctors, for the public makes no distinction between them and the quality of their training has considerable overlap.

MEDICAL EDUCATION

Any study of high level manpower must include careful appraisal of existing training facilities. Number of students graduated annually, capacity for expansion, quality of training, cost of training, and a historical perspective of the goals and development of the institution are all necessary parts of the appraisal. To obtain this information in Taiwan we used both institutional questionnaires and visits to all of the medical schools. The results of our findings are presented as a school-by-school review, showing the strengths and weaknesses of Taiwanese medical education.

National Taiwan University (Taikohu U., Taita U.)

In 1945, at the time of Taiwan's retrocession to China, Taihoku University Medical School was in desperate straits. The buildings had been damaged in air raids, equipment was worn and defective, and the Japanese physicians who had constituted the nucleus of Taiwanese medical educators during the occupation had returned to Japan. The twenty intervening years have shown amazing progress in the rebuilding and development of the National Taiwan University Medical School. It is truly a phoenix risen from the ashes.

Dr. Tsungming Tu, the professor of pharmacology and a distinguished medical educator and scholar, was appointed as the first Taiwanese dean of the school, renamed National Taiwan University Medical School. Under the leadership of Dean Tu, and his successor Dean Wei, the following changes were made. The old Japanese curriculum was replaced by a six-year course: one year premedical work, four years of medicine, and a year of internship. In 1949 the course was increased to seven years. The following year the residency training system replaced the old Japanese postgraduate system and the nursing school was es-

tablished. In 1953, pharmacy, physiology, pathology, and public health institutes were established. In 1954 the block system of training was instituted with the development of clinical clerkships. In 1955 the School of Dentistry was built, and in 1956 the College of Nursing and the School of Medical Technology came into being.

National Taiwan University has also made significant advances in research. Between 1954 and 1961 faculty and students published some 530 technical articles. The role of United States aid in the reconstruction should not be underestimated. The library, dormitories, Institute of Public Health, School of Nursing, School of Pharmacy, preclinical block, pathology, X-ray, and ophthalmology departments, the nursery, and the School of Dentistry were all restored with the help of United States aid; United States aid to medical education was not limited to bricks and mortar, but covered visiting consultants and overseas training for faculty as well.[11,16]

In summary, with United States aid for buildings, equipment, and instruction, and their own energy and insistence on excellence, Dean Tu, Dean Wei, and the faculty at National Taiwan University have built a medical school which ranks high among the medical schools of the world.

National Defense Medical Center (*NDMC*)—from Stables to Research Laboratories

In 1949 the faculty and staff of NDMC arrived in Taiwan under refugee conditions. No equipment, no supplies, and no buildings were available. The first classes actually used old stables abandoned by the Japanese cavalry. Today, however, modern classrooms, dormitories, and research laboratory buildings fill a well-planned medical center campus. The spirit and resourcefulness of the leaders of the school combined with the help from the United States government (over $1,000,000 [U.S.]) and China Medical Board (almost $1,000,000) brought about remarkable progress in the face of adversity. In the chaotic period of retreat from Shanghai and escape to Taiwan only one year of teaching was lost.

The NDMC was set up in Shanghai by a merger of the Army Medical School and the Army Field Service School with the primary purpose of providing the army with adequate medical service. This same objective prevails today and gives rise to the special attributes and special problems of the center. As might be expected, military training, physical education, and political

education receive considerable stress, but medical courses offered by NDMC meet or exceed the requirements of the Ministry of Education. One interesting feature of the teaching at NDMC is the *effective* and *extensive* teaching of public health and preventive medicine.

Training for physicians covers a period of six and a half years, including a year of rotating internship. The special needs of the army require a condensed medical course for the best candidates from army medical service officers. This four-year course has been equated with the old Grade-B medical training. However, the training and the graduates are far superior to the Grade-B level.[9,12]

The major problems of NDMC stem from the ten-year obligated service requirement for all male medical students. There are just not enough *well-qualified* applicants for the available places. To compound the problem, the NDMC does not participate in the joint university entrance examination with the other medical schools, but holds its own examination later, after the best students have already been selected by other schools.

A solution must be found to insure full utilization of this excellent training institution by well-qualified medical students. Otherwise, some of these medical students will choose inferior education in second-rate medical colleges rather than assume the ten-year military obligation. The chiefs of staff should study the potential effects of lowering obligated service time to five years or less. If five years' service, plus career military doctors, would meet the armed forces' needs, the shorter obligated service time is justified. Doctors leaving the army will take up civilian practice; a healthy civilian population is as important to national defense as healthy armed forces. There is further discussion of this point in chapter 10, on public sector demand.

Kaohsiung (Takau) Medical College

When Dean Tu retired from the National Taiwan University in 1953, he took over the difficult task of establishing a new medical college. Despite the many problems of assembling a faculty and building a teaching hospital, the new medical college developed rapidly.

In late 1953 an organizing committee with broad professional representation was set up. This committee developed plans which were submitted to the Ministry of Education early in 1954. The

Mayor and several leading citizens of Kaohsiung offered land and financial support to encourage the new college to establish in Kaohsiung. The offer was accepted by the committee. Ministry of Education approval was granted in September, 1954. Entrance examinations were given to over eight hundred candidates for sixty places. Registration of students was held in early October, 1954. In only slightly more than a year, an idea had been transformed into an operating medical school.[15]

Since 1954 the Kaohsiung Medical College has continued to grow through increases in clinical faculty, construction of new teaching facilities, and extension of the course from six to seven years. This rapid development has not been without attendant frictions between trustees and staff.

The major sources of income at Kaohsiung are tuition, hospital income, and "other contributions." The fact that tuition can cover as much as one-fourth of the running expenses of a medical school is a lesson for other medical school administrators. However, Kaohsiung Medical College income has exceeded expenditure for seven of its eight years of operation. We saw no evidence that the medical college had any justification for accumulating financial reserves or diverting surpluses to other activities. Rather, they should be seeking more support for better teaching and research facilities and more favorable faculty-student ratios. In a completely private institution there is danger that quality of education may be sacrificed to financial expediency.

In sum, an amazing job has been done in developing a private medical college in Kaohsiung. It can be a great force in improving the health of the people of Taiwan, *if*, and only if, the Ministry of Education insists that quality of education comes before monetary return.

Kaohsiung Aborigine Training Course

Dean Tu's long-standing interest in the history and welfare of the aborigines of Taiwan was manifested in the unique aborigines training program. This abbreviated (four-year) medical course was designed to train aborigine boys who would return to work with their own people. Room, board, and tuition were all furnished free. According to the instructors, the aborigines were apt and diligent pupils. Since the first class graduated in 1961, insufficient time has passed to evaluate the long-term benefits of this experiment.[17]

Taipei Medical College

In addition to the three medical colleges in Taiwan, there is a fourth institution that has recently started accepting medical students for training. It is the Taipei Medical College, headed by Dr. C. T. Hsu, a gynecologist without previous full-time experience in medical education. When we visited the college and talked with the faculty, it seemed that there were more problems than usual in a new school. Although there was a class in the second year of medical school at that time, the professor of medicine said that no plans had been made for developing the curriculum in medicine. No arrangements had been made for clinical experience and the medical school had no hospital of its own. The school buildings are a considerable distance from the center of the city, which may create problems in obtaining good clinical material for outpatient teaching. The semi-rural location, on donated land, may prove to be more of a handicap than a benefit to the supposed beneficiary. The buildings are incorrectly designed. Considerable expense and many difficulties have been encountered in correcting the mistakes of the first architect. Although new, the classrooms lack the imaginative and innovative features of the new buildings of the National Defense Medical Center, National Taiwan University, and Kaohsiung Medical College. Recent reports indicate that the course of development of the school is now proceeding somewhat more smoothly.

Tuition and Costs

Tuition at the medical colleges varies widely. The tuition listed for the China "Medical" College (the herbalist school) is greater than the tuition listed for National Taiwan University (NTU). There is certainly no correlation between the qualty of medical education and the amount of tuition charged. Indeed, it might be argued that there is an inverse relationship. Sample figures show that the tuition per student per year at the NTU Medical College is 1,200 NT$. At the Taipei Medical College it is 2,250 NT$, and at the China "Medical" College the fee is 2,760 NT$. Obviously even the highest of these figures is too low to approach the costs of medical education. Published figures show that the yearly cost per student at National Defense Medical Center (NDMC) is approximately $850 (U.S.) (34,000 NT$).[12] These figures include ancillary personnel whose training is less expensive than that of the

physicians. In addition, after discussions with staff of the NDMC, we feel that differences in systems of accounting and failure to allow adequately for depreciation might make this figure too low. The problem of tuition charges and costs of medical education will be discussed in Chapter 11.

Summary

At present there are two, good, established medical schools in Taiwan. There is one new school that shows promise and another school that is as yet unproved. These schools could take more students if more development and operating funds and staff were available. It would be far more economical to expand the existing schools than to develop new ones. In the next section we will see how many graduates will be produced if the schools continue present trends.

FUTURE SUPPLY OF DOCTORS

Estimate of Graduates 1963–83

In any area where there is essentially no immigration of foreign medical graduates and where it is unlikely that there will be carte blanche licensing of semitrained professionals in the future, the sole source of supply of physicians is graduates from the medical schools. In Taiwan we have estimated the output from the four recognized medical schools. Over the past five years at National Taiwan University the yearly number of graduates has ranged from sixty-eight to eighty-nine. The mean size of the ten most recent graduating classes is seventy. However, the policy of admitting classes up to 100 during the past four years indicates the possibility of somewhat larger graduating classes in the coming two decades. Making due allowances for the present demands for training overseas Chinese (residents of Hong Kong, Malaya, etc., who will not practice in Taiwan) at National Taiwan University[19] the best estimate of graduates per year for Taiwan is eighty physicians.

Taipei Medical College had as yet to graduate its first class. Forty-seven students were admitted in the first class of 1961; however, rather than decreasing in number, this class was augmented, probably by drop-outs from other medical colleges and transfers from the pharmacy school at Taipei. It is extremely difficult to predict what the average graduating class at Taipei will be during

the next twenty years, but based on the availability of teaching facilities and faculty, it *ought not* to have exceeded eighty per year, starting in 1966.

Kaohsiung Medical College graduated its first class in 1960. There were fifty-two members in the class. The next class had seventy-six members. A cohort analysis of the classes at Kaohsiung shows the same curious pattern of augmentation of classes after the first year that is found in Taipei Medical College. For the past eight years the average entering class was seventy-six students. Unless the practice of accepting transfers from the pharmacy and dental school to the school of medicine increases, an optimistic estimate of yearly graduates from Kaohsiung Medical College would be eighty per year, based on physical plant and faculty size.

Essentially all National Defense Medical Center (NDMC) graduates enter the armed forces for their obligatory ten-year period of service. Therefore, in calculating additions to the total number of physicians from the NDMC it is more appropriate to estimate future numbers returning to civilian practice, rather than number of graduates. It is estimated by military medical authorities that some 20 percent of the graduates in the past ten years have already returned to civilian practice on early discharges. No correction needs to be made for this in estimating the number of doctors becoming available for private practice, as long as the proportion who return early remains more or less constant.

Also, it is estimated that 20 percent of NDMC graduates make a career of military medicine. We anticipate that, of the 623 graduates from 1953 to 1962, about 500 (623 less 20 percent career military doctors) will take up civilian practice between 1963 and 1973. (The fact that 120 of these 500 secured early discharges should be offset by early discharges among the 1963–73 graduates.)

Assuming future graduating classes of sixty, and a military career rate of 20 percent, 480 (600 less 20 percent) will return to practice from 1973 to 1983.

Although the average class size for the past ten years is sixty, the past five years show a larger average class. We feel the ten-year average is better, as we do not believe that there is still a large reservoir of qualified candidates in the armed forces, for the vocational medical course.

Some career military doctors may take up civilian practice on their regular retirement at age fifty or sixty. The years of work

left to those few retiring in the next twenty years will not appreciably affect our projections.

We have included the "vocational medical graduates" from NDMC, even though these are all regular army men who almost invariably stay with the armed forces. Table 4–3 shows the number of doctors trained at NDMC over the past ten years.

TABLE 4–3. MEDICAL GRADUATES—NDMC, 1953–62
(excluding foreign students, "overseas Chinese")

Year:	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	Total
M.D.	40	54	91	[a]	50	36	38	54	48	60	471
Voc. Med. (Grade B)	—	—	—	—	—	—	52	60	—	40	152
										Ten-year total	623

[a] Extra year added to course.

Note: To calculate numbers returning to civilian practice deduct 20 percent for career medical officers.

Sources and Size of Errors

We believe it is unlikely that the number of fully qualified physicians graduated will exceed our estimates. The National Defense Medical Center (NDMC) has the capacity to adequately instruct and graduate larger classes, but such expansion will materialize only if the terms of military service are made more attractive to potential students. If the length of required service is lowered to five years, the NDMC could easily increase their graduating classes by 50 percent. As it is, we may be overestimating the number of NDMC graduates available for civilian practice, and 20 percent career officers may be too low an estimate. Over the past ten years the regular army Grade-B graduates made up 25 percent of the total graduates from NDMC.

The dean and faculty of the National Taiwan University (NTU) are most reluctant to expand the size of their classes unless there is a major infusion of developmental funds, as well as a major increase in operating budget. Past experience shows a graduating class of seventy; we used a class size of eighty and run some risk of overestimating future supply. A slight increase in the number of graduates serving Taiwan's health needs could be accomplished by replacing the overseas students by Taiwanese.

With present staffing it is unlikely that the Taipei Medical College or Kaohsiung Medical College could increase their number of graduates much over eighty without seriously jeopardizing the quality of instruction. The average graduating class at Kaohsiung numbers seventy six; we may be slightly overestimating supply by using eighty graduates per year for our projections.

One factor that might lead to increased numbers of graduates is the possible conversion of the herbalist school and the Dental School of Taichung to medical schools. We fear that they might be made medical schools in name only and produce inferior graduates who would downgrade the medical profession in Taiwan and render inadequate care to their patients.

Table 4–4 presents our conservative estimate of the number of graduates over the next twenty years if the past trends continue. For reasons presented in Chapter 11, on alternatives and consequences, we hope that action will be taken to increase the training of doctors.

TABLE 4–4. AVAILABLE MEDICAL GRADUATES, 1963–83

	1963–72	1973–83
NDMC[a]	500	480
Taipei[b]	480	900
NTU[c]	800	800
Kaohsiung[d]	760	800
Total	2,540	2,980

[a] Represents doctors returning to civilian work force, usually after ten years' service. Includes both A and B graduates. Predicted class size of 60 from 1963–72 based on past experience. Corrected for 20 percent who remain as career officers.

[b] 1963–72—6 classes of 80 will graduate; 1973–83, 10 classes estimated size 90.

[c] Class size 80.

[d] Estimated class-size increase from 76 to 80 in second decade.

Physician Deaths, 1964–83

For use in predicting physician survival, age-specific death rates may be estimated by several methods. All of these methods have advantages; all have drawbacks.

The method that potentially is most accurate is: determination of registered physicians deaths by age group over a period of time and calculation of the rates directly from the midperiod census population of physicians in each age group. In countries where

medical associations keep very accurate records of membership and deaths of members, and where essentially all physicians are members of the association or are counted in association statistics, association records offer an alternative source of data for direct calculation of physician death rate.[12] The use of official registration data and medical association data may be combined to secure a more accurate direct determination of physician death rate.[15] This direct method has the drawback of being quite time-consuming if death certificates are not coded with physicians as a separate class. It is doubtful that direct calculation of physician mortality for manpower studies is justified where accurate information is not readily available.

A second alternative is the use of age-specific death rates for the general population, assuming that physician rates approximate general rates. The weakness of this method is that the assumption is a bad one, for physician age-specific death rates are uniformly lower than general population age-specific death rates. In studies as widely separated in time as 1925 and 1951, and as widely separated in space as the United States and Japan, the lower mortality for physicians holds true.

The third alternative, applying a correction factor to general mortality rates, follows logically from the above observation that the rates for physicians are more favorable than those for the general population.

After careful review of available data we decided to collect information on deaths of health workers by age, and compute age-specific, profession-specific death rates. It is generally conceded that death registration in Taiwan, except for the newborn,[9] is quite good. Although some questions may be raised about reported *cause* of death, it is felt that reported *age* at death is sufficiently accurate for calculation of meaningful age-specific death rates. Unfortunately, the occupational breakdown of death statistics does not single out physicians, but it was possible to use the original certificates and make direct calculation of health workers' mortality. To calculate deaths over the period of 1964–73, we applied age-fifty death rates to the physician population age forty-five to fifty-four, age-forty death rates to the population age thirty-five to forty-four, and age-thirty death rates to the age twenty-five to thirty-four. The population age fifty-five to sixty-four will be "effectively retired" and thus should not be subjected to the losses from mortality to avoid double counting. For deaths in

the period 1973–83, we used the same process, after "aging" the groups by ten years, subtracting out the sixty-three to seventy-three deaths, and adding estimated graduates to the twenty-five- to thirty-four-year-old group.

TABLE 4–5. DEATHS OF PHYSICIANS, 1964–73 AND 1974–83

Age	Death rate per 1,000	Doctors	Year 1963	Deaths 1963–73	Doctors	Year 1973	Deaths 1973–83
50	7 × 10 yrs.	(45–54)	1,700	120	(45–54)	1,900	130
40	5 × 10 yrs.	(35–44)	2,000	100	(35–44)	400	20
30	2 × 10 yrs.	(25–34)	400	10	(25–34)	2,500	50
				230			200

The calculations for losses by death could certainly be refined, but as the numbers are small, it is not worth the time.

Migration of Doctors

Despite the high earnings of physicians in Taiwan, relative to other professions, a good Taiwanese doctor can earn twice as much in the United States or Canada. Therefore, many doctors, mostly under age thirty-five, leave for training in the United States. Increased salary may be one reason for their failure to return. In all, seven hundred doctors left Taiwan from 1953–62. In the same period, only four hundred returned. (We have been told that these figures from the Ministry of Interior grossly underestimate the loss. From preliminary information from the American Medical Association, we would suspect that there are more

TABLE 4–6. MIGRATION OF DOCTORS TO THE UNITED STATES

Year:	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62
Under 35										
Out-migration	8	2	36	23	13	21	29	16	10	23
Return migration:	0	1	1	6	0	4	2	2	2	0
Over 35										
Out-migration:	5	3	13	13	17	17	11	11	12	11
Return migration:	0	4	1	5	1	6	8	10	6	12

Taiwanese doctors migrating to the United States. However, other official figures on physician migration are almost nonexistent today.) The loss of doctors by migration is doubly serious as it is primarily younger doctors who do not return. Doctors over thirty-five are more likely to go to Japan and usually return.

Our data show that from thirty to fifty doctors go to Japan each year, but almost as many return. There are only a few doctors going to countries other than Japan and the United States.

Losses of over 160 doctors age twenty-five to thirty-four in the past ten years, from 825 civilian graduates, lead us to estimate future losses of at least 20 percent of Taiwanese graduates over the next twenty years if present policies continue. (Our survey of medical students showed that 30 percent of all students hoped to practice outside Taiwan.)

Retirement

Retirement is usually the greatest source of loss to the medical profession. The age of retirement varies from country to country. In India where the retirement system was designed for the British Colonial Service, retirement is compulsory at age fifty-eight. In Taiwan, by contrast, the age of official retirement was seventy. In private practice, however, where usually one does not retire but "fades away," the setting of a median retirement age is judgmental. To secure expert judgment, we talked with practitioners, medical society officials, and health administrators. The consensus was that the effective retirement age in Taiwan was approximately sixty-five. We know that some private physicians will work beyond the age of sixty-five, while some will retire earlier, and that the "fading away" process is a gradual one continuing over a period of ten years or so.[11]

A study of the decline in productivity of Taiwanese physicians from age fifty to seventy would be interesting and useful for more accurate determination of retirement age.

Summary of Losses

Table 4–7 outlines the major sources of loss to the medical profession over the next two decades. As noted earlier, the greatest loss comes in the second decade from the retirement of a large cohort of doctors.

TABLE 4–7. LOSSES OF DOCTORS, 1964–83

	1964–73	1974–83
Deaths[a]	230	200
Retirement[b]	850	1,630
Migration[c]	500	600
	1,580	2,430

[a] Based on ten-year, age-specific death rate for health workers; for details see text.
[b] Based on *effective* average retirement age of sixty-five; see text (corrected for under-enumeration).
[c] Based on estimated present rates of 20 percent of annual graduates.

The last table in this section shows our final prediction for the number of doctors available in 1973 and in 1983.

TABLE 4–8. TOTAL SUPPLY OF DOCTORS, 1973–83

Present supply	5,300	Supply in 1973	6,260
Graduates 1963–73	2,540	Graduates 1973–83	2,980
	7,840		9,240
Losses 1963–73	1,580	Losses in 1973–83	2,430
Supply in 1973	6,260	Supply in 1983	7,810

HERBALISTS

The Chinese colonization of Formosa was accompanied by the development of a system of traditional Chinese herbalist medicine. This system of traditional Chinese medicine has been described in detail in many other places.[8,10] Briefly, it is based on the circulation of five "elements," similar to the four humours of ancient Greek medicine. The efforts of the Chinese traditional practitioner are to place man in a favorable relation to his environment. The basic aim is said to be prevention rather than cure of disease: a commendable aim, but one which is rarely pursued, as shown by the lack of interest of the Chinese herbalists in sanitation, provision of safe water, or immunizations. Herbalists practiced innoculation with virulent smallpox virus as early as the ninth century, but this can scarcely be called preventive medicine.

The anatomical base for Chinese herbalist medicine has been weak because of the Confucian restrictions against dissection. As late as 1800, Wang Ch'in Ten studied and wrote a treatise on anatomy based on observation of dogs rending exhumed corpses. The herbalist's knowledge of physiology is not much better, as evidenced by bizarre beliefs such as: "The testes generate the marrow. The brain is the ocean into which the marrow runs; the hair is the efflorescence of the brain. When there is lack of brains the hair is deficient." (Wang Ping) As one might expect with the lack of anatomical, pathological, and physiological basis for diagnosis, the diagnostic techniques of traditional herbalist medicine are crude and to a certain extent illogical. Yet withal one has to grant that some herbalists did develop a keen sense of observation.

Therapeutics is certainly the best developed branch of herbalist medicine; for here, by empirical trials through the centuries, a number of useful drugs have been discovered. The best known of these is, of course, ephedrine. There are probably other drugs in the herbalist's armamentarium that have a more rational basis for treatment than the prescription of rhinoceros horn for impotence and tiger bones for rheumatism. Herbalists were familar with beriberi for a thousand years, but the cure and prevention were not discovered until scientific medical investigation was applied to the problem.

In addition to the use of drugs, one of the more picturesque systems of treatment in traditional Chinese medicine is that of acupuncture. This practice is based on the insertion of small needles at precise points in the body to open up alleged channels and thus exert healing effects on given organs. A similar practice, moxibustion, consists of burning small bits of the herb Mugwort at certain spots on the body. The fact that in some cases these treatments might have psychological value or "placebo effect" cannot be disputed.

The development of herbalist medicine in Japan presents an interesting contrast to its development in Taiwan.[1,20] The historical differences are pertinent, as they explain the present place of the herbalist in Taiwan. The attitudes of Japanese colonizers reduced the importance of the herbalist in Taiwan. In Japan, the first recorded visits by teachers of Chinese medicine were in 414 A.D. Scientific medicine was introduced in Japan by the Portuguese in 1542, as a competing element to traditional Chinese medicine,

almost a hundred years before the Dutch colonization and introduction of scientific medicine to Formosa. The ideas of scientific medicine spread slowly in Japan until 1870, seventeen years after Perry's visit, when the scientific system of medicine was adopted in Japan. The development of scientific medicine and the consequent decline of herbalist medicine from this point on was very rapid.[1]

In Formosa, before the arrival of the Dutch, most of the medicine was of a crude, native-healer type with no instruction in even the herbalist system. The brief Dutch occupation had little permanent effect on the teaching or practice of medicine. After the Dutch were expelled by Koxinga in 1662, the Chinese system of education was instituted. A Confucian temple constructed in Tainan in 1666 provided printed prescriptions for worshippers to take to the herb shops. A school, Yung Hua, was opened up in Tainan. Later, other institutions were developed through the seventeenth century in other countries. However, most of the education of the herbalists was not through formal training, but through the reading of Chinese herbal books, apprenticeship to drugstores, or serving as preceptees to practicing Chinese herbalists who had migrated from the mainland. According to I Tu Tei Chi, several herbalists achieved some renown in Formosa as practitioners and teachers.

The effects of missionary medicine upon traditional herbalist medicine during the nineteenth century were slight. It was not until the treaty of Shimonoseki, when Formosa was ceded to Japan, that the traditional herbalist practices started to decline.

On the mainland, after the Communist take-over, traditional herbalist medicine had a period of political ascendancy under the sponsorship of the Communists. Recently, however, even on the mainland, herbalist practices and beliefs are being put to the test of scientific evaluation. The few useful practices are incorporated in the practice of scientific medicine and the great bulk of worthless practices discarded.

At the end of World War II, Tze estimated that there were almost ten times as many herbalists as doctors in China. They were a potent political force. Tze, General Secretary of the Chinese Medical Association, stated the need to "tolerate the existence of such strong vested interests."[18] This pattern did not prevail in Taiwan where there were many more doctors than herbalists. The government thus has no apparent reason for permitting the continuation of a system of inferior medical care.

Numbers and Characteristics of Herbalists

Records in the health section of the Ministry of Interior show that there are 2,373 herbalists practicing in Taiwan. Provincial Health Department registers show 1,464, while our health manpower census turned up 1,504 herbalists. These 1,504 herbalists take care of some fifteen million patient visits annually. Unless there is serious underestimation, this would mean that the average practitioner was quite busy, seeing about thirty patients per day. However, most of these patients are the older, the poorer, and the less well-educated members of the population. It is likely that the demand for herbalist visits will drop off as education spreads and the older, more conservative members of the society die off. Also, as per capita income increases the lower fees of the herbalists will no longer serve as a major attraction.

The herbalists are not really serving the rural population as some authorities in Taiwan believe. Our census figures show that there are 4,200 people to every herbalist in the cities and more than double this number, 9,700, to every herbalist in the counties. In reality, the picture is somewhat worse than this, for within the countries the herbalists are generally concentrated in the major towns. Our household survey showed that usually it was quicker for a rural dweller to travel to a physician's office than to a herbalist's office.

The herbalists do not in any way serve as a bulwark to the official health services. Almost all of them are in private practice. All but nineteen are self-employed.

Review of our census figures on age of herbalists shows an even greater concentration in the older age-groups than is found among physicians. Table 4–9 clearly shows the pattern of aging without replacement. In the case of the herbalists, this probably is more a solution than a problem. As the herbalists die off, so will the demand for herbalists.

TABLE 4–9. AGE DISTRIBUTION OF HERBALISTS

Age	20–34	35–44	45–54	55–64	65–74	75+
Number	6	106	524	567	251	50
Percent	—	7	35	38	17	3

Sources of Education

At the time of our study, the herbalist school, the "China Medical College," had not yet graduated its first class. During the past ten years, approximately seventy-two herbalists have been licensed annually by the Ministry of Interior. On what basis were these herbalists licensed? Possibly, some of them had received training on the mainland, although the bulk of the professionals coming from the mainland had been registered by 1953. In addition, less than 20 percent of all herbalists are mainland-trained. One of our consultants explained this curious paradox by saying that herbalists could be given licenses after demonstrating the requisite number of years of satisfactory practice. We are told that the government no longer permits this practice. The 250 mainland-trained herbalists are concentrated in the cities, mainly Keelung and Taipei. This conforms to the concentration of mainlanders in the general population.

Unfortunately, we were unable to visit the "China Medical College" in Taichung during our study, as the Dean was in jail. However, his associates did send in a partially completed questionnaire with information about the school. The first class was matriculated in 1958 with 214 students in herbalist medicine, and 118 students in herbalist pharmacy. During the second year of operation, the numbers admitted dropped to sixty-seven in herbalist medicine and twenty-nine in herbalist pharmacy. In addition, there were 196 drop-outs from the first year's class for various reasons. We were told that the Dean had been sent to jail for accepting unqualified students, merely to permit them to be deferred from the draft. In 1961, to take care of a student body of 325, there were thirty-one full-time faculty, including teaching assistants. However, informants told us that the definition of "full-time" at the "China Medical College" was remarkably flexible. As might be expected, there is a slightly higher proportion of mainlanders attending the herbalist schools than attending the medical schools. This is probably due to the stronger herbalist tradition among the mainland Chinese than among the Taiwanese. There is also a much lower proportion of females in the herbalist school than in the real medical schools. This is in keeping with our observation that herbalist medicine is primarily a male profession.

The annual tuition fee and charges at the herbalist school are

almost as much as the highest medical college tuition, despite the infinitely higher expenses in maintaining a medical college's modern basic science laboratories and teaching hospitals. Perhaps this fact alone best explains the motives behind the initiation of an herbalist school in Taiwan today.

The course of study lasts four years and includes instruction in such subjects as moxibustion and acupuncture. The value that students in the school place on these ancient disciplines is shown by the recent demonstrations staged to have the school converted to a modern medical school. In summary, herbalists are less well-educated than doctors, less esteemed, and less able to improve the health of the Taiwanese people.

Conclusions

By 1973 Taiwan will have lost roughly 450 herbalists by death and retirement. For potential replacements, we can look to two sources. First, if licensing for "years of experience" continues at the same rate as the past five years, we can expect some 500 new herbalists, more than enough to make up the deficit of retiring herbalists. However, Taiwanese officials state that the numbers of herbalists licensed for experience will decrease. The second source may be graduates from the herbalist school. These would be produced probably at the rate of seventy-five per year, certainly enough to flood the market for herbalists. However, we recently learned that the Ministry of Education is considering the questionable step of permitting the "China Medical College" herbalist school to grant medical degrees. If this action stands, we could anticipate essentially no herbalists, as such, being graduated from the school, as students overwhelmingly prefer careers in modern medicine. A preferable action might be to curtail completely the licensing for years of practice and to restrict the enrollment to the herbalist school to less than fifty students per year.

"Quacks"—Unlicensed Practitioners

"Quacks" is the best translation of the Chinese word used to describe unlicensed or illegal practitioners. Such persons supply a surprisingly high proportion of the medical care of Taiwan. They account for some 4.5 million patient-visits annually, more than the number of visits to Taiwanese dentists. The pattern of unlicensed practitioners practicing illegally, but openly, is not unique to Taiwan. In New York State, where chiropractors are not

licensed, they "offered medical advice" and accepted "contributions to the chiropractic movement." On a per capita basis, there are as many chiropractors, naturopaths, and similar charlatans in the United States as there are quacks in Taiwan.

Unlicensed practitioners in Taiwan prey primarily on the uneducated. The uneducated account for thirty times as many visits as the educated. (Even on a per capita basis, the uneducated still invest ten times as much as the educated for the services of quack doctors.) Who are these quacks? Where do they practice? What is their background?

Characteristics and Numbers

In our health professional census we did not measure the attributes of the unlicensed practitioners in detail, for we did not realize how much of the private sector medical care they supplied. However, our figures do show that there were about 2,400 unlicensed quack doctors in Taiwan in 1963. These were divided into two groups: the so-called "professional" group that made a career out of their practice, and the "subsidiary" group who had their practice as a side line. On the average, the quack doctor would see less than six persons per day. Obviously, some of these quacks must have a practice that is very much a part-time endeavor. The unlicensed doctors are concentrated in the rural hsien where there is one for every 4,300 people. In the cities, possibly due to greater competition from real doctors, there is only one quack to every 7,000 persons.

In addition to the unlicensed doctors, there are also "quack herbalists" (probably a redundant term). Of these, some 300 are in full-time practice and 920 in subsidiary practice. Again, the quack herbalists show a predilection for the rural areas. Insofar as we are aware, all of these persons work in the private sector.

Where do the unlicensed practitioners prepare for the "profession"? Some are medical and pharmacy school drop-outs. Others are ex-hospital employees or ex-army medics, and, at the bottom of the barrel, there are said to be those who merely have an inclination to practice the "healing arts."

Conclusions

What actions should the government take in regard to this anomalous group of unlicensed practitioners? Apparently, strict and comprehensive enforcement of the licensing law is not possible.

We know of no country where the quack has been completely eradicated. It is very likely that a more adequate supply of real doctors would decrease the number of unlicensed practitioners through competition. As the well-educated make up a higher and higher percentage of the population in the coming years, the demand for the quacks will be replaced by a demand for real doctors. The government should prepare for this shift of demand by making sure that there are enough real doctors.

The difference in average price for a visit to the quack (29 NT$) as compared to the medical doctor's average fee (37 NT$) is probably enough to influence some of the poorer and less well-educated people to continue to use the services of unlicensed practitioners.

Quacks have not been burdened by a long, expensive (in terms of foregone income) education. The government should impose heavy and repeated fines on illegal practitioners. In this way the government could get additional revenue, make unauthorized practice less profitable, and fulfill its duty of protecting the public from untrained charlatans.

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CHAPTER 5

NURSES AND MIDWIVES

THE roles of the nurse and the midwife are different in Taiwan. However, much of their training is the same. There is a recognized professional category of nurse-midwife qualified to do both jobs. Both professions recruit from the same pool of girls interested in a health career. For these reasons we have combined the description of these two professionals in one chapter.

THE TAIWANESE NURSE

The shortage of nurses in Taiwan is more acute than the shortage of physicians. There is only one nurse for 5,600 people—less than in Thailand, Malaysia, Singapore, Hong Kong, and the Philippines. Not only is there an over-all shortage of nurses but there is also a serious imbalance in the ratio of trained professional nurses to physicians. Currently, there are more than twice as many physicians as qualified nurses in Taiwan. As a result, physicians perform inappropriate tasks better delegated to trained nurses, and untrained nurses' aides assume responsibilities for which they are not qualified. We suggest that all readers read the sections on nursing, as they have direct bearing on the problem of physician supply and demand.

Nursing has never been a high-prestige occupation in Taiwan. There is no strong, popular "Florence Nightingale" tradition. This lack of prestige can be traced to the period of Japanese occupation, for in mainland China nurses had much higher status. Attitudes formed during fifty years of Japanese occupation are the source of many of the problems in nursing in Taiwan today.

Fortunately, this is a dynamic situation. The massive influx of mainland Chinese with their high regard for the nursing profession, the opening of university nursing schools, the technical as-

sistance and advanced nursing training given by WHO and AID and their predecessor agencies, having all had their effects. We have seen changes occurring during the short time of our survey. For example, the number of applicants for nursing schools dramatically increased from 1962 to 1964. In the space of a few years this new interest in nursing may well obviate some of the problems discussed in this chapter.

Nursing Schools

At present, there are six types of nursing courses: (1) A four-year collegiate B.S. in nursing is given at the National Taiwan University (NTU) and the National Defense Medical Center (NDMC) for high school graduates. (2) There are three-year vocational courses in Tainan, NDMC, and the new school in Kaohsiung. (3) The Pingtung (nurse-midwife) and the Taichung schools now have a four-year vocational course. (4) The vocational (nurse-midwife) course in Taipei has been increased to five years. (All of these vocational courses admit students after three years of junior high school.) (5) The Taipei Nursing Junior College has a three-year course open to senior high school graduates. (6) Mission hospitals supply a small part of the total nurses trained, but do not qualify them for registration.

After the retrocession, the first nursing school was opened in Taipei in 1947; the other schools all opened in the 1950s. The level of training in the collegiate nursing schools is probably equivalent to that of collegiate nursing schools in the United States, as the prerequisites are the same and the curricula are similar except for local adaptation. The Taipei school's three-year senior high graduate program is similar to American hospital school courses. However, the other vocational nursing courses really cannot be compared to the R.N. hospital training courses in the United States because the Taiwanese educational prerequisites for entrance are considerably lower. Perhaps these could be compared to the new two-year "community nurse training programs" in the United States. In several of the training institutions there are opportunities for combined courses in nursing and midwifery which will be discussed in greater detail under the section on the midwife.

There were four missionary hospital nursing schools in Tainan when we were there.[7] The two that we visited differed considerably in terms of the academic training available to the nursing students.

One of these, the Seventh Day Adventist Hospital Nursing School, is probably good enough to meet the Department of Education standards, but we question the quality of classroom teaching in the other school. The Seventh Day Adventist school is interested in setting up a Bachelor of Science in Nursing program, in conjunction with its undergraduate school. With official governmental recognition, such a program would be of great benefit to nursing in Taiwan. We find it difficult to understand the failure of missionary nursing schools to meet the certification requirements of the Chinese government. At the present time, their graduates cannot register as approved nurses for work anywhere else on the island. Possibly their motive is to close the doors to alternate employment for the nurses that they train, thereby assuring themselves of an abundant supply of nurses. This situation, if true, presents a sharp contrast to the heritage from the church mission nursing schools of mainland China. Those missions can truly be said to have given birth to the professional nursing movement in China.

The tuition in the various nursing schools varies considerably. The National Taiwan University College of Nursing has an annual tuition of 1,400 NT$ (40 NT$ = $1 U.S.). This is as high as the tuition at its medical college, despite the fact that medical education is much more expensive. Tuition fees should be rationalized by raising tuition in the medical college rather than lowering it in the nursing college.

The other vocational nursing schools charge amounts ranging from 1,200 to 3,000 NT$ per year. In contrast to the fees charged by the government institutions, the proposed Seventh Day Adventist course anticipates a tuition of approximately 6,000 NT$ per year, which nearly covers the cost of training. Working trainees would be partially reimbursed.[1]

Employment Opportunities

As may be expected, the great majority of Taiwanese nurses practice in a hospital setting. Almost four-fifths of all of the 1,400 nurses in our census were working in hospitals. Another 11 percent worked in official health units throughout the island. An extremely small number were employed in physicians' offices. A nursing education expert suggested that this was because Taiwanese private practitioners consider nurses to be servants rather than professional assistants. Another nursing school official

commented that although recent medical graduates might regard nurses as confreres rather than servants, exposure to older physicians often changed their attitude.

It is said that a number of nurses leave the practice of nursing to take up other jobs which pay approximately as well as nursing. A study done in the Taipei School College of Nursing showed that 9 percent leave clinical nursing to teach nursing in high school. Other findings are given in Table 5–1.

TABLE 5–1. STUDY OF GRADUATES (1956–62) JUNIOR COLLEGE OF NURSING (by Miss A. C. Hsu)

		Number	Percent
Still in nursing	Public hospital	104	35
	Industry, private hospital, and clinics	32	11
	Health agency	27	9
	Teaching nursing	32	11
	Subtotal	195	66
Not actively nursing	Study in United States	39	13
	Midwifery	8	3
	Teaching nursing in high school[a]	34	11
	Housewife	21	7
	No information	1	<1
	Subtotal	103	34
	GRAND TOTAL	298	100

[a] By our definition a nurse teaching nursing in secondary school is not available for the clinical practice of nursing.

As expected, there are higher percentages of early graduates "lost to nursing" by marriage and study abroad than of recent graduates. Ministry of Interior statistics indicate that only half of the nurses working and purportedly studying in the United States will return to practice in Taiwan. The above data suggest that approximately 30 percent of each year's nursing graduates will be lost to the profession within three years of graduation. This agrees closely with the figure of 35 percent loss over a similar period from our own nursing study survey. The higher estimate of total losses to the nursing profession is probably more realistic than Miss Hsu's estimate based on experience in one school.

Distribution and Numbers

The Ministry of Interior Register for 1962 shows 2,760 nurses, the Provincial Health Department lists 1,395 (reflecting active nurses) and our census located 1,393 nurses. Since our census did not include Penghu (45 nurses), and may have missed a few nurses in private doctors' offices, we estimate that there are 1,500 working nurses in Taiwan. The distribution data is based on our census and totals should be revised upward.

Sixty-one percent of all nurses work in urban areas. This is quite different from the pattern of physician distribution because nurses are primarily employed in the larger hospitals, located in urban areas.

Since nurses' training was greatly augmented after retrocession, we find that the age pyramid of nurses is inverted in comparison to that of the physicians, i.e., there are more in the younger age groups.

TABLE 5–2. AGE DISTRIBUTION OF NURSES

Age	Census count
15 to 24	436[a]
25 to 34	492
35 to 44	386
45 to 54	71
55 to 64	8
	1,393

[a] This group is underrepresented as a ten-year cohort, as there are few nurses under age eighteen.

Table 5–2 shows quite clearly the increasing numbers being trained each year. The table suggests the question: "Where were the graduates in the thirty-five- to forty-four-year age group trained?" for they could not have been educated in the schools founded since the retrocession. Some were qualified by "examination," a few were trained in Japan, others came from the mainland, and the rest were trained in the Japanese hospital schools that were expanded to meet World War II demands. Less than one percent of Taiwanese nurses are males. Thus, nursing is as exclusively a female profession as in the United States. Many more mainlanders are enrolled in Taiwanese nursing institutions than

one would anticipate from their numbers in the general population. In the vocational nurse course at the National Defense Medical Center, 90 percent of all students come from families from mainland China. Percentages are smaller in the other schools but reflect the higher status of nurses among mainlanders.

Income Levels and Prestige

The average base pay of the nurse ranges from 290 NT$ per month in health stations, to 340 NT$ per month in the Provincial Health Department. Salary figures in Taiwan must be corrected by emoluments such as a "rice allotment," "oil allotment," and similar benefits. The average nurse's compensation ranges from 1,000 to 1,100 NT$ per month.[3] These official pay scales are surprisingly close to the scales for physicians (1,290–1,410 NT$ total compensation). Our nursing-student survey showed that most nursing students have realistic expectations of future salary. In a subsequent chapter there is a brief discussion of the potential effect of salary change on the supply of nurses, and the question: "Is improved quality of care worth the cost of replacing untrained nurses' aides by trained nurses?"

Our student survey confirmed the general belief that the nurse is ranked below the dentist and pharmacist in status. Nursing students seemed convinced that the public rates both nurses and midwives considerably higher than school teachers, government employees, and typists. It is fortunate that the student nurses think well of their own profession; consequently they will serve as better recruiters for future student nurses.

THE TAIWANESE MIDWIFE

Every year 150,000 Taiwanese women deliver without assistance from trained health workers. Another 200,000 deliveries are made by midwives. Our study shows that the number of midwives entering the profession not only fails to keep pace with the increase of population, but even fails to replace the retiring midwives. These facts give urgency to planning for better maternal care in the future.

There are more midwives than nurses registered in Taiwan. However, many of the midwives are inactive, or are working as nurses. The change of profession occurs despite the higher prestige of midwifery, as *young* graduate midwives are not fully accepted

by communities and are thus forced to turn to nursing as a career. The solution of nursing shortages may also ease the midwife shortage, for as qualified nurses fill hospital jobs the older midwives may go out and practice midwifery.

Training of Midwives

During the fifty years of Japanese occupation, some 800 midwives took the two-year training course in the provincial hospitals. Another 200 Taiwanese midwives were trained in Japan. Since the retrocession there have been two paths of study a girl could follow to become a midwife. The first is formal schooling. At the time of our study, there were four schools teaching midwifery. Two of these, a private school in Pingtung and a government school in Taichung, gave a three-year vocational midwife course. The Taipei and Tainan vocational nursing schools give one-year postgraduate courses in midwifery for graduate nurses. The basic prerequisite for entrance to the vocational schools is graduation from junior middle school (age 14–15). Thus the average nurse-midwife may be as young as eighteen, and the average midwife may be seventeen when she graduates. Quite naturally this gives rise to problems of placement, as the public is somewhat reluctant to place its confidence in such young girls. This placement problem is reflected in the findings of Peng and Huang[6] that only one-quarter of the 177 recent graduates from the Taichung midwife course were actually practicing midwifery. The educational system of Taiwan can ill-afford wastage of this magnitude.

The Pingtung Midwifery School is an interesting example of free enterprise in the field of health training. The director is a retired air force physician with no previous experience in educational administration. He built classrooms and started classes in 1957. When we visited the Pingtung school in 1962 it was apparent that needed expenditures had been made to develop a good school. The director seemed deeply concerned with the problems of providing trained midwives to serve the women of Taiwan. He recognized the problems of the young graduates trying to enter private practice initially and planned to switch to a nurse-midwife curriculum.

The school in Taichung has trained approximately thirty students per year for practice in the remote areas. In 1964 this course was discontinued. Authorities now plan for graduation of eighty nurse-midwives per year.

The Tainan school has never been large, averaging only fourteen graduates per year from the one-year midwifery program. It is likely that even this small training program will be curtailed.

In the Taipei Vocational School there have been three midwife courses: A one-year course for graduate nurses, a four-year nurse-midwife course, and a three-year midwife course. The three-year course was discontinued before 1950.

In the past there was a second way to qualify as a midwife, simply by examination. It has been said that these examinations, given just after the retrocession, were no real test of knowledge of midwifery and that occasionally they served only to change the official designation of unqualified birth attendant to midwife. Now qualification by examination is difficult and uncommon.

In addition to the formal academic midwifery courses there are special courses given by the Maternal and Child Health Institute (MCH). These courses run for a month. The curriculum is concise, well-planned, and intensely practical. The students taking this course must be literate, but need not be junior secondary school graduates. Most of the students are drawn from the ranks of the less well-qualified birth attendants. Thorough geographic coverage of the island is attained by taking the course to the students rather than bringing the students to the course; courses have been held in each of the twenty-two local health districts of Taiwan. By 1961, sixty-four courses had been completed with 1,100 graduates.

Numbers and Distribution of Midwives

There were 3,781 midwives registered by the Ministry of the Interior in 1963. This is an overestimate of active midwives, as the Public Health Administration register had only 2,080 in 1963 and our census located only 2,037 *active* midwives. In a study done in 1960 Peng reports that 704 registered midwives were not working.

TABLE 5-3. DISTRIBUTION OF MIDWIVES BY TYPE OF PRACTICE

	PHD–JHU census	Peng–Huang study
Private practice	1,370	1,350
Health centers	471	554
Not in midwifery	196	378

Of our 2,037 registered midwives: 1,370 were in private practice, 471 were in health centers, and 196 (almost 10 percent) were in hospitals and other health work. Peng's study showed an even greater percentage (nearly 20 percent) of registered midwives not practicing midwifery. As noted earlier, the bulk of those in hospitals and "other health work" were fully trained midwives. Indeed only one-quarter of the recently graduated midwives, and one-tenth of the nurse-midwives, actually practice midwifery. There are about 1,700 midwives actually delivering babies. This gives rise to a figure of 124 deliveries per active midwife, with roughly equivalent loads for the private-practice and health-center midwife.

In terms of geographical distribution, two-fifths of the private-practice midwives are in the five major cities where only one-fifth of the births occur. This imbalance is not as bad as in many countries; in fact, there is better distribution of midwives than of any other health workers. Furthermore, the midwives of the cities attend cases in the adjacent rural areas.

TABLE 5–4. DISTRIBUTION OF MIDWIVES BY PLACE OF PRACTICE

	Total	Private practice	Health center
Counties	1,314	837	393
Major cities	723	533	78

Table 5–4 demonstrates the effect of the Provincial Health Department's excellent program to make maternal health services available to the rural women of Taiwan.

In reviewing the age distribution of midwives, we find a rather disturbing pattern of aging without replacement. In 1961 over 40 percent of active midwives were age forty-five or older, while less than 10 percent were under thirty-four years of age (in 1958 27 percent were under thirty-five years of age). This age distribution, coupled with the fact that most midwives do not continue work after age fifty-four, makes it appear that there is not an adequate cohort of midwives to replace those in the working age group. There are several explanations for this. One is the high percentage of young, recently graduated midwives who are not practicing their profession. A second is the possibility that the "examination" midwives did not stand for examination until they were past thirty-four.

TABLE 5-5. AGE DISTRIBUTION OF MIDWIVES

Age group	15–24	25–34	35–44	45–54	55–64	65+
Number	102	99	886	668	211	51

Table 5–5 clearly shows the pattern of aging without replacement. The next section of this chapter shows some of the consequences of this problem.

FUTURE SUPPLY OF NURSES, NURSE-MIDWIVES, AND MIDWIVES

Girls trained as midwives are working as nurses in the hospitals of Taiwan. Some graduate nurses, with additional training, now work as midwives. The nurse-midwife training programs turn out graduates who can work in either profession. For those reasons we combine the three professions for our ten- and twenty-year projections. We then make estimates of the numbers who will ultimately work in nursing and in midwifery.

Additions

There is only one significant way that the supply of nurses and midwives in Taiwan will be augmented—through training. Although there were relatively large numbers of nurses migrating to Taiwan at the time of the Communist takeover of the mainland, it is highly unlikely that there will be any appreciable immigration over the course of the next ten years. Indeed, as we will see later, migration represents a loss rather than an addition to the nurse and midwife supply. In some countries, large numbers of married nurses return to practice after their children are self-sufficient.[4,6] We do not anticipate this in Taiwan, for the simple reason that, in the past, large numbers of nurses did not leave the profession to raise their families. The usual pattern has been to combine a career with raising a family.

The number of nurses and midwives trained each year presents a rapidly changing picture. In 1962, when we started our study, data from previous years' graduating classes would have indicated a total number of three to four hundred graduates each year for the coming ten years.

However, in 1964, Miss Hsu, the dean of the Taipei Nursing College, assured us that there were 600 first-year students enrolled in nursing schools throughout the island. She predicted that the drop-out rate would not be over 10 percent during their course of study. Miss Hsu's figures for new enrollment are shown in Table 5–6.

TABLE 5–6. ENROLLMENT OF NURSES, NURSE-MIDWIVES, AND MIDWIVES (Entering class 1963)

	Collegiate training		Junior college	Vocational				
	NTU	NDMC	Taipei	Taipei	Tainan	Tai-chung	NDMC	Ping-tung
Nurses & nurse-midwives	30	80	80	80	70	80	80	100[a]
Midwives	—	—	—	40	—	40	—	—

[a] The Director indicated that students from 1963 on would be qualified as nurse-midwives rather than midwives.

The difference between the number of graduates in 1962 and entering students in 1964 reflects recent increased enrollment rather than high drop-out rates (except for collegiate training courses).

A study of previous years' graduating classes shows a dropout rate of something less than 10 percent over the three years of nursing study, on an island-wide basis. The drop-out rate is unfortunately much higher in the collegiate nursing program. A five-year average for the program at NDMC shows a drop-out rate of 40 percent over the four years of the collegiate nursing program. The estimated drop-out rate for NTU collegiate nursing is also 40 percent. Table 5–7 may be a slight overestimate of graduates, as there may be double counting of nurses who graduated as nurses in the early years and then graduated again as midwives after a one year qualifying course (about twenty-five per year). This overestimate is offset by the military nurses who return to civilian practice. The table gives a five-year record of graduates from the nursing and midwifery schools and furnishes our basis for estimating the continued increase of numbers of students.

TABLE 5–7. NURSING AND MIDWIFERY GRADUATES, 1958–62[a]

	1958	1959	1960	1961	1962
Nurses					
NTU Collegiate	—	—	19	15	17
Taipei Junior College	41	41	41	39	63
Taichung Vocational Nursing	48	36	47	44	40
Tainan Vocational Nursing	31	30	24	31	52
NTU Hospital	46	21	—	—	—
Subtotal	166	128	131	129	172
Nurse-Midwives					
Taipei Vocational	56	58	59	95	63
Midwives					
Tainan Vocational	31	8	14	12	15
Taipei Vocational (1-year course for nurses)	28	30	21	15	24
Taichung Vocational (being changed to nurse-midwife)	—	38	37	40	29
Pingtung Vocational[b]	—	—	96	79	84[b]
Subtotal	59	76	168	146	152
Total	281	262	358	370	387

[a] Does not include 46 collegiate and 253 vocational NDMC-trained nurses, as they are expected to remain with the military.
[b] Director plans to convert to nurse-midwife course.

Making allowances for the trend of increasing numbers of graduates, our estimate of the total number of nurses graduated in the decade 1962–72 is 3,900. In the period 1972–82 total graduates will increase to 5,800. We feel that these figures are realistic as there are already two new nursing schools under serious discussion. These proposed schools will probably contribute graduates to the total pool of nurses.

The projections in Table 5–8 reflect our optimism that present trends of increasing nurse and midwife training will continue. This is by no means automatic as pointed out in Chapter 11, on alternatives and consequences.*

* We just learned that eight additional nursing schools have opened in Taiwan. Their probable output will be 1,400 by 1974 and an additional 2,000 by 1984.

TABLE 5-8. CIVILIAN NURSES GRADUATING, 1963-83

	1963-73	1973-83
University nurses[a]	180	180
Nurses & nurse-midwives[b]	3,900	5,800
Midwives[c]	720	720

[a] Assume entering class of 30 with 40 percent drop-out, based on experience.
[b] Based on students now enrolled, 8 percent drop-out rates, and estimated increase of 100 new students every five years based on past experience. At present time nurses make up 55 percent and nurse-midwife 45 percent of the total.
[c] Based on estimate of entering classes of 40 at Taipei and Taichung Vocational. Assume increase of midwifery training will be primarily nurse-midwives.

Losses

The losses by excess migration (the excess of nurses migrating away from Taiwan each year over those returning) are substantial. We have no reason to believe that these losses will decrease unless regulations are effected to limit the opportunities for skilled and essential professionals leaving Taiwan.

TABLE 5-9. MIGRATION OF NURSES, 1953-62

Year:	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62
Out migration	3	2	22	19	19	28	33	28	32	31
Return migration	—	4	—	3	16	3	7	5	7	5
Average loss per year (10-year period)	*17*									
Average loss per year (last 5 years)	*25*									

Comparing the average yearly loss, from Table 5-9, with the average number of nursing and midwifery graduates per year, we find the loss rate slightly over 8 percent. Informants tell us that the Ministry of Interior figures represent only a small proportion of the number of nurses migrating from Taiwan. (As mentioned earlier, Miss Hsu's study shows that 13 percent of college of nursing graduates migrate within three years.) Our figures indicate that 80 percent of these nurses go to the United States, 10 percent to Japan, and 10 percent to all other countries. As might be expected, approximately four-fifths of the migrating nurses are under thirty-five years of age, representing a greater aggregate of years of work lost by Taiwan. Recent reports from Taiwan indicate that nurse emigration is increasing.

We have no direct figures on midwife migration, but assume that it would be much less than nurse migration, as there is very little demand for midwives in the United States and Canada, the countries receiving most Taiwanese medical migrants.

In addition to the losses by migration, nurses and midwives will be lost by death. By applying an age-specific death rate for professionals, we find that over the next ten years there will be few nurses lost in this manner, primarily due to the preponderance of nurses in the younger age groups. Although the midwives will have proportionately greater losses from death, due to the larger numbers of older women, death will be less important than retirement as a cause of loss of midwives.

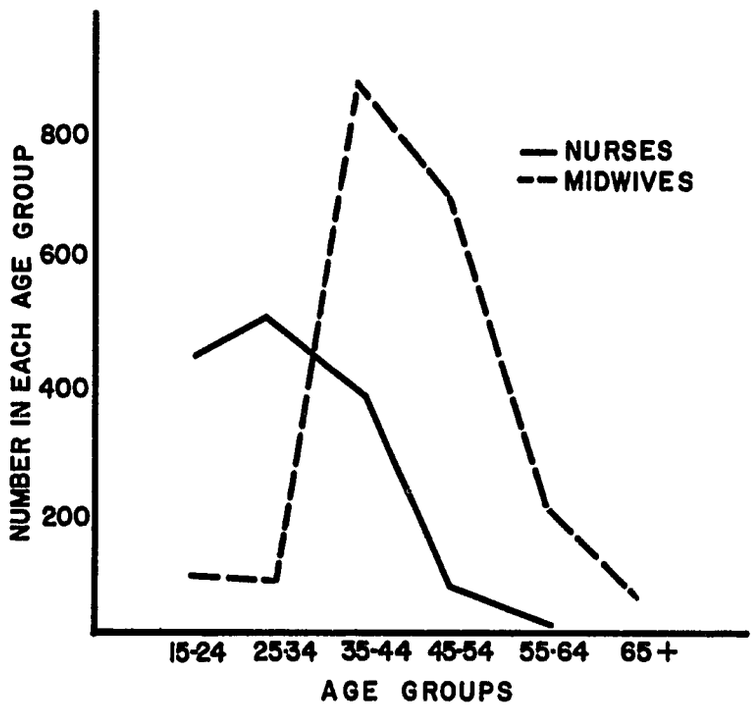

Figure 5–1. Age Distribution—Nurses and Midwives.

Although the government age for retirement is seventy years, in practice we have been told that the limiting age for retirement of nurses is in the neighborhood of sixty-five years. For midwives, as in the case of private-practice doctors, retirement is gradual, with some slowing down before sixty-five and a few midwives working beyond this age. We have accepted age sixty-five as the limiting retirement age as a basis for our calculations. Further studies to determine limiting retirement age more accurately would be useful. To estimate numbers of nurses leaving the profession we use the figure of 18 percent derived from special studies of college of nursing graduates. Data from the Maternal and Child Health Institute indicate that over 60 percent of newly graduating midwives leave the profession. We have assumed that this rate will decrease over the next decade and use a rate of 60 percent loss from 1963–73 and 50 percent from 1973–83. Since many midwives leave their profession for nursing, we must make corrections in our final estimates. Table 5–10 summarizes losses to the nursing and midwifery professions.

Table 5–11 gives our final estimate of the supply of nurses and midwives available in 1973 and 1983, if present trends continue.

TABLE 5–10. LOSSES OF NURSES AND MIDWIVES

(to nearest 10)

	1963–73		1973–83	
	Nurses & nurse-midwives	Midwives	Nurses & nurse-midwives	Midwives
Migration[a]	300	—	460	—
Deaths[b]	30	100	40	80
Retirement[c]	10	210	70	640
Leaving profession within 3 years[d]	700	430	1,040	360
Total losses	1,040	740	1,610	1,080

[a] Eight percent of each year's graduates based on Ministry of Interior data (none for midwives).

[b] Based on health worker age-specific death rates for each cohort.

[c] Based on "effective" retirement age of sixty-five.

[d] Based on Miss Hsu's findings of 18 percent of nurses leaving profession within three years and estimate of 60 percent of midwife graduates leaving profession 1963–73, and 50 percent 1973–83.

Of the total of nurses, we estimate that about half would be available for midwifery work as they have been trained as nurse-midwives or as midwives. We discuss this further in Chapter 11, comparing supply and demand.

TABLE 5-11. PROJECTED NUMBER NURSES AND MIDWIVES 1973 AND 1983 (to nearest 100)

	1973		1983	
	Nurses & nurse-midwives	Midwives	Nurses & nurse-midwives	Midwives
Number at start of period	1,500	2,000	5,000	2,000
Estimate of graduates	4,100	700	6,000	700
Midwives working as nurses[a]	400	—	300	—
Losses	−1,000	−700	−1,600	−1,100
Total	5,000	2,000	9,700	1,600

[a] Fifty percent of midwifery graduates 1963–73, 40 percent 1973–83.

In terms of total numbers trained, we predict a major increase, probably more than enough to meet the rising demands. Although there are not enough nurses in Taiwan for efficient staffing of hospitals, health centers, and doctors' offices, there is some doubt that the country is ready to pay enough to employ adequate numbers of nurses.

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CHAPTER 6

DENTISTS AND PHARMACISTS

THE DENTISTS

AN eminent dental educator has characterized Taiwanese dentistry as generally low in quality—a commercial enterprise rather than a professional activity.

We find no reason to disagree with his opinion of the quality of dental practice. Yet, even as a commercial undertaking, dentistry must be a failure for many of its practitioners. The average gross monthly income for dental practitioners is less than 3,100 NT$ (40 NT$ = $1 U.S.)—only one-tenth the income of the average physician. This income level may be adequate to attract unlicensed, untrained practitioners to the field, but it fails to attract adequate numbers of students to dental school. Today there are less than five fully qualified dentists per 100,000 population in Taiwan as compared to 36 per 100,000 in Japan and 45 per 100,000 in the United States.[1] Thus Taiwan is faced with an insufficient number of dentists to "meet the need" for dental care; at the same time, there appears to be an insufficient economic demand from the people to support adequately the trained dentists now available. This paradox is discussed in Chapter 11.

Our census lists 760 active practitioners of dentistry and 213 dental assistants. In reality, these dental assistants are primarily independent practitioners, assisting no one but themselves.

Table 6–1 shows that there are more unlicensed, untrained dentists than trained dentists working in Taiwan. The majority of dental care in Taiwan is rendered by practitioners who are little more than empiric tooth pullers. The qualifications of these unlicensed dentists are unbelievably poor. One of the busiest practitioners is a former dressmaker who started dentistry with no

TABLE 6-1. DENTAL PRACTITIONERS IN TAIWAN

	PHD Register	PHD/JHU Census
Dentists	804	760
Dental assistants	232	213
Unlicensed dentists		543
Unlicensed dental assistants		274
		1,790

additional training. It is said that the quality of practice of even trained dentists has deteriorated as a result of the lack of enforcement of standards and of licensing laws.

About 60 percent of the dentists are in rural areas serving 80 percent of the population. This ratio is even more favorable than the distribution of physicians. As might be expected, there are higher percentages of dental assistants and unregistered dentists in rural areas. However, if one may predict from our student attitude survey, the rural-urban imbalance will worsen progressively. Only 18 percent of all students surveyed indicated that they would be willing to work in rural areas.

The majority of dentists are in private practice. Less than 10 percent work in institutional settings such as hospitals and health centers. Dentistry in Taiwan is primarily a male occupation; only slightly over one-tenth of the licensed dentists in Taiwan are women. There are few dentists in the younger age groups.

TABLE 6-2. LICENSED DENTISTS BY AGE

Age	Number
25-34	10
35-44	234
45-54	358
55-64	143
65+	15
	760

This marked deficiency in the 25-35-year age group can be explained by the failure to reestablish dental training institutions before 1956. There was a hiatus of almost ten years when no stu-

dents were graduated. The serious implications of this manpower gap should be obvious.

In summary, dentistry has neither the financial rewards nor the high prestige of medicine. The profession is faced with a shortage of qualified dentists and a plethora of untrained quacks.

Dental Education

Today, university-level training for dentists in Taiwan is comparable to that of other places requiring five or six years of work after graduation from high school. However, the majority of dentists practicing in Taiwan were not trained under this system. The past two graduating classes from National Taiwan University Dental School have a total of only eleven students! Of the 800 dentists registered in Taiwan, experts estimate that not more than 400 have received full, university-level dental education.

Enrollment in dental colleges is characterized by a very high attrition rate, revealing the tendency of students to leave dental school whenever vacancies occur in medical schools. Transfers are possible, as the first two pre-clinical years are essentially the same in both medical and dental schools. An example of the high attrition is the 75 percent cumulative drop-out rate in the 1962 graduating class at National Taiwan University (NTU). Other schools have even higher rates.

The NTU Dental School is well-equipped by standards of the region, and has a competent staff. It is overcrowded. One frequently voiced opinion is that NTU and NDMC have the only real dental schools in Taiwan. At NTU there are, in addition to the part-time or additional staff, two full-time clinical faculty members at the professorial level and three at the instructor-teaching-assistant level. In addition, university basic science faculty members carry a large part of the teaching load for the dental school. Since its opening in 1955, the NTU Dental School has had an average entering class of twenty, but the first two classes graduated only five and six students. If the NTU Dental School is to approach the goal of replacing dentists now being lost by death and retirement it must drastically increase the number of graduates.

The newly started Chungshan Dental College reported twenty-five full-time and eighteen part-time faculty. The accuracy of this figure was questioned by most of the dental educators we met in Taiwan. In discussion with the acting dean of this dental school, a

dentist, we learned that the official dean, a surgeon who practices in another city, was contemplating changing the school from dentistry to medicine. We find it difficult to understand the motivation behind such a bizarre decision. We trust that the Ministry of Education will not consider the change before careful review by their Medical Education Advisory Committee. Should it become a medical college, dentistry may be taught in evening courses. At the time of our survey, this institution had 231 students, all in the preclinical years.

The dental college at Kaohsiung suffers from greater attrition rates than those prevailing at NTU. Of the initial entering class of thirty-three students who started in 1957, only four completed the fifth year. There appear to be as yet unresolved problems of inadequate staffing and teaching equipment.

The dental school at the National Defense Medical Center has been graduating classes of approximately thirteen since 1951. This number represents an attrition rate of slightly more than 50 percent, bad by most standards, but much better than the other dental training institutions in Taiwan. At the time of our last visit, the Taipei Dental College had eighty-three students and no qualified dentists on the faculty.

We conclude this depressing picture of dental education in Taiwan with a report that the herbalist school in Taichung is planning to accept dentistry students.

Future Supply of Dentists

Additions to the dental profession will come from the four dental schools. Table 6–3 shows our estimates of graduates per decade.

TABLE 6–3. PROJECTED NUMBER OF DENTAL GRADUATES PER TEN YEARS

Institution	Projected no. of dental graduates per 10 years
NTU[a]	60
NDMC[a]	130
Kaohsiung[a]	40
Chungshan[b]	250
Taipei Dental[b]	120
	600

[a] Based on trends in size of recent graduating classes.
[b] Assuming an attrition rate of 75 percent based on available records.

Table 6–4 gives our final estimates of the supply of dentists in 1973 and 1983. It is based on the following assumptions: (1) dental colleges will graduate 600 students each ten-year period; (2) Taiwan health workers' death rates applied for a ten-year period (2 percent for ages 25–34, 5 percent for ages 35–44, 7 percent for ages 45–54); (3) "effective" retirement age of 65 (later retirements probably balanced by some partial retirement before age 65; (4) better law enforcement decreasing illegal practitioners by 5 percent per year.

TABLE 6–4. ESTIMATION OF SUPPLY OF DENTISTS, 1973–83

Age group	1963	1973	1983
25–34	10	600	600
35–44	234	10	590
45–54	358	222	9
55–64	143	333	206
Subtotals:[a]	750	1,170	1,410
Illegally practicing untrained dentists	1,000	600	400
Total dentist practitioners	1,750	1,770	1,810

[a] All totals rounded off to nearest 10.
Note: These final figures are used in Chapter 11 for comparison with our projected demands for dentists.

THE PHARMACISTS

"Take medicine and add to the severity of the disease"
(*Chuang Tzu*)

Apparently the Taiwanese do not heed this warning for imported drugs alone cost 500,000 NT$ per year. To dispense these drugs there are 1,000 pharmacists and 460 assistant pharmacists. Due to excessive numbers of drugstores, the salary of the average practicing pharmacist is quite low—so low that many pharmacists leave practice and work as salesmen for large pharmaceutical companies.

Numbers and Distribution

The Provincial Health Department registry lists 1,003 pharmacists and 463 "assistant pharmacists." The Ministry of the Interior registry gives a total of 1,666 pharmacists and assistant pharma-

cists. The PHD-JHU census located 993 pharmacists and 334 assistant pharmacists. We believe that the Ministry figure is too high because of the inadequate system for removal from the registry.

There are now 13 pharmacists per 100,000 population in Taiwan compared to 60 per 100,000 in Japan, 26 per 100,000 in the German Federal Republic, and 68 per 100,000 in the United States.[2,4]

Approximately half of all pharmacists are in private practice; only 11 percent work in government hospitals and health centers. Assistant pharmacists show an even greater concentration in private practice. Sixty percent of qualified pharmacists are located in the five major cities (serving 20 percent of the population). Assistant pharmacists have slightly better rural-urban balance.

Pharmacy has a high percentage of female practitioners (33 percent), more than either medicine or dentistry. The age distribution of pharmacists shows the same skew as medicine; in the twenty-five- to thirty-four-year age group we found relatively few pharmacists, just as we found few dentists and physicians.

The Myriad of Drugstores

There are over 13,000 drugstores currently registered with the Public Health Department in Taiwan! Using our figure of 2.2 visits per capita, per year, a total population of 11.5 million, and 300 working days per year, we find an average of six customers per day. Even if drugstores are grossly overregistered we still find it difficult to see how so many can survive. There are nine categories of drugstores; the largest is the "Chinese herbalist medicine drugstore with temporary license" (5,100). The next most common type of drugstore is the "Western medicine drugstore with registered pharmacist" (2,100). These "Western" drugstores are the only ones allowed by law to sell "dangerous" drugs, such as antibiotics and narcotics, and prescription drugs. We stress the term—"allowed by law"—for, in practice, virtually all drugstores handle all types of medication except narcotics. Even traditional Chinese herbalist drugstores carry modern scientific medications, such as antibiotics. There are almost 2,000 registered "medicine sellers in booths." According to the description we received, these should be likened to traveling "snake-oil pitch-men."

Table 6–5 shows that less than one-third of these drugstores employ licensed pharmacists, and even this understates the lack of

qualified technical control of the sale of drugs, for there is a widespread practice of "renting a pharmacist license." That is, the pharmacist allows his license to be hung in a drugstore for a monthly fee while he works at another job.

TABLE 6–5. DRUG OUTLETS

	Number
I. *Major drug outlets*	
A. *Western-type drugstore* Must employ licensed pharmacists; no pharmacists may serve for more than two stores; permitted to sell dangerous drugs, antibiotics, narcotics, prescription drugs.	2,111
B. *Modern Western medicine drugstore* Supervised by pharmacists granted licenses by examination during Japanese regime. Narcotics, antibiotics theoretically should not be sold here.	152
II. *Other drug outlets*	
A. *Chinese-type pharmacy* Most employ qualified Chinese herbal doctor.	1,023
B. *Chinese medicine* Supervised by "Japanese licensed" pharmacists.	635
C. *Temporary licensed Western medicine pharmacies* Supervised by graduates of special two-month course offered since the retrocession, a *de facto* recognition of the unqualified pharmacists currently serving in Taiwan.	523
D. *Temporary licensed Chinese medicine pharmacies* Most now sell scientific medicines as well.	5,099
E. *Medical retailers* Homemade medicine.	1,755
F. *Medical sellers in booths* Usually no permanent shop.	1,923
Total	13,221

With 13,000 drugstores on an island having a population of 11.5 million, there is one drugstore for eight hundred people (the United States ratio is 1:3,300).[4] Naturally, most medicine is sold through these channels. Aspirin and vitamins can be bought in general stores in the rural areas, but the practice is uncommon.

This large number of drugstores gives rise to many interesting aspects of the practice of pharmacy. First, with the intensive competition, the income from most pharmacies is very low. The president of the Taiwan Pharmaceutical Association told us that although the gross receipts from a busy, large city drugstore might

be as much as 2,000 NT$ ($50 [U.S.]) per day, with monthly profits of 6,000 NT$, most pharmacies make far less. His statement on the low income of pharmacies was confirmed by our findings on expenditures for pharmaceuticals. It is easy to open a drugstore; the rentals for such a store are low, and very little capital is needed for stock; because of the intensive competition among the 700 manufacturers of pharmaceuticals it is possible for the young pharmacy graduate to hold drugs on consignment. However, the preference of the new pharmacy graduate is to be not a pharmacist, but a detail man (sales agent) for one of the drug houses, where salaries are as high as 4,000 NT$ per month. Also, the young graduate can add as much as 1,000 NT$ per month "renting" his license to pharmacies with no licensed practitioner.

In Taiwan, just as the physician practices pharmacy, so does the pharmacist practice medicine. It is not uncommon for the pharmacist to give injections as well as medical advice.

Information for Calculation of the Economics of the Drug Industry

Estimates of the importation of drugs into Taiwan run as high as $12 million (U.S.) per year. Of this, 70 percent is Western medicine and 30 percent herbal medicine. Officially reported figures show a local production of medications at the value of $4.9 million (U.S.). However, responsible authorities estimate that the true figure is four to five times this value.[3] This underestimate is associated with frequent tax-avoidance practices. Summing up the total drug bill for the island, we found that the figure came to 120 NT$ per year per person, not an unreasonable figure when compared to a similar statistic of 150 NT$ per soldier equivalent per year for the Chinese army. The age group in the Chinese army would probably require less medication, but this would be balanced by more honest reporting of prices of drugs dispensed to service men.

Patterns of Education of Pharmacists

There are pharmacy schools associated with the National Taiwan University, National Defense Medical Center, Taipei Medical College, and Kaohsiung Medical College. In addition, there is an herbalist pharmacy school associated with the herbalist center in Taichung. Currently the combined annual output of the first four schools is approximately 150 graduates annually. The schools have a standard four-year curriculum after high school. The first two years are similar to the basic science years of medical

school. The last two years of pharmacy school cover practical pharmaceutics.

Schools of pharmacy are relatively new in Taiwan. Under Japanese rule none existed. Pharmacists trained before 1947 were trained in Japan. Informal estimates given to us indicated that there were 800 graduates trained in Japan during the years prior to the retrocession. In addition, some 200 pharmacists came to Taiwan from the mainland.[3]

Although the attrition rate (20–30 percent) in pharmacy schools is not as bad as in schools of dentistry, we observed that at NTU the rate appears to be highest in the fourth year. Steps should be taken to check this loss in the last year, for it is wasteful of both students' and teachers' time. Why is the attrition rate at the NTU as high as 30 percent in some years? From our medical and pharmacy student surveys, we find that the pharmacist ranks low in the medical hierarchy, falling between nurses and herbalists. This lower prestige may be explained by the low income levels of pharmacists. The low prestige may also explain the failure to attract top students to pharmacy school and to graduate most who enter.

The "Pharmacist-Pharmacy Problem"

In reviewing the demand for pharmacists, we come to the conclusion that Taiwan is not so much faced with a shortage of pharmacists as it is faced with a plethora of drugstores. The government has until now eschewed any responsibility for limiting the number of pharmacies. Moreover, by its inaction the government has encouraged a quality-destroying type of competition to develop among the pharmacies.

In summary, we conclude that the problem of meeting the "demand for pharmacists" is minor in comparison to the more pressing issue of establishing a reasonable pharmacy control law, to replace the current one which is now almost thirty years old. Furthermore, we feel that the government must take steps to limit the number of drugstores, if for no other reason than to make competition a socially beneficial rather than a socially destructive process. Japan has a law limiting the number of drugstores on the basis of population densities and distance. Whether new legislation uses these "public utility criteria" or not, it surely must correct the abuse of "renting of licenses" by requiring that a full-time pharmacist actually be present in every pharmacy.

Future Supply of Pharmacists

Our estimates of the number of graduates from the schools of pharmacy in Taiwan are presented below. The attrition rates in these schools are higher than in medicine, but not as high as in dentistry.

TABLE 6–6. PROJECTED NUMBERS OF PHARMACY GRADUATES PER DECADE

Institution	Number
NTU[a]	440
Kaohsiung[b]	560
Taipei[c]	560
NDMC[d]	80[e]
Total	1,640

[a] Assuming entering classes increase to 55 and four-year total attrition remains at 20 percent.
[b] Assuming entering classes increase to 80 and four-year total attrition remains at 30 percent.
[c] Assuming entering classes stabilize at 80 and four-year total attrition is similar to Kaohsiung (30 percent); the school is too new to have any stable rates as yet.
[d] Based on average number of *graduates* of 8.5 per year over the last decade; assuming attrition rate continues to increase.
[e] Graduates returning to civilian life after ten years' military service.

The total graduates per decade, less estimated losses, give rise to our final figures in Table 6–7. In estimating losses, we made the following assumptions: (1) that Taiwanese health worker age-specific *ten-year* death rates will not change appreciably over the

TABLE 6–7. ESTIMATION OF SUPPLY OF PHARMACISTS, 1973–83

Age group	1963	1973	1983
25–34	170	1,640	1,640
35–44	510	170	1,610
45–54	260	480	160
55–64	50	240	450
Total licensed pharmacists	990	2,530	3,860
Total practicing pharmacy	660	1,690	2,580

Note: These figures are used as a basis of discussion in Chapter 11, on alternatives and consequences.

next two decades (25–34, 2 percent; 35–44, 5 percent; 45–54, 7 percent); (2) that the "effective" retirement age is sixty-five; (3) that losses by migration are minimal; (4) that the present rate of one-third of all pharmacists working outside of their profession will continue for the next two decades.

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CHAPTER 7

ENVIRONMENTAL SANITATION WORKERS—FROM POLLUTED WELLS TO PURE WATER

THERE is evidence that Taiwan suffers the effects of impure water and unsanitary environment. Official figures show that diarrheal disease is still one of the ten leading causes of death. According to published statistics, the diarrhea-enteritis death rate was almost 72 per 100,000 population. In comparison, Uruguay, another developing area, has a rate less than 20 per 100,000 population; the United States' rate is less than 5 per 100,000. In terms of morbidity, preliminary survey data show that the annual direct cost of enteric diseases in Taiwan approximates 370 million NT$ and the indirect costs from sickness and premature death are well over 3 billion NT$. The toll of the "defective sanitation" diseases cannot be measured by morbidity and mortality statistics alone. The entire food processing and exporting industry, Taiwan's major foreign exchange earner, was threatened by foreign trade restrictions resulting from Taiwan's 1962 cholera epidemic.[3]

What are the manpower implications of efforts to prevent these diseases of defective sanitation? We discuss current and future supply and demand for sanitary engineers, sanitarians, sanitary inspectors, and similar personnel in this chapter. The reason for separating sanitation workers is that sanitation is more the purview of the public works department than of the public health department. Public works is responsible for water supplies in places of over 2,500 persons. Moreover, the functions of sanitation workers differ from those of other categories of health workers. There is essentially no convertibility between sanitation staff and medical care workers. Many of a physician's tasks may be taken over by the nurse, the pharmacist, the midwife, or even the herbalist, but it is

highly unlikely that the sanitary engineer or sanitarian would assume the functions of the physician; the reverse is equally unlikely. Most of the demand for environmental health workers in Taiwan comes from the public sector. Since public sector plans only extend for ten years, we have made a ten-year estimate for manpower.

The potential effect of environmental sanitation workers on the health standards in Taiwan could be disproportionate to their numbers. The health benefits of the work of the sanitarian and sanitary engineer are primarily preventive. They do not ameliorate symptoms or shorten the course of illness, but work to *eradicate* diarrheal disease and its consequent cost in medical care and lowered productivity. Although there are few qualified Taiwanese environmental sanitation workers at the present time, their work is important enough to warrant a separate chapter.

Training Institutions

There were no university-level programs for sanitary engineering or public health engineering in Taiwan at the time of our study. Only National Taiwan University offered courses in sanitary engineering. These courses were part of the regular civil engineering program. However, over the past ten years there have been a number of sanitary engineers given special training in other countries: seven sponsored by the World Health Organization, thirty-two by the Agency for International Development and its predecessors, and two by other agencies.

Essentially all of the ancillary sanitation workers who have received formal training were trained at the provincial Institute of Environmental Sanitation (IES) now located at Pingtung. This Institute was established in 1955 with the aid of the Joint Commission on Rural Reconstruction to meet the obvious need for more trained sanitation personnel. Subsequent support came from the International Cooperation Administration (now AID) and the Provincial Health Department. By the end of 1962 it had graduated twenty-eight sanitation classes, four junior sanitary engineer classes, five water chemist classes, and two radiation health worker classes; in all, a total of 736 graduates.[4] Unfortunately, the Institute has little control over the selection of students as they are sent by local governments for in-service training. For this reason academic standards cannot be set too high. Although the Institute is certainly well-equipped to train sanitary

inspectors, we question the wisdom of training engineers outside a university.

In addition, the Institute of Public Health at National Taiwan University has courses and seminars on environmental sanitation to orient other health workers to sanitation problems. They have only taught sanitation personnel in short in-service training courses. Some thought might be given for expanding environmental sanitation training here under university auspices.*

Present Numbers of Personnel

The Public Works Department and the Regional Water Supply Commission had approximately sixteen senior engineers, twenty-nine assistant engineers, and twenty-two junior engineers.[6] (It might be noted that these junior engineers are not really engineers at all, but high school graduates with six months of special studies, or equivalent on-the-job training.) Personnel employed by the Provincial Health Department include engineers, sanitarians, and sanitary inspectors. In addition, there are currently 410 persons employed by local governments and designated as water plant operators in Taiwan.[6]

* Since the preliminary presentation of the recommendations of this study two more universities have started undergraduate sanitary engineering courses. National Taiwan University has initiated a two-year postgraduate master's course in sanitary engineering. Plans have been made to expand this course to meet all of Taiwan's basic training needs.[9]

TABLE 7-1. ESTIMATES OF PRESENT NUMBERS OF ENVIRONMENTAL SANITATION WORKERS

	Provincial government		
	Public Works Bureau[6]	Provincial Health Dept.[5]	Local government
Senior engineer	16	10	20[a]
Assistant engineer	29	—	
Junior engineer	22	20	
Senior sanitarian	—	3	
Sanitary inspector[a]	—	120	350–450
Water plant operator[a]	—	—	410

[a] Estimate—(some are untrained).

In Taiwan in 1966 there were sixty-two civil engineers, thirty-five with advanced degrees, who had some specialized training in sanitary engineering. They were employed primarily by government: The Public Works Bureau, the Institute of Environmental Sanitation, and local authorities. In addition, other types of engineers are also working on water supply projects.[9]

Proposed Construction of Water Supplies

Our random household survey showed that in cities, 64 percent of the people used piped water. In rural areas only 20 percent of the households surveyed used piped water.

TABLE 7–2. PERCENT OF PEOPLE SERVED BY WATER SUPPLIES, BY LOCATION

	Piped water	Wells	Surface water	Total (%)
Cities	64	32	4	100
Towns	23	58	19	100
Rural	20	48	32	100

Although these figures give some indication of the magnitude of the need for water supplies, we must turn to the *Draft Plans for Long-Range Development of Water Supply in Taiwan*,[6] the *Ten Year Development Plan for Community Water Supplies*,[7] and the *Ten Year Health Plan*[5] for details on proposed construction.

To give some perspective to proposed plans, a review of progress in water supply construction thus far is useful. In 1946, at the time of the retrocession, there were 120 water supplies serving one million people (18 percent of the population). By the end of 1965 there were 280 systems serving almost five million people (38 percent of the population). In addition, the production had increased sufficiently to permit a doubling of per capita consumption.

Although progress to this point has been commendable, the Public Works Bureau plans for a target date of 1974 are even more ambitious. They hope in ten years to almost double the increase of water supply accomplished over the past ten years.[7] Since the Public Works Bureau has the responsibility for larger water systems, their proposed construction is concentrated in the cities as shown in Table 7–3.

TABLE 7–3. WATER PRODUCTION BY 1974

Population	Water production 1974 (CMD)*	Increase 1964–74	Cost NT$ (000)	Unit cost NT$/CMD*	Total population served
over 50,000	1,220,700	436,900	912,000	18–2,200	5,038,000
10,000–50,000	277,000	99,000	293,000	28–3,000	1,580,000
2,500–10,000	132,000	72,000	244,400	32–3,500	1,462,000
Total	1,629,700	607,900	1,449,400		8,080,000

* CMD = cubic meters per day.

The demand for sanitary engineers called for by planned construction has been estimated by the Public Works Bureau and is shown in Table 7–4.

The Ten Year Health Plan calls for construction of 34,000 to 40,000 wells and 500 to 600 small water supplies for communities under 2,500 people. It seems doubtful that this target will be met, as only 5,600 wells and forty small water supplies were constructed in the past eight years. However, to double even the small water supply construction record of the past eight years would probably call for more sanitary engineers than are planned for in the Ten Year Health Plan. We also believe the estimate for senior sanitarians in the Ten Year Plan (Table 7–4) is too low for initiation, planning, and supervision of construction of 20,000 wells, let alone 40,000, over the next ten years. The public health department sanitarians have many other duties in addition to well construction. In addition it must be recognized that construction of private wells (and latrines as well) depends more on economic development than on government plans, unless all costs are to be borne by the government. Our household survey shows very clearly the association of poverty with unimproved water supply and unsafe systems of sewage disposal. In large cities only 13 percent of the rich rely on wells and surface water, while 57 percent of the poorest group rely on these sources. In towns and rural areas the differences are not so marked, due to general deficits in piped water, but the rural poor still lag behind the rich in percentage of households with adequate supplies.

Proposed Constructions of Sewage Systems

Our household survey showed that the overwhelming majority (almost 80 percent) of all households used privies, or even less

adequate systems of sewage disposal. The smallest number of all households (less than 7 percent) had water-carried sewage disposal systems. Although unmet needs for sewage disposal are greater than needs for water supply, sewage system construction has less importance in improving health. We used the *Ten Year Program for Drainage and Sewage Development in Taiwan*[8] and the *Ten Year Health Plan*[5] for government proposals for construction of new sewage systems and latrines.

According to Public Works Bureau data there were only three small sanitary sewer systems existing in Taiwan. The remainder of the water-carried sewage runs through storm sewers and open ditches. To improve these conditions, the Public Works Bureau proposed 424 million NT$ worth of sewerage system construction in ten years. This system would increase coverage from 0.1 percent to 10 percent of the population. In addition, 952 million NT$ worth of drainage work is proposed. Since drainage will have minimal health effects in Taiwan now (after malaria eradication), we will not include new sanitary engineers needed for drainage work in Table 7–4.

The Provincial Health Department, in its plans for rural sanitation, calls for construction of 3,500 public and 74,000 private latrines. Over the past eight years, 2,500 public latrines have been constructed, as well as an unknown number of private latrines. If the Provincial Health Department is to achieve its rural sewage disposal targets, as well as expanding sanitation programs such as food control, milk control, and stream pollution control, it will probably need more sanitarians than their figures, shown in Table 7–4.

Table 7–4 presents a composite estimate from several sources. We feel that the Provincial Health Department projection of the needs for sanitation personnel is understated in consideration of the ambitious goals in sanitation improvement. The Public Works Bureau estimates of engineers and water plant operators are realistic to meet its ten-year goals, but we are dubious about its ability to secure financing for such extensive new construction programs. The Institute of Environmental Sanitation's estimate of local government sanitarians and sanitary inspectors seems unrealistically high. Its estimates were not even based on Taiwanese studies, but on a report from the Philippines which presents desirable standards rather than attainable ones.

TABLE 7–4. ESTIMATE OF NEEDS FOR TRAINING FOR ADDITIONAL ENVIRONMENTAL SANITATION WORKERS, 1973

	Provincial government		Local government	
	Public Works Bureau[7]	Provincial Health Department[5]	City–county	Local
Senior engineer[c] (A)	10			
Assistant engineer[c] (B)	60	+50[b] 9		
Junior engineer[c] (C)	100			
Senior sanitarian			200[a,4]	280[a,4]
Sanitary inspector (D)		31	620[a,4]	1,380[a,4]
Water plant operator (A)[5]			5	
Water plant operator (B–D)[5]			327	

[a] Extrapolation of IES 1971 projection.
[b] For sewerage system construction planned.
[c] For water supply construction, 80 civil, 20 mechanical, 10 chemical, and 60 sanitary engineers.
Note: Letters (A) through (D) designate professional levels.

In summary, we believe that over the next few years from ten to twenty engineers should receive advanced training in sanitary engineering. In addition, consideration should be given to strengthening the graduate course in sanitary engineering at National Taiwan University. University programs for training sanitarians at the B.S. level should be considered for the future. The Institute for Environmental Sanitation should continue, expand, and upgrade its in-service training program for sanitary inspectors. A preliminary target of four classes of twenty-five per year seems reasonable. The possibilities of short courses in selected counties (hsien) for low-level sanitation personnel should be explored. Such courses proved very successful in the case of the Maternal and Child Health Institute midwife refresher courses.

A thorough review of proposed new environmental sanitation construction by a joint commission of the Public Works Bureau, Provincial Health Department, and the Joint Commission on Rural Reconstruction is important. The commission should assess the probability of financial approval of new projects (based on both past experience and improving economy) and determine the precise manpower implications of all new construction. The commission should also determine the future demands for environmental sanitation personnel to maintain and operate present and proposed

facilities and programs. Determination of the demand for sanitation workers is best done by experts familiar with existing programs and problems in Taiwan. After estimating exact demands, the Commission should meet with University and Institute of Environmental Sanitation officials to develop training plans.

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CHAPTER 8

THE BIOLOGICAL BASIS OF DEMAND FOR MEDICAL CARE

THE burden of disease is a basic determinant of a nation's demand for health manpower. However, it is neither possible nor practical to use only basic biological needs to predict the specific demand for health workers.

In the past there have been attempts to predict demand for doctors and nurses using estimates of mortality and morbidity. This approach is based on: (1) determining the level of mortality and morbidity of a country; (2) estimating the time of health professionals needed to care for the average case of each type of illness; (3) multiplying the estimated time per case by the estimated annual number of cases to get the total professional hours *needed*; (4) determining the average hours worked per year by the professionals; and (5) dividing total hours *needed* by hours per professional to determine total required supply of health professionals to meet basic biological needs. The best known document on this method is the Lee and Jones report.[1] Although this approach has the seductive appeal of seeming to be the most scientific appraisal, we feel that for many practical reasons it is unworkable. *First*, there is no country in the world with sufficiently detailed and accurate morbidity and mortality statistics to give the exact figures needed for this type of estimate. *Second*, one cannot measure the total health professional time required to combat a given disease if there are alternative approaches requiring different types of health workers. For example: should you equate the morbidity due to diarrhea with a sanitary engineer's time in designing a water supply system, or with the services of the nurse and doctor in the rehydration clinic? Practically, there is no answer to this problem. *Third*, and most important, even if one

could calculate "need," this is no measure of public "demand" for the services of health professionals. There are many examples of unused health clinics in areas of high health need in the world today. There are also many physicians unable to earn adequate incomes in the larger cities of underdeveloped countries where people cannot afford to express their urgent need for medical attention in terms of effective economic demand.

However, for clear understanding of health manpower analysis familiarity with the major disease patterns of a nation is essential.

Mortality

Taiwan's death statistics are of adequate quality to be useful in describing disease patterns. Senility plus ill-defined and unknown causes of death accounted for less than 10 percent of all deaths in 1962.[2] This indicator of the quality of death reporting is more favorable in Taiwan than in most developing countries. Indeed, there are some countries still reporting deaths in only the major cities.[3] A resurvey of death certificates from 1958 resulted in some change of order, but seven of the eight leading causes were still leading causes after the resurvey.[4] Taiwan's reporting of deaths is nationwide and of adequate efficiency.

The leading causes of death in Taiwan are changing from the disease pattern typical of underdeveloped nations to that of more developed nations. As recently as 1946–47 there were over 2,200 cholera deaths and 1,700 smallpox deaths. In 1952 malaria was still among the ten most important causes of death, diarrheal diseases led the list, and tuberculosis was the third most important cause of death. At that time, six of the ten leading causes of death in Taiwan were communicable diseases. However, by 1962 there were only three communicable diseases among the first ten causes of death. These major shifts in mortality over the short space of ten years represent substantial accomplishments in the field of public health and preventive medicine.

However, enteric diseases, even excluding diarrhea of the newborn, are still the fifth leading cause of death in Taiwan. This broad disease category, an indicator of the state of sanitation, gives emphasis to the importance of the training of sanitary engineers and sanitarians. Currently, tuberculosis is still seventh in the causes of death, which indicates the continuing need for training specialists in detection and treatment of tuberculosis.

The crude death rate of 6.33 for Taiwan in 1962 is strikingly low. Although this is generally conceded to be an underestimate it is still a surprisingly low death rate until one considers the age structure of the population. With a heavy weighting of persons in the younger and healthier age groups, Taiwan has a lower crude death rate than Japan, but still has higher age-specific death rates in every age grouping. It might be noted that the age-specific death rates and the most important causes of death by age groupings are not reported in the statistical summary prepared by the Provincial Department of Health in Taiwan.* These figures would certainly be useful to persons interested in a careful appraisal of health levels in Taiwan and to the Taiwanese health planners.

Natality

Births have implications in terms of demand for specialized health personnel. Currently there are some 420,000 births per year in Taiwan. This number had increased from 300,000 in 1949. The *rate* of increase has been erratic from year to year, reflecting major social changes in Taiwan, but in general it is decreasing. If the national family planning program is successful the number of births may actually dip to about 370,000 in 1973 and slowly rise to about 460,000 in 1983. If the family planning program is not successful there may be as many as 500,000 births in 1973 and 660,000 by 1983. The implications of a declining birth rate, with possibly increasing numbers of deliveries each year, is discussed in Chapter 10, under midwives.

Morbidity

The deficiencies in both quantity and quality of nation-wide morbidity figures are a problem for health planners in every nation. Taiwan is no exception. Data from doctors' offices are not readily available. The hospitalized and out-patients seen in provincial and local government hospitals are a small (one percent of all doctor visits) and possibly biased sample of the spectrum of disease in Taiwan. However, some impressions can be gained from a review of the discharge diagnoses from hospital records. In the provincial hospitals malaria has declined from 15,000 cases in 1947 to no cases in 1962. However, diarrhea-enteritis cases have risen

* The latest *Health Statistical Abstract* (just received) gives deaths by age and cause.

from 6,000 to 12,000 in the same period. Tuberculosis remains a major problem, with 14,000 cases seen in the provincial hospitals and 18,000 cases in the municipal hospitals. Beri-beri cases have decreased by one-half since 1953, but there were still 1,100 cases seen in 1962. Thus, although deficiency and infectious diseases have probably declined in importance, they still must be considered in the training of health manpower.

The figures on reportable disease represent a small and variable percentage of the disease existing in the community. An index of the accuracy of the reporting system is the fact that there were no cases of "epidemic encephalitis" reported in 1962, a time when even the public press was calling attention to the problems of Japanese B encephalitis in Taiwan. Furthermore, the reporting of diseases in Taiwan, as in most other countries, is exclusively restricted to communicable disease reporting.

The most representative morbidity data in Taiwan were obtained in the course of our random-sample household survey. This information is useful in elucidating the pattern of biological need in Taiwan. We asked the question of our 66,000 interviewees, "Were you sick *last month?*" If the person had been sick, we then asked for the number of days lost from his usual activity, medical services used for the illness, and the cost of these medical services.

There were approximately 310 illnesses (with or without losing a day) reported per year per 100 persons in Taiwan. Comparable data for the United States range from 280–310 acute and chronic conditions per year per 100 persons. Our figures for Taiwan may be an underestimate as we counted multiple illnesses in one month as one illness. In such instances we recorded all diagnoses, and found multiple illnesses to be quite rare. Another reason that our morbidity figures for Taiwan are slightly underestimated is our use of a thirty-day recall period. Minor illnesses were probably forgotten by a few of our informants.

Our definition of days lost from usual activity lies somewhere between the United States National Health Survey term "reduced activity days" and "bed days." The Taiwanese lost 12.9 days per capita, per year, from illness. Comparable American figures are 16 reduced activity days and 6 bed days per capita per year. Our figures indicate similar or higher disease rates for Taiwan, despite a much younger population. We found approximately half as many persons "losing days" as persons sick. To our surprise this relationship was relatively constant for urban and rural popula-

tions and for different economic classes. This consistency gave us more confidence in the comparability of responses from different groups.

Of what concern is the general morbidity pattern in Taiwan? We believe that it is the basic determinant of the number of doctor visits demanded. Different economic, educational, residential, and age groups have different rates of doctor utilization. However, these rate differences depend more on the morbidity differences from group to group than on: the availability of doctors (rural-urban status), the awareness of needs for medical care (educational level), and, within limits, the ability to pay (economic level). As the scatter Figure 8–1 shows, only two groups showed much divergence from the straight line relationship between morbidity and use of physicians. The poorest used less services and the richest more than would be anticipated from their morbidity level. This is not to say that education, age, residence, and economic level have no effect on use of doctors, independent of their associated levels of sickness. As Table 8–1 indicates, when a person falls ill he is more likely to visit a doctor if he is: (1) well-educated; (2) a city-dweller; (3) age five to fifty; and (4) rich.

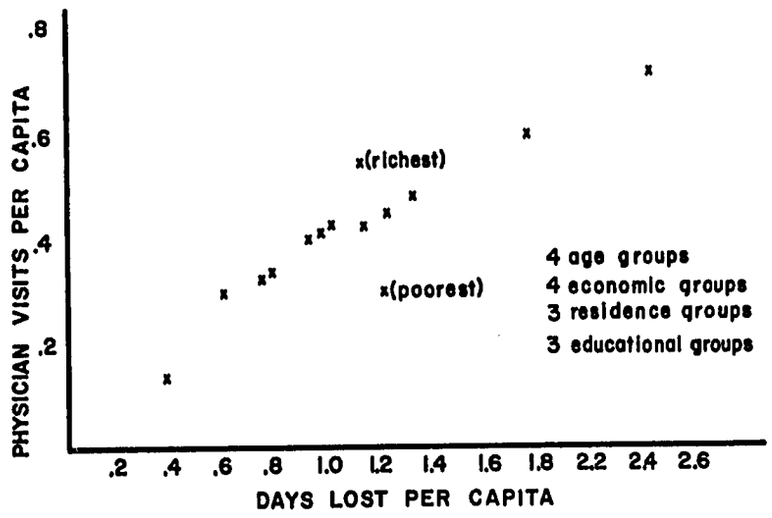

Figure 8–1. Relation of Morbidity to Physician Visits.

TABLE 8-1. RATIO OF PERSONS VISITING DOCTOR TO THOSE "LOSING A DAY" FROM ILLNESS
(figures over 1.0 reflect persons visiting doctor who were "sick" but did not lose a day)

A—Economic level NT$ per capita per month		B—Age		C—Stratum		D—Education	
<370	.70	0–5	.77	City	.93	None	.80
371–470	.87	6–15	.95	Town	.90	Primary	.84
471–650	.97	16–50	.92	Rural	.77	Secondary	1.13
651+	1.06	51+	.78				

Obviously these figures conceal the effects of correlations such as education and economic level, or age and education. They also fail to reveal interactions, such as the possibility of higher education and lower age having a synergistic effect on the percent of ill persons in that group demanding medical attention. However, when we look at education by age we see that at every age the illiterate sick use less care than do the well-educated. Also, as shown in Table 8–2, the illiterate sick use less care than the educated sick for every economic group.

Persons age five to fifty who fall ill use a higher percentage of medical care than both those older and those younger. This holds for every economic group. Conversely, the rich who are ill see doctors more frequently than the poor who are ill, in all age groups.

The lower rates of utilization of doctors by the rural sick holds for all economic groupings, as shown in Table 8–3, and for all age groupings.

TABLE 8-2. RATIO OF PERSONS VISITING DOCTOR TO THOSE "LOSING A DAY"
(over 1.0 reflects doctor visits by those "sick" but not "losing day")

	Economic Level			
	0–370	371–470	471–650	651+
Education				
None	.72	.84	.91	.89
Primary	.72	.86	.98	1.07
Secondary+	.91	1.05	1.17	1.40

TABLE 8-3. RATIO OF PERSONS VISITING DOCTOR TO THOSE LOSING A DAY FROM ILLNESS
(over 1.0 reflects doctor visits by those "sick" but not losing day)

	Economic Level			
	0-370	371-470	471-650	650+
Residence				
City	.78	.93	1.05	1.17
Town	.80	.88	1.01	1.12
Rural	.67	.84	.89	.92

Multiple two-variable tables will not reveal three- or four-way correlations and interactions. However, we have not taken the additional step of multivariable analysis in this part of our study because even this method leaves questions unanswered. Furthermore, such multiple interactions are probably relatively unimportant in determining the effect of morbidity levels on physician usage.

In summary, we feel that the rate of doctor visits per capita for any group in Taiwan is determined *primarily* by extent of morbidity, secondarily by economic level, and to a small extent by independent age, location, and education effects.

How is general morbidity distributed among the population? It is certainly highest in the old and the very young. A higher percentage of children are sick, but there are more days lost per capita for the over fifty group. (For sixty-five and over there is a higher percentage of sick as well as a greater number of days lost per capita.)

Morbidity rates, in terms of both reported "sickness" and "days lost per capita," are surprisingly constant for all economic levels. We had anticipated much higher morbidity rates among the poor because of factors such as their poor nutrition and overcrowding. Can our findings be explained by the poor working when they are sick, since they cannot afford to lose a day's wages? Probably not, as the poor also report less "sickness" *un*associated with lost time than the rich. Have the poor a different concept of illness, tending to minimize, ignore, or forget it? We believe that such cultural concepts would be more closely associated with a lack of education than with poverty. However, illiterates report more illness than the well-educated for *every* economic level. Have the poor a dis-

proportionate percentage of low risk ages? No, age adjustment does not increase the morbidity in the poor groups, nor decrease it in the rich. Then why are not the poor Taiwanese sick more than the rich? We really do not know.

It did not surprise us that the rural population seems to have more sickness than the city or town dwellers—this is observed for essentially all economic groups, age groups, and education groups. Our anticipation that the illiterate would have more disease was also confirmed by our household survey data. The illiterate had higher disease rates for all economic, age, and location groups. It should be noted that, using both multisort analysis and regression analysis, education did not appear as a major factor or explain variation of over-all morbidity.

At first we planned to ignore the variable of sex as we anticipated little change in sex ratio over the next ten years (thus cancelling out any sex differential effect on the number of doctor visits required). When our population projection showed appreciable shifts in sex ratios we included sex as a variable. To our great surprise we found only negligible differences in male and female morbidity by any measure, and no differences in rate of use of private doctors by men and by women. This finding is at variance with the data from the provincial hospitals, where males have over twice as many outpatient visits and inpatient days as females. However, physicians explained that Taiwanese women preferred not to use governmental facilities.

Initially, we did not plan to ask any questions about the *type* of illness, feeling that the information gained by interviews, unsupported by medical history, physician examination, and laboratory work, would not be accurate enough to use. However, we reconsidered and included questions on the cause of illness. In reviewing the replies for one month, we found that although there were many diseases which had to be classified as vague and nonspecific, there were enough meaningful replies to warrant analysis. Based on analysis of one month's data, we set up a listing of seventeen diseases and symptom-complexes for analysis. We then analyzed the full year's data.

From our analysis, it was apparent that the common cold was by far the most frequent sickness. Diarrhea and dysentery followed next with the surprisingly high figure of 250 cases per thousand, per year. The category "other respiratory illnesses" was third with a rate of 210 cases per thousand, per year. These figures include

TABLE 8–4. PHD–JHU SURVEY DATA
(three common illnesses in Taiwan)

	Illnesses[a] per person per year	Days lost[a] per person per year	Direct medical costs per capita per year(NT$)
All diseases	1.74	13.1	259.0
Common cold	.56	2.60	31.5
Other respiratory	.21	1.95	32.4
Diarrhea & enteritis	.25	1.45	29.7

[a] When at least one day was lost from usual activity.

only those illnesses which caused loss of time. Thus, the average number of days per illness seems high, as the less severe illnesses are not counted.

Probably more important than the actual number of cases is the number of days lost per person from each illness. Here again, we find that the common cold is still the leading cause for days lost per person, per year, closely followed by other respiratory illnesses, with diarrhea and dysentery in third place.

Our survey underestimates tuberculosis and other chronic illness requiring long hospitalization as a cause of lost time, since we surveyed only households and not institutionalized populations.

The importance of diarrhea and enteritis in all measures of morbidity is a clear-cut directive for starting more and better sanitation programs and training enough workers to staff them. A second question, raised by the high incidence of diarrhea, is: "If diarrhea were eliminated, would it decrease the demand for doctors?" We believe not, as experience in many other countries has shown that as the "defective sanitation diseases" are eliminated, the demand for care for other conditions, now ignored, takes their place.[5]

How much would the complete eradication of smallpox, diphtheria, pertussis, tetanus, measles, and polio (the effectively immunizable diseases) affect the demand for medical care? Probably very little, as all of these diseases together constitute less than one percent of the total disease burden.

In summary, a review of the basic biological needs for health services in Taiwan clearly shows the importance of training public health personnel and emphasizing preventive medicine in

the training of all health workers. We also conclude that changes from the disease pattern in Taiwan today will not markedly affect the demand for health workers over the next two decades.

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CHAPTER 9

PRIVATE SECTOR DEMAND: HOW MANY PATIENTS FOR TOMORROW'S PRIVATE PRACTITIONERS?

TAIWAN will face a shortage of at least 1,000 doctors in 1973; unless corrective action is taken the shortage will grow worse in the succeeding decade. This was our first estimate after a very rough analysis of preliminary data. It is still our best prediction after an exhaustive analysis of the best data available.

We delayed our report for an extensive analysis as we were not satisfied by a rough guess. The private sector demand for doctors is one of the most important parts of our entire study, for in Taiwan, most doctors are in full-time private practice. On the prediction of private sector demand rest such decisions as the founding of new medical schools, the restriction of out-migration of doctors, and even changing the period of required medical services for army-trained physicians. Our analysis shows that demographic shifts will cause a greater change in doctor demand than is caused by changing from low to high population projection using simple doctor-patient ratios.

Of perhaps even greater importance are the concepts that were formulated and the methods developed for predicting private physician demand. Although few developing countries have as large a private medical sector as Taiwan, most have a significant private sector of the health industry. Our methods should have applicability in other countries and possibly in other professions.

Objectives

1. Primarily, our study was planned to develop a method of analysis which would enable developing nations to understand and meet their health manpower problems. This chapter discusses the

effect of economic and demographic attributes of the population on utilization of doctors in private practice. The factors include economic level (adjusted for family size), age, education, degree of urbanization, morbidity, and sex. We have limited our efforts to the smallest number of variables which we could employ and still have meaningful results.

If this kind of information can be acquired for a number of countries, in differing levels of economic development, generalizations about the impact of demographic and economic transition on the demand for medical services can be developed. Such generalizations could furnish a basis for making projections for changes in demands for health services. They would certainly improve understanding of the dynamics of demand for medical care in developing countries.

2. As indicated earlier, we also wished to determine the number of doctors needed in Taiwan in the future as the population changes in size and composition. (Although attention is focussed on physicians, the method is applicable to other private practitioners, such as herbalists, midwives, and dentists. These professionals, much less important numerically, are discussed at the end of this chapter.)

Changes in demand occasioned by total population increase are not hard to comprehend. As the population of Taiwan continues to grow, more physicians will be needed if the present standards are to be maintained. However, the traditional patient/doctor ratios which have been used extensively for estimating future health manpower needs are so imprecise as to lose much of their value. This chapter develops an improved alternate method, one based on the study of the varying demands associated with a variety of socioeconomic population components. Our approach, therefore, can take into account differences in age, education, economic status and the rural-urban structure of populations.

This chapter on demand in the private sector perforce does not include all the physicians, since the public sector is not considered here. What we have to say about the private sector is, however, of general interest not only because the private sector is often of critical importance to economic development but also because it suggests ways to analyze the composite nature of effective economic demand.

Changes in demand for doctors occasioned by shifts in population composition are much harder to predict than those due to simple

population increases. If the population becomes better educated, just what effect will that shift have on the demand for physicians? What will be the impact of changes in age composition, changes in urban-rural location, improvements in economic levels, and even changes in sex ratios?

Method

To make our projections, four types of information are needed: (1) the present total number of "full-time equivalent" private practitioners (all doctors in full-time practice plus one-half of all salaried doctors; for details see Chapter 10); (2) the average number of visits *per doctor* per month; (3) the present *rates* of doctor visits *per capita* per month for the various population components; and (4) population projections, by components, for the target years.

We then multiply average visits per person per month for each population component, times the projected population for that component, and add the products. The result is the total visits per month for the future total population. (This sum will differ from the over-all average rate of present visits times the total future population, because of changes in population composition.)

The average number of visits per physician is divided into the total future demand for physician visits to give the total number of physicians needed. (The number of visits per doctor per month may have to be modified in order to maintain physicians' real earnings or improve standards of care in the future.)

$$\text{Doctor demand} = \frac{P_{1(1973)} \times V_{1(1963)} + P_{2(1973)} \times V_{2(1963)} \cdots + P_{n(1973)} \times V_{n(1963)}}{R}$$

$P_{1(1973)}$ = Projected population of component 1 in 1973.
$V_{1(1963)}$ = Visits/capita/month in component 1 in 1963.
R = Number of patients seen by doctor in a month.
n = Number of population components.

To clarify the various elements of this condensed description of method, we will discuss details under the following headings: (1) index of doctor usage (dependent variable); (2) demographic variables affecting doctor usage (independent variables); (3) alternate methods of multiple-variable analysis; (4) population projection problems; and (5) projection of doctor demand. For the

projection of demand for herbalists, dentists, and midwives, we used a less rigorous method of analysis as they serve a much smaller number of patients.

There are two major problems in our method of projection. First, major social or technological changes might affect both the rates at which doctors see patients (productivity) and the rates at which people visit doctors (utilization). The only social changes anticipated, such as increased medical insurance coverage, would tend to increase the number of doctor visits. In Taiwan, as in other developing regions, where doctors see from 50–100 patients in an office session, technological changes which improve patient care would tend to lower, not raise, the number of patients seen per doctor. While some technological advances—such as the use of penicillin in place of neo-arsphenamine—save doctors time, many other advances—such as open heart surgery, improved burn treatment, Papinicolaou smears for carcinoma diagnosis, etc.—increase the doctor-time per patient. Thus, we are in all likelihood underestimating future demand for doctors.

Second, we are only too well aware of the hazards of using cross-sectional analysis for long-term purposes. In the case of our general study of the supply of and demand for professional medical personnel in Taiwan, we have had no earlier data to permit examination of changes over time. We have thus been obliged to use cross-sectional analysis and have taken care to consider the various components of demand in order to speculate on the likelihood of their stability over a decade or so into the future. In sum, we think that, despite its limitations, the disaggregated approach we have adopted is better than the simple enumeration of ratios and the projections stemming from them.

DOCTOR USAGE—VISITS PER CAPITA

We used *physician visits per capita* per month as an index of doctor usage. This information was obtained in our random-sample survey by the question "How many times did you visit the doctor during the past month?" With a recall period as long as one month there are undoubtedly forgotten visits as well as "dislocation" of visits from longer ago than one month being reported as visits during the past month.[13] However, these errors are small in magnitude, and the net effect probably tends to underestimate the number of doctor visits.

DEMOGRAPHIC PREDICTOR VARIABLES

Six major variables were studied in detail. We measured the pattern of demand for medical services associated with economic levels, educational levels, urban and rural populations, and different age groups. In addition, sex and levels of morbidity were considered; sex as we will see was unimportant. The effect of morbidity on doctor visits was discussed in Chapter 8.

Economic Levels

Do the rich use different kinds and amounts of medical services than the poor? This seemingly simple question is really quite complex. First, we must define rich and poor. Economic level may be measured in at least three ways—income, expenditure, and wealth. These measures vary in ease of collection, and in suitability for analysis.

One may use *family* or *per capita* measures. Use of *family* expenditure tends to shift the larger families with larger expenditures and more opportunity for multiple wage earners into the higher economic levels. Per capita income or per capita expenditure is probably an improvement over the use of family data. Perhaps the best measure is a scale which takes cognizance of the fact that each additional unit in a family will not cause as much increase in expenditure as the initial unit.

If one uses expenditure as a measure of economic level in doctor-demand projection, it is essential to correct total expenditures by subtracting medical expenditures, since these are obviously highly correlated with use of medical services. In the case of Taiwan, failure to correct for the correlation would have significantly biased our results.

Expenditure, income or wealth? In the United States, probably due to the ready availability of income tax data, income has been used far more extensively than expenditure as a measure of economic well-being.[10,11,23] However, expenditure is more useful in certain circumstances. In Taiwan it is highly unlikely that we could have obtained useful information on income through direct questions, since the Chinese are reluctant to divulge their income. If information had been collected on income its validity would have been highly questionable. For physicians we collected direct information on income. The *reported* physician-income figures were less than

one-third of a very conservative estimate of physician income made from our island-wide consumer study of medical expenditures. Economists in Taiwan agreed that physician incomes were probably understated to this extent. An important draw-back to the use of both income and expenditure as a measure of economic level is that either may vary considerably from year to year.[21]

The third measure of economic level is wealth: accumulated savings, real estate, or durable goods. A study in the early 1930's in rural Wisconsin[8] used a "cow index" as a measure of economic well being. A "cow index," or similar measure of property holdings, is the only appropriate measure for determining economic level in those parts of developing nations which do not yet operate on a monetary economy.

Unfortunately, however, it is very hard to measure a household's wealth. Many of its assets are chattels, whose present market value is hard to estimate. Moreover, a large portion of many families' wealth is intangible; this includes trained skills and good will, both of which can be converted into loans. The measurement of wealth is so complex that we decided to use expenditure as an indicator of economic level.

Per capita expenditure, family expenditure, or a combination? Economic level is a family phenomenon, for the family usually possesses its assets collectively. Most expenditures are for the family, and the incomes of multiple wage earners are usually pooled. Families vary considerably in size. Indeed, they may, and usually do, possess numerous subdivisions, or households. For practical reasons, we use the household rather than the larger unit or extended family. Some inaccuracy creeps in because some households' assets may include the right to call on other households' wealth (as in the case of closely-knit families); but in the main, the "household," defined as a group of individuals living under one roof, is the best choice.

Because households vary in size and because the relative well-being of the members of a household is a function of the number in the household as well as a function of the household's aggregate wealth, we have used a per capita figure; that is, we have divided the total expenditure of the household by the number of persons comprising it.

In the United States National Health Survey, economic level is determined on a family basis rather than on an individual basis.[12,14] Possibly there is some justification for this, just as there is some

truth to the old adage that two can live as cheaply as one. However, the use of *family* expenditure (as compared to *per capita* measures) tends to concentrate the higher morbidity families in the lower income groups. These higher morbidity families are probably older, one and two person families.

In the past, attempts have been made to allow for the size of the family, recognizing that children, in general, do not consume as much as adults, and that there are certain economies of scale in larger families. One of these methods is to give an arbitrary rating factor for additional members in a family. This rating has been termed "adult maintenance unit" or "ammain."[17] We were not able to use this, as we did not have appropriate data.

"Net" versus "gross" expenditures. The unexpected association of higher morbidity with higher economic level led us to the discovery that we had artificially concentrated sick people in the upper economic levels by including their health expenditures with all other household expenditures. One should delete "associated expenditures" when using expenditure as a measure of economic level. For example, medical expenses should be excluded in studying morbidity or medical care; educational expenses should probably be excluded when determining the number of persons in college from various economic levels. These unusual expenses would tend to concentrate the very phenomenon one is looking for in higher economic groups than is justified. We corrected our full year's data for this "associated expenditure artifact" at considerable cost in human and computer time.

Our expenditure groups were divided into five, roughly equal classes, based on our first month's data. For the full year, the

TABLE 9-1. POPULATION DISTRIBUTION BY ECONOMIC GROUPS

Per capita expenditure (NT$)	1963 (%)	1963 (net adj.)[a] (%)	1973 (%)	1983 (%)
0–280	18	18	24	13
281–370	25	29		
371–470	24	23	27	20
471–650	20	18	31	36
651+	13	12	18	31

[a] Medical expenditures subtracted from gross expenditures.

highest group turned out to have 13 instead of the anticipated 20 percent. To furnish a more realistic base for our projections of changes due to economic development, we combined the two lowest groups.

Rural-Urban Residence

Originally, we considered the residential location of individuals an important factor in determining how physicians' services were used because we believed ease of access to physicians must be of critical importance. For that reason we divided the population into five location groups: major cities (five), small cities (seven), towns, rural areas, and aboriginal areas. These are based on official household registration definitions. On analysis, the small cities were enough like the large cities to permit combination. The very small (and nonrandom) aboriginal sample was combined with the other rural areas for our over-all analysis. Thus we emerged with three residence or location groups.

Urban-rural divisions in virtually all countries reflect an inchoate mix. Taiwan is no exception; crops are grown within the large cities; even in the "rural hsiangs" there is crowding similar to that seen in the cities. However, we believe that these anomalies are infrequent and should be considered as insignificant. We considered alternatives, such as classes of population density for each of 315 sub-units, but decided that the more densely populated rural village was less like the city than it was like a sparsely populated village.

Education

We originally thought that education would be an important variable in determining demand for medical services. We had hoped to use five levels of education but there were so few people in our sample with education beyond high school that we settled on (A) no schooling; (B) primary school; and (C) beyond primary school. The numbers in each group are as follows:

A — 30,499
B — 26,575
C — 8,383

One unusual aspect of our classification by education is categorizing children (0–5 and 6–15-year-olds) by the education of the mother rather than their own education. Our reason is that in Taiwan the

mother usually serves as the decision-maker for the extent and type of medical care that a child receives. For example, the thirteen-year-old high school girl who is sent to a herbalist by an uneducated mother is coded as an uneducated person visiting the herbalist. In all likelihood the uneducated mother made the decision.

Our education figures indicate a higher percentage of illiteracy than the official published figures. Many experts assured us that the published figures were much too low. Also, our classification of children by mother's education obscures the extensive program of universal public education that has been developed over the past fifteen years.

Age

We assumed that the most meaningful age groupings would be preschool, school age, working age, and elderly. To aid a colleague, we split one group to identify women in the childbearing ages. Thus, our original age groups run from 0–5, 6–15, 16–50, 51–64, and 65 and over. We recombined the two oldest groups for our final analysis, since the preliminary analysis of the 51–64-year age group showed it to be close to, but less than, the over-65 group in terms of physician services demanded. The 16–50-year group is of some use in analyzing demand for midwives.

Sex

We used a rather conservative approach; we divided our population into two groups—male, and female.

POPULATION PROJECTION

Population projection is at best a tedious, difficult process. Population projection by component groups factorially compounds the difficulty and tedium by each added component. The problems of component projection are well-recognized by demographers,[15,16,20] but universally satisfactory solutions are not at hand. A colleague suggested that we use an elegant method combining population flows between population subgroups in a series of differential equations (some 45,000) that would conceal any shaky assumptions. Instead we chose a method that is inelegant, laborious, and possibly imprecise. Its virtue is that any dubious assumptions are obvious to the reader who may substitute his own assumptions, and change the final figures.

We combined age groups 4 and 5, economic groups 1 and 2, location groups 1 with 2, and 4 with 5, as they were quite similar. Basically, our method is a cohort projection (by age) using appropriate age-specific death rates and age-specific fertility rates. We used a low fertility rate assuming anticipated success of the family planning program. We also used the present fertility rate (correcting for the existing downward trend) for our high population projection.

Our independent age projections for 1972 year-end populations tallied so closely with the projections made by Dr. L. P. Chow[18] for the Population Studies Center that we elected to use those figures. This permitted interpolation to midyear figures which better corresponded with the timing of our household survey. The assumptions we used in our population projection by age groups were as follows: (1) that there would be no significant external migration (immigration or emigration) over the next twenty years. We base this assumption on household registration statistics. Over the past five years, 1959–63, in-migration has dropped from 9,500 to 5,100 while out-migration has risen from 3,800 to 5,400. Although we have been told that the registry system underestimates migration, nonetheless, we believe that external migration will be insignificant in total population changes of the next ten and twenty years. (2) The age-specific death rates will not change significantly. This assumption is based on the belief that actual decline in infant and early childhood deaths, where the major reductions in death will occur, will be balanced by improved reporting of those deaths which occur. (According to Dr. Chow[3] there was fairly extensive underreporting of infant deaths.) (3) That age-specific fertility will: (a) continue its present downward trend (*high projection*), or (b) have an accelerated decline due to the family planning program (*low projection*).

Changes in Size of Economic Groups

After many discussions with Taiwanese and American economists, we took a very conservative approach to our projections for economic improvement in Taiwan. Despite yearly increases in real per capita income, ranging from 2.1 percent to 6.2 percent over the past five years,[4] we used a total 20 percent increase over the next ten years and an additional 20 percent increase over the following decade. Our decision was made with full understanding that even the official low estimate of 2.7 percent per year growth

rate would compound to more than 30 percent over the space of a decade and more than 70 percent in twenty years. However, we feel that the economic growth rate is bound to fall as the total economic base increases and that the growth rate might also be slowed by the recent cessation of the stimulus of the United States AID program of loans and grants. Our assumption would lead toward an underestimate of doctor demand in 1973 and 1983.

Our second assumption was that real per capita income increases would be uniformly distributed over the range of economic levels. In Taiwan this assumption is not unreasonable, as past surveys have shown a trend for equalization of the distribution of income over the past ten years. Our third assumption, a rather shaky one, is that the *per capita* income increase will be the same with either high or low population increase. A fourth assumption is that doctors will provide the same number of services per year independent of price per service. We doubt if they can provide more, even with additional price incentive. If price per service drops (relative to general price level) the physicians must keep up the number of services to prevent further fall in their income. A fifth assumption is that price for medical services will not rise faster than the general price increase. This assumption would not be valid if a shortage in the supply of physicians were allowed to develop. The consequences of a shortage of physicians is discussed in Chapter 11.

In order to redistribute our population, affected by increased real per capita income ten and twenty years in the future, we first prepared a frequency distribution (using numerous narrow intervals) of net total per capita expenditure for all families in one month. From this frequency distribution we calculated how many persons would move from economic group 1 to group 2 with a 20 percent increase in per capita income (assuming expenditure to be roughly similar). In like manner we calculated the numbers moving from group 2 to group 3 and group 3 to group 4. The same method was used for our twenty-year projections with a 40 percent increase in per capita income. The percentages in the various groups at the present time and ten and twenty years in the future are shown in Table 9–2.

We recognize that there are some sources of error in this method of redistributing the population by economic groups: equilibrating rise in per capita income with rise in per capita expenditure,

TABLE 9-2. PROJECTED POPULATION CHANGES BY ECONOMIC GROUPS[a]

Economic group	1963 (%)	1973 (%)	1983 (%)
A	45	24	13
B	25	27	20
C	21	31	36
D	9	18	31

[a] Based on net per capita expenditure.

assuming that our one-month distribution of expenditure groups is characteristic of the full year—and indeed of future years—and using expenditures net of health expenses. An additional potential source of error is our basic assumption that people who move from economic group 1 to economic group 2 will purchase medical care at the same rate as those persons who are now in economic group 2. However, the net effect of all our assumptions and approximations will tend to produce an underestimate of the increase in demand for physician services.

To combine economic changes with age shifts we make three basic assumptions. First, each economic group will reflect the same general pattern of age distribution which now prevails, i.e., a relatively higher percentage of dependent children in the lower economic groups; a relatively higher percentage of elderly in the higher economic groups. (This pattern seems reasonable for economic levels based on *per capita expenditure.*) Second, we assume that death rates of the rich will not change *in relation to* the poor. The poor may have more room for improvement of their death rate, but the rich have the money to buy better nutrition and better health care to improve their death rate. We believe these forces will balance the death rate changes in rich and poor. Third, we have assumed that the age-specific fertility rate of the poor will not change *in relation to* the rate of the rich. Again, although the fertility rate of the poor is higher, we believe that the rich will continue to lead in the trend toward smaller families, producing essentially parallel trends of fertility decline in all economic groups.

Table 9-3 shows our population projections by age and economic groups for 1973 and 1983, by high and low fertility assumptions.

TABLE 9-3. POPULATION PROJECTION BY AGE AND ECONOMIC LEVEL*

Low Population Projection
1973

Age group	Number (000)	Economic group A 24%	B 27%	C 31%	D 18%
A (0–5)	1,979	613	534	552	276
B (6–15)	3,848	1,040	1,040	1,192	578
C (16–50)	7,287	1,457	1,970	2,400	1,457
D (51+)	1,654	281	430	546	398
	14,768				

1983

Age group	Number (000)	Economic group A 13%	B 20%	C 36%	D 31%
A (0–5)	2,460	490	490	810	761
B (6–15)	3,388	542	678	1,220	948
C (16–50)	9,615	865	1,922	3,648	3,180
D (51+)	2,434	146	462	924	900
	17,897				

High Population Projection
1973

Age group	Number (000)	Economic group A 24%	B 27%	C 31%	D 18%
A (0–5)	2,563	795	693	716	359
B (6–15)	3,893	1,049	1,050	1,202	582
C (16–50)	7,287	1,457	1,965	2,400	1,457
D (51+)	1,654	281	430	546	398
	15,397				

1983

Age group	Number (000)	Economic group A 13%	B 20%	C 36%	D 31%
A (0–5)	3,527	705	705	1,461	951
B (6–15)	4,538	725	960	1,631	1,269
C (16–50)	9,670	871	1,939	3,680	3,200
D (51+)	2,434	146	462	924	900
	20,169				

* Figures do not add across since they are approximations.

To construct Table 9–3 we used a process of approximation that reflected the present distribution of age groups within each economic group.

Trend toward Urbanization

Our analysis of household registry figures for 1959 to 1962 showed a fluctuating yearly pattern in migration from rural to more urban areas.

	Annual *net* migration
Remote rural	No net change
Rural	23–37,000 loss
Towns	No net change
Small cities	5–12,000 gain
Large cities	23–37,000 gain

These figures tally well with the calculations of The Taiwan Population Study Center, although its figures are presented only by major cities and counties.[18] On the basis of our calculations we predict a *net* urban migration gain (and rural loss) of approximately 35,000 per year, a figure somewhat less than 10 percent of the annual crop of babies.

Thus, internal migration is less important than, and almost balances, the effect of differential fertility, morbidity rates, and age structure in determining rural-urban shifts in population.

Since our projection showed that the relative size of residence groups would not change appreciably over the next twenty years, we did not add this component to our basic population projection.

Sex and Education

Originally we decided to omit a breakdown by sex as we expected little change in sex ratio. Preliminary population estimates surprised us somewhat by showing a probable 4 percent change in sex ratio over twenty years (from 109 males per 100 females in 1963 to 105 per 100 in 1982).

However, what surprised us even more was the fact that the sexes used doctors essentially equally at all ages, in all locations, and at all educational and economic levels. Therefore, we excluded sex from our projections. Although this omission was justified in Taiwan, sex may be an important variable in other countries.

We were also surprised to learn that the different education groups did not have significantly different rates of doctor usage. Thus we were spared the necessity of projecting population by separate education groups.

In summary, the essential results of our population projections are presented in Table 9–3. The population in this table, combined with the rates from the next section, allow us to derive our estimate for doctor demand.

ANALYSIS OF DOCTOR USAGE TECHNIQUES OF MULTIVARIABLE ANALYSIS

As mentioned earlier, there were two reasons for undertaking multivariable analysis of the effects of the various demographic variables on the demand for physician services. First was our interest in clarifying and understanding the effects of demographic characteristics on doctor demand in a developing nation.

Second, as the number of components in the projection increases, problems in the determination of future population components multiply. Consequently, we sought to determine the feasibility of dropping one or more of our variables, if any proved to be unimportant in determining future demand. (By "unimportant" we mean that the difference in rates of doctor usage between groups was so small as to make no appreciable difference in our final calculation of doctor demand.)

For example, if the well-educated made essentially the same number of visits per capita as the illiterate, education would be unimportant for predictive purposes, even in the face of large

population shifts from poorly educated to well-educated. However, a difference of 0.2 visits per capita per month between groups, accompanied by a shift of 20 percent from the lower to the higher group, would entail an increase in demand from 500 to 800 physicians (depending on the size of increase of total population).

Unfortunately, associations among variables may exist to hamper the evaluation of the influence of each. Such associations take two forms, usually described as correlations and interactions. Correlations arise from peculiarities in the distribution of observations. If, for example, urban areas tend to have relatively large numbers of high-income residents, it would not be clear immediately whether observed rates of doctor usage resulted from conditions of urban living or from the income differential. Indeed the two forces could act in opposite directions, thus obscuring the real influence of each. Though difficult, the issue must be resolved if one is to assess the projected impact of economic improvements in rural areas.

Interactions come about when the influence of given combinations of variables is unlike the effect that would be anticipated from examining each variable separately. To illustrate, high income and urban residence might interact to produce a synergistic effect on raising usage rates higher than the sum of the individual effects.

Choice of Analytical Techniques

Perhaps the most popular method for overcoming the problem of correlations among the independent variables is multiple regression analysis.[6] This technique is not completely satisfactory in handling interactions, however. Also, with it one encounters difficulty in assessing the nature of the direct influences whenever they are nonlinear, or at least not well-known in advance. These difficulties are discussed more fully in Appendix I; we shall simply observe here that inasmuch as the technique develops a detailed regression equation the conclusions will depend to a large extent upon the specific terms included. Many of these terms, particularly the cross products, are so complex in interpretation that they are not useful in projection.

At the other end of the spectrum, the analysis of variance technique is extremely effective in uncovering effects and interactions whenever the correlation problem does not exist. In practice, this means that each combination of variables should be represented

equally. That is, each cell should have the same number of observations. While this restriction cannot be fully complied with in most random sample series, it should not distract us from the concept of examining blocks of effects instead of detailed mathematical expressions. The method of principal components analysis has also been applied to health data.[19] Specifically, it would be useful to determine whether income and residence interact in some way. For example, we could hardly know in advance whether this interaction should be expressed mathematically as (residence)^2 $\times$ (income) or (residence) $\times$ (income)^3.

Obviously what is needed is a technique that employs the block-sorting principle and also recognizes inequalities in cell observations. Modification of the standard analysis of variance technique to handle cell inequalities added a great deal of mathematical complexity. For this reason we have developed an approximate method which is considerably simpler but retains the essential features of analysis of variance. This method (called multisort analysis and described in more detail in Appendix I) provided the basis for our initial assessment of the importance of the variables. For confirmation of our results we employed a second technique, one devised by Vernon Lippitt.[9] It is a modification of the multiple regression approach utilizing the block-sorting principle but not directed specifically at the study of interactions.[22]

Having come this far, we utilized multiple regression analysis to smooth our estimates of doctor usage. The regression technique was quite useful at this point, for the preceding evaluation had identified the important elements to be included in the equation, and the regression analysis succeeded in quantifying each element. It may be noted that smoothing our rate data had only minor effects on our estimates of physicians required (less than one percent difference).

One last comment on the problems of analysis is that consideration of the inequality of cell sizes is of practical as well as theoretical importance. Weighted analysis gives a predicted number of 300–400 more physicians than the unweighted (assuming equal cell weights) analysis.

RESULTS OF THE MULTIVARIABLE ANALYSIS

By far the most important element in doctor usage was found to be age. Two other variables, expenditure and residence, produce a

lesser but still significant impact on usage. Finally, one interaction between age and expenditure was uncovered. More precisely, the nature of these influences can be observed from the final regression equation.

$$\text{Predicted } V = 1.039 - 0.987A + 0.223A^2 + 0.156W + 0.060R - 0.035AW$$

R = Residence
A = Age
V = Visits per capita per month
W = Economic level

Age

All the instruments agree that age is very important in determining the rate of physician visits. This effect of age is not a spurious effect that comes from other associated variables, but is a real effect which was identified by the "multisort" analysis, the Lippitt technique, and the straightforward regression analysis. In the case of regression analysis, age was quite naturally identified as a quadratic function or U-shaped curve, with rates of visits of the middle age groups lower than either the youngest or highest age groupings. Table 9–4 shows the pure effect of age on the monthly rate of doctor visits.

TABLE 9–4. DOCTOR VISITS BY AGE

Age	Visits per month
Group I (0–5)	0.7
Group II (6–15)	0.2
Group III (16–50)	0.4
Group IV (51+)	0.8

As we can see in this table, even a small shift in population from a low group such as Group III to the oldest group, Group IV, would cause a marked change in the over-all demand for physicians. In Taiwan the greatest effect from changes such as this would not be felt until after the year 2010. Until then the tremendous postwar population increase will not begin to affect the percentage of population in the oldest group. (This phenomenon is of no concern in our relatively short-term manpower projections but is a point of interest for those countries where the demographic distribution is such that major increases in the *percentage* of aged are anticipated.)

The effect of age in determining rates of doctor visits is significant at the $p = 0.001$ level with an F value of 105. The importance of this variable was certainly not unexpected. In Chapter 8, on biological demand, we noted a morbidity pattern with much higher morbidity in the very young and the elderly. The pattern of doctor visits in Taiwan is not too different from that of developed countries, except for higher rates of physician visits in the youngest age group.

Economic Level

The effect of economic level in determining the rate of private physician visits is also important.[1,2] It is significant at the $p = 0.001$ level with an F value of approximately 18 (see Appendix I). Although having less difference between groups than the variable of age, it will affect our results as we can expect major shifts in population from the low-rate groups to the high-rate groups over the next twenty years. Table 9–5 shows the rates of doctor usage for various economic groups.

TABLE 9–5. ECONOMIC GROUPS AND RATES OF PHYSICIAN USAGE

NT$ Income	Visits per month
Group I (0–370)	0.4
Group II (371–470)	0.4
Group III (471–649)	0.5
Group IV (650+)	0.6

Place of Residence

The place of residence is also a significant variable at the $p = 0.001$ level; however, the F value is only 12, using the multisort technique. Visits per capita per month by place of residence are as follows: cities 0.3; towns 0.5, rural areas 0.5. We were surprised to find that there was a higher rate of visits in the rural areas and particularly surprised that the most rural area had a slightly higher rate than the towns (not shown above due to rounding to the nearest tenth) and a considerably higher rate than the cities. This higher usage in rural areas must be caused by the considerably higher rates of illness in rural areas. In terms of morbidity (percent losing days), place of residence is considerably more important than economic level (ten times as large an F value). We were not surprised to find that the rates of mor-

bidity were higher in the rural areas, probably because of less effective sanitation and less adequate nutrition. The high rates in rural areas are not due to age or economic differences, as these have been compensated for in our analysis. When high rates of morbidity in rural areas are coupled with reasonably good distribution of doctors and an excellent transportation system, such as prevails in Taiwan, the rates of doctor usage from rural areas will be quite high. (It should be noted that this residence effect is independent of the economic variable of ability to pay. The lower economic level prevailing in rural areas does, in practice, lower demand for medical attention, with private payment medical care.)

Interaction

In examining the interactions of only the three important variables listed above, the interaction of economic level and age was the only one that had significance at the $p = 0.001$ level. Even this was not really very important, for the F value in the weighted analysis of variance was only 3.6. Finally the expenditure-age interaction shows that the age differential in doctor usage is especially pronounced among those of higher economic status.

Education

To our great surprise we found that education did not appear to be important in the determination of rates of doctor usage in Taiwan. Although in our rough two-by-two tables of rates of doctor usage the more highly educated almost invariably used less physician services per capita, the differences did not show up as significant in the multisort or regression analysis methods. It should be pointed out that the two-by-two tables also showed that for every age, economic level, and place of residence the less well-educated had more illness.

Of persons who were sick, the better educated, as we would expect, made more use of physician services. However, the possible propensity for the well-educated to use more care was balanced by their apparent lower morbidity, resulting in small differences in rates of doctor usage.

Sex

It also came as a surprise to us that women had essentially the same number of physician visits and the same levels of morbidity

as men. From our experience with United States data we expected that women would have a somewhat higher rate of physician usage. However, a recent, year-long study of 10,000 Koreans[7] paralleled our findings that there was little difference between the sexes in the utilization of physicians.

In terms of rates we had expected differences and found none. In terms of population changes we had expected none and found shifts, thus confirming the old Chinese proverb, "The man who studies sex meets many surprises."

DEMAND FOR DOCTORS 1973–83

All of the foregoing is interesting, but does it help us decide which are the important predictors of physician utilization? Will it help us estimate the number of physicians a future population of specified composition will demand? The answers to these queries are (like so many good answers) a qualified *No* and *Yes*. *No*, because that which we have discussed does not give the full answer to what we have to determine. *Yes*, because the answers we received from this analysis make over-all sense. The father of modern social statistics in America, I. M. Rubinow, once remarked that one should be skeptical of statistics which do not demonstrate the obvious. Statistical science has come a long way since Rubinow's time, but there is satisfaction in knowing that there is a semblance of sense in what we have found when we come to analyze the same data for use in answering the really operational questions we have put. We now come to the meat of our analysis.

As a first step, we multiply the projected age and economic level of population subgroups times the appropriate rates of doctor visits. We then total calculated doctor visits per month for all age-economic groups. Next we divided the total doctor visits by our estimates of average number of patients seen per month by a doctor, and thus arrive at the number of doctors required, expressed in simplified form:

$$\text{Total doctor demand} = \frac{\Sigma \text{Pop.}(\text{age}_1\text{ec}_1) \times \text{rate visits}(\text{age}_1\text{ec}_1) + \text{pop.}(\text{age}_2\text{ec}_1) \times \text{rate visits}(\text{age}_2\text{ec}_1) \ldots \text{age}_4\text{ec}_4}{\text{Average number of visits per doctor per month (1,000)}}$$

This procedure is carried out for 1973 and 1983 using both low and high population growth rates. Table 9–6 shows our basic predictions.

TABLE 9–6. PRIVATE DOCTOR DEMAND

1973		1983	
Low population increase	High population increase	Low population increase	High population increase
6,200	6,600	8,400	9,800

We calculated average visits per doctor per month by dividing the total number of visits per month from our survey, extrapolated to the total population, by the total number of full-time equivalent private practitioners. Assuming twenty-four working days per month, 1,000 patient-visits per month is about forty visits per day, a quite reasonable average figure.

Since the Population Studies Center projections included native Taiwanese members of the armed forces, a small correction had to be made in the estimates above. The correction was based on doctor visit rates of the 16–50-year-old group and a population of 200,000.

Relative Importance of Age and Economic Level

We were most interested in determining the relative effects on demand for doctors of simple population increase and of demographic shifts within the total population. For our example we used the 1983 high population increase projection. On the basis of *population increase alone* we would have predicted a demand for only 8,300 doctors. A demand for an additional 1,500 doctors (18 percent) will be caused by the demographic shifts within the total population. This difference in doctor demand is larger than the difference caused by the two extremes of population projection. The size of "demographic shift" difference, alone, justified the more sophisticated methods of analysis which we used in lieu of simple doctor-patient ratios. Moreover, our method facilitates a practical understanding of the dynamics of manpower planning that is missing in the doctor-patient ratio method.

In Taiwan the factor of economic change will account for

approximately four-fifths of the increased doctor demand, above simple population-based increases, while age will account for one-fifth of the increase. In countries with less rapid economic development the impact of economic level would probably decrease in importance. With aging populations the age factor will assume more importance in determining added demand.

Unimportance of Shifts in Rural-Urban Balance

Residence was the third variable that showed significant rate differences in our multivariable analysis. However, there are two opposing, partially balancing forces that will affect the rural-urban *population* distribution. The birth rate in the rural areas will probably continue to exceed the birth rate in both the towns and cities, by some 60,000 to 80,000 births each year. Partially balancing this extra population growth in the rural areas is the migration from the rural areas to the cities. (Although the pattern of migration may be from rural areas to the towns and from the towns to the cities, all that we could measure was net migration.) Approximately 30,000 persons a year move out of rural areas; approximately 30,000 persons move into cities.

We are not certain that the migration rate will remain at the same level as for the past few years. With increasing industrialization it may well increase. Nor are we certain that the difference in numbers of births between rural areas and cities will remain the same over the next twenty years. The present rural-urban difference in births will result in approximately 5 percent more of the total population being in rural areas and 5 percent less in the cities in 1983. Counterbalancing this shift is our estimate that about 3 percent of the total population would move from rural areas to cities over the next twenty years. This gives a net change in rural-urban balance of roughly 2 percent of the total population.

This relative increase of total population in the rural area, together with the slightly higher rate of physician usage in the rural area, calls for an increase of only fifty physicians. We have disregarded this increase in our projection, both because the number of doctors involved is so small and because our confidence in our assumptions on rural-urban population shifts is not great. However, we do feel relatively confident that changes in strata will not be a major factor in changing physician demand over the next twenty years. In other countries the rural-urban shift may be a major factor in changing demand for doctors.

DEMAND FOR PRIVATE SECTOR MIDWIVES, DENTISTS, AND HERBALISTS

We have used sophisticated methods of projection only for physicians. The demand for other private practitioners has been calculated by simple projections based on population increase plus minor estimated corrections for other factors. Predictions based on the use of more time-consuming methods would not have differed greatly in absolute numbers of health workers.

Herbalists

On the basis of our household survey, we estimate that there were some eighteen million visits made per year in 1963 to the 1,500 active herbalists in Taiwan. In terms of productivity (not effectivity), the average herbalist sees as many patients as the average physician. They are, in fact, meeting a demand for medical care. This demand will not disappear in the next two decades merely because physicians feel that the herbalist is not practicing scientific medicine. Although the per capita rates of usage may decline, there will probably continue to be an appreciable demand for practicing herbalists in 1973 and even in 1983.

The average annual number of herbalist visits per person in our survey was 1.5. We have measured the rates of use of herbalists by age, sex, residence, education, and economic groups. Females seemed to visit herbalists slightly more often than males, but our education-by-sex tables indicate that this is an education effect rather than a real sex difference in rate of herbalist usage. At similar educational levels women have the same rates as men. Surprisingly enough, the highest rate of herbalist visits occurs in the towns and villages rather than in the most remote rural areas. In all likelihood this situation exists because most herbalists do *not* practice in the remote areas of Taiwan. Our survey showed that the distances traveled to point of health service in the rural areas were longer for herbalists than for physicians. The finding that herbalists do not serve the remote rural populations came as a surprise to us, for many Taiwanese health officials had told us that herbalists filled a necessary role in serving *rural* populations. Although there are more doctor visits than herbalist visits in all areas, the rate of herbalist visits per capita are lower in cities than in either towns or rural areas. This may reflect the greater sophistication of the urban dweller as well as the greater availability of modern medical care.

As one would expect, older people visit the herablist more frequently than the young. The rate for our oldest age group is approximately three times as high as the average rate. This reflects both the lower rates of education in the older groups and their higher over-all rates of illness. Economic level does not seem to be an important factor in determining rate of visits to the herbalist. There is little difference in visits per month between the richest and the poorest group. However, a real difference may be overshadowed by the positive correlation of economic and education levels.

In a practical sense education is the most important variable. There are large differences in rates of visits between the illiterate and the best educated. Furthermore, we can expect large population shifts from the illiterate to the better educated groups over the next twenty years.

To calculate the demand for herbalists in 1973 and 1983, we have taken the current rate of herbalist visits per capita per month of 0.13 and modified it to 0.12 visits per capita in 1973 and 0.11 visits in 1983, on the basis of improvement in educational levels in Taiwan.

In light of the small differences of rates of visits by economic level and small shifts of population groupings by age and residence, we did not correct for these factors. Table 9–7 gives our prediction for demand for herbalists in 1973 and in 1983 by the two population projections.

TABLE 9–7. DEMAND FOR HERBALISTS, 1973–83

1973		1983	
Low population estimate	High population estimate	Low population estimate	High population estimate
1,800	1,300	2,000	2,200

The Ten Year Health Plan anticipates no further training of herbalists in Taiwan over the next ten years (and presumably the decade from 1973 to 1983 also). The effect of such an assumption, coupled with our estimated increasing demand for herbalists, will be discussed in Chapter 10.

Practitioners of Dentistry, Trained and Untrained

The 1,700 individuals who are currently practicing dentistry in Taiwan handle some four million patient visits per year (we include unlicensed dentists as well as dental assistants in independent practice and deduct dentists in the public sector). These practitioners of dentistry obviously have a low rate of productivity, seeing on the average only 200 persons per month. We cannot distinguish between productivity of licensed dentists, illegal dentists, or independent dental assistants for we did not differentiate between these practitioners in our household survey question on dental services.

Analysis by demographic variables yields the expected results. The highest economic group used much more dental care than the other groups. Higher educational groups use more dental care. Also, as expected, the urban dwellers use almost twice as much dental care per capita as the rural dwellers. From our household survey data it appears that preschool children have essentially no dental problems which cause their parents to take them to the dentist. From our data we are also led to believe that over age sixty-five Taiwanese have no dental problems; perhaps they have no teeth. In other words, demand for dental care is concentrated in the middle age group. Since number of visits are small, we did not use cross-tabulations or multiple variable analyses for dental visits. Currently the rate of dental visits is 0.3 per capita per year. Because of improvements in economic and educational level we believe that this rate will rise to 0.45 by 1973 and to 0.6 visits per year by 1983. We also believe that dental productivity (patients per dentist per month) can and *must* increase if dentistry is to survive. We are confident that the dentist can easily see as many as 350 patients per month (less than fifteen per working day) and have used this figure in our calculations. (We discussed methods of securing higher productivity in Chapter 11.) Our projections for dental practitioner demand, based on estimated changes in population, rates of usage, and dentist productivity is shown in Table 9–8.

Midwives

In 1963, out of the 424,000 births, some 170,000 deliveries were made by the 1,370 private practice midwives. If the figure of 170,000 deliveries really represents deliveries attended and not

TABLE 9-8. DEMAND FOR PRACTITIONERS OF DENTISTRY, 1973-83

1973		1983	
Low population estimate	High population estimate	Low population estimate	High population estimate
1,600[a]	1,700	2,600	2,900

[a] This number is lower than the total of dentists, unlicensed dentists, and independent dental assistants in 1963. We anticipate a decline in the illegal practitioners over the next ten years.

just birth certificates signed by the midwife, it implies that a midwife delivers on the average more than 120 babies per year, a quite respectable rate of productivity considering the fact that virtually all of these deliveries are home deliveries. From our household survey we found that the women of Taiwan made some 520,000 visits per year to midwives. These data imply that there were approximately three visits to each midwife per delivery. We interpret this finding as evidence that midwives in private practice give some antenatal or postnatal care, or take care of abortions, in addition to deliveries.

In relation to demographic variables, our survey findings show that the per capita visits to midwives are similar in all educational levels. We feel that this may be a statistical artifact associated with higher birth rates in the poorly educated groups, where the patients visit midwives less frequently per delivery. As for economic levels, we found a similar pattern with the lowest and the highest economic group showing similar levels of midwife visits per capita. Again, we beleive this to be a statistical artifact. In terms of residence, the rates of midwife visits are highest in the cities, next in the towns, and lowest in the rural areas. As we noted earlier, the largest number of births occur in the areas which we designate as rural. On a per delivery basis there are far fewer births attended in the rural areas than in the urban areas. This fact is well recognized by the Taiwanese health authorities.

In predicting the future demand for private sector midwives, we have assumed that demand will closely follow the size of the annual crop of babies. We would like to think that improved economic conditions and educational status would increase the number of deliveries attended by midwives. However, evidence does not indicate that even 75 percent of deliveries will be attended

by trained midwives in ten years, or even twenty years. In making our calculations, we have assumed that the percentage of deliveries cared for by the private sector midwives will have a 15 percent increment over each of the next two decades. This is a conservative estimate based on the 20 percent rate of economic growth that we used in our projection for public sector midwives. In actual terms, we have assumed that the number of private sector midwife deliveries would increase from 40 percent (1959 figures) to 46 percent in 1973, and 52 percent in 1983. The results of applying these rates to the anticipated number of deliveries in the target years are shown in Table 9–9.

TABLE 9–9. DEMAND FOR MIDWIVES

	1973	1983
Deliveries (low birth rate)	344,000	436,000
Number of midwives	1,300	1,900
Deliveries (high birth rate)	472,000	634,000
Number of midwives	1,800	2,700

The figures in Table 9–9 are extremely conservative. We have no doubt that the demand for private sector midwives might well exceed these figures. The table shows a demand for midwives for 1973 (low population increase) which is *less* than the number of midwives currently available. To achieve this low population increase requires the services of more midwives in the family planning programs. Thus we have concluded that there would be no decline in the number of midwives required for 1973.

Summary of Private Sector Demand

In conclusion, we estimate that the demand for private practitioners will be as shown in Table 9–10.

TABLE 9–10. DEMAND FOR PRIVATE PRACTITIONERS IN THE PRIVATE SECTOR, 1973 AND 1983

	Private sector demand	
	1973	1983
Doctors	6,200–6,600	8,400–9,800
Herbalists	1,800	2,000–2,200
Dental practitioners	1,600–1,700	2,600–2,900
Midwives	1,300–1,800	1,900–2,700

These estimates, plus estimates of public sector demand from Chapter 10, will be compared with our projected supply of health workers. Chapter 11 deals with alternative courses of action that the government of Taiwan may take to deal with imbalances.

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CHAPTER 10

PUBLIC SECTOR DEMAND—PRESENT AND FUTURE

"The superior physician serves the government, the average physician teaches, the inferior physician treats the patient" (*One Thousand Gold Remedies*)

WHAT is the importance of government hospitals, health centers, and other agencies as employers of health workers? Essentially all qualified nurses work in government service, as do a third of the midwives and 30 percent of all doctors. Sanitary engineers and sanitarians also work primarily in the public sector, but they are discussed in Chapter 7 on environmental sanitation. Technicians, assistant nurses, and clerks work in the public sector; the first category is small, the others are not professionals. Table 10–1 shows the relative numbers of persons in the public and private sector.

TABLE 10–1. PHA–JHU HEALTH PROFESSIONAL CENSUS

	Doctors[a]	Nurses	Midwives	Pharmacists
Full-time (self-employed) private practice	3,809	48	1,370	540
Hospital	873[b]	1,073[b]	122[b]	91[b]
Health center	352	147	471	16
School	35	38	16	10
Other	158	89	58	336
Total filled positions public sector	1,418	1,347	667	453
Grand total:	5,450[c]	1,435[d]	2,055[d]	1,000[d]

[a] Includes both A and B doctors, see Chapter 4.
[b] Includes employment in public and private hospitals.
[c] Corrected for lack of census data, Penghu Islands (30), underenumeration of doctors in four cities (98), and doctors with incomplete census cards (95).
[d] Corrected for lack of census data, Penghu Islands.

Although public sector nurses can be counted as full-time in the public sector, the physicians almost invariably have a private practice in addition to their governmental job. Authorities estimate that one should discount the number of physicians listed as working in the public sector by 50 percent, as, on the average, half of their time is spent on private practice.

What are the public sector institutions that use health professionals? *First*—the hospitals in Taiwan: provincial hospitals, municipal hospitals, mission hospitals, public enterprise, and teaching hospitals. *Second*—the military health services that offer some help for civilian dependents. *Third*—the new government insurance plans which have great potential for changing the demand for health services in the future. *Fourth*—the health bureaus and stations of the twenty-two cities and counties, and *Fifth*—the Provincial Health Department. Although the Provincial Health Department is not a large employer its health programs are so vital that they should be discussed in any report on health manpower.

We shall present these five segments of the public sector separately, summarize their present demands for health professionals, and then project this demand to the future, based on the objectives of the Taiwan Ten Year Health Plan. Our bases for projection are the increase of facilities scheduled in the Ten Year Health Plan, the increase in total population, and corrections for marked understaffing in certain areas. We do not have adequate data to determine the degree to which increasing economic level, education, and urbanization will affect the people's demands on their government for more and better health care. We believe the effect of these factors will be to increase demands for public sector medical workers well above our estimates.

HOSPITALS OF TAIWAN

The fact that impressed us most about the hospitals of Taiwan was the relatively high level of health that has been achieved despite a bed-to-population ratio, which, for a region of Taiwan's economic development, is remarkably low. For example, Taiwan's 1.01 beds per thousand persons may be compared with: Japan, 8 per thousand; North Borneo, 2.8 per thousand; Malaya, 4 per thousand; Singapore, 4.3 per thousand; Hong Kong, 2.9 per thousand; and Peru, 2.4 per thousand. We do not feel that the relatively low bed-to-population ratio in Taiwan is an immediate

indication for increasing the number of beds, and consequently demanding more health personnel to attend these beds. Rather, we feel that as a first step, better utilization of the existing beds could be secured. This too will have its effect on increasing the demand for health workers.

Provincial Hospitals

In 1963 there were twenty-six general and special hospitals under the administration of the Provincial Health Department. These twenty-six hospitals had a total of 3,900 beds. However, 1,100 of the beds were in the leprosarium, another 600 were in the two mental hospitals, and 300 were in the four tuberculosis sanitariums. The remaining 1,900 beds were divided among fourteen general provincial hospitals with their three branches, a small women's hospital, and a children's hospital.

Over the past ten years there has been an active hospital building and renovation program. The United States Agency for International Development (AID) assisted in the expansion and the new construction of six provincial general hospitals, two branch hospitals, three tuberculosis hospitals, the mental hospital, and one county hospital. As a result of this program, provincial hospital expansion has kept pace with the general population growth. This is not to say that the over-all Taiwanese hospital-bed-to-population ratio is satisfactory, or that the expansion programs for other hospital systems have been adequate. It simply shows that the Provincial Health Department has not lost ground in the struggle to provide hospital care for a rapidly increasing population.

Has the deficient staff-to-bed ratio improved over these ten years? Were increases in staff able to keep pace with increases in the number of beds? Unfortunately, the staff-to-bed ratio dropped somewhat from 1954 to 1963. The largest part of the decrease was due to failure to increase professional staff. (*The 1963 Health Statistical Abstract for Taiwan*[1] gives a total of 2,334 employees for the provincial hospitals, although the *Ten Year Health Plan*[7] lists only 1,900.) We use the larger figure from the *Health Statistical Abstract* in comparing staffing ratios of 1954 to those of 1963, but believe that the health plan figure, 1,900, should be used in calculating the over-all staff-to-bed ratio: 0.5 staff per bed. This ratio is well below acceptable levels and is even below the figures for the better hospitals in Taiwan.

Provincial hospitals take up the lion's share of the Provincial

Health Department budget: 134 million NT$ out of 191 million NT$. In 1964 part of the budget for provincial hospitals included a 92 million NT$ "revolving fund" which represented fees collected. We estimated from our survey data that 230 million NT$ in fees were paid annually to all *government* hospitals of Taiwan. This includes municipal and county hospitals, but the municipal-county inpatient load is only one-eighth that of the provincial hospital load. The discrepancy between 230 million NT$ and 92 million NT$, plus whatever fees were reported for municipal hospitals, is puzzling. Probably it is explained by methods of fiscal reporting.

The provincial hospitals are quite well distributed throughout the island, following the pattern of population distribution. The demand on their facilities has increased faster than facilities have been augmented. Since 1954 the load of new inpatients has doubled, going from 16,000 to 34,000 per year. The number of outpatients has gone up somewhat less rapidly, from 180,000 in 1954 to 274,000 in 1964. Although complete figures are not available to permit accurate calculation of the average length of stay, we estimate that it would range from ten to twenty days in the various provincial hospitals. The average length of stay and the variation from hospital to hospital indicate that the Provincial Health Department might carefully review hospital utilization practices with a goal of more efficient use of the hospital facilities. The effect of improved hospital utilization would create an increased demand for physician and nurse services as rapid turnover of patients necessitates more intensive care.

According to Taiwan's *Ten Year Health Plan*, five provincial general hospitals, the maternity hospital, and the children's hospital have inadequate physical facilities and are urgently in need of improvement. The changes recommended in the *Ten Year Health Plan* will improve the services offered at these provincial hospitals, but are unlikely to affect demands for staff.

Municipal and County Hospitals

In 1963 there were nine municipal general hospitals, one municipal maternity hospital, and three municipal communicable disease hospitals. One of these was apparently rented to the military. According to information supplied us by the Provincial Health Department, these hospitals had a total of 555 beds; the *Health Statistical Abstract for 1963* gave a figure of 641 beds and the *Ten Year*

Health Plan estimated 850 beds. They served some 4,300 inpatients (approximately 56,000 days of stay) for an estimated average daily stay of fourteen days and an estimated occupancy rate of less than 30 percent.

It is difficult to accurately determine the load of outpatients in the municipal and county hospitals, as outpatient visits are lumped with visits to the health bureaus. In 1963, 375,000 total visits were reported. (We estimate that 300,000 of these visits were to the hospital outpatient departments.) Apparently there has been a decrease of almost 40 percent in the combined number of outpatient visits to municipal-county hospitals and health bureaus over the past ten years.

The surprising drop in municipal-county hospital outpatient visits has been partially explained by a large increase in provincial hospital outpatient department visits. (Health officials say that there is less adequate staffing and service in the municipal-county hospitals.) Probably greatly increased numbers of visits to private practitioners over the past ten years explain the rest of the drop.

Although the provincial and municipal hospitals are in the public sector as far as their staffing and administration are concerned, they are in no sense free or charity hospitals. Fees are charged for both inpatients and outpatients, and although the government subsidizes a certain portion of the budget of the hospitals, the fees effectively reduce utilization of hospital services by the poorer segment of the population. If fees were discontinued by the government hospitals, this would certainly increase the demand for medical manpower.

Public Enterprise Hospitals and Teaching Hospitals

There are two teaching hospitals currently in operation in Taiwan; one of these is the National Taiwan University Hospital, and the other the Kaohsiung Medical College Hospital. According to the official *Ten Year Health Plan*, these hospitals have a total of 800 beds. Currently, the Kaohsiung Medical College Hospital is listed as having only sixty beds, but expansion is planned for the near future. *The National Taiwan University Hospital, College of Medicine Bulletin*, indicates that there are 748 beds in the hospital and sixty-five bassinets. Thus, the University Hospital is the largest general hospital on the island. It handles some 800 outpatients daily and admits an average of 10,000 inpatients annually.[4] If the hospital has approximately 80 percent occupancy, the average

daily stay must be over twenty days, somewhat long for a teaching hospital. The University Hospital could profitably study its utilization practices. In projecting the future demand for health manpower it is necessary to recognize that teaching hospitals require a far more intensive staffing ratio than general hospitals.

The *Ten Year Health Plan* lists seventeen public enterprise hospitals with 450 beds. Further details are not available to us at the present time. We presume that this category includes government industrial hospitals.

Shih-Pai Veterans Hospital, the new showpiece just to the north of Taipei, is certainly one of the most impressive hospitals on the island. Although it is affiliated with the military, at least fifty of its five hundred beds are reserved for nonveteran civilians. It has the best physician and nursing staff-to-bed ratio of any of the hospitals on the island. The bed occupancy rate is 85 percent. Figures are not available on the average length of stay. This hospital serves as a teaching hospital for the National Defense Medical Center.

Missionary Hospitals

The *Ten Year Health Plan* of Taiwan Province reports twenty-two missionary and philanthropic hospitals with 1,500 beds. A mission-sponsored survey made in 1962 indicated that there were some 960 mission hospital beds with firm plans for construction of approximately 300 more beds in the immediate future. Many of these hospitals are hospitals in name only, such as the leprosarium run by a nurse without any medical supervision.

Even the MacKay Hospital in Taipei, which enjoys a fine reputation, falls far short of the standards for good, modern, scientific medical care. With a total of 174 beds, 6,000 inpatients, and 70,000 outpatients per year, this hospital has only fourteen licensed nurses (there are sixty-one unlicensed nurses, graduates of the nonaccredited MacKay Nursing School). There were also said to be twenty-seven full-time doctors (we were not able to find any of them when we visited the hospital).

The Seventh Day Adventist Hospital of 100 beds is a new, modern facility with two American and three Chinese full-time physicians. There are sixty-two nurses on the staff and two part-time radiologists. This hospital gives good care and charges proportionately. The other mission hospitals are said to fall below the standards of the MacKay and Seventh Day Adventist Hospitals.

According to the mission hospital survey, lengths of stay are overly great in mission hospitals. If hospital stays are to be reduced in length, mission hospital facilities are to be used efficiently, and high quality care is to be given, then the mission hospitals will require more qualified health manpower.

Private Hospitals

Although private hospitals are not in the public sector, they represent a demand for medical care that we have not included in our private sector analysis, which included only visits to the private physicians' offices and clinics. There are some 170 private hospitals in Taiwan with a total of 4,600 beds, according to the *Ten Year Health Plan.* This may be an overestimate as figures supplied us by the Provincial Health Department in 1963 indicated only 3,150 beds, and a recent article in the *American Journal of Public Health*[2] stated that there were 3,530 private beds. Possibly, the *Ten Year Health Plan* figures include herbalist hospital beds. According to the *Ten Year Health Plan*, the private hospitals tend toward "over-medication, over-surgery, and abuse of insurance," and, in general, a "low quality of medical practice." These criticisms of the private hospital system were confirmed by all of the authorities we spoke with in Taiwan. They are also confirmed by a special study made for the government health insurance scheme. Many of the private hospitals are hospitals in name only, having less than ten beds and none of the equipment needed for a modern hospital.

There is probably even more need for improvement of staffing ratios in the private sector hospitals than in the public sector hospitals, with a greater resultant demand for health manpower.

THE SPECIAL CASE OF THE MILITARY DEMAND FOR MEDICAL CARE

Exact information on the number of men under arms, the number of medical personnel in the armed forces, and the size and number of military hospitals is quite naturally classified information and not available to civilian investigators. However, this part of the health sector is too large to be ignored in our study. Estimates must be made of the potential demand and the potential supply of health workers to meet this demand. We believe that our estimates are accurate enough for purposes of inclusion in our over-all projections.

From what population does the military demand for medical services come? It comes from three different groups. First, the draftee component of the army. This group probably numbers 180,000 to 200,000, according to calculations from the household registry data. These draftees, or volunteers, range from twenty to twenty-four with the modal age being twenty-three. This is an extremely healthy age group, further screened to weed out the obviously unfit. Their medical demands should be minimal.

The next population group exerting demand for military medical personnel is the regular nationalist army that came from the mainland. This group, from about thirty-six years to retirement age, would have slightly higher demands for medical care than the younger age group. However, it is also a highly selected population in terms of low risk of disease. For our purposes, we would estimate some 300,000 to 400,000 persons in this group.

The third population that must be considered is the civilian dependents. Estimates for the size of this group run from 200,000 to 300,000 persons. We have no reason to believe that the pattern of demand from these civilian dependents would vary greatly from the demand of the civilian population at large.

The military's demand for medical care is not only that which can be calculated from peacetime rates of illness. The military must be prepared for wartime conditions. The armed services must have adequate staffing to meet peak demands.

The calculations in Table 10–2 indicate that currently there is a basic peacetime medical care demand for some five hundred military physicians. In addition to this, there should probably be 100–150 physicians to serve in teaching, research, and administrative positions and also to act as a readily available reserve in case of emergency, making a total of 600–650 physicians.

TABLE 10–2. MILITARY DEMAND FOR DOCTORS

$\frac{\text{200,000 men} \times \text{2.8 visits per year (est.)}}{\text{7,500}^{a} \text{ visits per Dr. per year}}$	=	75 doctors
$\frac{\text{400,000 men} \times \text{4.0 visits per year (est.)}}{\text{7,500 visits per Dr. per year}}$	=	213 doctors
$\frac{\text{300,000 civilians} \times \text{5.0 visits per year (est.)}}{\text{7,500 visits per Dr. per year}}$	=	200 doctors
	Total	488 doctors

[a] 7,500 visits was used instead of the 10,000 visits calculated for civilian physicians, for it is assumed that army doctors have additional military duties.

In addition to fully qualified four-year and six-year graduates, the army would also need several hundred "assistant doctors" who could serve as battalion surgeons, handle routine sick call problems, attend to immunizations and sanitation, and refer difficult problems to divisional level medical services.

To calculate the demand for military nurses we must first make an estimate of the number of hospital beds to be covered. At best guess, this would be some 12,000 beds, very close to the total for the civilian population. Of course, many of these beds would be in a reserve capacity. There is certainly no higher than two-thirds occupancy during peacetime. To cover these beds with approximately the same nursing coverage that exists in the civilian population, about 1,100 nurses of all levels would be needed. Probably half of these would be graduate vocational nurses and the remainder aides. Of the graduate nurses, probably less than 10 percent serve as supervisors and have collegiate nursing degrees. In addition to the nursing personnel, there would also be supporting clerical staff, technicians, and ward boys to help make up the deficit in nursing personnel. (There are almost eight active beds per nursing staff member.)

Current Supply of Military Health Personnel

Since we have no figures on actual numbers of military health personnel, we must assume that the military has been able to meet the obvious demands for health services. This assumption is supported by the following evidence and logic. Over the past ten years, the National Defense Medical Center (NDMC) has graduated close to seven hundred doctors. Most of the doctors who graduated more than a decade ago would have taken advantage of the ten-year retirement plan. If we assume that early retirements (before ten years) balance the additional number of career military physicians, who serve more than ten years, we arrive at a figure which is quite close to our demand estimate of 650 doctors.

Nursing graduates from the NDMC during the past ten years number altogether only eighty bachelors of science, and 340 vocational graduates. To reconcile this number of graduates with our estimates of approximately 550 currently demanded, we must assume that either: (1) military hospitals are less well staffed with nurses than civilian hospitals, or (2) the military has been successful in recruiting civilian nurses for work in their hospitals, or (3) a large number of nurses came to Taiwan in the withdrawal from the

mainland. Even if the first of these assumptions is incorrect there is a shortage of nurses to meet the needs of the armed forces.

Dentists and pharmacists were not included in the demand section as we have no valid basis for estimating the armed forces' demand for these professionals. In terms of supply over the past ten years, there have been some one hundred and twenty dental graduates and almost one hundred pharmacy graduates from NDMC. A higher proportion of these men than of doctors will still be working in the armed forces, as the private practice of dentistry or pharmacy is far less attractive than that of medicine. We would guess that the total number of pharmacists and dentists currently working for the military is somewhat in excess of the number graduated during the past ten years. The excess is composed of persons already trained when they migrated to Taiwan.

Projections of Military Supply and Demand

Major changes in military demand would rest on either drastic change of size of the armed forces or actual warfare. Since it is impossible for us to predict the occurrence of such changes, let alone their magnitude, we must content ourselves with a projection that is based on continuance of the status quo, plus improvements that we feel sure the military would wish to make. If the standing army remains at approximately the half-million mark and has associated with it some 200,000 to 300,000 dependents, the military should try to meet an over-all medical demand in the neighborhood of 700 to 800 physicians. If the NDMC continues to accept and train four-year graduates at the same rate they have over the past six years, we could anticipate a *constant force* of at least 500 military doctors from this four-year program. If they continue to train doctors in the six-year course at the same rate that has prevailed over the past ten years, we may anticipate another constant force of 500 doctors, giving a total of some 200 to 300 doctors more than are actually needed by the armed forces.

If the military decided to drop the service requirement from ten years to five, they might well attract enough students to fully utilize their teaching capacity, i.e., eighty students per class rather than an average of fifty. This would still produce a constant force of 400, six-year graduates; coupled with the four-year graduates, it would be quite adequate to meet the military needs. We will return to this point in Chapter 11, on alternatives and consequences.

With military nurses the future holds little prospect of supply

catching up with demand. There are just not enough girls applying to the NDMC Nursing School to provide enough nurses to meet military needs.

GOVERNMENT INSURANCE SYSTEMS

In Taiwan there are two major health insurance plans. The largest, the Labor Insurance Scheme, covers over half-a-million persons for hospitalization expenses only. This scheme is financed by contributions equal to 4 percent of salary (one-quarter paid by the individual, three-quarters by the employer). The average daily census of labor insurance beneficiaries in hospitals on the island is 1,300 and the cost per day for these patients is 98 NT$.

The Government Employee Insurance Plan covers outpatient care as well as hospitalization. (It also has death benefits and compensation provisions.) It fully covers 220,000 government workers and provides maternity benefits for wives. These 220,000 workers have some 890,000 dependent family members. Of these half are below the age of fourteen. It was impossible for the insurance to be extended to this additional number of persons and still have a realistic financial base. At present, a contribution of 7 percent of the salary of the individual is put into the government insurance plan (35 percent of this from the individual, 65 percent from the government). With an average government employee's salary of 800 NT$ per month, the average monthly contribution is 56 NT$. Almost 70 percent of the total insurance funds go into employee medical care; an additional 8 percent cover maternity benefits.

It is said that the present rate of contribution does not cover the costs of the program. There is an annual deficit of approximately 15 percent of the total budget. The average cost of medical care per person insured is 65 NT$ per month, compared to 56 NT$ average monthly contribution to the insurance scheme.

There are a number of institutions approved for reimbursement under the government employee insurance plan. These include 23 provincial hospitals, 13 city-county hospitals, 18 military hospitals (civilian beds), 2 teaching hospitals, 13 missionary hospitals, and 23 private hospitals, In addition to hospital facilities, 55 institutional clinics, 3 health centers, 271 health stations, and 36 "health rooms" are approved. These "health rooms" have virtually no medical staff, yet are approved under the insurance scheme. In addition to these facilities, the insurance plan runs its

own large insurance clinic in Taipei. Although the costs of care rendered in the government insurance clinic are somewhat higher than those in the outpatient clinics of the hospitals and the health bureau clinics, it is generally believed that, per dollar expended, the government insurance clinic renders better care.

Services and Costs in Comparison to Our Findings

We were astonished to find that, compared to approximately 5 visits per year for an uninsured population, there were *0.75 visits per person per month* (9 per year) for people covered by government insurance. There was a total of 166,000 services (162,000 in clinics or as outpatients) rendered to 74,000 persons. These surprising findings from government records are in keeping with the unusually high rates of private physician visits that we found in the upper economic brackets. In the government insurance plan, as in our highest economic group, the major economic barriers to medical care have been removed. These government insurance figures show a rate of physician visits somewhat in excess of rates for similar groups in the United States. This confirms our impression that when economic barriers are removed, the higher disease rate in Taiwan results in greater demand for medical services than in the United States.

In addition to the outpatient or clinic visits, there were 2,400 hospitalizations, plus 1,000 hospital deliveries, and 780 home deliveries by midwives. Hospital deliveries cost 800 NT$ for the average stay of seven days; midwife deliveries cost only 160 NT$. Obvious savings would result from a screening system which limits deliveries to the difficult or potentially hazardous.

TABLE 10–3. HOSPITAL CHARGES TO INSURANCE PLAN (NT$)

	Charge per visit, outpatient	Charge per hospital admission	Average cost per day	Average stay
Average	39	1,147	136	8–9 days
Provincial hospital	50	1,161		
City-county hospital	39	725		
Military hospital (civilian beds)	42	1,255		
Private hospital	28	953		
Mission hospital	43	1,197		

It is interesting to see that the average stay is only eight to nine days, which indicates that insurance patients must be handled more expeditiously than other patients.

TABLE 10–4. CLINIC CHARGES FOR INSURANCE BENEFICIARIES (NT$)

	Health station health bureau	Industrial clinics	Government insurance clinic
Cost per visit	27	29	53

In summary, utilization and cost figures from the government insurance scheme confirm the figures from our island-wide survey of medical services. The government insurance scheme offers an effective way to control the quality of medical care through the mechanism of accreditation of hospitals and clinics for insurance payments. The Provincial Health Department might consider how it could apply the methods of the insurance scheme to improve its own services.

The main lesson learned from a study of the government insurance scheme is the probability that demands for physicians will almost double if the payment barrier is removed. The government must consider this fact in planning for an extension of medical insurance.

HEALTH BUREAUS AND HEALTH STATIONS

Taiwan is fortunate in having an unusually complete province-wide network of health bureaus and health stations. Every one of the 22 cities and counties has a health bureau staffed with full-time personnel. These health bureaus are backed by 361 health stations, widely distributed throughout the island. In addition, there are 32 special health stations for areas with unusual disease problems. For the sparsely settled areas of the island there are 195 health rooms or substations which offer emergency treatment and act as referral points for the fully staffed health stations.

The health stations and health bureaus carry out both preventive and medical care programs, According to our household survey, there are approximately 5.5 million patient visits per year to the health stations; a substantial number, but only one-tenth of the number of visits to private doctors. Although the primary purpose

for these health stations is to give medical care to the poor, fees are charged. Our survey indicates that the average fee is in the neighborhood of 23 NT$. Surprisingly enough, these health stations are patronized by both the rich and the poor at almost the same rates, although health units have almost 50 percent lower charges than private doctors.

City, town, and rural dwellers all have similar rates of utilization of health station services. The aborigines in remote mountain areas, however, use almost ten times as many health station services as other groups. This is partially explained by the greater distances to private doctors, and partially by the aborigines' higher rates of illness. There is no unusual pattern of usage of the health units by the different age groups, but our survey reveals a surprisingly high usage by the better educated. We have no ready explanation for this phenomenon. The staffing of the health units is surprisingly good, despite the unfortunately low salaries offered. According to the Provincial Health Department, the basic starting salary for physicians is "wei grade 10" (250 NT$ per month, plus a subsidy of 240 NT$). This is to be compared with a private practitioner's net income of almost forty times as much. Even when one recognizes that the health unit physician almost invariably has a part-time practice, it is clear that the salary scales for physicians are blindly unrealistic.

The health station nursing salaries are *comparatively* far better than the physicians' salaries, as a starting nurse will earn 465 NT$ per month—not very different from what alternative employment might offer.*

There are 373 physicians actively engaged in medical care at the health stations. Assuming 300 working days per year, each physician would see approximately fifty patients per day. *If* the physician spends adequate time with each patient, this might represent at least nine working hours. (Actually many health center patients do not see the doctor.) In economic terms the government salary for the physician amounts to less than 1 NT$ for every patient he sees. The health stations collect 23 NT$ from the patient. Under some circumstances this might be considered exploitation of the health center doctors. We would reserve judgment until

* Dr. S. C. Hsu, in the February, 1963, issue of *The Taiwan Public Health Journal*, reports higher salary and subsidy scales: 1,185 NT$ for doctors and 1,017 NT$ per month for nurses. These levels are still most inadequate for physicians.

we knew how many patients are actually seen by the physician and how much time the physician spends with each.

The grossly defective salary scale has resulted in failure to fill 92 out of 126 positions for assistant doctors in the health stations. Even at the level of health station director, which carries a higher rate of pay, there are still 10 percent vacancies. In the twenty-two city and county health bureaus, 16 percent of doctor positions are unoccupied. There is reasonably full staffing of the other professions within the health bureau. In the health stations there is an understaffing of 40 percent of public health nurses and midwives with an overstaffing of 40 percent in the ancillary and aide category. In other words, unqualified persons are filling professional jobs in the health stations.

What does all this mean in terms of planning health manpower for the future? It shows that the health bureaus and health stations must expand personnel not only to keep up with the demand created by an increase in population, but they must also fill their budgeted vacancies and replace unqualified personnel, if they are to fulfill their function of health protection and medical care.

PROVINCIAL HEALTH DEPARTMENT

The Provincial Health Department budget, like most government budgets, defies facile analysis. Published figures in the *Health Statistical Abstract of 1963* give a budget of 124 million NT$.[1] The same source for 1964[2] gives a budget of 191 million NT$. Obviously this increase represents a change in reporting rather than a real increase, for in the official publication, *Taiwan's Health 1965*, the lack of adequate increase in health budget is emphasized.[5] The increase from 1963 to 1964 is probably explained by the inclusion of funds from nonprovincial government sources in the 1964 data, although this change is not described in any of the documents. *Taiwan's Health 1965* says in one place that the Provincial Health Department budget for fiscal year 1965 was 120 million NT$. In another place the budget is stated as 228 million NT$. The total of funds from nonprovincial sources almost exactly equals the difference.

The *Ten Year Health Plan*[7] gives the Provincial Health Department budget for fiscal year 1965 as 102.529 million NT$ as compared to 120.529 million NT$ in the source noted above.[6] We believe this is a misprint in the Ten Year Plan. The *Ten Year Health*

Plan gives 91.8 million NT$ as the local health budget. *Taiwan's Health 1965* gives a local health budget of 200.7 million NT$. We believe this is a matter of definition.

If the above discussion leaves the reader confused, we are not surprised. For the purposes of this chapter the 1964 budget of the Provincial Health Department should be regarded as approximately 191 million NT$.[2] The bulk of the budget, 134 million NT$, goes for operation of provincial hospitals.

The central Provincial Health Department spends only 30 million NT$ annually (750,000 dollars [U.S.]). It is amazing that its effective program can be carried out with such a modest budget. In addition to the central department, there is an Institute of Environmental Sanitation, Institute of Health, Malaria Research Institute, Institute of Maternal and Child Health, Hygienic Laboratory, and Serum and Vaccine Laboratory, with an aggregate budget of 23 million NT$.

The Provincial Health Department is also responsible for port and airport quarantine and maintains quarantine stations at key points throughout Taiwan and the Pescadores at the cost of 5 million NT$ per year.

Excluding the hospitals, the Provincial Health Department manages to run its complete program with approximately 50 physicians, 30 nurses, and under 200 technicians. In the staffing of the various programs of the Provincial Health Department, low salaries represent the same problem as in the health stations. To continue the high level of effectiveness in the face of a rapidly increasing population, the Provincial Health Department will need more professional staff. However, increases will be small in relation to the over-all demand for private physicians and doctors and nurses for the hospitals.

PUBLIC SECTOR DEMAND—1973–83

Much of the increasing demand for health workers in the public sector is based on the increasing number of hospital beds. For this reason, in Table 10–5 we have outlined the planned and projected construction of new hospital beds.

Estimates of numbers of hospital beds vary. For example, special data from the PHD, May, 1963, show 560 city-county hospital beds while the *PHD Statistical Abstract, 1962*[1] shows 640 beds. Special PHD data show 3,100 private hospital beds while

TABLE 10-5. HOSPITAL BED PROJECTION, 1973-83[a]

		1973	1983	
	1963	Av. pop. incr. (26% incr.)	Low pop. incr. (49% incr.)	High pop. incr. (69% incr.)
Provincial hospitals				
Acute	1,840[b]	2,640[c]	2,900[f]	3,800[f]
Chronic[h]	2,030[b]	2,230[c]	3,000[e]	3,400[e]
City-county hospitals	850[b]	1,140[c]	1,400[f]	2,300[f]
Teaching hospitals	800[b]	1,200[c]	2,400[c]	2,400[c]
Philanthropic and mission hospitals	1,500[b]	1,800[d]	6,700[f]	6,700[f]
Public enterprise hospitals	450[b]	4,900		
Private hospitals	4,600[b]			
Total	12,100[g]	13,900[e]	16,400[e]	18,600[e]

[a] All figures rounded to nearest 10. All totals rounded to nearest 100.
[b] *Ten Year Health Plan.*[7]
[c] *Ten Year Health Plan*—proposed construction.
[d] *Mission Report*—proposed construction.
[e] Estimates based on population increase.
[f] Estimates based on assumptions in text.
[g] Total of Ten Year Plan figures overestimated by 1,000 beds.
[h] Leprosarium, mental, and tuberculosis hospitals.

Li and Brown[3] report 3,530 private beds. The *Ten Year Health Plan* figures all seem to be overestimated.

Our projection of hospital beds is based on two broad assumptions: first, that the construction outlined in the *Ten Year Plan* will actually take place and second, that the total number of hospital beds will keep pace with population growth.

In making the projection we use, as a base, 11,000 total beds in 1963, for we believe that the *Ten Year Plan* overestimates the present number of private beds. For 1973 we subtract existing and planned beds in government, teaching, and mission hospitals from the over-all total (126 percent of 11,000) needed to just keep up with the population increase. The remainder are allotted to "public enterprise" and private hospitals.

For 1983 we assume that the teaching hospital construction targets will be met, that the government Chronic Disease Hospital construction will accelerate to meet the population increase since 1963 (49 or 69 percent), and that all additional construction will be divided between city, county, and provincial hospitals. This last assumption is based on the belief that essentially all new construction of private, philanthropic, and mission hospitals will replace present inadequate hospitals rather than create new beds.

Doctors

As a starting point for our projection of public sector demand, Table 10–6 shows the present vacancies and filled positions.

TABLE 10–6. DOCTORS IN PUBLIC SECTOR, 1962–63[a]

	Budgeted positions		Filled positions	
Provincial hospital, acute	380[b]		330[c]	
Provincial hospital, chronic	70[b]		70[c]	
City-County hospital	150[c]		130[d]	
Nongovernment hospital	480[c]		390[f]	
Total hospital		1,080		920[g]
Health bureaus	110[h]		90[h]	
Provincial Health Department, Quarantine Station, etc.	40[b]		40[f]	
Schools and other	80[e]		70[f]	
Total nonhospital, nonhealth station		230		200[g]
Health stations		490[h]		370[g,h]
Grand Total		1,800		1,490[g]

[a] All figures rounded to nearest ten.
[b] *PHD Statistical Abstract, 1963;* Table 2.
[c] *PHD Statistical Summary, 1962;* Table 9.
[d] *PHD Statistical Summary, 1962;* Table 13.
[e] Estimates based on filled positions.
[f] Difference between known filled positions and total hospital physicians.
[g] PHD–JHU census—corrected for Penghu, underestimation in four cities and incomplete census cards (5 percent).
[h] Special PHD data, January, 1964.

As may be noted, our data come from several sources. In general, these sources are consistent, but none has a complete picture of the numbers of government doctors. Our first estimate of demand

for public sector doctors is shown in Table 10–7. We have very simply corrected for existing vacancies and then increased the total numbers in accordance with two population estimates.

TABLE 10–7. ESTIMATED PUBLIC SECTOR DOCTOR DEMAND, 1973 AND 1983

	1963	1973 positions	Full-time equivalent[a]	1983 positions	Full-time equivalent[a]
Low est.		2,210[b]	(1 105)	2,680[d]	(1,340)
High est.	1,800[f]	2,320[c]	(1,160)	3,040[e]	(1,520)

[a] Full-time equivalents are estimated at 50 percent of government positions.
[b] Low population estimate is 23 percent increase for 1973.
[c] High population estimate is 29 percent increase for 1973.
[d] Low population estimate is 49 percent increase for 1983.
[e] High population estimate is 69 percent increase for 1983.
[f] Present number plus unfilled vacancies.

We use the concept of "full-time equivalent" to correct for the fact that government doctors devote considerable time to private practice. As mentioned earlier, we estimate 50 percent of government doctors' time should be subtracted from the public sector and added to the private sector.

Although this project is useful as a check, the method is oversimplified and does not give enough information for the individual parts of the public sector. To make detailed estimates we first calculated the number of physicians needed to handle the outpatient department visits to the provincial and city-county hospitals. This number of outpatient doctors was subtracted from the total for provincial hospitals to determine the approximate number actually caring for bed patients. We are not able to correct for outpatient department visits to private hospitals as data were not available. We then calculated the bed/physician ratio shown in the table below. Our calculations were based on 5,000 visits per physician per year (one-half the private sector daily norm of 42 on the assumption that public hospital physicians devoted half-time to hospital practice for 240 days per year). The estimate of productivity for physician-time in hospital outpatient departments seems low in comparison to health unit doctor productivity. This may be explained by a concentration of more serious cases in outpatient departments, or by the fact that hospital doctors are spending more time with inpatients, thus lowering inpatient productivity.

TABLE 10–8. BED-PHYSICIAN RATIO, 1963

Municipal	Provincial (acute)	Provincial (chronic)	Other
7	6	30	14

These figures coincide closely with ratios from our manpower study in Peru, where there are 16 private hospital beds per doctor and 5.2 social security hospital beds per doctor.

In Table 10–9 we present our detailed projection of doctor demand.

TABLE 10–9. PUBLIC SECTOR DEMAND FOR DOCTORS, 1973–83[a]

		1973		1983	
	1963 budgeted	Low pop. incr. (23% incr.)	High pop. incr. (29% incr.)	Low pop. incr. (49% incr.)	High pop. incr. (69% incr.)
Hospitals					
Provincial					
Acute					
Inpatient	320	440[c]	440[c]	480[c]	630[c]
Outpatient	60	70[b]	80[b]	90[b]	100[b]
Chronic	70	80[c]	80[c]	100[c]	120[c]
City-county					
Inpatient	90	160[c]	160[c]	200[c]	320[c]
Outpatient	60	70[b]	80[b]	90[b]	100[b]
Other	480	610[c]	610[c]	760[c]	760[c]
Health Stations	490	600[b]	630[b]	730[b]	830[b]
Other Public	230	280[b]	300[b]	340[b]	390[b]
Total	1,800	2,310	2,390	2,790	3,250
Full-time equivalents		1,160	1,190	1,400	1,630

[a] All figures rounded to the nearest 10.

[b] Estimates based on population increase and filling vacancies.

[c] Estimates based on number of beds and: 7 city-county beds/doctor, 6 provincial acute beds/doctor, 30 provincial chronic beds/doctor, 13 "other" beds/doctor for 1973, and 12 "other" beds/doctor 1983. See Table 10–5 for hospital bed projections.

To make the estimations in Table 10–9 we applied present bed-to-physician ratios for provincial and city-county hospitals to the increased number of hospital beds projected for 1973 and 1983 (see Table 10–5). The anticipated demand for physicians in

"other" hospitals was based on the assumption that the bed/doctor ratio would slightly improve: to thirteen in 1973 and twelve in 1983. Our estimates for outpatient physician demands were based solely on population increases.

We made several assumptions in our projection. First, we project demand as if provincial and city-county hospital doctor-staffing ratios will not change, and "other" hospital ratios will improve only slightly. (We hope that the ratios will improve markedly. The *Ten Year Health Plan* also recommends improvement.) Therefore, our assumption that staffing ratios will not improve is likely to result in underestimation of demand. Second, we assume that the firm targets for hospital expansion in the Ten Year Plan will be met. They may well be exceeded, in which case our estimates again will be too low. Third, we assume that health station, health bureau, outpatient department visits and other government health services will expand only to keep pace with the expanding population. Since visits per capita are likely to increase also, this assumption will probably result in further underestimation of demand. Fifth, our estimate of hospital beds (Table 10–5) is probably very conservative as we do not allow for improvement of the present bed-to-population ratio. We merely assume that in the decade from 1973–83 hospital construction will maintain the present ratios to population. Sixth, we assume that outpatient physicians will continue to see 5,000 patients per year on a *de facto* half-time basis. If better care is to be given, the time per patient will probably increase, lowering the physicians' productivity in terms of persons seen, thus again leading to underestimation of demand.

In conclusion, we estimate that at least 2,300–2,400 physicians will be demanded by the public sector (excluding the military) in 1973 and at least 2,800–3,300 in 1983. Again, we emphasize that these are extremely conservative projections. They may be underestimated by as much as 30 percent.

Nurses

Government hospitals and health stations of Taiwan currently need many more nurses. This fact is recognized by most Taiwanese health authorities. Furthermore, in addition to shortages of nurses in government hospitals, there is a similar shortage of nurses in private hospitals. (Since nurses in private hospitals cannot be

analyzed by the same method as private practitioners, we will include private hospital nurses with public sector nurses.)

The distribution of nurses by type of institution shown in Table 10–10 will serve as our starting point for the projection of nurse demand.

TABLE 10–10. NURSE, ASSISTANT NURSE, AND MIDWIFE POSITIONS, 1963[a]

	Nurses		Assistant Nurses		Midwives	
	Filled	Budgeted	Filled	Budgeted	Filled	Budgeted
Provincial Hospital (3,900 beds)	430[f]	450[e]	320[f]	320	30[g]	30[g]
City-County hospital (640 beds)	120[c]		90[c]		30[h]	
Private and other hospital (6,800 beds)	520[d]				60[d]	
Total hospital	1,070[b]				120[b]	
Health bureau	90[g]	90[g]			50[g]	
Health stations	150[b]–170[h]	460[i]			470[b]–490[h]	560[i]
School	40[b]				20[b]	
Total	1,350				660	

[a] All figures rounded to nearest 10.
[b] PHD–JHU census.
[c] *PHD Statistical Summary, 1962;* Table 13 (120 nurses and assistant nurses).
[d] Difference between total hospital nurses (or midwives) and government hospital nurses (or midwives).
[e] *PHD Statistical Summary, 1963;* Table 2, corrected for nonhospital nurses.
[f] *PHD Statistical Abstract, 1962;* Table 9, plus special data PHD.
[g] PHD special data.
[h] *PHD Statistical Abstract, 1962;* Table 13.
[i] PHD data gives nurse *and* midwife shortage of 400 (we estimate 75 percent of shortage is in nursing positions).

Although Table 10–10 indicates major staffing shortages only in the area of health stations, we have been told that even in the provincial hospitals there are assistant nurses or aides filling nursing positions. The figures in the table are drawn from many sources and show reasonable agreement, with the exception that our census showed fewer health station nurses and midwives than reported. This may be due to the use of unqualified personnel in nursing and midwife positions and to the fact that our figures for health station nurses do not include those on Penghu Island.

TABLE 10-11. HOSPITAL BEDS PER NURSE

Provincial (acute)	City-County	"Other"	Provincial (chronic)
5.4	5.4	10.7	22.5

To calculate the demand for hospital nurses for the provincial and municipal hospitals, we applied the present hospital-bed/nurse ratios to the new beds planned or estimated (see Table 10–5). For "other" hospitals we assumed that the existing ratio of 10.7 beds per nurse would improve by 15 percent in each decade, to 9.1 beds per nurse in 1973, 7.5 in 1983. (It should be pointed out that today, with three shifts, a nurse is caring for 16 acute beds in the government hospitals and 32 beds in "other" hospitals, at any given time.)

For health bureaus we assumed that the demand for nurses would increase as the population increased. There was no appreciable backlog of vacancies to be filled. For health stations the unmet demand to fill budgeted positions must be met. In addition, increasing population will create new nursing positions. Thus we anticipate the demand for 1973 at 126 percent (based on average of population estimates) or current *budgeted* positions. In 1983 demand will be 149 percent (low population estimation), or 169 percent (high population estimation) of current budgeted positions. Our projection of demands for "other" nurses was done in a similar manner, as shown in Table 10–12.

As mentioned earlier in this chapter, Taiwan, on a per capita basis, has only one-ninth as many hospital beds as the United States, one-eighth as many as Japan, and one-half as many as even Peru. The utilization of beds is not efficient in Taiwan. We believe that the rising per capita income will bring increasing demands for more and better-utilized hospital beds. Furthermore, there will be greater demand for service from the health stations. This increasing demand, which is over and above the demand to keep pace with rising population, will require more hospital and health station staff, primarily nurses. We estimate that the rising economic level in Taiwan will call for at least a 10 percent increase in nurses each decade (based on our conservative estimate of a 20 percent increase in real per capita income per decade). Therefore, in addition to

the estimates in Table 10–12, 240 nurses in 1973 and 600–700 in 1983 will be required due to the rising economic level.

TABLE 10–12. ESTIMATED DEMAND FOR NURSES, 1973 AND 1983[a]

	1973		1983 low pop. incr.		1983 high pop. incr.	
	Beds[b]	Nurses	Beds[b]	Nurses	Beds[b]	Nurses
Hospitals						
Provincial						
Acute[d]	2,640	490	2,900	540	3,800	700
Chronic[e]	2,230	100	3,000	130	3,400	150
City-county[d]	1,140	210	1,400	260	2,300	430
Teaching, mission, private and public enterprise[f]	7,900	870	9,100	1,210	9,100	1,210
Health bureau[c]		110		130		150
Health station[c]		580		690		780
School[c]		50		60		70
Total		2,400		3,000		3,500

[a] All figures rounded to nearest 10; totals to nearest 100.
[b] See Table 10–5 for projection of beds.
[c] Number of nurses in 1963 increased by 26 percent for 1973, by 49 percent or 69 percent for 1983.
[d] Bed to nurse ratio of 5.4 used in calculating number of nurses.
[e] Bed to nurse ratio of 22.5 used in calculating number of nurses.
[f] Bed to nurse ratio of 9.1 assumed for 1973; 7.5 for 1983.

In conclusion, we predict the public sector demand for nurses to be 2,600 in 1973 and between 3,600 and 4,200 in 1983.

Midwives

Future demand for hospital and health station midwives is more difficult to predict than demand for nurses. Several social patterns may undergo drastic changes in the next twenty years, with consequent major changes in demand for midwives in the public sector. First would be an increased demand for trained, professional, birth attendants. Presently, approximately only half of all births are attended by professionals.[2] Increasing education and increased ability to pay for obstetrical care will probably greatly increase demands for midwives over the next twenty years. Second would be the expected increase in hospital and health station deliveries, as has been seen in so many other countries.

TABLE 10–13. PROJECTION OF PUBLIC SECTOR MIDWIVES

1963	1973 Low pop. increase	1973 High pop. increase	1973 Socio-economic change increase	1983 Low pop. increase	1983 High pop. increase	1983 Socio-economic increase
660	660[a]–	730+	160	780–	1,040+	200

[a] Actual number of deliveries predicted for 1973 is less than 1963 if family planning program is effective; however, we assume that an effective family planning program will call for employment of any excess of midwives.

In estimating the number of midwives we used the predicted changes in total number of births per year rather than total population increase. Table 10–13 shows that, if socioeconomic changes follow our predictions, 800–900 midwives may be demanded in 1973, and 1,000–1,200 in 1983.

Other Public Sector Personnel

The numbers of other professional health personnel are small in comparison to doctors, nurses, and midwives. Therefore, we have used the simple, Ten Year Health Plan approximation of future demands based only on growth of population and proposed new government jobs. The Provincial Health Department might, at a future date, wish to make a work load analysis for the other personnel to secure more accurate estimates of future demands. Table 10–14 summarizes the projections.

TABLE 10–14. OTHER PUBLIC SECTOR HEALTH WORKERS

	Lab. technician		X-ray tech.		Nurses aides		Industrial health worker
	Govt.	Other	Govt.	Other	Govt.	Other	
1963	370[a]	300[d]	50[a]	40[d]	410[b]	450[d]	
1973	460[a]	370[c]	60[a]	50[c]	460[a]	560[c]	3,380[a]
1983							
Low pop.	550[c]	450[c]	70[c]	60[c]	610[c]	670[c]	
High pop.	630[c]	510[c]	80[c]	70[c]	690[c]	760[c]	

[a] *Ten Year Health Plan.*
[b] *PHD Statistical Abstract.*
[c] Estimates based on 26 percent, 49 percent, and 69 percent population increase.
[d] Estimates (see text).

In calculating the approximate numbers of workers in the non-government hospitals we assume the same ratio of nurses to nurse-aides as exists in provincial hospitals. For laboratory and X-ray technicians we deduct for laboratory workers in the Provincial Hygiene Laboratory and assume that the better staffed teaching hospitals combined with the poorly staffed private hospitals will give a balance of about half as many technicians per general bed as in the government hospitals.

Note the estimated demand for industrial health workers. Despite the real importance of improved industrial health we feel that this target may be too high, in the light of over-all health personnel shortages and the ability of the Taiwanese economy to support such a program.

In conclusion we present a summary table of our very conservative estimates of public sector demand for 1973 and 1983.

TABLE 10-15. SUMMARY OF ESTIMATES OF PUBLIC SECTOR DEMAND, 1973-83

	Physicians (Full-time equiv.)	Nurses	Laboratory technicians	Midwives	Nurses aides
1973	1,200	2,600	800	300-900	1,000
1983	1,400-1,600	3,600-4,200	1,000-1,100	1,000-1,200	1,300-1,500

In the next chapter we combine these estimates with private sector demand estimates to see how nearly supply will meet demand if present trends continue.

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CHAPTER 11

POTENTIAL PROBLEMS AND POSSIBLE SOLUTIONS

"The good doctor first treats the diseases of the nation, then human ailments"
(*Ancient History*)

IN THREE years of study of health manpower in Taiwan, we were, above all else, impressed by the great strides forward since 1946. In the past twenty years there have been major improvements of medical and nursing education facilities. Official health services have developed greatly in scope. Competence of personnel has increased. Disease rates have been lowered and major steps taken to control excessive population growth.

However, we would be remiss in our duty if we did not point out the potential health problems of the future. Some of these are discussed in the excellent *Ten Year Health Plan* of the Provincial Health Department. However, the full extent of potential problems in manpower was not recognized at the time as the manpower study results were not available. Solutions to some of the future manpower problems do not lie in the power of health authorities alone. The solutions call for joint efforts of the Ministry of Education, the National University, private medical schools, the armed forces, private practitioners, private hospitals, *and* the Provincial Health Department. Practically all of the pressing problems in health manpower require multiagency solutions and co-ordinated community efforts.

Making the changes needed now to prevent problems in ten or twenty years is rarely easy. As Descartes wrote, "Defects are always more tolerable than the changes necessary for their removal." However, we have confidence, based on past performances, that the "doctors" of Taiwan will "treat the diseases of the nation" successfully.

Table 11–1 summarizes some of the problems in health manpower that will develop over the next two decades if changes are not made in the present sytem. Within these figures, as we will explain later, are also some guidelines for solutions of manpower problems.

TABLE 11–1. HEALTH WORKERS—SUPPLY AND DEMAND

	1973		1983	
	Supply	Demand	Supply	Demand
Doctors	6,300	7,400–7,800	7,800	9,700–10,400
Herbalists	1,800	1,800	2,500	2,000–2,200
Dentists	1,800	1,600–1,700	1,800	2,600–2,900
Midwives	2,000	2,100–2,700	1,600	2,900–3,900
Nurses	5,000[a]	2,600	9,700[a]	3,600–4,200
Sanitary engineers	62+30±	130	—	—

[a] A recent report on the opening of eight new nursing schools indicates a supply of 6,500 by 1974 and 11,700 by 1984, if these schools continue in operation.

Although the greatest imbalance shown in the table above is in the field of nursing, we feel that the potential shortage of doctors is a far more serious problem, because of time restrictions. The first restriction is the long period of training (seven years) required for doctors. Second, it takes far longer to establish an adequate medical school than a school for any other health profession. For this reason, we will initiate discussion with problems dealing with physician training and utilization. Our second section will deal primarily with nursing and midwifery problems and the last section will deal with other health workers. There will be some overlap among these sections, as the professions do not practice independently. What happens to one profession very strongly affects the activities of other professions.

The Physician Manpower Gap

As Table 11–1 clearly shows, there will be a shortage of over 1,000 physicians in 1973, that shortage will further increase to almost 3,000 by 1983.

What steps could the government take to avoid or lessen the pending physician shortages? First, they might do nothing. In countries less dynamic than Taiwan this probably would be the

expected action. The consequences of allowing major shortages of physicians to develop would be increasing demands for each doctor's time. Doctors would become increasingly busy, seeing more and more patients every day. Fees would rise in response to demand out-stripping the supply of doctors. The increasing load of patients to be seen each day would result in inadequate time for each patient. The quality of medical care would in all likelihood decrease. *The public would pay more and receive less-adequate care.*

Second, the government could permit unregulated, unsupervised, rapid conversion of commercially oriented dental and herbalist schools to medical schools. What would be the consequences of such a course of action? Certainly there would be increased numbers of "physicians" to help meet the increased demand, but the quality of medical care would inevitably suffer. Modern scientific medicine cannot be taught successfully by amateurs. Although the cost per visit would probably not rise if the supply increased in pace with the demand, *the public would get worse care for the same price.*

Third, the government might reactivate the Medical Education Commission, giving it the power to set minimum standards for approval of medical colleges and the responsibility for determining the best way to train a thousand additional good basic doctors in Taiwan over the next ten years. If this action is to be effective, it must be made soon, for it will be seven years before additional graduates could possibly be available from the new facilities. We believe that there is a slight reserve capacity within the present medical education system of Taiwan. The Medical Education Commission might recommend, and the government accept, actions which would permit utilization of this reserve capacity. Full utilization of reserve capacity would come close to producing enough physicians over the next ten years to meet the future demand estimates. What would be the consequences of this action? By focussing attention on the quality of medical education, as well as increasing the number of graduates, the quality of care in the community should improve. *The public would get better care for the same price.*

Fourth, the efficiency of physicians could be increased. It is probably not possible to increase the number of patients seen by the average doctor without sacrificing quality of medical care *unless* the doctor is given more adequate assistance in his office practice than is now available. We will return to this point in

discussion of the problems of the potential surplus of nurses. Efficiency could also probably be raised in the government hospitals of Taiwan. However, changes in the government health system require recognition of what we feel to be one of the major deficits in the whole health industry: the shockingly inadequate salaries paid to government physicians.

The average doctor in the private practice of medicine nets 20,000 NT$ per month (40 NT$ = $1 U.S.); the director of a health station, a man with some experience, earns 1,800 NT$ per month. In every country of the world where government medicine and private practice co-exist, it is expected that the government physician is a man with high motivation, one who will make the sacrifice of lower earnings in order to serve his country. However, in Taiwan, the gap between government salary scales and private practice opportunities is too great. Human altruism cannot make up for the vast difference in earnings. A salary gap of 1,000 percent will prevent the government from meeting its responsibility of providing enough competent physicians for the public sector.

The consequences of increasing productivity are difficult to predict. Although it would help ease the shortage of doctors, it would by no means solve the problem. In addition, increase of productivity carries the danger of decrease of quality of care if the physician merely sees more patients in the same time period without changing his pattern of work.

Fifth, there are a number of less definitive actions that the government might consider in its quest for a solution to the impending physician manpower gap. The armed forces might consider decreasing the ten-year obligated service for National Defense Medical Center (NDMC) physician graduates to five years. As outlined in Chapter 10, on public sector demand, we believe five years of service would still give the armed forces enough doctors to meet military demands for medical service. As noted in Chapter 4, on supply of physicians, the NDMC Medical School has not been operating at full capacity for a number of years, because most potential students do not wish to commit ten years of their life in return for a medical education. From our student-attitude study, we concluded that dropping the time requirement from ten to five years might have an appreciable effect in encouraging students to undertake training at NDMC.

We believe that the major consequence of decreasing obligated service from ten to five years would be the complete utilization of the excellent facilities of the NDMC Medical School.

In addition to permitting operation of the NDMC Medical School at full capacity, the return of physicians to civilian practice after five years in the army would have the effect of increasing the total supply of doctors by as much as 400 by 1973. An alternative measure to fully utilize the medical school at NDMC would be to train all overseas Chinese students there. The vacancies created at NTU would be filled easily by qualified local applicants.

Over the next ten years at least three hundred doctors will leave Taiwan to practice in the United States. Some may return after a number of years of "training." Others will obtain permanent entry, take out state licenses, and settle down to practice. The Chinese government should consider action to plug this leak, for these young doctors have been educated in Taiwan and they owe a debt to their country. Possibly by granting only one-year, or at the most two-year visas for students in courses of study which must be approved by the Medical Education Commission, the government could cut down on the loss of physicians by migration. There is no real value to Taiwan in having a young medical graduate get "training" in a second-rate hospital in the United States in a residency where high pay is a greater inducement than any educational experience. By exercising control on the granting of visas the government would help assure that the nation receives some return for public money invested in physician education. The government's investment in education leads us to the next point.

How can the government finance the expansion of medical schools? The tuition charged bears little relation to the cost of education. According to current estimates the government invests almost thirty times as much money in the physician's education as he himself invests. One potential source of revenue for expanding teaching facilities and improving the quality of medical education is raising medical college tuition to at least 10 percent of actual costs. One logical consequence of such an action would be the increase of funds for new medical school construction and, possibly, the increase of teaching staff to handle additional students.

If tuition were raised, the government should consider increasing available scholarship or student loan funds for qualified students unable to meet the higher tuition payments. This would prevent the exclusion of medical students from poor families.

A Surfeit of Nurses?

If the training of nurses proceeds at the present rate, we believe that there will be a surplus of approximately 2,000–3,500 nurses in 1973 and 3,000–5,000 nurses in 1983. While some planners may regard this surplus as a serious problem, we feel it may offer solutions to other potential manpower problems. A small number of nurses will undoubtedly turn to the practice of midwifery when they become old enough to gain the confidence of the public. Since our projection of the demand for midwives indicates a small potential shortage in 1973 and 1983, we will assume that some of the surplus of nurses will be absorbed by nurses serving as midwives. There are also several other possibilities to be considered.

First, it has been noted that private physicians almost never have nurses working in their offices and clinics. The usual consequence is that physicians spend a great deal of time doing work that could better be delegated to nurses. The government should consider alternative plans to encourage private physicians, clinics, and hospitals to use more nurses. The Government Insurance Administration is already encouraging this increased use by its contract mechanism. Possibly some training of nurses in conjunction with physician training, particularly in the clinical years, might help show the physicians the advantages of having a nurse available in their private offices. We have no other ready suggestions for encouraging such an organizational change. However, utilization of nurses in private doctors' offices is a means of securing effective utilization of the potential surplus of nurses and at the same time increasing the usefulness of physicians.

Second, the government might consider increasing the staffing patterns in provincial hospitals and encouraging the municipal hospitals to increase their staff of nurses by subsidies or grants-in-aid. The consequence of such a program would be to improve the standards of hospital care and, at the same time, better prepare the hospitals to meet the added influx of patients stemming from the rising standard of living in Taiwan. Actually the private hospitals probably have far fewer nurses than either provincial or municipal hospitals. The government should consider the development of hospital staffing standards, backed up by strong hospital licensing laws. The consequence of such a move would almost certainly be an improvement of hospital care, after an initial period of friction with the private hospital authorities.

Third, another action which the government might wish to consider would be the augmentation of staffing of the outpatient services in the health units throughout the island. A study should be made of present and potential utilization of these units. It is generally agreed that group practice, in a set-up similar to the health units, offers the most efficient and probably the best system of medical care. Even in the United States, the bastion of solo practice, group practice is increasing. One of the consequences of an augmented health center program would be a larger health budget. Some of this increased budget could be balanced by increased fees at the health centers.

Fourth, despite the problem of a potential over-all surplus of nurses, we feel that there will be a shortage of college graduate nurses due to the high drop-out rate and small numbers trained. If nursing is to gain in stature and effectiveness in Taiwan, it will be necessary to train enough college graduate nurses to serve as supervisors. The Medical Education Commission should consider what types of encouragement are necessary to train at least fifty college graduates per year, in order to provide adequate supervision for the 5,000 nurses who will be working in 1973.

Other Health Workers

What actions should be taken on herbalists? Should the government continue to encourage the herbalist school in Taichung, recognizing that by 1983 there will be a surplus of herbalists in Taiwan? Herbalists do not serve primarily the rural population of Taiwan, since they are concentrated in the cities. As described in earlier chapters, doctors are more readily available to the rural population than are herbalists. Therefore, the government should discount the value of herbalists in supplying rural medical care.

Should the government take a carefully considered course of inaction in either promotion or suppression of herbalist medicine? We are too strongly prejudiced in favor of modern, scientific medicine to give unbiased answers on the possible consequences of government actions. Policies should be a matter of decision for the Medical Education Commission of the Ministry of Education and the Ministry of Interior.

As mentioned in Chapter 7, on sanitation workers, we feel that the government should consider developing training programs for adequate numbers of sanitary engineers within the universities of Taiwan. Continuation and expansion of sanitarian and sanitary

inspector training programs should be considered as functions of the Institute for Environmental Sanitation. Specialized training outside Taiwan should be reserved for a few high level sanitary engineering personnel. The consequences of such training programs would be to help prepare Taiwan to meet the demands of the much needed programs for improvement of environmental sanitation.

The problems of dentistry in Taiwan are not so much those of shortages or surpluses, but rather of the system of practice. The productivity of dentists is excessively low. How can this productivity be increased? Can the earnings level of dentists be raised to the point where more qualified students finish dental school? One action the government might consider is the requirement that dental assistants be, in every sense of the word, assistants; i.e., that they work under the direct supervision of a dentist. This change would secure better quality-control of dental work, and would place the dental assistants in a more appropriate relationship to the professional dentist. It would also increase the dentists' income. The second action that the government should consider is enforcement of the dental practice laws by prosecuting illegally practicing, untrained practitioners of dentistry. The public deserves protection from these quacks. This entire matter of the "dental industry" should be given careful consideration by a subcommittee of the Medical Education Commission.

As mentioned earlier in Chapter 6, on pharmacists, the problem with pharmacies is more one of legislation and control of drugstores than it is of manpower. Until new legislation has been passed we have no meaningful suggestions dealing with pharmacist manpower.

Organizational Changes

Our final suggestions deal with the need for continued planning and evaluation of health manpower. Our study cost approximately $50,000 and took considerable professional time of the United States and Taiwanese experts. For the results of this study to have maximum utility, the government should consider setting up a planning unit that would have, as one of its functions, a continuing review of the utilization of health manpower employed in the public sector. This unit could also assume responsibility for such programs as the up-to-date maintenance of a card file of health practitioners, to permit the government to chart progress in

programs for meeting potential shortages of health personnel. Another governmental action which should be considered is the reconstitution of the Medical Education Commission of the Ministry of Education with broad representation from the medical and paramedical professions. The present problems that are developing in the field of medical and paramedical education are clear evidence of the need for such a commission. General educators have too many other responsibilities and not enough professional expertise to handle the very specialized problems of medical education.

Conclusion

This chapter began with the warning that it was difficult to initiate change. We conclude with the statement that the Chinese government has the capacity to make the changes needed to meet the health manpower challenges which it faces. The capacity for change is shown by the great strides in economic development and the successful program of population control.

Today there are health manpower imbalances in Taiwan. As we have shown, they could seriously compound in the next two decades. However, with an early warning, the government can institute corrective actions in time. We believe that the government will take action and solve Taiwan's health manpower problems.

APPENDIX II

THE MULTISORT ANALYSIS

William Reinke

To clarify the correlations, interactions, and effects of demographic variables on the rates of doctor usage, we developed the new modification of multiple variable analysis presented here.

Most populations are heterogeneous. Differences in usage of a given service usually exist between various segments of the population. We seek to identify these characteristics of the population that account for different rates of doctor usage by the various segments of the population.

In practice we usually consider such demographic variables as age, education, economic status, residence (urban or rural), and sex. We then divide the population into cells, each cell representing a unique combination of demographic conditions. Often we proceed to a tabular or graphic comparison of results among cells, only to find that the essential determinants of differences are not clear from our tables.

We are then led to statistical analysis, but such analysis is hampered by at least two problems: (1) With most socioeconomic survey data the proportion of the population in cells is not constant. Indeed, a few uncommon combinations of demographic attributes may not be represented at all. (2) The nature of a given influence may be unknown, especially when the demographic variable is simple classificatory rather than quantitative (sex, for example). Also the influence may be nonlinear, such as the young and the old visiting doctors more frequently than the middle age groups. In another case the effect may involve an interaction, for example, the rural residents making more frequent visits than their urban counterparts, *only to the extent that they are economically able.*

A host of statistical techniques has been enunciated, each with its peculiar advantages and disadvantages. The multiple regression approach is quite popular[1] but can easily lead to an unwieldy detailed equation of questionable merit. More sophisticated multivariate analyses have been attempted in an effort to reduce a mass of individual variables to a few important factors[2] or principal components[3], but nonlinearities and

interactions are typically ignored. Moreover, one often finds that the complex relationships established, while impressive, cannot be subsequently reproduced. Finally, the analysis of variance has been proposed as an excellent means for detecting nonlinearities and interactions. Unfortunately, however, with unequal numbers of observations per cell, the analysis of variance methodology becomes quite cumbersome.

In seeking a solution to these difficulties in connection with the manpower analysis, I have developed a technique—multisort analysis—which is patterned after the analysis of variance. Certain approximations are employed, however, which are designed to simplify the computations without seriously distorting the results.

The multisort technique will be discussed first in terms of a simple hypothetical problem involving the use of certain services by a population of various ages (A), wealth status (W), and education (E). The hypothetical data are presented in Table I–1. After describing the methodology in these terms, we shall comment upon the conclusion which it produces from the real data under investigation.

TABLE I–1. DATA FOR HYPOTHETICAL PROBLEM

Average no. services per cell

	W_1		W_2	
	E_1	E_2	E_1	E_2
A_1	4	4	11	13
A_2	4	6	2	0
A_3	7	5	2	2

No. individuals per cell

	W_1		W_2	
	E_1	E_2	E_1	E_2
A_1	5	8	4	1
A_2	6	3	4	2
A_3	3	5	3	6

In an age of computers the most tempting approach is to perform a multiple regression analysis. This technique conveniently handles the problem of unequal numbers of observations per cell, and the uncertainty regarding the nature of influences can be superficially overcome by including in the regression equation terms that express every possibility. Since two points can be connected by a straight line, only the linear forms of the wealth and education effects need be included. A quadratic effect, A^2, would be added in the case of age, however. Recognizing the possibility of interactions, we would develop the following model.

$$\text{Predicted service level} = B_0 + B_1A + B_2A^2 + B_3W + B_4E + B_5AW + B_6A^2W + B_7AE + B_8A^2E + B_9WE + B_{10}AWE + B_{11}A^2WE.$$

We would find that the twelve coefficients, B_1, computed in the regression analysis would perfectly fit the twelve cell averages. Of course, we could hardly expect this entire relationship to remain valid in the future. On the other hand, when we seek to identify the few terms of the equation that really are meaningful, we confront several obstacles. The hurdles are especially difficult in practice when we attempt to use the regression technique to identify the meaningful terms among the 288 potential terms that could be associated with the 288 cells actually used in the manpower study.

In practice we ask initially only whether a variable such as age is important in any way, regardless of the mathematical form of the effect. We take a similar view of interactions. Instead of analyzing the so-called degrees of freedom associated with our twelve cells as twelve separate terms of an equation, it seems more practical to evaluate blocks of potential effects as shown in Table I–2. While the advantage is relatively small in this simple illustration, we can see even here the benefit of not having to specify the nature of each effect in advance.

TABLE I–2. BLOCKS OF EFFECTS ANALYZED BY MULTI-SORT TECHNIQUE
(hypothetical illustration)

Block	Degrees of freedom
Over-all response	1
Age	2
Wealth	1
Education	1
Age–Wealth	2
Age–Education	2
Wealth–Education	1
Age–Wealth–Education	2
	12

Conceptually this approach is much like the analysis of variance technique. Like the latter it requires some response, perhaps estimated in each cell. The need for a few estimated responses need not disturb us, however, for they can be given minimal weight in the analysis.

The investigation proceeds, block by block as follows. First, the over-all response is obtained as a weighted average of the twelve-cell means. Since cell $A_1W_1E_1$ contains five of the fifty observations obtained in all, the $A_1W_1E_1$ mean of 4 is given a weight of 5/50. Considering all cells we compute:

$$\text{Over-all Response} = (4)\left(\frac{5}{50}\right) + (4)\left(\frac{8}{50}\right) + \ldots + (2)\left(\frac{6}{50}\right)$$
$$= 4.46.$$

Subtracting 4.46 from each cell-mean in Table I–1, we question whether the adjusted entries differ substantially from zero. If not, we can assume that the effect of each of the other blocks is negligible. The results in the present case, shown in Table I–3, suggest that further investigation of effects is merited.

TABLE I–3. CELL MEANS LESS OVER-ALL EFFECT
(hypothetical illustration)

	W_1		W_2	
	E_1	E_2	E_1	E_2
A_1	−0.46	−0.46	6.54	8.54
A_2	−0.46	1.54	−2.46	−4.46
A_3	2.54	0.54	−2.46	−2.46

In studying the effect of A_1, for example, we note that it is an average of the four results involving A_1, namely, −0.46, −0.46, 6.54, and 8.54. Once again it seems advisable to weight these results. Consider the weight for 6.54, the W_2E_1 component, for example. In all, the W_2E_1 combination accounts for 11(4+4+3) of the 50 observations; hence the value 6.54 is given a weight of 11/50. Handling the other results similarly, we have

$$A_1 = (-0.46)\,(14/50) + (-0.46)\,(16/50) + (6.54)\,(11/50) + (8.54)\,(9/50) = 2.70$$

The cell values in the A_2 and A_3 rows are weighted similarly to produce

$$A_2 = (-0.46)\,(14/50) + (1.54)\,(16/50) + (-2.46)\,(11/50) + (-4.46)\,(9/50) = -0.98$$

$$A_3 = -0.10$$

The next step is to evaluate the degree of difference among the three results: 2.70, −0.98, and −0.10. The usual method of handling this is to establish the variance of the results. Recalling their source, however, we must utilize another set of weights based upon those used in the previous calculation, and in addition, the number of observations in each cell. Specifically we have:

$$M_1 = \left[\left(\frac{14}{50}\right)^2\left(\frac{1}{5}\right) + \left(\frac{16}{50}\right)^2\left(\frac{1}{8}\right) + \left(\frac{11}{50}\right)^2\left(\frac{1}{4}\right) + \left(\frac{9}{50}\right)^2\left(\frac{1}{1}\right)\right]^{-1} = 13.70$$

$$M_2 = \left[\left(\frac{14}{50}\right)^2\left(\frac{1}{6}\right) + \left(\frac{16}{50}\right)^2\left(\frac{1}{3}\right) + \left(\frac{11}{50}\right)^2\left(\frac{1}{4}\right) + \left(\frac{9}{50}\right)^2\left(\frac{1}{2}\right)\right]^{-1} = 13.25$$

$$M_3 = \left[\left(\frac{14}{50}\right)^2\left(\frac{1}{3}\right) + \left(\frac{16}{50}\right)^2\left(\frac{1}{5}\right) + \left(\frac{11}{50}\right)^2\left(\frac{1}{3}\right) + \left(\frac{9}{50}\right)^2\left(\frac{1}{6}\right)\right]^{-1} = 14.67$$

The essential result of these calculations is to give more weight (a larger numerical result) to estimates of effects that are based upon a large number of observations, especially if those observations are approximately uniformly distributed among cells.

From the preceding computations we construct a crude index of total differences (S'_a) which is quite analogous to the sum of squares employed in the analysis of variance.

$$S'_a = M_1A_1^2 + M_2A_2^2 + M_3A_3^2 = (13.70)\,(2.70)^2 + (13.25)\,(-0.98)^2 + (14.67)\,(-0.10)^2 = 112.74.$$

Also analogous to analysis of variance procedure is the introduction of a factor (C'_a) of "adjustment for the mean."

$$C'_a = \frac{(M_1A_1 + M_2A_2 + M_3A_3)^2}{M_1 + M_2 + M_3} = 12.21.$$

The final index of total differences (S_a) is then stated as

$$S_a = S'_a - C'_a = 100.53.$$

After removing the age effect from the cells we proceed to a similar analysis of the wealth and education effects. The investigations of interactions then proceed in an entirely comparable fashion. In the end we are able to assign numerical values to the blocks of Table I–2, apart from the over-all response, which is taken for granted. The results are shown in Table I–4.

TABLE I–4. ANALYSIS OF MEAN DIFFERENCES
(hypothetical illustration)

Block	Degrees of freedom	Index of squared differences	Index of mean differences
Over-all response	1	—	—
Age	2	100.5	50.3
Wealth	1	3.7	3.7
Education	1	0.0	0.0
Age–Wealth	2	302.4	151.2
Age–Education	2	7.9	4.0
Wealth–Education	1	0.1	0.0
Age–Wealth–Education	2	22.6	11.3

In view of the fact that some of the indexes are based upon more average differences than others, we must divide by appropriate numbers of degrees of freedom in order to obtain indexes of mean differences. These are quite like the mean squares computed in the analysis of variance.

The crux of the analysis lies in the determination of those indexes of mean difference which are significantly large. For these purposes one would usually obtain an estimate of residual variance in some manner and use this as a basis for comparison. In this case the age and age-wealth effects are clearly the important ones.

At this stage one may be interested in the specific form of the significant effects. For these purposes a meaningful multiple regression equation with a manageable number of terms can be computed. In the illustrative case the model would take the form:

$$\text{Predicted Service Level} = B_0 + B_1A + B_2A^2 + B_3AW + B_4A^2W.$$

Instead of detailing the hypothetical equation, let us turn to the real Taiwan problem. The indexes of mean differences are presented in Table I–5. Interactions involving more than three variables have been judged meaningless. They have all been lumped together to provide a residual index of 8.1 with 132 degrees of freedom. By dividing each of the indexes of mean differences by this residual, we obtain ratios which can be treated as F values for testing the significance of the effects. Tables of critical F ratios clearly verify the influence of only four effects in doctor visits per capita (V): age group (A), economic class (W), residence (R), and economic-age interaction.

TABLE I–5. ANALYSIS OF MEAN DIFFERENCES

(real problem)

Block	Degrees of freedom	Index of total differences	Index of mean differences	Index of mean differences −8.1
Over-all response	1	—	—	—
Economic (W)	3	433.2	144.4	17.8
Education (E)	2	22.4	11.2	1.4
Age (A)	3	2,081.2	693.8	85.7
Residence (R)	2	156.4	78.2	9.7
Sex (S)	1	5.5	5.5	0.7
Economic–Education	6	44.2	7.4	0.9
Economic–Age	9	272.3	30.3	3.7
Economic–Residence	6	26.6	4.4	0.5
Economic–Sex	3	11.8	3.9	0.5
Education–Age	6	85.1	14.2	1.8
Education–Residence	4	41.9	10.5	1.3
Education–Sex	2	6.7	3.4	0.4
Age–Residence	6	29.2	4.9	0.6
Age–Sex	3	5.2	1.7	0.2
Residence–Sex	2	35.6	17.8	2.2
Economic–Education–Age	18	169.2	9.4	1.2
Economic–Education–Residence	12	81.4	6.8	0.8
Economic–Education–Sex	6	28.3	4.7	0.6
Economic–Age–Residence	18	86.0	4.8	0.6
Economic–Age–Sex	9	38.7	4.3	0.5
Economic–Residence–Sex	6	28.1	4.7	0.6
Education–Age–Residence	12	78.6	6.6	0.8
Education–Age–Sex	6	106.3	17.7	2.2
Education–Residence–Sex	4	32.6	8.1	1.0
Age–Residence–Sex	6	90.3	15.1	1.9
Other	132	1,069.2	8.1	—

Bearing this in mind, we formed a multiple regression model.

$$\text{Predicted } V = B_0 + B_1A + B_2A^2 + B_3W + B_4R + B_5AW.$$

Numerically, the coefficients which resulted were as follows:

$$\text{Predicted } V = 1.039 - 0.987A + 0.223A^2 + 0.156W + 0.060R - 0.035AW$$

Squared terms involving wealth and residence could have been included, but they produced a negligible reduction in the standard error of estimate from 0.164 to 0.162.*

Since the multisort technique is a modification of the analysis of variance approach, the preceding results were compared with those obtained from a modified multiple regression technique known as the Lippitt method. The latter uses the so-called dummy variable approach, which means that it also handles blocks of variables. It is not especially geared to the handling of interactions, however.

The Lippitt results were in agreement with the multisort conclusions with three exceptions. First, the Lippitt technique did not detect the economic-age interaction, because it did not seek it out. Second, the iteration procedure employed by the Lippitt method encountered difficulty in achieving convergence with respect to the sex variable, even though this factor was obviously of no importance.

Finally, the Lippitt results attached some importance to education, suggesting that more highly educated individuals tend to make fewer doctor visits. In order to further test this possibility we formed a multiple regression equation which contained the education term. This term reduced the standard error of estimate from 0.164 to 0.163, an even smaller reduction than the slight one obtained from the introduction of nonlinear wealth and residence terms.

In the end, then, we place reliance upon the last equation as a realistic portrayal of the fundamental relationships involved in physician visits.

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* Standard errors are based upon the 288 cell means, not the individual observations.

APPENDIX III

HOUSEHOLD SURVEY SAMPLING DESIGN

L. P. Chow

As mentioned in the body of the book, the purpose of the household survey was to collect information on the utilization of health services in Taiwan by a representative sample of the total population. Information gained from this representative sample could be extrapolated to use in predicting future demands for medical services.

Sample Selected

The sample was designed to include roughly sixty thousand persons, a sample fraction of approximately 0.5 percent. For administration and logistic reasons, the population sampled included only the island of Taiwan. The offshore islands of Penghu, Lu-Tao, Lan-Yu, and Liu-Chiu were not included. Other exclusions from the total population to be sampled included military personnel and residents of nonfamily households, such as institutions, hotels, etc. Military personnel were excluded due to security problems involved in sampling and interviewing this group, and institutional populations represented such a small percentage of the total population that we did not feel it was worth developing the involved sample design required to include them. Although the aborigines were included in our sample, they were included on a nonrandom basis, as will be described later. The survey population included all residents of the selected family households, who were listed in the household registers plus all temporary residents of the selected households, who had been in the household for more than fifteen days at the date of interview.

Sampling Design

The over-all sample was divided into twelve monthly samples, a sample: population ratio of 1:2,300. Each monthly sample was composed of approximately 5,000 persons and was representative of the entire province.

To secure wider coverage, each monthly sample was drawn separately and represented illness and health professional usage for one month.

Multistage Stratified Random-Sampling Procedure

We first divided the population of the island into five strata, based on the degree of urbanization. Our first stratum consisted of the five major cities, Keelung, Taipei, Taichung, Tainan, and Kaohsiang (total population 2,377,000). The second stratum consisted of the small cities, San-Chung, Hsin-Chu, Chang-Hua, Chia-Yi, Ping-Tung, I-Lan, and Hua-Lien (total population 824,000). The third stratum consisted of the seventy-seven chen or towns with a total population of 3,325,000. The fourth stratum consisted of the 197 hsiang or rural areas (total population 4,511,000). The fifth stratum consisted of the twenty-nine mountain or aboriginal hsiang with a population of 163,000. The population base from which the sample was drawn was the household register, year-end population for 1961.

The units for the first-stage sampling in the first stratum was the chu or district. Of these forty-two chu, ten were sampled—two from each city chosen on a random-sample basis. For the second stratum, the seven smaller cities were used as sampling units and here the sampling fraction was roughly one-quarter. For the third stratum, nineteen chen or towns were selected at random from the total number of seventy-seven—roughly one-quarter of the chen in each country were selected. In the fourth stratum, forty-six out of the 197 hsiang or rural townships were selected at random—roughly one-quarter of the hsiang in each county. The first-stage sampling for the fifth stratum will be described later as a different technique was used.

The li is the second-stage sampling unit in strata one, two, and three—the cities and towns. The chun is the second-stage sampling unit for the fourth stratum—rural areas. The sampling fraction used for this stage is one-tenth. As in the first stage, population is used as a weight in the sampling process. A diagrammatic description of the sampling process is shown in Table II-1.

The third stage of sampling uses the smallest political unit of population in Taiwan—the lin. The number of lin are selected from each li or chun on a population weighted basis.

The final stage in the sampling involves the selection of the total number of households in each stratum. This is done by first determining the average number of persons per household for each of the selected chu, chen, and hsiang, by dividing the total population by the total number of households in the selected chu, chen, hsiang. The total number

TABLE II–1. SAMPLING STAGES

	Stratum I (5 large cities of 42 chu "districts")	Stratum II (7 small cities)	Stratum III (77 chen "towns")	Stratum IV (197 hsiang "rural areas")	Stratum V (29 aboriginal hsiang "mountain areas")
Stage I sample	10 chu	2 small cities	19 chen	46 hsiang	5 hsiang
Stage II sample	30 li	11 li	43 li	71 chun	5 chun
Stage III sample	53 lin	17 lin	58 lin	82 lin	24 lin
Stage IV sample	215 HH	70 HH	236 HH	331 HH	101 HH
Total population each stratum	2,377,000	824,000	3,325,000	4,511,000	163,000

of persons required for a given stratum is then divided by the correct average number of persons per household to give the desired number of households which must be included in the sample. The number of households required are then assigned to each chu, chen, hsiang in proportion to the populations of these individual units. Since the sample follows the cluster technique, with a cluster of four houses adjacent to the index house, we may divide the total number of households required by four to determine the number of index households to be selected at random from the household registration offices.

The nurse interviewers were furnished with the appropriate numbers of households and the locations of these randomly selected households for each month of the years that the survey was in progress. Alternate randomly selected households were supplied in case the selected household had been dissolved by the time of the interview. In case of temporary absence of the housewife from the household, the interviewer was instructed to make a return visit.

Sampling Design for the Fifth Stratum (Aboriginal Area)

As mentioned earlier, the fifth stratum was treated separately because of the lack of sufficient number of qualified interviewers and the extensive travel time that would have been involved in a fully randomized sample.

Out of the twenty-nine aboriginal hsiang on the island, only those twenty having a medical graduate in charge of the Hsiang Health Station were included in our sample. Our reason for excluding the others was the lack of supervision for the nurse-interviewer. The twenty usable hsiang are then divided into five blocks on a geographic basis. These blocks are of approximately equal population size. One hsiang is randomly selected from each block to give geographic representation to the different aboriginal groups. Thus, there are five sample hsiangs in the first stage. In the second stage, one chun next to the smallest population unit is selected on an arbitrary basis. The criteria for selection are convenience to the health station where the interviewer is posted and predominance of aborigines in the total population of the chun. (In some parts of the aboriginal areas, there are large numbers of Chinese settlers.) The overall sampling:population ratio for the aboriginal hsiang was 1:300. The number of households to be included is determined by dividing the size sample to be drawn from the total population of the twenty-nine aboriginal hsiang by the average population per household in the selected chun. The total number of households to be included in the sample is then assigned to each sample hsiang in proportion to the population in

each of these hsiang. Thus, the sampling design for the fifth stratum is not on a probability basis, but rather a combination of random selection plus feasibility for the carrying out of interviews.

Measures of Validity of Sample

As mentioned earlier in the body of the book, we found that our sampling method was defective in that the present administrative-political divisions of the country did not correspond to usually accepted criteria for rural and urban. Thus, we found rice fields within the major cities and urban concentrations of populations in some rural areas. However, we feel that on the whole our sample was a good one. For example, our survey showed 22.8 percent of the population in Stratum I while the household data showed 21.3 percent. (Here a portion of the discrepancy may be made up by the fact that we did not include the rural areas in Penghu and the other offshore islands in our sample.) We found 49.4 percent males out of our total sample while the household data registered 51.2 percent males. A part of the very slight discrepancy here might be explained by the fact that the household registry data has some males listed as living in the family household when they are in reality living in a workers' boarding house or hotel. In terms of age group we found the following concordance of our data from the sample with that from the household registry.

	Age group I	Age group II	Age group III	Age group IV	Age group V
Sample survey data	21.3%	27.1%	42.0%	7.1%	2.3%
Household registry data	20.3%	27.5%	42.7%	6.8%	2.5%

Despite a few alterations in a purely random sampling frame, made for practical reasons, we feel that we have drawn a sample that is representative of the population of Taiwan in essentially all demographic aspects.

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The effective planning of human resources is essential to the creation of adequate health services in the developing nations. This book is designed to serve a dual purpose—to assist the government of Taiwan in planning health programs for the next twenty years, and to develop methods of health manpower analysis. The lessons learned in Taiwan may be applied to professional manpower planning in other developing nations.

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