

## Summary

This article described three heuristics that are employed in making judgments under uncertainty: (i) representativeness, which is usually employed when people are asked to judge the probability that an object or event A belongs to class or process B; (ii) availability of instances or scenarios, which is often employed when people are asked to assess the frequency of a class or the plausibility of a particular development; and (iii) adjustment from an anchor, which is usually employed in numerical prediction when a relevant value is available. These heuristics are highly economical

and usually effective, but they lead to systematic and predictable errors. A better understanding of these heuristics and of the biases to which they lead could improve judgments and decisions in situations of uncertainty.

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## Rural Health Care in Mexico?

Present educational and administrative structures must be changed in order to improve health care in rural areas.

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The present health care structure in Mexico focuses attention on the urban population, leaving the rural communities practically unattended. There are two main factors contributing to this situation. One is the lack of coordination among the different institutions responsible for the health of the community and among the educational institutions. The other is the lack of information concerning the nature of the problems in rural areas. In an attempt to provide a solution to these problems, a program has been designed that takes into consideration the environmental conditions, malnutrition, poverty, and negative cultural factors that are responsible for the high incidences of certain diseases among rural populations. It is based on the development of a national information system for the collection and dissemination of information related to general, as well as rural, health care, that will provide the basis for a national health care system, and depends on the establishment of a training program for professionals in community medicine.

The continental and insular area of Mexico, including interior waters, is 2,022,058 square kilometers (1, 2). In 1970 the population of Mexico was 48,377,363, of which 24,055,305 persons (49.7 percent) were under 15 years of age. The Indian population made up 7.9 percent of the total (2, 3). As indicated in Table 1, 42.3 percent of the total population live in communities of less than 2,500 inhabitants, and in such communities public services as well as means of communication are very scarce or nonexistent. A large percentage (39.5 percent) of the economically active population is engaged in agriculture (4).

The country's population growth rate is high, 3.5 percent annually, and it seems to depend on income, being higher among the 50 percent of the population earning less than 675 pesos (\$50) per family per month (5). The majority of this population lives in the rural areas. The most frequent causes of mortality in rural areas are malnutrition, infectious and parasitic diseases (6, 7), pregnancy complications, and

accidents (2). In 1970 there were 34,107 doctors in Mexico (2). The ratio of inhabitants to doctors, which is 1423.7, is not a representative index of the actual distribution of resources because there is a great scarcity of health professionals in rural areas and a high concentration in urban areas (Fig. 1) (7, 8).

In order to improve health at a national level, this situation must be changed. The errors made in previous attempts to improve health care must be avoided, and use must be made of the available manpower and resources of modern science to produce feasible answers at the community level. Although the main objective of a specialist in community medicine is to control disease, such control cannot be achieved unless action is taken against the underlying causes of disease; it has already been observed that partial solutions are inefficient (9). As a background to this new program that has been designed to provide health care in rural communities, I shall first give a summary of the previous attempts that have been made to provide such care, describing the various medical institutions and other organizations that are responsible for the training of medical personnel and for constructing the facilities required for health care.

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## Previous Attempts to Provide Rural Health Care

*The School of Rural Medicine.* Since its founding, this school has motivated its students to practice medicine in an urban style, both socially and economically. Federal resources that would have enabled professional rural practice to be put into effect were lacking, so that most students either went into urban practice or simply deserted the profession. At present, this institution is known as the School of Medicine of the National Polytechnical Institute, and its rural practice is very limited (8).

*The School of Public Health.* This school offers training for doctors, technicians, and nurses who wish to spe-

cialize in a particular branch of public health. There are six areas for specialization on a postgraduate level. Laboratory assistants can specialize in either of two areas, while hygiene technicians, public health nurses, and public health statisticians are each offered a special course. The students are given a useful professional orientation in public health to enable them to contribute to the solution of problems in rural areas. Unfortunately, however, the number of graduates in hygiene technology and public health nursing and statistics during the past 8 years (438) is too small to be of much benefit to the country (8).

*Schools of medicine.* There are 22 medical schools in the country. These institutions take 6 years to prepare a single class of professionals oriented

toward urban and hospital medical practice. Study plans are generally based on patterns established by European and American schools and little or no attention is given to medical practice in communities where resources are lacking. The curriculum at the School of Medicine of the National Autonomous University of Mexico has not undergone any changes in its orientation since 1906. Only two schools, the Military Medical School and the School of Medicine of the Autonomous University of the State of Mexico, emphasize rural practice. Thus, it is clear that there is little relationship between the country's needs, that is, the frequency and the distribution of diseases in Mexico, and the orientation of the institutions responsible for training medical personnel (8). This situation contributes to the dropout rate (51 per-

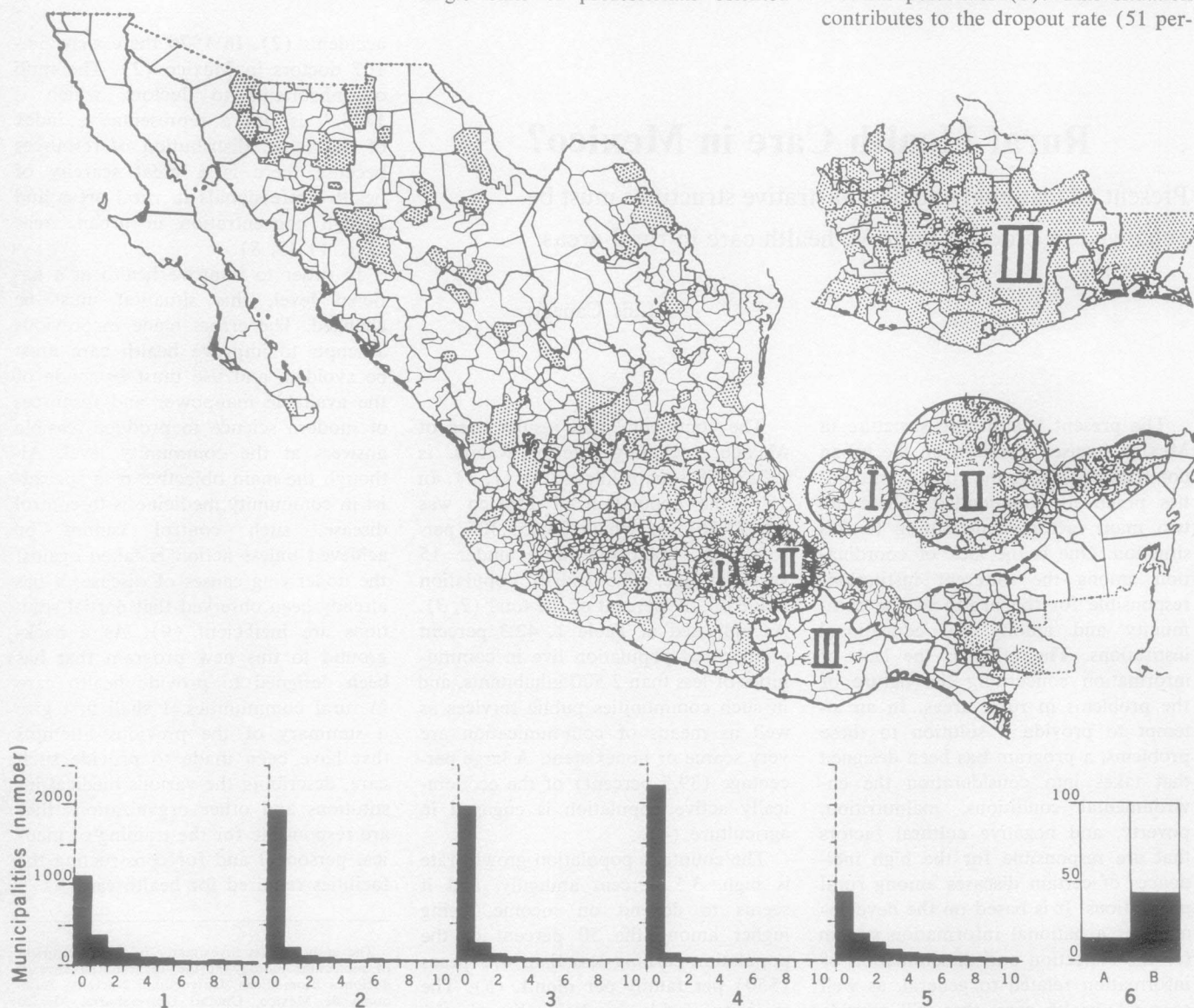


Fig. 1. The number of municipalities in Mexico for 1970 (2388). The areas marked I, II, III, are shown enlarged on the right. Stippling indicates municipalities having no qualified medical doctors. The number of qualified personnel per municipality (from 0 to 10 only) is shown in the graphs: (1) medical doctors; (2) dentists; (3) veterinarians; (4) health related professionals; (5) health related technicians. Graph (6) indicates the concentration of medical doctors in the urban areas: (A) population; (B) medical doctors; shaded bars are for Mexico City, the light areas represent the rest of the country (2).

cent) from medical schools (10), although a certain number of dropouts do subsequently return to school and obtain their degrees. Under the present conditions and with the present educational programs, the schools of medicine will not solve the problem of the future demand for doctors in Mexico (8, 10).

**Undergraduate Social Service Program.** This program, designed to counteract the poor distribution of doctors in rural areas, has not fulfilled its initial objectives because, among other reasons, the health problems have not been specified, the geographical distribution of students in working areas where they are most needed has not been determined, resources are lacking, many undergraduates fulfill their social service in the cities, and there is no coordination of the efforts of the different institutions. Recently, an integral and multidisciplinary system of social service was initiated, but a general plan on a national level that would coordinate the efforts of the different institutions is still lacking. The National Autonomous University of Mexico now has various groups of undergraduates performing social services in the rural areas (11) (279 students, out of 10,976 available from 18 different disciplines in 1974, are working in rural areas. Out of these 279, only 33 are medical students).

**Officers' School of Military Health.** This school's objective is to preserve the army's health. Under special circumstances it provides assistance to civilians. It offers one of the most adequate training programs to medical personnel for solving rural health problems. Unfortunately, the very nature of the school, as well as its objectives, limits the number of graduates and the number of people who have access to its services (8).

**Nursing schools.** There are 39 such institutions that train nurses and nurse's aides. Although there are no precise data on the municipal distribution of nurses, half of them work in the Federal District and their distribution in rural areas is very scarce (8).

**Schools of odontology.** There are 17 such schools, of which 4 are of recent formation. The total number of graduates is still small. The lack of dental attention among the Mexican population is very important, and the index of centralization is greater for odontologists than it is for doctors (Fig. 1) (8).

Table 1. Demographic distribution (2) of the Mexican population.

Number of inhabitants	Number of communities	Total number of inhabitants
1 to 99	55,650	1,471,154
100 to 499	28,055	6,889,077
500 to 999	7,437	5,190,166
1,000 to 2,499	4,232	6,355,285
2,500 and up	2,170	28,308,556

**Schools of veterinary medicine.** There are nine of these institutions in the country, all located in urban areas. The total number of graduates in the country until 1970 was approximately 3000, an insufficient number to attend the animal population (213.5 million in 1970). The problem is magnified because of the high index of centralization of these professionals (Fig. 1) (8).

**Schools of homeopathic medicine.** Graduates in homeopathic medicine are in great demand, but there are only two schools producing such doctors and their graduates are concentrated mainly in urban areas (8).

**National Indigenous Institute.** This institute has 40 coordinating centers made up of multidisciplinary, profes-

sional groups localized in the country's different indigenous zones. This institute is used as an effective means through which to help community development, but at present the doctors who are working in these areas have been trained for urban practice (8).

**Ethnomedicine.** The different types of *curanderos* are consulted more frequently in rural areas than are doctors (12, 13). In practicing their science they make use of their knowledge of ethnomedicine, magic, and, occasionally, modern medicine (14). They play a very important role in the health of people living in these areas, because the majority of patients consider magic and religion as part of the reason for their being ill, and because rural self-medication is symbolic of prehispanic tradition (11). Nevertheless, we know too little about these *curanderos* to be able to evaluate their role in health improvement in these areas (12).

**Information media.** Although radio, television, and newspapers have penetrated many of the rural areas (15), no programs are provided that would systematically and efficiently educate the population in matters of health, disease prevention, and self-medication.

**Medical assistance establishments.** Figure 2 shows the percentages of the urban and rural population that do or do not have access to health services in official institutions. The solution to this problem, which is dependent on the supply of doctors and centers and requires great expenditure, has been concentrated in the urban areas, leaving 89.5 percent of the rural population without these services (4, 6, 16, 17).

**Rural medical assistance facilities.** The rural health centers and other establishments now in existence only partially cover the rural localities, while the objective of these establishments is to maintain the health of the inhabitants in these areas (8, 17). They do not fulfill the functions proposed for them by the World Health Organization (18) or by the individuals who have suggested that those functions be extended to include the promoting of improved sanitary conditions in rural communities and the exercise of preventive medicine and certain measures of curative medicine (19).

**Pharmacies.** The pharmacist plays an important role in health care in many localities, often assuming the role of diagnostician, healer, and general advisor on matters of health and

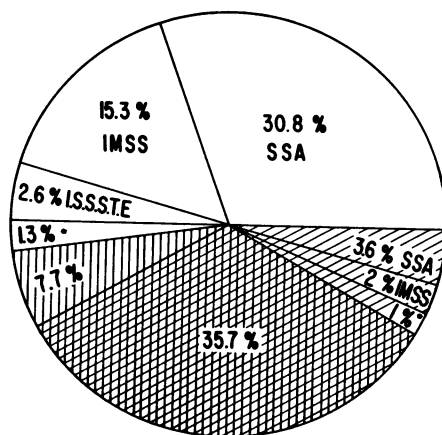


Fig. 2. Percentages of total Mexican population living in urban (unshaded) and rural (shaded diagonally) areas and having access to health services in official institutions; populations having no access to such services are shown by vertical shading. Data for 1968. Recent data on rural and urban distribution of medical attention were not complete at the time this research was concluded (4, 5, 16, 17); IMSS, Instituto Mexicano del Seguro Social; SSA, Secretaría de Salubridad y Asistencia; ISSSTE, Instituto de Seguridad Social al Servicio de los Trabajadores del Estado; \*, Ferrocarriles Nacionales, Petróleos Mexicanos, Secretaría de la Defensa Nacional, Secretaría de Marina.

disease. Since there are relatively few endemic diseases that occur with high frequency, the pharmacist can easily become an expert at diagnosing them. Thus, it is to the local pharmacy that people in a rural community often go to for medical advice. It is difficult to evaluate the overall importance of pharmacies in providing health care, however, because they are not organized to provide the care (8).

**National health campaigns.** Among the most important campaigns now in operation are those against onchocerciasis, poliomyelitis, typhus, rheumatic fever, rabies, goiter, venereal diseases, whooping cough, pinta, tetanus, smallpox, leprosy, measles, and malaria. There is also a campaign for the prevention of accidents (20). These campaigns are ineffective in rural communities because of the inadequate communication systems and the general lack of physical and human resources in these areas.

From the preceding data it is evident that the emphasis in health care in

Mexico has been on the urban population and that, at the national level, the few programs aimed at providing health care to rural communities have suffered from inefficiency, duplication of efforts, and lack of coordination. The program I shall now describe is designed to remedy this situation.

### Formation of a National Information System

Effective information systems are essential to modern health care programs. For example, to understand why certain transmissible diseases occur at particular frequencies, one must obtain information not only on their possible biological, social, cultural, legal, economic, and ecological causes, but also on the responsibilities of the organizations that are supposed to provide some measure of control of these diseases: universities, schools, medical assistance programs, and other socially oriented organizations that influence

such factors as human waste disposal and general housing conditions. To be of use, the information obtained on these matters must be sorted and stored in such a way that statistical data related to any one aspect of the problem can be easily retrieved. Only then will it become possible to devise a program of health care at the national level without duplication of efforts and wastage of manpower and funds.

The information system now in operation at the National Autonomous University of Mexico includes the following:

1) A data bank for geographic, demographic, economic, social, ecological, and medical information. Information that is obtained from census, investigation programs, banks, federal and international agencies, and university programs, for example, is incorporated into either or both of two systems, one relating to health information on a federal, state, and municipal level, the other to more precise and extensive data on small localities.

2) Software developed for the purpose of relating health problems to their possible causes and the potentially responsible institutions.

3) Two main sources of data that are fed into the information system (Fig. 3). One of the sources, described in 1) above, is external to the system; the other source consists of work reports elaborated by personnel working for the information system. Data from both sources are carefully sorted and stored for easy retrieval; statistical analyses are made, as well as graphic representations generated of the various data that are applicable to each of the geographical localities (21). All of the information is made available to the appropriate government agencies, universities, and other personnel concerned with administration programs.

By utilizing such information, it will be possible (i) to design training programs for doctors, paramedical personnel, and social workers based on real problems and needs; (ii) to determine which public health problems require a basic investigation before an attempt can be made to solve them (investigators interested in solving national problems of this kind can thus orient and motivate students to work on them); and (iii) to organize a coordinated system of health care programs throughout the country.

To reduce both the costs of this information system and the complexity of programming, and to increase effi-

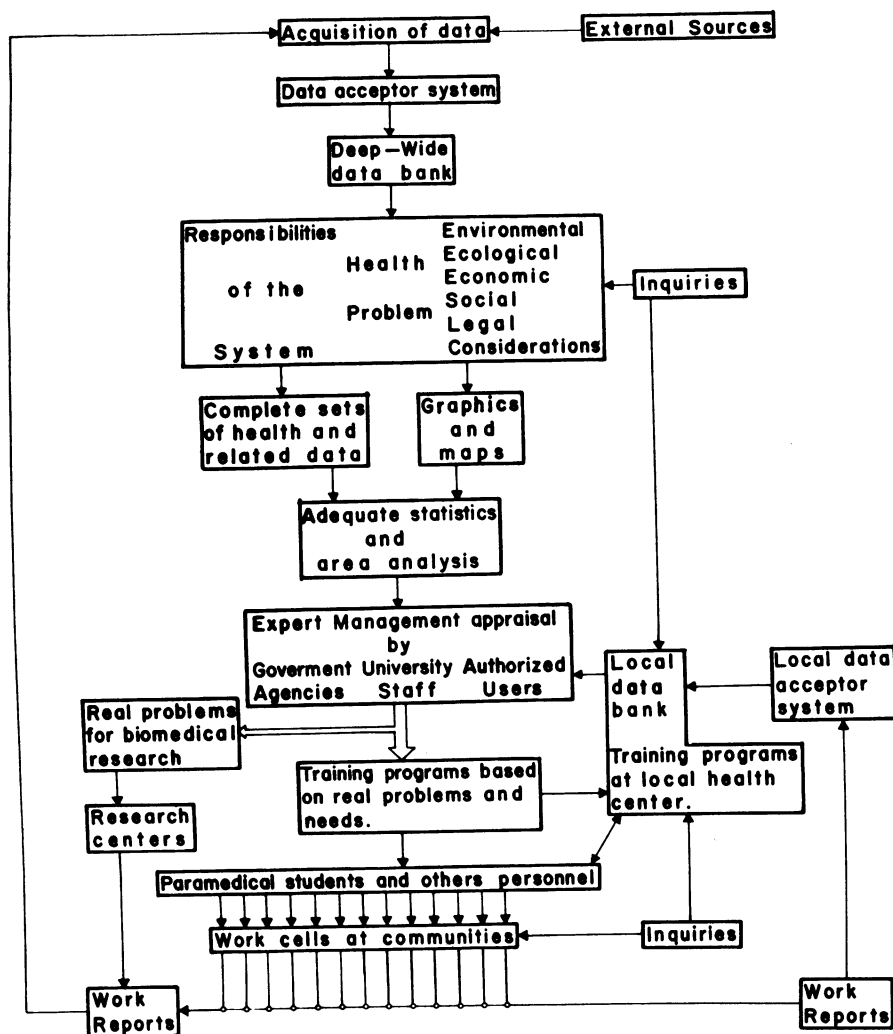


Fig. 3. Diagram to illustrate the national information system now in operation at the National Autonomous University of Mexico.

ciency, information centers should be created on the local level, the radius of action of such centers depending on actual geographical locations and on local needs. Such centers would function as data banks, training centers (associated with schools and health centers), and sites for gathering information on the local level. They would be in continuous communication with the national information system so that any new information would be quickly disseminated and policy discussions could be put rapidly into effect. Such centers would only be established in those areas where, because of size and technical facilities, they would be effective and economical. Use might be made of microcomputers, census, and information bulletins to increase the inflow of information.

At present, data are available on the most important variables related to health on a municipal level. Some data are also available from a few rural localities, from the 1970 census, and from private research. Some of these data have been classified as follows: population, health manpower, institutional patients, facilities and agencies, mortality, morbidity, education, housing, socioeconomic conditions, geographic, demographic, and climatic data. The level of medical attention has been analyzed through the use of a distribution index (22). To provide detailed analyses of these data, the country is divided into territorial groups which have conditions and problems of health in common (geomedical areas).

### Training Programs in Community Medicine

An effective rural health care program would depend largely on the type and quality of training that was provided for the medical personnel who would work in the rural communities. Toward this end, a medically oriented training program has been designed that is based on the existence of a real national problem, and is oriented toward enabling professionals to solve the most frequently encountered problems in rural practice (7).

A pilot program, "Medical Ecology," is being prepared to complete the university requirements, in order to be put into effect during April 1975 at the Escuela Nacional de Estudios Profesionales, Cuautitlan, of the National Autonomous University of Mexico. After an evaluation of the

	Ecological Sciences	Medical Sciences	Formal Sciences	Social Service (Fieldwork)	Professional Competence
1st. Year	Social Sciences I General Ecology	Community Medicine I Public Health I	Introduction to Statistics Scientific Methodology I Mathematics I	2 Months	Health Data Collector
2nd. Year	Social Sciences II Human Ecology I Education I	Community Medicine II Public Health II	Statistical Design of experiments Scientific Methodology II Mathematics II	2 Months	Public Health Statistician
3rd. Year	Social Sciences III Human Ecology II Education II	Community Medicine III Public Health III	Computer Programming Introduction to Operation Research	6 Months	Community Health Professional
4th. Year	Possibility for further specialization				
	Community Promotion and Recollection of Information	Action in: Medicine Architecture Agronomy Education Etc.	Handling of Information	<input checked="" type="checkbox"/> Permanent Module <input type="checkbox"/> Optional Module	

Fig. 4. A general scheme for the preparation of professionals in community development and health care.

fulfillment of the teaching objectives, self-teaching units will be prepared to be distributed to those local schools that wish to operate with them. In this program, students will be trained not only in the techniques of community medicine, but also in the methods of obtaining and utilizing information related to rural health care. Field work will begin during the first year of training. Professional competence in a limited range of subject areas will be tested annually and students passing the test will be given a diploma (Fig. 4). This measure is being taken to avoid a high dropout rate: the students will be capacitated to work at an increasingly higher level every year. Provisions will be made for those students who might subsequently consider specializing in a particular branch of community medicine.

Such an academic program is shown diagrammatically in Fig. 4. The courses in the ecological sciences will provide the students with information on the country's social, economic, and anthropological status and on the relevance of these fields to health in rural communities; students will thus be prepared for field work, data collection, teaching, and for practicing techniques of community development. Courses in the formal sciences will include training in the handling of information and in the formal planning of programs aimed at solving health-associated problems in the communities. Courses in community

medicine will enable students to become familiar with those diseases occurring most frequently in rural areas, and will cover various aspects of basic as well as clinical medicine; students will be trained to select the most practical solutions to the problems they might encounter in the field. Courses will include epidemiology, the functioning of health institutions, public health measures, and medical techniques necessary for the improvement of conditions in rural areas.

The School of Medicine of the National Autonomous University of Mexico has approximately 21,000 students registered in 1974. The hospitals in the urban areas are equally over saturated and can no longer incorporate the increasing number of students graduating from the health sciences; and, because of this situation, the graduates in medicine have less job opportunities open to them. The Medical Ecology program will give the official institutions an alternative answer to health care, creating rural health centers (8) and updating those already in existence that would open up new job opportunities to its graduates, orienting them toward the rural communities where health care is most needed. Those students who might otherwise drop out of a more conventional training program will be encouraged to complete the program and take advantage of the wide choice of careers and new job opportunities opened to them.



## Fieldwork

Communities must be carefully selected according to their problems and resources if fieldwork is to be effective. To prepare a community to accept health measures, it is necessary to translate the methods and techniques that have been designed in a different social and cultural context into a form suitable for each particular rural environment. They must then be introduced in a socially acceptable manner so support of groups detrimental to the community can be avoided.

The promotional work that such a program would require could be done by one field investigator who was experienced in rural community work. Together with members of the community, the investigator would determine the nature of the local problems and the amount of available human and material resources, and would serve as a translator between the program and the community. After analyzing the information he obtained, and after considering the interrelationships among the problems and characteristics of the community (23), the investigator would be able to determine which projects were most in need of development, and would be able to decide on the type of organization required to meet the objectives. In the initial investigation it might be found that economic productivity could be increased through greater work efficiency, better use of the existing material resources, and rational use of new investments; and that consumer capacity could be increased by improving marketing efficiency and reducing costly intermediaries. The medical personnel already present in the community could be reorganized to increase the efficiency of the existing health care system.

As a result of such an investigation, the following program of action might be recommended:

1) A system for providing preventive and curative medical care should be organized in such a way that the most common and simple problems are dealt with by selected members of the community who should also be responsible for providing the community with information on health and hygiene. The more complicated medical problems should be referred to specialists in the community, rural and suburban health centers and clinics, and general and specialized hospitals (8, 24).

2) A system for furnishing medically

oriented instruction to rural laymen should be organized, the instruction being oriented toward producing assistants for the medical personnel brought in from elsewhere by the program. The training should include aspects of preventive medicine, diagnosis and treatment of the community's most common diseases, first aid, midwifery, and public health measures. A combination of ethnomedicine and of modern medicine should be practiced. After their preliminary training, the trainees should practice in the community under the supervision of a doctor, and once a week for an indefinite period they should attend the health center in small groups to continue their training (8, 25).

3) A program to educate the community in matters of family planning should be initiated with the help of the Mexican government.

4) Refresher courses for local doctors should be provided.

5) University students should be brought into the community to study specific problems. Multidisciplinary work groups should also be formed.

6) Medical equipment should be de-

signed especially for fieldwork (Fig. 5) (26).

7) There should be a joint effort of the major health care agencies (the Instituto Mexicano del Seguro Social, the Instituto de Seguridad Social al Servicio de los Trabajadores del Estado, and the Secretaría de Salubridad y Asistencia) to provide health care in the rural areas, the costs being shared according to their resources.

The field investigator, in cooperation with professors from the medical schools and other teaching institutions, would design the community work for the medical students and would give classes to both the professors and students, who could then put the programs they have decided on into effect, gather new information, and test equipment and strategies in health improvement.

## Conclusions

A very large percentage of Mexico's population living in rural areas lacks resources for health care. Any new effort to provide such care must emphasize the health of the infant population because of the high percentage of infants in the country. Plans made at the national level have not been correlated with the conditions that exist in rural areas. For example, the majority of university programs are oriented toward urban medical practice, and the construction of more schools of medicine to solve the problem of doctors in rural areas is based on a mistaken premise. This problem has not been solved even in developed countries such as the United States where, as in Mexico, graduates in medicine migrate to the cities where optimal conditions are met for practicing the type of medicine for which they have been trained. Furthermore, it is both expensive and illogical to maintain urban doctors in rural areas where they cannot practice their profession for lack of resources; to do so is to deny the purpose of their education (27). Conventional schools of medicine, for reasons of investment and of structure, should teach only very selected groups of students who, on finishing their training, are fully capacitated to practice specialized medicine. A different system is required if we are to provide adequate health care in the rural communities. A system such as that described herein, adapted to the real need of rural communities, would avoid the necessity to create dysfunctional bu-

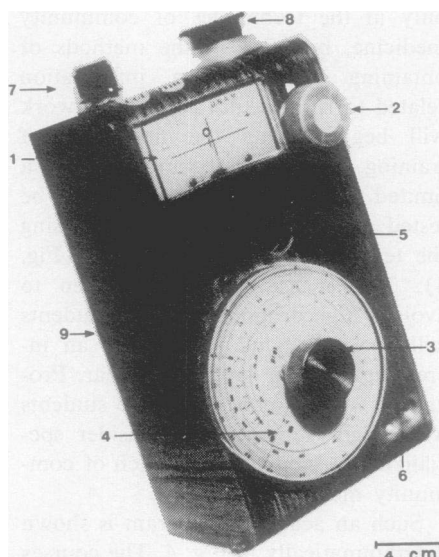


Fig. 5. Colorimeter-microscope developed for fieldwork: (1) galvanometer; (2) null balance (3) reading knob for optical density and direct readings in units; (4) reading indicator; (5) tube entrance; (6) switch for alternating current; (7) microscope-colorimeter selector; (8) ocular; and (9) filter entrance. The field kit designed includes equipment for a complete blood, urine, and coproparasitoscopic analysis; diagnostic tests for the most common bacteria and fungi; and a book written through computer that includes methods for dealing with specific, important illnesses that are frequently present in the rural communities, minor surgery equipment, and common drugs.

reaucratic and would not destroy those institutions which have proved useful in the past. This study should be considered as one of the many pilot programs that should be initiated in order to determine the type of program that would best solve the problem of health care in rural Mexico. Other programs already being considered at the National Autonomous University of Mexico include the A36 plan of the Faculty of Medicine, now in operation; the work of C. Biro carried out in Netzahualcoyotl City (both focused on providing medical care to the urban poor); and the Open University program.

Unless an efficient program designed to meet the needs of rural communities is quickly put into operation, Mexico will, in the near future, be facing the same problems now confronting Southeast Asia.

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#### NEWS AND COMMENT

## Safeguard: Disputed Weapon Nears Readiness on Plains of North Dakota

*Nekoma, North Dakota.* The distinctive black earth of North Dakota is the sediment left by a vanished lake that covered the region in the wane of the last ice age. From the fertile, dark deposits grows much of the country's durum wheat, used to make spaghetti and other pastas. The ancient lake bed is also the site of one of the wonders of the modern world, a flat-topped pyramid only 75 feet tall but housing the most complex electronic system in existence. Poking up amid the wheat fields of Cavalier County, midway between Devil's Lake and Walhalla, stands the Missile Site Radar, heart of the Safeguard antiballistic missile system.

Across Route 1 from the Missile Site Radar is the one street hamlet of Nekoma. Anyone staying at the Nekoma Wigwam on the day nuclear war broke out would be witness to a remarkable aerial battle, although he would see only a small part of it. He

would not see the Russian missiles en route to attack the 15 pockets of Minuteman missiles defended by Safeguard. But 25 miles to the northeast, the gigantic eye of the Perimeter Acquisition Radar, its beam ranging far across Canada, will catch the salvo as it comes over the North Pole.

The radar plots the trajectory of each missile and passes the information to Central Logic and Control, the Safeguard computer housed on the second floor of the Missile Site Radar pyramid. With about 5 to 10 minutes to calculate and act, the computer plans out the battle ahead, arranging that its interceptors engage the incoming salvo at points where their warheads will not destroy each other or black out the radars' vision.

As the Russian missiles close in, the computer launches Spartan missiles from the silos near the base of the pyramid. The Spartan is a long range

interceptor which flies out to meet its target above the atmosphere and destroys it in a burst of x-rays. But the Spartan's target may be concealed among decoys, rocket fragments, and a cloud of other debris, all moving in at about 4 miles a second. If the Spartan misses, or if no interception is attempted at this stage, the computer waits for the cloud to hit the atmosphere so that with the Missile Site Radar it can sort out the real warheads. With seconds remaining, the computer launches its close-in interceptors. The cone-shaped Sprint missiles are flung out of their cells at the radar's base, ignite, and race toward their target faster than bullets. Under the computer's guidance they reach it in seconds and, at the computer's command, detonate their warheads in a burst of neutrons.

Safeguard might or might not survive such a battle, depending largely on how many missiles the Russians could spare to throw at it. But the antiballistic missile system already has won an equally ferocious battle for survival, a 20-year odyssey which included scenes of high melodrama such as then Vice President Agnew breaking a tie Senate vote in favor of continuing work on the system, and former AEC chairman James R. Schlesinger flying his