WORLD WATER DAY

Message from the Regional Director

THE theme of 'Water for Health' is well-chosen for this year's World Water Day. Water is essential for life, and safe water is essential for health. There is a close relationship between the quality of water and health in the countries of the South-East Asia Region.

λA major achievement of this region was the eradication of guinea-worm disease in 2000. This is an example of what can be achieved with the multi-sectoral collaborative efforts of health, water and sanitation, supported by social mobilisation. However, other important water-related concerns remain in the region:

λOver three million people worldwide, most of them children, die each year of diarrhoeal diseases linked to inadequate water supply, sanitation and hygiene. Nearly one-third of these fatalities happen in this region. Availability of safe drinking water, improved sanitation and personal hygiene can significantly reduce the burden of water-related diseases.

λThe large-scale exploitation of groundwater, usually considered to be safer than surface water, has inadvertently resulted in widespread exposure of the population to arsenic, fluoride, nitrates, and other chemicals in some countries. Simple, time-honoured water quality surveillance procedures that evaluate the safety of drinking water are now being given a new impetus.

λThe term 'sanitation gap in Asia' highlights the fact that sanitation coverage has lagged far behind water supply coverage on this continent. Among SEAR countries, nearly 1.3 billion people have access to improved water supplies but the number of people enjoying access to basic sanitation facilities is less than half that number, at 615 million. Provision of basic, low-cost sanitation facilities would be an important element to alleviate poverty and promote development among this group.

λExcess water, as in floods, or the lack of it, as in droughts, is also linked to health emergencies in the South-East Asia Region. Many of the member countries have also been affected by other natural disasters like earthquakes and cyclones. These disrupt water supplies, put a heavy strain on sanitation systems and increase the vulnerability of populations to water-borne diseases. This highlights the urgent need to improve disaster preparedness measures and reduce the vulnerability of water and sanitation systems.

Amidst grave concerns, there is cause for hope. 'The Global VISION 21: Water for People' initiative, envisages "acceptance of access to water and sanitation as basic human rights," and gives us a target for the year 2015:

"a clean and healthy world: a world in which every person has clean and adequate water and sanitation and lives in a hygienic environment."

(World Water Vision Commission Report, World Water Commission 2000)

In November 2000, at a meeting in Iguacu, in Brazil, some 250 "ambassadors" for Vision 21 adopted the Iguacu Action Programme. Its focus is on the reduction of the huge death toll from diarrhoeal disease in developing countries by ensuring better hygiene, more sanitation facilities and safe water. Ambitious? Yes, but achievable through collaborative efforts guided by innovative policies with renewed energy and commitment.

The Iguacu Action Programme outlines global strategies to achieve the Vision, placing advocacy and communication clearly at the fore. We must take advantage of the unprecedented communication opportunities available now to mobilise global attention on solving the water, sanitation and hygiene needs of the people. In our region, we now need to effectively advocate action among a wider audience, not only among the policy-makers but reaching out to every actor in civil society.

Elements of such action can be seen already in SEAR countries. The Gujarat 2010 Vision is a good example. This local Vision set concrete targets for policy and institutional reforms, technological developments, and health and social achievements in that Indian State. The key strategies for achieving these goals are advocacy and partnerships. Work towards implementing this had begun but was disrupted by a devastating earthquake which rocked the state earlier this year.

Another important example is the Safe Tap Water Certification Programme being implemented in Thailand through the collaboration of health authorities and water suppliers. Joint action coupled with public education and community participation is bringing safer, and more affordable, drinking water to an ever-growing number of consumers. The 'Bangkok Declaration on Safe Drinking Water and Health', issued by delegates of SEARO Member Countries in January 2001, urges that countries follow similar approaches.

In numerous other water and health initiatives throughout the Member Countries, the themes of advocacy and partnerships recur. Some examples of such initiatives in this region can be found in the SEARO World Water Day Information Kit.

Our purpose in highlighting such initiatives is not only to applaud their success but also to encourage others to follow their examples. Renewed dedication and commitment to the task will be necessary if the needs of the growing population are to be met. In addition to employing strategies of advocacy and partnerships, health authorities in particular must take action to ensure interprogrammatic collaboration, where water and sanitation concerns intersect with programmes for disease-prevention and control, primary health care and healthy settings, infants' and children's health, and women's health and gender equity.

The call for partnerships is not limited to countries alone but applies to external support agencies (ESAs) too. Here again one sees signs of encouragement as technical agencies. NGOs and donor organisations increasingly collaborate at the national level. In many countries of the region, UN interagency working groups on water and sanitation provide forums for coordination that even reach out to bilateral and other non-UN agencies. Sensitized by crises such as that of arsenic contamination in drinking water, many ESAs are showing new interest in and commitment to the safety of drinking water in addition to issues of sustainability and coverage.

I urge everyone not to look upon World Water Day celebrations as just another event, but as an occasion to renew their commitment to water and health. I hope that you will find these materials useful.

Dr Uton Muchtar Rafei

Water-borne diseases and environmental health situation

EVERYONE knows that water sustains life. But not everyone knows that water can also endanger life. Ingestion of or exposure to contaminated water causes several diseases. Others may be caused by exposure to naturally found harmful chemicals or man-made pollutants in ground water.

There are short-term and long-term health risks associated with contaminated water these may be microbial (bacteria, viruses, parasites), or chemical (metals, pesticides, disinfection byproducts, etc.); and toxin-related (toxins produced by algae). Aquatic life can also be contaminated by chemicals or other effluents discharged into lakes, ponds and seas. Contaminants in water used for irrigation can also affect agricultural products. Thus, the poison may enter the food chain and can also cause health problems.

Water-related diseases

Diarrhoeal diseases are associated with unsafe water and poor sanitation coupled with poor food-handling practices and bottle-feeding of infants during the first 4-6 months of life. The main cause of death from acute diarrhoea is dehydration resulting from loss of fluids and electrolytes. Other causes of death are dysentery and malnutrition resulting from incorrect management of diarrhoea along with inappropriate feeding practices.

Globally, there are an estimated 1.8 billion episodes of childhood diarrhoea each year. Diarrhoeal diseases, including dysentery, claim the lives of three million children annually. Household surveys carried out during 1994-1995 show that diarrhoea episodes ranged from 0.7 to 3.9 per child less than five years of age in countries of the South-East Asia Region.

A regional programme for the Control of Diarrhoeal Diseases (CDD) has been in operation since 1979 to reduce mortality and morbidity due to these diseases in infants and children below five years of age.

Cholera is endemic in all countries of the South-East Asia Region except DPR Korea where cholera has not been officially reported since 1968. Traditionally, countries of the region have been the home of both the classical and *El Tor* cholera strains. Now, however, *El Tor vibrio* is the only biotype identified in all countries of the region, except in Bangladesh where the classical biotype is also still present. Since there is a large proportion of inapparent clinical cases among *El Tor vibrio*-infected persons, it is not possible to prevent the spread of cholera between countries. However, in most cases, outbreaks of cholera can be contained within individual countries.

In October 1992, a new strain of *V. cholerae*, serotype 0139 (Bengal), was discovered in India and Bangladesh. It raised fears that this might be the start of a new pandemic. However, the 0139 strain has not spread beyond Asia and now seems unlikely to become a global threat.

Although there has been no report of a major epidemic of cholera in any country of the region during the past few years, new epidemics may occur if the disease is not closely monitored through an appropriate surveillance mechanism.

Based on the number of cases and deaths reported to WHO from several countries of the region, there has been a continuous decline in the cholera case fatality rate (CFRs) from 2.51% in 1991 to 0.8% in 1997. The low CFRs in the region and in Asia may be attributed to increased access to proper diarrhoea case-management.

Dengue (including dengue haemorrhagic fever) is one the world's most important emerging diseases. The disease vector is the Aedes mosquito which breeds in and around the house in stagnant water collected in man-made water containers. By 1997, most countries in the SEA region, especially India, Indonesia, Myanmar, Sri Lanka and Thailand had experienced major outbreaks. Approximately 1.3 billion people living in the seven endemic countries (Bangladesh, India, Indonesia, Maldives, Myanmar, Sri Lanka and Thailand) are at risk of infection. Humans are the main reservoir of dengue infection. It is estimated that nearly 400,000 cases and 8,000 deaths occurred in the region in 1998. Its mortality rate, however, has been substantially reduced with effective case-management. Over the last 10-15 years dengue has, after diarrhoea, become the leading cause of hospitalisation and death among children in the region. Community participation during the transmission season for a mass campaign of regular and synchronised cleaning of all man-made water containers would significantly reduce larval Aedes mosquitos, and consequently, reduce the disease-transmission potential.

Hepatitis claimed 28,000 lives in SEAR countries according to the 1999 Regional Health Report. Hepatitis A is very common in areas with poor hygiene and sanitation in all countries in this region. Studies in Bangladesh, Bhutan, India, Maldives and Nepal showed that hepatitis A infection is responsible for approximately 10.25% of total cases of hepatitis in children. Improvements in hygiene, sanitation and drinking water facilities between 1978 and 1995 may have contributed to a decline from 85-90% to 30-35% in hepatitis seropositivity in children between 7 and 12 years of age.

Intestinal parasitic diseases. Some parasitic diseases such as intestinal worm infections are transmitted through the soil in communities where there are poor standards of personal hygiene due to water shortage and inadequate sanitation facilities.

Lymphatic filariasis is a disease caused by three lymphatic filaria parasites (worms) that inhabit the lymphatics. It is spread by various mosquito vectors which breed in stagnant water in drains, ditches and ponds in the village. It is also called elephantiasis, and it is the most debilitating and disfiguring scourge among all diseases. It is one of the major public health problems in the SEA region where eight out of ten countries are known to be endemic for filariasis. It is estimated that there are over 60 million infected people throughout the region which make up half of the global figure. Countries in the SEA region are committed to a global effort for the elimination of lymphatic filariasis by 2020. Successful programmes will be achieved by instant deworming using albendazole delivered through improved health care with the support of the community and intersectoral partnerships.

Malaria is another important parasitic disease spread by mosquito vectors. Out of a total population of 1.4 billion in the region, it is estimated that 1.2 billion people live in malarious areas of which an estimated 397 million people live in areas with malaria resistant to drugs. The problem of multidrug-resistant malaria is a serious concern shared by many countries as one of the important cross-border health problems. In 1999, the region reported 3.1 million confirmed cases (estimated 22-23 million clinical cases). Selective use of insecticides and integrated vector control methods, including the use of treated mosquito nets for personal protection, are being encouraged to combat malaria. Countries in the SEA region could afford to cover only 7.3% of the population-at-risk with expensive house spraying. While personal protection will reduce the risk of getting the disease, early detection and prompt treatment with appropriate and effective drugs would reduce suffering and deaths due to malaria. Knowledge of the breeding habitats of malaria vectors has been the basis for interventions to reduce mosquito density through environmental management. Small breeding habitats around the house could be attacked through community efforts (filling, draining, implanting fish, etc), but large breeding sites would require commitment for intersectoral actions e.g. drainage. In the SEA region, the Roll Back Malaria (RBM) initiative has been launched in 24 pilot districts with 15.5 million population in Bangladesh, India, Indonesia, Myanmar, Nepal, Sri Lanka and Thailand. Malaria, as part of a cross-border problem, is being tackled by improving surveillance, synchronizing field operations and improving health services for better access to diagnosis and treatment.

Dracunculiasis (guineaworm) has been successfully eradicated from the SEA Region. Following a review by the International Commission for the Certification of Dracunculiasis in February 2000, India joined the other 109 countries already certified free from guineaworm disease. When India launched its Guineaworm-Eradication Programme in 1979, the disease was estimated to affect 1.3 million people. What helped this successful programme was the provision of safe water sources and massive community participation through social mobilization and education efforts. The end of this disease means much more than a significant health achievement. It has generated major social and economic gains which are nonetheless easy to see on the happy faces of villagers who were once afflicted. Eradication of guinewaorm is a success story for the SEA Region.

TOUCHING A WATER SPROUT WITH HANDS SHOULD BE AVOIDED TO HELP CURB SPREADING OF BACTERIA AND DISEASES. Picture: **WHO**

Diseases related to chemicals in drinking water:

A number of chemical substances, if present in certain concentration in drinking water, may constitute a risk to health. Two of the more prevalent chemicals that are found in drinking water in some parts of our Region are arsenic and fluoride. Short-term health consequences of exposure to excessive levels of inorganic arsenic in drinking water include dermal conditions and pigmentation changes. Long-term exposure to inorganic arsenic is associated with the risk of developing bladder, skin and lung cancers. Excessive levels of fluoride in drinking water may give rise to dental fluorosis in some children, while higher doses may cause endemic cumulative fluorosis with resulting skeletal damage in both children and adults.

These public health problems underscore the importance of safe drinking water and proper sanitation facilities.

Water is life. Picture: **WHO**

Water and Health

THE international observance of World Water Day is an initiative that grew out of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. The United Nations General Assembly designated 22 March of each year as the World Day for Water by adopting resolution (A/res/47/193).

The theme for 2001 is "Water and Health". For this reason, and for the first time the World Health Organization (WHO) is the lead agency.

Water and health are inter-twined in many ways. Water is one of the earth's most precious and threatened resources. Health is precious to all of us and equally vulnerable. We need to protect and enhance them both.

22 March is a unique occasion to remind everybody of the unseen contribution water makes to health, and how it can reduce disease. More than one billion people do not have access to improved drinking water sources. Practical efforts can help us to make an impact in providing clean drinking water to improve health, as well as to increase worldwide awareness of both problems and solutions. To make a difference our tasks include turning words into political commitment and action.

A series of activities are planned by WHO and others for the ninth celebrations of World Water Day on 22 March 2001. WHO is adopting a process approach, in a way stretching the day into a year-long event series of events. The activities are:

- The launch of a World Water Day web-site in collaboration with the International Water and Sanitation Centre (IRC) and WHO. This will provide a wealth of information on water and health issues and give free access to information about World Water Day. It will be updated throughout the year, forming the main source to attract and empower the largest possible audience for this event. The web-site will emphasize the importance of water and health, providing an efficient and appropriate way to disseminate information. The site will be launched in January 2001, featuring information from around the world on World Water Day activities on the day, and throughout the year. The address will be www/irc.nl/waterday (to be confirmed by IRC).

Information on the WWW will include :

- 'An advocacy guide' to encourage partners, international organizations, private companies, governments, NGO's, schools, and the community at large to support and celebrate this unique occasion.
- Disease fact sheets will describe each water related disease and will provide you with the latest up to information and statistics.
- Theme articles linking water and health will highlight the cross cutting issues such as poverty, war, flooding, infection human rights and much more.
- Case studies will be published covering success stories as well as continuing water and health dilemmas. These will explore the crucial need for adequate and safe water and how this can improve people's health and well being.
- An explanatory leaflet.
- On the day, WHO will launch a new report.

Water and Health Highlights

Water is intimately linked to health in several ways. It is important to address the increasing need for adequate and safe water to protect both people and the planet:

- Preventing disease helps to alleviate poverty. The billion or more people without access to even improved water sources and the 2.4 billion or more without basic sanitation include the poorest people in the world and some of the unhealthiest. A first step towards alleviating poverty is to acknowledge the many components as well as note the major contribution of water and sanitation to poor alleviation and development.
- Improving health : Safe water, adequate sanitation and hygiene education are basic human rights that protect health, increase the sense of well being and improve economic and social productivity. In addition, water-related leisure activities, such as sports and spas, contribute to healthy lifestyles and longevity.
- Preventing disease : Two million children die each year of diarrhoeal disease linked to inadequate water supply, hygiene; another million die of malaria; in China alone, 30 million suffer from chronic flourisis, and 1.5 million are infected with hepatitis A. Improved water quality, sanitation and personal hygiene significantly reduce the spread of these and many other water-related diseases. Better water resources planning and management have a similar beneficial impact on the incidence of malaria, schistosomiasis and other vector-borne disease.
- Changing attitude and actions : WHO is lead agency and its role for World Water Day 2001 is congruent with the integrated approach to health issues introduced by Dr. Brundtland, Director General, WHO. WHO welcomes the opportunity to increase the awareness of water and health as central to sustainable development; by viewing water as central to health, and health as crucial to the complex web of life which also includes protecting the environment and alleviating poverty.

Contamination of drinking-water by arsenic in Bangladesh: a public health emergency

ALLAN H SMITH, ELENA O LINGAS, AND MAHFUZAR RAHMAN

EXCERPTS

IN Bangladesh, arsenic contamination of water in tubewells was confirmed in 1993 in the Nawabganj district. Further testing was done in the following years; this included investigations by the Department of Occupational and Environmental Health of the National Institute of Preventive and Social Medicine. Results from various Laboratories were collated in a WHO country situation report in 1996. The institutions that provided results included the Jadavpur University in Calcutta, India, the Bangladesh Atomic Energy Commission, the Department of Public Health Engineering's laboratories in the Khulna and Rajshahi districts, and the National Institute of Preventive and Social Medicine in Dhaka. Altogether, 400 measurements were presented in the report, although contamination in some wells was measured by more than one laboratory. In about half of the measurements concentrations were above 50g/1, which is clearly in excess of the maximum level recommended by WHO of 10g/1 and greater than the maximum level of 50g/1 permitted in Bangladesh.

To raise awareness of the seriousness of the arsenic problem in West Bengal and to draw attention to the need for studies in Bangladesh, a conference was convened in 1995 by D Chakraborti and the School of Environmental Studies of Jadavpur University in Calcutta. In the years after the conference, the extent of the problem in Bangladesh has become clearer through additional surveys of the water and population, many of which were led by Chakraborti.

A study conducted in the Rajarampur village of the Nawabganj district, by the National Institute of Preventive and Social Medicine and the School of Environmental Studies, found that 29% of the 294 tube-wells tested had arsenic concentrations greater than 50g/1. Between September 1996 and June 1997, a survey was jointly conducted by Dhaka Community Hospital and the School of Environmental Studies. An examination of 265 wells in Samta village in the Jessore district found that about 91% of the wells had arsenic concentrations higher than 50g/1 (13). In 1998, a British Geological Survey of 41 districts collected 2022 water samples 35% were found to have arsenic concentrations above 50g/1 (Table 1) and 8.4% were above 300g/1 was about 21 million. This number would be approximately doubled if WHO's standard of 10 g/1 were adopted. Further studies conducted by the School of Environmental Studies and the Dhaka Community Hospital found that 59% of the 7800 groundwater samples had arsenic concentrations greater than 50g/1.

Surveys of the effects on the population's health have occurred concurrently with the previous studies of groundwater contamination. From December 1996 to January 1997, a three-week survey was conducted by the Dhaka Community Hospital and the School of Environmental Studies. The survey team visited 18 affected districts. Of the 1630 adults and children examined, 57.5% of them had skin lesions due to arsenic poisoning. In another study , approximately one-third of the 7364 patients examined had skin lesions due to arsenic.

The population of the 42 affected districts was 76.9 million. These studies do not imply that the entire population is drinking contaminated water. A recent report from the World Bank has estimated that 20 million inhabitants of Bangladesh may be drinking arsenic-contaminated water.

The actual extent of the contamination and the number of people with skin diseases caused by arsenic might be many times higher than is currently estimated. For comparison, it has been estimated that in West Bengal the number of people exposed to arsenic is 1.5 million, and one estimate of the number of patients with arsenicosis exceeds 200 000. Since the estimate of those who may be drinking arsenic-contaminated water in Bangladesh is in the tens of millions, it is reasonable to expect the unless exposure ends the number of people with arsenicosis will eventually far exceed the number observed in West Bengal. Although all wells and all villagers have not been systematically tested and examined, this should not delay action. The evidence that has accumulated since 1997 has only confirmed that this is a public health threat of great magnitude.

Long-term health effects of exposure

The health effects of ingesting arsenic-contaminated drinking-water appear slowly. For this reason, a more important issue than the number of patients who currently have arsenic-caused diseases in the number who will develop these diseases in the future as a result of past and continuing exposure to arsenic. Large numbers of tubewells were installed in Bangladesh approximately 5 to 20 years ago. If the population continues to drink arsenic-contaminated water, then a major increase in the number of cases of diseases caused by arsenic may be predicted.

Skin lesions

The latency for arsenic-caused skin lesions (i.e., the time from first exposure to manifestation of disease), in particular keratoses, is typically about 10 years. In the 1997 consultancy, it was found that the youngest individuals with skin lesions caused by arsenic were about 10 years old. Other studies have shown that skin lesions also occur in children younger than 10 years. It was also found that in adults, exposures commenced approximately 10 years before they stated the skin lesions began to appear. In some instances, the apparent latency for the appearance of skin lesions from the time of first exposure to contaminated water from the tubewell currently in use was much shorter, but as no measurements were available for water from previously used tubewells, a short latency from first exposure could not be inferred. However, latency that is shorter or longer than 10 years may occur, and the rapidity of the appearance of skin lesions appears to be dose dependent. Further studies of the latency and latterns of occurrence of skin lesions are needed and these will require careful interviewing of participants about their current andp ast exposures.

Cancer

Skin cancer. Small numbers of cases of skin cancer have started to appear. Since the typical latency is more than 20 years after the beginning of exposure, the fact that only a small number have been found provides little reassurance about the future incidence of skin cancer. A study of a large population in Taiwan found a clear dose-response relationship between arsenic concentrations in drinking-water and the prevalence of skin cancer. In this study, the average concentration of arsenic in water was about 500 µg/l, and by age 60 more than 1 in 10 had developed skin cancer. The lifetime risk of developing skin cancer from the intake of 1 µg. kg body weight^{-1} day^{-1} (roughly equivalent to 1 litre per day at concentrations of 50 µg/l) of arsenic in water ranges from 1 per 1000 to 2 per 1000. Though large numbers of skin cancers have been reported in Taiwan, the future burden of arsenic-caused skin cancer in Bangladesh is uncertain. Differences in susceptibility between the populations of Taiwan and Bangladesh may exist that only time and further study will identify. However, as yet there is no evidence to indicate that the long-term risks of skin cancer would be any lower in Bangladesh than in Taiwan.

Mortality from internal cancers. In other countries, the main causes of death associated with chronic ingestion of arsenic in drinking-water are internal cancers; skin cancers are not usually fatal if treated appropriately. Dramatic increases in mortality from internal concerns have been reported in Taiwan and Chile. In Taiwan, populations exposed to high concentrations of arsenic in their drinking-water, containing an average of 800 µg/l of arsenic, had estimates of their relative risk of bladder cancer in the order of 30-60. In Region II of northern Chile, 5-10% of all deaths occurring among those over the age of 30 were attributable to arsenic caused internal cancers, in particular bladder cancer and lung cancer. Average exposures were in the order of 500 µg/l (0.5 mg/l) over 10-20 years; exposure decreased in subsequent years after remediation efforts were introduced. Long latency was apparent, and increase in mortality continued for 40 years after the highest exposures began. In Argentina, a mortality study in the arsenic-exposed region of Cordobo found increased risks of bladder and lung cancer among men and women from 1986 to 1991, although concentration were lower (average 178 µg/l) than in Taiwan and Chile.

Although specific estimates of the current and future health effects of arsenic exposure are uncertain, in the case of Bangladesh it can be inferred that since there are many people who currently have skin lesions caused by ingesting arsenic, many more cases will occur if exposure continues; based on what is known about the relationship between ingestion and the development of internal cancers, it is reasonable to expect marked increases in mortality from internal cancers once sufficient latency has been reached.

Treatment

The basic treatment is to supply the patient with drinking-water that is free from arsenic. This is the first priority. Indeed, in the absence of good evidence for the effectiveness of other treatments, the second priority is to continue providing arsenic-free water, and the third priority is to monitor patients to ensure that they remain unexposed to arsenic. Providing arsenic-free water reduces the risk of further complications and disease caused by arsenic. There are no well-designed studies to show whether cessation of exposure leads to improvement in skin keratoses. Thus far, anecdotal interviews of patients suggests that mild to moderate keratoses do improve with cessation of exposure.

Chelation. Some physicians have been giving chelation therapy to arsenic patients in West Bengal and Bangladesh. The objective of chelation therapy is provide the patient with a chemical to which arsenic binds strongly, and is then excreted in urine.

Providing such treatment could remove large stores of arsenic from the body in a matter of hours.

There are several problems with chelation therapy in cases of chronic arsenic exposure. The first is related to the observation that arsenic is excreted rapidly even without chelation therapy. Most of the readily available arsenic in the body will be excreted in the urine within 1 week. The question is whether chelation might remove arsenic which is, for example, bound in the skin and which might without chelation only be removed slowly. This is possible but exposure to arsenic generally occurs over many years, and chelation may make little difference to the cumulative dose of arsenic that patients have received. Thus, chelation therapy is unlikely to reduce the future risk of cancer. Whether it might improve keratoses more rapidly than simply stopping exposure is unknown. This idea has some plausibility but its effectiveness has not been established.

The second problem with chelation therapy is the lack of any clinical trials that found evidence of its effectiveness. When exposure to arsenic ceases, improvement in skin lesions might occur. Thus, if a patient improves after chelation therapy it could be due to the cessation of exposure alone or to both cessation and chelation therapy. (Finding that patients improve after chelation therapy does not provide evidence that the therapy) itself is effective.

The third problem with chelation therapy is that it is of no benefit if the patient continues to drink contaminated water after treatment, and it may give the false impression that effects can be treated despite continued exposure. Thus, chelation therapy should not be used routinely, although careful controlled studies of chelation therapy in patients with keratoses and other arsenic effects should perhaps be undertaken.

Nutrition. Since evidence from Taiwan suggests that some nutritional factors may modify cancer risks associated with arsenic, it has been proposed that providing vitamins and improving nutrition may be of benefit to patients. In particular, vitamin A is known to be beneficial in the differentiation of various tissues, particularly the skin. If the doses given are not excessive, there are other nutritional benefits to providing vitamins, particularly in populations that may have inadequate levels of micronutrients. For these reasons, it is recommended that all patients with skin lesions be provided multivitamin tablets and that research projects be undertaken to establish whether or not they are effective for patients with arsenicosis.

Other considerations. Advanced keratoses on the palms of the hands and soles of the feet are extremely debilitating, and superimposed infections, such as fungal infections, may cause serious problems. Providing moisturizing lotions and treatment for infections may be beneficial and should be part of routine care in advanced cases. These topics should be systematically studied. Arsenic is a probable contributor to causation of diabetes mellitus. For this reason, urinary glucose should be tested in all patients with arsenicosis, and appropriate treatment and monitoring should be started if necessary. Patients' blood pressure should also be monitored since arsenic exposure may induce hypertension.

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