EPIDEMIOLOGIC ASPECTS OF VIRAL AGENTS IN RELATION TO WATERBORNE DISEASES

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ONE WOULD expect that enteric viruses should produce disease on some occasions when drinking water becomes contaminated by human wastes. Despite this fact, only one viral agent, that of infectious hepatitis, has been clearly associated with waterborne epidemics.

Several epidemics of jaundice in which drinking water could be reasonably implicated were reported in Sweden (*1*) from as early as 1916 through 1943, and a clear-cut instance producing 173 cases among students at a Canadian college was described by Fraser (*2*) in 1931. The possibility of waterborne transmission, however, did not receive general recognition. One of the difficulties may have been Fraser's erroneous conclusion from serologic agglutination tests that *Salmonella schottmulleri* was the responsible agent, an observation which could not be confirmed in other cases.

Due recognition to waterborne infectious hepatitis was provided by Neefe and Stokes (*3*) from their study of a summer camp epidemic in Pennsylvania in 1944. By that time the human volunteer studies of World War II had shown the viral nature of the etiological agent, and the fecal-oral route of infection was experimentally established. Since 1945, there have been published reports of 31 epidemics, each involving from 6 to 29,000 persons, attributed to water (*1, 4–13*). While all the reports are not necessarily well substantiated, there is no question that waterborne transmission does occur.

Poliovirus is the only other viral agent mentioned frequently as being possibly waterborne. Kling suggested drinking water as a source of infection in 1928 (*14*), and he was able in 1939 to isolate poliovirus from a well used by a patient (*15*). The water was not tested, however, until after the patient had onset of typical symptoms, and the contamination could have been the result rather than the cause of the infection. Epidemics of poliomyelitis attributed to water occurred in Sweden in 1939, 1944, 1948, and 1949 (*16*), in Nebraska in 1952 (*17*), and in Alberta in 1953 (*18*). In no instance has the evidence been sufficiently complete to carry conviction. The possibility that poliomyelitis is very occasionally waterborne is not excluded, but proof for it is lacking.

One group of viral agents which may well be waterborne is that responsible for acute gastroenteritis. Here the problem is somewhat the opposite of that in poliomyelitis. In many epidemics of gastroenteritis, there has been sufficient evidence for waterborne transmission, but no viral agent could be definitely implicated. While viral etiology of many such episodes seems likely, the possibility that they are caused by an unrecognized bacterial pathogen or even chemical intoxication cannot be excluded. With continued improvement in virological methods, answers to the question of the etiological agents can be anticipated.

How do we demonstrate that a particular epidemic is waterborne? There are two simple epidemiologic principles involved:

- One attempts to show a significant difference in the attack rate among those exposed to the suspected water source compared with that in persons in the same area not so exposed.
- One must also demonstrate that no other mode of transmission was common to the cases or could account for the pattern.

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What clues are helpful in suggesting that the possibility of waterborne transmission should be considered? These may be illustrated by observations on infectious hepatitis but also can be applied to other diseases, keeping in mind such factors as differences in the length of incubation periods and probable susceptibility of the populations involved.

Shape of epidemic curve. In a community-wide epidemic of infectious hepatitis transmitted person to person, the 20- to 40-day incubation period results in a slow increase in cases over several months. When waterborne transmission occurs with a number of persons exposed at the same time, cases have their onsets within a 2- to 3-week period. The simultaneous infection of many persons through contaminated water results in an abrupt epidemic curve. Either contamination or exposure can be intermittent, however, so that it is possible for waterborne infection to be scattered over many weeks or sometimes several months.

Unusual age distribution of cases. In several waterborne epidemics in which a broad age segment was exposed, the highest attack rate has been in the young adult group. With person-to-person transmission the highest rate is usually among school children (*1*, *8*). A predominance of cases in school children, however, does not exclude waterborne transmission (*10*).

Focal differences in attack rates. There may be variations in attack rates which conform to differences in the characteristics of the water system when there is source contamination, or to the area of a defect when there is proximate contamination. In an epidemic (*19*) in Curwensville, Pa., in 1956, attack rates differed sharply on the two sides of town. Almost all of the cases were in areas served by one of the two sources for the system.

History of source exposure. Inquiry concerning exposure to a water source other than that usually used by the population should be routine in questioning patients with infectious hepatitis. Particular attention to exposure may be rewarding, however, when a group of cases has some distinguishing characteristic. As an example, if several cases occur in teenage boys, one would wish to ask about athletic activities, hiking, and camping.

It is obvious from this discussion that documentation of waterborne infection depends upon recognition of several cases having a common exposure. There is no way of assessing how many cases result from exposure of only one or two persons to a contaminated source. Even virological techniques for demonstrating the agent in water will have only limited value unless the incubation period is very short, as for some types of gastroenteritis presumed to be viral.

It is also worth remembering that mixed patterns of waterborne and person-to-person transmission are frequent, so that lack of exposure to the suspected source in some of the cases investigated does not necessarily eliminate it from consideration.

Waterborne epidemics of viral diseases are often not immediately obvious. Their recognition depends on alertness of physicians and public health workers. Recognition is important since the responsible defect can be corrected and further cases prevented.

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The Health of Mobile Populations

The health needs of the transient population of a small residential tract adjacent to Denver County, Colo., are being investigated jointly by the Tri-County District Health Department, the Colorado State Department of Public Health, and the U.S. Children's Bureau.

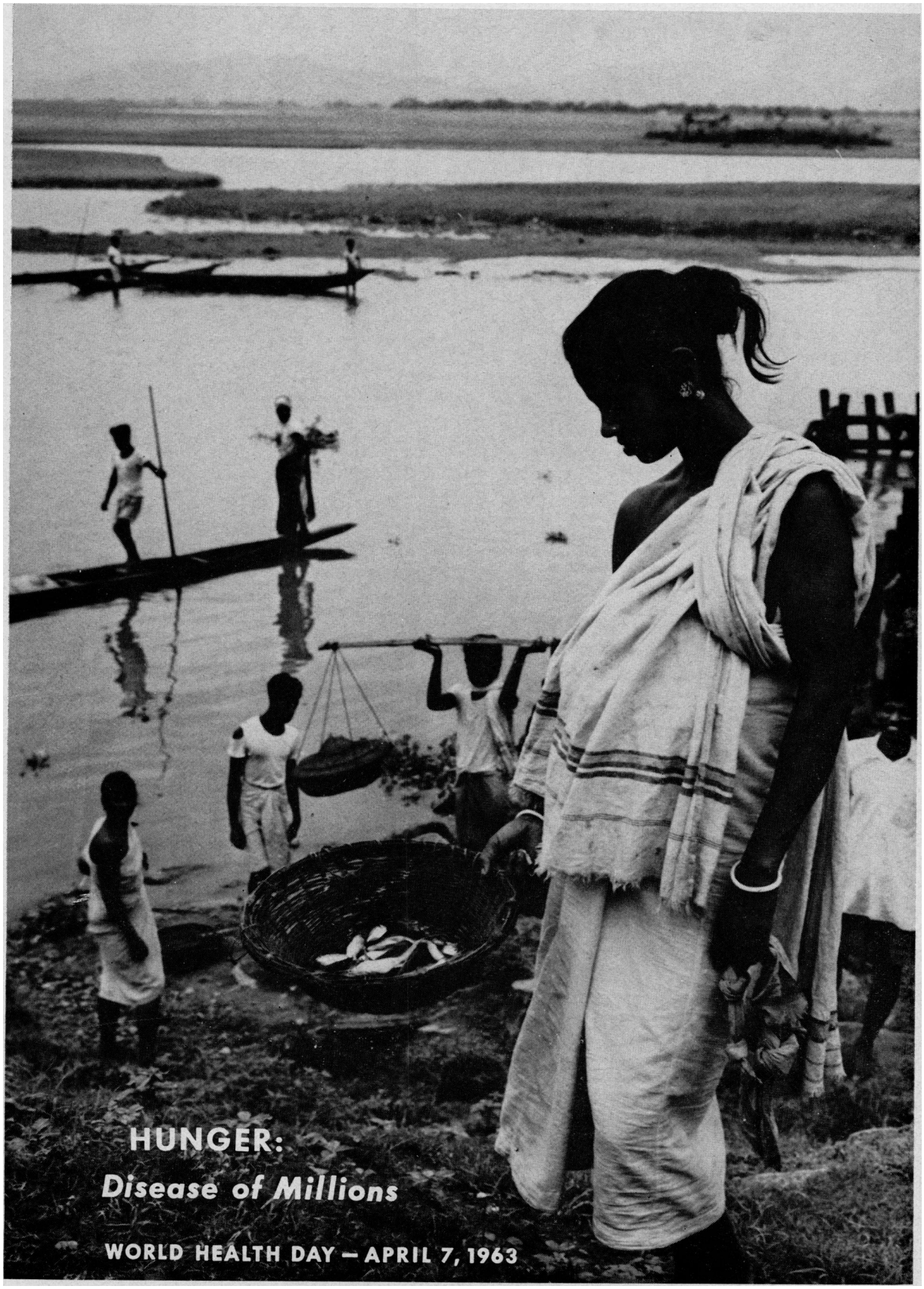
The objectives are (*a*) to establish a practical distinction between mobile and residential populations, (*b*) to explore the differences between the health needs of mobile and resident populations of similar status and the differences in health services received, (*c*) to translate the findings of the study into whatever actions are indicated, and (*d*) to observe and evaluate the results.

The project began in October 1961 with a staff consisting of a public health nurse, a sanitarian, a medical social worker assisted by temporary field interviewers, and consultants in public health, behavioral science, and research.

The public health nurse and the sanitarian collected all available data on the approximately 2,000 persons living in the area. They checked health department records, school records, census data, municipal and county agencies, and other sources. The sanitary conditions and housing in the area were surveyed and mapped. A definition and an index of population mobility was developed as part of the frame of reference for the project. In May 1962 every third dwelling unit was visited and 255 residents were interviewed. A coding system was developed and tabulation of the responses is being completed.

The project plan calls for a second survey 6 months after the first, covering a 50 percent sample of the households previously interviewed. The total data will be analyzed for possible health service needs. The findings will guide the modification of existing programs or the development of new ones in the health department. Long-range plans will be developed for evaluating the new services.

The findings of the surveys will be reported in the near future. The methodology developed in this study will serve as a basis for similar studies of mobile populations in other areas of Colorado.—RUTH B. HOWARD, M.D., *director, children's health services division, Colorado State Department of Public Health, and* WILLIAM S. HAYNES, M.D., *director, Tri-County District Health Department, Aurora, Colo.*


HUNGER:
Disease of Millions
WORLD HEALTH DAY – APRIL 7, 1963

Contribution of WHO

The United States has enjoyed 14 years of freedom from outbreaks of quarantinable disease known to have been introduced from abroad. We, like other countries, have our own foreign quarantine program. The Public Health Service has administered it for nearly 80 years. But I do no injustice to the vigilance of our quarantine officers when I say that we owe this protection primarily to the World Health Organization.

Health and medical leaders in the United States and elsewhere have known for decades that true protection against the world spread of disease depends upon improved health conditions at the source of disease. This is what the World Health Organization and its member countries have been working toward these past 15 years. I cannot give you an eyewitness account. But every member of my staff, every colleague in outside institutions who has brought me accounts of world health conditions testifies to the striking improvements that have taken place.

The growth in rapid transport and world travel teaches us that the most vigilant quarantine system at ports of entry could not have given the United States such protection—alone and unaided. Moreover, the International Sanitary Regulations promulgated by the World Health Organization liberate international transport from many of the outmoded concepts of earlier periods. Modern procedures emphasize immunization and inspection of travelers, insect and rodent control, and sanitation of conveyances. Still more important, WHO acts as a clearinghouse for worldwide reporting of quarantinable disease and for the control measures taken at sources of infection. It has also set up a world network of "listening posts"—cooperating laboratories—that identify and alert health authorities to epidemics in the making which are not quarantinable. Such viral infections as influenza, for example, are under constant surveillance.

The World Health Organization provides a common meeting place where leaders of our own country can plan and work with those of more than 80 other nations. I cannot overemphasize the importance of this contribution of WHO.

Several hundred American professionals are serving with more than a thousand of their foreign colleagues on WHO expert committees. Also the United States Delegation to the World Health Assembly has included members of our health professions and leaders in public affairs. They have come from private practice, as well as from organizations devoted to medical research and teaching, public health, and hospital administration. International voluntary associations have participated in special sessions of the assembly.

Americans who have had these experiences hold the World Health Organization in highest respect. They have firsthand knowledge of its policies, its programs, its skilled operations. They have the highest admiration for WHO's international staff and for its talented director, Dr. M. G. Candau.

The Public Health Service will do everything in its power to support the objectives and programs of the World Health Organization. Let us remember that they are our objectives, our programs. For when our government signed the United Nations Charter, when it adopted the constitution of WHO, it made every citizen a participant in the world's great struggle for human health and welfare.—LUTHER L. TERRY, *Surgeon General of the Public Health Service.*

These observations on diverse aspects of world health were excerpted from papers presented at the Los Angeles World Health Conference, October 6–7, 1961.

Malnutrition and Child Health

If the almost universal occurrence of underlying protein malnutrition among children of lower income groups in technically underdeveloped areas meant only increased mortality due to a synergism of nutrition and infection, this would be bad enough. If the children who survived suffered nothing more than permanent stunting of their growth and development, this might conceivably be looked upon as a useful adaptation. Unfortunately, recent studies from Mexico suggest that intelligence is impaired as well.

Ramos Galvan and co-workers are finding a significant correlation between retardation in height and weight and the score of children reaching school age on the standard Good-enough "Draw-a-Man" test and on the standard Gesell tests. Retardation in weight for age may reflect to some extent current nutritional status, but it is largely a reflection of impaired nutritional status during several of the formative years. Retardation in height is more clearly due to previous malnutrition.

If malnutrition during preschool years affects the intellectual performance of children, it is

WHO photograph

INCAP psychologist tests little boy in Guatemalan village to study the effect of a protein-rich diet on intellectual growth

essential to prevent malnutrition in preschool children if educational measures are to have a fair chance of contributing to the improvement of the productivity, prosperity, and democracy of a country. In other words, malnutrition during the preschool years is serious for the children who survive as well as for the many who die as a direct or indirect consequence of it. . . .

The total protein-rich foods program sparked by the Protein Advisory Group and the staffs of WHO, the Food and Agriculture Organization, and the United Nations Children's Fund has resulted in the construction of UNICEF-equipped plants for the production of fish flour in Chile and Morocco, a soya milk preparation called Saridele in Indonesia, and the local production of powdered milk in many countries. Commercial production of Incaparina, a low-cost, protein-rich vegetable mixture, has begun in several countries of Latin America. The Indian Multipurpose Food Mixture, consisting mainly of a combination of peanut flour and chick-pea, is now being used in India, and a mixture of peanut flour and corn with added skim milk is being distributed in Uganda on a pilot basis. Many other research developments are expected to reach practical application soon.

The most extraordinary and hopeful development in international nutrition has been the way in which, in the last decade, WHO in cooperation with FAO and UNICEF has led a vigorous and effective assault on the widespread problem of protein malnutrition and on the accompanying high prevalence of kwashiorkor and marasmus in young children in technically underdeveloped areas.—NEVIN S. SCRIMSHAW, PH.D., M.D., *professor and chairman of the department of nutrition, food science, and technology, Massachusetts Institute of Technology.*

Health as Successful Adjustment

It is clear that we have brought ourselves into a serious unhealthy imbalance in our overall adjustment to our total environment, largely as a result of the very success of our effort to get verifiable knowledge of that environment. The trouble is that the knowledge has not yet brought understanding. The imbalance seems to reside fundamentally in our relative lack of understanding of ourselves, and thus in our inability effectively to control ourselves with respect to our total environment. Overpopulation, air and water pollution, radiation hazard, famine and war, and increasing organizational bureaucracy are all aspects of our individual and social failure to adjust ourselves appropriately, understandingly, and harmoniously with our total and long-evolving environment.

If things are going well for us, there is cyclic and repeated satisfaction, with resulting feeling of good health, joy of living, and returning desire to experience further the pleasures of living. When these satisfactions are denied, or when abnormal situations develop, either within the cells or within their integration, or within the environment of individuals, then anxiety develops lest the satisfactions may not come. This is followed by frustration if the hope of satisfaction is blocked, and is succeeded by anger which may go to rage, and to the extremes of behavior that are characterized as being "unhealthy" or "antisocial"—CHAUNCEY D. LEAKE, PH.D., *professor of pharmacology, College of Medicine, Ohio State University.*

Respiratory Diseases

Influenza was one of the first virus diseases with which the World Health Organization concerned itself. The reason is obvious. There is no disease which treats manmade frontiers with such disdain. As long ago as 1947, WHO initiated an international network of laboratories to study the problem, headed by the World Influenza Centre in London under Andrewes, one of the original discoverers of the human influenza virus. This center works in close cooperation with 60 national influenza centers in many countries in the world.

The change in our ability to perceive, rather than any change in the virus diseases themselves, has enabled us to view the large group of respiratory virus infections, including influenza, in a better perspective. WHO has reorganized its expert committees and research programs to take into account this changing pattern of disease intelligence. Mainly owing to the work of Huebner and Channock in the United States, and Andrewes and Tyrrell and their colleagues

WHO photograph

Guatemalan children drinking Incaparina at school

in England, we have come to realize that, apart from pandemics, the influenza virus is responsible, on the average, for less than 10 percent of clinical infections of the lower respiratory tract. It is responsible for a very small percentage of common cold-like infections of the upper respiratory tract.

It is estimated that we can now identify the causal agents of about two-thirds of all severe infantile and childhood lower respiratory illnesses and a considerable proportion, perhaps half, of upper respiratory illnesses of the common cold type. Lower respiratory infections are commonly due—roughly in order of importance—to the respiratory syncytial virus, the parainfluenza viruses, Eaton's agent (not, however, a true virus), adenoviruses, and about half of them to enteroviruses and the newly recognized related agents which have been referred to as the rhinoviruses. There are a wide variety of types which may enter into the clinical picture of the common cold.

Respiratory disease constitutes the major cause of absenteeism from work in highly industrialized countries. Moreover, contrary to a widely held misconception, respiratory disease is common in the tropics. It is one of the greatest unsolved communicable disease problems in the world today.—Anthony Monck-Mason Payne, M.D., *chairman of the department of epidemiology and public health, Yale University School of Medicine.*