

Communicable Diseases

Afternoon Session

Chairman: Dr. F. Grant; Consultant, Global 2000, Accra

Lecture 1

The Role of the Noguchi Memorial Institute for Medical Research (NMIMR) in the Control of Communicable Diseases and Malnutrition in Ghana.

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The initial aim of the founding fathers of the Noguchi Memorial Institute for Medical Research (NMIMR) was to develop the Institute into an international centre of medical research covering the entire scope of medical sciences. However in August 1984, an Evaluation Team from Japan International Co-operation Agency (JICA) recommended that in order to achieve immediate impact on the health and welfare of the people in greatest need, the Institute was to carry out research on priority health problems in support of programmes for the control of communicable diseases and malnutrition.

Since then the objectives of the Institute have been:

1. To research into the problems of communicable diseases and nutrition.
2. To provide training opportunities for postgraduate students in medical research.
3. To provide some specialized laboratory diagnostic and monitoring services in support of public health programmes.

In order to achieve the Institute's objectives, 11 Research Units supported by administrative staff have been created with clearly defined objectives and activities. These Units are:

- 1) Bacteriology
- 2) Parasitology
- 3) Epidemiology
- 4) Nutrition
- 5) Chemical Pathology
- 6) Virology
- 7) Immunology
- 8) Electron Microscopy
- 9) Laboratory Animals
- 10) Histopathology
- 11) Haematology

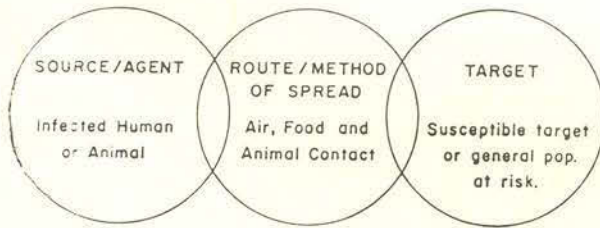
The Institute has a dual function of Research and Service. The services include specialized laboratory diagnostic and monitoring and training.

RESEARCH

In helping to control communicable diseases and malnutrition, Basic, Applied, Operational Research (to reduce cost in terms of time, money and manpower), or Special studies are carried out. All these are necessary because of the nature of communicable diseases and malnutrition.

Communicable Diseases are caused by living agents like Bacteria, Parasites, Viruses and Fungi. They are spread from the SOURCE which is an infected sick human or animal or by one of the following routes: Air, Food, Water, Animals, Insects or Direct Contact, to the target which is the healthy but susceptible contact and/or susceptible general population (Fig. 1).

Fig. 1 THE LINKS IN COMMUNICABLE DISEASES TRANSMISSION



The process is multifactorial in nature, however, breaking the chain at any of these three links and usually the weakest link stops the spread of the disease. The principle could also be applied to malnutrition and other disease conditions.

Formulation of sound policies for the control of communicable diseases and malnutrition

depends on sound and scientifically accumulated knowledge on

1. What causes the disease?
2. How is the disease transmitted?
3. Who gets the disease (age, sex, occupation)?
4. Where and when does the disease occur?

I would now like to look at our role under causes of diseases - biological agents of some communicable diseases.

On the determination of causative agents, the Bacteriology Unit has conducted investigation into diarrhoeal diseases and has determined the prevalence of Enteropathogenic (EPEC) and Enterotoxigenic *Escherichia coli* (ETEC) in rural and urban areas of Ghana; isolating and identifying different serotypes. *Escherichia coli* Serotypes 0143: KXI and 0155: K59 were reported by the Unit for the first time in Ghana. It appears from the study that ETEC may be more important than EPEC in diarrhoeal diseases in infants due to *E. coli* in Ghana. Work on *Campylobacter* and pathogenic *Aeromonas* as causative agents of diarrhoea has also been done.

The Bacteriology Unit has also shown that intestinal contents of household cockroaches (*Periplaneta americana*), contain *Salmonella*, *Shigella dysenteriae*, *Coliforms*, *Proteus* and *Pseudomonas* species. Cockroaches could, therefore, play a role as sources/routes of spread of these pathogenic organisms, and the need to prevent them from coming into contact with food cannot be overemphasized.

A multidisciplinary study has also been conducted by Epidemiology, Virology, Bacteriology and Parasitology Units on diarrhoea diseases in a rural community in the Central Region. *Giardia lamblia* and Rotaviruses were identified to be statistically associated with

acute diarrhoeal than non-diarrhoeal stool. Intestinal helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis* and *Necator americanus* (hookworms) have been isolated to different degrees in diarrhoeal and non-diarrhoeal stools, and may also constitute important causative agents.

In times of disease outbreak and epidemics, the Institute has been called upon to assist in investigations leading to control of such diseases like diarrhoea and especially when cholera is suspected and Acute Haemorrhagic Conjunctivitis (AHC) locally known as "Apollo" in isolating and confirming the causative agents. In 1987, following an outbreak of AHC, the Virology Unit in collaboration with the Eye Clinic of the Korle-Bu Teaching Hospital isolated *Coxsackie* type 24 CA variant from 96% of patients. To our knowledge this is the first time this virus has been found to be involved in eye infection in Africa outside its endemic areas of South East Asia and the Caribbean.

The Same Unit in 1988 at the request of the Ministry of Health investigated an outbreak of haemorrhagic fever in the Afram Plains in the Eastern Region; Yellow-fever was suspected.

The Virology Unit in collaboration with Japanese scientists and World Health Organisation (WHO) have worked on HIV infection. The WHO AIDS Proficiency Testing Laboratories preliminary report indicates that the Unit's results for a panel of samples tested are in perfect agreement with those of the Public Health Research Laboratory (PHRL) in Collindale, U.K. The Virology Unit has also conducted field evaluation of three rapid kits for HIV Antibody Assay in seven field stations in Ghana in collaboration with Family Health International/AIDSTECH and the Ministry of Health. *Herpes simplex* virus is being used in investigating the molecular mechanisms underlying viral latency and activation.

The Laboratory Animal Unit produces and supplies mice, rats, rabbits and monkeys for

both intramural and extramural biomedical investigations. Communicable diseases research in the Institute takes about 70% of the animal supplies.

The Immunology Unit will collaborate with the Faculty of Pharmaceutical Sciences of Osaka University in Japan to examine the molecular basis of malaria parasite surface antigen interaction with antibodies which will assist in improving the development of vaccine against malaria.

With respect to disease transmission from the source to the target, the Institute has been involved in research into the mode and routes of transmission of communicable disease through food, water, air, animals, insects or by direct contact. The Bacteriology Unit has conducted studies on weaning foods to determine if fermentation of maize reduces bacterial contamination of food. Results obtained so far have shown that fermented maize dough inhibits the growth of *Shigella flexneri*, but cooking the dough reduces the antimicrobial effect.

The bacteriological quality of drinking water available to a cross-section of urban and rural population in Ghana was studied in towns and villages along rivers Densu and Volta. Many water samples were not consistent with the recommended bacteriological standards of potable water. Some samples of iced water sold to the public contained *E. coli*, an indication of contamination.

Bacteriological surveys of nine popular beaches along the entire coastline of Ghana have been carried out during a period of one year; in accordance with the United Nations Environmental Programme (UNEP) activity to control marine pollution and manage marine and coastal resources. Preliminary analysis of data shows that faecal pollution exists at all nine sampling points monitored.

Vectors and intermediate hosts in disease transmission have also been studied. The

Parasitology Unit is conducting chromosomal studies to identify sibling species of *Anopheles gambiae*, the principal vector of malaria transmission in Ghana, in order to improve our chances of their control.

The Unit is also studying the biology, ecology and predatory behaviour of some identified mosquitoes - genus *Toxorhynchites* and the sub-genus *Lutzia* of *Culex*: as potential biological control agents. Snails which serve as intermediate hosts for schistosomiasis are also being studied by the Unit.

Considering the third link of the transmission chain, the population at risk have to be identified and placed under surveillance. Promotive and preventive services should be initiated to reduce the risk of getting disease. The Institute has carried out special surveys, undertaken special studies and provided some much needed services.

The Epidemiology and Immunology Units have been conducting studies to determine the earliest age at which Malaria infection takes place in a rural community; as well as follow up these infants from birth to determine protective antibody levels. Such a study looks to the future when a malaria vaccine may be available.

A quarterly survey of malaria infection among pre-school children at Gomoa Onyadze/Otsew Jukwa was conducted in 1986/87 by the Epidemiology Unit. The prevalence of *Plasmodium falciparum* infection among the children is high especially during and immediately after the rainy season. Apart from making anti-malaria drugs available regularly at the research station, the community and mothers in particular are being trained to recognize early symptoms and signs of malaria and administer effective treatment. Work done by the Parasitology Unit at Gomoa Fetteh showed that the prevalence of *Plasmodium falciparum* infection in the rainy season exceeded that of the dry season whilst *P.malariae* infection showed the opposite.

In vivo and *in vitro* sensitivity of *P. falciparum* to chloroquine in 3 schools in Nima, Madina (urban and peri urban) and at Gomoa Fetteh - a rural area showed 19.4% resistance to chloroquine at RI and RII levels. The study, the first of its kind in Ghana has shown that resistance to chloroquine has emerged in the country; and more work is required to form the basis for sound drug policy for malaria treatment in Ghana. The Epidemiology and Immunology Units which conducted the studies, in collaboration with the Centre for Tropical Clinical Pharmacology and Therapeutics, Ghana Medical School, have started the mapping out of *P. falciparum* resistant areas in Ghana.

At the same research stations in Gomoa District, the Epidemiology Unit has collected baseline data for diarrhoeal diseases control. A diarrhoeal diseases control programme forms part of the Unit's activities in the research stations - where mothers are taught to recognize diarrhoea in its early stages and to use oral rehydration therapy for prevention of dehydration and death.

Seroepidemiological studies are being carried out by the Epidemiology, Virology and Immunology Units at the Institute's rural research stations to determine antibody responses to measles, polio and tetanus toxoid vaccines given to infants and pregnant women.

The Virology Unit has evaluated the new WHO schedule of immunization against polio - the first dose of OPV at birth, 6 weeks, 10 weeks and 14 weeks in infants from Kade, Akwatia and Takorase. The Unit has shown that a high level of seroconversion rate can be achieved by increasing the immunization doses of the vaccine from 3 drops to 6 drops and reducing the schedule to two instead of four. This study was done in Suhum Kraboa Coaltar in collaboration with the Department of Community Health, Ghana Medical School. WHO and JICA are to collaborate with the Institute and Ministry of Health to study the serological responses in infants to different volumes of two formulations

of OPV. The results will play an important role in policy formulation in relation to the control and eradication of Polio in Ghana.

The Unit has also conducted seroepidemiological surveys to determine the prevalence of *Rubella* virus infection in Accra. An inexpensive technique for detecting *Rubella* antibodies in women is being developed by the Virology Unit.

In the area of herbal treatment for viral infections, the Unit in collaboration with the Centre for Scientific Research into Plant Medicine, Mampong-Akwapim, has started a project on some antiviral drugs with selected plant extracts against both DNA and RNA viruses like Herpes simplex, Cytomegalovirus, *Varicella-zoster* virus, Epstein-Bar virus Yellow Fever virus, Rotavirus, Coxsackie virus and Measles virus.

SERVICES

Special services provided by the Institute include central storage facilities for all vaccines brought in for use in Ghana. The Virology Unit monitors the effectiveness of the cold chain system for the EPI viral vaccines.

The Unit remains the only centre for confirmatory testing for AIDS in Ghana. The Virology Unit also provides specialized diagnostic services in suspected cases of sub-acute sclerosing panencephalitis (SSPE) seen at the Paediatric Department of the Korle-Bu Teaching Hospital by assessing the levels of measles antibodies in blood and cerebrospinal fluids. *Rubella* virus infection in pregnant women has also been investigated as well as polio viruses involvement in paralysis referred from Korle-Bu Teaching Hospital.

The Epidemiology Unit provides the following services to the rural field stations within the Primary Health Care Context. These are:

1. Education of mothers on disease prevention and control.
2. Treatment of the sick pre-school child.
3. Vaccination against the six childhood preventable diseases, and Yellow Fever and Tetanol for pregnant women.
4. Ante natal and post natal care.
5. Provision of essential drugs for the treatment of the sick.
6. Training and supervision of community health workers.

The vaccination coverage for children aged between one and two years is about 80 per cent, and measles which used to be one of the major killer diseases in the childhood population is now a disease of the past in the three rural communities in the Gomoa District.

Detailed demographic studies of these rural stations have been carried out and in 1987, the rate of natural population increase of 3.9% was considered to be far in excess of the 2.6% recorded nationally (1984 census). The crude death rate and infant mortality rates were far lower than the national figures. The crude birth rate compared favourably with the national rate. It therefore appears that our primary health care activities in the communities have succeeded in reducing deaths but have not affected births, hence the introduction of family planning services in the villages.

In the three rural communities of the Gomoa field stations, pre-school children are followed up at a weekly clinic. Heights, weights and health status measurements are recorded. The four most common causes of morbidity have been identified as acute respiratory illnesses, malaria, diarrhoea diseases and skin conditions. Control programmes now exist for diarrhoea diseases and malaria.

The Epidemiology Unit collaborates with the University of Ghana Medical School and the Ministry of Health in the training of community health specialists to be agents of change in disease prevention and control especially at the district levels. The Institute is also training young scientists (postgraduate training) to strengthen the manpower needs to increase the scope and quality of research activities not only in the control of communicable diseases but also in non-communicable diseases.

On the Institute's role in the control of malnutrition, the Nutrition Unit is assessing nutritional problems in Ghana and tries to provide solutions. Research activities of the Unit have covered the following areas:

1. Nutrition requirement of Ghanaians
2. Assessment of nutritional status
3. Factors relating to malnutrition
4. Nutrients of some local food items.

The Nutrition Unit in collaboration with the Chemical Pathology Unit studied Nitrogen balance among adult males. The results showed that Nitrogen requirement is similar to that obtained in Japan or other developed countries; indicating that there is no significant racial difference in protein requirement. Among adolescents however, it was found that more protein and energy are required by adolescents to achieve normal growth than what the adult requires.

In a study of food consumption patterns in different communities in Southern Ghana, results indicated that the caloric intake for children compares favourably to the recommended allowance by FAO/WHO for 3 year olds. In one community in Greater Accra Region, it was discovered that there was inadequate and poor quality protein consumption due to food shortage as well as mothers' ignorance for nutritional knowledge and this manifested in

malnutrition among the children. It was also observed that consumption of fruits and other vegetables with the exception of kontomire (cocoyam leaf) and palm products were minimal or absent from the diets of the participants. Mothers were advised accordingly. A similar survey is currently being conducted in the Upper East Region.

The Nutrition Unit in collaboration with the Epidemiology Unit conducted a study into the status of Vitamin A in a rural community in the Central Region. Blood levels of Vitamin A showed that only 15% of the children aged 0-4 years had normal levels. A nutritional survey of the population is currently going on to determine the factors predisposing to low levels of Vitamin A found in some of the subjects. This would be followed by nutritional education and/or Vitamin A supplementation to address the situation.

The Epidemiology Unit is organizing surveillance on nutritional status of children in the two communities of the rural field stations. It has been discovered that the growth deficit in these areas are mainly due to lack of knowledge in food values, negative food habits and inadequate food supply as a result of low income levels from poor agricultural/fishing and trading practices. The situation is further worsened by the high population growth in the two communities. The following measures have been undertaken:

1. Education in food values and positive food habits.
2. Preparation of weanmix for the children
3. Day care centres have been organized and each child is assured of at least one balanced meal a day.
4. Organization of mothers into co-operatives to produce soap, biscuits etc. on commercial scale.

5. Introduction of block farming through global 2000/Ministry of Agriculture.

6. Family planning services.

The Nutrition Unit has studied the effect of prolonged breast-feeding on the nutritional status of children. The results indicate that prolonged breast-feeding can reduce total food intake and thus predispose to malnutrition. This study has generated a keen debate in scientific circles. The Unit is currently assessing the acceptance of some locally available weaning foods like maize porridge with or without milk or groundnuts.

The Unit is presently analysing energy, moisture, nitrogen, fibre, ash, lipid, vitamins like retinol, thiamin, riboflavin, ascorbic acid and minerals like sodium, potassium, calcium, phosphorus, zinc and iron content of some local food items to improve the currently available food consumption table published by Food Research Institute in 1975.

A study on the effects of alcohol intake on biochemical, haematological and immunological parameters has been carried out by the Immunology, Haematology and Chemical Pathology Units. The results indicate elevation of major liver enzymes. The nutritional status of individuals did not influence the development of liver disease as a result of alcohol intake.

In conclusion Mr. Chairman, the Noguchi Memorial Institute for Medical Research has conducted research on biological agents of communicable diseases causation, their mode of transmission; as well as special surveys on population at risk of getting diseases like diarrhoea, acute haemorrhagic conjunctivitis, AIDS, rubella, poliomyelitis, yellow fever and malaria. The Institute has also embarked on a project to look at the possible role herbal medicine could play in the treatment of viral infections.

In the area of Nutrition, research activities have covered assessment of nutritional requirement and nutritional status of Ghanaians, factors relating to malnutrition and nutrients like Vitamin A, minerals - sodium, potassium and iron of some local food items.

The Institute also provides specialized laboratory diagnostic services especially during outbreak/epidemics of communicable diseases like diarrhoea and yellow fever-like diseases. It also trains young scientists in medical research.

The Institute provides storage facilities for vaccines brought in for use in Ghana. The effectiveness of the cold chain system for the viral antigens used in EPI is also monitored by the Institute. Primary Health Care services within the context of the Primary Health Care strategy in Ghana are also provided to three rural communities in the Central Region of Ghana to improve the health of children aged 0-4 years and pregnant women.

The results of studies that I have mentioned in this lecture included published works, papers read at various international conferences and seminars as well as papers to be presented at this forum and results yet unpublished.

Mr. Chairman, Ladies and Gentlemen, the Noguchi Memorial Institute for Medical Research in the past ten years has played an active role in the control of communicable diseases and malnutrition but much more will have to be done in the areas of basic biomedical research, specialized laboratory diagnostic and monitoring services and training in medical research. The Institute in the years ahead shall:

1. Collaborate with other research institutions in Africa, other developing and developed countries, and attract scientists to share expertise and ideas with the Institute within the spirit of technology transfer to strengthen our research capabilities in basic aspects of biomedical research.

2. Attract experienced scientists, train more scientists to create a pool of resource personnel who will organise training programmes with local and international support to strengthen research capabilities of health institutions especially at the District levels. It will enable these institutions identify priority health problem areas and carry out applied and operational research activities to effectively control diseases at a reduced cost in terms of time, money and manpower.
3. Continue the present collaboration with the University of Ghana Medical School in the training of Community Health Specialists and Epidemiologists for the country.
4. Increase the scope to services currently being provided by the Institute to:
 - a) Improve skills of middle level manpower who would be potential trainers in the country.
 - b) Offer specialised laboratory diagnostic and monitoring services for individuals, health institutions and industries to support public health programmes, and generate funds to support research activities in the Institute.
 - c) Strengthen available expertise to provide quality control services for laboratories in both governmental and private institutions. These services will improve the quality of laboratory diagnostic services which play invaluable role in disease control and prevention.
 - d) Collaborate with other institutions in quality control of imported and locally produced drugs and reagents.
5. Strengthen the collaboration existing between the Institute and Centre for Scientific Research into Plant Medicine, Mampong-Akwapim, and other institutions to increase

the present scope of research into plant medicine which is playing increasing role in disease control in Ghana.

6. Study the effect of naturally occurring and manmade toxic chemicals on our health.

Mr. Chairman, distinguished ladies and gentlemen, Noguchi Memorial Institute for Medical Research is looking for better approaches to improve methods for the control of communicable diseases and malnutrition. You form a part of the population at risk of contracting communicable diseases and non-communicable diseases and malnutrition. You form a part of the population at risk of contracting communicable diseases and non-communicable diseases in our environment. You can support the Institute by promoting research activities and together we can improve our health for a better life in Ghana. Thank you.

Chairman: Thank you very much Dr. Afari. The floor is now open for questions.

Questioner: I was interested in Dr. Afari's statement about the nutritional findings particularly relating to Vitamin A. I am a little bit surprised that he says there is evidence of vitamin A deficiency in the study area in the Central Region. One assumes that since palm oil is a staple oil in their diet, some Vitamin A will become available. I am interested to know whether, they did their study, on the vitamin A levels or Vitamin A equivalence, and also if by any means they did the serum culturing levels. Thank you.

Speaker: I will attempt to answer the question on behalf of the Nutrition Unit, but I hope they are here so they could contribute after my contribution. It is preliminary study, and we determined the vitamin A levels as a first step. The result showed that only 15% of the children had normal levels. We are now going to relate this to other factors which you have mentioned.