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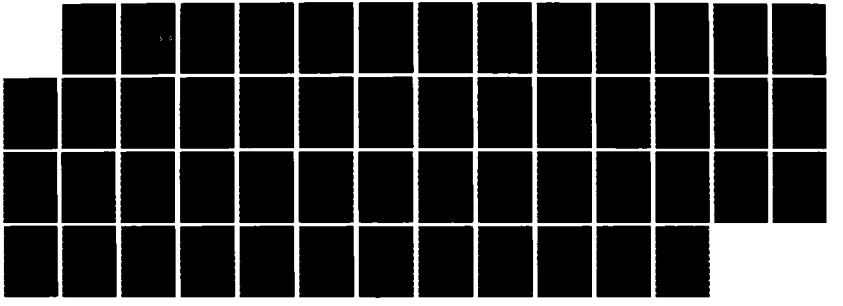

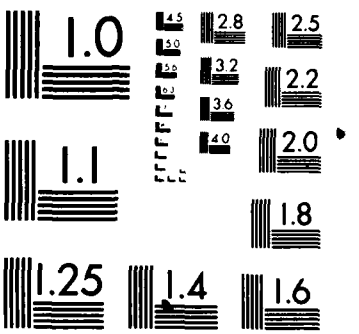

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# LASSA FEVER IMMUNE PLASMA

ANNUAL REPORT

John D. Frame, M.D.

June 1983

Supported by

U.S. ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND
Fort Detrick, Frederick, Maryland 21701-5012

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122 units of plasma were obtained in Liberia from convalescents from Lassa fever. 98 units were forwarded to the USAMRIID for its use, of these, 59 were found to have Log Neutralization titers of 00.3 or higher, indicating a protective value against Lassa fever (LF) adequate for the use of USAMRIID. Surveys of patient sera in a number of hospitals indicated that as many as 15% of adults admitted for fever had LF. Surveys of hospital staffs throughout Liberia indicated that LF is endemic in all parts of the country. Surveys of

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village populations revealed prevalences of Lassa virus (LV) antibodies at a titer of 1:8 or more by the indirect fluorescent antibody technique. Prevalences were higher in roadside villages than in villages in the "bush". LV was isolated 38 times from 31 patients in specimens forwarded to USAMRIID. At least one virus type was found different from that previously discovered in nearby Sierra Leone.

This is a cumulative report of the work under the cited contract from its inception.

## Summary

(This is a cumulative report since the inception of the Contract.)

Investigation of Lassa (LF) fever has resulted in the collection of 122 units of plasma from donors who were considered convalescent from LF on the basis of serological and virological tests. Seventy-five units had neutralizing antibodies at a Log Neutralization Titer (LNI) indicating that they offered some protection against Lassa virus (LV) infections. Ninety-eight units were forwarded to USAMRIID; 59 had LNI acceptable to USAMRIID, and 10 were returned to Liberia.

Investigations of febrile patients in northwestern Liberia showed many with LF. In series of consecutive patients in three hospitals the incidence of LF varied from 6 to 15%. Among patients in whom the diagnosis of LF was entertained, the diagnosis was confirmed by virological and serological grounds in 9 to 21%.

Surveys of Hospital staff members for LV antibodies revealed prevalences of 4 to 40%. These hospitals were selected from all parts of Liberia, and indicate that LF is in fact endemic throughout the country, with rates apparently rising as one travels inland and to the Northwest.

Seven villages were surveyed for the prevalence of LV antibodies. The rates varied from .9% to 14%. Prevalences among men and women, and among the various age groups showed no significant differences. Prevalences of LV antibodies were higher in villages on the main highway than in their paired villages in the bush. There was a significantly higher prevalence in one village on the highway than in the second; the difference may reflect differences in the traditional village sanitary measures practiced in them.

A Field Investigator has been employed who has learned to perform the indirect fluorescent antibody test. He is also able to conduct surveys, and to supervise plasmapheresis. Recently a Clinical Investigator, a physician, has started clinical and epidemiological investigations, most notably in the villages. Cooperation of the staffs of the hospitals in Liberia, and particularly in the areas when LF shows the highest prevalences, has contributed markedly to the program, and has been instrumental in educating Liberian health personnel in Lassa fever.

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# Chapter I
# GENERAL INTRODUCTION

## Statement of the Problem

Investigations of Lassa fever, a recently discovered viral disease of West Africa, are somewhat limited by the risk the disease poses to investigators. The availability of immune plasma from convalescents from this infection would provide needed protection, as well as material to be used in the investigations proper.

Testing of patients suspected of having Lassa fever will identify potential donors of Lassa fever immune plasma, and in addition may lead to the isolation of strains of Lassa virus suitable for intensive study.

## Background

Since its discovery in Nigeria in 1969, Lassa fever has been identified in a number of hospital outbreaks, with case fatality rates in the range of 35-40% (1,2,3,4). Subsequently, serological evidence of viral activity has been found to be widespread throughout West Africa (5), though some investigations have suggested that the disease is not as uniformly severe as the experience of hospital outbreaks indicated (6,7). At present, it is unclear what factors in the agent or host may influence the severity of the clinical infection.

It would appear that so widespread and potentially so lethal a disease would deserve intensive investigations of the nature and epidemiology of the virus, and development of a vaccine for the protection of populations at risk. However, investigations have been limited to date in part because of meager financial resources for research, and more significantly, because of the risk to the investigator. Presumably in response to this situation, and following preliminary conversations with Col. Gerald Eddy of the U. S. Army Medical Research Institute of Infectious Diseases, USAMRIID wrote this institution in 1977 indicating its interest in the development of a vaccine protective against Lassa virus infections and inviting a proposal for the procurement of Lassa fever immune plasma and Congo virus immune plasma, and the development of data regarding the prevalence and disease attack rate of Lassa fever in the area where plasma was to be obtained.

Liberia in general, and within it, Lofa County was selected as the main area of investigation, on the basis of previous work done in the region. Investigations had indicated that the region where Sierra Leone, Guinea and Liberia join was highly endemic for Lassa virus infection (3,4,8). The political situation in Liberia appeared to be such that an agreement to work there could be negotiated. A pilot study funded by the Rockefeller Foundation had been conducted in Liberia since 1976 (7) and had resulted in an awareness of the disease among hospital and governmental people who were likely to be cooperative in the pursuit of further knowledge of Lassa fever as a disease of public health importance among them.

With the need for further work on Lassa fever apparently established, with a cooperating laboratory and funds available, and with a suitable location for research identified, the project was started in Liberia in early 1979.

## Approach to the Problem

On the basis of the previous findings it was decided that the major effort of research and plasma collection would be centered around the Curran Lutheran Hospital in Zorzor, Lofa County. Staff and patients found to have antibodies to LV would be identified and requested to donate plasma. In addition continuing investigations would be done in that and other hospitals as a means of discovering the incidence of LF in staff members, and among patients in the hospitals. Serological surveys would be conducted in nearby villages as a means of discovering the prevalence of LV infections in the environs.

To accomplish these ends facilities for the serological diagnosis of LV infections would be set up at the Liberian Institute for Biomedical Research in Robertsfield (LIBR), and a field station would be established at Curran Lutheran Hospital. An investigator with some training and experience in nursing or biology would be employed to assist in the field investigations. The Principal Investigator would make periodic trips to Liberia, would review what had been done in his absence, conduct experiments and determine what other investigations would be conducted during his absence.

Wherever investigations were carried out local health workers would be encouraged to participate to the extent possible as a means of augmenting the small staff permanently engaged in LF research. Close liaison would be maintained with local and national governmental agencies, particularly the Ministry of Health and Social Services, in order to assure the cooperation of the official agencies of the Republic of Liberia in whatever developments might grow out of the investigations.

## General Narrative

Initially much time was required to negotiate a subcontract with the Liberian Institute for Biomedical Research (LIBR). The original subcontract submitted by Columbia was unsatisfactory to that institution, in part because of misunderstandings of the nature of a subcontract, and in part because of uncertainty regarding the development of the capability to conduct testing for LV antibodies in Liberia. The points at issue were eventually cleared, and by November 1979 the LIBR accepted the terms of the revised subcontract.

In October an immunofluorescence microscope was installed at the LIBR, and a small supply of LV antigen slides was deposited there. At the end of November the diagnostic capabilities came to good use when a case of LF was found at the ELWA Hospital near Monrovia. Testing of the patient and family, and of hospital contacts indicated the practical nature of the projected program, gave important visibility to it, and ensured continued governmental cooperation as investigations proceeded.

A second subcontract was negotiated at that time with the New York Blood Center. This institution through its VILAB II, which was conducting hepatitis research in Liberia, agreed to supervise the training and work of the field investigator during the initial phases of the research project. In February 1980 Mr. J. E. Yalley-Ogunro, a graduate in Zoology from the University of Liberia, was employed through the LIBR to serve as Field Investigator, and was trained in the ensuing months by Dr. Rinus van den Ende and Miss Betsy Brotman of the VILAB II in the conduct of serological techniques and maintenance of records needed to document the investigations which were to be carried out.

A planned trip by the Principal Investigator was cancelled in April 1980 because of the political coup in Liberia. In a brief trip in July of that year arrangements made previously for village surveys were amended, as the chief of the district in which some were to be carried out had fallen into the displeasure of the new government of the country. Arrangements were made at Zorzor for the cooperation of the CLH there, and the electric centrifuge and freezer purchased for the field station were installed.

Subsequently the Principal Investigator returned to Liberia two or three times each year for the duration of the contract. Because of the delays incurred in development of the subcontract, and further delays resulting from the political situation the terms of the contract were not fulfilled at the end of the two years expected to complete the investigations, and the contract was extended first for a year and then for an additional six months without increase in costs. Eventually the contract was extended another four months, to December 31, 1982, with supplemental funds from the contracting agency.

The schedule of visits of the Principal Investigator and what was accomplished on these visits is given in Appendix A.

## Results

1. Serological testing.

Serological testing of specimens from surveys and hospital staffs were initially carried out both at the LIBR and at the Yale Arbovirus Research Unit (YARU), New Haven, Connecticut. It became apparent early that the techniques used at the LIBR were accurate, and parallel testing at YARU was soon discontinued.

Tests at the LIBR were by means of the indirect fluorescent antibody technique (IFAT) using the Leitz Dialux Fluorescence Microscope purchased to this end under the terms of the contract. The test was that described in the literature (9,10). After initial screening at a serum titer of 1:4, positive sera were tested to their dilution end-points. Antigen consisted of spot slides of Vero cells infected with LV and then inactivated, as prepared by Dr. Peter B. Jahrling of the USAMRIID. Conjugate was the Cappel anti-human-globulin goat globulin. Tests in Liberia were performed by Mr. Yalley-Ogunro, initially under the supervision and subsequently with consultation of Dr. van den Ende of VILLAB II.

In all, 3,902 specimens were tested at the LIBR; Table 1.1 indicates the numbers of sera tested in the various parts of the program. The numbers of sera are more than the number of people, for in some instances serial specimens were obtained from patients, and plasma donors were tested on a number of occasions. The specific results of testing are indicated in the following chapters.

Table 1.1. Number of specimens tested for LVA by IFAT at the Liberian Institute for Biomedical Research through December, 1983

| Class | Number tested |
|---|---|
| Lassa fever immune plasma donors | 117 |
| Febrile patients in hospitals | 1,256 |
| Hospital staff surveys | 637 |
| Village surveys | 1,848 |
| Miscellaneous | 44 |
| Total | 3,902 |

---

2. Plasmapheresis

The primary objective of the program was the collection of units of plasma from convalescents from Lassa fever. Details regarding the criteria means and results of plasmapheresis are given in Chapter 2. One hundred twenty two plasma units were collected, of which 75 were deemed to have evidence of protective neutralizing antibodies. Plasma was collected at the Curran Lutheran Hospital (CLH) and the Swedish Free Pentecostal Mission Clinic (SFPMC), and the staffs of these institutions cooperated fully to make this work possible.

3. Clinical Lassa fever

Febrile adult patients admitted to hospitals were tested for the diagnosis of LF. The study of consecutive admissions in three hospitals, CLH, Phebe Hospital and the G.W. Harley Memorial Hospital in Ganta demonstrated that from 10 to 15% of adult patients admitted with fever did in fact have LF. LF is thus likely the most common cause of fever among adult hospital admissions in this area. Chapter 3 gives more details on the attempts to diagnose LF among patients, and the changing patterns of diagnosis in hospitals after the presence of LF has been demonstrated in them.

4. Hospital staff surveys

The prevalence of LV antibodies among hospital personnel in all parts

of Liberia showed LV infections to be endemic throughout the country. Prevalences varied from 4% to the Southeast to 40% in the Northeast. Differences in prevalences found in the same institution in different years likely reflect the recent occurrence of an outbreak of LF among the staff (Chapter 4).

5. Village surveys

Prevalences of LV antibodies in various villages vary from 1 to 14%. There are no differences in prevalences of IFA between men and women, nor among the various age groups. However, in the villages studied those on the main road have higher prevalences of LV antibodies than those in the bush. Even on the highway, the differences between two villages are significant. The details of the technique and results of village surveys are given in Chapter 5.

6. Virus isolation

LV was isolated 38 times from 31 patients since the inception of this program. At least one new type of LV, the Macenta strain, was identified, one that proved lethal to the patient and to Cynomologus monkeys, though not to experimental guinea pigs. The virological investigations were conducted by Dr. Peter B. Jahrling at USAMRIID and do not fall within the province of this report.

## References


1. Frame, J.D., Baldwin, J.M., J r, Gocke, D.J., & Troup, J.M. Lassa fever, a new virus disease of man from West Africa. Clinical description and pathological findings. Am. J. Trop. Med. Hyg. 19: 670-676 (1970).

2. White, H.A. Lassa fever. A study of 23 hospital cases. Trans. Roy. Soc. Trop. Med. Hyg. 23: 1131-1139 (1972).

3. Monath, T.P., Mertens, P.E., Patton, R., Moser, C.R., Baum, J.J., Pinneo, L., Gary, G.W., & Kissling, R. A hospital outbreak of Lassa fever in Zorzor, Liberia, March-April, 1972. Amer. J. Trop. Med. Hyg. 22: 773-784 (1973).

4. Fraser, D.W., Campbell, C.C., Monath, T.P., Goff, P.A. & Gregg, M.D. Lassa fever in the Eastern province of Sierra Leone, 1970-197?. Am. J. Trop. Med. Hyg. 23: 1131-1139 (1974).

5. Frame, J.D. Surveillance of Lassa fever in missionaries stationed in West Africa. Bull. W.H.O. 52: 593-598 (1975).

6. Arnold, R.B. and Gary, G.W. A neutralization test survey for Lassa fever activity in Lassa, Nigeria. Trans. Roy. Soc. Trop. Med. Hyg. 71: 152-154 (1977).

7. Frame, J.D., Casals, J. & Dennis, E.A. Lassa virus antibodies in hospital personnel in Western Liberia. Trans. Roy. Soc. Trop. Med. Hyg. 73: 219-224 (1979).

8. Henderson, B.E., Gary, G.W., Jr., Kissling, R.E., Frame, J.D. & Carey, D.E. Lassa fever: Virological and serological studies. Trans. Roy. Soc. Trop. Med. Hyg. 66: 409-416 (1972).

9. Wulff, H. and Lange, J.V. Indirect immunofluorescence for the diagnosis of Lassa virus infections. Bull. W.H.O. 52: 429-436 (1975).

10. Jahrling, P.B., Hesse, R.A., Eddy, G.A., Johnson, K.M., Callis, R.T., and Stephen, E.L. Lassa virus infections in rhesus monkeys: pathogenesis and treatment with ribavirin. J. Inf. Dis. 141: 580-589 (1980).

# Chapter 2
# Lassa Fever Immune Plasma

The first objective of the program in Liberia under the present contract was the collection of units of Lassa fever immune plasma (LFIP) to be used at USAMRIID in the investigation of Lassa virus (LV), and for the treatment of cases of Lassa Fever (LF). Attempts to collect LFIP began late in 1980, and continued throughout the life of the project.

## 1. Methods of Collection

Plasma was collected at the Curran Lutheran Hospital (CLH), Zorzor, and the Swedish Free Pentecostal Mission Clinic (SFPMC), Foya Kamara, both in Lofa County in northwestern Liberia.

At CLH plasmapheresis was conducted using a RC3 refrigerated Sorval centrifuge. Plasma donors were informed of the purpose of the collection, that plasma might be used at the hospital for treatment of patients, or sent to the United States to be used in experiments being conducted there as a means of understanding LF, and looking toward the eventual development of a vaccine protective against LF. In most instances two units were collected from each donor in a single session. After separation of the plasma in the centrifuge the erythrocytes were returned to the donors.

At SFPMC blood was obtained and stored in the refrigerator over-night in order to permit cells to separate by gravity. The next morning the plasma was extracted and the cells returned to the donors. Here only one unit was obtained at a time, though several donors submitted to plasmapheresis on more than one occasion.

### A. Phase 1.

Initial criteria for the selection of donors for LFIP included the presence in them of a LV antibody (LVA) titer of 1:128, as determined by the serological tests performed at the Yale Arbovirus Research Unit (YARU) at New Haven, Connecticut, and at the laboratory of the LIBR. There were some discrepancies between the results in the two laboratories. At YARU tests were not done to end-points, and at the LIBR testing was conducted only to a titer of 1:32. Inasmuch a earlier work by Henderson et al (8) suggested that neutralizing antibodies persisted for a relatively long period of time, and that antibodies found by IFAT disappeared rather quickly (7), we used as donors hospital staff members who showed evidence by IFAT of previous LV infections, no matter what the titer might be.

Staff members of CLH and SFPMC had been surveyed for the presence of IFA in 1976, 1979 and 1980, and they formed the initial group asked to donate LFIP.

### B. Phase 2.

The second phase of the collection of LFIP began with the decision to

use as donors those staff members whose previous neutralizing titers (NT) had suggested good protective capability against LV infection, and patients who had been demonstrated to have had acute LF. It was recognized that LVA titers as determined by IFAT should be 1:128 if at all possible. However, such titers might not be demonstrated during the hospital stay, for specimens were at times not being obtained late enough in the course of infection to permit development of high titers.

C. Phase 3.

Earlier work with Rhesus monkeys by Jahrling ( 11 ) had by this time demonstrated NT to be relatively low at the end of clinical illness and in early convaiescence. Titers did not reach what might be clinically important levels until three months or more after the onset of illness. During this phase LFIP was collected from donors who had had LF as determined by virus isolation or seroconversion or a four-fold rise in LVA titers, at least three months after the onset of their illness. Subsequently, the collection of LFIP was postponed until the fifth month or so after the onset of infection.

II. Results

A. Phase 1.

Forty-two units were collected at SFC and CLH (Table 2.1). Initial tests showed only one to have potentially therapeutic levels of neutralizing antibody. Later, tests were repeated on some of the plasma, and it was found that four other donors who had contributed 9 units did in fact have NT with a Log Neutralization Index (LNI) of 0.3 or more. During this time 29 units of LFIP were forwarded to USAMRIID (Table 2.2) one of which had therapeutic levels of antibody by the initial tests, and five found to be therapeutic in retesting.

B. Phase 2.

Fourteen units were collected during this period (Table 2.3). Nine were found to have adequate NT initially and two more were found to have potentially therapeutic LNI of 0.3 or higher on subsequent testing. All 14 units were forwarded to USAMRIID.

C. Phase 3.

Sixty-seven units of LFIP were collected from donors meeting the criteria given above, and 55 forwarded to USAMRIID (Table 2.4). Of these, 42 had LNI of 0.3 or higher against one or both of the viral strains used for testing.

D. Summary.

In all, 122 units of LFIP were obtained by plasmapheresis during the period of the investigation, and 98 forwarded to USAMRIID. 75 of the units collected and 59 of the units supplied to USAMRIID had LNI of 0.3 or more, and were considered to have adequate protective capacities to be used at that institution. Ten units were returned by USAMRIID to Liberia.

## III. Discussion

During the investigation there was initially some difference in the results of neutralization tests performed at different times and some of the differences were sizable. It is not in the province of this report to discuss the reasons for the differences, but they did cause confusion in the setting of standards for the selection of potential donors. Subsequently the discovery at USAMRIID that there were several strains of LV active in the region, and that specific units might have an adequate NT as determined by LNI against one strain but not another explained some, but not all, of the discrepancies of the earlier tests. Many of the unsatisfactory specimens in Phase 1 were obtained at the SFPMC. By the time of Phase 2 several of these donors were found to have high titers against the Macenta strain, which had not been available during Phase 1. Some of the rejected donors out of this phase might well have had adequate NT if they had been tested against the Macenta strain as well as the Josiah, which was the standard used initially.

It was also noted that NT of a single donor might fluctuate from time to time, dropping to levels below an LNI of 0.3, only to rise again. Thus, a donor who was satisfactory on one occasion might not be considered so later, and then show protective antibodies in high titer subsequently. The course of such donor, GbZ is demonstrated in Table 2.5. In general, however, during the time frame of this investigation NT did tend to rise with time against one or both of the virus strains used as antigen.

11. Jahrling, P.B. Arenaviruses. In: Manual of Clinical Microbiology, Lennette, E.H., Hansler, W.J., Jr., and Truant, J.P., Editors, 3rd edit. Washington, D.C.: American Society for Microbiology, pp. 884-890, 1980.

Table 2.1. LFIP Units Collected in Liberia, Phase 1 (October 1980 - January 1981)

| Name of Donor | Date of Illness | IFA | | Neutralization (Josiah)* | | Date of Plasmapheresis | Units |
|---|---|---|---|---|---|---|---|
| | | Date | Titer | Date | LNI | | |
| MoW | ? | 1979 | 1/8 | 12/11/80 | - | 10/80 | 2 |
| | | | | | | 1/81 | 2 |
| ThF | ? | 1979 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| | | 1981 | 1/4 | 9/09/82 | 0.3# | 11/81 | 2 |
| JaM | ? | 1977 | 1/4 | | | | |
| | | 1979 | 1/16 | 12/11/80 | - | 10/80 | 2 |
| SoS | 1975? | 1979 | 1/16 | 12/11/80 | - | 10/80 | 1 |
| | | 1981 | 1/4 | 9/09/82 | 0.8# | 1/81 | 1 |
| FiS | ? | 1979 | 1/16 | 12/11/80 | - | 10/80 | 1 |
| | | 1981 | 1/4 | | | 1/81 | 1 |
| RuB | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| | | | | | | 1/81 | 1 |
| FiF | ? | 1979 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| | | | | | | 1/81 | 1 |
| JoV | 1977 | 1977 | 1/32 | 12/11/80 | 0.9 | 10/80 | 1 |
| DaZ | 10/79 | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| | | | | 9/08/82 | 0.2# | 1/81 | 1 |
| NeM | ? | 1979 | 1/32 | 12/11/80 | 0.1# | 10/80 | 1 |
| | | | | 9/09/82 | (0.3M) | 1/81 | 1 |
| | | | | | | | 1 |
| DaM | ? | 1979 | 1/16 | 12/11/80 | - | 10/80 | 1 |
| YaS | ? | 1977 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| NeT | ? | 1979 | 1/8 | 12/11/80 | - | 10/80 | 1 |
| | | 1981 | Neg | 9/09/82 | 1.4,0.4# | 1/81 | 1 |

Table 2.1 (Continued)

| Name of Donor | Date of Illness | IFA | | Neutralization (Josiah)* | | Date of Plasmapheresis | Units |
|---|---|---|---|---|---|---|---|
| | | Date | Titer | Date | LNI | | |
| KuW | 1978 | 1979 | 1/32 | 12/11/80 | - | 10/81 | 1 |
| JoS | ? | 1979 | 1/32 | 12/11/80 | - | 10/81 | 1 |
| | | | | | | 1/81 | 1 |
| FaS | ? | 1979 | 1/16 | 12/11/80 | - | 10/80 | 1 |
| SaK | ? | 1979 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| ThB | No | 1979 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| DaM | | 1979 | 1/4 | 12/11/80 | - | 10/80 | 1 |
| KuK | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| KuC | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| | | | | | | 1/81 | 1 |
| JoW | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 2 |
| TeB | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| BeV | ? | 1979 | 1/32 | 12/11/80 | - | 10/80 | 1 |
| AgN | 1977 | 1979 | 1/16 | 12/11/80 | - | 10/80 | 1 |
| | | | | | | 1/81 | 1 |
| Total | | | | | | | 42 |

* Early sera were tested only against Josiah strain.

\# Retesting of sera obtained in 10/80 and 1/81.

Table 2.2. Summary of LFIP Units sent to USAMRIID

| Date sent at USAMRIID | Number sent | IFA positive ( 10) | NT positive (LNI 0.3) |
|---|---|---|---|
| 21 Oct 80 | 29 | 9* | 6# |
| 14 May 81 | 7 | 7 | 6@ |
| 24 Oct 81 | 7 | 5 | 5 |
| 3 Feb 82 | 19 | 17 | 12 |
| 20 Jul 82 | 10 | 10 | 10 |
| 12 Nov 82 | 26 | 26 | 20 |
| Total | 98 | 74 | 59 |

* Including 3 IFA positive on retesting in 1982, after initial tests had indicated they were negative.

\# Including 5 NT positive on retesting in 1982, after initial tests had indicated they were negative.

@ Including 2 NT positive on retesting in 1982, initial tests had indicated they were negative.

Table 2.3. LFIP units collected in Liberia, Phase 2 (April - October, 1981)

| Donor | Date of Illness | IFA | | Neutralization | | | | Date of Plasmapheresis | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Josiah | | Macenta | | | |
| | | Date | Titer | Date | LNI | Date | LNI | | |
| ChH | 1978 | 1979 | 1/32 | 5/21/81 | 1.4 | 5/21/81 | 2.4 | 4/30/81 | 1 |
| SoS | 1975 | 1979 | 1/16 | 5/21/81 | 1.0 | 5/21/81 | 1.5 | 4/30/81 | 2 |
| | | 1981 | 1/4 | | | | 2.4 | | |
| KuC | ? | 1979 | 1/32 | 5/21/81 | 0 | 5/21/81 | 0 | 4/30/81 | 2 |
| | | 1981 | 1/4 | | | | | | |
| GbZ | 10/80 | 4/20/81 | 1/8 | 11/04/81 | 0.2 | 5/21/81 | 1.2) | 4/30/81 | 2 |
| | | 10/12/81 | 1/8 | | 0.4 | | 1.1) | | |
| | | | | | 0.4 | | 0.9 | 10/13/81 | 2 |
| KlY | 6/81 | 6/19/81 | 1/16 | 11/04/81 | 1.0-1.3 | | 1.6-1.9 | 10/13/81 | 2 |
| Bez | ? | 10/12/81 | 1/16 | 11/04/81 | 0.0 | | 0.0 | 8/21/81 | 1 |
| JaF | ? | 10/12/81 | 1/18 | 11/04/81 | 0.1 | | 0.3 | 10/13/81 | 2 |
| | | | | 2/14/81 | | | 0.0 | | |
| | | | | | | | | Total | 14 |

Table 2.4. LFIP Units Collected in Liberia, Phase 3 (December 1981 - November 1982).

| Donor | Date of Illness | IFA | | Neutralization | | | | Date of plasmapheresis | No. Units |
|---|---|---|---|---|---|---|---|---|---|
| | | Date | Titer | Date | LNI: | Josiah | Macenta | | |
| FlG | 6/81 | 6/03/81 | 1/64 | 12/08/81 | | 0.0 | 0.7 | 12/08/81 | 2 |
| | | 12/08/81 | 1/128 | | | | | | |
| FlM | 9/81 | 9/30/81 | 1/128 | 9/30/81 | | 0.2 | 0.2 | 12/09/81 | 2 |
| | | 12/09/81 | 1/128 | 10/05/81 | | 0.0 | 0.4 | 5/08/82 | 2 |
| | | 1/12/82 | 1/256 | 12/09/81 | | 0.2 | 0.1 | 8/13/82 | 2 |
| | | 5/08/82 | 1/4 | 5/08/82 | | 0.0 | 0.1 | | |
| | | | | 8/13/82 | | 0.8 | 0.9 | | |
| JaP | 6/81 | 6/12/81 | 1/512 | 6/11/81 | | 0.0 | 0.4 | 12/08/81 | 2 |
| | | 12/08/81 | 1/128 | 12/08/81 | | 1.9 | 2.4 | 5/04/82 | 2 |
| | | 5/04/82 | 1/4 | 5/04/82 | | 3.3+ | 3.2+ | | |
| YaW | 9/81 | 10/16/81 | 1/128 | 12/10/81 | | 1.0 | 1.0 | 12/30/81 | 2 |
| | | 12/10/81 | 1/4 | | | | | | |
| DoM | 5/81 | 1/12/82 | 1/256 | 1/12/82 | | 0.0 | 0.8 | 1/12/82 | 2 |
| | | 12/17/82 | 1/8 | 5/12/82 | | 0.4 | 1.4 | 5/08/82 | 2 |
| | | | | 8/13/82 | | 1.0 | 1.8 | 8/31/82 | 1 |
| | | | | 12/17/82 | | 2.4+ | 2.7+ | | |
| SuY | 11/81 | 1/12/82 | 1/1024 | 2/14/82 | | 0.0 | 0.9 | 2/14/82 | 2 |
| | | | | 5/08/82 | | 0.5 | 0.3 | 5/08/82 | 2 |
| | | | | 11/3/82 | | 0.3 | 1.0 | 11/03/82 | 2 |
| JaM | ?1974 | 12/10/81 | 1/16 | 1/13/82 | | 0.0 | 0.0 | 1/12/82 | 2 |
| | | 1/13/82 | 1/16 | 5/8/82 | | 0.2 | 0.6 | 5/08/82 | 2 |
| | | 12/15/82 | 1/8 | 8/12/82 | | 0.0 | 0.0 | 10/09/82 | 2 |
| | | | | 10/09/82 | | 1.1 | 0.1 | | |
| AwM | 10/81 | 10/22/81 | 1/1024 | 1/11/82 | | 0.0 | 0.0 | 1/11/82 | 1 |
| | | 1/11/82 | 1/256 | 5/05/82 | | 0.2 | 0.1 | 5/05/82 | 2 |
| | | | | | | | | 8/05/82 | 2 |

Table 2.4 (Con't.). LFIP Units Collected in Liberia, Phase 3 (December 1981 - November 1982).

| Donor | Date of Illness | IFA | | Neutralization | | | | Date of plasmapheresis | No. Units |
|---|---|---|---|---|---|---|---|---|---|
| | | Date | Titer | Date | LNI: | Josiah | Macenta | | |
| DaK | 10/81 | 12/09/81 | 1/512 | 1/12/82 | | 1.2 | 1.5 | 1/12/82 | 2 |
| | | 1/12/82 | 1/512 | 5/05/82 | | 2.3 | 3.2+ | 5/05/82 | 2 |
| | | 10/01/82 | 1/64 | 8/13/82 | | 3.1+ | 3.0+ | 8/10/82 | 2 |
| | | | | 10/09/82 | | 3.1+ | 3.0+ | 10/09/82 | 2 |
| YaK | 10/81 | 11/06/81 | 1/256 | 1/12/82 | | 0.0 | 1.8 | 1/12/82 | 2 |
| | | 1/12/82 | 1/512 | 5/04/82 | | ? | ? | 5/05/82 | 2 |
| | | 10/09/82 | 1/32 | 10/09/82 | | 3.0 | 3.0 | 10/09/82 | 2 |
| GbZ | 10/80 | 4/30/81 | 1/8 | 4/30/81 | | 0.4 | 0.4 | 5/05/82 | 2 |
| | | 10/12/81 | 1/8 | 10/12/81 | | 0.4 | 1.2 | 8/12/82 | 2 |
| | | 5/5/82 | 1/4 | 5/05/82 | | 0.0 | 0.4 | 10/09/82 | 2 |
| | | 10/09/82 | 1/16 | 8/12/82 | | 0.0 | 0.5 | | |
| | | | | 10/09/82 | | 1.3 | 1.2 | | |
| GaV | 1/82 | 1/21/82 | 1/512 | 8/11/82 | | 1.1 | 1.6 | 8/11/82 | 1 |
| | | | | 11/02/82 | | 2.2 | 2.5 | 11/02/82 | 2 |
| YaS | 1/82 | 1/21/82 | 1/2048 | 11/02/82 | | 1.3 | 1.7 | 11/02/82 | 2 |
| WuT | 3/82 | 3/25/82 | 1/64 | 11/01/82 | | 0.0 | 0.0 | 11/01/82 | 2 |
| LoF | 1/82 | 1/08/82 | 1/1024 | 10/09/82 | | 0.2 | 0.4 | 10/09/82 | 2 |
| MuS | 11/81 | 11/25/82 | 1/1024 | 10/09/82 | | 3.1+ | 3.0+ | 10/09/82 | 2 |
| Total units collected, Phase 3 | | | | | | | | | 67 |

Table 2.5. Falling IFA titers and fluctuating NT by LNI in with time in the specimens of a single donor, GbZ, and the differences of NT when tested against Josiah and Macent strains of LV.

| Date | IFA titers | NT (LNI) | |
|---|---|---|---|
| | | Josiah | Macenta |
| 20 Apr 81 | 1/8 | | |
| 21 May 81 | | 0.2<br>0.4 | 1.2<br>1.1 |
| 12 Oct 81 | 1/8 | 0.4 | 0.9 |
| 04 May 82 | 1/4 | 0.0 | 0.4 |
| 09 Oct 82 | | NT | 1.3 |

# Chapter 3
# Lassa Fever in Hospitalized Patients

The identification of patients with LF in hospitals in Liberia was necessary in order to find potential donors for LFIP. As a result of this portion of the investigation strains of LV were isolated from patients in the acute stage of their illness, and the incidence of LF in hospitalized patients was found. The small permanent staff of the program in Liberia necessitated the enlisting of staff members of the Liberian hospitals in the investigation. They were given criteria for the selection of patients, and instructions for the collection and preservation of specimens. Specimens were collected by syringe and needle, or by Vacutainer, and allowed to stand in a cool place until the clot had separated. The serum was then pipetted or decanted into stoppered polyethylene tubes and stored at -20° in a freezer supplied to the hospital. They were kept frozen until collected by the Field Investigator, and then transported on wet ice to the LIBR.

At the LIBR specimens were divided into two samples, one to be forwarded to USAMRIID for further testing there, and the other tested at the LIBR by IFAT. The specimens sent to USAMRIID were frozen and kept at -20°C. From time to time, they were sent to the United States, at times on dry ice and at times on wet ice. At USAMRIID attempts were made to isolate virus, and tests were repeated by IFAT. Some specimens negative by virus isolation were also tested for NT by neutralization tests.

Formal surveys of hospitalized patients were conducted at CLH, the G.W. Harley Memorial Hospital (GWH) at Ganta in Nimba County, at Phebe Hospital (PH) in Bong County, and at the hospital on the compound of Radio Station ELWA in Paynesville, a suburb of Monrovia at the coast in Montserrado County. There were some differences in the selection of patients in the hospitals, and this will be described below.

In addition, some patients were also tested at other hospitals; the Swedish Free Pentecostal Mission Clinic (SMC) at Foya Kamara, the Tellewoyan Memorial Hospital (TMH) at Voinjema, the B.F. Goodrich (BFG) plantation hospital, and the government hospital at Robertsport (RGH). A serological survey was also conducted of patients at the outpatient clinic at the LIBR, Charlesville.

## 1. Selection of patients

### a. Curran Lutheran Hospital

1. From February 1979 through June 1980 staff at CLH collected specimens from patients who appeared to have unusual fevers. At this time there was no freezer in which specimens could be stored, nor formal guidelines were being followed for collection of specimens, and virus isolation was not attempted.

2. Between July 25, 1980 and May 31, 1981, the staff of the CLH obtained specimens from patients with fever as they became aware of them. A review of hospital admission diagnoses suggested that only about one fourth of

potential febrile patients were tested. Fever was diagnosed as a temperature of 37.6°C occurring at any time during the hospital admission. Exclusions of patients from testing was apparently not systematic, except that in the midst of a very busy schedule only patients who appeared very ill were likely to be tested.

3. In the month of June 1981 an attempt was made to collect sera from all patients with fever, and the Chief of the Medical Service supervised the collection to ensure as complete a coverage of the candidate patients as possible.

4. From July 1, 1981 through May 31, 1982 specimens were collected from all patients suspected of having LF.

5. During the month of February specimens were collected from all pediatric patients, whether or not they had fever.

b. Phebe Hospital

1. Two medical students from the United States requested permission to conduct a brief survey at PH, and did so for a six-day period in May, 1981.

2. Following the initial brief series, and as a consequence of the amount of LF found in the patients tested there, the PH staff members attempted to collect specimens from all patients with significant fever admitted there in subsequent months.

c. G.W. Harley Memorial Hospital, Ganta

Over a six-week period in January and February 1982 two American medical students collected specimens from all patients at GWH, and summarized data from the patients' clinical records which they forwarded with the specimens.

d. ELWA Hospital, Paynesville

All patients with fever were tested during a five-week period in May and June, 1981.

e. Other patients

Sporadic collection of specimens was conducted at SMC, BFG, MRH and RGH. There were no reliable freezer facilities available, and consequently no virus isolation was attempted. Additionally a survey of all patients tending the clinic at the LIBR was carried out on a single day; again, virus isolation was not attempted.

## II. RESULTS

The results of serological tests among the patients tested in the various institutions are given in Table 3.1. Detailed results in specific series

including those with attempts at virus isolation follow.

A. CLH

1. Sera from 57 patients were tested for IFA at YARU; 8 were found to have LVA. In only a few were paired sera submitted. Dr. Casals reported results as moderate or strong reactions at a serum titer of 1:4, and did not titer out to end points except in one instance. One or more sera were found positive in 8 patients, for a 14% incidence of LVA among the patients (Table 3.1).

2. Between July 25, 1980 and May 31, 1981, sera were obtained from 72 patients and subsequently tested serologically and virologically for LF. LF was diagnosed in 10 cases by virus isolation and in five others by a rise in LVA, a total of 15 cases of LF. An additional three were considered presumptive cases of LF because of high LVA titers (Table 3.2).

3. In June sera were collected from 35 of 45 patients with fever. In five LF was diagnosed by seroconversion or rising LVA titers; there was one case of presumptive LF. No LV was isolated from specimens of this series.

4. Between July 1, 1981 and April 30, 1982, 64 patients were surveyed for LV infection. LF was diagnosed by virus isolation in 5 cases, and by seroconversion or rise in LVA in 10, for a total of 15 cases. There were 6 presumptive cases as well.

5. Laboratory results were correlated with clinical records for the patients diagnosed as having LF or presumptive LF between July 1980 and April 1982. The review of the records was performed by Dr. Mark Monson of CLH. In Table 3.4 the case and deaths are tabulated in accordance with the hospital service in which the diagnosis was made, and by sex. In Table 3.5 the diagnoses are given, by the phse of the investigation in CLH. Early many cases of LF were misdiagnosed as typhoid fever and pelvic inflammatory disease, but as familiarity with LF improved, the most common diagnosis among LF patients other than LF was pneumonia, one case was diagnosed as cerebro-spinal meningitis.

B. PH

Between May 10 and 15, 1981, sera were obtained from adult patients in the wards with fever. Two of 36 were diagnosed as LF by virus isolation or seroconversion (Table 3.3).

Between June 1981 and January, 1982 the hospital staff obtained sera from patients suspected of having LF. In most instances paired sera were not obtained. Virus was isolated from two and seroconversion occurred in one for three cases of LF. In six other patients high LVA titers indicated presumptive LF (Table 3.2).

C. GWH

Between January 13 and February 28, 1982, 28 patients with fever in adult wards were tested serologically. Three were positive by seroconversion,

and one other was considered to be a presumptive case of LF (Table 3.2).

D. ELWA

In a group of 24 patients serum pairs were obtained in only 10. Two patients had LVA, in low titer, but no virus isolation nor seroconversion was found (Table 3.3).

DISCUSSION

LF is found frequently among patients with fever in northern Liberia. In fact, it appears to be the most common cause of fever among adult patients admitted to CLH, and is probably the most common at PH and GWH as well. Perhaps because it was considered an unusual illness in the past, LF fever cases have been misdiagnosed as enteric fever, pneumonia, pelvic inflammatory disease, post-partum sepsis and other febrile illnesses. It is only since the awakening of clinical suspicion among health care personnel and the availability of specific diagnostic procedures that the true dimensions of LF as a cause of human illness has become apparent in this part of Liberia.

It has become clear that the establishment of the frequency of LV infections among patients requires time and rigid adherence to collection of specimens, particularly serum pairs, by a hospital staff that is in many instances undermanned and overworked. However, the initial effort results in the education of health personnel, not only in the recognition of the frequency of a disease that presents a threat to their health, but also in means needed to establish the diagnosis. Thus, even in a "bush" hospital efforts to identify cases of LF continues once its presence in a hospital has been demonstrated.

In due time the adoption of techniques used in the hospitals in this part of Liberia will likely determine the true importance of LF as a public health problem in other parts of West Africa as well.

Table 3.1 LVA Titers Among Patients in Liberian Hospitals and Clinics Tested by IFAT Through Oct. 1982. (see text)

| Hospital | Number tested | Numbers with antibody titers by IFAT | | | | | | | | | | Total Positives | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ± | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024* | No. | Rate(%) |
| CLH# | 57 | | 7 | | | | | | | 1 | | 8 | 14.0 |
| CLH | 339 | 7 | 12 | 9 | 7 | 5 | 14 | 8 | 2 | 9 | 7 | 80 | |
| CLH (Pediatric) | 140 | 2 | 1 | 1 | | 1 | | | | | | 5 | 3.6 |
| PH | 219 | 15 | 6 | 5 | 2 | 2 | 3 | 5 | 1 | 1 | 2 | 42 | 19.2 |
| GWH | 28 | 1 | 1 | 1 | 1 | | 1 | | | | 1 | 6 | 21.4 |
| SMC | 28 | 1 | 1 | | 1 | 1 | | | | 1 | | 5 | 17.9 |
| TMH | 7 | 1 | | | | | | | | | | 1 | 14.3 |
| BFG | 11 | 1 | | | | | | | | | | 1 | 9.1 |
| RGH | 7 | | | | | | | | | | | 0 | -- |
| LIBR | 25 | 1 | | | | | | | | | | 1 | 4.0 |

* Titers expressed as reciprocals

\# Tests performed by Dr. Jordi Casals, Yale Arbovirus Unit. In most instances titers were not carried to end-points.

Table 3.2 Lassa Virus Infections Among Febrile Patients at the Curran Lutheran Hospital, Zorzor, Liberia, July 1980 - April 1982.

| Dates | No. tested | Lassa fever | | | Presumptive Lassa fever (titers) | Total No. (%) |
|---|---|---|---|---|---|---|
| | | Virus isolation | or rise in LVA | No.(%) | | |
| 7/80 - 5/81 | 72 | 9* | 5 | 14 (19) | 3 (1:128, 1:128, 1:64) | 17 (24) |
| 6/81 (Ward) | 35 | | 5 | 5 (14) | 1 (1:512) | 6 (17) |
| 6/81 (OPD) | 8 | | 1 | 1 (13) | | 1 (13) |
| 7/81 - 4/82 | 61 | 5# | 10 | 15 (28) | 5 (1:128, 1:128, 1:64, 1:1024, 1:1024) | 20 (31) |
| Total | 176 | 14 | 21 | 35 (20) | 9 | 44 (25) |

* IFAT results: 6 with seroconversion, or rise in LVA, 2 with high LVA titers (1:64, 1:128).

\# IFAT results: 2 with seroconversion, 2 with high LVA titers (1:412, 1:2048).

Table 3.3 Lassa Virus Infections in Febrile Patients with Various Hospitals, Liberia, July 1980 - February 1982.

| Hospital and dates | No. tested | Lassa fever | | | Presumptive Lassa fever | Total No. (%) | Other LVA Positive |
|---|---|---|---|---|---|---|---|
| | | Virus Isolation | Seroconversion or rise in LVA titer | Total No. (%) | | | |
| Phebe | | | | | | | |
| 5/10/81 - 5/15/81 | 36 | 1* | 1 | 2 (6) | | 2 (6) | 4 |
| 6/81 - 1/82 | 25 | 2* | 1 | 3 (12) | 6 | 9 (36) | 5 |
| GWH, Ganta | | | | | | | |
| 1/13/82 - 2/28/82 | 28 | # | 3 | 3 (11) | 1 | 4 (14) | 1 |
| ELWA | 24 | - | - | - | - | - | 2 |

* IFAT results: 1 with high LVA titer in each group.

\# Virus isolation not attempted.

# Chapter 4
# Testing of Hospital Staffs for LVA

During the period of the pilot study of LF in Liberia which preceded the present program, surveys of hospital staff were conducted as a means of determining the relative prevalence of LV activity in Liberia, and the identification of potential donors of LFIP. During the investigations under the current contract surveys were repeated in some of the hospitals, and hospitals which had not been investigated previously were included in the investigation. The prevalence of LVA among hospital personnel has now been extended to representative institutions in all geographic areas of Liberia. This permits elucidation of the fluctations in prevalences with time, and also affords an estimate of the relative distribution of LV activity in the whole country.

## I. Methods

After discussion with the hospital directors, staff members were approached and requested to cooperate in the determination of the significance of LV infections in their institutions. Most staff members knew of LF and were interested in learning the risk of LV infection in their institution. More than 90% of staff members in each institution agreed to contribute specimens for testing.

Investigations were repeated in a number of institutions where surveys had been conducted previously; these were the Curran Lutheran Hospital (CLH) in Zorzor, the Swedish Free Pentecostal Mission Clinic ( SMC ) in Foya Kamara, and the G. W. Harley Memorial Hospital (GWH) in Ganta. In addition surveys were conducted at the B. F. Goodrich Hospital (BFG) and the Bomi Territory Government Hospital (BTG), both in Bomi Territory, the National Iron Ore Company Hospital in Mano River (MRH) and the Robertsport Government Hospital (RGH), both in Grand Cape Mount County, the Martha Tubman Memorial Hospital (MTH) in Zwedru, Grand Gedeh County, J. J. Dossen Hospital (JJD), Harper, Maryland County. (see Map).

The research team obtained blood samples from the SFPMC, MTH and LIBR. In all other institutions specimens were obtained by hospital personnel. They were stored in the refrigerator until clot retraction, sera separated and then sotred in the hospital freezer until they could be forwarded to the LIBR for testing.

## II. Results

The results of tests are given in Table 4.1. LVA prevalence ranged from about 4% at JJD and LIBR to 40% in the 1979 survey at SMC. Highest prevalences were found at CLH and SMC in Lofa County, and at GWH near the Guinea border in Nimba County. A high rate was also found in 1980 at MRH;

The results are confounded by the loss of over half the specimens there. On the second year the rate was 9%. LVA titers of 1:32 or over were found in CLH, SFPMC (1979), RGH and GWH.

The institutions were requested to indicate the places of origin of their staff members; some neglected to do so. The county of origin of tested personnel in the hospitals which supplied this information, and the numbers of LVA positive are recorded in Table 4.2. There were LVA positive staff members listed from every county but Nimba and Maryland. In addition, most staff members at GW came from Nimba County, and at JJD, from Maryland.

For purposes of comparison the prevalences of LVA in the hospitals reported previously by (7) are recorded in Table 4.3. They indicate higher prevalences in recent testing in CLH, SFPMC (1979) and GWH; the rate in SFPMC in 1981 was comparable to that found previously.

## III. Discussion

Testing of hospital and clinic personnel discloses the presence of LV activity in all parts of Liberia. When a single institution is tested on several occasions, sizable differences in prevalence may be found. For example, it is known that there was an outbreak of LF among staff members at SFPMC in 1978; this likely accounts for the rise in prevalence in that institution between 1977 and 1979. The decreased number of seropositive staff members in 1981 may reflect the unwillingness of some who knew they were positive to participate yet another time; it is also likely due to the known fall in IFA titers with time (7).

The distribution of titers varies from place to place. The relatively larger number of persons with higher titers at GWH (and the increased prevalence of LVA-positives there, when compared with the earlier survey) likely reflects an increased LV activity in its vicinity between the two surveys. There was a considerable discontinuity of medical persons in the hospital on several occasions in the interval, and it was not possible to obtain an accurate account of unusual illnesses among staff, under the conditions in which the investigation there was done.

In spite of the fluctuations in the prevalences of IFA in the hospitals, it is clear that LV activity is present in all parts of Liberia. The lowest prevalences tend to be near the coast, and in the Southeast, with increasing prevalences inland and to the Northwest.

This appears to be the first country-wide survey of LVA in Africa.

Table 4.1. Surveys of Hospital Staffs in Liberia for LVA by IFA, 1979-1982.

| Hospital* and Date | No Tested | Positive 1:4 | 1:8 | 1:16 | 1:32 | 1:64 | Total | Rate | Non-specific or Questionable |
|---|---|---|---|---|---|---|---|---|---|
| CLM (1979) | 97 | 4 | 2 | 2 | 14 | | 22 | 22.3 | 19 |
| SMC (1979) | 52 | 2 | 3 | 7 | 9 | | 21 | 40.4 | 5 |
| SMC (1981) | 40 | 9 | | | | | 9 | 23.5 | 1 |
| BFG (1980) | 48 | 4 | 2 | | | | 6 | 12.5 | |
| BTG (1981) | 52 | 2 | | 1 | | | 3 | 5.8 | |
| MRH (1980)# | 25 | 6 | | | | | 6 | 24.0 | 1 |
| MRH (1981) | 67 | 5 | 1 | | | | 6 | 9.0 | 1 |
| RGH (1981) | 52 | 1 | 1 | | 1 | | 3 | 5.8 | |
| GWH (1982) | 69 | 3 | 3 | 2 | | 2 | 12 | 17.4 | 3 |
| MTH (1982) | 55 | 3 | 1 | | | | 4 | 5.8 | 5 |
| JJD (1981) | 50 | 3 | | | | | 3 | 3.8 | |

* Hospitals: See text for explanation.

\# 29 additional specimens were lost because of inadequate handling.

Table 4.2. Distribution of LVA Positive Staff Members of Selected Liberian Hospitals, by County of Origin.

| County | Lofa | Cape | Mont-serrado | Nimba | Bong | Grand Bassa | Grand Gedeh | Mary-land |
|---|---|---|---|---|---|---|---|---|
| Hospital* | | | | | | | | |
| BDG | 5/21# | 0/7 | 1/16 | 0/2 | 0/8 | 0/2 | | 0/1 |
| MTG | 1/17 | 1/24 | | 0/4 | 1/4 | 0/6 | | |
| MRH | 2/17 | 1/26 | | 0/4 | 1/3 | 3/6 | | |
| RGH | 1/3 | 2/32 | 0/6 | 0/3 | | 0/5 | | |
| MTH | 0/3 | | | 0/1 | | 0/2 | 4/43 | 0/7 |
| | 9/61 | 4/91 | 1/12 | 0/14 | 2/15 | 3/21 | 4/43 | 0/8 |

* Hospitals: See text for explanation.

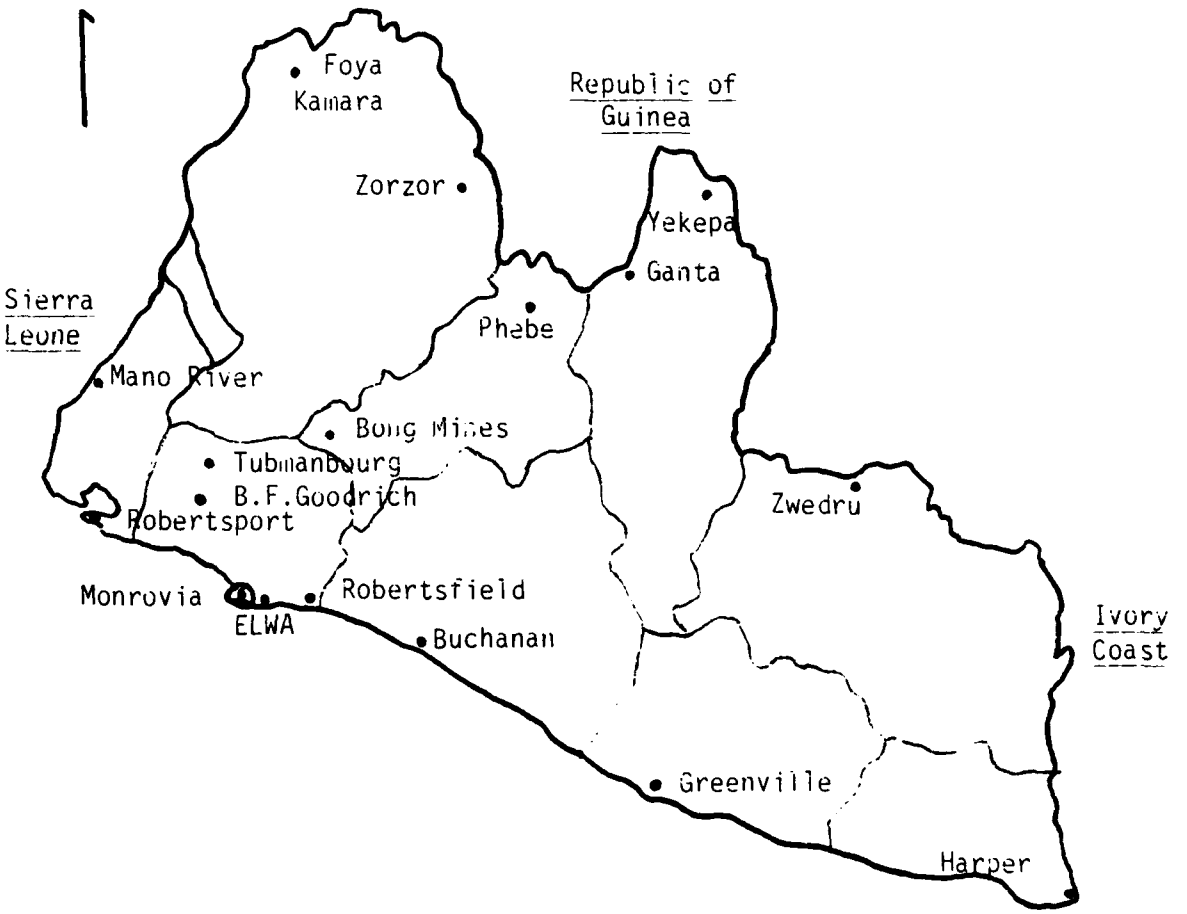
\# No. LVA-positive/No. tested.

Table 4.3. Previous Surveys of Hospital Staffs in Northwestern Liberia for LVA by IFA; Tests Performed by Jordi Casals, Yale Arbovirus Research Unit, New Haven. (7).

| Hospital* | No. Tested | Positive | Rate(1%) |
|---|---|---|---|
| SMC | 35 | 8 | 22.9 |
| CLH | 95 | 12 | 12.6 |
| PH | 236 | 24 | 10.2 |
| GWH | 59 | 4 | 6.8 |
| ELWA | 92 | 5 | 5.4 |
| LNH | 82 | 4 | 4.9 |
| LBH | 62 | 4 | 6.9 |
| MC | 109 | 7 | 6.4 |
| BMC | 74 | 3 | 4.1 |

* Hospitals: See text. In addition, Phebe Hospital, Bong County; ELWA-ELWA Mission Hospital, Paynesville; LNH-LAMCO-Nimba Hospital, Yekepa; LBH- LAMCO Hospital, Buchanan; MC - Maternity Center, John F. Kennedy Memorial Hospital, Monrovia; BMC - Bong Mining Co. Hospital, Bong Mines.

Fig. 4.1. Liberia, with Cities in which Hospital Staffs were Surveyed.



# Chapter 5
# Village Surveys

Surveys of village populations were carried out as a part of preliminary studies of the epidemiology of LF in Liberia. It appeared that some clue regarding the prevalence of LVA in hospital staffs might be discovered by the investigation of the extent of LV activity in the communities where the hospitals were located. It also seemed useful to determine whether any particular aspect of village culture might be associated with an increased prevalence of LF.

Four villages were selected for survey in the Zorzor health district, and two in Kolahun district. Near Zorzor villages were selected from two language groups, Loma and Kpelle, and from roadside and "bush" villages. Gbanwei and Yapoa were chosen as villages of about 300-400 inhabitants among Kpelle speaking people; the former was on the main road through Zorzor district, and the latter "in the bush" five miles from the highway. Similarly, Zuwulo was on the road in Loma-language country, and Balagualazu 20 miles to the southeast of Zorzor, again "in the bush." Yapoa can be reached by 4-wheel drive vehicle; Balagualazu may be reached by foot after the road ends, or by small plane to a near-by landing strip.

In Kolahun district the original plan to test villages selected by the clan chief had to be modified when he fell out of favor with the new regime. The communities surveyed were chosen on the basis of their accessibility to the survey team, as a means of obtaining a preliminary assessment of the prevalence of Lassa virus activity near the Swedish Free Pentecostal Mission Clinic where high prevalences had been found among staff members. The first community selected is on the grounds of the Clinic, in Foya Kamara. The other, Borlelo, is located about 12 miles to the northeast, on a secondary road near the Guinea border and on the verge of the savannah. The predominant language group in the area is Kissi, and extends to the north and west into adjacent Sierra Leone, and up to Kissidougou in the Republic of Guinea.

## I. Methods

A. Preparation - In each village the village chief and local health worker were approached and the purposes of the village survey were outlined. In the Zorzor health district villages the investigative team was introduced by the community health worker from the Health Center at Zorzor. The chief then called the village elders to assemble, and the plans of the survey and its purposes were discussed again. After the leaders here satisfied of the usefulness of the survey and were informed that they would be told of the results, general plans were made regarding the time that the survey would be conducted.

B. Conduct of the surveys

1. The team, generally led by the Field Investigator, came to the village some time before the appointed hour of the survey, and organized the place and personnel for the survey. A local person who could read and write English was appointed as registrar. The village health worker and some members of the

Community Health group were appointed to collect specimens. The village chief or his deputy prepared the villagers for testing.

2. Villagers were tested in households, under the leadership of the head of the household.

3. Each person to be tested was registered and given a waxed paper envelope to which a label was affixed with his number corresponding to the number of the roster being maintained by the registrar, and the number assigned to his household group.

4. The subject then moved to one of the testing team who cleaned a finger with an alcohol swab, pricked his finger with a disposable lancet, and expressed blood to saturate two 1-inch filter paper discs.

5. The discs were placed on the envelope which was then placed in a kerosene-lamp heated drying oven built locally.

6. When specimens were dry, each was inserted into its labelled envelope, and stored in a box.

7. At the end of the day the box was returned to CLH or SFPMC, and stored in the freezing compartment of the refrigerator.

C. Testing

1. Specimens were transported to the LIBR on wet ice, and stored there in the freezer at -20°C, until they were tested.

2. The filter papers were then placed in polysterene culture tubes, and 1 ml. normal saline added to each specimen.

3. Specimens were screened by IFAT at 1:4 dilution of the reconstituted solution.

4. All specimens which were positive on screening were then titered to end-points.

D. Calculations

1. The capacity of two filter paper discs was tested by blood delivered by a syringe with a fine needle, and found to be about 0.6 ml. of blood, corresponding to about 0.25 ml. of serum.

2. It was calculated that after reconstitution with 1 ml. normal saline each specimen had been diluted 1:2. Thus the screening dilution was 1:8.

3. A number of specimens from various sources were tested simultaneously by venous blood, and by blood collected on filter paper discs. It was concluded that the screening dilution based on mathamatical analysis was confirmed by the empirical tests.

## II. Results

A. The prevalences of IFA positive-sera in each of the villages is given in Table 5.1, classified by titers found on testing. In Gbanwei and Zuwulo surveys were conducted a second time, and the prevalences of the two villages were essentially what they had been in the initial survey. The highest prevalence was in the village on the SFPMC compound. Two sera were positive in Farwein, near the LIBR and the coast of Liberia.

B. Table 5.2 displays the seropositives classified in terms of the number of village households with varying numbers of members with LVA in each household. Twenty-nine or about one-half the seropositives were the only members of their household with LVA. In all villages except Farwein there were some instances of households with evidence of multiple infection.

C. In Zorzor district (Table 5.3.) the prevalence of positive sera among males, 4.7% was significantly different from that among females, 3.5%. There were no significant differences among the prevalences in the various age groups tested.

D. Comparisons between the villages in Zorzor district were made by the language groups in the villages, and by the location of the villages near the main highway or "in the bush" (Table 5.4.). There were 21 positive sera among the 685 inhabitants of Zuwulo and Balagualazu, Loma speaking villages; in Gbanwei and Yapoa, where Kpelle was the predominant language, 34 of 603 were positive. The differences were statistically significant at the $P < .05$ level, Table 5.3. Similarly, when the location of the villages was taken into account, the prevalence of IFA-positive sera in the population of Gbanwei and Zuwulo, 44 out of 684, was significantly different ($P < .001$) than the 11 out of 604 of Yapoa and Balagualazu which were located off the main road.

E. In Kolahun district the prevalence of IFA-positive sera among males, 7.3% and among females, 9.4%, did not differ significantly, and again, there was no real difference to be found among the age groups (Table 5.5.).

F. The prevalence of LVA positives in Foya Kamara Village differs significantly from that in Borlelo in the same district (Table 5.6., $P < .05$).

G. In Table 5.7 the prevalences in the villages are compared with those found in the hospitals geographically close to them. In this tabulation, modified from Table 4.1, the prevalence of staff members with IFA titers of 1:8 or higher was calculated, to permit valid comparisons with the screening titers of the village surveys.

## III. Discussion

Though the investigations under the Contract were designed primarily for the collection of plasma units, preliminary studies of LV activity in selected villages were deemed necessary to assess the importance of LF in the community. It seemed important to determine what relationship might be found between the prevalence of LV antibodies in the hospital staffs, and in the communities where the hospitals are situated. Furthermore, if a vaccine is indeed developed and

field trials of its efficacy are to be undertaken, some knowledge of the baseline prevalence of LVA in the population would be needed, as well as experience in means of studying it for antibodies.

The technique used a filter-paper technique for the collection of specimens. After elution and reconstitution of specimens for testing they were at an effective dilution of 1:8, and this, then, became the screening titer for the surveys. When the technique is evaluated in terms of some of the investigations presented earlier in this report, and with information reported elsewhere, certain precautions are apparent at once.

The IFA titer tends to fall rapidly with time (7). The results of the 1981 survey at the SFPMC are instructive for the light they cast on survey results. Though 9 of 24 members of the hospital had LVA titers of 1:4, none would have been picked up with screening at a titer of 1:8. Because of this there is intrinsic uncertainty in the interpretation of point-surveys for LF.

The results of repeated surveys in two villages, Zuwulo and Gbanwei, in 1982, do give one confidence about the prevalences of LVA antibodies in the villages. The presence of antibodies at various titers in both years suggested that in these villages there is continued viral activity with new infections every year, and the gradual degradation of the antibody titers with time, so that in these communities prevalence will reach a "steady state." It is not as easy to explain the significance of the antibody titers in the "bush" villages in Zorzor district, and Borlelo in Kolahun district. In none of these were there people with IFA titers of greater than 1:8. This finding may result from outbreaks of LF some years previous to the time of the survey, or from a few cases several years before. It does tend to cast doubt on LF as a frequent or recurrent cause of illness in the communities.

Overall, the "bush" villages differed from those on the main highway in a more obvious way. The prevalence of LVA in them was considerably and significantly less than in their roadside counterparts. Several hypotheses should be considered in attempts to explain the differences.

In the first place, the "bush" villages are indeed in the forest with much less open land immediately about them. In Balagualazu, for example, the forest begins within three or four yards of the outermost house in the community. Mastomys natalensis is gramnivorous, and perhaps prefers open fields of grass, rice or sugarcane for its habitat.

The villages do subsist on rice farming, and there are fields within a mile of which the farmers walk each day. However, from this small investigation no evidence could be found indicating a higher than average risk of acquiring LV infection among men working in the field and women staying at home. The prevalence of LVA was essentially the same among men and women.

The differences in the prevalence of LVA in the roadside and "bush" villages may result from the extensive commercial and transport activity along the highways. It is possible that people living in these villages have more opportunity of acquiring infection from visitors from other communities. Or

it may be that Mastomys carrying more virulent strains of LV become passengers on the trucks traveling the highway, and have distributed the strains into communities where otherwise milder, indigenous strains would be found.

Yet other explanations of the differences in the prevalence of LVA in "bush" and roadside villages may relate to changes in village discipline and life-style with increased contact with the outside world. When one travels in Liberia one does observe differences from village to village. Some are cleanly swept, with a hard dirt surface covering the areas between homes, whereas in others weeds and litter are found between the houses. It may be that these differences reflect changes in tribal discipline, or acceptance of, and submission to the authority of the village chief.

Further investigations of village population should help determine whether any of these hypothesis are the true explanation of the differences in LVA-prevalence among them.

Originally it was planned to compare the results in Zorzor district with those in Kolahun district, separated from the former by about 100 miles. These plans could not be carried out within the period of this contract; political changes made use of the process of selection carried out in Zorzor not feasible. However, certain results of the surveys which were conducted are useful. It is noteworthy, though perhaps not surprising, that the highest prevalence of LVA was found in the village associated with the Health Center and Clinic which has the highest rate of LVA of any hospital or Clinic in Liberia. One might expect a certain amount of infection to spread from the Clinic to the village where staff lives. On the other hand, the relatively low prevalence of LV in Borlelo located in the vicinity suggests caution in interpreting the rate of LVA in the Foya village as due to the transmission of LV from Clinic staff to their families. The association may be the opposite; the LV may be unduly common or unduly severe in the rats of the village, and both staff and families may be infected primarily in their own homes.

Most Lassa fever in Liberian hospitals occurs among women. In the villages we surveyed there was no significant difference in the prevalence of LVA between men and women. However, there was a preponderance of women in our surveys, with about twice as many adolescent and adult females as males in a village; the numbers of children below twelve were similar in the sexes. It appears that the relative numbers of males and females found to have LF reflect the numbers of men and women admitted to the hospitals, which in turn, reflect the proportion of men and women in the community. Indeed, polygamy is present in much of Liberia, and there are more women than men in most households. Whether this is due to a higher death rate among little boys, or to migration of men to the city, or to other causes, it does suggest that the Lassa fever affects men and women in rural Liberia equally in terms of the numbers living there, and not in terms of their gender.

The interpretation of the LVA distribution among households must be made with some caution. It has been suggested that in some of the villages the absence of higher titers of LVA suggests that infection has occurred at some relatively distant time; it is possible that other members of the family of the LVA-reactors were infected then, but that their IFA titers have dropped to

levels too low to be found by our technique. The results do not differentiate between multiple infections from a common household source, or of transmission between people. The preponderance of single case households does suggest that person-to-person transmission is not predominant.

Table 5.1. Prevalence of LVA Among Inhabitants of Selected Liberian Villages by IFA Titers. (See Text).

| Village | No. tested | Positive, by Numbers/antibody titer 8 | 16 | 32 | 64 | 108 | Total | Rate % | Question-able |
|---|---|---|---|---|---|---|---|---|---|
| Gbanwei* (1980) | 391 | 28 | 2 | 1 | 1 | | 32 | 8.2 | 8 |
| Gbanwei* (1982) | 162 | 7 | 3 | 2 | 1 | | 13 | 8.1 | 3 |
| Yapoa* | 212 | 2 | | | | | 12 | .9 | 1 |
| Zuwulo* (1980) | 293 | 7 | 4 | | | 1 | 12 | 4.1 | 9 |
| Zuwulo* (1982) | 128 | 1 | 3 | 2 | | | 6 | 4.7 | 7 |
| Balagualazu* | 392 | 9 | | | | | 9 | 2.0 | 1 |
| Foya Kamara# | 85 | 7 | 1 | 1 | 1 | 2 | 12 | 14.1 | 2 |
| Borlelo# | 138 | 7 | | | | | 7 | 5.1 | 1 |
| Farwein@ | 47 | 2 | | | | | 2 | 4.3 | |

* Zorzor District, Lofa County

\# Kolahun District, Lofa County

@ Montserrado County

Table 5.2. Distribution of LVA Positives in Selected Liberian Villages, by Number of Positives in a Household.

| Village | Number of Households | Households with 0 positives | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Gbanwei | 36 | 21 | 10 | 3 | 1 | 1 | |
| Yapoa | 43 | 42 | | 1 | | | |
| Zuwulo | 36 | 27 | 6 | 3 | | | |
| Balagualazu* | 17 | 10 | 5 | 1 | | | 1 |
| Foya Village | 17 | 10 | 4 | 2 | | 1 | |
| Borlelo | 23 | 20 | 2 | | | | 1 |
| Farwein | 10 | 8 | 2 | | | | |
| Total | 182 | 138 | 29 | 10 | 1 | 2 | 2 |

* In Balagualazu the patients come in "families", some of which lived in different but adjoining buildings.

Table 5.3. Prevalence of LVA in Inhabitants of Four Villages in Zorzor District, by Age and Sex, 1980.

| Village | Age | | | | Total | Rate |
|---|---|---|---|---|---|---|
| | Adult | Adol-escent | 5-12 years | Under 5 years | | % |
| Males | | | | | | |
| Gbanwei* | 4/48# | 1/8 | 4/31 | 4/43 | 13/130 | 10 |
| Yapoa | 1/32 | 1/8 | 0/25 | 0/38 | 2/96 | 2.1 |
| Zuwulo | 5/41 | 0/3 | 1/40 | 1/41 | 7/125 | 5.6 |
| Balagualazu | 2/50 | 0/30 | 0/52 | 1/49 | 3/181 | 1.7 |
| Total males | 12/171 | 2/49 | 5/148 | 6/171 | 25/532 | 4.7 |
| Females | | | | | | |
| Gbanwei | 5/96 | 0/3 | 2/32 | 3/51 | 10/182 | 7.4 |
| Yapoa | 0/48 | 0/5 | 0/27 | 0/36 | 0/116 | -- |
| Zuwulo | 3/85 | 0/4 | 1/26 | 1/53 | 5/168 | 3.0 |
| Balagualazu | 7/113 | 0/15 | 0/51 | 2/32 | 9/211 | 4.3 |
| Total famales | 15/342 | 0/27 | 3/136 | 6/172 | 24/677 | 3.5 |
| Total | 27/513 | 2/76 | 8/284 | 12/343 | 49/1209 | 4.1 |
| Rate (%) | 5.2 | 2.6 | 2.8 | 3.5 | 4.1 | |

* A number of labels at Gbanwei became separated from the samples. Of 79 specimens which could not be identified, 9 were LVA positive, and 3 gave questionable reactions, in addition to those tabulated above.

\# Results: Number LVA-positive/number tested.

Table 5.4. Comparisons of Prevalences of IFA-positive Sera Among Selected Villages in Zorzor District by Language Group (see text).

| Villages | IFA-Positive | IFA-Negative | Total | Rate |
|---|---|---|---|---|
| Loma-speaking Zuwulo and Balagualazu | 21 | 664 | 685 | .031* |
| Kpelle-speaking Gbanwei and Yapoa | 34 | 569 | 603 | .056* |
| Total | 55 | 1233 | 1288 | .043 |
| Roadside Zuwulo and Gbanwei | 44 | 640 | 684 | .064# |
| "Bush" Yapoa and Balagualazu | 11 | 593 | 604 | .019# |
| Total | 55 | 1233 | 1288 | .043 |

* $X = 4.67$, $P < .05$

\# $X = 15.6$, $P < .001$

Table 5.5. Prevalence of LVA Among Inhabitants of Two Villages in Kolahun District, by age and sex, 1981.

| Village | Age | | | | Total | Rate |
|---|---|---|---|---|---|---|
| | Adult | Adol-escent | 5-12 years | Under 5 years | | % |
| Males | | | | | | |
| Borlelo | 2/34* | 0/7 | 0/14 | 0/12 | 2/67 | 3.0 |
| Foya Kamara | 1/9 | | 0/5 | 4/15 | 5/29 | 17.2 |
| Total males | 3/43 | 0/7 | 0/19 | 4/27 | 7/96 | 7.3 |
| Females | | | | | | |
| Borlelo | 2/34 | 0/9 | 3/17 | 0/11 | 5/71 | 7.0 |
| Foya Kamara | 2/21 | 1/2 | 1/16 | 3/17 | 7/56 | 12.5 |
| Total females | 4/55 | 1/11 | 4/33 | 3/28 | 12/127 | 9.4 |
| Total | 7/98 | 1/18 | 4/52 | 7/55 | 19/223 | |
| Rate (%) | 7.1 | 5.6 | 7.7 | 12.7 | 8.5 | |

* Results: Number LVA-positive/number tested.

Table 5.6. Comparisons of Prevalences of LVA in Two Villages of Kolahun District.

| Village | IFA-Positive | IFA-Negative | Total | Rate |
|---|---|---|---|---|
| Foya Village | 12 | 73 | 85 | .141* |
| Borlelo | 7 | 131 | 138 | .051* |
| Total | 19 | 204 | 223 | .085 |

* $X = 4.4$, $P < .05$

Table 5.7. Comparisons of LVA-positive Prevalences Among Adults of Village Surveys, and Hospital Staffs with IFA Titers of 1:8 and Above.

| Survey Location | Number Tested | LVA ≥ 1:4 No. | LVA ≥ 1:4 Rate(%) | LVA 1:8 No. | LVA 1:8 Rate(%) |
|---|---|---|---|---|---|
| CLH Staff (1979) | 97 | 22 | 22.3 | 18 | 18.6 |
| Gbanwei | 144 | | | 9 | 6.3 |
| Yapoa | 80 | | | 1 | 1.3 |
| Zuwulo | 126 | | | 8 | 6.3 |
| Balagualazu | 163 | | | 9 | 5.5 |
| SMC Staff (1979) | 52 | 21 | 40.4 | 19 | 36.5 |
| SMC Staff (1981) | 40 | 9 | 23.5 | 0 | -- |
| Foya Kamara | 30 | | | 3 | 10.0 |
| Borlelo | 68 | | | 4 | 5.9 |

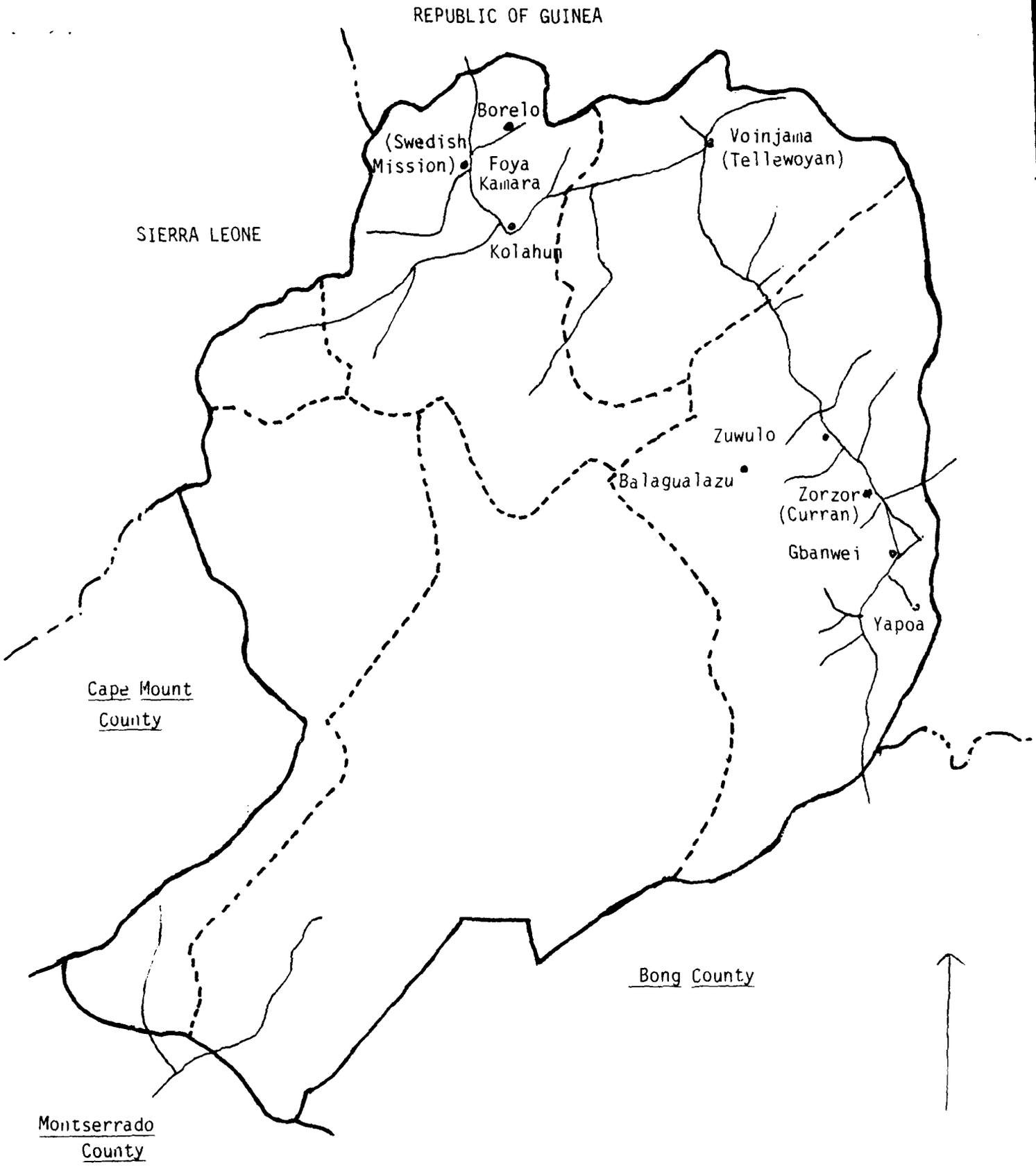



Fig. 5.1 Lofa County, Liberia. Survey Villages and Hospitals.

Appendix A. Principal Investigator's activities during trips to Liberia.

The Principal Investigator had made a trip to Liberia in January, 1979, prior to the inauguration of work under the current contract. At that time it appeared that arrangements for the Subcontract between the LIBR and Columbia University had been completed. However, when the draft Subcontract was sent to the LIBR there were major questions regarding its terms, and it did not seem fruitful to make any further trips until it would be clear that a Subcontract acceptable to the LIBR would be completed within the terms of DAMD 17-79-C-9024. By October points of difference had been narrowed, and a trip to Liberia to complete the Subcontract and start work under its terms seemed appropriate.

October 1979 - Negotiations regarding the Subcontract were completed. Fluorescence microscope delivered to the LIBR, and tested. Trip made to Curran Lutheran Hospital (CLH) to collect patient specimens and aliquots of plasma in the hospital freezer. Discussion with staff at CLH regarding future serum collection from febrile patients. Trip to George W. Harley Memorial Hospital at Ganta, but Medical Director was not present to discuss further work there. Discussion of the project at Phebe Hospital.

Janury 1980 - At Zorzor, patient specimens collected and arrangements made for continued study of febrile patients. Discussed village surveys with Community Health Staff at CLH, and visited village health posts at Gbanwei, Sucromu and Konia. In Kolahun District arranged with District Superintendent and Chief Tumba Taylor for serological surveys in Kissi tribal villages in Kolahun. Brief visit to Foya Swedish Free Pentecostal Health Center (SFPMC) to maintain relationships there. In Southeast Liberia, visited B.F. Goodrich and Bomi Government Hospitals in Bomi Territory, Montserrado County, and the NIOC Hospital at Mano River, Cape Mount County, discussed the LF project in Liberia, and requested them to conduct serological surveys for LVA in their staffs.

July 1980 - This was a brief trip after the projected trip in April was cancelled because of the coup in Liberia. Met the Field Investigator, Mr. J.E. Yalley-Ogunro, who had already had training in IFAT by Dr. Rinus van den Ende at the LIBR. Instructed him in the principles, procedures and scope of the LF project in Liberia. Trip to CLH at Zorzor to continue collection of patient specimens there. With the field team of the Community Health Project visited Gbanwei and Yapoa to discuss with village chiefs the projected village surveys for LVA.

October 1980 - Met with Minister of Health to discuss the state of the Lassa fever project, known in Liberia as the Lassa Fever Control Project. Met with Dr. Aloysius P. Hanson the new Acting Director of the LIBR to inform him of the Project. At Zorzor, continued collection of patient sera. Trip by light plane to the "bush" village of Balagualazu to conduct village survey. Visited Phebe Hospital to discuss possible patient surveys, and the state of the LF project.

January 1981 - Conducted plasmapheresis at Zorzor, and at the SFPMC in Foya. In Zorzor, saw LF patients with new Chief Medical Officer at CLH, Dr. Mark Monson. Reviewed with him results of patient surveys since July 1980, and criteria for diagnosis of LF. Visited Borlelo to arrange with local health worker and village chief for future village survey there. Surveyed staff of SFPMC at Foya, and of mission village there. In Southeast Libera, visited Robertsport General Hospital, NIOC Hospital at Mano River, BGH at Tubmanbourg and B.F. Goodrich Hospital to report on previous findings, and arrange for further staff and patient surveys there.

April - May 1981 - Discussed project with Dr. Hanson at LIBR. Reviewed patients in Zorzor, and set up plan for survey of every febrile patient in June. At SFPMC at Foya discussed possible patient surveys. Transported three donors from SFPMC to Zorzor for plamspheresis. Arranged for brief patient survey at Phebe. Visited GWH at Ganta to discuss patient surveys. Conducted village survey at Farwein near Robertsfield.

October 1981 - Plasmapheresis at Zorzor. Reviewed results of survey of febrile patients conducted in Zorzor in June. At Phebe, discussed with Dr. Walter Gwenigale, Medical Director, and Dr. John Fredell results of brief survey of febrile patients at Phebe Hospital. Discussed possible future work at Phebe.

January 1981 - Plasmapheresis in Zorzor. Arranged for Pediatric survey at Zorzor. Visited Ganta. Arranged for staff and patient surveys at Ganta. Visited Zwedru, and conducted staff survey there. Visited Greenville and Harper to arrange for staff surveys there. Visited Phebe, discussed significance of patient surveys there. Interviewed Andrew Cole, and engaged him for future work as Clinical Investigator with the Project.

October 1982 - Phebe - picked up Dr. Andrew Cole. Discussion of clinical plasmapheresis at Zorzor. Reviewed project with Dr. Aloysius P. Hanson regarding the 4-month extension of the project. Visited Phebe Hospital to discuss future prospects there. Met again with Dr. Andrew Cole, and traveled with him to Curran Lutheran Hospital in Zorzor, to demonstrate plasmapheresis and to discuss clinical aspects of the project. Conducted plasmapheresis at Zorzor; reviewed the possibility of expanded work there. Reviewed the whole project with Dr. Hanson at the LIBR, and discussed possible future work under a new contract which had been proposed to USAMR&DC.

END

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