TRIP REPORT:

Zambia

(September 14 - September 23, 1983)

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TRIP REPORT: Zambia

Table of Contents

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SUMMARY

Vitamin A deficiency has long been implicated as a major cause of childhood blindness in Zambia, particularly in the Luapula Valley where blindness is known to be highly endemic. At the request of the National Food and Nutrition Commission, Government of Zambia (GOZ), we visited the area and reviewed the Government's draft proposal for the assessment and prevention of nutritional blindness in the Luapula Valley. During the visit we were impressed by the relatively large numbers of blind adults but the scarcity of very young children with active xerophthalmia or corneal scars. The WHO measles vaccination program and an apparent increase in the consumption of vitamin A-rich, small fish in the region may be important factors in what is perceived to be less blindness in recent years. The GOZ proposal was critiqued and redefined to comprise an initial, population-based xerophthalmia/blindness prevalence survey to serve as a basis for planning appropriate interventions. The specific details of the protocol are currently being developed by the Zambian collaborating institutions in consultation with ICEPO.

INTRODUCTION

Upon our arrival in Lusaka on the 13th and 14th of September, we met with Mr. Vamoer, Executive Secretary of the National Food and Nutrition Commission (NFNC), to establish our terms of reference and schedule our activities, including a several day visit to the Luapula Valley. While Mr. Vamoer hopes to eventually determine the risk of xerophthalmia and establish appropriate prevention programs in high risk areas throughout the country, he clearly requested that during our visit we provide technical consultation on the proposal to assess xerophthalmia in the Luapula Valley with the further goal of identifying specific areas of the proposal in which ICEPO could provide assistance. The proposal is a joint undertaking by the NFNC (Lead agency), the Tropical Disease Research Center (TDRC), the Zambia Flying Doctor Service (ZFDS), and the Zambia Ministry of Health (MOH). Plans were set to spend several days in the Luapula Valley to visit hospitals, health centers, and observe the general village ecology, followed by working sessions to modify the proposal where appropriate.

Prior to departing Lusaka we met with Dr. Shukla, the Senior Ophthalmologist at the University Teaching Hospital, who shared his impressions of the importance of the blindness problems in the Luapula province as well as other areas of the country. Essentially, his comments were very similar to the historical review of previous investigators' reports summarized in the proposal.

On Thursday, 15 September '83, we flew to Ndola with Ms. Darina Mukupo, a Nutritionist with the NFNC. Both the ZFDS and the TDRC are based in Ndola. The following day we were joined by Mr. David Mwandu, a

Nutritionist with the TDRC and the primary author of the draft proposal, who accompanied us into the Luapula province via a Flying Doctor aircraft. After a two hour flight we arrived in Kashikishi, a lakeside rural town in the District of Nchelenge. During the following four and a half days we visited either by land vehicle or aircraft the following health care centers in the province: Kashikishi General Hospital, Mbereshi General Hospital, rural health centers at Chipungu, Kabuta, Chabilikila, Kanyembo, Puta, a leprosarium, Mansa General Hospital (the provincial seat), and St. Margaret's Mission Hospital in Kasaba. In each health care center patients were examined, available records reviewed, and clinical and medical officers interviewed to gain an impression concerning the severity and magnitude of xerophthalmia, measles and its associated blinding complications, trachoma, and other major causes of blindness in the province. In addition, approximately 100 kilometers of the northern districts in the valley were toured to observe the general ecology of the area, typical village layout, household structure, local dietary habits, sources of water supply, and other environmental factors present in the valley. While regular meetings were held with Mr. Mwandu and Ms. Mukupo concerning the proposal while in the valley, a large work session was held in Ndola among the major collaborating parties to share our findings of the Luapula visit and to provide critical input for the development of the second draft of the proposal.

HOSPITAL AND RURAL HEALTH CENTER FINDINGS

Ophthalmic Components of Visit to Zambia

At the University Teaching Hospital Lusaka the Chief Ophthalmologist, Dr. Shukla, stated that between 25 and 50 cases of corneal ulceration associated with measles or malnutrition were seen a year at that hospital. He also mentioned that there were estimated to be 18,000-19,000 Zambians blind from cataract out of a total population of 6.5 million. There are 12 ophthalmologists in the country and about 400 cataract extractions performed a year in Lusaka.

In Kashikishi the Assistant Medical Officer with special training in ophthalmology is Mr. Alex Capui. He has been working in Kashikishi for only eight weeks having just completed a year of training in Nairobi. Since his return he has seen 8 children with corneal ulceration and 6 adults. One child, a three-year old male, was severely malnourished and developed unilateral corneal ulceration that resolved with treatment that included vitamin A. The other 7 cases in children were all thought to be either bacterial ulcers or corneal abrasions, but he has little follow-up on these cases. He has not seen a child with measles develop a corneal ulcer in the time that he has been at Kashikishi. Dr. Hans Koch is a Dutch physician who has been at Kashikishi for seven months. His arrival coincided with the onset of an epidemic of measles with approximately 60 admissions over a 2-3 month period. During this time, only one child developed corneal ulceration. As a routine, all children admitted with measles are given 100,000 or 200,000 IU of vitamin A either by injection or orally. For the year 1982, 137 children were admitted to Kashikishi with measles and 8 died.

It is particularly relevant that of the children under the age of six years 95 had not been vaccinated, whereas, 18 had been vaccinated. It is estimated that 75-80% of the children in the area have received measles vaccine.

Approximately 60 children were examined in the pediatric ward of Kashikishi and no signs of xerophthalmia were seen. Approximately two-thirds of the children examined had signs of trachoma. Nineteen adults were examined in the male surgical ward and 17 of these had evidence of trachoma. This was mild in all cases.

At Mbereshi Hospital, Dr. De Jong, a Dutch physician, has worked for three years. This year they have had a small measles epidemic with between 25 and 40 children being admitted with only one child developing keratomalacia. They usually see approximately 5 children with corneal ulcers a year which they attribute to malnutrition or measles. Again, as a routine, vitamin A is given to all children with measles or malnutrition on admission. Approximately 20 children in the pediatric wards were examined without any obvious signs of xerophthalmia or corneal scarring. Four mothers were examined with corneal scarring attributed to measles. In 3 of these cases this was unilateral and one was bilateral.

At Chabilikila, a rural health clinic on the edge of the lake between the Mbereshi and the Kashikishi approximately 80 people, who had attended for other reasons, had an ocular examination. Four were found to be bilaterally blind, and 4 were unilaterally blind. Causes of blindness include: cataract, corneal scarring acquired in childhood and attributed to measles in one case, and uveitis. Approximately 80% of

the people had evidence or mild trachoma and 2 adolescents had severe vernal catarrh. Approximately 20-30 children were seen this year with measles and one may have developed corneal ulceration.

Approximately 60 patients at a leprosarium, south of Mbereshi were examined and a number of blind were found. The cause of blindness included bilateral cataracts in 2 cases, severe anterior uveitis in 2 cases, advance trachoma with trichiasis in 2 cases and 2 cases of exposure keratitis. One man was unilaterally blind from a corneal opacity acquired in childhood associated with measles.

Mansa General Hospital is a large hospital servicing approximately 28,000 people. Most patients come from within a ten kilometer radius. A Danish pediatrician has worked there for approximately 1 1/2 years and in that time has seen approximately 8 cases of keratomalacia in malnourished children and although serious PEM is common, few cases have ophthalmic involvement. Dr. Guta, who was the ophthalmologist at Mansa in 1980, made daily rounds in the kwashiorkor ward for three months and found very few cases with ocular involvement. The clinical impression of the two pediatricians at the hospital was that they had between 5-25 cases of measles in the measles ward all year round, but on an average they had approximately ten cases. Approximately 10% of these children or about 50 children a year developed corneal ulceration and about 5-10 children per year developed blindness from this. All children who have evidence of malnutrition together with measles receive 100,000 IU vitamin A intramuscularly on three consecutive days. The malnutrition is worse in the rainy season (January-March) when approximately 80% of the children with measles are malnourished. At other times it is closer

to 20%. Forty children in the pediatric ward including the kwashiorkor ward were examined but none had evidence of xerophthalmia. There were only 4 children in the measles ward and one had a moderate superficial punctate keratitis without evidence of conjunctival or corneal xerosis. This child was well nourished and had not been given vitamin A on admission one day before. It is estimated by the pediatricians that approximately 10% of the measles admissions have received the vaccination, whereas, the EPI coverage in the area is 75%, so that an unvaccinated child is twenty-seven times as likely to have measles as a vaccinated child.

In 1980 Dr. Guta reviewed the causes of blindness in 12,000 blind people seen in the outpatients ward in a twelve-month period. In 30% blindness was attributed to the use of muti, 25% cataract, 15% phlyctenular disease and tuberculosis, 15% trachoma, 5% measles, 5% dendritic ulcers, 2% glaucoma, and 1% vitamin A deficiency. He concluded that malnutrition and measles have decreased as public consciousness has risen and improved medical facilities provided. This is in striking contradiction to the figures presented in the Government of Zambia report prepared by Dr. Nyaywa and Ms. Dirorimwe in 1980 in which they quote figures obtained from the Mansa Hospital. To summarize their figures they reported approximately 1,000 cases of keratomalacia (X3B) for the year 1979 with 293 cases of XB, 155 cases of XN, 389 cases of XM, and 81 cases of measles and 41 cases of severe PEM. With extensive searching we were unable to uncover the origin of these figures. We discussed them with a medical superintendant of the hospital, the provincial medical officer, the chief of medical records, the ophthalmology staff who were available, and the pediatricians. The

case reportings could not be verified and indeed the apparent inpatient case load of xerophthalmia during recent years has not been anywhere close to that reported in the 1980 report titled, "Program for Control of Vitamin A Deficiency in Zambia", from the Ministry of Health (see Appendix A for a summary of inpatient cases of PEM, inflammatory eye diseases, and measles for the period 1980 through the first eight months of 1983). In 1980 there were 70 inpatients less than 15 years of age with any inflammatory eye disease, 44 in 1981, 28 in 1982, and 20 during the first eight months of 1983. This report on a very high prevalence of signs of xerophthalmia seems erroneous. Again, the examination of children in the pediatric ward showed that many of them had evidence of trachoma.

It is interesting to note that while the numbers of children admitted to Mansa Hospital for severe PEM from 1980-83 have remained similar (approximately 300 per year), reported mortality has nearly tripled among these children (8.5-23.6%). No immediate explanation can be offered to this trend.

Kasaba is a mission hospital which has 2-3 small epidemics of measles a year in which 6-10 children may be admitted. In the last twelve months there have been 2 children who developed keratomalacia. Three-quarters of the children have been vaccinated. Measles now usually occurs in older children and is much milder being similar to that seen in Europe. On examination of children and adults in the adjacent village at least 3/4 of the children had evidence of active trachoma which was severe in a number of children. Interestingly, the adults in this region, as in other regions, had relatively mild

trachoma, although definite scarring could be seen in the majority of adults. The finding of a high prevalence of active follicular disease in children and particularly the frequent finding of severe inflammation with the relative paucity of scarring and trichiasis in adults suggest that there may be a real recent change in the prevalence and/or severity of trachoma. This question would be best examined in a population based study. An ophthalmologist visits Kasaba 3-4 times a year and performs 1-2 operations on each visit. Kasaba is a hospital of sixty beds and serves approximately 28,000 people.

The use of traditional medicine, or "muti" seems to vary widely in the different regions that we visited. In the north muti is perceived to be used relatively infrequently, whereas in the south, particularly Mansa, and Kasaba, it's use is blamed for most of the eye disease in children. Whether this is a real difference or a very strong observer bias is unclear, and again would require confirmation by a population based survey.

In the haphazard sample of adults we examined in the Luapula Valley there were a large number who had corneal scarring acquired in childhood and attributed to measles. This was almost always unilateral scarring and presumably children with bilateral scarring have not survived. In each hospital, however, the number of children being seen each year to develop corneal ulceration scarring with or without measles or malnutrition seems to be quite low. This may well reflect a true change in the occurrence of corneal ulceration and presumably xerophthalmia. In total we examined several hundred children and failed to see one who demonstrated clear signs of xerophthalmia. Such a change could be

attributed to the reduced frequency of measles or a reduction in the severity of measles associated with the good coverage achieved by the EPI over the last 3-4 years. A further factor may be the routine administration of vitamin A to children admitted with measles and malnutrition. Another factor that could have influenced the frequency of keratomalacia may be a real change in vitamin A status which could possibly be attributed to the apparently widespread introduction of the small fish kapenta into the local diet as is discussed later.

We found no evidence of ocular onchocerciasis in any patients that were examined, nor did we find evidence of the demotological changes seen with onchocerciasis. The physicians that were questioned about onchocerciasis had not seen patients with the characteristic skin lesions, nor had they seen patients with nodules. It is our firm impression that onchocerciasis probably does not occur in this region, or if it does it occurs at such a low prevalence that it is not of public health significance.

ENVIRONMENTAL OBSERVATIONS

The Luapula Valley lies along the western rim of the province, itself located in the northeastern portion of the country bordered on the east by the Northern Province to the east, and Zaire to the west and north. Lake Mweru (approximately 60 kilometers long) and the Luapula River form the natural boundaries between Zambia and Zaire in the northern and southern portions of the valley, respectively. While ecologic differences exist particularly among lakeshore communities and those further away from any natural body of water, the valley can be broadly described as a Savannah region lying between 4,000-4,500 feet

above sea level. The total population is approximately 200,000, densely distributed along the lakeshore, the few major (usually dirt) roads, and occasionally, directly along the river or one of its tributaries. Low grasses and shrubs predominate throughout the valley with a predictable, more sparsed distribution of a large variety of trees. Our visit coincided with the hottest and dryest season of the year, a time when numerous large brush fires can be frequently seen throughout the province.

Food and Dietary Habits

Overwhelmingly, cassava is the dietary staple throughout the province, a rather unique feature since maize predominates as the staple throughout most of Zambia. In Luapula, maize is considered the staple for the more wealthy individuals in the community, as it sells for approximately 20 kwacha ($15.00)/50 kg bag, a price which the vast majority of valley residents cannot pay. The cassava tuber is dug up, scraped, soaked in slowly running fresh water for 3-4 days, chopped or sliced and dried in the sun. The dried material is then pounded, sieved to a flour, and boiled to a thick porridge called "nsima", which is consumed from about 5-6 months through adulthood.

Red palm trees are scattered through various communities in the valley. Essentially, where they are found the palm oil is made, used, and sold. Where red palm trees are not found, it is not consumed. It is generally thought to be inferior to other vegetable oils.

A second major food in the Luapula diet is a relish which can comprise a variety of foods, preferably fish which has been dried,

pounded and cooked, often along with some vegetables and spices. Where fish is not readily available during certain times of the year the relish may comprise only vegetables, of which cassava, pumpkin, and sweet potatoe leaves are primary ingredients. Ground nuts are grown to some extent and used also in relish when available. In infants, while breastmilk is often supplemented with nsima at 5-6 months the family meal relish is usually not introduced until 10-12 months of age, or until the child is observed to have some upper and lower teeth.

It is particularly inviting to link apparent changes in consumption in the relish food, particularly among valley residents living in close proximity to Lake Mweru, to the perceived reduction in blindness among children during the past few years. Specifically, a small fish called 'kapenta' (or "chisenje") which is native to the waters of Lake Mweru has only been caught in small quantities in the past using locally made baskets. Between one and three years ago the Government made available for sale a fine mesh fishnet capable of catching kapenta fish. Many families along the lake have purchased the small mesh nets resulting in a tremendous increase in the availability of kapenta fish in markets, at least throughout the northern districts of the Luapula Valley. Because of their small size the kapenta fish is dried, pounded, and eaten in its entirety including its vitamin A - rich viscera. Whereas, until only a few years ago the primary fish for relish consisted of larger fish (e.g., tilapia, bream, etc.) which are eviscerated prior to drying an increased consumption of kapenta fish represents a major, new source of vitamin A in the diet. The impact of this dietary change may be greatest in the lakeside communities where the fish is readily available and affordable, costing approximately 20-25 ngwee ($0.15-$0.18)/cup. In

the southern districts of the valley the kapenta fish is less available and costs 40-50 ngwee for the same amount of fish. While fish may be relatively available in the northern lakeside districts compared to the south, the bulk of caught fish are sent to the copper belt province.

During the dry season (e.g., September) few vegetables are available in the valley, which may include cassava leaves, pumpkins and their leaves, sweet potatoes and their leaves, and okra. The amounts of these vegetables consumed at the household level are small, and the amounts typically consumed by very young children in the households are not known, but believed to be even less.

Major fruits observed growing throughout the valley in decreasing order were: mango, papaya, banana, guava, and in a few northern communities, pineapple. By far the predominant fruit growing during this season is mango. However, many mangos at the tops of large trees are believe to spoil due to inaccessibility.

Sources of Water

Water for most residents of the valley comes from surface water; i.e., from the lakes, rivers, and marshes. Few boreholes or other protective wells are in use. Thus, there is great variation in the proximity of a water source to a housing compound throughout the valley. During the dry season distances of up to several kilometers must be travelled, often along winding footpaths, to get water in some of the sparser areas of the Luapula province.

Housing Compounds

Due to the suitability of the soil for brick making throughout much of the province, most houses and other structures are built from brick, nearly always with thatched roofs. A fully equipped rural housing compound may include the house, a cooking shed, a closed-end pit latrine, a small, cylindrical, elevated store room (ubatula) where food staples are kept, an elevated chicken coop, a garden plot (used during the rainy season), and is near a water source and at least a few mango and papaya trees. The exterior of wealthier homes include glass windows. Additionally, houses may be painted with special designs, painted plainly, or unpainted. Thus, variations of this "model" housing compound are numerous, including the use of holes in the brick walls for windows (vast majority of homes), no separate cooking shed, no latrine, no chickens, and so on.

VITAMIN A PREVENTION PROGRAM IN ZAMBIA PROTOCOL

Given the primary purpose for our visit to Zambia, discussions about the Zambian protocol to investigate vitamin A deficiency and xerophthalmia in the Luapula Valley began with Mr. Vamoer during our first day in-country. The protocol was first written about two years ago providing a general review of survey activities in the Luapula Valley during the past twenty-five years drawing very heavily from previous publications. Thus, its major strength was in providing a rather succinct background paper on nutrition in the area. While the document listed a few broad goals of a vitamin A deficiency prevention program it provided little in way of specific objectives, methods, resource and budget requirements normally required of a viable and

fundable protocol. Since then the project proposal has undergone two minor revisions in which a vague outline of a two year field study to investigate clinical, nutritional, biochemical, agricultural, and socio-economic factors which may be associated with vitamin A deficiency. Mr. David Mwandu, a nutritionist/biochemist at the TDRC and trained at Tulane University, has been the primary author of the project proposal.

During discussions throughout our stay in Zambia it became apparent that the initial goal of the project was to carefully determine the prevalence of xerophthalmia and other major causes of blindness in the valley, describe associated risk factors, and identify local resources which could be utilized in a xerophthalmia prevention program, should one be justified from gathered information. Senior representatives from all major collaborating institutions, except the MOH, attended a morning long work session at the TDRC, Ndola to review the proposal in detail (See Appendix B for list of attendees). During this meeting we suggested that a carefully planned and executed epidemiologic survey during the (assumed) highest risk season (i.e., August-November) as the most efficient first step toward a program to prevent nutritional blindness in the area. Such a survey could be conducted during a 3-4 month period with one field team.

Six specific objectives for the Luapula Valley Survey were identified at the work session:

(1) to determine the prevalence and severity of xerophthalmia among children under 6 years of age;

(2) to determine the prevalence and major causes of blindness across all age groups;

(3) to identify nutritional, infectious, and other biochemical factors associated with xerophthalmia among children under 6 years of age;

(4) to biochemically validate the historical assessment of night blindness;

(5) to identify resources at the community and household level which can be utilized in a program to prevent nutritional blindness; and

(6) to determine hygienic and other household characteristics associated with trachoma in children.

Given an assumed high prevalence of blindness among children and practical resource constraints, a sample size of between 5-6,000 children and 2,000-2,500 persons 6 years of age and older was agreed upon, similar in scope to the Malawi survey. The survey will involve a random selection of "wards" (political/administrative unit of up to 1,500 people), house-to-house enumeration, ophthalmic examination of all subjects, nutritional and dietary assessment of a random 10% sub-sample of children, xerophthalmic cases and their suitably matched controls. In addition, blood samples from all cases and controls will be analysed for serum vitamin A, RBP, and albumin.

The NFNC has an adequate administrative capacity and a staff of nutritionists who possess the necessary dietary and nutritional assessment skills; the TDRC in Ndola has the capability of providing in-depth epidemiologic, statistical, and biochemical expertise; and the

ZFDS can provide fast and efficient logistical support. One can only be impressed with the potential for collaboration among these institutions to carry out such a xerophthalmia/blindness survey, given a rigidly set out protocol and sufficient funding.

Plans for Future Collaboration

It was decided that during the next 3-4 weeks, Mr. Mwandu would modify the proposal to reflect the discussed changes in the study. Dr. Chelemu (Director, ZFDS) will bring a copy of the proposal with him to Baltimore when he visits the USA in late October. At that time ICEPO staff will meet with Dr. Chelemu, and Dr. Kwendakwema (Chief Medical Officer, ZFDS and current MPH/PHO student at Hopkins) to review the updated proposal, discuss any additional changes needed, and provide a set of written comments for further consideration in Zambia.

The Zambians are strongly committed to carrying out this survey, probably next year, as well as a blindness prevention project in the future, if indicated. Thus, time is of the essence. An approximate timetable was developed calling for completion of the protocol by the end of November, with distribution to potential funders during December. Dr. Njelesani, Director of the TDRC, is likely to visit the USA and Baltimore in early December, affording one more chance for ICEPO to review the final document. Work on forms development and sample selection should begin in January 1984, with an eye toward team selection and training to be done by June-July, and the actual survey begun during late July - early August 1984.

It is likely that ICEPO will continue providing technical support to the (funded) Zambian study in terms of forms review, training, and other activities as requested.

Addendum

Dr. Chelemu arrived in Baltimore on October 23rd, prior to this report being completed. During his 3 day visit to Hopkins the revised proposal was critiqued and an ICEPO "Memordandum" (Appendix C) drawn up providing detailed comments to assist in the MOH/NFNC/TDRC/ZFDS revision of the proposal during November in Zambia.

APPENDIX A

SUMMARY OF INPATIENT CASES OF MEASLES FOR 1978, PEM, INFLAMMATORY EYE DISEASES, AND MEASLES FOR THE YEARS 1980-1983

Table 1. Number of inpatients admitted with Measles, Mansa General Hospital, 1978 (prior to EPI program).

Disease	Period	Age (yrs) <1	Age (yrs) 1-14	Age (yrs) <15	% Total Cases	CFR
MEASLES	I	77(4)	104(18)	181(22)	52%	12.2
	II	29(4)	90(7)	119(11)	34%	9.2
	III	17(0)	31(2)	48(2)	14%	4.2
	TOTAL	123(8)	225(27)	348(35)	100%	10.0

1 Disease: Measles= (ICD 055)

2 Period: I = January - April
II = May - August
III = September - December

3 CFR: Case Fatality Rate as a percent ot cases for the stated period.

4 ( ): Number of deaths.

Table 2. Number of inpatients admitted with PEM, Inflammatory diseases of the eye and measles, Mansa General Hospital, 1980.

Disease	Period	Age (yrs) <1	Age (yrs) 1-14	Age (yrs) <15	% Total Cases	CFR
PEM	I	44(2)	67(12)	111(14)	41%	12.6
	II	29(3)	65(4)	94(7)	35%	7.4
	III	26(1)	39(1)	65(2)	24%	3.1
	TOTAL	99(6)	171(17)	270(23)	100%	8.5
EYE	I	9(0)	16(0)	25(0)	36%	0
	II	6(0)	20(0)	26(0)	37%	0
	III	5(0)	14(0)	19(0)	27%	0
	TOTAL	20(0)	50(0)	70(0)	100%	0
MEASLES	I	34(1)	41(0)	75(1)	28%	1.3
	II	14(0)	16(1)	30(1)	11%	3.3
	III	52(2)	114(3)	116(5)	61%	3.0
	TOTAL	100(3)	171(4)	271(7)	100%	2.6

1 Disease: PEM= Protein-energy malnutrition (ICD 267-268)
EYE= Inflammatory diseases of the eye (ICD 360-369)
MEASLES= (ICD 055)

2 Period: I = January - April
II = May - August
III = September - December

3 CFR: Case Fatality Rate as a percent of cases for the stated period.

4 ( ): Number of deaths.

Table 3. Number of inpatients admitted with PEM, Inflammatory diseases of the eye and measles, Mansa General Hospital, 1981.

Disease	Period	Age (yrs) <1	Age (yrs) 1-14	Age (yrs) <15	% Total Cases	CFR
PEM	I	40(8)	103(22)	143(30)	46%	21.0
	II	27(2)	38(4)	65(6)	21%	9.2
	III	21(3)	81(12)	102(15)	33%	14.7
	TOTAL	88(13)	222(38)	310(51)	100%	16.5
EYE	I	0(0)	13(0)	13(0)	29%	0
	II	13(0)	13(0)	26(0)	59%	0
	III	0(0)	5(0)	5(0)	12%	0
	TOTAL	13(0)	31(0)	44(0)	100%	0
MEASLES	I	175(11)	220(18)	395(29)	83%	7.3
	II	28(2)	29(1)	57(3)	12%	5.3
	III	1(0)	23(0)	24(0)	5%	0
	TOTAL	204(13)	272(19)	476(32)	100%	6.7

1 Disease: PEM= Protein-energy malnutrition (ICD 267-268)
EYE= Inflammatory diseases of the eye (ICD 360-369)
MEASLES= (ICD 055)

2 Period: I = January - April
II = May - August
III = September - December

3 CFR: Case Fatality Rate as a percent of cases for the stated period.

4 ( ): Number of deaths.

Table 4. Number of inpatients admitted with PEM, Inflammatory diseases of the eye and measles, Mansa General Hospital, 1982.

Disease	Period	Age (yrs) <1	Age (yrs) 1-14	Age (yrs) <15	% Total Cases	CFR
PEM	I	30(5)	117(18)	147(23)	45%	15.6
	II	32(10)	62(6)	94(16)	29%	17.0
	III	22(3)	61(14)	83(17)	26%	20.5
	TOTAL	84(18)	240(38)	324(56)	100%	17.3
EYE	I	2(0)	8(0)	10(0)	36%	0
	II	1(0)	4(0)	5(0)	18%	0
	III	4(0)	9(0)	13(0)	46%	0
	TOTAL	7(0)	21(0)	28(0)	100%	0
MEASLES	I	6(0)	5(0)	11(0)	4%	0
	II	68(5)	95(4)	163(9)	66%	5.5
	III	31(0)	44(5)	75(5)	30%	6.7
	TOTAL	105(5)	144(9)	249(14)	100%	5.6

1 Disease: PEM= Protein-energy malnutrition (ICD 267-268)
EYE= Inflammatory diseases of the eye (ICD 360-369)
MEASLES= (ICD 055)

2 Period: I = January - April
II = May - August
III = September - December

3 CFR: Case Fatality Rate as a percent of cases for the stated period.

4 ( ): Number of deaths.

Table 5. Number of inpatients admitted with PEM, Inflammatory diseases of tne eye and measles, Mansa General Hospital, 1983 (first 2 perioos only).

Disease	Period	Age (yrs) <1	Age (yrs) 1-14	Age (yrs) <15	% Total Cases	CFR
PEM	I	22(6)	96(22)	118(28)	-	23.7
	II	18(4)	55(13)	73(17)	-	23.3
	III	-	-	-	-	-
	TOTAL	40(10)	151(35)	191(45)	-	23.6
EYE	I	0(0)	12(0)	12(0)	-	0
	II	2(0)	6(0)	8(0)	-	0
	III	-	-	-	-	-
	TOTAL	2(0)	18(0)	20(0)	-	0
MEASLES	I	36(0)	56(5)	92(5)	-	5.4
	II	45(3)	107(5)	152(8)	-	5.3
	III	-	-	-	-	-
	TOTAL	81(3)	163(10)	244(13)	-	5.3

1 Disease: PEM= Protein-energy malnutrition (ICD 267-268)
EYE= Inflammatory diseases of the eye (ICD 360-369)
MEASLES= (ICD 055)

2 Period: I = January - April
II = May - August
III = September - December

3 CFR: Case Fatality Rate as a percent of cases for the stated period.

4 ( ): Number of deaths.

APPENDIX B

Attendees to the Luapula Valley Eye Disease Survey Work Session, Ndola, 21 September 1983

Name	Position
Mr. A. P. Vamoer	Executive Secretary NFNC Lumumba Road Box 32669 Lusaka
Dr. E. K. Njelesani	Director TDRC Box 71769 Ndola
Dr. V. R. Chelemu	Director ZFDS Ndola Airport Box 71856 Ndola
Dr. Boatin Boachie	Medical Epidemiologist TDRC Box 71769 Ndola
Dr. M. Bulsara	Chief Statistician TDRC Box 71769 Ndola
Mr. David Mwandu	Nutritionist/biochemist TDRC Box 71769 Ndola
Ms. Darina Mukupo	Nutritionist NFNC Box 32669 Lusaka
Dr. Hugh R. Taylor	ICEPO, Baltimore
Mr. Keith P. West, Jr.	ICEPO, Baltimore

APPENDIX C

Memorandum: Luapula Valley Eye Disease Survey

INTERNATIONAL CENTER FOR EPIDEMIOLOGIC AND PREVENTIVE OPHTHALMOLOGY

Wilmer Institute
600 North Wolfe Street
Baltimore, Maryland 21205 U.S.A.
Cable: EYESIGHT Telephone (301) 955-2770

October 28, 1983

M E M O R A N D U M

TO: NFNC ZFDS
MOH ICEPO File
TDRC

FROM: ICEPO

SUBJECT: Luapula Valley Eye Disease Survey Proposal

A meeting to discuss the above proposal was held in Baltimore on October 25, 1983. Attending were Drs. Chelemu, Sommer, Taylor, and Mr. West. The proposal has progressed far during the past month, especially in terms of defining the initial phase of the project as a prevalence survey, and stating the project's long term goals and immediate objectives. It is also clear that much work went into the document following the discussions at the TDRC in Ndola on September 21st. Upon careful review of the proposal, there are still several issues which we believe need further clarification and/or expansion. The following remarks summarize the points discussed and based on our experiences, are offered for further consideration in developing the proposal:

Recommend clarifying the two study phases. For example,

1. Overview, p. 14-16: The overall study design involves two phases. Phase I comprises a population-based, cross-sectional survey to investigate the prevalence and severity of xerophthalmia among children under 6 years of age, the major causes of blindness across all age groups, as well as the prevalence of risk factors associated with blindness during the high risk season of the year. This phase has several components including survey preparation, the actual field survey (July-November), data entry, analysis and reporting of results. Once funding is available, this phase will require approximately 15-18 months to complete. During Phase II, information generated from the survey will be used to design, implement and evaluate a blindness prevention strategy in the Luapula Valley, it indicated. The length of this second phase will be determined subsequent to Phase I.

The following broad parameters will be investigated: (Note: In each of these above sections in the protocol, only a brief description of the basic factors need be given while a more thorough description of the field activities could follow in a later section.)

Ophthalmic status: All eligible survey children and adults will be clinically examined for the presence and severity of xerophthalmia, trachoma, onchocerciasis, cataracts, and other eye disorders. In addition, adults will be measured for visual acuity and, if observed to have significant visual loss (i.e., less than 6/18), receive a delated examination of the lens and posterior pole to determine the cause of visual loss.

Nutritional status: Anthropometry (height/length and weight) will be performed on all cases of xerophthalmia, their age-sex-village or ward matched controls, and a random 10% sub-sample of all under 6 year old children. In addition, samples of blood will be drawn from all cases and controls to assess biochemical status (e.g., serum vitamin A, holo- and apo-RBP, albumin, pre-albumin, etc.).

Dietary habits: Dietary investigation will primarily concern the availability of vitamin A and beta-carotene containing foods in the valley, their seasonality, and differences in their consumption by families and children with and without xerophthalmia. The diets of cases, controls, and a limited (5%, 10%?) systematic sub-sample of children and their families will be investigated using a 3 day recall. (Note that the 3 day recall, be it quantified or frequency type, will give a good estimate of diet during the season of the survey, but will not give "seasonality". For this, questions will need to be developed to inquire about food intake during any or other times during the year).

Socio-economic factors:. . . . .

Additional Data: We would recommend adding under "Additional Data", investigation of the impact of the EPI on the prevalence of measles-related blindness among children.

2. At this point the basic goals of the survey and the factors being investigated have been described. The next question is "How is it going to be done?" While "Sample Size Considerations" looks good, some clarification of terms and procedures on p. 18 would be very helpful. This could include a brief description of the administrative/political units in a Zambian province. If the ward is going to be the primary sampling unit it would be best to use that term throughout the text and delete the words "village" and "block" as these may confuse a reader. For example, are there 71 wards, blocks, or villages required to achieve the desired sample size of 5-6,000 children? While a random sample using a table is very appropriate for selecting the sampled wards from the entire list of wards in the valley, systematic sampling after a random start may allow greater balance of the sample across different areas. Once a ward is included in the sample we recommend surveying all households with young children in that ward (or all households if an

adult sub-sample ward). We also recommend that the "base of operations" concept be applied only to the logistics of the survey (for supplies, forms, storage, etc.) rather than relating the sample size of an area to the base of operations. The sample will draw wards from all over the valley as stated in the protocol; however, the statement at the bottom of p. 18 regarding 2,000 children at each proposed base of operation could be misleading, even though the sample will likely come very close to that if the population is evenly dispersed throughout those 3 areas.

3. Following the Sampling Section we suggest at this point putting in a section on "Field Methods" (or Procedures, Activities) where the basic steps for the field work are described and linked to the objectives of the survey. For example,

> To achieve as complete a response as possible each sampled ward will be visited prior to the survey to collect village level information, explain the purposes of survey to local leaders and gain their cooperation, and assess the general layout of the community. On the survey day a house-to-house enumeration will be conducted by a specially trained interviewer to enroll all eligible under 6 year old children into the survey. During the household interview demographic, socio-economic, hygienic, and other household characteristics, as well as individual child histories, will be investigated. All under six year old children and a responsible adult from each household will be directed to a central site for an ophthamologic examination and nutritional assessment, if indicated. In adult sub-sample villages, all household members will be directed to the central site for an eye examination.
>
> At the central site, each eligible child will be registered, and examined by an opthalmologist for any pathology of the anterior segment of the eye. In addition to receiving the examination of the anterior segment, lens, and fundus if significant visual loss is observed, each subject over 6 years of age will be tested for visual acuity by a trained ophthalmic medical assistant. Treatment and/or referral of eye conditions will be performed as indicated. In addition, all surveyed under 6 year old children will receive a prophylactic 200,000 IU dose of vitamin A (with 40 IU of vitamin E).
>
> (Note: Given the definitive nature of this survey, the decision to have a suitably standardized ophthalmologist on the team is one which we fully support. We further recommend that the ophthalmologist be solely responsible for the eye findings and examine every survey subject, young children as well as adults in the sub-sample villages. By having one examiner standardization is considerably easier, and the confusion of inter-observer error is eliminated should there be different prevalences by geographic locale, thus making the results more interpretable. The idea of having each of the 3 (ophthalmic) medical assistants participate in the clinical and operational aspects of survey (assumed as the team enters their respective areas) is quite good. Their responsibilities could involve assisting the ophthalmologist in examining the patients providing opportunities for them to upgrade

their skills further), treating and referring patients, and acting as overall coordinator at the examination site.)

Children with any stage of xerophthalmia (XN, X1, X2, X3) or with a corneal scar, their age-sex-ward/village matched controls, and a __% systematic sub-sample of all surveyed children will receive a dietary interview by a specially trained fieldworker to describe child and household eating patterns, particularly with regards to the availability, consumption, and preparation of foods high in preformed vitamin A and beta-carotene. Height or length and weight will also be measured in a standardized manner on each of these children. In order to compare the biochemical nutritional status (i.e., serum vitamin A, holo- and apo-RBP albumin, pre-albumin, etc.) of both children with and without xerophthalmia, __cc of blood will be drawn by a trained laboratory technician using (method) from each case and control child. Samples will be appropriately stored, and transported to the TDRC in Ndola for analysis. The biochemical determinations will, in addition, permit validation of the historical assessment of nightblindness and some estimation of the vitamin A status of the non-xerophthamic child population in the Luapula Valley.

Forms will be checked for completeness prior to leaving a sample site each day, collated in field base of operations, and shipped to the data entry center at the TDRC in Ndola.

4. With the field work now defined, the support activities can be addressed under sections such as "Biochemical Analysis" (since much more than vitamin A analysis is being planned) which is nicely laid out in Table 1, and "Data Management and Analysis". In the latter section some description of the data entry procedures (i.e., double entry, etc.), the time required for data entry (our quick estimate at the Ndola meeting of 80 hours or so is a vast underestimation as it may well take 400-500 hours of data entry time), and the equipment needed for data management. Given the numerous other responsibilities at the TDRC statistical center, putting in for a microcomputer for data entry may be a very justified item.

25

5. In our experience, funders/reviewers appreciate knowing the types of personnel involved both in the field and in the support facilities so they can link tasks to people or positions as they read the proposal. Along this line, we suggest a more exact listing of required positions (p. 22) for the Phase I survey to be conducted. Two separate sections could be considered:

Professional and field support staff

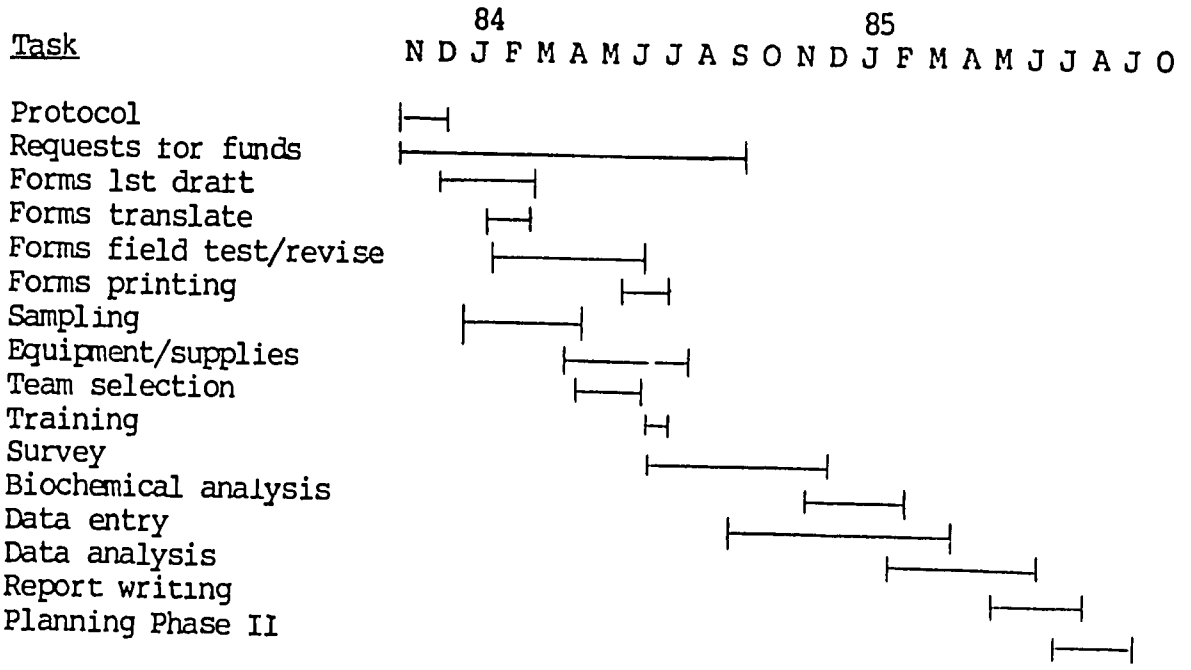
Position	Percent time		
	First 6 Months	Second 6 Months	Third 6 Months
Principle investigator			
Administrator			
Epidemiologist			
Biostatistician			
Biochemist			
Data entry clerk			
Secretary			
etc.			

Following this with a description of functions as is in the proposal seems most appropriate.

Field team (example)

Position	Number required
Ophthalmologist (team leader)	1
Ophthalmic medical assistant	1
Registrar	1
Dietary interviewer/anthropometrist	1
Lab technician	1
Household enumerator	4
Driver/team assistant	1

6. It is, of course, always important to keep on an established schedule as much as possible. This is particularly difficult when a number of organizations are collaborating in a project and need to progress in a coordinated manner. An approximate but carefully planned timetable is the best way to help keep everyone "on track". An example follows:



7. Given the essential description of the study in the body of the protocol, the equipment needed should reflect what is required to carry out the procedures. For example, 1 4-wheel drive, long-base vehicle; 2 weighing scales (1 back-up), 1 locally constructed height/length board, 1 ophthalmoscope, 1 hand-held slit lamp, biochemistry materials (should probably plan for 500-700 specimens if xerophthalmia prevalence is 4% x 5,000 children x 2 [for controls]), microcomputer, etc.

8. Budget: The budget needs to be realistic and complete, and include costs directly attributable to the survey. It may be broken down into amounts required from outside sources and government contributions. For example,

	1st year		2nd year	
	Required	Gov't	Required	Gov't
A. Personnel/positions (listed)				
B. Consultant costs				
C. Equipment				
D. Forms (paper, printing)				
E. Supplies (stationery, medical, etc.)				
F. Operations (vehicle maintenance, petrol, ZFDS aircraft costs, telephone, etc.)				
G. Data Management (i.e., computer time)				
H. Miscellaneous				
I. Contingency (__%)				

(Just a reminder to include salaries for workers during training also!)

After working out the budget, the question of its reasonableness always must be addressed, both in terms of being too high or too low. The Malawi survey is costing approximately $100,000 without any biochemical analysis. The Luapula survey may easily be this amount or higher when counterpart contributions are considered into the budget.

9. We appreciate having the opportunity to work with you on this proposal and look forward to any continued collaboration as this most exciting project is developed.

ICEPO