Centers for Disease Control and Prevention
Case Studies in Applied Epidemiology
No. 921-211

Rapid Assessment of Health Status and Preventive Medicine Needs of Kampuchean Refugees in Thailand

Student's Guide

Learning Objectives
After completing this case study, the participant should be able to:

- ☐ List health problems common among refugee populations;
- ☐ Identify sources of health information on persons living in refugee camps;
- ☐ Calculate crude and age-specific mortality and morbidity rates;
- ☐ Discuss the strengths and weaknesses of different survey methods for assessing the health needs of a displaced population; and
- ☐ Use anthropometric data to determine nutritional status of the population.

HSPH Homework: Hand in answers to Questions 6, 8, 13, and 16.

This case study is based on the experience of the CDC epidemiologists who formed the ICRC Epidemiolgy Unit at the Sakaeo refugee camp in Thailand. This case study was written by Jeanette Stehr-Green in 1992. Current version updated and edited by Richard Dicker.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

CENTERS FOR DISEASE CONTROL AND PREVENTION

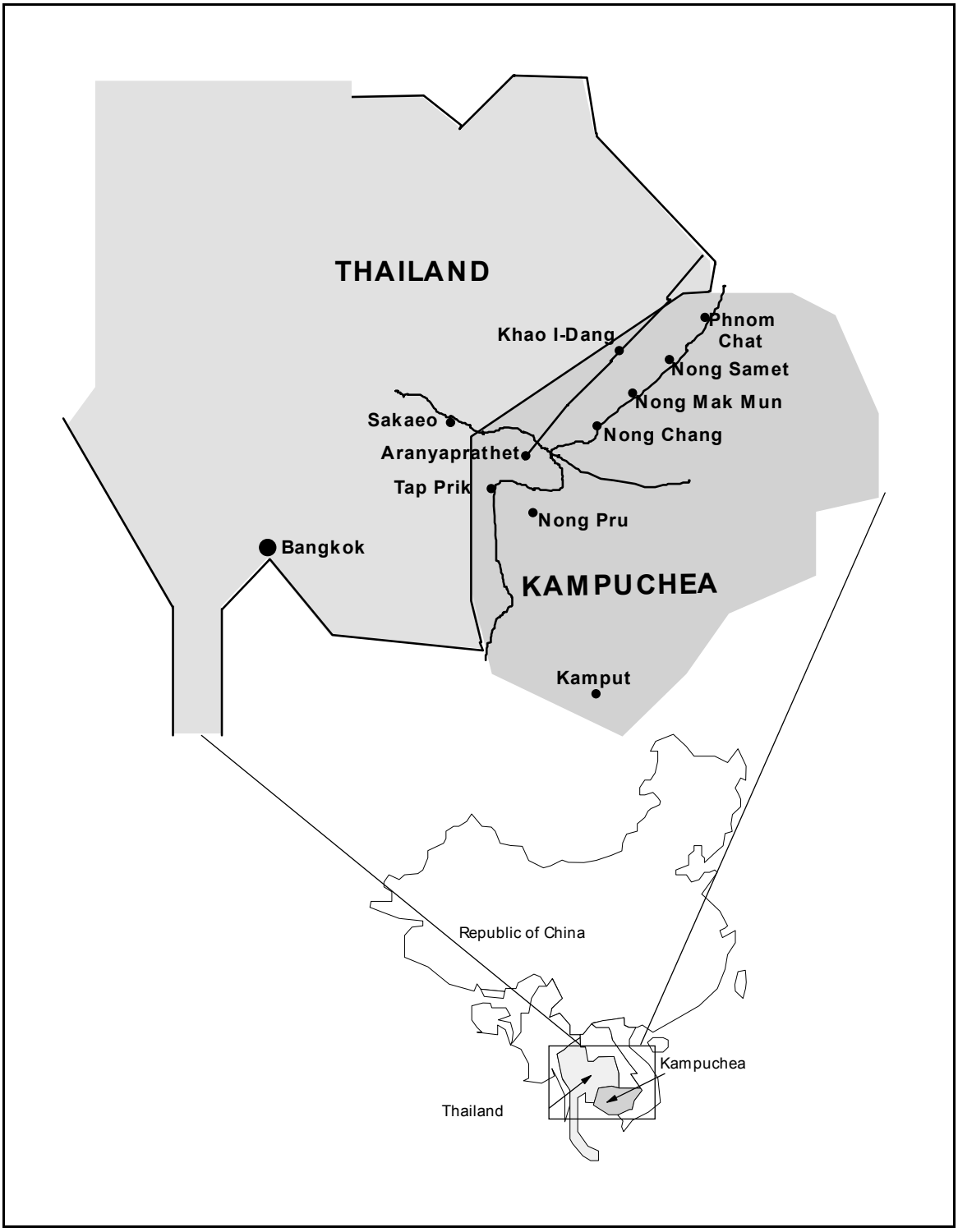


Figure 1. Map of Thai-Kampuchean border showing area of major refugee concentration, 1979-1980

PART I

Kampuchea (Cambodia) was proclaimed an independent nation in 1953 after nearly 100 years of French colonization. Although initially at peace, the country became increasingly involved in the war in Southeast Asia and was the scene of extensive military conflict in the early 1970's. In 1975, Khmer Rouge forces supported by the Vietnamese captured the capital, Phnom Penh. During the ensuing three years, the Khmer Rouge Government became notorious for its brutality which led to social and political disruption, hundreds of thousands of homeless people, and the loss of many civilian lives.

The Khmer Rouge and the Vietnamese eventually became hostile to each other. In December 1978 Vietnamese troops invaded Kampuchea and drove the Khmer Rouge west from the capital. During the spring of 1979, large numbers of Kampuchean refugees crossed into Thailand. In October 1979, the Government of Thailand officially agreed to give refuge to the Kampuchean population displaced by the war.

Between 24-October and 27-October, an estimated 31,900 Kampuchean refugees crossed into Thailand and were taken to a site at Sakaeo. At the request of the Royal Thai Government, the International Committee of the Red Cross (ICRC) took charge of health care activities and construction of the camp. Many governments and humanitarian organizations responded with support. However, the overwhelming number of refugees, their poor health, and lack of coordination led to chaos during the first few days of the relief effort.

Within a week of arrival of the first refugees at Sakaeo, the ICRC invited epidemiologists from the U.S. Centers for Disease Control to join relief effort activities. These epidemiologists served as the nucleus of the ICRC Epidemiology Unit whose goal was to identify the principal causes of death and severe illness among the refugees at Sakaeo so that public health interventions could be directed most effectively and efficiently.

Question 1: What are the usual diseases/health conditions of concern among refugee populations?

The area where Sakaeo was located was a flat plain characterized primarily by empty rice fields, scrub vegetation, and a small grove of trees. Initially, the camp was no more than 33 acres of fenced-off bushland with no housing facilities, no water, and no sewage system; approximately 2.7 square meters of space were available for each person.

Question 2: In general, what services and physical aspects of a refugee camp are of immediate concern to those organizing a relief effort?

On arrival at the camp, the Kampuchean refugees were given food, cooking utensils, and shelter. The shelter consisted of tents scattered in 15 sectors around the camp (Figure 2). Water was carried by truck to the camp and stored in aluminum drums. A trench latrine was dug around the periphery of the camp and people were taught how to use it.

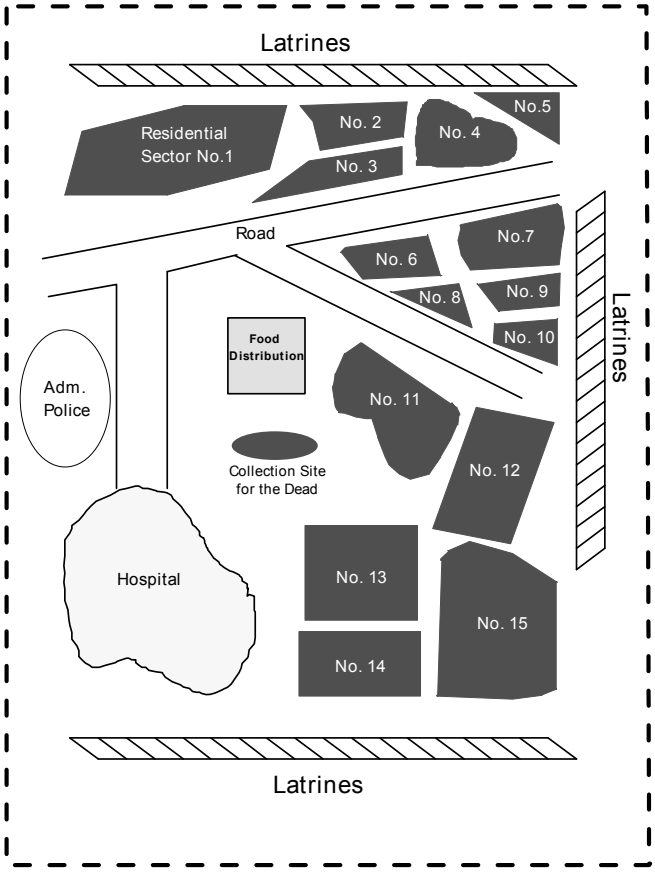
Initially, the camp hospital consisted of tents and shelters primitively constructed of bamboo and canvas on a cleared field. When the first refugees arrived, the hospital was staffed by three doctors and eight other health care workers. Nearly 2,000 severely ill or dying refugees were brought to the hospital in the first few days.

Within a week, a 1,050-bed field hospital was set up in large tents. Separate wards were designated for pediatrics, obstetrics, intensive feeding, contagious diseases, and surgery. Each ward was staffed by doctors and nurses from one of nearly a dozen private volunteer organizations. At the beginning of the second week of camp operation, an admission ward and three outpatient clinics were established.

A single technician set up a make-shift laboratory in a tent at the hospital for both inpatient and outpatient services. The laboratory was equipped with a microscope, slides, and simple stains and reagents suitable for blood typing, malaria smears, gram stains, and acid fast stains.

People who had died in the camp were brought to a central location by family members. The dead bodies were placed in bags for daily collection by a contractor for burial outside the camp

Figure 2. Map of Sakaeo Camp.



Question 3a: How might you go about assessing health problems among the Kampuchean refugees? (What people would you consider consulting? What type of data would you collect? What sources would you use to collect specific data?)

Question 3b: What challenges might you expect to face in setting up a surveillance system?

Initially, mortality and morbidity data on Kampuchean refugees were collected from two sources. Mortality data (including date of death) were available from the burial contractors and Thai health authorities (Table 1). Information on morbidity (admitting diagnosis) was obtained from a retrospective review of admissions from the first week at Sakaeo Hospital. Malaria, malnutrition, and respiratory infections were the three most common causes for admission.

Table 1. Total deaths and deaths occurring in hospital by date, Sakaeo, 28-October to 6-November

Date	# Deaths	# (%) Deaths in hospital
28-Oct	35	9 (26%)
29-Oct	36	17 (47%)
30-Oct	37	14 (38%)
31-Oct	23	17 (74%)
1-Nov	43	21 (49%)
2-Nov	24	12 (50%)
3-Nov	26	16 (62%)
4-Nov	34	14 (41%)
5-Nov	23	10 (43%)
6-Nov	21	5 (24%)

Question 4: Graph the data in Table 1.

Question 5: Interpret the data in Table 1. What are possible causes of variation in numbers of deaths from day to day?

The crude mortality rate in Kampuchea was estimated to be 15.6 deaths / 1,000 population / year in 1972. In the refugee setting, the threshold for designating the situation as an **emergency** is a crude mortality rate greater than 1 death per 1,000 population per day.

Question 6: Using Table 1, determine the crude mortality rate at Sakaeo for the period 28-October – 6-November. (Use an estimated population of 31,900. Express results in terms of deaths/10,000 population/day.) How does the crude mortality rate for Kampuchean refugees compare with that for the Kampuchean population prior to the unrest? Is it appropriate to compare these crude rates?

Retrospective review of admissions to Sakaeo Hospital by the ICRC Epidemiology Unit during the first week of camp operation provided only limited information. The Unit decided to set up a prospective register of admissions and deaths occurring at the hospital to provide more timely and complete information on morbidity and mortality.

Question 7: What information would you collect through the register?

Question 8: How would you collect the information? (Who should collect it? How frequently should it be collected? How frequently should it be reviewed?)

Question 9: Is it necessary to use standard case definitions in these surveillance activities?

On 7-November, staff from the admitting ward at Sakaeo Hospital began systematically collecting information on morbidity and mortality among hospital patients. Each admitting team was responsible for recording information on the patient's age, sex, and diagnosis in a logbook maintained in the admission ward. The physicians were responsible for recording the date the patient was discharged from the hospital, whether the patient died during the hospitalization, and the cause of death.

An epidemiologist from the ICRC Epidemiology Unit examined the logbook on a daily basis and summarized the information for a daily meeting of the medical staff. This meeting was chaired by the ICRC medical coordinator and included representatives of the Epidemiology Unit, hospital wards, outpatient clinics, nutrition and sanitation services. Health policies for the camp were developed at these meetings based on reports of the various participants.

Tables 2 and 3 provide information collected from the morbidity and mortality register at Sakaeo Hospital from 8-November to 14-November.

Table 2. Primary cause of admission and death among hospitalized patients as reported by admitting and attending physicians, Sakaeo, 8–14 November

Diagnosis	Admissions	Deaths*
Fever/malaria	112	19
Pneumonia	63	10
Diarrhea	20	7
Malnutrition	24	13
Prematurity	0	4
Anemia	28	0
Meningitis	20	2
Other	23	7
Total	290	62

*Deaths and admissions in this table are not directly related.

Table 3. Admissions and deaths among hospitalized patients by age group, Sakaeo, 8–14 November

Age Group (years)	Admissions	Deaths*
<1	82	9
1-4	64	8
5-14	135	11
15-44	248	29
45+	45	5
TOTAL	574	62

*Deaths and admissions in this table are not directly related.

Question 10: Interpret the data in Tables 2 and 3. From these initial findings, what activities would you consider? (Include additional information you would like to collect.)

Intermittently, the ICRC epidemiologists provided feedback to the people who collected the data to help them understand the usefulness of surveillance in this setting and to improve the accuracy and completeness of data collection.

The ICRC received offers of free vitamin A, drugs, contraceptives, childhood vaccines, oral rehydration salts (ORS), mobile hospitals, over 500 physicians, a team of psychiatrists and rehabilitation specialists, and a crack military trauma unit, all of which were waiting to be dispatched to the camp. In order to better evaluate the need for specific health interventions and understand the composition of the refugee population, the ICRC Epidemiology Unit decided to undertake a community survey.

Question 11: What might be the objectives of the survey?

Part II

On the 6th and 7th of November, the Epidemiology Unit carried out a community survey to collect information on the age and sex distribution of the population, nutritional status of the population, and the prevalence of medical problems in non-hospitalized patients. No detailed map or register of the camp existed at the time of the survey.

Eleven of 15 residential sectors were selected at random. A landmark was identified on the edge of each of these blocks and occupants in the cluster of 6–8 tents adjacent to this landmark were included in the survey. Age and sex of all persons who had slept under each tent the previous night were recorded. Children under 110 cm. were weighed, measured, and examined by a physician who looked for signs of vitamin deficiency and other medical problems. People needing medical treatment were treated or referred to the hospital. Every fourth person was tested for malaria with thick and thin blood smears.

Question 12: What are the major strengths and weaknesses of the sampling method used in the survey? What alternative method might you suggest?

The following data on the Kampuchean refugees were collected through the community survey.

Table 4. Age and sex distribution of Kampuchean refugees at Sakaeo, 6-7 November

Age (years)	# Males	# Females	Total
<1	9	3	12
1	1	1	2
2	1	1	2
3	3	1	4
4	5	2	7
5-9	12	19	31
10-14	24	24	48
15-24	54	68 (3*)	122
25-34	19	24 (2*)	43
35-44	12	14	26
45-54	6	6	12
55+	5	5	10
TOTAL	151	168	319

( ) = pregnant

Note: The estimated population in any group is roughly 100 times the number in the sample.

Question 13: What can you say about the age structure of the refugee camp? How might you explain this age distribution? What impact might this age structure have on intervention activities?

Question 14: Estimate the total population in each age group from Table 4. Complete Table 5 by calculating the admission rate and mortality rate among Kampuchean refugees at Sakaeo from November 8-14 by age group. Express rates in terms of "per 10,000 population/day".

Table 5. Rate (per 10,000 population per day) of admission and death among Kampuchean refugees by age group, Sakaeo, 8-14 November

AGE GROUP	POPULATION	ADMISSIONS	RATE OF ADMISSION*	DEATHS	MORTALITY RATE*
<1	1,200	82	_____	9	_____
1-4	1,500	64	_____	8	_____
5-14	7,900	135	_____	11	_____
15-44	19,100	248	_____	29	_____
45+	2,200	45	_____	5	_____
TOTAL	31,900	574	_____	62	_____

During the community survey, children under 110 cm. in height were examined as part of a nutritional assessment. [The height of 110 cm. is a crude means of identifying children <5 years of age. In developing countries, 110 cm. often covers children more than 7 years of age. As a result, many investigators are now using 100 cm. to ensure a higher proportion of younger children in the sample.]

Question 15: What measurements of nutritional status could be used in the refugee camp? What are the advantages/disadvantages of these methods?

Part III

The ICRC Epidemiology Unit decided to use percent of median weight-for-height as the measure of nutritional status. Percent of median weight-for-height is calculated by dividing the weight of each child by the median weight of children of that height in the reference population (as determined by NCHS-CDC/WHO) and multiplying by 100. Children less than 80% of the median weight-for-height are considered malnourished.

percent of median weight-for-height = (weight of child / median weight-for-height) x 100

Z-scores are another means to determine the proportion of children who are considered to be malnourished based on weight and height measurements. Z-scores are based on standard deviations of the mean weight of children of a certain height in a reference population (as determined by NCHS-CDC / WHO). The z-score is calculated by subtracting the mean weight of children of a certain height in the reference population (expected weight) from the weight of the child being examined (observed weight) and dividing by the square root of the variance (standard deviation) of the reference population.

$$\text{Z-score} = \frac{\text{observed} - \text{expected}}{\text{standard deviation}}$$

Children with z-scores less than -2 (i.e., more than two standard deviations below the mean weight-for-height of the reference population) are considered to be malnourished. Both percents of median weight-for-height and z-scores of mean weight-for-height can be obtained from NCHS Charts of Reference Values.

Question 16: Using the attached tables of reference values and the above equations, determine the percent of median weight-for-height and z-score for the first four children examined in the survey.

Answer 16

Instructors Note: Do the first calculation for the class and then let them do the remaining three.

Child 1 weight for height: for 72 cm height, median weight = 9.0, so % of median weight-for-height = 8.0 (observed) / 9.0 (expected) = 89%

Child 1 z-score: (8.0 – 9.0) / 0.8 = -1 / 0.8 = -1.3

Table 6. Line listing of children's anthropometric measures, Sakaeo, November

Number	Height/Length (cm)	Weight (kg)	% of Median Weight-for-Height	Z-score
1	72.0	8.0	_____	_____
2	74.0	6.2	_____	_____
3	105.0	14.0	_____	_____
4	99.0	12.2	_____	_____

Line listing continued on next page

Table 6 - continued. Line listing of children's anthropometric measures, Sakaeo, November

Number	Height/Length (cm)	Weight (kg)	% of Median Weight-for-Height	Z-score
5	51.0	3.3	94%	-0.5
6	65.5	6.1	85%	-1.5
7	57.5	4.5	92%	-0.7
8	55.5	4.4	100%	0.0
9	94.0	12.9	92%	-0.9
10	102.0	12.1	75%	-2.8
11	101.0	13.2	84%	-1.9
12	81.5	10.3	93%	-0.9
13	102.5	16.2	100%	0.0
14	100.5	14.2	90%	-1.1
15	107.5	16.7	94%	-0.6
16	98.5	14.0	92%	-0.9
17	93.5	12.0	86%	-1.6
18	60.5	5.8	102%	+0.2
19	64.0	5.6	84%	-1.6
20	79.5	9.3	87%	-1.6
21	85.5	10.0	83%	-1.9
22	91.0	10.7	80%	-2.2
23	94.0	12.8	91%	-1.0
24	100.0	13.1	84%	-1.8
25	93.5	9.7	70%	-3.5
26	107.0	15.4	88%	-1.4
27	58.0	4.5	88%	-1.0
28	106.0	13.8	80%	-2.3
29	94.0	11.7	84%	-1.9
30	70.0	7.5	88%	-1.3
31	54.5	4.1	98%	-0.2
32	59.0	5.1	96%	-0.3
33	61.5	5.0	83%	-1.5
34	69.5	7.1	86%	-1.6
35	99.5	12.8	83%	-1.9
36	108.5	19.0	106%	+0.6
37	97.5	13.1	88%	-1.4
38	93.5	9.7	70%	-3.5
39	91.5	12.1	90%	-1.1
40	88.0	12.5	99%	-0.1
41	69.5	6.7	81%	-2.1

Through international agreement, the following interpretation has been developed for the prevalence of malnourished children in a community.

Table 7. Guidelines for interpreting prevalence of malnutrition in a community

Prevalence of Malnutrition*	Interpretation
<5%	acceptable
5-9%	poor
10-14%	serious
≥ 15%	critical

* as determined by z-scores <-2.0 or % of median weight-for-height <80

If the prevalence of malnutrition is much lower than would be expected from the severity of the emergency, the possibility must be considered that many children have already died (and the more well nourished ones survived).

Question 17: What proportion of children in this survey would be considered malnourished using percent of median weight-for-height? What proportion of children would be considered malnourished using z-scores?

WEIGHT-FOR-HEIGHT REFERENCE VALUES
NCHS/CDC (WHO) Reference Growth Tables*

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Height (centimeters)	Weight in Kilograms				
	Median / Mean Wt	Std Dev	Mean −2 SD	Mean − 3 SD	Mean − 4 SD
50.0	3.4	0.400	2.6	2.2	1.8
50.5	3.4	0.400	2.6	2.2	1.8
51.0	3.5	0.400	2.7	2.3	1.9
51.5	3.6	0.430	2.7	2.3	1.9
52.0	3.7	0.450	2.8	2.4	1.9
52.5	3.8	0.460	2.9	2.4	2.0
53.0	3.9	0.480	2.9	2.5	2.0
53.5	4.0	0.485	3.0	2.5	2.1
54.0	4.1	0.500	3.1	2.6	2.1
54.5	4.2	0.500	3.2	2.7	2.2
55.0	4.3	0.515	3.3	2.8	2.2
55.5	4.4	0.520	3.4	2.8	2.3
56.0	4.6	0.550	3.5	2.9	2.4
56.5	4.7	0.555	3.6	3.0	2.5
57.0	4.8	0.565	3.7	3.1	2.5
57.5	4.9	0.570	3.8	3.2	2.6
58.0	5.1	0.600	3.9	3.3	2.7
58.5	5.2	0.600	4.0	3.4	2.8
59.0	5.3	0.600	4.1	3.5	2.9
59.5	5.5	0.630	4.2	3.6	3.0
60.0	5.6	0.630	4.3	3.7	3.1
60.5	5.7	0.625	4.5	3.8	3.2
61.0	5.9	0.660	4.6	3.9	3.3
61.5	6.0	0.650	4.7	4.1	3.4
62.0	6.2	0.680	4.8	4.2	3.5
62.5	6.3	0.675	5.0	4.3	3.6
63.0	6.5	0.700	5.1	4.4	3.7
63.5	6.6	0.685	5.2	4.5	3.9
64.0	6.7	0.675	5.4	4.7	4.0
64.5	6.9	0.700	5.5	4.8	4.1
65.0	7.0	0.700	5.6	4.9	4.2
65.5	7.2	0.725	5.8	5.0	4.3
66.0	7.3	0.715	5.9	5.2	4.4
66.5	7.5	0.730	6.0	5.3	4.6
67.0	7.6	0.730	6.1	5.4	4.7
67.5	7.8	0.760	6.3	5.5	4.8
68.0	7.9	0.750	6.4	5.7	4.9
68.5	8.0	0.750	6.5	5.8	5.0
69.0	8.2	0.770	6.7	5.9	5.1
69.5	8.3	0.760	6.8	6.0	5.3
70.0	8.5	0.785	6.9	6.1	5.4
70.5	8.6	0.780	7.0	6.3	5.5

* Under 85 cm Assumed Recumbent; 85+ cm Assumed Standing

WEIGHT-FOR-HEIGHT REFERENCE VALUES
NCHS/CDC (WHO) Reference Growth Tables

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Height (centimeters)	Weight in Kilograms				
	Median / Mean Wt	Std Dev	Mean − 2 SD	Mean − 3 SD	Mean − 4 SD
71.0	8.7	0.770	7.2	6.4	5.6
71.5	8.9	0.800	7.3	6.5	5.7
72.0	9.0	0.800	7.4	6.6	5.8
72.5	9.1	0.800	7.5	6.7	5.9
73.0	9.2	0.800	7.6	6.8	6.0
73.5	9.4	0.830	7.7	6.9	6.1
74.0	9.5	0.830	7.8	7.0	6.2
74.5	9.6	0.830	7.9	7.1	6.3
75.0	9.7	0.825	8.1	7.2	6.4
75.5	9.8	0.825	8.2	7.3	6.5
76.0	9.9	0.825	8.3	7.4	6.6
76.5	10.0	0.825	8.4	7.5	6.7
77.0	10.1	0.825	8.5	7.6	6.8
77.5	10.2	0.825	8.5	7.7	6.9
78.0	10.4	0.880	8.6	7.8	6.9
78.5	10.5	0.880	8.7	7.9	7.0
79.0	10.6	0.880	8.8	8.0	7.1
79.5	10.7	0.880	8.9	8.1	7.2
80.0	10.8	0.885	9.0	8.1	7.3
80.5	10.9	0.885	9.1	8.2	7.4
81.0	11.0	0.900	9.2	8.3	7.4
81.5	11.1	0.900	9.3	8.4	7.5
82.0	11.2	0.900	9.4	8.5	7.6
82.5	11.3	0.900	9.5	8.6	7.7
83.0	11.4	0.900	9.6	8.7	7.8
83.5	11.5	0.925	9.6	8.7	7.8
84.0	11.5	0.900	9.7	8.8	7.9
84.5	11.6	0.900	9.8	8.9	8.0
85.0	12.0	1.080	9.8	8.8	7.7
85.5	12.1	1.100	9.9	8.8	7.7
86.0	12.2	1.100	10.0	8.9	7.8
86.5	12.3	1.100	10.1	9.0	7.9
87.0	12.4	1.100	10.2	9.1	8.0
87.5	12.5	1.100	10.3	9.2	8.1
88.0	12.6	1.100	10.4	9.3	8.2
88.5	12.8	1.150	10.5	9.4	8.2
89.0	12.9	1.150	10.6	9.5	8.3
89.5	13.0	1.150	10.7	9.6	8.4
90.0	13.1	1.160	10.8	9.6	8.5
90.5	13.2	1.160	10.9	9.7	8.6
91.0	13.3	1.175	11.0	9.8	8.6
91.5	13.4	1.170	11.1	9.9	8.7
92.0	13.6	1.200	11.2	10.0	8.8
92.5	13.7	1.200	11.3	10.1	8.9

WEIGHT-FOR-HEIGHT REFERENCE VALUES
NCHS/CDC (WHO) Reference Growth Tables

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Height (centimeters)	Weight in Kilograms				
	Median / Mean Wt	Std Dev	Mean − 2 SD	Mean − 3 SD	Mean − 4 SD
93.0	13.8	1.200	11.4	10.2	9.0
93.5	13.9	1.215	11.5	10.3	9.0
94.0	14.0	1.215	11.6	10.4	9.1
94.5	14.2	1.260	11.7	10.4	9.2
95.0	14.3	1.260	11.8	10.5	9.3
95.5	14.4	1.260	11.9	10.6	9.4
96.0	14.5	1.275	12.0	10.7	9.4
96.5	14.7	1.300	12.1	10.8	9.5
97.0	14.8	1.300	12.2	10.9	9.6
97.5	14.9	1.300	12.3	11.0	9.7
98.0	15.0	1.300	12.4	11.1	9.8
98.5	15.2	1.350	12.5	11.2	9.8
99.0	15.3	1.350	12.6	11.3	9.9
99.5	15.4	1.350	12.7	11.4	10.0
100.0	15.6	1.380	12.8	11.5	10.1
100.5	15.7	1.380	12.9	11.6	10.2
101.0	15.8	1.380	13.0	11.7	10.3
101.5	16.0	1.400	13.2	11.8	10.4
102.0	16.1	1.415	13.3	11.9	10.4
102.5	16.2	1.415	13.4	12.0	10.5
103.0	16.4	1.440	13.5	12.1	10.6
103.5	16.5	1.450	13.6	12.2	10.7
104.0	16.7	1.480	13.7	12.3	10.8
104.5	16.8	1.480	13.8	12.4	10.9
105.0	16.9	1.475	14.0	12.5	11.0
105.5	17.1	1.500	14.1	12.6	11.1
106.0	17.2	1.500	14.2	12.7	11.2
106.5	17.4	1.530	14.3	12.8	11.3
107.0	17.5	1.525	14.5	12.9	11.4
107.5	17.7	1.560	14.6	13.0	11.5
108.0	17.8	1.550	14.7	13.2	11.6
108.5	18.0	1.580	14.8	13.3	11.7
109.0	18.1	1.575	15.0	13.4	11.8
109.5	18.3	1.600	15.1	13.5	11.9
110.0	18.4	1.600	15.2	13.6	12.0
110.5	18.6	1.600	15.4	13.8	12.2
111.0	18.8	1.630	15.5	13.9	12.3
111.5	18.9	1.625	15.7	14.0	12.4
112.0	19.1	1.650	15.8	14.2	12.5
112.5	19.3	1.680	15.9	14.3	12.6
113.0	19.4	1.660	16.1	14.4	12.8
113.5	19.6	1.680	16.2	14.6	12.9
114.0	19.8	1.700	16.4	14.7	13.0
114.5	19.9	1.700	16.5	14.8	13.1

WEIGHT-FOR-HEIGHT REFERENCE VALUES
NCHS/CDC (WHO) Reference Growth Tables

Height (centimeters)	Weight in Kilograms: Median / Mean Wt	Std Dev	Mean − 2 SD	Mean − 3 SD	Mean − 4 SD
115.0	20.1	1.700	16.7	15.0	13.3
115.5	20.3	1.730	16.8	15.1	13.4
116.0	20.5	1.750	17.0	15.3	13.5
116.5	20.7	1.760	17.2	15.4	13.7
117.0	20.8	1.760	17.3	15.5	13.8
117.5	21.0	1.775	17.5	15.7	13.9
118.0	21.2	1.785	17.6	15.8	14.1
118.5	21.4	1.800	17.8	16.0	14.2
119.0	21.6	1.815	18.0	16.2	14.3
119.5	21.8	1.830	18.1	16.3	14.5
120.0	22.0	1.850	18.3	16.5	14.6
120.5	22.2	1.860	18.5	16.6	14.8
121.0	22.4	1.875	18.7	16.8	14.9
121.5	22.6	1.900	18.8	16.9	15.0
122.0	22.8	1.900	19.0	17.1	15.2
122.5	23.1	1.950	19.2	17.3	15.3
123.0	23.3	1.960	19.4	17.4	15.5
123.5	23.5	1.975	19.6	17.6	15.6
124.0	23.7	2.000	19.7	17.7	15.7
124.5	24.0	2.030	19.9	17.9	15.9
125.0	24.2	2.050	20.1	18.1	16.0
125.5	24.4	2.060	20.3	18.2	16.2
126.0	24.7	2.100	20.5	18.4	16.3
126.5	24.9	2.115	20.7	18.6	16.4
127.0	25.2	2.155	20.9	18.7	16.6
127.5	25.4	2.175	21.1	18.9	16.7
128.0	25.7	2.200	21.3	19.1	16.9
128.5	26.0	2.260	21.5	19.2	17.0
129.0	26.2	2.275	21.7	19.4	17.1
129.5	26.5	2.300	21.9	19.6	17.3
130.0	26.8	2.360	22.1	19.7	17.4
130.5	27.1	2.400	22.3	19.9	17.5
131.0	27.4	2.450	22.5	20.1	17.6
131.5	27.6	2.460	22.7	20.2	17.8
132.0	27.9	2.500	22.9	20.4	17.9
132.5	28.2	2.550	23.1	20.6	18.0
133.0	28.6	2.630	23.3	20.7	18.1
133.5	28.9	2.660	23.6	20.9	18.3
134.0	29.2	2.700	23.8	21.1	18.4
134.5	29.5	2.760	24.0	21.2	18.5
135.0	29.8	2.800	24.2	21.4	18.6
135.5	30.2	2.880	24.4	21.6	18.7
136.0	30.5	2.925	24.7	21.7	18.8
136.5	30.9	3.000	24.9	21.9	18.9
137.0	31.2	3.050	25.1	22.1	19.02

Part IV - Epilogue

The information provided in this case study was collected during the first two weeks of operation of the ICRC Epidemiology Unit at Sakaeo. Sakaeo was only the first of several Kampuchean refugee camps in Thailand; relief efforts were also set up at Khao I-Dang and Kamput and at the border camps of Samet, Mak Kun, and Nong Chan. The ICRC Epidemiology Unit was involved in public health surveillance at each of these sites. Surveillance activities (as did health problems) varied by site, but the rapid collection and analysis of basic medical information early in the relief effort influenced health planning and helped activities to be more effective and efficient.

The crude death rate for the Sakaeo refugee population fell from 9.7 deaths/10,000 population/day in early November 1979 to 0.7 deaths/10,000 population/day in early December 1979. By the week of 6-December, the mortality rate among refugees had reached a level comparable to the Kampuchean population prior to the war. Deaths due to malaria, pneumonia, malnutrition, and diarrhea all decreased. This decrease was attributed to improved nutrition and medical care but also to the loss of the sickest persons from the population during the earlier periods of the effort. Young children (i.e., 0-4 years of age) and persons older than 45 years of age continued to be at greatest risk of death with mortality rates five times higher than other age groups combined.

Hospital admissions remained high until January 1980. Malaria continued to be the major cause for admission followed by pneumonia, tuberculosis, and diarrhea; admissions for malnutrition decreased markedly accounting for <1% of admissions by April.

Although malaria continued to account for a sizeable proportion of hospital admissions through April 1980, it became a less frequent cause of death. Only nine deaths due to malaria were reported between 31-January and 2-April, 1980 compared to 46 deaths between 8-November, 1979 and 9-January, 1980. Initial intervention activities included vector control by Thai provincial health authorities (e.g., draining stagnant water and spraying DDT). In addition, health care workers were instructed to treat fever presumptively as malaria and cerebral malaria cases were admitted to one ward in the hospital for treatment according to a special protocol.

Although the nutritional status of the population improved with a decrease in deaths and hospitalizations due to malnutrition, surveys in January and February suggested that 4% of children <5 years of age and 1% of children 5-7 years of age were still undernourished. Despite the "adequate" level of nutrition among Kampuchean refugees, 15 cases of wet beriberi were identified in January. Dietary analyses indicated inadequate thiamine for people recovering from malnutrition and an increased thiamine intake was recommended.

In addition to the major causes of morbidity and mortality, the occurrence of several other diseases at the camp is of note. Between 8-November, 1979 and 2-March, 1980, 32 cases of meningococcal meningitis and one case of meningococcemia were reported. Children <5 years of age had the highest attack rate (8.1 cases per 1,000 population) and the highest case fatality rate (50%). No clusters of cases were seen in any area of the camp and no cases were reported among persons who received prophylaxis. Because initial cases were unrelated, control measures were limited to administration of sulfadiazine to people living in the same tent or in tents adjacent to each of the cases. An active search for cases was undertaken and diagnosis and treatment of suspected cases were expedited.

During the first two months of the camp's existence, acid fast bacilli were identified in sputum specimens of 126 of 4,999 (2.5%) inpatients. At least 23% of the 236 patients hospitalized at Sakaeo with chronic cough and fever were found to have tuberculosis. A special tuberculosis ward was set up for initial inpatient treatment and case finding was extended to family contacts of hospitalized cases and symptomatic outpatients. Because of continued large numbers of cases of tuberculosis, an extensive tuberculosis control program was initiated in December. An inpatient education program was developed and an outpatient training and treatment program (with follow up of patients who did not report for treatment) was

also initiated. In addition, a program was set up to provide BCG vaccine to children <12 years of age.

Initially measles was not a problem in the Sakaeo refugee population. The small number of children between 9 months and 3 years of age at the camp and their relatively good nutritional status made measles immunization a secondary priority. In late November 1979, however, several dozen cases of measles and one death due to measles occurred in Sakaeo. As a result measles vaccine was given to most children <8 years of age. Programs were also set up to provide DTP and polio vaccine to children <5 years of age.

The rapid assessment of the health status of the refugee population at Sakaeo was critical to the relief effort: it helped to identify persons in immediate need of health care and current health needs of the population. It also served to predict long-term needs at the refugee camp. Surveillance systems and other studies undertaken at Sakaeo were relatively simple in design; however, information gained through these systems was paramount to the effective and efficient use of resources and was essential in influencing medical decisions. The surveillance systems were ultimately taken over by Kampuchean health workers after the departure of ICRC epidemiologists in April 1980. The systems continued to provide information for administrators and health care workers until the camp was closed in 1982.

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