

# Communitywide Pregnancy Reporting in Kauai, Hawaii

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A STUDY envisioned in 1953 by Yerushalmy and Bierman starts not with the birth, or the fetal death, but rather with the pregnant woman from the time she becomes aware that she is pregnant (1). Such a longitudinal study entails observation over a period of time of all women in a community who are known to be pregnant. Fetal deaths can therefore be studied not as isolated instances but as part of all the pregnancies in the group. The study on the island of Kauai, Territory of Hawaii, was planned along these lines.

In 1952, the Department of Health, Territory

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of Hawaii, and the University of California School of Public Health joined efforts in the countrywide Kauai project, designed to study the outcome of all pregnancies in the community and to learn as much as possible about the factors associated with that outcome. The basic methodology involves periodic investigations made from early in pregnancy through termination in live birth or fetal death and continuing with surviving infants for at least a year.

Thus, unfavorable outcomes can be studied not as isolated instances but as part of all the pregnancies in the group. By following each pregnancy throughout its course and the infant for a period of time, it is possible to study physical and mental abnormalities related to prenatal or natal influences, as well as the social and economic factors involved.

An initial phase of the study used material obtained through a census carried out in 1953 to evaluate the usefulness and limitations of retrospective studies of pregnancy. Retrospective data gathered in this way, shown to be reliable for women under 50 years of age, have provided refined knowledge concerning familial tendency to three components of pregnancy loss: early fetal, late fetal and neonatal, and postneonatal fatalities (2). The second phase had the objective of determining the feasibility of communitywide pregnancy reporting with the size and type of staff and organization used in the study. The collection of adequate material would result in meaningful rates of fetal death, by period of gestation. At the end of the longitudinal study in 1958,

reports will be made on these fetal loss rates and on any associations between factors in the environment of the fetus and newborn and the outcome of pregnancy.

We present here the setting of the study, our experience thus far in communitywide reporting of pregnancies, and data accumulated during the 2½ years ending June 1956. It is hoped that this part of the study, which is comprehensive rather than intensive, will answer a few questions and produce clues for other research by more intensive or perhaps different means.

### **Setting of the Study**

The island of Kauai lies at the northwest end of the Hawaiian chain, some 100 miles from Honolulu. Although three-fourths of the 30,000 inhabitants were born in Hawaii, the population is ethnically variegated. The population pattern shows Japanese (44 percent), Filipino (25 percent), Caucasian (14 percent), part-Hawaiian (11 percent), and a sprinkling of Chinese, Koreans, and Hawaiians. The people live in small towns and plantation camps that are scattered around the shoreline, while the mountainous and often rainy central part of the island is mostly uninhabited.

Agriculture is the principal "industry," the skills it requires increasingly approaching those of a large-scale industrial enterprise. Sugar cultivation goes on all year around, while pineapple harvesting and processing reach a peak in the summer, when a large number of women are employed in the canneries. Rates of pay are comparatively high in these two fields, but employment opportunities are distinctly limited, and other jobs pay poorly. The cost of living is high except for clothes and housing, of which not much is required because of consistently mild weather.

Since 1950 the size of the population has remained fairly constant, but the emigration of many of each year's high school graduates has left a disproportionate number of children and of older men, the latter mostly Filipinos brought in to work on the plantations. In 1950 nearly half of Kauai's dwellings were plantation houses, but since then there has been a notable increase in private home building.

Running water is practically universal, and only a few small districts lack electricity.

Excellent provision is made for health and medical care. There are 13 physicians on the island, 7 associated with the plantations and 2 serving as government physicians. Virtually all plantation employees and their families are enrolled in plantation medical care and hospitalization plans, and the Hawaii Medical Service Association, patterned after the Blue Shield-Blue Cross organization, currently has a Kauai membership of more than 5,000.

Hawaii's health department, one of the oldest in the United States, has had a notable record of achievement in the face of extraordinary problems. For example, it is said that none of the babies born in 1848 survived. Thirty years ago Hawaii's infant mortality rate far exceeded that of continental United States; now it is one of the lowest in the country, with 21 infant deaths per 1,000 live births in 1955. Kauai's rate was a little lower than that of the Territory as a whole.

The search for a place where a communitywide survey of fetal waste and a study of reproductive pathology could be carried out with some hope of success led to the selection of Kauai. The population is relatively stable; people live close to one another and are concerned with each other's welfare; babies are highly prized, and virtually all of them are born in hospitals. A high standard of medical care is maintained and is available to all, and excellent cooperation with health programs has been achieved in the past. It seemed likely, therefore, that such a research project might be given widespread cooperation by the physicians and by the population as a whole.

### **The Census**

After a trial run in the summer of 1952, the first phase of the study got under way in February 1953. Six interviewers resident in Hawaii, 5 nurses and 1 social worker, set about obtaining a census. They listed the occupants of each house and recorded household information and brief personal data, including a reproductive history of all women 12 years of age or older. All apparent prospects were asked if they were then pregnant; if so, the date of the

reported last menstrual period was recorded. A pregnancy report card with a postage-free envelope was left with each woman, and she was requested to mail it to the health department as soon as she believed she was pregnant.

Local physicians were asked to submit each month a list of the mothers who had come to them for prenatal care. During later months, the physicians were supplied with special forms serving, among other purposes, as a source of pregnancy reports to the study. These were used by some physicians.

By September 1953, the enumeration was finished and data necessary for the retrospective phase of the study were at hand. Since then an attempt has been made to obtain similar information on new residents and to record the departure of persons who had been enumerated in the original census.

### **Campaign for Early Reports**

In this study the earliest possible reports of pregnancy are those made by women after their first missed menstrual period. A drive for such early reports of pregnancy began in October 1953. In this same month, 2 public health nurses were added to the regular staff of the health department, regular reports of new pregnancies began to come in from some of the physicians, and newspaper articles about the study appeared in the weekly paper. A series of mother and baby care classes was planned by the health department, and nurses went from door to door asking mothers if they or their friends or neighbors would be interested in such classes—and if they were pregnant. Visits were made to newly wed couples, and talks were given to women's groups and church gatherings.

In the spring of 1954, an all-out drive to publicize the study got under way. Three local community organizers visited women and talked to small groups in various parts of the island, and a reporter's services were engaged for help with newspaper releases. Leaders in the community were brought together for a meeting at which the study was explained, and letters were mailed to all prospectively pregnant women, urging them to see their physicians early and to return an enclosed pregnancy re-

port card when they became pregnant. At meetings of the county medical society, the continued help of the physicians was solicited. As a crowning touch, milk bottles delivered around the island one day were bedecked with a printed message urging mothers to cooperate with the pregnancy study. As a result of these efforts more reports came to the study in 1 month than had ever been received before.

The job of finding new pregnancies continued with radio talks, speakers for various groups, slides shown in the theaters, posters, and mimeographed throwaways. In August 1954 and in January 1955, letters were sent to the pregnancy prospect list, thanking them for their past cooperation and enclosing a report card and envelope once again. In early 1955, the resident research director arrived, and during the next 6 months there was a gradual crescendo of activity. Starting in September, the health department laboratory, from which prenatal serology was ordered by the physicians, became an additional source of reports for pregnancies known to the physicians but not yet reported to the study. The next letter sent to the mothers at the end of 1955 took the form of a calendar with a report card. The campaign for early reporting continued until the end of 1956, when the number of pregnancies for followup was considered adequate.

### **Periodic Interviewing**

Simultaneous with the drive for early reporting was the periodic interviewing of all reported pregnant women during their pregnancy. This activity began in May of 1954. Women identified early were interviewed three times during pregnancy; others twice or only once.

For this part of the study, 2 full-time and 4 part-time interviewers were added to the staff since the load was too heavy for the health department nurses to carry in addition to their regular duties. The project also had the assistance of two office clerks.

In early 1956, the first group of babies born to mothers who had been interviewed during their pregnancy were given pediatric and psychological examinations, procedures heartily welcomed by the mothers. Periodic inter-

viewing is scheduled for completion at the end of 1958.

### Resulting Pregnancy Reports

Although some reports of pregnancy were received during the time the population was being enumerated, there was no attempt to obtain early reports until after the census. Since this paper deals with what was done to obtain reports early in pregnancy, analysis is limited to pregnancies with reported last menstrual period (LMP), beginning in 1954. LMP indicates the beginning of the last menstrual period. Weeks of gestation refers to weeks since LMP. Although the date of conception is usually fixed 10 to 14 days after the beginning of the last menstruation ( $\beta$ ), conception is used synonymously with LMP here.

In addition to equalizing monthly periods, the lunar month, or 4-week period, has other advantages in keeping track of the week and lunar month of occurrence of many events involved in this kind of study. The first 7-day period in 1953 was called the first week and each succeeding week was given its appropriate number. As a result, intervals between various reports are determined easily. For example, if a first report of pregnancy was made on May 5, 1955, the 70th week, and the reported LMP was December 16, 1954, the 50th week, the interval from LMP to first report was 20 weeks. Groups of 4-week periods were designated as lunar month 1 through 13 for each year. This was particularly useful in comparing lunar months from LMP to first report with lunar months from LMP to first visit to physician or to termination of pregnancy.

Since each report of pregnancy was related back to the lunar month of reported LMP, for any particular month, after 40 weeks or so have elapsed, we accumulate the total cohort with reported LMP in that month. Some are reported soon after the LMP and some are not known until several months later; in fact, full-term pregnancies missed until delivery are not added to the cohort until approximately 10 lunar months after LMP. This procedure means a timelag, of course; cohorts for the first months of 1956 had not been followed completely by the cutoff date of June 30, and, for this reason,

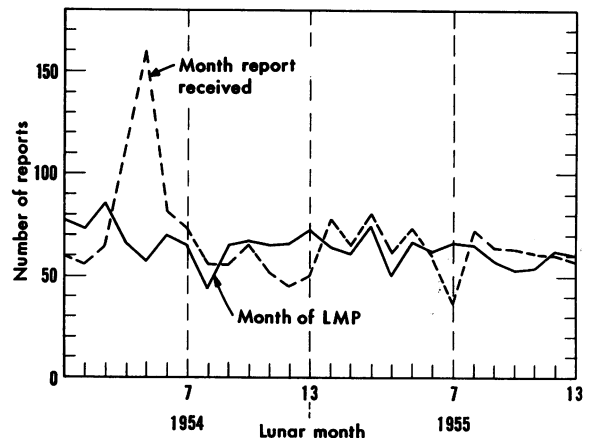
figures 1 and 2 are carried through 1955 only. Cohorts with LMP in late 1955 may be slightly increased with very late reports coming in after June 30, 1956.

Such an allocation has definite advantages in this type of study. During each month there are a certain number of early pregnancies which are available for reporting. By looking at the total cohort, the percentage which was reported, for example, under 12 or 16 weeks' gestation can be determined for each month and results evaluated. After some experience in a community under study, the seasonal pattern of monthly cohorts and the percentage of early reports can be estimated without waiting for the total cohort to accumulate.

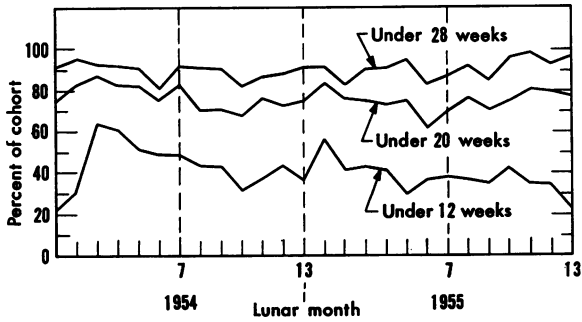
The success of the drive for early reporting in the late spring of 1954 and the drop in reports during pineapple-canning season each summer are particularly evident in figure 1. The solid line in this figure indicates the result of allocating each report to the month of reported LMP. As would be expected, fluctuations are less extreme than for reports by month received. With only 2 years for study, generalizations with regard to seasonal variation are not warranted. However, winter and spring months show a somewhat larger number of conceptions than do the summer months.

In table 1 and figure 2 we observe that about 40 percent of all first reports were for pregnancies with gestation period under 12 weeks and 75 percent under 20 weeks, while 90 percent were for those under 28 weeks. The percentage

**Figure 1. Month pregnancy report received by study and month of LMP, 1954 and 1955.**



**Figure 2. Percentage of monthly cohorts of conceptions reported to study by weeks, since LMP, 1954 and 1955.**



of reports under 20 weeks was about the same for the 2 years, but the yield of earlier reports was not so large in the second year.

### Source of Reports

Notification of many pregnancies were received from more than one of the following sources: the mother, the physician or his records, interviewer's activities, reports of laboratory serology tests, or social agencies. First reports are analyzed here in order to eliminate duplication.

Although most women presumably knew of

the study and had pregnancy report forms available through periodic mailings and therefore could have reported their first missed menstrual period in the 4-7-week period of gestation, only about 20 percent of first reports came directly from them. In spite of publicity that unceasingly stressed early reporting, some mothers were surprised that the study should want to know about them before they were absolutely sure they were pregnant. Indeed, it may be that the study's success in gaining acceptance by the community militated against early reporting by the mothers themselves. Some, when asked why they didn't notify the study immediately after they realized they were pregnant, answered that they knew the interviewer would be around sooner or later anyhow, so what was the need?

However, first reports sent in by mothers themselves were by far the earliest: more than 20 percent were for pregnancies under 8 weeks' gestation compared with 14.4 percent from study interviewers and 5.9 percent from physicians' records (table 2). Almost 90 percent of first reports from mothers were made before the 20th week compared with about 80 percent for interviewers and 70 percent for physicians' records.

**Table 1. Percentage of monthly cohorts of conceptions reported to study, by weeks of gestation, according to lunar month of reported LMP**

Lunar month	1954				1955			
	Monthly cohort	Percent of monthly cohort by weeks from LMP to first report			Monthly cohort	Percent of monthly cohort by weeks from LMP to first report		
		Under 12	Under 20	Under 28		Under 12	Under 20	Under 28
1.....	77	22.1	75.3	90.9	64	57.1	84.1	92.0
2.....	73	31.5	83.6	95.9	61	41.7	76.7	83.3
3.....	86	63.6	87.5	93.2	75	43.2	75.7	90.5
4.....	66	60.6	83.3	92.4	50	40.8	73.5	91.8
5.....	57	50.9	82.5	91.2	67	30.3	75.8	95.5
6.....	70	48.6	75.7	81.4	62	37.7	62.3	83.6
7.....	65	49.2	83.1	92.3	66	38.5	70.8	87.7
8.....	44	43.2	70.5	91.0	65	37.5	76.6	92.2
9.....	65	43.1	70.0	90.8	57	35.7	71.4	85.7
10.....	67	31.3	68.7	82.1	53	42.3	75.0	96.2
11.....	65	36.9	76.9	87.7	54	35.8	81.1	98.1
12.....	66	43.9	72.7	89.4	62	35.5	80.6	93.5
13.....	73	38.4	75.3	91.8	60	23.3	78.3	96.7
Total.....	874	43.4	77.7	90.1	796	38.5	75.5	91.2

LMP=Last menstrual period.

**Table 2. Source of first reports of pregnancy by weeks from LMP to report to study, LMP January 1954—June 1956**

Weeks from LMP to first report	Source of first report		
	From mother directly (percent)	From interviewers <sup>1</sup> (percent)	From doctors' records <sup>2</sup> (percent)
Under 8.....	22.3	14.4	5.9
8-11.....	38.2	34.9	27.7
12-15.....	20.1	22.1	22.7
16-19.....	8.6	12.2	17.1
20-27.....	7.6	11.2	18.1
28 and over.....	3.4	5.3	8.3
All periods:			
Percent.....	20.6	28.3	51.2
Number.....	359	493	893

<sup>1</sup> Includes reports from health department nurses and 11 reports from social agencies.

<sup>2</sup> Includes reports from prenatal serology requests and those obtained by interviewers from doctor's records.

LMP=Last menstrual period.

NOTE: Limited to the 1,745 reports made prior to termination of pregnancy.

As it turned out, the largest number of first reports came from the office records of the physicians; these, however, were for more advanced pregnancies, on the average, than reports from other sources. Some physicians or their nurses sent in reports directly; others, however, preferred to have a member of the study staff copy the required information from

their office records. Some pregnancies were missed altogether, and others did not come to our attention until some time after the first prenatal visit to the physician. Beginning in 1955, some pregnancies which were known to physicians but not yet reported were learned about through requests for prenatal serology. Another large group is credited to the initiative of the health department nurses and the study interviewers. For all first reports received prior to termination of pregnancy, the yield of these various sources was about 50 percent from physicians' records and prenatal serology requests, about 30 percent from interviewers, and 20 percent from mothers.

### Physicians' Records

Although 50 percent of first reports had their source in physicians' records, the remaining 50 percent were not completely unknown to the physicians. In fact, the study's records show that only 6 percent of all reported pregnancies were without prenatal visits. There are, undoubtedly, some incompleteness and some inaccuracies in the study's records of first prenatal visits to physicians. For example, inconsistencies sometimes appear between the date of the first prenatal visit given on the physician's report form or in his records, and the date reported by women in their interviews. The latter date is sometimes earlier in pregnancy—some physicians probably record as the first

**Table 3. Reported pregnancies by weeks from LMP to first recorded prenatal visit to doctor, and by weeks from LMP to first report to study, LMP January 1954—June 1956**

Weeks from LMP to first prenatal visit to doctor	Weeks from LMP to first report to study						Report after termination	Total reports	
	Under 8	8-11	12-15	16-19	20+	Unknown		Number	Percent
Under 8.....	86	94	22	13	11	1	13	240	12.9
8-11.....	34	261	87	33	17	0	29	461	24.8
12-15.....	26	68	178	49	15	0	4	340	18.3
16-19.....	18	35	36	104	26	0	1	220	11.8
20+.....	9	39	37	33	268	0	19	405	21.8
Unknown.....	12	29	12	9	12	0	5	79	4.2
No visit to doctor.....	19	30	12	3	7	0	43	114	6.1
All periods:									
Number.....	204	556	384	244	356	1	114	1,859	-----
Percent.....	11.0	29.9	20.7	13.1	19.2	0.1	6.1	-----	100.0

LMP=Last menstrual period.

visit the first which is made after the pregnancy is reasonably well confirmed. In this analysis, the earliest visit in the prenatal period is used.

The fact that all but a small percentage were known to physicians prior to delivery points up the potential value of their records as an exclusive source of reports. However, certain questions arise: Were more reported pregnancies unknown to the physicians than to the study? How early in pregnancy were the pregnancies known to the physicians as compared with total reports to the study?

Six percent, or 114 pregnancies, were not reported to the study until a fetal death or live birth occurred, and, by coincidence, the same number, 114, had no recorded prenatal visit to a physician; 4 percent, or 71, were known only to the study and another 4 percent only to the physicians; and 2 percent, or 43, were unknown to both during the prenatal period.

The percentage of total reports known to the physicians in each lunar month of gestation is almost the same as the percentage known to the study (table 3). Close to 50 percent were known to each in the same lunar month. Of the 71 known exclusively by the physicians, 27 percent had no prenatal visit until 20 weeks or more gestation; of the 71 known only to the study, only 10 percent were learned about that late. An analysis of reports by single weeks from reported LMP indicates that for the first 6 weeks of gestation, reports to the study were, on the average, about 1 week earlier than those to the physicians; for the 7th through the 13th weeks there was no difference; for reports coming to the study after the 13th week, prenatal visits to physicians averaged about 1 week earlier.

### Comments

Although the longitudinal method used here has definite advantages over the retrospective approach and over studying isolated aspects of the total problem, it presents some difficulties. In a community the size of Kauai with some 5,700 women 15 to 45 years of age, 3 years are necessary to identify about 2,000 pregnant women. Arousing community interest to the high pitch apparently necessary for early reporting, primarily by the women themselves, is obviously a difficult task; and maintaining

such interest over several years is even harder. However, in a community three times the size of Kauai, the early reporting period could probably be cut to 1 year. A shorter time span would certainly be an advantage, although finding a relatively stable and closely knit community of such size is not easy.

As has been pointed out, the earliest possible reports of pregnancy are those made by women after their first missed menstrual period. Although we did not consider it feasible in this setting, it would have been advantageous to have had confirmation of early reports through the provision of pregnancy tests. Furthermore, it is possible that the offering of such tests might stimulate very early reporting and add knowledge about pregnancy wastage during the earliest weeks after conception.

While the analysis of physicians' records as a potential source of pregnancy reports indicates that pregnancies, on the average, were known to physicians on Kauai almost as early in pregnancy as they were known to the study, it is necessary to bear in mind that in many communities, fewer than 94 percent of the pregnant women receive prenatal care. Our findings suggest that among the preliminaries for such a study is an investigation of the extent of prenatal care in the community and how early the care is sought. The custom of the women as well as physicians' policies regarding encouraging or discouraging early prenatal care will be important factors. Of course, the most critical point is the real assurance that all pregnancies, including those that are not yet confirmed, would be made known to the investigators without delay.

### Summary

Besides the objective of utilizing data collected at a special census to evaluate the usefulness of retrospective studies of pregnancy, the principal aims of the longitudinal part of the study were to investigate the feasibility of communitywide reporting of pregnancies, to determine fetal loss rates by period of gestation, and to study associations between factors in the mother and the outcome of pregnancy.

A census of the 30,000 inhabitants of the island of Kauai was taken in 1953. The pres-

ent progress report on communitywide reporting of pregnancies deals with the identification, as early as possible after the first missed menstrual period of all women who became pregnant from the beginning of 1954. Periodic interviews of all such women identified and examinations of their babies began in the middle of 1954 and are still continuing.

The great variety of methods used to obtain early reporting of pregnancies included interviewing by regular public health nurses of the health department and by study staff, activities of community organizers, talks to community groups, newspaper articles, radio programs, letters to prospective mothers, and posters.

All reports of pregnancy are related to the month of reported last menstrual period, thereby allowing an analysis by monthly cohorts of conception. About 40 percent of all pregnancies were reported before the 12th week of gestation, 75 percent before the 20th week, and 90 percent before the 28th week.

First reports of pregnancies came directly from mothers in 20 percent of the cases, 30 percent came from interviewers, and 50 percent from physicians' records. Reports were earliest for those who reported least: 60 percent of first reports from mothers were under 12 weeks, 50 percent of the interviewers' reports were in this period, and 35 percent of those from physicians' records.

Although physicians' records yielded only 50 percent of first reports, 94 percent of the pregnant women on Kauai made at least one pre-

natal visit. A comparison between the time when physicians learned of the pregnancies and the time when first reports reached the study shows that physicians knew of the pregnancies almost as early as the study. Some 6 percent were known only to the study (mainly very early pregnancies resulting in early fetal deaths) and another 6 percent were known only to the physicians; 2 percent were unknown to both groups until after termination.

Creating and maintaining interest sufficient to get adequate reporting by the women themselves is an undertaking of no small magnitude. However, if a relatively stable population of larger size than Kauai could be found, the same number of pregnancies could be identified for followup in a shorter period, and community interest would not have to be maintained for such a long period of time.

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## Reorganization in Michigan School of Public Health

The University of Michigan School of Public Health has set up a new department of industrial health and abolished the department of tropical diseases. This action was taken November 22, 1957. Personnel from the department of tropical diseases have been transferred to the department of epidemiology.

The change reflects a shift in emphasis in epidemiology since establishment of the school in 1941. Tropical diseases were of paramount importance then because of World War II. Now, industrial health has come to the fore with the advent of new plastics, pesticides, and other chemical products, and the interest in radiological health, air pollution, and other aspects of the industrial environment.