15. Hammond, E. C.: Smoking in relation to the death rates of one million men and women. *In* Epidemiological approaches to the study of cancer and other chronic diseases, edited by W. Haenszel. J Natl Cancer Inst Monogr 19: 127–204 (1966).
16. Haenszel, W., Loveland, D. B., and Sirken, M. G.: Lung cancer mortality as related to residence and smoking histories in white males. J Natl Cancer Inst 28: 947–1101 (1962).
17. Godley, F. H.: Cigarette smoking, social factors, and mortality: new estimates from national samples. Doctoral dissertation, University of Maryland, College Park, 1974.
18. Enstrom, J. E., and Godley, F. H.: Cancer mortality among a representative sample of non-smokers in the United States during 1966–1968. J Natl Cancer Inst 65: 1175–1183 (1980).
19. Casey, A. E., and Casey, J. G.: Long-lived male population with high cholesterol intake, in Slieve Loughner, Ireland. Ala J Med Sci 7: 21–26 (1971).
20. Miller, G. H.: Male-female longevity comparisons among the Amish. J Ind State Med Assoc 73: 471–473 (1980).
21. Miller, G. H.: Smoking and longevity. J Ill Lung Assoc 39: 2–14 (1976).
22. Rogot, E., and Reid, D. D.: The validity of data from next-of-kin in studies of mortality among migrants. Int J Epidemiol 4: 51–54 (1975).
23. U.S. Bureau of the Census: 1970 census of housing. Housing characteristics for States, cities, and counties. Pt. 1, United States summary. U.S. Government Printing Office, Washington, D.C., 1972, vol. 1, p. 1–81.
24. U.S. Bureau of the Census: Current housing reports. Series H–150–79. General housing characteristics for the United States and regions: 1979. Annual housing survey: 1979, pt. A. U.S. Government Printing Office, Washington, D.C., 1981.
25. Department of Health, Education, and Welfare: Smoking and health—a report of the Surgeon General. DHEW Publication No. (PHS) 79–50066. U.S. Government Printing Office, Washington, D.C., 1979.
26. Chiang, C. L.: Introduction to stochastic processes in biostatistics. John Wiley & Sons, Inc., New York, 1968.
27. Shryock, H. S., and Siegel, J. S.: The methods and materials of demography. Third printing (revised). U.S. Government Printing Office, Washington, D.C., 1975.
28. Keyfitz, N.: Introduction to the mathematics of demography. Addison-Wesley Publishing Company, Reading, Mass., 1967.
29. Lewis, C. E., and Lewis, M. A.: The potential impact of sexual equality on health. N Engl J Med 297: 863–869 (1970).
30. U.S. Department of Health and Human Services: The health consequences of smoking for women—a report of the Surgeon General. U.S. Government Printing Office, Washington, D.C., 1980.

Status of Nutrition Surveillance Activities in 24 State and Metropolitan Health Departments

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SYNOPSIS

A study was undertaken to examine nutrition surveillance activities and their usefulness in managing programs of nutrition intervention. Questionnaires were returned by 24 of 26 directors of nutrition units in State or metropolitan health departments participating in 1981 in the coordinated nutrition surveillance system of the Centers for Disease Control, which monitors high risk pediatric patients and pregnant women.

The mean years of experience in surveillance activities among the agencies was 4. Only 25 percent of the responding departments reported a self-sufficient computerized surveillance system. Personnel most involved in the coordinating, analyzing, and interpreting of the data were nutritionists who spent an average of 17 hours per month.

Major uses of surveillance data reported for purposes of the nutrition programs were to (a) *identify collection sites with problems such as errors in measuring heights and weights and hematocrits warranting checks for quality control,* (b) *define the extent of nutrition-related disorders in the target populations,* (c) *provide objective local data to assist in*

decision-making and program planning, (d) *enhance followup of specific clients, and* (e) *provide feedback to clinic staffs about the quality and relative impact of their services.*

The survey results yielded evidence that nutrition surveillance activities have important consequences for the planning, implementation, and evaluation of programs of nutritional intervention.

NUTRITION SURVEILLANCE in the last decade has emerged as an integral tool in planning, implementing, and evaluating nutrition and health programs. In 1973, the Centers for Disease Control's (CDC) Nutrition Activity assisted five States to initiate surveillance systems. By 1981, surveillance coverage had expanded to 26 States and 2 metropolitan areas. The goal of nationwide surveillance was a joint proposal of the U.S. Departments of Agriculture and Health, Education, and Welfare ("Proposal: a Comprehensive Nutritional Status Monitoring System," a document submitted to Congress in March 1978).

The differences between nutrition surveys and nutrition surveillance are worth clarification. Nutrition surveys, such as cycles I and II of the National Health and Nutrition Examination Survey (NHANES) carried out by the National Center for Health Statistics, provide comprehensive information on the nutritional status of the total U.S. population and data on which to establish normative reference values such as growth charts. Nutrition surveillance, in contrast, is a continuous, relatively inexpensive system that uses convenience sampling in local health facilities to monitor key indicators of the nutritional status of low-income persons and groups via rapid data collection, tabulation, and reporting. Thus, in surveillance, selected indicators of nutritional problems, such as birth weights, weights, heights (statures or lengths), hemoglobin (or hematocrit) values, and serum cholesterol levels of local populations are monitored so that changes in prevalance of abnormal values can be detected early and appropriate action taken. Linking these activities to the screening and followup components of WIC (Women, Infants, and Children), EPSDT (Early and Periodic Screening, Diagnosis, and Treatment), MIC (Maternal and Infant Care), and other programs in turn can provide a basis for planning and for determining the quality and impact of services.

Although there is a growing body of literature concerning the objectives, development, and selected findings of nutrition surveillance, there has been to date no formal assessment of the users of surveillance data in U.S. health departments. The purpose of this paper is to report on a survey of all State and metropolitan health department nutrition units with continuing surveillance activities. The survey questions were aimed at examining the usefulness of surveillance in managing nutrition intervention programs. For a full review of the history and additional specifics about nutritional surveillance, the reader may consult a WHO technical report (*1*) and papers by Nichaman and Lane (*2*) and Robbins (*3*).

Methods

Questionnaires were mailed to directors of nutrition units in 24 State and 2 metropolitan health departments participating in CDC's coordinated nutrition surveillance system, which monitors high risk pediatric populations and pregnant women.

(Two other States began participation in the systems in 1981, but they lacked sufficient experience to respond.)

The questionnaire items addressed the following information:

- years of participation in CDC's nutrition surveillance system;
- whether data are tabulated by State computation units or by CDC;
- type of professionals (and hours spent per month) to coordinate, analyze, and interpret the surveillance data;
- to what extent the data have served a purpose in fulfilling each of eight objectives;
- what barriers have impeded efforts to make as accurate as possible nutrition screening measurements collected in local health department clinics; and

'Although there is a growing body of literature concerning the objectives, development, and selected findings of nutrition surveillance, there has been to date no formal assessment of the users of surveillance data in U.S. health departments.'

• perceived strengths and limitations attributable to nutrition surveillance in the monitoring of participants and the management and evaluation of programs.

Questionnaires were returned completed, reflecting a response rate of 92 percent, by the following 22 States and 2 metropolitan counties:

Alabama, Jefferson County	Minnesota, Ramsey County
Arizona	Missouri
California	Montana
Colorado	Nevada
Florida	North Carolina
Idaho	Ohio
Illinois	Oregon
Indiana	Rhode Island
Kentucky	Tennessee
Louisiana	Vermont
Maine	Washington
Michigan	Wisconsin

We assume, on the basis of this response, that the results reflect a fairly accurate representation of the status of nutrition surveillance activities in the United States in 1981.

Results

We report the survey findings according to the categories of information listed previously.

Years. The average number of years of surveillance experience was 3.9. The range was from a minimum of 2 months to a maximum of 9 years.

Computerization. Nutrition surveillance systems in State and metropolitan units optimally should be operated at a level of self-sufficiency (that is, the computer operations are health-department facilitated, using CDC's software). Only 25 percent of the departments, however, reported that data were tabulated by their State's computation center; 58 percent relied on CDC for this assistance; and the remainder, 17 percent, reported using a combination of both systems (for example, CDC furnishes both quarterly and annual reports but not monthly ones). Reliance on CDC for computer assistance was prompted most commonly by lack of funds (50 percent), followed by lack of necessary assistance from the State computer system (28 percent), lack of such a priority in the nutrition plan (22 percent), and lack of time or nutrition personnel (17 percent).

Personnel. Person-hours per month spent in coordinating, analyzing, and interpreting surveillance data at the State or metropolitan level are presented in table 1. Nutritionists spent by far the most time—an average of 16.6 hours per month—coordinating the flow of surveillance data. Clerks, who record data, visually edit collection forms, xerox, and mail forms, spent an average 8.5 hours per month. Time spent by others—statisticians, computer analysts, paraprofessionals, and administrators — accounted for less than 10 percent of their total hours on the job.

The ranges of time spent by the different personnel reveal a distinct organizational pattern in the supervision or coordination of surveillance activities. In the majority of departments, a nutritionist or an administrator has, as a major job responsibility, the coordination of the surveillance system. This arrangement was readily apparent in 13 departments in which a nutritionist or an administrator spent at least 10 hours each month in surveillance activities.

In three departments, a full-time person spent at least 120 hours per month in surveillance activities. In the remainder of the responding agencies, rather than differing in organizational structure, generally there were far fewer total person-hours spent in surveillance; nine reported spending less than 20 hours per month.

Meeting intended objectives. The extent to which surveillance is a useful tool in meeting its intended objectives (*1,2*) was assessed using Likert scale items, one for each objective. A response of 1 indicates that surveillance is not at all useful in accomplishing the objective; a 4 indicates that it is extremely useful. The means for eight objectives are given in table 2.

Accurate data. Providing a means to detect quality control problems is reportedly the most useful purpose of surveillance. To explore the health department's views on the effectiveness of the surveillance,

Table 1. Staff positions and person-hours spent per month coordinating nutrition surveillance activities in 24 State and metropolitan health departments

	Number per department		*Hours per month*	
Position	*Average*	*Range*	*Average*	*Range*
Nutritionists	1.5	0–5	16.6	0–99
Clerks	0.25	0–3	8.5	0–32
Statisticians	0.4	0–1	4.6	0–40
Computer technicians	0.5	0–2	4.3	0–25
Paraprofessionals	0.25	0–5	4.3	0–99
Administrators	0.6	0–9	1.9	0–20

the agencies were asked, "What barriers, if any, have impeded efforts to enhance nutrition screening measurements in local health clinics?"

The most common responses were lack of personnel or time (79 percent), lack of motivation or resistance by district or regional personnel (21 percent), lack of a training manual and materials on the proper way to do nutrition screening measurements such as weights or heights (21 percent), lack of support by other programs or State legislators (21 percent), and lack of funds to buy proper equipment (12 percent).

Strengths and limitations. Participants were asked to describe in open-ended fashion major strengths and limitations of nutrition surveillance according to their experience in monitoring clients and in the management and evaluation of programs. Table 3 lists these attributes as reported by 23 participants in State and county agencies.

Table 2. Reported usefulness of nutrition surveillance system in meeting intended objectives

Objective	Number	Average rating [1]
To identify "problem collection" sites in which measurement errors warrant checks in quality control	24	3.1
To define the extent of nutrition-related problems in target populations	24	3.0
To provide information on local situations for appropriate identification of target groups for program planning	24	2.7
To provide a basis for monitoring individuals in need of followup or treatment	23	2.5
To demonstrate the effectiveness of a nutritional status data-flow system which can be applied to other at-risk populations (such as school)	22	2.5
To determine effectiveness of nutrition intervention programs by assessing changes in nutritional status of groups and individuals over time	22	2.4
To obtain data on which to base priorities for allocating funds and personnel	24	2.4
To provide a research base for investigating relationships between nutritional status and health or disease	22	2.1

[1] Rating of 4 extremely useful; 1 not at all useful.

Table 3. Strengths and limitations of nutrition surveillance in public health as perceived by 23 participants in the nutrition surveillance survey, 1981

Characteristic	Number of times reported	Percent
Strengths		
Identifies at-risk populations for geographic comparisons over time	14	61
Improves the quality of nutrition screening	14	61
Enhances individual followup	10	44
Provides feedback to clinics about the quality of service	10	44
Provides a data base with which to base priority decisions concerning personnel, resources, and program emphasis	8	35
Makes program planning feasible with objective health outcome data	7	30
Increases awareness of nutrition-related problems by health professionals	4	17
Provides objective data with which to write grants	4	17
Serves as a communication tool with Federal, legislative, consumer-advocate, and other groups	3	13
Helps coordinate management information systems	1	4
Limitations		
Lengthy turn-around time of data	9	38
Lack of linked data on individuals	8	35
Lack of guidance for use of data by health staff	7	30
Lack of appropriate knowledge, attitudes, and training of personnel	6	26
Involves additional paperwork to record data	4	17
Questionable accuracy of data	3	13
Data often require manual consolidation from computer printouts	2	9
Lack of local agency acceptance of surveillance as a useful tool	2	9
Too limited in scope to provide meaningful data	2	9
Too much data	1	4

Some of the strengths listed were reiterations of the uses discussed previously by several respondents. For example, the major strengths cited by more than half were identifying at-risk populations for geographic comparisons over time and improving the quality of nutrition screening measurements. Other strengths attributed by 30 to 50 percent of participants were enhancing individual followup, providing feedback to clinics about the quality of services, and providing objective data with which to base decision making and planning. Other strengths mentioned by less than 20 percent of respondents were increasing awareness of nutrition-related problems by health professionals, providing data for grant-writing purposes, serving as a communication tool with various groups, and helping to coordinate management information systems.

The major limitations listed by 30 percent or more of those surveyed were the lengthy turn-around time (the length of time before the analysis of the information reaches the data collectors), the lack of linked data on individual persons, and the lack of guidance in the use of the data by health staff. Lack of appropriate knowledge, attitudes, and training of personnel, the additional paperwork required, and questionable validity and reliability of the data were mentioned as weaknesses by 10 to 29 percent of the respondents. Other limitations cited were the need to consolidate manually data from printouts, lack of local agencies' acceptance of surveillance as a useful tool, data too limited in scope to provide meaningful information, and too much data.

Discussion

Nutrition surveillance will be widely accepted by health providers as a useful tool in program management only when more people become attuned to its history, purposes, strengths, limitations, and to the major advances made in the last few years in this field. The fact that three departments have assigned a full-time position to supervision of surveillance illustrates its potential importance and usefulness.

Interestingly, nutrition surveillance is perceived as being most useful in identifying sites with problems in collecting data in terms of measuring and recording weights, heights, and hemoglobin and hematocrit values. Since accurate information is the foundation of nutrition surveillance, personnel trained in public health nutrition need to learn methods for quality control. For instance, it becomes imperative to rule out errors in measuring recumbent length of infants or stature of children when a clinic reports an abnormally high prevalence rate of low height-for-age or high weight-for-height measurements. When a clinic reports a prevalence rate of low weight-for-height children that is greater than 5 percent, measurement error should also be ruled out. Surveillance reports, now made available with CDC's software, rank clinics by prevalences (high to low) for selected nutrition problems and percentage of probable errors. Probable errors are values (for example, of height-for-age) that approximate at or below the 1st percentile or at or above the 99th percentile ($\pm$ 3 Z-scores). These reports can serve as extremely useful tools in identifying collection sites with potential problems.

Orientation of new personnel and workshops in skills development provide opportunities to demonstrate proper equipment, weighing and measuring techniques, plotting of growth charts, and use of data in program management (*4*). In 1981, the Bureau of Community Health Services of the Health Services Administration and the Division of Nutrition of the Centers for Disease Control co-sponsored regional workshops on the nutritional assessment of physical growth for nutrition, nursing, and other medical personnel in the States. Several training aids are available in these subject areas, including manuals for nutrition screening and followup (*5*), audiovisuals (*6–10*), a manual for supervisory staff (*11*), a standardized procedure for evaluating the impact of training (*12*), and "Growth Chart Guidelines" (*13*). Relatively inexpensive and acceptable recumbent length and stature measuring devices have made it possible for many States to furnish all or a majority of their clinics with proper equipment (*14*).

Barriers that impede quality control efforts are several. Foremost are lack of time or personnel and lack of motivation by local clinic staffs. These responses reflect the need to emphasize the importance of accuracy in nutrition screening. In 1975, the CDC Nutrition Activity staff conducted a survey of 31 people involved in the weighing and measuring of children in a health department (*2*). More than 80 percent reported that accuracy of measurement was not checked in their clinics, and more than half of these persons reported that they never discussed with their supervisors the accuracy of their weighing and measuring. Local clinic staffs' increased awareness that others are concerned and interested in the measurements that they take may help to improve the quality of their measurements. Suggesting for example, that a measuring error of an inch can change a child's ranking from the 10th to below the 5th percentile for length-for-age demonstrates the

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importance of accuracy in making a proper evaluation of a nutritional status indicator.

In defining the extent of common nutrition disorders in target populations, surveillance reports can provide useful information. For example, time-series data can be made available on the frequency of low birth weight infants born to mothers with respect to mother's age, or on the prevalence of anemia by age in blacks, whites, Hispanics, and Orientals, for every clinic, county, and region in a State. These data, in turn, are helpful in writing measurable planning objectives for nutrition programs.

Another adjunct to the CDC-based surveillance system provides a basis for monitoring persons in need of followup. This task is accomplished by listing infants and children who have one or more measurement values below or above preselected cutoff points. When the list is returned to clinic personnel, the information can be used to assure that all those persons needing followup have been appropriately managed or referred. Another purpose of this system is to demonstrate the effectiveness of a data-flow system. There has been interest recently in applying the techniques used with pregnant women and children to other at-risk groups such as the elderly.

The use of a surveillance system in estimating the health effects of nutrition intervention has both advantages and disadvantages (*15*). Evaluation by use of existing data is inexpensive and effectively consolidates both cross-sectional and longitudinal information on key nutritional indicators of the at-risk population. However, this assessment may be accomplished at the expense of uniform reliability of the data, because standard procedures are not always used to collect them. Another limitation is lack of a suitable comparison group, which precludes drawing conclusions that the changes observed are solely the result of the intervention. Regression toward the mean, the phenomenon of an extreme indicator value showing inadequate nutritional status on an initial screen and improvement on subsequent measurement without an actual improvement in nutriture, must also be considered. Not accounting for regression toward the mean can drastically overestimate the program's effects in an evaluation. It is potentially controlled for, however, in the data analysis (*16*). As the respondents reported, lack of routine linking of data on one person over successive visits has hampered the effectiveness of surveillance as an evaluation tool. The CDC has recently made great progress in this area by making retrospective analysis of data in this manner possible for several States (*17*).

Owen and White used surveillance data to make decisions about the allocation of funds and personnel (*18*). Before surveillance was initiated in Arizona, Mexican-Americans were thought to have major nutritional problems of underweight and growth retardation. A closer look at first-year surveillance data revealed a much greater than expected prevalence of overweight and hypercholesterolemia. These findings warranted a reexamination of their earlier assumptions. Surveillance data on southeast Asian refugees in California and Washington have more recently helped to influence the public health priorities relating to the nutritional care of this population at extremely high risk (*19*).

Providing a data base for research is regarded by participants as the least useful purpose of surveillance information. Although health departments can, for reasons of lack of time and personnel, understandably find limited use for data pertinent only to research, others have demonstrated their worth in investigations of growth trends among children of various ethnic groups (*20*) and in studying the sensitivity and specificity of hematocrit in relation to hemoglobin values (*21*). Users of surveillance data for research must be careful to apply stringent editing procedures to eliminate improbable values attributable to errors of measurement or recording.

The strengths identified by the survey participants demonstrate a great deal of support for surveillance in many facets of nutrition program management. For instance, using surveillance information to enhance awareness or communicate with key advocacy groups and significant persons can be a valuable strategy in endeavors such as lobbying for program support.

The limitations that the participants identified, on the other hand, reflect various areas in which sur-

veillance systems can be improved. Guidance for health staff in the use of nutrition data will be simpler when a training manual for users is issued by CDC or a State or metropolitan unit. Major barriers to the optimal use of a surveillance system in the administration of programs are lack of knowledge about these systems, lack of favorable attitudes toward them, and lack of training for staff members. However, nutrition surveillance is being taught in undergraduate and graduate level classrooms as a part of courses in health planning and community assessment as well as in public health nutrition courses; the knowledge base among health workers should therefore be broadened.

The new periodic reports of CDC should reduce the users' concerns of having too much data by limiting reports to quarterly and annual issuances (formerly they were also issued monthly). They should also reduce both the need to consolidate the data manually and the lengthy turnaround time between collection and final analysis. These advantages will be especially appreciated when States gain the flexibility to carry out their own data analyses and generation of reports.

Orienting the health department staff through carefully supervised hands-on experience can result in many benefits. For instance, setting planning objectives, such as reducing the frequency of low birth weight infants or anemia in young children, may help to unify the health team while maximizing use of the data.

References

1. Methodology of nutrition surveillance: a report of a joint FAO/UNICEF/WHO expert committee. WHO Technical Report Series, No. 593. Geneva, 1976.
2. Nichaman, M. Z., and Lane, J. M.: Nutrition surveillance in developed countries: the United States experience: *In* Nutrition and growth. Vol. 2 of Human nutrition: a comprehensive treatise. D. B. and E. F. P. Jelliffe, editors. Plenum Press, N.Y., 1979, pp. 409–429.
3. Robbins, G. E.: Surveillance of nutritional status in the United States. Ross Timesaver, Public Health Currents 20: 1–4, March-April 1980.
4. Fleshood, H. L.: Training aids for assessing physical growth of infants and children. Ross Timesaver, Public Health Currents 21: 1–4, March-April 1981.
5. Bureau of Community Health Services, Health Services Administration, Public Health Service: Nutrition screening of children: a manual for screening and follow-up. DHHS Publication No. 81–5104. Rockville, Md., 1981.
6. Division of Nutrition/WIC Services, Tennessee Department of Public Health: The road to life. Nashville, 1980. 35 mm slide show with cassette. 30 minutes.
7. Child Development and Mental Retardation Center, University of Washington: A guide for weighing and measuring. Seattle, 1981. 35 mm slide show cassette. 11:20 minutes.
8. Division of Health, Wisconsin Department of Health and Social Services: Screening. Madison, 1979. 35 mm slide show with cassette. 32 minutes.
9. Ross Laboratories: Pediatric anthropometry. Columbus, Ohio, 1980. ¾" videocassette. 16 minutes.
10. Division of Nutrition/WIC Services, Tennessee Department of Health and Environment: The big picture: use of nutrition screening (surveillance) data in program management. Nashville, 1983. 35 mm slide show with cassette. 25 minutes.
11. Nutrition activity, CDC: Weighing and measuring children: a training manual for supervisory personnel. Atlanta, Ga., November 1980.
12. Nutrition activity, CDC: Weighing and measuring children: a simplified standardization exercise for training and performance evaluation. Atlanta, Ga., March 1982.
13. Division of Nutrition/WIC Services, Tennessee Department of Public Health: Growth chart guidelines. Nashville, 1980.
14. Nutrition activity, CDC: a review of selected anthropometric and hematologic instruments used in nutrition assessment. Atlanta, Ga., 1980.
15. Food and Nutrition Service, USDA: Evaluating the nutritional and health benefits of the special supplemental food program for women, infants and children. FNS–165, Washington, D.C., November 1977.
16. Davis, C. E.: The effects of regression to the mean in epidemiologic and clinical studies. Am J Epidemiol 104: 483–498 (1976).
17. Nutrition activity, CDC: Nutrition surveillance: annual summary. Atlanta, Ga., 1981.
18. Owen, A. Y., and White, M.: Nutrition surveillance in Arizona: selected anthropometric and laboratory observations among Mexican-American children. Am J Public Health 67: 151–154, February 1977.
19. Peck, R. E., Chuang, M., Robbins, G. E., and Nichaman, M. Z.: Nutritional status of Southeast Asian refugee children. Am J Public Health 71: 1144–1148, October 1981.
20. Harrison, G. G., and White, M.: Overweight in Arizona infants: relation to birthweight and ethnic group. *In* Social and biological predictors of nutritional status, physical growth and neurological development, edited by L. S. Green and F. E. Johnston. Academic Press, New York, 1980, p. 33.
21. Graitcer, P. L., Goldsby, J. B., and Nichaman, M. Z.: Hemoglobins and hematocrits: are they equally sensitive in detecting anemias? Am J Clin Nutr 34: 61–64 (1981).