

GUIDELINES FOR ASSESSING
IMMUNITY LEVELS

CENTER FOR DISEASE CONTROL
Bureau of State Services
Immunization Branch

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TABLE OF CONTENTS

INTRODUCTION	1
OBJECTIVE OF IMMUNIZATION LEVEL ASSESSMENT	3
DECISION MAKING GUIDELINES	5
BASIC SYSTEMS	7
APPENDIX	21
Informational Materials--School Entry Survey	22
Informational Materials--Two-year-old Survey	26
Examples of Surveys--School Entry	32
Examples of Surveys--Two-year-old	39
Statistical Considerations	44
Format of Final Report	49
Contributors	50

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INTRODUCTION

A principal part of any immunization program is the establishment of an effective assessment mechanism, whereby current immunization levels of children can be monitored on an on-going basis. Such systems are now working effectively in a number of health jurisdictions throughout the United States.

An efficient system can identify geographic areas in need of increased immunization services, groups within these areas where immunization levels are low, and individuals within these groups who need intensive motivation or material assistance to obtain immunizations.

This document is intended to serve as a reference for the design of specific techniques for the assessment of immunization levels prerequisite to program direction. Because of variations in such factors as geographic areas, population density, standard of living, ethnic or religious influence, extent of the overall immunization problem, and available resources, methods of operation will vary from project to project. This notwithstanding, the systems outlined in this guide apply to all jurisdictions, and design should adhere as closely as possible to the basic guidelines presented in the following sections.

INTRODUCTION

DEFINITION

Immunization Level Assessment:
a procedure(s) for monitoring current status
to determine program direction

OBJECTIVE OF IMMUNIZATION LEVEL ASSESSMENT

Assessment of immunization levels is not an end in itself but should be a vital part of every immunization program in order to: demonstrate need for such a program, solicit needed support and resources, effectively plan and determine direction of program, and measure the impact of the program.

First, through assessment of immunization levels, the problem is identified and defined. Once this is accomplished this data can then be used to secure needed resources to attack the problem. Local, state, and federal legislation can be generated according to need as demonstrated by the data. Public support of all kinds as well as resources from other governmental and voluntary agencies can be secured when a need is effectively demonstrated and areas of responsibility and concern are clearly defined.

A second important purpose of assessment of immunization levels is the increased ability to persuade various levels of government, private and public medicine, school officials, private organizations, and parents that they should get involved in your program. Also properly generated and presented, the data can create an attitude of friendly competition between population segments aimed at raising immunization levels.

Third, assessment of immunization levels will allow for the establishment of priorities and development of the most effective means of attacking the problems. The data will give specific information concerning immunization levels for each disease, thus pointing out where and what kinds of programs should be initiated. Age specific immunization programs can be conducted

OBJECTIVE OF IMMUNIZATION LEVEL ASSESSMENT

as indicated. When, where, and what kind of education programs are needed can be determined. Long-range meaningful planning for future programs can be initiated. More effective placement and utilization of personnel can be achieved based on assessment data.

Fourth, efficient immunization level assessment will allow for a continuing measuring of program impact and effectiveness. As programs are conducted, assessment will provide comparative data on which techniques employed may be evaluated.

Remember, the ultimate objective of assessment is to secure, maintain, and utilize adequate information concerning the degree to which children in specific age groups and geographic areas complete programs of immunization. Unless there is a commitment to use the data for determining program direction, the immunization level surveys should not be conducted.

DECISION MAKING GUIDELINES

The need to develop a system for collecting immunization level data was recognized in the initial legislation covering federal support for the development of broad-based immunization programs. Since then, a great deal of experience in organization and design has resulted in more current concepts that give emphasis to methods that are characterized by their simplicity in design and economy in terms of resources and time.

In the past, the assessment of immunization levels in programs has often depended on time-consuming household interview surveys. The United States Immunization Survey provides "hard" baseline data for the nation in the form of data on the immunizable diseases of measles, rubella, polio, and DTP. This survey reflects the most accurate national and regional estimates of the immunity levels of these diseases that are available to us. It does not, however, present state-by-state, much less particular area data. It is a foregone conclusion that states and local areas could benefit more by a simple ongoing index of immunization levels which would provide time trend information.

The results must be obtained in the most efficient and useful manner. For this reason the term stratification is mentioned when sampling procedures are used. Data obtained from one stratum throughout the United States would result in the estimation of the immunization levels for the nation. Obviously, this estimate proves meaningless if the objective is to pinpoint pockets of high susceptibility.

The smallest number of strata which allows effective use of data is

DECISION MAKING GUIDELINES

desirable, i.e., poverty areas vs. non-poverty areas within the Standard Metropolitan Statistical Areas, lower socioeconomic area vs. upper and middle (combined), etc. In the less populous areas groupings of several counties into a rural stratum would seem feasible.

Surveys should be conducted in small geographic areas but be broad enough to provide statewide results. Special interest areas should be a portion of the total survey. Each project area should determine the priority areas and stratify as necessary.

Before deciding upon the exact procedure your system will follow, there are certain conditions, above and beyond funding limitations, that must be considered:

- A. Availability of personnel and necessary resources.
- B. Availability of birth registration and school census by meaningful geographic subdivisions to the immunization project.
- C. Population factors such as birth rate, geographic concentrations, special problem groups, and mobility.
- D. Extent of immunization problem--

Does the area of concern have a productive public health delivery system for the administration of vaccine? How about private physicians and school health programs? Past immunization levels must be considered as well as morbidity.

BASIC SYSTEMS

A combination of two simple immunity level assessment techniques seems advantageous at this point. Previous data have shown the greatest changes in immunization levels take place between the first and second birthdays and again at school entry. Therefore, a stratified simple random sample survey of two-year-old children using birth certificates as the sampling frame combined with school entry immunization level data will provide the two major pieces of information necessary to assess immunity levels.

The school entry immunity level assessment activity is of primary importance because it offers a captive audience from which immunization data can be obtained. The combined efforts of the health and education agencies within the various states is required for completion of this activity. Endorsement of state medical associations and state parent-teachers' organizations is a prerequisite to the ultimate success of the school entry assessment activity.

At annual school registration, immunization data should be obtained for each child entering into the first grade (or kindergarten). These data can easily be compiled within the hierarchy of state, county, school district, and school.

In the event complete cooperation from all appropriate agencies cannot be obtained, then a sampling scheme should be employed to collect the school entry data based on the most efficient stratification scheme for the defined area.

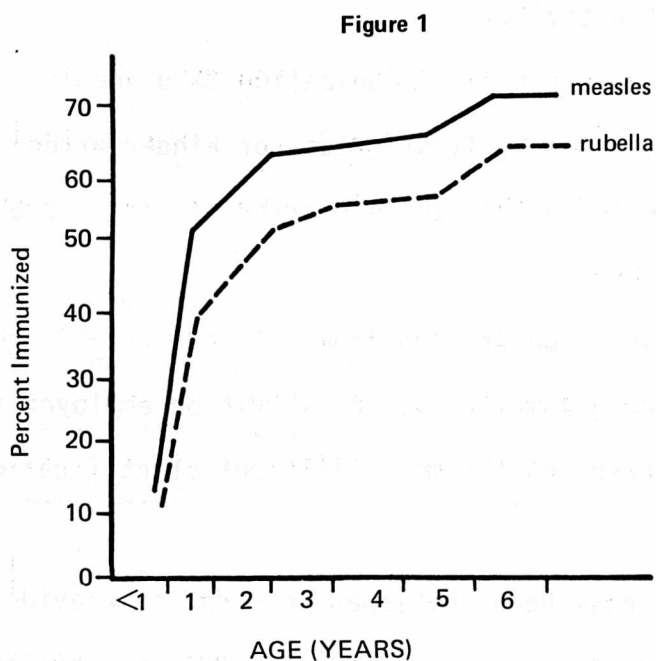
Survey procedures have been developed in order to provide immunization level assessment techniques that can be carried out as a health department

BASIC SYSTEMS

operation with little or no outside consultation. Training in survey theory or methodology, although desirable, is not necessary for the person in the health department to whom planning and direction of the survey is assigned. Administrative experience and seasoned judgment are necessary since, as in any application of theory, adjustments and compromise must be made to adapt to local situations.

I. Relationship of School Enterer Survey and Two-year-old Survey

The underlying reason for collecting school entry and two-year-old immunity level data is to quickly assess the problem. Using national survey data, the following trends are observed when plotting immunization level by age (Figure 1.).



BASIC SYSTEMS

Note the sharpness of the slope until age 2 with a relatively horizontal slope until age 5 when a slight rise occurs. From these data, the inferences made from two-year-old and school entry surveys seem straightforward.

The two-year-old survey becomes less important when the school enterer survey indicates a low level of immunity. If immunization levels are low at school entry then immunization levels at age two will likewise be low (Figure 2).

When the immunization level at school entry is high, then the two-year-old survey is required to determine shape of curve as illustrated by Figure 3.

Figure 2

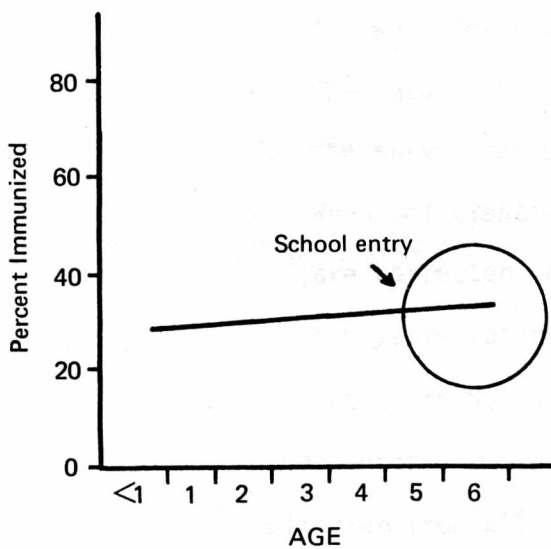
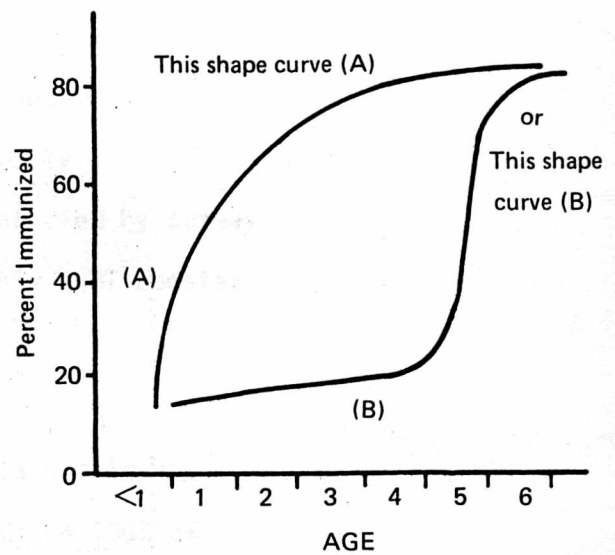
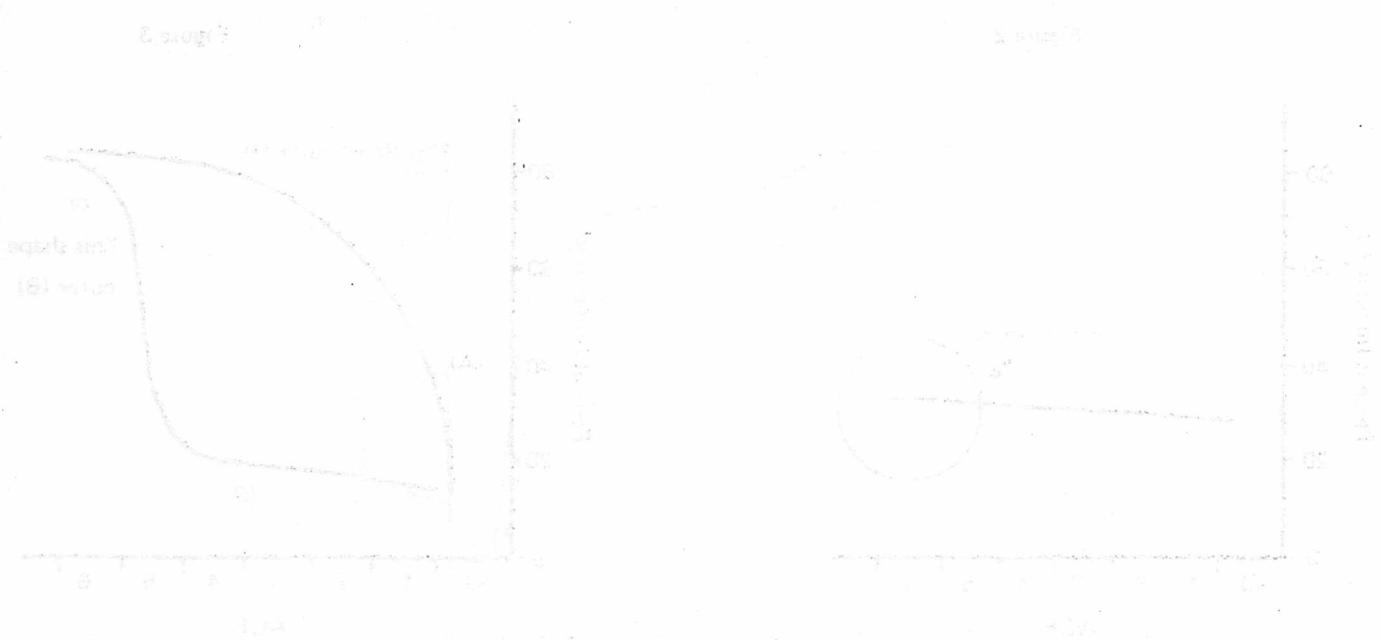


Figure 3



BASIC SYSTEMS

Population mobility is a chronic problem when using birth certificates as a base for surveys, particularly in low income areas. Since school entry immunization levels will in general be low throughout the low income areas, the problem of population mobility is reduced through the school survey.



BASIC SYSTEMS

II. School Entry Immunization Survey

A. Advantages

1. This is one of the simplest and most accurate of surveys.
2. Immunization levels of school enterers are indicative of preschool children. Immunization histories should be collected by date of immunizations (recommended in high mobility areas).
3. Students are a captive audience, therefore optimal percentage response.
4. The survey will indicate the level of compliance with school immunization laws.
5. It is an inexpensive type survey as others (PTA volunteers, room mothers, etc.) can do the work for you.
6. The data is relatively easy to obtain.
7. The survey can be repeated annually.
8. When deficiencies that are identified by survey are corrected, children need only a DT booster ten years later.

B. Population to be surveyed

School entry immunization level data should be collected from all schools statewide on 100% of

BASIC SYSTEMS

the school enterers. If this is impossible, all school enterers in a sampling of schools may be surveyed. In general, fifteen (15) schools for each strata will be sampled. *Refer to Appendix IV, 1, for additional information.*

- C. Sampling Frame (appropriate if schools are sampled)
This should include all schools (public and private) within the defined strata.
- D. Time Frame
The survey should be conducted annually and completed very early in the school year (4-6 weeks after school starts) to allow for program activities before seasonal peaks of morbidity and interference of school holidays. If possible it should become a part of registration.
- E. Successive steps in designing an immunization level survey of school enterers:
1. Explain the rationale to and obtain the support of the local and state education and health agencies, the local and state medical affiliations, parent-teacher organizations, etc.
 2. Develop the questionnaire and school summary sheet in cooperation with the health and education agencies. *Refer to Appendix I, 3 & 4, pages 24 and 25. Be sure to include a question regarding where the child received*

BASIC SYSTEMS

his immunizations -- doctor, clinic, etc.

3. Develop informational materials for distribution from the state to local level which illustrates the joint cooperation of the health and education agencies. *Refer to Appendix I, 1 & 2, pages 22 & 23.*
4. Develop time frame for survey which includes the preparatory phases, the data collection phases, the data summarization activities, the data dissemination responsibilities and the data utilization efforts. In general this time span should cover 2 to 3 months.
5. Define the area according to health and/or education jurisdictions.
6. Determine the procedure for school selection from the defined area.
 - a. Preferred option - obtain immunization histories on all school enterers from all schools.
 - b. Alternative option - randomly select a sample of schools after determining the optimal scheme for stratification, i.e., school district, socioeconomic area, poverty vs. non-poverty, etc.
7. Designate individual(s) to be responsible for

BASIC SYSTEMS

conducting the survey within the schools and train these individuals.

8. Initiate the survey by distributing the questionnaire to the schools.
9. Have designated individuals conduct follow-up through schools by using PTA volunteers, room mothers, etc.

NOTE: A commitment to complete the survey and make every effort to obtain the required data on all the survey population is of paramount importance.

10. Compile and analyze the data in a logical manner as rapidly as possible. Make sure that schools forward you only summary sheets and not all the questionnaires.
11. Take the necessary remedial action.

BASIC SYSTEMS

III. Survey of Two-year-old Children

A. Advantages

1. Current immunity status of these children is obtained.
2. Immunization levels of two-year-olds are indicative of the levels of both younger children and older children.
3. Indicates adherence to recommended immunization schedule of younger children. Children should have completed their basic series by this age.
4. Quick, reliable, inexpensive method of "keeping a pulse" on the population most at risk of serious complications from disease.
5. The surveys can be repeated annually.
6. The sample size is small and easy to complete.
7. A large portion of the data collection can be accomplished through a mailout questionnaire with follow-up only on non-responders.
8. Birth certificates are easily accessible and would be fairly standard from community to community.
9. It is especially useful for establishing and following trends since the known bias is constant from year to year.

BASIC SYSTEMS

B. Disadvantages

1. If birth certificates are used as a sampling frame there is no way to allow for two-year-olds who were born elsewhere and have since moved into the area.
2. In areas of high mobility there may be many changes in address of the selected families.
3. The birth certificate based immunization level survey is biased, but in most cases will provide acceptable data.

C. Sample Size

The sample size for each stratum should be sufficiently large to produce statistically valid results. In order to obtain significant data for any defined area, select 150 two-year-old children to be included in the sample population of each stratum to be surveyed.

The procedure for randomly selecting birth certificates is given in the following steps:

1. Obtain a complete listing of the births for the selected time period for each strata. For example, 1500 births occurred in Stratum 1.
2. Divide the total number of births by the required sample size, i.e., $1500 \div 150 = 10$.
3. Select a random number between 1 and 10. Assume

BASIC SYSTEMS

the selected random number is 4.

4. From the list of 1500 (mentally numbered 1-1500) the 4th certificate will be the first child to be included in the sample.
5. The remainder of the sample is selected thusly:

	Random Number
First child	4
Second child	14
Third child	24
.	.
.	.
149th child	1484
150th child	1494

A sample of 150 is taken directly from each strata.

To obtain the statewide estimate, the result will need to be weighted in the following manner:

BASIC DATA

Strata	Number in Sample	Number of Births/Year	Proportion Births/Year
1	150	5,000	.1351
2	150	10,000	.2703
3	150	20,000	.5405
4	150	2,000	.0541
		37,000	1.0000

BASIC SYSTEMS

SAMPLE RESULTS

Strata	Sample Results	Weighting Factor	Product col. 2 x col. 3
1	73.5%	.1351	9.93%
2	63.4%	.2703	17.14%
3	65.0%	.5405	35.13%
4	93.1%	.0541	5.04%
<u>STATEWIDE ESTIMATE</u>			<u>67.24%</u>

Refer to Appendix for statistical considerations and examples.

D. Sampling Frame

A properly selected sample of births occurring two years previous to the study would yield a sample of two-year-old children. All infant deaths should be purged from this sample.

E. Time Frame

Data should be collected annually and in the shortest possible time to minimize problems of personnel commitment and to allow for any remedial action before seasonal peaks of morbidity.

F. Successive steps in designing an immunization level survey of two-year-old children

1. Define the survey area within the health jurisdiction.

BASIC SYSTEMS

2. Determine the number of persons required to provide estimates of specified precision.
3. Explain the rationale to and obtain the support of the vital records office. Through the vital records office the sample will be drawn. The procedure will generally require review of birth certificates for selected periods with children being selected by the addresses which fall in the previously defined strata.
4. Develop the questionnaire. *Refer to Appendix II, 4, 5, & 6, pages 29, 30 and 31 for examples.*
5. Develop informational materials which explain; (1) the purpose to health officials at the local level and (2) the intent of the study to the parents of the randomly selected children.
6. Develop time frame for the survey which includes; (1) mailout, (2) reminder mailout, and (3) telephone calls and field visits. In general this time span should cover 1 month allowing 1 week for original mailout, 1 week for reminder mailout and 2 weeks for telephone calls and field visits.
7. Through the use of birth registrations, randomly select the children that will be surveyed according to the procedural description previously mentioned.

BASIC SYSTEMS

8. Conduct local health department record search on survey population.
9. Mail questionnaire to or conduct telephone interview with the remainder.
10. Conduct field follow-up on locatable non-responders.

NOTE: A commitment to complete the survey and make every effort to obtain the required data on all the sample population is of paramount importance.

11. Compile and analyze the data in a logical manner.
12. Take the necessary remedial action.

AN EXAMPLE OF EFFECTIVE COMMUNICATION

From the Department of Psychology, University of California, San Diego, La Jolla, California 92037

It is a pleasure to inform you that your application for admission to the Department of Psychology, University of California, San Diego, has been reviewed and you have been accepted for admission to the Department for the fall semester of 1975.

The Department of Psychology is pleased to have you join our faculty. We are confident that your presence will contribute significantly to the Department's activities. We are particularly pleased to have you join our faculty as a member of the Department's research staff. We are confident that your presence will contribute significantly to the Department's activities.

APPENDIX

We feel that it is an important part of our responsibility to provide you with information regarding the Department's activities. We are particularly pleased to have you join our faculty as a member of the Department's research staff. We are confident that your presence will contribute significantly to the Department's activities.

You are being asked to provide the following information for the Department's records:

(a) Your current address in the United States

(b) Your current telephone number

(c) Your current e-mail address

(d) Your current fax number

(e) Your current postal address

(f) Your current e-mail address

(g) Your current fax number

(h) Your current postal address

(i) Your current e-mail address

(j) Your current fax number

(k) Your current postal address

(l) Your current e-mail address

(m) Your current fax number

I. INFORMATIONAL MATERIALS--SCHOOL SURVEY

1. AN EXAMPLE OF LETTER TO SCHOOL OFFICIALS (NEW YORK)

To: Chief School Officers, Building Principals, Date: September 1, 1972
Non-Public School Administrators
From: Assistant Commissioner for School Services
Subject: Immunization Survey

In reference to:

The New York State Department of Health, Division of Epidemiology and Preventive Health Services, is conducting a survey to determine the immunization status of all children entering school. Every school district in the State, and each non-public school, is being asked to cooperate. The purpose of the survey is to identify areas needing greater immunization activity by determining immunization levels of five- or six-year-olds.

We feel this is an important way to assist the Department of Health in planning to better meet the needs of children. Please provide the information asked, as of September 20, 1972 for all children entering the school district or private school for the first time, either in Kindergarten or Grade One.

You are being asked to provide the following information for the entrance grade:

- . total number enrolled in the entrance grade
- . number of entering children fully immunized
- . number of entering children partially immunized
- . number of children unimmunized
- . number exempt for religious or medical reasons
- . number of children exempt because of history of measles or rubella

Criteria for determining complete and partial immunization are provided on the form.

Return the completed self-addressed postage paid form, by November 1, 1972.

Your cooperation is greatly appreciated.

I. INFORMATIONAL MATERIALS--SCHOOL SURVEY

2. AN EXAMPLE OF LETTER TO SCHOOL OFFICIALS (MINNESOTA)

January 1972

Dear School Administrator:

In recent months a great deal has been written about the national concern over ever declining immunization levels, particularly for polio, measles, and diphtheria among children.

Information from the State Health Department has shown that we, too, in Minnesota have reason for concern. Pockets of low immune levels exist throughout Minnesota, but exactly where and to what extent is not known. Without these data, corrective measures cannot be appropriately instituted, and without these corrective measures, children will continue to enter school unprotected against these diseases and school based outbreaks will continue. These outbreaks are costly not only from a medical standpoint but also in the amount of valuable school time lost.

For these reasons we have, in conjunction with the State Health Department, developed the attached School Enterers Survey forms as part of a program aimed at raising immunization levels among school enterers and preschoolers in each school district.

School enterers should be surveyed during the spring and summer roundup or immediately upon entering school. This information for each school should then be summarized, recorded, and sent to the school district office by October 15th where it will be forwarded to the State Health Department by November 1st. Those schools which have already completed the survey need not submit the summary for this year. Those schools having 90% of their school enterers immunized against diphtheria, tetanus, pertussis, polio, and rubella, and 100% against measles at the completion of the survey or who achieve these percentages during the school year will be awarded a certificate of accreditation. Children exempted by law from immunization because of medical or religious reasons should be excluded when determining your percentages.

Accreditation certificates will be awarded anytime during the school year when the above percentages have been reached. However, the survey should be completed and turned in by November 1st of each year. Those school districts having all eligible school enterers meeting the above requirements will also receive a district certificate of accreditation.

Thank you for your support of past programs and your assistance in this most worthwhile undertaking.

I. INFORMATIONAL MATERIALS--SCHOOL SURVEY

3. AN EXAMPLE OF SCHOOL ENTRY SURVEY QUESTIONNAIRE (KANSAS)

Please use ballpoint pen and PRESS FIRMLY. Do not separate sheets. School will forward second copy to the Kansas State Department of Health, Topeka, Kansas by November 1st.

KANSAS CERTIFICATION OF IMMUNIZATION

NAME OF PUPIL _____ BIRTH DATE _____
 NAME OF PARENT _____ SCHOOL _____ SCHOOL DISTRICT _____
 ADDRESS _____ CITY _____ COUNTY _____

IMMUNIZATIONS

	(Circle the number of Immunizations received.)						Date of Last Immunization: (Year)
DPT and/or DT	1	2	3	4	5	None	_____
DT	1	2					_____
POLIO ORAL	1	2	3	4	5	None	_____
SMALLPOX	1	2	3	None			_____
MEASLES	Vaccine		Disease		Neither		_____
RUBELLA (<i>German measles</i>)	Vaccine						_____

Initial Test	TUBERCULIN SKIN TEST	Follow-up Test (If Indicated)
Test Used _____		Test Used _____
Date Given _____		Date Given _____
Date Read _____		Date Read _____
Induration _____		Results _____
(In mm. or grade)		

I hereby certify that this child has received the above immunizations, and the child has received a skin test, or tests, for tuberculosis and is considered free of a contagious form of the disease.

Signed: _____ (Date) _____
 (Licensed Physician)

LEGAL ALTERNATIVES

- (1) The physical condition of the above pupil is such that immunization at this time would constitute a serious threat to his health.
 Signed: _____ (Licensed Physician)
- (2) This child is an adherent of a religion whose teachings are opposed to immunization.
 Signed: _____ (Parent or Guardian)
- (3) The financial circumstances are such that I request and give permission to the local health department to administer immunizations and test, as prescribed by the Kansas State Department of Health, to the child named above.
 Signed: _____ (Parent or Guardian)

KANSAS STATE DEPARTMENT OF HEALTH
 K. S. A. 72-5381 (amended 1970)

KANSAS STATE DEPARTMENT OF PUBLIC INSTRUCTION

I. INFORMATION MATERIALS--SCHOOL SURVEY

4. AN EXAMPLE OF SCHOOL ENTRY SURVEY QUESTIONNAIRE (NEW YORK)

N. Y. STATE EDUCATION DEPARTMENT
Ewald B. Nyquist, Commissioner

N. Y. STATE HEALTH DEPARTMENT
Hollis S. Ingraham, M.D., Commissioner

FILL OUT TO INCLUDE ALL STUDENTS IN LOWEST GRADE IN YOUR SCHOOL

SCHOOL: _____ DISTRICT: _____ COUNTY: _____

GRADE: Kindergarten First NUMBER ENROLLED _____
(Circle One)

STATUS	NUMBER OF STUDENTS			
	Diphtheria	Polio	Measles	Rubella
Fully Immunized				
Partially Immunized				
Exempted by having had Disease				
Exempted for Medical/ Religious Reasons				
Unimmunized*				

*Includes those whose immunization status is unknown.

Date: _____ Signed: _____

INSTRUCTIONS:

- Fill out to include all students in kindergarten or first grade, whichever is the lowest grade offered in your school.
- To reflect immunization status of children as of Sept. 20.
- Return by November 1.

DEFINITIONS:

	Diphtheria	Polio (Oral or inactivated)	Measles	Rubella
Fully immunized	3 or more DPT, Td	3 or more doses	1 dose live vaccine since age 1	1 dose since age 1
Partially immunized	1 or 2 doses	1 or 2 doses	killed or live vaccine before age 1	vaccinated before age 1
Unimmunized	None	None	None	None

(Detach before mailing)

II. INFORMATIONAL MATERIALS--TWO-YEAR-OLD

1. PROTOTYPE - LETTER TO LOCAL HEALTH DIRECTORS

Memorandum

TO: _____, M.D., Director
_____ County Health Department

FM: _____, M.D., Immunization Project Director
_____ State Department of Health

SUBJECT: Immunization Level Survey of Two-Year-Old Children
and School Enterers

A principal part of any immunization program should be the establishment of an effective assessment mechanism, whereby current immunization levels of children can be monitored on an ongoing basis. Such a system can identify geographic areas in need of increased immunization services, groups within these areas where immunization levels are low, and individuals within these groups who need intensive motivation or material assistance to obtain immunizations.

Previous data have shown that the greatest changes in immunization levels take place between the first and second birthdays and again at school entry; therefore, a simple survey of two-year old children combined with a school entry survey will provide the two major pieces of information necessary to assess immunization levels.

Many other health jurisdictions throughout the United States have adopted this system and have enjoyed favorable results. I sincerely believe that the establishment of this system in your county would certainly improve an already productive health delivery system. Our Project Coordinator, Mr. _____, will be in contact with you soon to discuss this proposal in greater detail. If in the interim you have any questions, do not hesitate to give me a call.

Thank you for your interest and support in this important public health matter.

II. INFORMATIONAL MATERIALS--TWO-YEAR-OLD

2. COPY OF INITIAL LETTER TO PARENTS (EXAMPLE FROM NORTH CAROLINA)

July 1, 1972

Dear _____,

The North Carolina State Board of Health would like to ask you a few questions about your two-year-old child, who was born in June, 1970. Your child is one of about 900 that we have randomly selected.

All five questions are about immunizations ("shots") that your child may or may not have had so far. Your answers to the enclosed questions will help us plan better health programs for North Carolina's preschool children.

You can answer these five questions by filling out the enclosed card and mailing it back in the envelope that we have provided. The envelope already has a stamp on it.

We will send you a free gift if you will fill out the card and mail it back right away. This free gift is a certified copy of your child's birth certificate. It is an official record that usually costs \$2.00, and it will be very useful to you and to your child.

When you answer the five questions, be sure that you answer them right. If your doctor or health department has given you a written record of your child's shots, please look at that record before you fill out the card.

Please fill the card out and mail it back right away. Do this even if you have moved from North Carolina since your baby was born. All answers are confidential, and we will send you the FREE official certified copy of your child's birth certificate shortly after we get the card back.

We appreciate your help.

Sincerely,

II. INFORMATIONAL MATERIALS--TWO-YEAR-OLD

3. COPY OF FOLLOW-UP LETTER TO PARENTS (EXAMPLE FROM NORTH CAROLINA)

Early in July we mailed you a card that asked five questions about the immunizations (shots) that your two-year-old child, _____, has had.

There could be any number of reasons why we have not gotten the card back from you--

- maybe you didn't receive it,
- maybe you lost it,
- maybe you haven't had a chance to fill it out,
- maybe you just plain forgot about it.

We need the answers to the five questions in order to plan better health programs for young North Carolina children. Another card and another stamped envelope are enclosed, and you could be a great help to us by filling this card out and mailing it back.

If you will take a minute or two to do this we will mail you an official certified copy of your child's birth certificate. This important record usually costs \$2.00, but we will send you a FREE copy if you mail the card back before August 1.

Please help the State Board of Health help young North Carolina children. Mail the card back today.

Sincerely,

II. INFORMATION MATERIALS--TWO-YEAR-OLD

4. AN EXAMPLE OF A TWO-YEAR-OLD SURVEY QUESTIONNAIRE (NORTH CAROLINA)

NORTH CAROLINA STATE BOARD OF HEALTH
 IMMUNIZATION QUESTIONNAIRE
 FOR
 CHILDREN BORN IN JUNE, 1970

CODE _____

PLEASE ANSWER ALL FIVE QUESTIONS
 CHECK ONE BOX FOR EACH QUESTION

1

HAS YOUR CHILD HAD ANY DPT SHOTS? (IF "YES", WRITE IN NUMBER OF SHOTS HE HAS HAD)	<input type="checkbox"/> YES	<input type="checkbox"/> NUMBER OF SHOTS	<input type="checkbox"/> NO	<input type="checkbox"/> DON'T KNOW

2

HAS YOUR CHILD HAD ANY ORAL POLIO VACCINE? (IF "YES", WRITE IN NUMBER OF DOSES HE HAS HAD)	<input type="checkbox"/> YES	<input type="checkbox"/> NUMBER OF DOSES	<input type="checkbox"/> NO	<input type="checkbox"/> DON'T KNOW

3

HAS YOUR CHILD HAD A <u>RED</u> MEASLES SHOT?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> DON'T KNOW

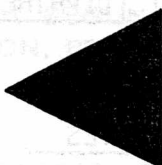
4

HAS YOUR CHILD HAD A <u>GERMAN</u> MEASLES (RUBELLA) SHOT?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> DON'T KNOW

5

WHERE DID YOUR CHILD GO FOR MOST (OR ALL) OF THE SHOTS THAT HE HAS HAD SO FAR?	<input type="checkbox"/> PRIVATE DOCTOR
	<input type="checkbox"/> HEALTH DEPARTMENT
	<input type="checkbox"/> MILITARY
	<input type="checkbox"/> OTHER _____
	<input type="checkbox"/> HAS HAD NO SHOTS

PLEASE FILL THIS OUT



YOUR NAME _____

ADDRESS _____

CITY _____ COUNTY _____ STATE _____

TELEPHONE NUMBER _____

MAIL THIS BACK IN THE ENCLOSED ENVELOPE

II. INFORMATIONAL MATERIALS--TWO-YEAR-OLD

5. AN EXAMPLE OF TWO-YEAR-OLD SURVEY QUESTIONNAIRE (ARKANSAS)

All of the questions below pertain to your child,

This is not a test and we are not looking for any right or wrong answers. To answer the questions below, please check the appropriate box.

1. How many shots for whooping cough, diphtheria and tetanus (sometimes called "DTP shots", "baby shots", "triple shots") has your child received?
 0 1 2 3
 4 DON'T KNOW
 2. How many times has your child received oral (Sabin) polio drops? (by mouth, not by injection)
 0 1 2 3
 4 DON'T KNOW
 3. Has your child had a shot for measles (sometimes called red or 10-day hard measles)?
 YES NO DON'T KNOW
 4. Has your child had a shot for rubella (German measles, sometimes called 3-day measles)?
 YES NO DON'T KNOW
 5. Has your child had a single shot that protects against BOTH 10-day measles and rubella?
 YES NO DON'T KNOW
 6. Has your child had a shot for mumps?
 YES NO DON'T KNOW
 7. Where do you usually take your child for immunizations?
 DOCTOR HEALTH UNIT OTHER
 8. Please place a check mark before each ILLNESS that your child has had:
 PERTUSSIS POLIO
(whooping cough)
 MEASLES MUMPS
(red measles)
 DIPHTHERIA RUBELLA
(German measles)
- A. Was your child seen by a doctor for the illness that you checked?
 YES NO OTHER

II. INFORMATIONAL MATERIALS--TWO-YEAR-OLD

6. AN EXAMPLE OF TWO-YEAR-OLD SURVEY QUESTIONNAIRE (NEW MEXICO)

TWO-YEAR-OLD CHILDREN IMMUNIZATION SURVEY

1. _____ HAS HAD THE IMMUNIZATIONS (SHOTS) CHECKED
(CHILD'S NAME)

BELOW:

DPT (DIPHTHERIA - PERTUSSIS - TETANUS)

1. _____
MONTH/YEAR

2. _____
MONTH/YEAR

3. _____
MONTH/YEAR

POLIO

1. _____
MONTH/YEAR

2. _____
MONTH/YEAR

3. _____
MONTH/YEAR

MEASLES (10-DAY, HARD, RED MEASLES;
 RUBEOLA)

MONTH/YEAR

RUBELLA (3-DAY, GERMAN MEASLES)

MONTH/YEAR

2. IMMUNIZATIONS RECEIVED FROM: PRIVATE DOCTOR

HEALTH DEPARTMENT

MILITARY

OTHER _____

WHERE

3. I NEED HELP IN ARRANGING FOR MY CHILDREN'S IMMUNIZATIONS. YES NO

4. IF YOU HAVE NOT BEGUN YOUR CHILDREN'S IMMUNIZATIONS, PLEASE LET US
 KNOW THE REASON; PERHAPS WE CAN HELP YOU.

III. EXAMPLES OF SURVEY--SCHOOL ENTRY

1. OREGON

KEYSORT IMMUNIZATION PROGRAM

The Keysort Immunization Program is designed to obtain an accurate immunization history on every child entering school for the first time. This includes children entering first grade or kindergarten. The program is also designed to raise the entering population's immune level through a school based immunization program.

The keysort card, (see example) used for immunization history, will include a signed consent or refusal for further immunizations. Other integral features of this form include:

1. Keysort capabilities
2. Multiple copies (6)

The keysort capability has three functions:

1. Allows rapid identification of every child in the entering population needing a specific immunization. This will greatly reduce clerical time required to identify who is to get a specific vaccine on the clinic day.
2. Allows rapid tabulation of the immunization levels in each school. The initial analysis will measure the existing pre-school program. The final analysis will monitor the effectiveness of the program itself.
3. Allows additional space and coding possibilities for optional usage.

The multiple copies will undergo the following distribution:

1. Original copy for school records and for legal purposes.
2. Hard copy for health department records.
3. 4 tissue copies available to be sent home to inform parents of immunizations administered on a given day.

The essential benefits of this combined program are:

1. To identify and to immunize those children needing a specific immunization.

2. To supply annual information on immune levels by disease, age, and elementary school. This will measure immunization services available to preschoolers from both public and private sources, by neighborhood.
3. To analyze specific problem areas by school, susceptible populations, and their associates.
4. To allow health departments to determine more accurately the amount of vaccine to be ordered thus permitting the direction of remaining immunization monies to high risk neighborhoods.
5. To rapidly compile accurate statistics.

The immunizations to be included in the program are Diphtheria, Tetanus, Measles, Rubella, and Polio.

Mumps vaccine has been excluded due to its high cost and the fact that it is not recommended for community programs at this time.

Smallpox has been excluded because of the difficulty in adequately excluding children who have a rash disease or siblings at home with rash disease.

TB skin tests have been excluded because of low productivity in the target age group. Optional coding space has been provided for programs which intend to continue TB skin testing.

The keysort card has been field tested in Washington County in the Reedville School District (3 schools) with the following results:

Total cards sent home	673	
Total cards returned	637	94%
Total cards returned for correction	49	7%

93% of the cards returned were correctly filled out.

	Immune level status before	After status if immunizations are given
Smallpox	88%	97%
Mumps	56%	81%
Measles	82%	95%
Rubella	80%	94%
DPT complete	77%	92%
partial (needing only booster)	91%	97%
Polio complete	64%	92%
partial	88%	98%

Overall immunization level for vaccines to be included in program (Polio, Measles, DT, Rubella) Before 75% After 93%

Based on the analysis of the above:

Tabulation and notching time -- 2 minutes per card

Administration time -- 1 minute per shot

Based on 931 shots given

Example of key-sort card:

PLEASE CHECK THE IMMUNIZATIONS THIS CHILD HAS RECEIVED IN THE PAST

1	DPT-1ST TIME	
2	DPT-2ND TIME	
3	DPT-3RD TIME	
4	DPT BOOSTER BEFORE AGE 4	
5	DPT BOOSTER AFTER AGE 4	
6	POLIO-1ST TIME	
7	POLIO-2ND TIME	
8	POLIO BOOSTER BEFORE AGE 4	
9	POLIO BOOSTER AGE 4 OR LATER	
10	MEASLES OR MEASLES VACCINE	
11	RUBELLA VACCINE	

PLEASE PRINT - USE BALL POINT PEN - PRESS HARD

DATE OF BIRTH: MONTH DAY YEAR TELEPHONE

ADDRESS: STREET MIDDLE FIRST CITY

CHILD'S LAST NAME

COMPLETE HISTORY

READ REVERSE SIDE THEN COMPLETE THIS SIDE

FOR ANY MISSING AND/ OR INCOMPLETE IMMUNIZATIONS LISTED ABOVE. GIVE PERMISSION OR REFUSAL.

I HAVE READ AND UNDERSTAND THE REVERSE SIDE AND GIVE PERMISSION FOR MY CHILD TO RECEIVE THE FOLLOWING IMMUNIZATIONS. PLEASE CHECK

1 DT 2 POLIO 3 MEASLES 4 RUBELLA

I DO NOT WANT MY CHILD TO RECEIVE THE FOLLOWING IMMUNIZATIONS IN THIS PROGRAM. PLEASE CHECK

1 DT 2 POLIO 3 MEASLES 4 RUBELLA

SIGNED PARENT OR LEGAL GUARDIAN

DATE

NAME OF FAMILY PHYSICIAN (IF-ANY)

COMPLETE AND RETURN CARD ON EVERY CHILD

DEAR PARENT:

"CATCH UP" IMMUNIZATIONS ARE BEING OFFERED IN SCHOOL WITHOUT CHARGE. THIS PROGRAM OFFERS IMMUNIZATIONS FOR DIPHTHERIA- TETANUS (DT), POLIO, (ORAL VACCINE), MEASLES, RUBELLA.

P OF DPT IS SHORT FOR PERTUSSIS OR WHOOPING COUGH VACCINE. IT IS NOT RECOMMENDED AFTER AGE 5.

MEASLES IS COMMONLY CALLED HARD OR 10 DAY MEASLES.

RUBELLA IS COMMONLY CALLED 3 DAY OR GERMAN MEASLES.

DPT IS FREQUENTLY CALLED BABY SHOTS.

WE RECOMMEND THESE IMMUNIZATIONS UNLESS

- FOR POLIO, MEASLES, RUBELLA IMMUNIZATION**
THE CHILD IS NOW UNDER THE CARE OF A DOCTOR FOR ANY ILLNESS. THE DOCTOR SHOULD BE CONSULTED BEFORE GIVING PERMISSION FOR IMMUNIZATIONS.
- FOR DT IMMUNIZATIONS**
THE CHILD HAS PREVIOUSLY EXPERIENCED CONVULSIONS OR OTHER UNUSUAL REACTIONS TO DPT OR DT SHOTS.
- FOR MEASLES AND RUBELLA IMMUNIZATIONS**
THE CHILD IS ALLERGIC TO EGGS, FEATHERS, NEOMYCIN OR RABBITS (RUBELLA ONLY).
- A CHILD WITH FEVER ON THE DAY OF THE CLINIC SHOULD HAVE IMMUNIZATION POSTPONED.

IF YOU ARE NOT SURE WHETHER YOUR CHILD SHOULD RECEIVE AN IMMUNIZATION, CHECK WITH YOUR DOCTOR OR SCHOOL NURSE BEFORE GIVING PERMISSION.

COMMON REACTIONS

- MEASLES- FEVER AND OR RASH 8 TO 10 DAYS AFTER SHOT.
- RUBELLA- TEMPORARY JOINT PAINS 14 TO 60 DAYS AFTER SHOT IN 1 TO 5% OF CHILDREN.
- DT - LOCAL PAIN AND TENDERNESS AT INJECTION SITE WITH LOW FEVER IN 10% OF CHILDREN.

IF YOU CANNOT REMEMBER WHETHER YOUR CHILD HAS RECEIVED AN IMMUNIZATION, IT CAN BE REPEATED WITHOUT ADDITIONAL RISK IF THE ABOVE ARE NOT PRESENT.

III. EXAMPLES OF SURVEYS--SCHOOL ENTRY

3. RETROSPECTIVE SURVEYS OF IMMUNIZATION LEVELS (NEW JERSEY)

Problem

The New Jersey Immunization Program faced a need for determination of the levels of protection against the immunizable diseases among children in the State. The program needed maximal outputs of information from minimal investments of time, effort and money in implementation of survey techniques.

Hypothesis

The program conjectured that important information concerning immunization levels and patterns among elementary school children and preschool children could be derived by assessing the school health records of kindergarten children.

Method

The Retrospective Survey Method is recommended for those cities and states where immunization histories of school enterers are routinely recorded in terms of specific dates. From the purely mechanical viewpoint the method works as follows:

1. The individual records of kindergarten children in a given school are reviewed and tabulated by calendar year of receipt of specific vaccines or doses of vaccines. (See Exhibit A)
2. The numbers on the tabulation form are (Exhibit A) converted to percentages (Exhibit B). The individual tabulations may be combined for municipalities, districts or counties.
3. Inferences may be drawn from the tables of percentages:
 - A. Precise levels of protection are indicated for school enterers. The sample can equal 100 percent of that population.
 - B. Reasonable presumptions about older children may be made after consideration of the school entry requirements and the length of time such requirements have been in effect.
 - C. Values for these children as of age two years (or 3 years or 4 years) may be projected as being reasonably representative of present values of preschool children. The profiles of these children indicate trends, at least, and transience of the

population does not have the great significance it would have with a survey of two-year-old children per birth certificate.

D. Attitudes towards immunization and influence of school entry immunization requirements are indicated.

E. The presence, prevalence or absence of significant percentages of children who were immunized against measles before their first birthdays is indicated.

See Exhibit B for specific interpretations of the above.

From an administrative viewpoint, the method could work as follows:

1. Tabulations from the records may be made by representatives of the Immunization Program or by school nurses. Two persons can easily tabulate the records of 200 children in less than two hours. No mailings are necessary, no follow-up is needed, and participation is 100 percent. A few minutes with a calculator converts the tabulations into data subject to immediate interpretation.
2. Tabulations could be made by school nurses at the same time the data is elicited for school registration. The data could be transmitted by the schools for handling by the Immunization Program, or it could be incorporated into computer operations of the school systems and provided to the Immunization Program in final form. The procedure could, of course, be perpetrated as an annual evaluation tool, and programs to protect susceptible school enterers could be systematized.

Evaluation

The method has been evaluated by comparison of data obtained with retrospective surveys and data from conventional random surveys patterned after Serfling and Sherman in three different communities. The correlations have been excellent. Until now, information concerning rubella would have been suspect because of the relationships of the date of rubella vaccine licensure and the birthdates of children in 1970-71 or 1971-72 Kindergarten classes and the probability that many of such children would have been no longer under routine pediatric surveillance when the vaccine was begun to be used widely. We believe that rubella data for 1972-73 Kindergarten classes is representative and that next year will be even better.

NEW JERSEY STATE DEPARTMENT OF HEALTH

RETROSPECTIVE KINDERGARTEN SURVEY
OF IMMUNIZATION LEVELS

COUNTY _____
MUNICIPALITY _____
SCHOOL _____
KINDERGARTEN ENROLLMENT 43
NUMBER IN SAMPLE 43
DATE OF SURVEY 7/26/72

S A M P L E W O R K S H E E T

YEARS DURING WHICH ENTERING KINDERGARTEN CHILDREN
HAD RECEIVED SPECIFIC INOCULATIONS

Type of Immunizations	Measles ** Vaccine Before Age 1 yr.	Date Unknown	YEARS DURING WHICH ENTERING KINDERGARTEN CHILDREN HAD RECEIVED SPECIFIC INOCULATIONS							1 or 2 Doses	Zero Doses
			1967	1968	1969	1970	1971	1972			
DPT (3rd Dose)	X		### ### ###	### ### ###							
ORAL POLIO (3rd Dose)	X		### ###	### ### ###							
HISTORY OF MEASLES * DISEASE	X									X	
MEASLES * VACCINE	### ### 			### ### ###					###	X	
RUBELLA VACCINE	X		X	X	### ###	### ###		### ### 		X	

*If a child has a history of both measles diseases and measles vaccine, mark only the vaccine.
**If a child's birthdate and the date of receiving measles vaccine are less than a year apart, mark only the column measles vaccine before age 1 year. Do not mark in the calendar year column.

NEW JERSEY STATE DEPARTMENT OF HEALTH
RETROSPECTIVE KINDERGARTEN SURVEY OF IMMUNIZATION LEVELS

YEARS DURING WHICH ENTERING KINDERGARTEN CHILDREN
 RECEIVED SPECIFIC INOCULATIONS EXPRESSED AS PER-
 CENTAGES OF THE SAMPLE

Type of Immunization	Measles Vaccine Before 1 Yr.	Date Unknown	1967	1968	1969	1970	1971	1972	1 or 2 Doses	Zero Doses
DPT (3rd Dose)	X		58.2	37.2	2.3				2.3	
ORAL POLIO (3rd Dose)	X		23.2	53.4	4.7			7.0	4.7	7.0
HISTORY OF MEASLES DISEASE	X								X	
MEASLES VACCINE	27.9			46.5	7.0	4.7	2.3	11.6	X	
RUBELLA VACCINE	X		X	X	14.0	46.5	2.3	32.5	X	4.7

38

EXHIBIT B

Studies have documented reduced vaccine efficacy rates among children immunized before they were one year old. This percentage may be of significance in program planning.

When comparing the levels of these children with preschoolers, one should discount immunizations received in 1972 as being influenced directly by school entry requirements or recommendations.

All of these children are within months of the same age. The greater the grouping around the years 1967-68-69, the closer the sample has come to the ideal schedule of immunizations.

III. EXAMPLES OF SURVEYS--TWO-YEAR-OLD

1. GENERAL FORMAT

Assume that a state project has one major city with a well defined poverty area and eight (8) secondary cities with each having well defined poverty areas. The remaining portion of the state is rural and can be subdivided as northern rural and southern rural.

The survey design includes the following strata:

1. major city poverty
2. major city non-poverty
3. secondary cities poverty
4. secondary cities non-poverty
5. northern rural
6. southern rural

A total of 900 children would be sampled to obtain independent estimates for each strata and summed over the six strata (with appropriate weighting factors) to obtain the statewide estimates.

III. EXAMPLES OF SURVEYS--TWO-YEAR-OLD

2. VERMONT

The Vermont birth certificate form was revised to include items concerning the education of the father and mother and the mother's prenatal care. Using this and other known data, a survey was conducted to study the relationships between demographic, social, and medical characteristics and the levels of immunization of children 20 months of age.

Education of mother appears to be the strongest characteristic for predicting immunization status, that is, immunization status varies more rapidly with differences in education than by age, number of children, etc. The most noticeable change occurs between the status of a child whose mother is a high school dropout and one who completes high school, with little added advantage of higher education.

Other surveys conducted in Ohio and North Carolina corroborate the Vermont findings. It appears that these children present a high risk potential and should receive special attention.

These results offer an inherent system for area stratification. Birth certificates can be stratified into groups depending upon the education level of the mother and a sample of certificates can be taken in this manner. For example:

Stratum 1: education level less than 9th grade

Stratum 2: education level 9-11 grades

Stratum 3: education level greater than 12th grade

In areas where socioeconomic stratification has not been done, then stratification by mother's education level seems a likely substitute.

III. EXAMPLES OF SURVEYS--TWO-YEAR-OLD

3. TENNESSEE

The mechanics of the two-year-old survey in Tennessee are briefly summarized below:

1. A listing of births occurring in the required time interval for the defined survey area is obtained from the data processing office.
2. The sample is selected from this listing (based on 95% confidence level with a precision of $\pm 7.5\%$).
3. A portion of the sample questionnaire is then completed with the remaining data (education level of mother, number of other children, etc.) entered at the Division of Vital Records. Additionally, the selected sample is then screened for infant deaths and adoptions.
4. Efforts to obtain telephone numbers through the telephone company's complete listing of Tennessee residents are made.
5. Detailed highway department maps for the survey area are obtained.
6. Advance publicity is released in the local newspaper, with pictures of the interviewers being released in the local newspaper.
7. Interviewers then go to the survey area and search local health department records. For those not found, telephone calls are made (in the afternoon and evening).

8. Field visits are the made (after assistance from nurses, sanitarians, and post office personnel to verify the address of the prospective respondent).
9. After completing this stage of the survey, each child in the survey falls into one of three categories: known immunization status; known to have moved outside the county; purged because of infant death or adoption.
10. The survey is now completed. By carefully planning the survey and making total use of all available time, the survey is conducted by two individuals in two full days and one night. The survey is completed in five (5) man-days.

IV. STATISTICAL CONSIDERATIONS

1. SAMPLE SIZE DETERMINATION FOR SCHOOL-ENTERER SURVEYS

It is generally recommended that immunization level data be collected on all school enterers in the project area. This data collection activity is usually made the primary responsibility of the education agency and its ancillary organizations. However, if such a system cannot be established, a sampling scheme must be used to obtain the data.

The sampling procedure for school enterers is more complex than for the two-year-old children because a complete listing of students is generally not available. For this reason it is much simpler to complete the questionnaire on all school enterers from a sample of schools within the defined strata.

The calculation of the standard deviation for purposes of determining the 95% confidence limits becomes more complex than the formula given in the two-year-old survey section (Formula 4).

For this reason we make the following generalizations. Sample fifteen (15) schools from each strata if the average number of children per classroom is at least 20 children. The resulting 95% confidence limits will be approximately $\pm 10\%$. If the average number of children per classroom is less than 20, seek additional statistical advice.

2. SAMPLE SIZE DETERMINATION FOR TWO-YEAR-OLD SURVEYS

A. The required sample size for estimating immunity levels is based on the binomial distribution. This is appropriate because an individual is categorized into only two classes: immunized or not immunized. Applying statistical theory, the required sample size is given by the formula

$$n = \frac{Z^2(P)(1-P)}{d^2} \quad (1)$$

n = the sample size

Z = value associated with the confidence level

P = the proportion immunized

$1-P$ = the proportion not immunized

For planning purposes it is reasonable that the sample estimates be as precise as ± 10 percentage points (d). The confidence level has been selected at 95%, thus $Z = 1.96$ (or rounded up to 2). For determining the sample size, an estimate of the variance is required. By substituting $P = .5$, the variance becomes maximized which also maximizes the required sample size. Substituting these values into the formula results in the estimated sample size. The calculated number has been inflated to 150 children to account for losses due to infant deaths, illegitimates, non-locatable children, etc. Efforts should be made to obtain data on as many of these 150 children as possible.

B. In certain situations the required sample size can be adjusted downward. This situation results when the total number of annual births within a strata is small relative to required sample of births. As a general rule, if the ratio (percent) of the sample size to the total number of births is 10% or greater, then the adjustment should be made. This adjustment is made using the following formula

$$n_a = \frac{n}{1 + \frac{n}{N}} \quad (2)$$

n_a = the adjusted sample size

n = the sample size determined by formula 1

N = the total number of annual births in the chosen stratum

EXAMPLE:

Five hundred (500) births occurred in the selected strata during 1970

$$n_a = \frac{150}{1 + \frac{150}{500}} = \frac{150}{1 + .3} = \frac{150}{1.3} = 116$$

C. Because we are able to estimate the sampling error, an interval of values can be calculated for which we can be relatively certain that the true universe value falls within. This interval is commonly referred to as the confidence interval. From statistical theory, we can be 95% certain that the true universe value falls within two standard deviations of the sample estimate.

The 95% confidence limits are obtained by using formula 3.

$$p - 2\sqrt{\frac{p(1-p)}{n}} \quad \text{and} \quad p + 2\sqrt{\frac{p(1-p)}{n}} \quad (3)$$

EXAMPLE

annual births	10,000
required sample size	150
completed questionnaires	125
sample estimate	65%

$$65\% - 2\sqrt{\frac{(65\%)(35\%)}{125}} \quad \text{and} \quad 65\% + 2\sqrt{\frac{(65\%)(35\%)}{125}}$$

$$65\% - 8.5\% = 56.5\% \quad 65\% + 8.5\% = 73.5\%$$

From the above, the results from the sample survey can be presented for each disease category. Using this example of formula 3 we can present the immunization level with the 95% confidence limits. These data are: (1) immunization level -- 65%; (2) 95% confidence limits -- 56.5% - 73.5%.

D. When the total number of annual births within a strata is small relative to the required sample, the 95% confidence limits are calculated using formula 4.

$$p - 2\left(\frac{N-n}{N}\right) \times \sqrt{\frac{p(1-p)}{n}} \quad p + 2\left(\frac{N-n}{N}\right) \times \sqrt{\frac{p(1-p)}{n}} \quad (4)$$

EXAMPLE

annual births	500
required sample size	150
adjusted sample size	116
completed questionnaires	91
sample estimate	68%

$$68\% - 2\left(\frac{500-91}{500}\right)\sqrt{\frac{(68\%)(32\%)}{91}}$$

$$68\% - 2(.818)(4.9\%)$$

$$68\% - 8.0\% = 60\%$$

$$68\% + 2\left(\frac{500-91}{500}\right)\sqrt{\frac{(68\%)(32\%)}{91}}$$

$$68\% + 2(.818)(4.9\%)$$

$$68\% + 8.0\% = 76\%$$

From the above, the results from the sample survey can be presented for each disease category. Using this example of formula 4 we can present the immunization level with the 95% confidence limits. These data are: (1) immunization level -- 68%; (2) 95% confidence limits -- 60% - 76%.

V. FORMAT OF FINAL REPORT

An excellent report format is illustrated by the recent issuance of the North Carolina survey report. The report followed this outline:

Introduction

Sample Design and Survey Methodology

Tabular Presentation of the Data with Short
Concise Summaries

Information Materials (letters, questionnaires, etc.)

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