Measles Control in Oregon

Despite limited resources, the Oregon State Health Division is conducting an effective measles control program by using existing staff and funds

DONALD P. FRANCIS, MD, RANDALL S. POPE, BS, and EDWARD J. PASTERNAK, BS

MEASLES, a disease causing substantial morbidity (*1*) and financial loss (*2*), continues to occur in the United States (*3*). Yet, with today's highly effective vaccine, it should be possible to control or even eliminate the disease from this country. For this endeavor, the recommendations by Sencer and co-workers in 1967 (*4*) of (*a*) an effective routine vaccination program, (*b*) a sensitive surveillance system, and (*c*) rapid vaccination of contacts of cases in outbreaks (containment vaccination) are applicable today. Unfortunately, in most States these three essential components do not exist, and transmission of measles continues. Lack of staff and funds often is given as explanation for the failure to stop transmission.

Even with limited resources, progress in measles control can be achieved. For instance, the Oregon State Health Division, unable to increase expenditures, has attempted to improve its measles control program with existing funds. Through the collaboration of county health department personnel and a three-person State immunization office, the three essentials of measles control have been strengthened in this State of slightly more than 2 million population.

Oregon's Program

Vaccination. After the introduction of measles vaccine and the large national vaccination drive in 1966, Oregon, although continuing to emphasize the importance of measles vaccination, had little yearly improvement in immunity levels as determined by national surveys. To localize areas of low immunity in the State, a county program to assess the immunization status of entering first-grade students was begun in 1970. The following assessment procedure is used: (*a*) the parents of all entering students are interviewed, and the student's history of measles disease or immunization is reviewed, (*b*) for each student the interviewer records the immunization or disease history on a marginal punchcard (key-sort card), (*c*) each card is hand punched for each immunization (including poliomyelitis, rubella, DTP, mumps and

☐ *Dr. Francis, a former Epidemic Intelligence Service officer in the Field Services Division, Bureau of Epidemiology, Center for Disease Control, at the Oregon State Health Division, Portland, is currently career development officer, Center for Disease Control, Department of Microbiology, Harvard School of Public Health, Boston. Mr. Pope is public health advisor, Kidney Donor Activity, Center for Disease Control, and Mr. Pasternak is information representative, Immunization Program, Oregon State Health Division, Portland.*

Tearsheet requests to Center for Disease Control, Attn.: Field Services Division, Bureau of Epidemiology, Atlanta, Ga. 30333.

measles), (*d*) a stylus is placed through the desired immunization hole, and the cards of immunized children fall free from those still requiring immunization, (*e*) immunization levels of each disease for the school are calculated, recorded, and submitted to the country health department for countywide compilation, and (*f*) non-immunized students are identified, and necessary immunizations are given by the county health department or a private physician.

At the State level, the key-sort survey is used mainly to reveal areas with low immunization levels and to monitor levels after improvement efforts have been made. To establish a survey in a county, a full-time employee at the State immunization office instructs county workers on the use of the key-sort system and works extensively with each county during the initiation of the system. After the first year of operation in a county, the survey is performed by county staff with minimal State input, including supplying the key-sort cards.

When a county with low immunization levels is identified, State immunization staff consult with the county's health department and develop specific plans to improve the level of preschool immunization.

Two criteria are used to assess the key-sort survey: (*a*) the acceptance of the program by the counties and (*b*) the improvement of immunization levels after the institution of the program.

The first of these criteria reflects the real world of any system that is developed at the State level but executed by the county health departments, where staff, time, and sometimes interest are limited. The acceptance by the counties of the system as workable and beneficial is necessary for its contribution. Since the institution of the key-sort survey in 1970, increasing numbers of Oregon's 36 counties have used it, as shown in the following table.

Academic year	*Number of counties*
1970–71	1
1971–72	11
1972–73	26
1973–74	25
1974–75	27
1975–76	[1]32

[1] 90 percent of the State's first-graders are in these counties.

Measles immunity levels also have improved since the inception of the survey. Measles immunity (history of vaccination or disease) in children entering the first grade increased from 76.5 percent in 1971 to 92.2 percent in 1975.

In an additional attempt to increase preschool and school immunization levels, Oregon enacted a compulsory school entry immunization law in 1973. This law requires students to have measles immunization or a history of clinical measles before entering school.

Since both the key-sort program and the school immunization law were in effect in 1973–75, it is impossible to assess the influence of each on immunity levels. During the years when both were in effect, a marked improvement occurred in school entry immunity levels for measles. The percentages of entering first-grade students with a history of measles or measles vaccination at the time of school registration were as follows:

Academic year	*Percent immune*
1971–72	76.5
1972–73	75.3
1973–74	84.2
1974–75	88.6
1975–76	92.2

Surveillance. The discovery of measles cases (surveillance) is essential for any control program. Early discovery is extremely important so that containment vaccination can begin before additional areas are infected. Surveillance of measles in Oregon is the responsibility of physicians, public health nurses, and the State public health laboratory.

Physicians. Several measures were instituted to increase reporting of measles by physicians: (*a*) measles was placed on the list of communicable diseases mandatorily reportable by telephone, (*b*) information about the measles control program and the importance of reporting cases of measles were relayed to physicians through the county health departments and medical societies, (*c*) the State communicable disease summary, which is received by 70 percent of the State's 2,900 physicians, has repeatedly stressed measles reporting, has reported outbreaks, and has described results of containment activities, and (*d*) reporting physicians are contacted immediately by county and State immunization staffs.

Public health nurses. All of Oregon's counties have public health nurses on their staffs. Responsibilities vary according to the number of nurses and the size of the county, but most nurses are responsible for community and school health programs. These nurses are usually cognizant of the measles control program and the importance of early reporting of any suspected cases. They serve as important sentinels of measles surveillance.

State public health laboratory. The Oregon State Health Division Laboratory assists in diagnosing exanthematous diseases in serum specimens sent from throughout the State. All specimens from persons suspected of or with diagnosed measles are reported to the State immunization office.

We examined two aspects of surveillance to assess the State's surveillance system: (*a*) who reported measles outbreaks and (*b*) how much time elapsed between the first case and the report of the outbreak. For this assessment, an outbreak is defined as a case or epidemiologically related cases occurring within a single city or county. Between December 1974 and August 1975, six outbreaks of measles occurred in Oregon—physicians reported three, public health nurses two, and the public health laboratory one. In the six outbreaks, the median time from the onset of the first case to the report to the State was 14.5 days (range 11 to 24 days). Thus, although an outbreak should be reported immediately after the onset of the first case or cases, most are not reported until the second generation of cases has already occurred.

Containment. Containment of measles is the selective vaccination of contacts of patients. The goal is to form a wall of immunity around patients so that transmission is interrupted. The number of persons who are vaccinated to form this wall depends on the size of the outbreak. Theoretically, only the immediate contacts of patients and the contacts of these contacts need to be vaccinated. However, because of the difficulty in identifying all contacts of measles patients, a larger population is usually targeted so that all actual and potential contacts can be immunized.

Measles containment vaccination, a program priority in Oregon since 1970, has become increasingly systematized. When a report of suspected measles is received at a county health department or the State health division, it is investigated immediately. In most instances the county staff perform the initial investigation. To determine the exact size of the outbreak, they contact all physicians' offices and schools to locate all cases. When the size of the outbreak is determined, the number of immediate and potential contacts is estimated. While plans are made for immunization clinics for the community, county personnel vaccinate the immediate contacts, either actively with vaccine or passively with gamma globulin. Immediate contacts include household and classroom contacts and any others found by history to have close contact in group gatherings such as physicians' offices, buses, sporting events, or parties. Next, the county personnel publicize the outbreak in the local media and distribute vaccination permission slips in the schools.

The State immunization office and the county health department jointly plan and operate the community and school immunization clinics. After establishing times and places for clinics, the county personnel make local arrangements for these clinics and the State workers arrange for vaccine and jet injectors from State stocks or from the Center for Disease Control in Atlanta. The State and county staffs meet to make final containment plans before the immunization clinics begin. They discuss and record outbreak epidemiology (including source of the first case and possible movement of infectious patients), ongoing surveillance of the outbreak (physicians, hospitals, and schools), and the extent of control vaccination. Both State and county staff work together in the immunization clinics, which usually are held from 2 to 7 days. Afterward, county personnel vaccinate any remaining suspectible persons and continue to survey for additional cases. Meanwhile, the State personnel notify other counties or States of suspected measles outbreaks that are linked to the outbreak. These include the outbreak in which the first patient acquired the disease and any patients or susceptible contacts who traveled outside the outbreak area.

To evaluate the measles containment system in Oregon, two measurements of containment time have been monitored: (*a*) the time from the report of an outbreak to the beginning of the containment effort and (*b*) the time from the report to the end of measles transmission.

The delay in initiating containment is a measure of the ability of State and county officials to mobilize their staffs and handle the logistics of vaccination clinics. This delay can be measured from several points in the reporting pathway, which usually flows from physician to county and then from county to State. We have used the time from the county's receipt of a report to the administration of vaccine at a community or school clinic. For the six outbreaks evaluated, the median delay from receipt of a report by the county health department to the administration of vaccine was 7.5 days. The range was 2 to 30 days (see table).

The second containment measurement, the delay from report to end of transmission, assesses the total of effectiveness of containment. The delay is shortest (less than one incubation period) when all susceptible contacts are vaccinated immediately after the report is received. The delay is long when susceptible persons remain unvaccinated and continue to contract measles. We measure this delay from the receipt of the first report by the county to the onset of the last case in the outbreak. In the same out-

Intervals between onset of the first measles case and the report to the county health department, between the report and the first immunization clinic, and between the report and onset of the last case in 6 outbreaks, Oregon counties, December 1974–August 1975

County	*Number days first case to report*	*Number days report to first clinic*	*Number days report to last case*
Josephine	24	2	57
Klamath	14	10	17
Douglas	21	30	14
Clackamas	11	5	16
Rogue River	13	5	16
Jackson	15	10	36
Median number days	14.5	7.5	16.5

breaks the median time to stop tranmission was 16.5 days, ranging 14 to 57 days (see table).

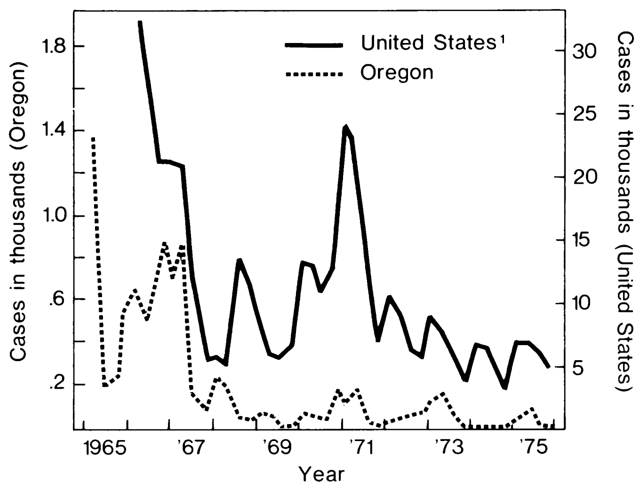
Discussion

The ultimate criterion to assess the success of a measles control program is the occurrence of measles. From 1965 through 1975, measles in Oregon showed a predominantly downward trend despite a marked increase in surveillance (fig. 1). Oregon reached zero cases in late 1973 and maintained zero cases until late 1974, when an acute case from California caused an outbreak in southern Oregon. The outbreak was poorly contained (57 days from report to onset of last case), and cases occurred in surrounding counties. During the 8 months after the initial importation, two additional imported cases caused outbreaks, and three indigenous outbreaks occurred (fig. 2). In these 6 outbreaks, 189 cases of measles were reported. Of these cases, 88 (49 percent) were from the 3 imported outbreaks, and the remaining cases occurred in the 3 indigenous outbreaks in which the source of initial infection was either from Oregon or was untraceable and presumed to be from a nearby area that was having an outbreak. The large number of cases in these few outbreaks was due to common-source exposures on school buses, and in one, members of a large skating party were exposed. Although it was possible to stop transmission in all six outbreaks, transmission was prolonged (more than 17 days from report to onset of last case) in two outbreaks.

We are confident that measles morbidity has decreased in Oregon because of the three-part program. However, documentation of the program's success or of the contributions of its individual parts is not easy. The major measure of success of a measles program should be the annual incidence of measles in the population at risk. But, the measured incidence depends on the effectiveness of the surveillance system in discovering and reporting all cases. Surveillance in Oregon has improved year by year and therefore comparisons of 1 year's reported measles cases to the previous year's cases is inaccurate. The total number of cases reported each year (fig. 1) was low after the marked decline in 1967 following widespread vaccine use. The true extent of the decrease in measles morbidity is probably concealed by the increasing efforts of casefinding. The most significant sign of success is perhaps the 12 months of zero cases—a period of intensive surveillance.

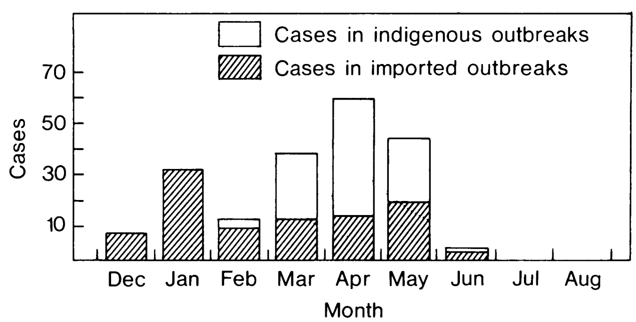
It is generally agreed that routine vaccination of all children is the foundation for any measles control

Figure 1. Reported cases of measles by quarter, Oregon and United States, 1965–75



[1] Smoothed with three quarter moving mean.

Figure 2. Imported and indigenous measles cases, by date of onset, Oregon, December 1974–August 1975



program. We do not know which parts of our preschool vaccination program were most effective since we measured only the sum (the immunization level at school entry) of the parts. We believe that the combination of a strictly enforced school entry requirement with a key-sort (or equivalent) system to identify the unvaccinated children are the keys to success. In addition, stress should be placed on accurate vaccination histories to circumvent the documented inaccuracies of parental recall.

In contrast to the agreement on the need for routine vaccination, there is considerable debate about the need for containment vaccination in outbreaks. We believe containment vaccination is an important addition to a measles control program, but it does require a commitment by county and State public health personnel to divert staff in case of an outbreak. Containment vaccination would not be required if 100 percent of the population were immunized. But we have not yet attained 100 percent immunization, and the remaining suspectible persons maintain transmission of measles. The reasons are twofold—first, 100 percent of the population is never vaccinated and second, some of those vaccinated are not protected. Thus, even the best measles control programs probably leave more than 20 percent of the population susceptible to measles. Unless this residual can be reduced by improved vaccine and delivery, we feel that containment vaccinations should be a part of State and county immunization programs. To further document this need, we welcome future reports from other areas that are assessing the effects of containment vaccination.

Conclusions

Although the Oregon measles control program is not a high-powered experimental program, it is a functioning one. It is a day-by-day effort promoted by a few interested persons and operated by existing staff using existing funds. Despite its imperfections, the program has controlled measles. Moreover, during 12 months of extensive surveillance no cases occurred. From our experience in Oregon, we have concluded that:

- A measles control program can succeed if it is given priority and interest by health departments.
- Measles control should be a combined national effort, with all States controlling measles simultaneously so that one State does not suffer importations from its neighbors.
- Specific leadership for measles control is important. An active person whose primary responsibility is measles control should be designated by each State.
- The measles control program should be simple but structured with specific written instruction and forms for each expected problem (case investigation, containment vaccination, outbreak surveillance, and so on).
- It is probably best to initiate a containment vaccination program in one of the months, May to December, when the disease decreases naturally. During these months the number of outbreaks is small, and transmission is slower. Interrupting transmission in a few foci early in the year will prevent the later development of numerous foci that could overwhelm the containment system.
- Assessment of all steps in the program (immunization status, time from onset of first case to report, report to initiation of containment, report to last case, and so) is the key to identifying problems and stimulating improvement.
- Strictly enforced school immunization laws should be a basic ingredient of all immunization programs.
- Once measles is controlled, surveillance is important for discovery of importations (either national or international) before spread occurs.

Finally, measles control need not be considered solely in respect to measles. All immunizable diseases can benefit from and often can be linked to measles surveillance and vaccination. The stimulation that physicians, nurses, and county health departments experience from involvement in measles control is often followed by expanding interest in other immunizable diseases. Besides measles, our key-sort surveys determine immune levels for tetanus, diphtheria, pertussis, rubella, poliomyelitis, and mumps. These surveys localize areas of low immunity where immunization and surveillance can be intensified. Vaccination campaigns aimed at one disease can often include other diseases and serve as foci from which immunization information can be distributed. Moreover, the lessons learned and the satsfaction received from successfully executing a well-planned program may motivate efforts in other public health programs.

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