The Organization and Evaluation of a Computer-Assisted, Centralized Immunization Registry

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Abstract: The rationale for, and establishment of, a computer-assisted, centralized immunization registry are described. This registry was created to improve the quality and quantity of information regarding immunization status for a defined population receiving primary care from a variety of providers, principally public clinics and private practitioners. An evaluation of the feasibility of the registry after one year's function shows that 93 per cent of eligible providers initially agreed to participate and 73 per cent continue to do so. Their reports have resulted in the creation of 17,500 individual patient files. Of a prospective cohort of newborns, 23 per cent were identified as "high-risk" for overdue immunizations. After one year, the immunization rates in audited groups improved significantly. The direct cost of this registry is less than 65 cents per currently registered child per year. (*Am J Public Health* 1983; 73:1298–1301.)

Introduction

The centralized, computer-assisted immunization registry to be described evolved from concerns that preventive measures of proven efficacy are often inefficiently applied;[1] that the efficiency of the application of many such measures can be greatly improved by coordination of the flow of information;[2–5] and that confusion often exists over designation of responsibility for preventive services. The importance of these last two aspects increases when services are offered both by doctors in private practice and by public health clinics, and/or when patients do not consistently use a specific provider.[6] Primary immunizations of childhood have universal clinical acceptance and clear definitions, thus providing a marker for delineating the extent of these problems that is also an area amenable to solutions based on a cooperative approach between providers.

Immunization registries have been organized and maintained in several European countries, notably England, France, and Bulgaria.[2–5] Subsequent improvement in the ability to monitor a population's immunization status, and in the rates of immunization, is also well documented.[4,7] Although there are many differences between European health care and that in North America, there is no structural reason to doubt that similar registries may be a useful way to improve immunization rates here, and to address the problem of children who "fall through the cracks" of the current delivery system of preventive services.[8]

A feasibility study was carried out in Montreal, where the provincial health care system[9] provides universal access to, and complete coverage for, medical services for all residents. The delivery system, however, is still divided along traditional lines, i.e., with both private practices and public clinics. Private practitioners are reimbursed on a uniform fee-for-service basis, but may charge additional fees for materials such as vaccines. All services provided within the public health sector are covered by a comprehensive budget and vaccines are free. This paper describes the establishment of the registry and the results of its initial year of operation.

Methods

The registry was established in Montreal at the end of 1979 in one public health district that serves a heterogeneous population of 250,000 people. The public health department responsible for this territory receives birth notification data on all infants born to district residents. All providers within the district were eligible to participate. This included eight public health department clinics, six hospital-based family medicine units, five community clinics, and 45 physicians in private, predominantly pediatric, practice.

Children are enrolled in the registry either as newborns or at a later age, upon receiving any of the routine immunizations of childhood* from a participating clinic or practitioner. The information for each child is entered into a computerized record, or file, along with the latest date by which a subsequent immunization report is expected. A child appears overdue at the registry if an immunization report is not received within three months of the expected due date for the next immunization. The registry generates a list, every other month, for each provider, of all those children whose expected immunizations appear overdue. These lists are circulated to the provider for use in follow-up and are returned to the registry with information that permits updating or reclassification of files.

A computer program was specifically designed for this project utilizing a Hewlett Packard 3000 computer located at the Montreal Children's Hospital. Individual records are maintained in the registry as separate files located by the child's name, birthdate, and sex. If the first immunization reported to the registry for a child is not the initial DPT/OPV, the immunizations which would have preceded it in the routine sequence are annotated in the file as "assumed to have been given." If a child receives a subsequent immunization from a different provider, the child's file is reassigned to the new provider.

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*An initial series of three Diphtheria, Pertussis, Tetanus (DPT) and Sabin oral Polio vaccines (OPV) followed by two boosters, and Measles, Mumps and Rubella vaccines (MMR) are hereafter referred to as "routine immunizations".

Participation by a large proportion of those who immunize children was essential to the project's success. We therefore visited each eligible clinic and private practice to explain the goals, invite participation, and assess the best method of integrating the project into the normal functioning of each practice. For clinics, it was simple to modify the daily appointment sheets, which already contained the patient's name and date of birth, to include a checklist column for each of the routine immunizations. For private practices, an extra page listing the routine immunizations was attached to the triplicate form used to bill the health insurance plan. As each patient's name and date of birth are mechanically embossed on this form, the additional work required of each practitioner consists of checking off the immunization just given and noting the date.

To determine the effect of the registry on immunization rates, all infants born to residents of the study area were assigned to a "newborn" cohort. Two discrete subgroups of the total registry population were identified and their immunization status audited prior to institution of the registry and after one year of its use: 1) all children immunized by one unit (three clinics) of the public health department; and 2) all patients of one private pediatric group practice.

Results

Provider participation

All 19 eligible clinics agreed to participate, and all but one still do so. Of 45 eligible practitioners,** 40 accepted visits and 37 (93 per cent of those visited) agreed to participate, 35 began the project and 29 (73 per cent of those visited) were still participating at the end of the study year.

Three physicians declined visits because they disagreed with the project's premises. The predominant reasons given by the private practitioners who declined or ceased to participate were related to internal office organization and personnel issues. Two practices closed during the study year.

Information Flow

The registry received notification of almost 200 births per month to residents in the study area. By the end of the first year of operation, the registry was receiving 2,000 immunization reports per month, 70 per cent of which were subsequent reports for children already in the registry. By the end of the first study year, the registry contained 17,500 entries.

Newborn Cohort

By the time the latest born member of the first year's newborn cohort should have received his first immunization (study year plus four months), the registry had received a report of at least one immunization on 1,283 (59 per cent) of the 2,175 infants. Of these 1,283 children, 590 (46 per cent) were receiving immunizations from private practitioners and 693 (54 per cent) from public clinics (Figure 1).

Utilizing the overdue lists initially generated by the registry and circulated to providers for review and modification, it was possible to categorize the 892 children (41 per cent of the newborn cohort) whose files did not yet show immunization into three categories. Of these children, 49 per cent indicated to their provider or to the public health nurse that they intended to receive care from a non-participating provider; another 12 per cent either moved out of the area or were adopted; and 39 per cent of these children (who represent 16 per cent of the total newborn cohort) appeared to both their provider and the registry to have been inadequately immunized.

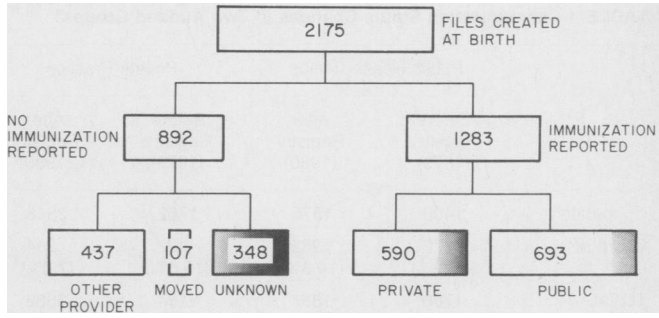

FIGURE 1—Immunizations Reported to the Registry for the Newborn Cohort after One Year (Numbers in the boxes are totals for each grouping; shaded areas are proportional representations of children who appear to be inadequately immunized).

Audited Subgroups

The results of the cross-sectional audits of immunization status performed on the two prospectively designated groups, both before and after one year of registry function, are shown in Table 1. In the public health clinics, the proportion of children listed as overdue decreased by one-third, in the private practice by 60 per cent. Both of these changes are clinically and statistically significant ($p < .001$).

Cost

It requires about 10 hours per week to process the incoming information at the computer terminal and another 20 hours per week to coordinate information flow between the registry and participants. The average expense for the first year of operation was less than $1,000 per month, or 65 cents per registered child per year.

Additional indirect costs (not estimated) would include hardware depreciation and overhead, as well as provider time devoted to review and follow-up of overdue children. The willingness of the majority of private practitioners to continue participating in the registry suggests that the benefits accrued were worth these latter costs.

Discussion

This project demonstrates the feasibility of a collaborative approach, between many providers and across public and private sectors, to improving the delivery of a preventive service. There is also evidence of the registry's effectiveness.

In order to estimate immunization levels for entire populations, it has been necessary in the past to rely on sample surveys. Although it has been shown that, with excellent organization and attention to detail, good survey results can be obtained,[10] the more common experience is that surveys of reported immunization levels are subject to error.[11,12]

**Although family physicians and general practitioners provide the primary care for many children in Quebec, the downtown Montreal area is particularly well colonized with pediatricians, who continue to serve as primary care providers for most children there. Our providers did include several general or family practitioners with predominantly pediatric practices but, for this first phase of the registry, we did not attempt to include general practitioners whose practices contained few children.

TABLE 1—Immunization Status Changes in Two Audited Groups[a]

	Public Health Clinics		Private Practice	
	Before Registry (1979)	After Registry (1980)	Before Registry (1979)	After Registry (1980)
Up-to-date	1408	1575	1762	3348
Overdue[b]	372 (20.9%)	262 (14.3%)	422 (19.3%)	284 (7.8%)
TOTAL	1780	1837	2184	3632
	$\chi^2 = 27.5$ $p < .001$		$\chi^2 = 168.1$ $p < .001$	

[a]Tabulations in the private practice include all patients who started the study year in the practice.

[b]Partially complete (with the exception of elective postponement of Mumps and/or Rubella) or status-unknown immunizations were considered inadequate and tabulated as overdue.

The level of immunization for the Montreal area was surveyed in 1976[13] and is consistent with other contemporary results.[14,15] In a 1979 survey of children entering public school in the study's public health district, immunization status was documented in 86 per cent. Considering missing data as incomplete immunizations (consistent with the approach used in evaluating the registry) the rates were 79 per cent for 4 DPTs and 82 per cent for measles.[16]

In order to capture all immunizations given to each member of the newborn cohort, it would be necessary to obtain the participation of many other providers and/or expand the geographic boundaries of the registry. The combination of both maneuvers would presumably improve the ability of the registry to continue to follow a mobile, urban population seeking care from multiple providers.[17] It also would be desirable to link the documentation of preventive services delivered to both the recording of vital statistics and the providers' billing and payment mechanism in Quebec.

To locate the smaller core of children who are truly overdue for an immunization, less than one-fourth of the total cohort requires more individualized attention. There is evidence that specifically targeted outreach programs do improve outcome.[18–20] Most private practitioners do not have the resources to allocate to such tasks and should be willing to accept assistance from public health nurses. At least one pediatric group practice has already requested this service. The public health department is responsible for the immunization status of its entire population. The relative cost saving of focusing outreach in this manner is attractive and should more than adequately account for the program's direct and indirect costs.

School entry requirements, which have been shown to be effective in improving immunization rates in the United States,[15] are not yet applicable in Quebec, although New Brunswick[22] and Ontario[23] have instituted such requirements. School entry requirements do not necessarily improve appropriate immunization of infants and preschool age children, however.

Some of the improvement in immunization rates stems from improved documentation of the status of children whose records were incomplete and/or inaccurate, rather than from actual immunization of overdue children.[12,23] Our data do not allow quantification of this factor.

Centralized, automated documentation of patient data raises concern regarding confidentiality. The practitioners participating in the registry perceived it as an extension of the service rendered to a patient, and did not therefore solicit individual consent from their patients. Individual rights and privacy are protected in the registry in that children are identified only by name, data of birth, and provider of immunizations, and therefore direct access to them would be difficult; subclassification is available in the computerized files for those who choose not to accept routine immunizations or for whom they are medically contraindicated. Finally, positive documentation of immunizations is required by law in most places now, so that for childhood immunizations in particular, the data this registry stores is already a matter of public record.

Addendum

The registry continues to function, now an integral program within the public health department. Preliminary data from the second year of operation are encouraging in many regards: 83 per cent of the providers who completed the first year are still participating at the end of the second year; the registry's size has continued to grow at the expected rate, with an increasing proportion of children already on the registry reappearing for subsequent immunizations; and the costs have remained stable.

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International Physicians for the Prevention of Nuclear War

When the 3d Congress of the International Physicians for the Prevention of Nuclear War (IPPNW) met in The Netherlands, June 17–21, 1983, under the auspices of the Dutch Medical Association for Peace Research, the meeting (with 43 countries represented) approved a petition calling for an end to the nuclear arms race. The document is to be disseminated during the coming year in all countries where physicians are active against the nuclear arms race. Following the IPPNW's 4th Congress, the completed petition will be presented by an international delegation of physicians to the leaders of the five nations known to possess nuclear weapons. The complete text of the document is available from IPPNW, 225 Longwood Avenue, Boston, MA 02115. Excerpts are printed below:

". . . the first and greatest of all the nuclear illusions is the assumption that nuclear war is simply one of many alternatives facing humanity, and that nuclear war is but conventional war with magnified consequences. . . .

"A kindred illusion is the view that nuclear war—both its start and its duration—could be controlled. . . . We base this conclusion on our knowledge of the medical consequences of nuclear explosions and of the manner in which human beings make decisions under stress. . . .

". . . The long-term environmental effects of the nuclear blasts would also afflict children of the future. Indeed, given what is known, and even more important, all that is still unknown about the effects of multiple nuclear explosions, there is the risk that human life on our planet would cease to be.

"Still another illusion is that of gaining and using nuclear "superiority" . . . The notion that one side or another can be "ahead" or "behind" in nuclear arms no longer has meaning, and nuclear weapons have ceased to be a means to achieve rational political goals.

"Since the destructive potential of the present USA and USSR arsenals vastly exceeds the possible targets of either side, it is an illusion that the acquisition of more nuclear weapons of any type confers any military or political advantage. Hence there is no justification for the introduction of any additional nuclear weapons into Europe or any other region. Furthermore, since maintenance at this excessive level is unnecessary and dangerous we favour reduction of weapons currently deployed.

"The general policy of nuclear deterrence has held hostage vast populations of innocent people. It has led to an ever accelerating arms race. It threatens our children's hope of the future. It weakens our struggle against poverty, famine, and illness. It has fostered war-fighting doctrines which increase the risk of nuclear conflict. What is needed are new peace initiatives from both sides—not new missiles. . . .

"All nuclear powers should unequivocally agree to refrain from the introduction of nuclear weapons into a conflict. The initiation of nuclear conflict would be tantamount to both genocide and national suicide.

"All powers should agree to a sufficiently verifiable freeze on the development, testing, production, and deployment of nuclear weapons and their means of delivery.

"A freeze should then be followed by reduction and eventual elimination of nuclear weapons from the arsenals of nations.

"Arms control and reductions require a renewed and serious effort to reach agreement on a comprehensive nuclear test ban.

"The negotiations currently in progress should be pursued with diligence, good will, and consideration for the interests of both sides. The recent history of arms control negotiations, however indicates that agreements are falling ever further behind the development and multiplication of nuclear weapons. We wish to emphasize, therefore, that there are routes to progress in addition to negotiation. Both the USA and the USSR have the opportunity to take independent initiatives to reduce tensions, to diminish the risks of nuclear war and to break the deadlock in current negotiations. World attention would then focus on all other nuclear powers to see if such a positive gesture were reciprocated. In such a manner the direction of the arms race would be reversed.

"We believe that both the USA and the USSR must learn more about each other. The stereotyped view of each other which now complicates US/USSR relations must be eliminated. This could be accomplished through a large increase in the volume of scientific, technical, and cultural exchanges, tourism, and trade. It is essential to increase the information each country has of the other through television, mass media, and other means."