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Prevention of congenital rubella in Iceland by antibody screening and immunization of seronegative females

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A programme to eradicate congenital rubella from Iceland was started in 1979, based on (1) screening of all females aged 12–45 years for rubella antibodies and (2) vaccination of all seronegative persons with the RA/27/3 rubella vaccine, given free of charge. Thus, individual protection was offered to all who needed it. The collection of serum samples was planned to last for 2 years while, simultaneously, the already established rubella screening and immunization programmes for 12-year-old schoolgirls and pregnant women continued.

During assessment in 1983, 95.2% of females in the first 7 age groups (by now aged 14–20 years) participating in the school programme had been tested and 80.4% of them were found to be naturally immune. Of the seronegatives, 93.7% were subsequently vaccinated, thus giving an overall immunity rate of 98.8%. Among the women in the peak of the childbearing period (by now aged 21–35 years), 84.4% had been tested and 92.7% were found to be naturally immune; vaccination of 61.4% of seronegative individuals then gave an overall immunity rate of 97.2% for this age group.

If it is assumed that the natural immunity rate of females still untested is like that of the above groups, then the percentage of non-immune persons is at present 2.1% in the younger group and 3.4% in the older.

INTRODUCTION

Prevention of congenital rubella is the ultimate goal of any nationwide rubella immunization programme. In order to reach this goal two main approaches have been applied in various countries during the past decade (*7, 10, 11, 13*). Some national programmes aim at vaccinating all young children in order to prevent the spread of rubella to adult pregnant women, while others aim at vaccinating all teenage girls, thus giving individual protection against rubella during the fertile period, although rubella epidemics are not prevented. In both approaches some attempts have been made to immunize adult females usually shortly after childbirth, advising contraception for 2–3 months afterwards. Antibody studies to select candidates for rubella immunization have not been widely carried out.

Rubella immunization began in Iceland in 1977, when 12-year-old seronegative schoolgirls in the capital, Reykjavík, and vicinity and in Akureyri, the second largest town, were selected for vaccination with RA/27/3 rubella vaccine (*15*). In addition, seronegative women who were leaving maternity wards after a child birth were offered the vaccine. A nationwide rubella screening and immunization programme, designed to include all teenage girls and women of childbearing age in Iceland was subsequently launched in 1979. The central idea behind this programme was vaccination of seronegative females only in order to give individual protection to those who needed it. The programme gave the opportunity to study the long-term effectiveness of rubella vaccination and the antibody profiles of the vaccinees during epidemics, thus providing additional safety for immunized pregnant women. This paper describes the design, operation, and results of this programme and gives the overall rubella immunity status of Icelandic females.

Social and epidemiological background

Iceland is a sparsely populated, mountainous island in the North Atlantic (Fig. 1), with a population of 229 187 inhabitants in an area of about

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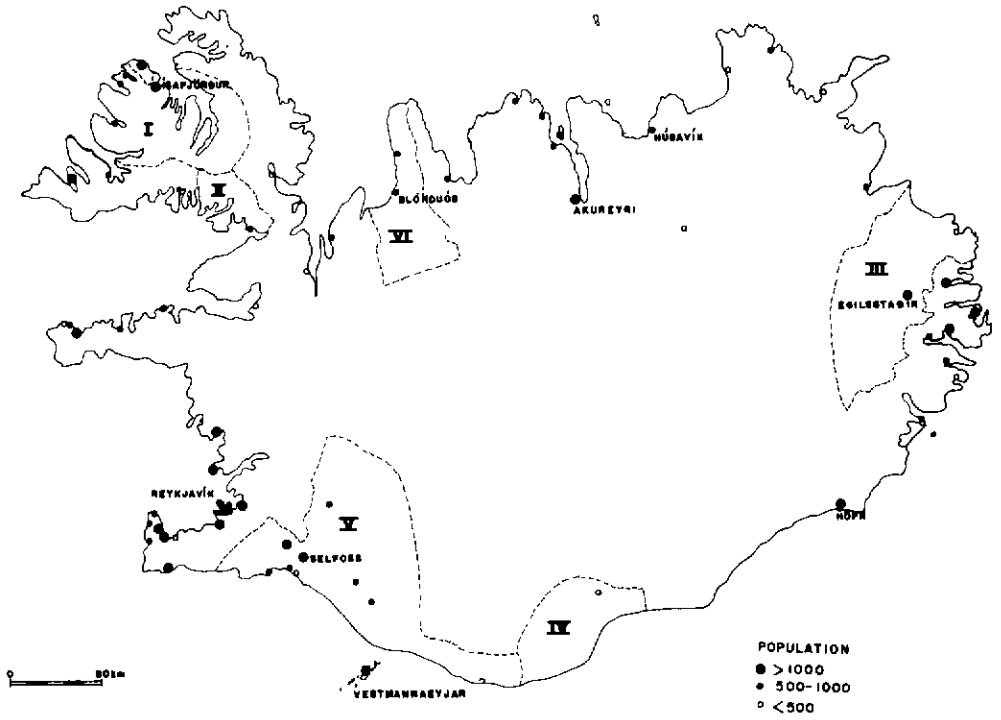

Fig. 1. Map of Iceland showing towns and villages and the boundaries of the six districts (labelled I to VII) mentioned in the text.

100 000 km^2 (national census, December 1980). Roughly 53% of the population lives in the capital city and nearby communities, 34% in smaller towns and villages, and 13% in rural farming areas. Large areas inland are dominated by glaciers, lavas, and mountains and are uninhabited. The population has almost doubled since 1940 (Fig. 2) and during the same period the proportion living in urban areas has increased steadily. The country's health care system is nationalized and comprises 27 medical districts that are further subdivided. The Ministry of Health and the Chief Medical Officer are in overall administrative charge of this system and decide on health care policies. The virus laboratory in the Department of Microbiology, University of Iceland, is the only laboratory in the country offering services in human diganostic virology and advice on viral immunizations.

Rubella has been a notifiable disease in Iceland since 1888 and well defined epidemics have occurred at intervals of 5–10 years (*14*, *20*). Fig. 2 shows the number of registered cases in epidemics since 1940. An estimate of the infection rate in the 1963–64

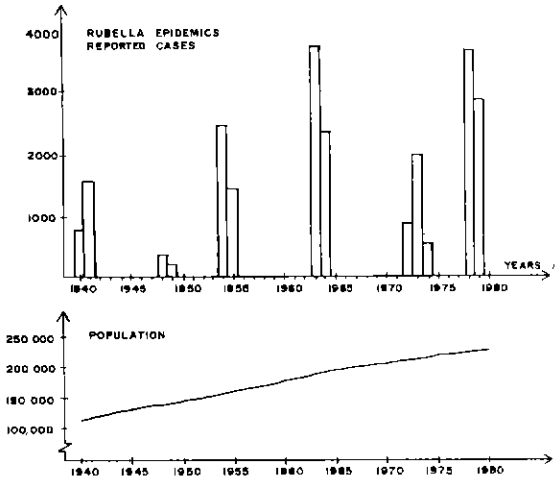

Fig. 2. Number of cases of rubella reported during epidemics from 1940 to 1980 and the population during the same period.

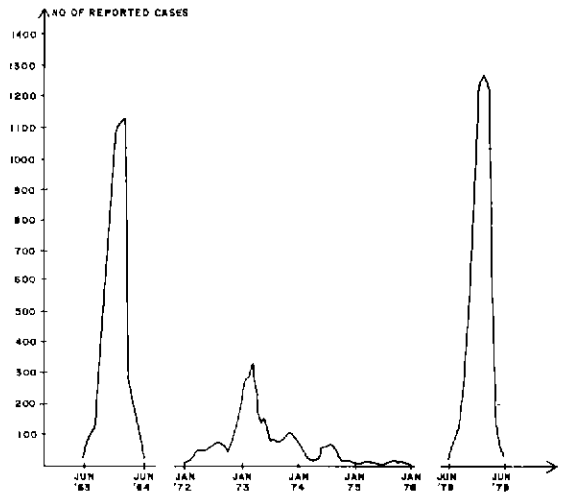

Fig. 3. Number of reported cases of rubella in the last three epidemics (1963–64, 1972–75 and 1978–79) in Iceland.

epidemic suggested that only 1 out of 7 cases was reported (*20*). The epidemics usually run their course in about 12 months although there are exceptions (Fig. 2). The epidemics of 1963–64 and 1978–79 were typical major epidemics, reaching a sharp peak in December and January. A different pattern was seen in 1972–75 when no such peak occurred and the epidemic lasted longer (Fig. 3).

Rubella has been one of the accepted medical reasons for legal abortion in Iceland since the epidemic of 1954–55. In spite of 77 therapeutic abortions performed, the epidemic of 1963–64 left Iceland with 37 severely malformed children out of approximately 5000 births during and shortly after the epidemic (*14*). Up to the autumn of 1981, two cases of congenital rubella from the epidemic of 1978–79 had been diagnosed. This epidemic was comparable in size with that of 1963–64 but serological tests were now extensively applied in early pregnancy. Therapeutic abortions were performed in 104 cases and the decision was usually based on the serological results (A. Antonsdóttir, unpublished observations).

Seroepidemiological studies, carried out in 1972–79, had shown that on average 80% of Icelandic females had rubella antibodies when entering the childbearing period (*1*, *20*), and that this figure usually reached 85–90% among females of 25 years of age. It also appeared that the immune status of 12-year-old schoolgirls could vary considerably, depending on the number and size of the epidemics they had experienced and their age in their first epidemic (*15*, *20*). The extremes noted so far are a rate of 49.1% seropositive among girls born in 1964, who had experienced one epidemic when tested in 1976, compared with 89.3% seropositive among girls born in 1966 who had experienced two epidemics when tested in the autumn of 1979.

Planning of the programme

When the rubella immunization policy for Iceland was first discussed, it was decided to vaccinate seronegative females only. Two rubella screening and immunization programmes were consequently selected:

(1) In 1974, rubella screening of pregnant women (4000–5000 per annum) was started, and vaccination of all seronegative persons in the first week postpartum began in 1977.

(2) In 1976, rubella antibody screening of 12-year-old schoolgirls was started, and vaccination of seronegative persons began in 1977.

During the first three years, only girls in and around Reykjavík and in Akureyri were included, i.e., about 50% of that age group in the country. Since 1979, this programme has covered the whole country as a result of close cooperation with school nurses or health centres and district nurses.

Plans for a nationwide rubella screening and immunization programme, including all teenage girls and women of childbearing age, had been discussed before the epidemic of 1978–79. During that epidemic, the serious distress experienced by pregnant women, for the majority of them unnecessarily, and the tremendous work-load in the laboratory when 14 709 serum samples from 5126 pregnant women were tested, emphasized the need for action. Accordingly, the nationwide programme was designed in cooperation with the public health authorities towards the end of the epidemic.

All females born between 1940 and 1967, and in the rural areas also all women born in 1934–39, were to be included. Two years were considered to be long enough for the collection of serum samples. Furthermore it was decided to continue to use exclusively the RA/27/3 rubella vaccine.

MATERIALS AND METHODS

Subjects

The total number of females in the selected age groups and of girls born in 1968 and 1969 was 57 121. Prior to the programme, 18 691 of these subjects had already been tested and recorded in our laboratory, and approximately 80% had positive titres. It was not

considered necessary to confirm these earlier positive results, so only the persons with negative results had to be tested again. To identify and locate the latter and persons not tested before, our laboratory records were compared manually with the yearly population registers published by the National Bureau of Statistics for each of the country's 224 communes.

In the summer of 1979 a team of 4 medical students was sent to the rural districts to collect venous blood specimens. They covered the most difficult areas and managed to collect 6263 samples. During the following winter, the health centres in these areas continued to search for unscreened women. In towns and other densely populated areas, the health centres cooperated in the collection of blood specimens in their areas during the two-year period of the programme. The previously established programmes for screening of pregnant women and 12-year-old schoolgirls continued as usual. In Reykjavík and surrounding areas, a team from the laboratory visited the schools and collected capillary blood samples from 12-year-old schoolgirls and from unscreened schoolgirls between the ages of 13 and 20 (*5*, *6*). The mass media as well as letters and phone-calls were used to advertise the programme nationally and locally.

Specimens and test methods

A special effort was made to have the samples from the rural areas sent to the laboratory, by road or by air, on the day of collection or the next day. The venous blood samples were collected into vacutainers and centrifuged at 1380 *g* for 10 minutes. All sera were transferred into sterile vials and kept at −25 °C until tested. Whole blood samples were taken from the earlobe with a capillary tube and placed directly on the test plates.

The haemolysis-in-gel (HIG) test was the screening method selected for the programme (*19*). Fresh pigeon red blood cells, from a local colony, sensitized by a commercial HA-antigen (Orion Diagnostica, Helsinki, Finland) were used for the gel; 5 μl of serum or whole blood were placed in 3-mm diameter wells (*5*). Each sample was also tested on a control plate without rubella antigen. Zones of $\geqslant 8.5$ mm in diameter for serum samples and $\geqslant 8.0$ mm for whole blood samples were regarded as definitely positive (*5*).

Prior to the screening programme, a slight modification of the haemagglutination-inhibition (HI) test of Halonen et al. (*9*), using pigeon red blood cells and kaolin-treated sera, was the screening method used in this laboratory. Titres $\geqslant 1/40$ were considered positive and the previously mentioned calculations on the level of immunity in the population were solely based on results of the HI test.

Distribution and collection of information

The women participating in the programme were told that the results of all the tests would be available at their health centre and that those who were seronegative or weakly positive (i.e., the candidates for vaccination) would be informed individually by letter. In the letter, rubella vaccination was offered free of charge and the following points were stressed:

(1) As the vaccine contains a live virus, it is important not to be pregnant at the time of vaccination and it is necessary to use contraceptives for three months afterwards.

(2) The immune response following vaccination is probably not as good as the response elicited by a natural infection so that vaccinees should have a post-vaccination antibody test.

The health centres were requested to collect a post-vaccination blood sample for antibody testing, 8 weeks after the vaccination. The sample had to be sent to the laboratory, along with a letter stating when the vaccination had taken place. It was considered very important to have all the information available in one place for future reference. Two years after the beginning of the programme it was obvious that this part of the programme was not sufficiently effective and therefore questionnaires with the names of persons found to be seronegative, and not reported on subsequently, were sent to the health centres.

The schoolgirls were vaccinated in the schools as part of the school health care immunization programme. Before vaccination they had to show a letter of consent from their parents or guardians. A post-vaccination sample was collected 8 weeks later or in the following year.

All results and dates of sample collections and vaccination were filed in the laboratory records and in the state hospital computer and were thus available in both places. In case of a future epidemic or other situations where there is a risk of rubella infection, the records for any individual woman would therefore be easily accessible.

RESULTS

Participation

Between 1 June 1979 and 1 June 1981, blood samples from 20 338 subjects were collected through the special efforts of the nationwide programme. Of these, 1457 (7.2%) were vaccination candidates (1112 completely negative and 345 low positive in the HIG test).

Table 1. Percentage of Icelandic females born in 1935–69 who participated in the rubella antibody screening programme up to July 1983

Year of birth	Total number of subjects[a]	Percentage tested
1935–1939	2331	45.3
1940–1944	6285	47.4
1945–1949	7748	69.7
1950–1954	8884	83.6
1955–1959	10 376	86.7
1960–1964	11 090	88.5
1965–1969	10 407	96.2

[a] Based on national census, December 1980; in the group born in 1935–39, only the rural areas are included.

To assess the overall status, all usable data accumulated up to 1 July 1983 were taken into account. Up to that date, a total of 74 016 rubella antibody tests had been done on samples from 45 742 individuals in the age groups included in the programme. In addition to figures derived from the three special screening programmes, these numbers included serum samples that were sent to the laboratory for various diagnostic tests and were tested for rubella as well, if the subject had not previously been tested for rubella antibodies. In Table 1, the women are divided into 5-year age groups and the percentage tested in each group was found to rise steadily from the oldest group to the youngest. Clearly the school programme, starting with girls born in 1963, was the most successful because it covered 95.2% of the girls born in 1963–69, compared with 84.4% coverage of women aged 21–35 years (born in 1948–62). The highest coverage in any single group was for girls born in 1967, 98.2% of whom were tested for rubella antibodies.

As an example of participation in the younger age groups, calculations were made for females aged 16–35 years in six representative areas that included small towns, villages, and farming areas both inland and on the coast. The majority of children (92.9% in 1979) were born to mothers in these age groups and this was clearly reflected when the programme began. Younger women showed great interest in having their rubella antibodies measured, whereas in the older age groups, many women considered themselves beyond the age of childbearing and were less enthusiastic. Table 2 shows the proportions of those who had already been tested in these six areas when the nationwide programme started in 1979 (range, 9.5–36.2%); in July 1983 the proportions tested ranged from 83.7% to 95.3%. This implies that of those untested at the start of the programme, 75.6% (in area V) to 93.8% (in area IV) were tested 4 years later.

Immunity rates

The immunity rates are illustrated in Fig. 4. The lower curve shows "natural immunity", i.e., immunity acquired after natural rubella infection, the rates of which exceeded 90.0% in all age groups born before 1963. The natural immunity rate among girls born in 1963–69, as tested in the school programme, was 80.4%. The lower curve (Fig. 4) shows a depression for girls born in 1963, 1964 and 1965. About 50% of these girls were screened for rubella antibodies and those who were negative were vaccinated before the epidemic of 1978–79. This accounts for the low rate of natural immunity among these girls compared with girls born in 1962 or 1966, none of whom was vaccinated before the epidemic. The natural immunity rate of women born in 1948–62 (aged 21–35 years in 1983) was 92.7% and the rate for all females

Table 2. Percentage of 16–35-year-old women who were tested for rubella antibodies in six areas at the beginning of the nationwide programme in 1979 and 4 years later

Area	Total number of subjects	Percentage tested	
		Till June 1979	Till June 1983
I	1022	21 4	86.9
II	58	36 2	84.5
III	494	9.5	92.1
IV	106	23.6	95.3
V	3893	33.2	83.7
VI	440	12 9	88.9

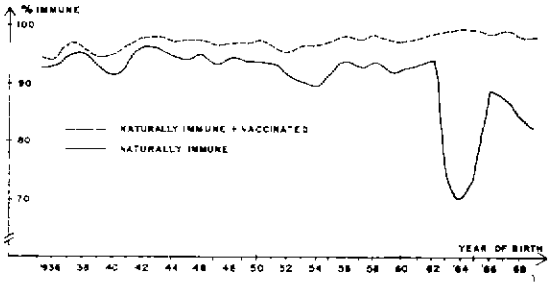

Fig. 4. Rubella immunity (natural and total) among Icelandic females born in 1935–69.

born in 1935–69 was 89.1%. In the 1972 rubella survey in Iceland (*20*), 81.1% of the women aged 16–42 years were seropositive, whereas at present the natural immunity rate for comparable age groups is 93.1%.

A comparison of the natural immunity rates in different communities showed that the status of comparable age groups was on the whole similar throughout the country. The youngest age groups in area IV are a notable exception and seem to have escaped the epidemic of 1978–79 partially or totally; in this area, the natural immunity rate of girls, 15–20 years old, turned out to be only 34.4%. On the other hand, the vaccination programme in that area was a complete success, as all negative subjects were vaccinated.

The total immunity rate (see upper curve in Fig. 4) represents the sum of both naturally immune and vaccinated individuals. This curve lies mostly over 95.0% and reaches 99.3% for girls born in 1964, out of 91.8% tested.

Vaccinations

Between January 1977 when the first rubella vaccinations took place and 1 July 1983, a total of 3879 individuals were vaccinated and reported to us. In Fig. 5, all the reported vaccinees are indicated by the percentage of seronegative girls, by their year of birth, and the overall rate was 78.1%. Again the school programme, starting with girls born in 1963, proved to be very successful because 93.7% of negatives in these age groups were vaccinated. The rate for women born in 1948–62 (aged 21–35 years) was 61.4%. As a result of the special efforts of the nationwide programme from 1 June 1979 to 1 June 1981, 1078 (74.0%) of the 1457 seronegative candidates identified during this period were vaccinated.

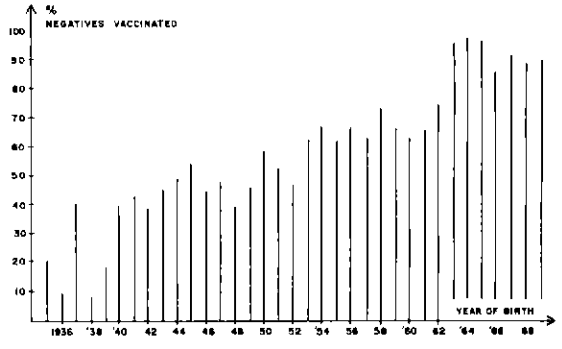

Fig. 5. Rubella vaccinees shown as the percentage of seronegative females born between 1935 and 1969.

The vaccine (RA/27/3) was imported by the Icelandic State Import of Drugs and Medicines, and up to 1 July 1983, 6051 doses had been distributed to health centres. Vaccinations reported to us therefore account for 64.1% of the vaccines distributed. We know from experience that sometimes the health centres neglect to report a given vaccination, especially if the women fail to come for a post-vaccination antibody test. We also know that some of the vaccine distributed was never used. When the nationwide programme started, many health centres ordered far more doses than were later required, since the natural immunity rate turned out to be higher than expected. Information however is still coming in. If a serum sample from a pregnant woman was negative after the last epidemic and is now positive, inquiry is made by letter or telephone and the previously unrecorded vaccination is now entered into the files. Preliminary results indicate that 99.1% of vaccinations have been successful in terms of seroconversion, as measured in the HIG test.

This study did not include recording of vaccine reactions and vaccinees were not asked to report such reactions. Women returning to their health centres for a post-vaccination blood-sampling could, however, be expected to complain of any major discomfort resulting from the vaccination. A check with the larger health centres showed that such complaints were exceptional.

Since the beginning of the nationwide programme we know of only 3 women who conceived shortly after the vaccination. One woman chose to have her pregnancy terminated, but the other two continued to term. One of them was definitely susceptible when vaccinated about 5 weeks before the estimated date of conception. When she delivered, an umbilical-cord blood sample was collected and tested along with a sample from herself that had been taken 7 weeks earlier. Both samples showed a diameter of 9.0 mm in the HIG test. When the child was 3 months old, this measurement had decreased to 6.5 mm, and no antibodies were detectable in the HIG test when the child had reached 7 months of age. We therefore conclude that these were maternal antibodies. The other woman had low antibodies (HIG diameter of 7.0 mm and a HI titre of 1/10) when vaccinated approximately 2 weeks before conception. Six weeks after the vaccination her HIG diameter had expanded to 9.0 mm but her HI titre did not change and the complement fixation test remained negative (1/4). Samples from her child were not obtainable. Both children were healthy at birth and had no clinical evidence of a congenital rubella infection. Now, at the age of 2 years, they remain healthy and have shown a normal course of growth and development.

DISCUSSION

This paper describes the very active participation of females in the three rubella screening and immunization programmes in Iceland since 1977. As a general rule, the women and parents (on behalf of their school-age daughters) readily accepted the offer of vaccination. The awareness of the public concerning rubella as a major cause of congenital malformations, especially deafness, increased greatly after the epidemic of 1963–64. In this context, the importance of personal involvement in events occurring in a small population should be kept in mind. Another point of importance is that when the nationwide programme was launched in 1979, the disturbing experiences of the recent severe epidemic promoted even more interest in this preventive operation. An additional fact, also worth mentioning here, is that the therapeutic abortion rates, for whatever reason, are considerably lower in Iceland than, for example, in the other Nordic countries (*21*) in spite of fairly similar legislation. This fact was clearly reflected in the attitude of many seronegative women who, while pregnant during the epidemic of 1978–79, chose to isolate themselves during the first trimester rather than risk rubella infection and potential therapeutic abortion.

Whether the epidemic of 1978–79 could have been prevented by vaccination of all children aged 2–12 years instead of only the 12–13-year-old schoolgirls in 1977 is open to question. We feel that this epidemic could not have been prevented and base this conclusion on the following facts. In 1977, the natural immunity of young adults was low. About 47 000 people were in the age group 15–24 years and, according to the Public Health Reports, the attack rate was 28 per 1000. Experience tells us that the real figure was probably 10 times higher, i.e., that only 1 case out of every 10 was reported. In addition, there were the seronegative individuals in the older age groups. We consider it likely that the virus could have gained a foothold and caused an epidemic among young adults that might have been more prolonged. An epidemic with a more prolonged course would be expected to cause less public concern and awareness among pregnant women and could thus have led to more rather than fewer cases of congenital rubella.

Reports from various countries, published during the past 15 years, show immunity rates of 80–95% in unvaccinated adult female populations (*3, 8, 16–18*). In Iceland as in many other places, the proportion of naturally immune females has been increasing over the last 15 years and is at present higher than reported in earlier Icelandic studies (*1, 15, 20*). For example, 81.1% of women aged 16–42 years in 1972 were seropositive whereas, in comparable age groups, the natural immunity rate is at present 92.7%. There are several likely reasons for this observed trend. These include the two epidemics in the seventies, easier transport between places, and greater sensitivity of the HIG test in comparison with the HI test previously used (*2, 12*). In addition, the nationwide programme was launched immediately after an epidemic and so had greater impact, whereas in 1972, 9 years had passed since the previous major epidemic.

In practical terms, a natural immunity rate of 80–95% means that only 5–20% of the subjects need rubella vaccination. Thus, in Iceland after the 1978–79 epidemic 6.3% of women aged 16–42 years (or 10.9% of all females born in 1935–69) were in need of such vaccination. A total of 6051 doses of vaccine had been imported for vaccination of all the seronegative persons in the group of 45 742 tested individuals, but not all of them were used. Each dose of vaccine was 3 times the cost of a rubella screening test (*22*). The cost of importing sufficient vaccine and vaccinating all 45 742 females without screening would have exceeded the cost of our programme of screening these subjects and importing sufficient vaccine for only those who were seronegative. As the giving of live rubella vaccine to adult women is not entirely without risk (*13*), special measures were taken to minimize this risk by sending each vaccination candidate an explanatory letter underlining the need for contraception for 3 months after the vaccination. Health care personnel in charge of the vaccination repeated this warning. Nevertheless 3 pregnancies were recorded in the 3-month period post-vaccination. This is a small number but shows that such events are difficult to prevent entirely; in a larger group of unscreened vaccinees this particular problem would have been greater. To avoid such pregnancies and the possibility of subsequent abortions is therefore very important. A systematic effort to identify those without natural immunity who really need rubella vaccination gives the benefit of reducing the cost of vaccination as well as minimizing the risk of pregnancies among vaccinees.

In the last decade, rubella antibody tests became part of routine antenatal investigations in many countries. When there is a danger of rubella infection in the environment, this test may be requested too late and the laboratory will have to deal with distressed clients among doctors and patients. Where the laboratory facilities are limited, as in Iceland, it may be more convenient to select a suitable time and make a special effort to test as many females as possible rather than to work through a routine procedure. The efforts described here have already reduced the routine laboratory work for antenatal investigations throughout the country. In future epidemics, the laboratory work on rubella in pregnancy can concentrate on pregnant vaccinees, seronegative

persons, and subjects who were never tested.

The high proportion of females already tested for natural immunity to rubella and the recording of rubella vaccinations give a fairly accurate picture of the susceptibility rate in Iceland (see Fig. 4). On the assumption that the immunity among persons still untested must be about the same as that for those already tested, the percentage of susceptible persons in the group now aged 21–35 years is 3.4% and in the group now aged 14–20 years 2.1%. These figures may be still too high because of the certainty that vaccinations already performed have been under-reported. Our search for untested pregnant women will continue, as well as the screening and vaccination programme for 12-year-old schoolgirls. A similar school programme has been operating successfully in Edinburgh since 1972 (*4*). Through our own programme, which has now become a regular part of health care in the schools, we aim to keep our present standards even in the future. Several factors contributed to the success of this programme; they include an organized health care system, easily accessible public records, good cooperation with health personnel, and perhaps most importantly the interest and cooperation of the general public. We feel that, wherever some of these factors are present, it should be worth while to consider the Icelandic approach when planning a prevention programme for congenital rubella even in a larger population.

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RÉSUMÉ

PRÉVENTION DE LA RUBÉOLE CONGÉNITALE EN ISLANDE PAR DÉTECTION DES ANTICORPS, ET VACCINATION DES FEMMES SÉRONÉGATIVES

Des épidémies de rubéole bien caractérisées se reproduisent en Islande avec une périodicité de 5–10 ans. En 1979, vers la fin d'une grave épidémie, on a mis sur pied un programme visant à éradiquer la rubéole congénitale. Ce programme reposait sur deux points principaux: 1) la recherche systématique, chez toutes les femmes de 12–45 ans (antérieurement non positives), d'anticorps antirubéoliques, et 2) la vaccination gratuite des femmes trouvées séronégatives, au moyen du vaccin RA/27/3, de façon à assurer la protection individuelle requise. Parallèlement, il était prévu de poursuivre deux programmes plus anciens, visant d'une part les femmes enceintes, d'autre part les écolières de 12 ans. Les groupes étudiés comprenaient 57 121 sujets de sexe féminin, dont 18 691 avaient déjà été soumises à des épreuves au moment du lancement du programme national. Pour choisir les personnes à examiner, on a comparé les dossiers de laboratoire aux registres d'état civil. Une équipe de 4 étudiants en médecine s'est chargée de la collecte d'échantillons de sang dans les zones rurales éloignées ou inaccessibles, pendant l'été 1979, tandis que, dans les autres régions, les prises de sang ont été effectuées par les centres de santé au cours des deux années suivantes. L'épreuve de dépistage employée exclusivement depuis 1979 était l'hémolyse en gel (HIG) alors que, auparavant, on s'était servi d'une épreuve d'inhibition de l'hémagglutination. Toutes les femmes trouvées séronégatives ont reçu une lettre d'explication où on leur proposait de se faire vacciner contre la rubéole. Il était souligné dans la lettre que le vaccin contient un virus vivant, de sorte que l'intéressée ne doit pas être enceinte au moment de la vaccination et doit recourir à la contraception pendant les 3 mois suivants, outre qu'une épreuve est nécessaire après la vaccination

pour confirmer la présence des anticorps.

En 1983, on a procédé à l'évaluation de toutes les données recueillies en Islande depuis le début des épreuves relatives à la rubéole. On a constaté que, dans le groupe d'âge regroupant les sujets ayant alors 14 à 20 ans, 95,2% des sujets avaient été soumis à des épreuves (le plus souvent en milieu scolaire), la proportion correspondante étant de 84,4% pour les femmes de 21 à 35 ans. Les femmes plus âgées se sont montrées moins intéressées. Le taux d'immunité naturel était de 80,4% pour les jeunes filles de 14 à 20 ans et de 92,7% pour les femmes de 21 à 35 ans; 78,1% de toutes les femmes séronégatives enregistrées ont été vaccinées. Le programme a été particulièrement efficace dans les écoles, où 93,7% des jeunes filles séronégatives ont été vaccinées, contre 61,4% pour les 21–35 ans. Diverses raisons font qu'il est plus fréquent qu'on néglige de notifier la vaccination quand l'intéressée appartient à un groupe d'âge plus élevé. Si l'on admet que les femmes pour lesquelles aucune épreuve n'a encore été pratiquée bénéficient du même taux d'immunité naturel que les autres, la proportion totale des sujets sensibles serait actuellement de 2,1% chez les jeunes femmes et de 3,4% chez les femmes plus âgées. Trois femmes se sont trouvées enceintes peu après avoir été vaccinées. L'une d'elles a décidé de faire pratiquer une IVG tandis que les deux autres ont poursuivi leur grossesse jusqu'à terme. Toutes deux ont donné naissance à un enfant bien portant qui a grandi et s'est développé normalement. Dans l'un de ces cas, des épreuves sérologiques répétées sur une période de plusieurs mois n'ont révélé aucun signe d'infection rubéolique *in utero*.

Un programme du type décrit ici exige que plusieurs conditions sont remplies: l'intérêt du grand public pour la prévention, l'existence d'un bon système de santé et celle d'un système de notification à la fois rigoureux et facile à appliquer. Si ces conditions peuvent être remplies, on en tire plusieurs avantages: 1) le vaccin est administré uniquement aux personnes qui en ont besoin; 2) quand la vaccination, comme c'est le cas en Islande, revient trois fois plus cher qu'une épreuve de dépistage, le gain est manifeste sur le plan économique; 3) ce choix des personnes pouvant utilement être vaccinées réduit en outre au minimum le nombre de grossesses à problèmes, débutant pendant les premières semaines suivant la vaccination; 4) en cas d'épidémie, les femmes enceintes chez qui l'on a précédemment observé une immunité naturelle peuvent être rassurées tandis qu'une attention particulière est accordée aux femmes séronégatives et à celles qui n'ont encore jamais été soumises à une épreuve de dépistage. A l'avenir, les programmes visant les femmes enceintes et les écolières de 12 ans seront poursuivis, mais la vaccination ne sera pratiquée qu'en cas de séronégativité. On s'efforcera de maintenir l'acquis actuel grâce au programme mis en oeuvre dans les écoles, qui constitue désormais un élément permanent de la médecine scolaire.

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