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Quality Assurance in Cervical Cancer Screening: The Icelandic Experience 1964–1993

K. Sigurdsson

Monitoring of the effectiveness of a screening programme is vital to ensure optimal use of public resources. This report correlates the results of the Icelandic cervical cancer screening programme with the results of monitoring the programme since 1964. Screening has significantly decreased both the incidence and mortality rates and greatly affected the stage distribution of squamous cell carcinomas, but not of adeno- and adenosquamous carcinomas. In the 25–64 years age group, 84% were screened, 80% of whom were in the organised screening. Smears taken outside the guidelines amounted to 10%. Sensitivity at 1 year was 93% for all smears. At 3 years it was 81% for squamous cell carcinomas, and 42% for adeno- and adenosquamous carcinomas. The rate of unsatisfactory smears was 1.3% for all smears, and 4.5% of the women had abnormal smears (7.7% in the 20–24 years age group). The specificity of the smears test was 98%. It is concluded that monitoring is vital for optimal screening results and although screening is effective in the targeted age group of 25–64 years it should preferably start sooner after age 20 years with a screening interval of 2–3 years.

Key words: quality assurance, health care, sensitivity and specificity, mass screening, cervix neoplasms, vaginal smears, incidence, mortality, organisation, adenocarcinoma, squamous cell carcinoma
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INTRODUCTION

VIEWED GLOBALLY, invasive cervical cancer accounts for approximately 15% of all cancer in women, the second most prevalent after breast cancer which accounts for approximately 18% [1]. In many countries, cervical cancer is the leading cancer in women. In the U.S.A. (SEER Programme), during the period 1983–1987, the average world-adjusted incidence among Caucasian females was approximately 7 cases per 100 000 women and among black females approximately 12 cases per 100 000 per year. The incidence is, however, highest in the developing areas of the world with approximately 40 to 55 cases per 100 000 women per year in some areas of Latin America and Asia [2].

In the Nordic countries, during the period 1981–1985, cervical cancer was the sixth most common malignancy in women with an average world-adjusted incidence rate of 11 per 100 000 women per year. The age-specific incidence rose from 3.1 at the ages of 20–24 years to 21.8 at the ages of 45–49 years, reached a maximum of 31.2 at the ages of 65–69 years and then decreased to 20.3 at the ages of 90–94 years. Although the disease is rare below the age of 25 years, the incidence is increasing in the 20–24 years age group in all the Nordic countries except Finland [3,4].

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The risk factors for the disease are most commonly related to sexual intercourse, and the human papilloma virus (HPV) is now the most frequently indicated main causal factor [5]. This virus penetrates the nucleus of the epithelial cells of the cervix (at or near the transformation zone) and causes asymptomatic preinvasive disease most commonly designated as cervical or glandular intraepithelial neoplasia (CIN or GIN). The disease can be diagnosed at this preinvasive stage and even at an early invasive stage (stage I A) by removing a sample of cells from the transformation zone and the cervical canal, and examining the cells under a light microscope [the Papanicolaou (Pap) smear test]. The experience from the Nordic countries shows that both the incidence and the mortality rates of this disease can be effectively reduced by the use of the Pap test. Although the Nordic data give differing results because of the various policies regarding the screening interval and targeted age group, the Nordic experience confirms the importance of organised screening as the main basis for good screening results [6].

For those planning to implement a cervical cancer screening programme, an EC committee of cancer experts working for the Europe against Cancer Programme have recently recommended the following criteria for cervical cancer screening (summarised in [7]): (1) Screening should be promoted by personal invitation and the screening quality monitored and controlled. Every screening programme should have a responsible manager. (2) An optimal screening programme should aim at screening all women in the population aged 25 to 65 years at 3- to 5-year intervals. (3) A high participation rate should be inspired by giving practical information to the women through newspapers, television and leaflets about the causes of the disease and purpose of the screening. (4) Detailed information should be given to the health profession about the organisation of the screening programme, as well as regarding the quality of smear taking and smear reading. A uniform nomenclature for both cytology and histopathology is recommended. (5) A detailed protocol should be accessible for the management and follow-up of women with abnormal screening results. (6) A comprehensive person-based register including information about invitation, attendance, results and follow-up are of prime importance for monitoring the screening programme. The register is used to: evaluate the attendance rate and control the follow-up of abnormal smears; evaluate the screening effect on the incidence and mortality rates of invasive cancer; review negative smears both as a means for quality control and self-education for the cytotechnicians; ensure an even flow of smears to the cytological laboratories and counteract overfrequent screening; and exchange information between screening centres for evaluating different screening strategies.

The trends in the incidence and mortality rates of invasive cervical cancer in the Nordic countries have confirmed that up to 1985 the reductions in these rates are most marked in Iceland and Finland [8]. The purpose of this paper is to analyse the organisation and monitoring of the Icelandic screening programme with regard to the EC recommendations [7].

MATERIALS AND METHODS

The country and the health care system

Iceland is an island in the North Atlantic, 103 000 km^2 in size (2.5 times the size of Denmark) with a mean population of 2.5 inhabitants per km^2 living mostly along the coasts. Approximately 60% of the population lives in and around the capital area of Reykjavík. The 1978 Health Care Act divided the country into eight health care regions which are in turn subdivided into 31 health care areas with a total of 83 health care centres (with 14 of these in and around Reykjavík). The planned health care centres in Reykjavík are still not fully implemented. A number of the GPs working in this area are, therefore, still not attached to a health care centre, and this area also has a high number of specialists offering consultation outside the hospitals.

The cervical cancer screening programme

The Cancer Society launched a screening programme for cervical cancer in June 1964. The aim was to offer the target population a Pap smear screening at 2- to 3-year intervals. During the first 5 years, the screening concentrated on women aged 25–59 years living in the capital area, Reykjavík, but in 1969 the programme was expanded to reach the entire female population aged 25–69 years. Owing to the increasing incidence of preinvasive lesions in the group below the age of 25, the lower age limit was changed to 20 years in 1988 [8]. Women outside the targeted age group are not invited to be screened, but the older women may attend of their own accord, and screening is recommended in younger women with condylomata. The screening programme is conducted in close collaboration with the Statistical Bureau of Iceland. Names and addresses of the target population are obtained from the computer centre through the state identification numbers. Women are then invited by letter to participate in the screening programme held at the Cancer Detection Clinic in Reykjavík and at 45 different regional health care centres throughout the country. Women may also come of their own accord without invitation. GPs and consultant gynaecologists take part in the screening by taking smears from those not attending the organised screening. Spontaneous smears are registered at the Cancer Detection Clinic, and these women are not invited to participate in the organised screening during the next 2 years. Attendance and spontaneous screening is counted as a part of the official screening attendance rate, and these women are observed and treated in conformity with the working rules of the Cancer Detection Clinic.

Working rules for abnormal smears

All information regarding attendance, abnormalities, follow-up and treatment is registered at the Cancer Detection Clinic in Reykjavík. The follow-up routine for abnormal smears since 1990 is: (1) to repeat unsatisfactory smears within 3 months; (2) to keep women with CIN 1 and atypia under observation for 6 and 12 months, respectively; (3) to refer those with CIN unclassified, CIN 2 or higher grades and all repeated CIN 1 and atypias for colposcopic examination. The treatment for histologically verified CIN 2 and higher grades is a cone biopsy, and a control colposcopy is recommended within 4–6 months after a non-radical cone [9]. The numbers of follow-up smears after colposcopy or cone biopsy are, on average, three smears during a 3-year period.

Working rules at the cytological laboratory

A uniform nomenclature is used for both cytology and histopathology. All smears are prepared, stained and screened by four cytotechnicians and one supervisor (less than 7000 smears per cytotechnician per year). Smears from women with earlier diagnosed cytological abnormality are always screened by two cytotechnicians. A specialist in cytopathology rescreens: (1) all abnormal smears; (2) selected smears from women with clinically suspicious cervix or abnormal bleeding; (3) smears classified as non-satisfactory to decide if a reminder should be sent to the smear taker; (4) earlier normal smears from women with newly

diagnosed CIN 2 or higher grades to detect earlier false-negative smears; (5) normal smears from women with earlier diagnosed cytological abnormality to decide if they should be kept under surveillance or discharged from observation.

Methods

To evaluate the quality and efficacy of the screening programme, the following analyses were carried out as recommended by the EC Committee [7].

(1) To evaluate the effect of screening on the incidence and mortality rates of invasive disease, these rates were obtained in 5-year periods from the Cancer Registry and the Statistical Bureau of Iceland for the period 1955–1993 and age-standardised by use of Segi's world population figures [10].
(2) The overall attendance rate for 1964–1993 was obtained, as well as the yearly registered 3-year attendance rate between 1966 and 1993. As in earlier reports, the 3-year attendance was defined as the proportion of the average annual female population aged 25–69 years who at the end of each year had attended at least once during the past 36 months [8].
(3) For the period 1990–1992, the coverage of the population by screening and the consumption of smears were analysed in 5-year age classes and for attendance at organised or spontaneous screening. In accordance with the EC Committee's recommendations, the 3-year attendance was now defined as the proportion of the mid-year population (1991) who had attended at least once during the 3-year period (1990–1992).
(4) For the period 1990–1992, the number of women and the proportion of smears giving abnormal or unsatisfactory smear results were analysed for the age groups <20, 20–24, 25–64, 65–69 and >69 years according to the grade of the preinvasive lesions.
(5) The invasive cervical cancer cases diagnosed during the period 1980–1989 were analysed according to age, stage and mode of detection. Cases screened with a true negative smear up to 3 years before diagnosis were classified as interval cases. Cases with no Pap smear or a Pap smear at diagnosis but symptomatic clinical cancer were classified as non-screened cases. Other cases were classified as screened cases.
(6) The sensitivity of the smear test was analysed for the period 1980–1989 in accordance with the EC Committee's recommendations as the number of invasive cases aged 25–64 years with a positive smear divided by the number of these cases, plus the number of cases with true negative smears (interval cases) taken during a period of 1 and 3 years prior to diagnosis of invasive disease.
(7) The specificity of the smear test was analysed for the period 1980–1989 according to the number of women aged 25–64 years with a negative smear test at first visit divided by the number of these women, plus the number of women with an abnormal smear test at first visit who, after 1 year of observation in accordance with the working rules before 1990 [9], turned out negative without treatment and remained negative for the following 3 years.

RESULTS

Figure 1 shows the time trends for both the incidence and mortality rates from 1955–1993. Both rates were increasing before screening started in June 1964 and reached their highest values a few years after the start of screening. After this initial rise, both rates decreased significantly until 1977, which was the year with the lowest recorded incidence ever (3.1 per 100 000 women). Subsequently, there was a temporary increase in the incidence rate and the mortality rate plateaued but decreased again after 1985.

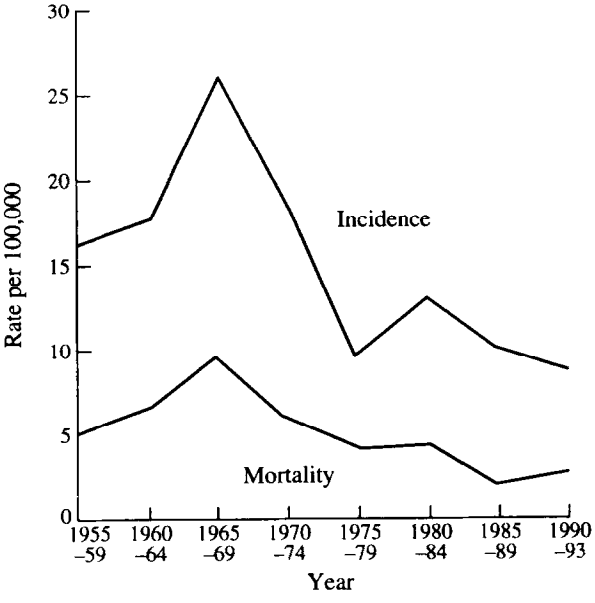

Figure 1. Cervical cancer in Iceland. World standardised rates per 100 000 per year.

Figure 2 shows that the overall 3-year attendance rate was only approximately 50% up to 1981, but rose to 81% in 1989 and has since plateaued at 81–82%. This improvement in attendance was distributed through all age groups from 25 to 69 years. By the end of 1993, approximately 94% of women aged 25–69 had been screened at least once since 1964 and only about 6% had never been screened.

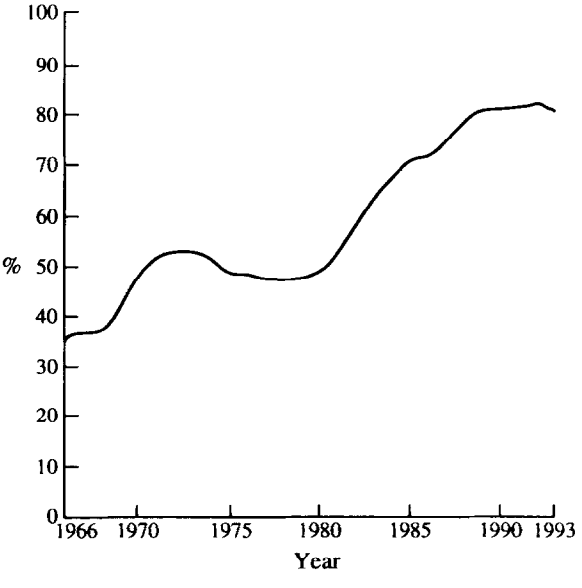

Figure 2. Cervical cancer screening in Iceland. Three-year attendance rates (women age 25–69 years).

Table 1 shows the screening coverage of the population and the proportion screened in organised screening in 5-year age classes during the period 1990–1992. The coverage was 83% in the targeted age group of 20–69 years and 84% in the 25–64 years age group. Organised screening accounted for 79% of the screening in the age group 20–69 years and 80% in the 25–64 years age group. Spontaneous screening accounted for 21% of the women screened in the age group 20–69 years and was more frequent among the younger women (approximately 28% in the age group 20–39 years) than among the older women (approximately 12% in the 40–69 years age group). The use of smears varied per 5-year age class from 1.3 to 1.5 in organised screening and from 1.5 to 1.9 in spontaneous screening. Smears outside the targeted age group were mostly taken at organised screenings (76%) in older women and at spontaneous screenings (77%) in younger women.

Table 2 shows the number of women and proportion of smears giving abnormal or unsatisfactory smear results during the period 1990–1992. In the 25–64 years age group, the proportion of women with unsatisfactory smears was 0.1% and 1.3% for the total number of smears. The rate of unsatisfactory smears varied from 0.5 to 4.4% for each smear-taker taking more than 100 smears per year. In the 25–64 years age group, the proportion of women with abnormal smears was 4.5% and for the total number of smears 3.8%. The proportion of women with medium to high-graded smears (CIN unclassified, CIN 2 and graver lesions) was higher in the 20–24 years age group (2.2%) than in the 25–64 (1.7%) and the 65–69 years age groups (0.9%).

As shown in Table 2, the average use of smears during the period 1990–1992 was 1.5 smears in the targeted age group 20–69 (92 055 smears from 62 976 women). Of these women, 59 904 had a negative smear and 3072 had an abnormal (or unsatisfactory) smear. The number of excess smears during any 3-year period was thus 19 863 or 22% [92 055 − 59 904 − 3072 − (3072 × 3 repeated follow-up smears)]. After correcting for 10 714 women rescreened at 2 years within a 3-year screening round (Table 1), the excess smears taken outside the guidelines in the targeted age group amount to 9.9%. Including smears from women outside the targeted age group and not fitting within the guidelines of the Detection Clinic for these age groups increases the proportion of excess smears to 10.4%.

Table 1. Number of women screened and population coverage. Proportion in organised screening and proportion rescreened at 2-year interval within a 3-year screening period. Iceland 1990–1992

Age groups (years)	No. of women screened	Organised screening (%)	Rescreened at 2 years (%)	Mid-year population size	Population screened (%)
15–19	594	20.2	0.3	10 490	5.7
20–24	8186	69.2	8.3	10 133	80.8
25–29	9186	68.7	12.7	10 894	84.3
30–34	9010	72.2	14.1	10 371	86.9
35–39	8182	77.9	15.8	9408	87.0
40–44	7298	83.4	18.9	8200	89.0
45–49	5813	84.0	20.3	6712	86.6
50–54	4268	86.6	22.4	5182	82.4
55–59	4129	91.1	24.8	5260	78.5
60–64	3854	94.1	27.5	5261	73.3
65–69	3050	94.9	22.9	4555	67.0
70–74	769	86.7	3.8	3799	20.2
75+	330	71.2	1.8	6979	4.7
25–64	51 740	79.7	18.0	61 288	84.4
25–69	54 790	80.6	18.3	65 843	83.2
20–69	62 976	79.1	17.0	75 976	82.9

Table 3 shows the distribution of age, stage, histology and the mode of detection among the 145 women registered at the Cancer Registry with invasive cervical cancer during the period 1980–1989. In the age group 25–64 years Pap smears had been taken from 73 cases within a year (59 screening-detected + 5 interval + 9 non-screened cases) and from 93 cases (59 screening-detected + 25 interval + 9 non-screened cases) within 3 years prior to diagnosis. The sensitivity of the Pap smear thus decreased from 93% (68/73) during the first year to 73% (68/93) during the third year. During a period of 3 years, the rate of false-negative smears (missed by the cytotechnicians) was 4% (4/93), all taken from screening detected stage I A and I B occult cases.

As shown in Table 3, 59 (49%) of the 120 invasive cases in the 25–64 years age group were screen-detected stage I cases, of which 34 (58%) had microinvasive disease (stage I A). Only 7 (11%) of the 61 interval (20%) and non-screen-detected cases (6%) in this age group had microinvasive disease.

According to Table 3 approximately 80% (74 women: 52 screening detected + 14 interval + 8 non-screened cases) of the 93 cases with a Pap smear in the 25–64 years age group had squamous cell carcinomas and 19 (20%; 7 screening-detected + 11 interval + 1 non-screened case) had adeno- and adenosquamous carcinomas. Of the 25 women in this age group with a true negative smear, 14 (56%) had squamous cell carcinomas and 11 (44%) had adeno- and adenosquamous carcinomas. When calculated for histology, the sensitivity of the Pap smear in this age group at 3 years was 81% (60/74) for the squamous cell carcinomas and 42% (8/19) for the adeno- and adenosquamous carcinomas. Of the 25 women with true negative smears, 7 of 14 (50%) with squamous cell carcinomas and 3 of 11 (27%) with adeno- and adenosquamous carcinomas had an earlier abnormal smear not followed-up according to the working rules. After correction for these cases, the sensitivity increased to 91% (67/74) and 58% (11/19) for the respective histological type. After further corrections for women with only one negative smear prior to diagnosis, the proportion of *de novo* cancers arising within 3 years was 5% (3/55) for the squamous cell carcinomas and 36% (4/11) for the adeno- and adenosquamous carcinomas.

During the period 1980–1989, a total of 25 214 women in the age group 25–64 years were screened for the first time. Of these, 23 781 (94.3%) had negative smears and 1433 (5.7%) had abnormal or unsatisfactory smears (Table 4). After 1 year of observation, 532 women (37.1%) had negative smears without treatment and 27 women (1.9%) did not attend follow-up. The specificity of the smear test was thus 23781:23781+532 or 97.8%. If unsatisfactory smears are excluded, the specificity was 98.9%. The regression rate was more frequent for the low-graded lesions as compared to the medium- and high-graded lesions. The follow-up compliance rate was 98%.

DISCUSSION

The effectiveness of screening is evaluated by the observed changes in incidence and mortality rates before and after the start of screening [11]. Reductions in both these rates have been reported to be directly related to the intensity of the organised screening [12], and monitoring of the programme is said to be vital for optimal results [7]. The Icelandic screening experience substantiates these statements. Organised screening has been

Table 2. Number of women and proportion of smears with abnormal or unsatisfactory results. Iceland 1990–1992

Smear results	Age of women (years) <20	20–24	25–64	65–69	>69	Total
Women						
1. Cancer suspected	0	0	27	3	8	38
2. CIN3	4	66	379	10	1	460
3. GIN3	0	5	24	1	0	30
4. CIN2	11	76	212	8	0	307
5. CIN	0	31	233	5	4	273
6. CIN1+CIA	68	431	1281	21	11	1812
7. GIA	0	22	157	5	2	186
8. Negative	508	7543	49 371	2990	1068	61 480
9. Unsatisfactory	3	12	56	7	5	83
Total, women	594	8186	51 740	3050	1099	64 669
9/total %	0.5	0.2	0.1	0.2	0.5	0.1
1–7/total %	14.0	7.7	4.5	1.7	2.4	4.8
1–5/total %	2.5	2.2	1.7	0.9	1.2	1.7
Smears						
1. Cancer suspected	0	0	29	3	9	41
2. CIN3	4	67	399	10	1	481
3. GIN3	0	5	26	1	0	32
4. CIN2	11	78	224	9	0	322
5. CIN	0	36	273	9	4	322
6. CIN1+CIA	78	572	1742	33	14	2439
7. GIA	0	34	209	5	3	251
8. Negative	636	10 067	72 940	4142	1371	89 156
9. Unsatisfactory	14	112	967	63	35	1191
Total, smears	743	10 971	76 809	4275	1437	94 235
9/total %	1.9	1.0	1.3	1.5	2.4	1.3
1–7/total %	12.5	7.2	3.8	1.6	2.2	4.1
1–5/total %	2.0	1.8	1.2	0.7	1.0	1.3

CIA, cervical intraepithelial atypia, GIA, glandular intraepithelial atypia.

Table 3. Invasive cervical cancer by detection, age, stage and histology. Iceland 1980–1989

Histology stage	Screen-detected cases: Age (years) 25–64	65–69	≥70	Interval cases screened within 3 years: Age (years) 25–64			65–69	Non-screened cases*: Age (years) <25	25–64	65–64	≥70
Squamous cell stage											
I A	34	2	1	5	(2)†	(3)‡			2		
I B occ	6			2	(2)†				1		
I B	12			4 (2)§	(1)†		1		9 (4)	2 (2)	1
II				2 (1)§	(2)†				13 (4)	1	6 (2)
III				1 (1)§		(1)‡			4		3 (2)
IV									1		1
Adeno- and adenosquamous stage											
I B occ	3			3 (1)§	(1)†		1				
I B	4			4		(2)‡		1	5 (1)	1	2
II				3	(1)†	(2)‡	1	1	1		
III				1	(1)†						
Total	59	2	1	25 (5)§	(10)†	(8)‡	3	2	36 (9)	4 (2)	13 (4)

*Number of Pap smears taken at diagnosis are in parentheses. †Number of cases where working rules were not followed. ‡Number of cases where only one smear was taken prior to diagnosis. §Interval cases screened within 1 year.

Table 4. Results for women aged 25–64 years diagnosed with abnormal smears at first visit and followed up for 4 years. Iceland 1980–1989

Smear results at first visit	Smear results from the second to fourth year of observation: Abnormal (%)	Negative (%)	No follow-up (%)	Total
Cancer suspected	27 (100)	0	0	27
CIN 3+GIN3	236 (94.4)	12 (4.8)	2 (0.8)	250
CIN 2	109 (76.2)	32 (22.4)	2 (1.4)	143
CIN	136 (80.5)	31 (18.3)	2 (1.2)	169
CIN 1	109 (58.0)	76 (40.4)	3 (1.6)	188
GIA+CIA	219 (45.3)	250 (51.8)	14 (2.9)	483
Unsatisfactory	38 (22.0)	131 (75.7)	4 (2.3)	173
Total	874 (61.0)	532 (37.1)	27 (1.9)	1433

nationwide in Iceland since 1969 for the age group 25–69 years, with a screening interval of 2–3 years. Before screening started, both the incidence and mortality rates were increasing [13] but have since decreased markedly. The reductions in the overall world-adjusted incidence and mortality rates were 70 and 62%, respectively, from 1966–1970 to 1981–1985, which is the highest reduction in these rates among the Nordic countries [8]. Analysis of the Icelandic data confirmed that the temporary rise in the incidence and the levelling out in the mortality rates after 1978 were mainly due to lack of regular attendance and lack of thoroughness in the follow-up of cytological and clinical abnormalities found at screening [14]. This information led to a reorganisation of the screening programme, which resulted in a new decrease in both the incidence and the mortality rates [8].

Screening programme quality control was restricted until the Cancer Detection Clinic acquired its own computer in 1980. The data have since been increasingly computerised and information regarding invitations, attendance and abnormalities detected are now registered and followed-up through the computer centre. Women who have not attended screening during the preceding 2 years receive a personal invitation and women attending for the first time receive a booklet explaining the purpose of the screening. Women diagnosed with an abnormal screening test receive a personal letter stating the result and the timing of the next control visit and a reminder if they do not visit within 6 weeks after the intended control visit. As required by the 1978 Health Care Act, the local board of each health care centre is now asked to appoint a local GP responsible for the organisation of the screening in co-operation with the Cancer Detection Clinic in Reykjavík. To control the flow of smears, the timing of organised screening in each health care area is now scheduled centrally. The local GPs are regularly informed about the attendance rates and the results of the screening tests. A list with names and state identification numbers of women not attending the organised screening is posted twice a year to the local GPs and they are encouraged to get smears from these women when they visit the health care centres. The public is now regularly reminded of the screening through advertisements on television and in local newspapers and by leaflets handed out at the local health care centres. Finally, financing of the screening programme has been assured (since 1988) by a contract between the Health Department and the Cancer Society guaranteeing a fixed user charge (now ISK 1500 or about US$ 23).

The EC committee recommend that organised screening programmes aim at 85% coverage of the female population aged 25–64 years with a specified screening interval of 3–5 years. The committee also recommends that invitations should be limited to women not already screened by spontaneous screening; that the number of smears outside the guidelines should not exceed 10%; and that the proportion of unsatisfactory smears should not exceed 5% for a given smear-taker. In Iceland the targeted age group is 20–69 years and screening is offered every 2–3 years. Spontaneous screening is counted as a part of the official screening attendance. Excess smears outside the local guidelines are 10% of the total number of smears. The coverage in the targeted age group is 83% and the proportion of unsatisfactory smears is 1.3% with a variation of 0.5–4.4% among smear-takers. The rate of false negative smear reading is 4% and the follow-up compliance for abnormal smears is 98%. These results indicate that the standards of the screening programme are acceptable as set by the guidelines of the EC committee.

This study confirms the statement of the EC committee that screening promotes the detection of early asymptomatic and microinvasive disease. Of all the screening-detected cases, approximately 74% (46/62) had early or microinvasive disease (stage IA or IB occult), as compared to only 17% (14/83) of the interval (36%) and non-screened cases (6%). This study also confirms that adeno- and adenosquamous carcinomas are not easily detected at screening [15]. Approximately 11% (7/62) of the screening-detected cases compared to 46% (13/28) of the interval cases had adeno- and adenosquamous carcinomas. The location of these histological types higher in the endocervix may explain the difficulty in diagnosing these cancers with a Pap smear.

Guidelines regarding upper and lower age limits of the targeted age group and the screening interval must consider the following parameters: the age-specific prevalence of preclinical (preinvasive and microinvasive) disease in the various age groups; the length of the detectable preclinical phase (the sojourn times) of invasive disease; and the sensitivity and specificity of the smear test [16, 17].

The incidence of invasive disease after a negative smear reflects both the sensitivity of the test and, after excluding the false negative cases (those with only one negative smear prior to diagnosis), the sojourn times of *de novo* cancers. Within a screening interval of 2–3 years, the *de novo* cancers indicates the number of fast growing tumours arising within that time interval [17, 18]. This study confirms that the sensitivity of the smear test in the 25–64 years age group decreases from 93% at 1 year to 73% at 3 years prior to diagnosis of invasive disease. After correction for cases with earlier abnormal smears not followed up in accordance with the working rules, the sensitivity at 3 years is 91% for the squamous cell carcinomas and 58% for the adeno- and adenosquamous carcinomas. *De novo* cancers arising within 3 years account for approximately 5% of the correctly screened squamous cell carcinomas and 36% of the adeno- and adenosquamous carcinomas. Squamous cell carcinomas are thus more sensitive to screening [15]. The specificity of the smear test is found to be approximately 98%, which indicates a low false positive rate of abnormal smears in this age group. These results confirm that a well-organised screening with 2–3 year screening intervals gives high protection with few early stage *de novo* cancers and few false negative and positive cases in the 25–69 years age group. These findings are in agreement with the findings of the IARC working groups [18].

The aim of screening is to diagnose the disease at a preinvasive

stage or at the microinvasive stage at the latest [17]. In an earlier report from this clinic [9], it has been stated that approximately 60% of the preinvasive CIN unclassified lesions are in fact CIN 2 or more advanced lesions and should accordingly be treated as these graver lesions. This study confirms that the prevalence of the more advanced lesions in the 20–24 years age group is in fact higher than the prevalence of these lesions in the 25–64 years age group. The rate of these graver lesions is increasing among the younger women in Iceland at the same time as these appear at a fairly consistently high rate only a year after a normal first visit [8]. It is also a fact that in the Nordic countries (except Finland) the age-specific incidence of invasive disease is increasing in the 25–29 years age group at the same time as there is a slight increase in the 20–24 years age group [3, 4]. This indicates that screening should preferably start soon after the age of 20 with a screening interval of 2–3 years. Alternatively, the low rate of invasive disease among screened women over the age of 64 (3 stage IA cases) indicates that the upper age limit does not need to extend beyond the age of 64 among women who have regularly attended screening before that age [8, 19].

The results of this study lead to the following conclusions: organised screening for cervical cancer is an effective method of reducing both the incidence and mortality rates; the value of the screening is mainly identification of squamous cell carcinomas in preinvasive and microinvasive stages; monitoring is vital for optimal screening results; a comprehensive person-based register is needed for effective control; the effectiveness of the screening programme can easily be assessed in relation to the European guidelines for quality assurance; and although the European guidelines are effective, they are suboptimal for the younger women regarding the lower age limit and screening interval.

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