COLORECTAL CANCER SCREENING PROGRAMME

Monitor 2017

National Monitoring of the Colorectal Cancer Screening Programme
Erasmus MC – NKI / AvL

The monitor 2017 shows that, for the first time, faecal testing detects colorectal cancers better than expected. Furthermore, participation in both the first and subsequent rounds remains high.

Erasmus MC
Department of Public Health

P.O. box 2040
3000 CA Rotterdam

Tel. +31-10-7038460
Email: mgz@erasmusmc.nl

Summary

In the fourth year of the screening programme, 1,941,121 (95.2%) individuals of the target population were invited for colorectal cancer screening with the faecal immunochemical test (FIT). Of those invited for the first time, 668,336 (70.3%) participated, and test results were unfavourable for 38,036 (5.7%) individuals. Of the individuals participating in the first round with an unfavourable test result (positive test) and referral for colonoscopy, colorectal cancer was found in 2,526 (8,0%) and advanced adenoma in 13,572 (42.9%) individuals. Of those invited for a subsequent round, 743,662 (75.1%) participated in screening, and test results were unfavourable for 33,596 (4.5%) individuals. Of the people participating in a subsequent round who received an unfavourable test result and were referred for colonoscopy, colorectal cancer was found in 1,677 (6.1%) and advanced adenoma in 9,648 (35.1%) individuals.

Introduction

The Dutch colorectal cancer screening programme is coordinated by the National Institute for Public Health and the Environment (RIVM). The RIVM commissioned Erasmus MC and the Netherlands Cancer Institute (NKI)/Antoni van Leeuwenhoek to carry out an annual national monitoring of the colorectal cancer screening programme. Monitoring ensures the quality of the colorectal cancer screening programme and identifies bottlenecks. Monitoring is conducted using data from ScreenIT, the national information system for the colorectal cancer screening programme. The current monitoring report presents the results of the national colorectal screening programme for 2017, the fourth year of the programme. This monitor is based on data of individuals invited between 1 January to 31 December 2017 who are followed up until 30 June 2018. The screening programme is carried out by five regional screening organisations, each of which is responsible for several provinces. Data of individuals who objected to the use of their personal data for quality assurance (n= 141) were excluded from the results, except for the total number of invitations sent.

Target population

The colorectal cancer screening programme's target population consists of men and women aged 55 to 75, who once every two years are invited to do a self-test that measures blood in the stool (faecal immunochemical test, FIT) . In case of an unfavourable test result, i.e. when the amount of blood in the stool samples exceeds the cut-off value of 47 µg Hb/g faeces, the participant is invited for a colonoscopy intake interview. The screening programme will be gradually implemented, with a projected roll-out of five years. In 2017, the following groups were invited to take part:

- 987,273 (48.4% of the total) individuals of the birth cohorts 1942, 1944, 1958 and 1960 who received an invitation for the population screening programme for the first time;
- 85,869 (4.2% of the total) individuals of the 2016 target population who had not yet received an invitation;
- 966,093 (47.4% of the total) individuals who were eligible for a subsequent (second or third) round in 2017.

Terminology

Cut-off value = threshold of concentration of haemoglobin in the faeces at which participants are referred for diagnostic colonoscopy (unfavourable test result), presented according to the international standard in 47 µg Hb/g faeces.

Detection rate = number of subjects with colorectal cancer or an advanced adenoma per 1,000 screened individuals.

FIT = faecal immunochemical test; primary test used in the colorectal cancer screening programme to detect blood in the stool.

Intake interview = clinic visit in which the consequences of a positive FIT are explained and information about the follow-up procedure is provided.

Unassessable FIT = FIT which cannot be interpreted by the lab, for example due to unreadability of the barcode or because the kit contains too much stool material.

Unreliable FIT result = FIT whose expiry date has expired or for which the period between stool collection and analysis in the lab exceeded 7 days, with a result below the cut-off value.

Positivity rate = number of participants with unfavourable test results (above the cut-off value) divided by the total number of participants with an assessable FIT.

Positive predictive value = number of participants with colorectal cancer or advanced adenomas divided by the total number of participants who underwent a colonoscopy.

ScreenIT = nationwide information system for the colorectal cancer screening programme.

Cumulative risk for an interval cancer = the number of individuals with an interval cancer after a favourable FIT result divided by the total number of individuals with a favourable FIT result.

Sensitivity = the number of cancers detected by screening in a specific round divided by the sum of the number of interval cancers and the number of cancers detected by screening in the same round.

MONITORING THE PARTICIPATION RATE AND RESULTS OF PRIMARY SCREENING

1. Invitees

The target group for 2017 consisted of 2,039,235 individuals. From 1 January until 31 December 2017, 1,941,121 individuals had been invited (subjects who received an invitation and non-participants on pre-invitation letters), encompassing 95.2% of the target population. In total, 950,617 first round and 990,504 subsequent round invitations have been sent. The remaining 98,114 (4.8%) individuals of the target population of 2017 will be invited in 2018.

2. Participation in screening using FIT, first and subsequent rounds 2017

Of the invited individuals in 2017, 1,411,998 (72.7%) participated. Those invitees who did not participate can be divided into two groups: those who actively opt out of screening (non-participants) and those who did not respond (non-responders). There were a total of 140,712 non-participants and 388,411 non-responders. Among the non-responders are also individuals that have emigrated or passed away after receiving an invitation (n = 12,614). Of all other non-responders, 99.2% received a reminder letter. Of the 1,405,595 individuals sending in a FIT, 1,159,960 (83.3%) initially returned an assessable and reliable test. The initially returned test was unassessable (for example due to an excess of faeces) in 3,224 (0.3%) participants, unreliable (return period longer than 6 days) in 9,421 (0.7%) participants and incomplete (for example due to missing or incomplete filled form) in 232,990 (16.6%) participants. The proportion of participants with an incomplete returned test seems much higher compared to the previous years. This is caused by the abolition of the reply form since December 2017, while a returned test without this form was still registered as incomplete. Finally, after (repeatedly) sending a new FIT, 1,403,096 (99.4%) participants had an assessable FIT.

First round

Of those who received an invitation for the first time, 950,617 participated. Therefore, the total participation rate of the first round of the screening programme comes to 70.3% (table 1). In total, 84,646 (8.9%) people opted out (non-participants). Of those, 42,492 already opted out upon receipt of the pre-invitation letter. 197,635 (20.8%) individuals did not respond to the invitation (non-responders)

Subsequent rounds

Of those who received an invitation for a subsequent round, 990,504 participated. Therefore, the total participation rate of the subsequent rounds of the screening programme comes to 75,1% (table 1). In total, 56,066 (5.7%) people opted out (non-participants) and 190,776 (19.3%) did not respond to the invitation (non-responders). Of the individuals that had participated in the first round, 694,688 (93.2%) participated again in the second round.

Table 1: Numbers and percentages men and women who participated in FIT* screening by age and screening round (Source: ScreenIT)

Age groups	Men		Women		Total	
First screening round						
55-59 years	145,772	*66.4%*	161,823	*73.9%*	307,595	*70.2%*
60-64 years**	81,350	*68.8%*	88,315	*74.7%*	169,665	*71.8%*
70-75 years	92,532	*69.6%*	98,544	*69.0%*	191,076	*69.3%*
Subtotal	**319,654**	***67.9%***	**348,682**	***72.7%***	**668,336**	***70.3%***
Subsequent screening rounds						
60-64 years	54,429	*70.9%*	60,006	*76.3%*	114,435	*73.6%*
65-69 years	227,078	*73.6%*	249,180	*77.2%*	476,258	*75.4%*
70-75 years	72,980	*74.3%*	79,989	*75.9%*	152,969	*75.1%*
Subtotal	**354,487**	***73.3%***	**389,175**	***76.8%***	**743,662**	***75.1%***
All screening rounds						
Total	**674,141**	***70.6%***	**737,857**	***74.8%***	**1,411,998**	***72.7%***

* Abbreviations: FIT = faecal immunochemical test
** Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

3. FIT findings first and subsequent rounds 2017

Of all participants with an assessable FIT, a total of 71,632 (5.1%) had an unfavourable test result.

First round

Of the first round participants with an assessable FIT, 38,036 (5.7%) individuals had an unfavourable test result (positivity rate). Of these, 22,328 (7.0%) were male and 15,708 (4.5%) were female (table 2). The positivity rate increased with age (Figure 1).

Subsequent rounds

Of the subsequent round participants with an assessable FIT, 33,596 (4.5%) individuals had an unfavourable test result. Of these, 19,123 (5.4%) were male and 14,473 (4.1%) were female.

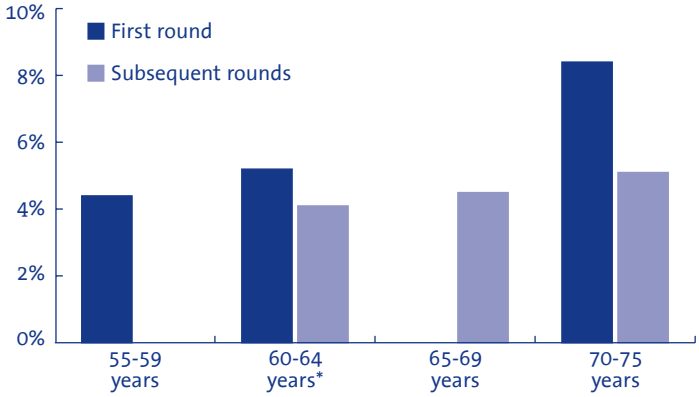

Figure 1: Unfavourable FIT result (positivity rate) by age category and screen round (Source: ScreenIT)

* Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

Table 2: Numbers and percentages men and women with unfavourable test results (positivity rate) of persons with an assessable FIT*, by age and screening round (Source: ScreenIT)

Age groups	Men		Women		Total	
First screening round						
55-59 years	7,832	*5.4%*	5,623	*3.5%*	13,455	*4.4%*
60-64 years**	5,137	*6.4%*	3,559	*4.1%*	8,696	*5.2%*
70-75 years	9,359	*10.2%*	6,526	*6.7%*	15,885	*8.4%*
Subtotal	**22,328**	***7.0%***	**15,708**	***4.5%***	**38,036**	***5.7%***
Subsequent screening rounds						
60-64 years	2,615	*4.8%*	1,996	*3.3%*	4,611	*4.1%*
65-69 years	12,143	*5.4%*	9,083	*3.7%*	21,226	*4.5%*
70-75 years	4,365	*6.0%*	3,394	*4.3%*	7,759	*5.1%*
Subtotal	**19,123**	***5.4%***	**14,473**	***3.7%***	**33,596**	***4.5%***
All screening rounds						
Total	**41,451**	***6.2%***	**30,181**	***4.1%***	**71,632**	***5.1%***

* Abbreviations: FIT = faecal immunochemical test
** Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

Part 2

MONITORING THE PARTICIPATION RATE AND RESULTS OF THE DIAGNOSTIC FOLLOW UP

This section gives an overview of the colonoscopy participation and its most important findings. The findings are based on the colonoscopy report and the pathology report when available.

1. Participation intake interview

In total, 71,632 participants had an unfavourable FIT result. Of these, 71,623 (99.99%) were invited for an intake interview for colonoscopy; the other 9 were either sent invitations after 30 June 2018 or had died or migrated before they received the invitation. The initial intake interview was rescheduled by 24,568 (34.3%) of the participants. Appointments were moved to a different time, date or location. Of all those invited for an intake interview, 65,015 (90.8%) participated. Of the remaining invitees, 226 (0.3%) still had an intake interview scheduled, 5,472 (7.6%) opted out, and 1,220 (1.7%) did not show up for their intake interview. Of those who opted out prior to the intake interview, 1,483 (27.1%) did so on the advice of the general practitioner. Reasons were unknown for the remaining 3,970 (72.6%) cancellations.

2. Recommended follow-up strategy from intake interview

Of the 65,015 people who attended the intake interview, 60,762 (93.5%) were advised to undergo a colonoscopy and 1,032 (1.6%) were advised to undergo CT colonography. 1,128 (1.7%) participants were advised to postpone the colonoscopy for the time being or were referred to a different colonoscopy centre. 1,916 (2.9%) participants were advised to not undergo follow-up examination.

3. Participation in colonoscopy

Of the individuals who during the intake interview were advised to undergo a colonoscopy, 59,321 (97.6%) underwent colonoscopy and had colonoscopy reports and/or pathology reports available. Thus, a total of 82.8% participants with an unfavourable FIT result underwent a colonoscopy (Table 3).

Table 3: Numbers and percentages of participants with an unfavourable FIT* who underwent a colonoscopy, by age and screening round (Source: ScreenIT)

Age group	Total	
First screening round		
55-59 years	11,543	*85.8%*
60-64 years**	7,430	*85.4%*
70-75 years	12,756	*80.3%*
Subtotal	**31,729**	***83.4%***
Subsequent screening rounds		
60-64 years	3,849	*83.5%*
65-69 years	17,475	*82.3%*
70-75 years	6,268	*80.8%*
Subtotal	**27,592**	***82.1%***
All screening rounds		
Total	**59,321**	***82.8%***

* Abbreviations: FIT = faecal immunochemical test
** Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

4. Colonoscopy findings

Participants were classified according to the most relevant abnormality found during colonoscopy. This involved the following sequence: colorectal cancer, advanced adenomas, non-advanced adenomas, serrated polyps, other malignancies and no polyps or tumours. At national and international level, colorectal cancer and advanced adenomas (collectively referred to as "advanced neoplasia") are considered as relevant findings within a colorectal cancer screening programme. The pathology report to confirm the colonoscopy diagnosis was unavailable in ScreenIT in 5,025 (8.5%) of the 59,321 individuals that underwent a colonoscopy. For 163 subjects, the diagnosis was unclear based on the colonoscopy and/or pathology report. The latter were not included in the following calculations.

Table 4 summarizes colonoscopy yield in 2017 by birth cohort. During colonoscopy, colorectal cancer was found in 4,203 participants. In 23,220 participants, the most relevant finding was an advanced adenoma.

Table 4: Colonoscopy yield by age group and screening round (PPV*) (Source: ScreenIT)

Age group	Colorectal cancer		AA*	
First screening round				
55-59 years	661	*5.7%*	4,796	*41.6%*
60-64 years**	465	*6.3%*	3,191	*43.0%*
70-75 years	1,400	*11.0%*	5,585	*43.9%*
Subtotal	**2,526**	***8.0%***	**13,572**	***42.9%***
Subsequent screening rounds				
60-64 years	217	*5.7%*	1,346	*35.1%*
65-69 years	1,035	*5.9%*	6,108	*35.1%*
70-75 years	425	*6.8%*	2,194	*35.1%*
Subtotal	**1,677**	***6.1%***	**9,648**	***35.1%***
All screening rounds				
Total	**4,203**	***7.1%***	**23,220**	***39.3%***

* Abbreviations: PPV (Positive predictive value); AA (advanced adenoma)
** Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

First round

During colonoscopy in the first round, 2,526 (8.0%) participants were diagnosed with colorectal cancer. An advanced adenoma was the most important finding in 13,572 (42.9%) participants. Both percentages increased by age. The positive predictive value of the FIT, that is the percentage of participants who underwent a colonoscopy and were diagnosed with colorectal cancer and/or advanced adenoma, was 50.9%. Furthermore, 7,055 (22.3%) participants were diagnosed with non-advanced adenomas, 1,571 (5.0%) with serrated polyps and 6 (0.02%) with other malignancies. No polyps or tumours were found in 6,914 (21.8%) individuals (Figure 2a).

Subsequent rounds

During colonoscopy in the subsequent rounds, 1,677 (6.1%) participants were diagnosed with colorectal cancer. An advanced adenoma was the most relevant finding in 9,648 (35.1%) participants. The positive predictive value of the FIT in a subsequent round was 41.2%. Furthermore, 7,505 (27.3%) participants were diagnosed with non-advanced adenomas and 1,640 (6.0%) with serrated polyps. No other malignancies were detected at colonoscopy. No polyps or tumours were found in 7,044 (25.6%) individuals (Figure 2b).

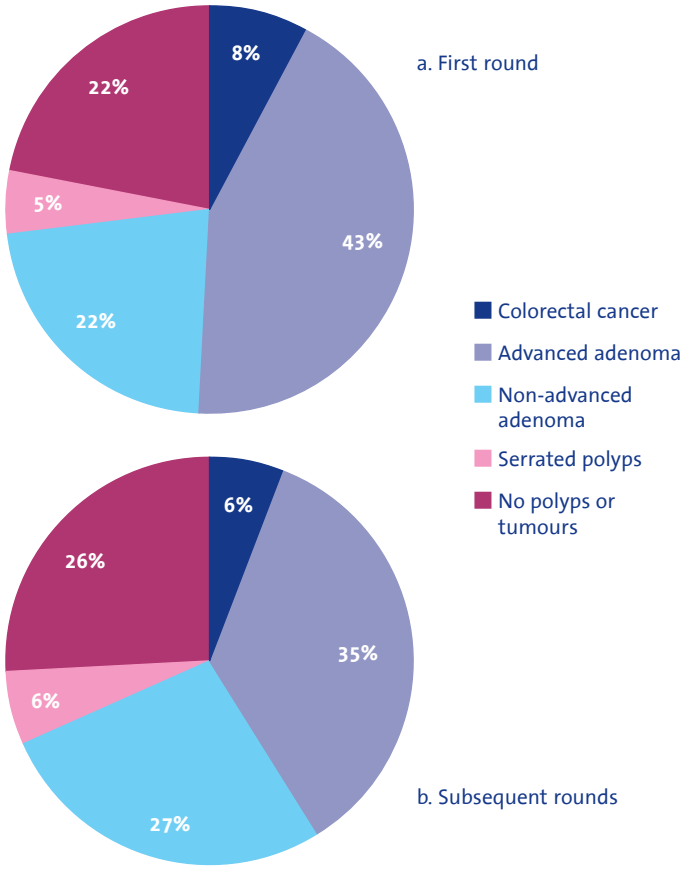

Figure 2: Colonoscopy yield of first and second screening round
As a result of rounding, the total percentages can be over 100%.

5. Detection rate of the screening programme

Colorectal cancer or advanced adenomas were found in 27,423 of the 1,411,998 participants. This corresponds to a detection rate of 19.4 per 1,000 screened individuals. Table 5 shows the difference between the detection rates by birth cohort and the first and subsequent rounds. The detection rate in the first round was 24.1 per 1,000 participants and in the subsequent rounds 15.2 per 1,000 participants.

6. Interval cancers after favourable FIT results

To evaluate the effectiveness of the national screening program it is of great importance to monitor the interval cancers. These are defined as colorectal cancers that were detected even though the individual had a favourable FIT result, between the date of analysis of a favourable FIT and the date of invitation for the next screening round, two years later (Sanduleanu et al. (2015)).

Of the 485,112 individuals with a favourable FIT result in 2014, 544 were diagnosed with an interval cancer in the period 2014-2016. This amounts to a cumulative risk of being diagnosed with an interval cancer after a favourable FIT in the first round of 0.112%. These cancers can be regarded as missed colorectal cancers in the screen round of 2014. In the same screen round, 3,290 bowel cancers were detected. Together this results in a sensitivity of the first round of 85.5%. These rates show that participants are at a very low risk of being diagnosed with colorectal cancer after receiving a favourable FIT result. However, the results are based on individuals that participated in the first round. The number of interval cancers in the subsequent rounds will show if the presented sensitivity and risk for an interval cancer are also observed after subsequent rounds .

7. Complications during or after colonoscopy

The number of participants for whom a complication was recorded during or within 30 days after colonoscopy is shown in Table 6. These numbers reflect the colonoscopies performed in 2017. The reports are gathered from the Dutch Registration of Complications in Endoscopy (DRCE).

In total, the following complications were registered in 2017: 1 (0.002%) individual with a fatal complication (i.e. death of the individual); 39 (0.068%) individuals with a severe complication (i.e. hospitalization of more than 10 days), 171 (0.296%) individuals with a moderate complication (i.e. hospitalization between 4 and 10 days) and 218 (0.378%) individuals with a mild complication (i.e. hospitalization of less than 4 days).

Table 5: Detection rate per 1,000 participants by age and screening round (Source: ScreenIT)

Age group	Colorectal cancer		AA*	
First screening round				
55-59 years	661	*2.1*	4,796	*15.6*
60-64 years**	465	*2.8*	3,191	*18.8*
70-75 years	1,400	*7.3*	5,585	*29.2*
Subtotal	**2,526**	***3.8***	**13,572**	***20.3***
Subsequent screening rounds				
60-64 years	217	*1.9*	1,346	*11.8*
65-69 years	1,035	*2.2*	6,108	*12.8*
70-75 years	425	*2.8*	2,194	*14.3*
Subtotal	**1,677**	***2.3***	**9,648**	***13.0***
All screening rounds				
Total	**4,203**	***3.0***	**23,220**	***16.4***

* Abbreviations: AA (advanced adenoma)
** Age-category 65-69 years is not separately shown due to low numbers, but added to the age-category 60-64 years

Table 6: Number of colonoscopy complications* in 2017 (Source: DRCE)

Type	Mild		Moderate		Serious		Fatal	
Perforation	8	0.014%	11	0.019%	21	0.036%	-	-
Bleeding	147	0.255%	149	0.258%	7	0.012%	-	-
Other	63	0.109%	11	0.019%	11	0.019%	1	0.002%
Total	**218**	**0.378%**	**171**	**0.296%**	**39**	**0.068%**	**1**	**0.002%**

* A total number of 57,691 colonoscopies were performed in 2017. An individual may have undergone more than one colonoscopy. As not all institutions that performed colonoscopies for the screening program reported their complications to the complication registration (DRCE) in 2017, these rates may be an underestimation.

Part 3

MONITORING PROCESSING TIMES

The various processing times are displayed in calendar days (return period) or work days (waiting time for an intake interview) as averages, the first (Q1) quartile, median (Q2) and third quartile (Q3). The first quartile (Q1) indicates the maximum processing time for the first 25% of individuals, the median (Q2) is the processing time for half of the individuals, and the third quartile (Q3) corresponds to the processing time for the first 75% of individuals.

- The **return period** (the time interval between the self-sampling date and sending the letter with the FIT result to the participant) was on average 3.6 days (Q1: 3 days, Q2: 3 days, Q3: 5 days). *Target value: 7 week days.*
- The **waiting time for an intake interview** (the time interval between sending the letter with the FIT result and the date of the initially scheduled intake interview) was on average 12.2 days (Q1: 9 days, Q2: 12 days, Q3: 15 days). *Target value: 15 work days.*
- The **screening interval** (the time between date of self-sampling of the previous round and the subsequent round), was on average 23.3 months (Q1: 24 months, Q2: 24 months, Q3: 25 months). *Target value: 22-26 months.*
- The **average travel distance to the initial scheduled intake interview location** (the distance between an individual's home address and the intake location) was 14.5 km on average (Q1: 6.4 km, Q2: 12.5 km, Q3: 20.2 km). *Maximum limit: 40 km.*

The average processing times and travel distance are all within the defined target values.

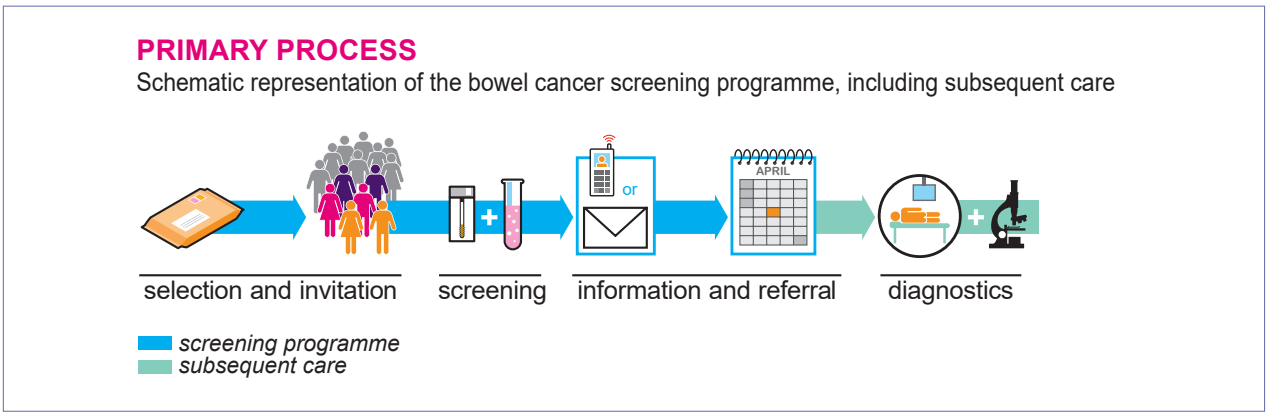

Figure 3: Monitoring processing times (Source: ScreenIT)

Part 4

TOTAL SCREENING PROCESS

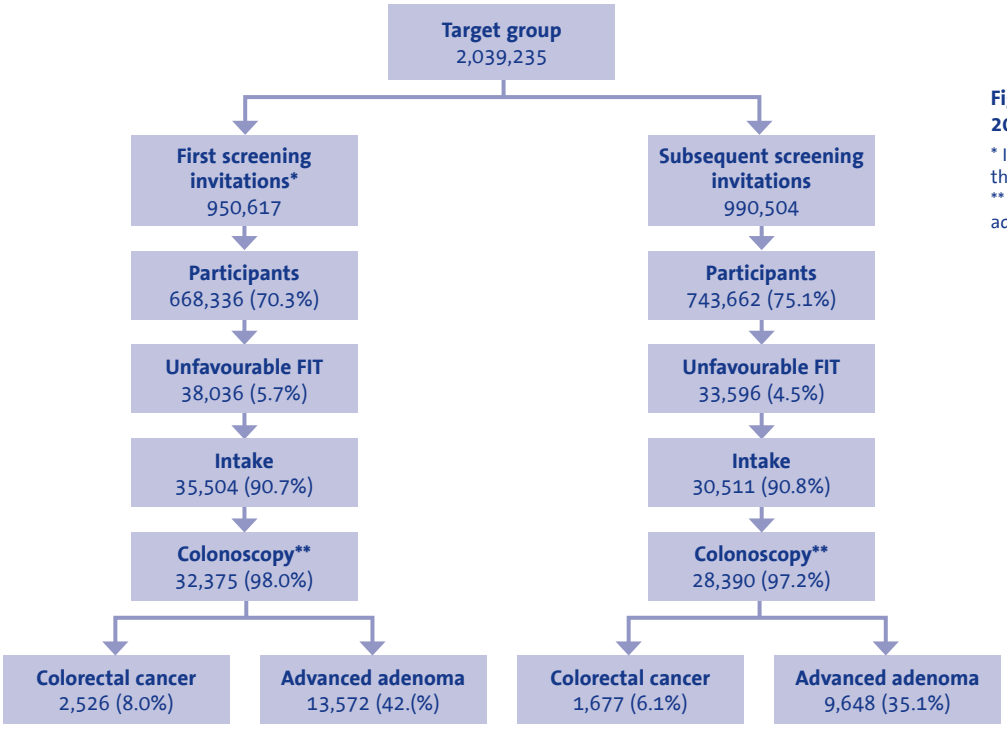

Figure 4: Total screening process of invitees in 2017 (Source: ScreenIT)

* Including individuals that opted out upon receipt of the pre-invitation letter
** Divided by the number of participants who were advised to undergo colonoscopy

Part 5

NATIONAL INCIDENCE AND MORTALITY

The incidence of colorectal cancer in has slightly decreased in 2017. In 2013, the year previous to the implementation of the national colorectal cancer screening programme, there were 77.7 new cases (crude incidence rates per 100,000). This rate increased to 90.2 in 2014 and to 93.8 in 2015 but decreased in 2016 to 89.6 and in 2016 to 80.5.

At the time this monitor was submitted for publication, mortality rates for 2017 had not yet been made available. In 2013, the mortality rate was 29.5 (per 100,000 individuals), in 2014 it was 29.1, in 2015 it was 30.3 and in 2016 it was 29.9.

Part 6

COMPARISON BETWEEN 2014–2017

The results of the first three years of the national colorectal cancer screening programme have been separately reported in the 2014, 2015 and 2016 annual monitors. A comparison between the first three years and the year 2017 gives insight in the programme's continuity and quality (table 7 and figure 5). The comparison includes for 2014 only individuals who were assessed with the same FIT cut-off value as the present report (47 µg Hb/g faeces).

The comparison shows the results of important indicators such as participation in FIT, intake referral percentage, positive predictive value (PPV) and detection rate. Considering the first round participants of all four years, the participation rate is comparable.

The positivity rate and the detection rate for advanced adenomas and colorectal cancer is more or less comparable in the first round participants of all four years. A different age composition due to different invited birth cohorts could explain the small differences. Partly, this could also explain the small decrease in the PPV over the years.

In the subsequent rounds, the participation rate is increased compared to the first round. As expected, the positivity rate, detection rate and PPV decreased in the second round. Fewer abnormalities are found during colonoscopy, because the prevalence of colorectal cancer and advanced adenoma decreased after a first round of screening.

Table 7: Comparison of results monitor 2014, 2015, 2016 and 2017(Source: ScreenIT)

	First screening round				Subsequent screening rounds	
	2014	2015	2016	2017	2016	2017
Mean age participants	68.3	66.2	64.9	63.4	67.1	67.1
Participation	71.6%	73.0%	71.8%	70.3%	75.9%	75.1%
Positivity rate (47 µg Hb/g faeces)	6.4%	6.4%	6.1%	5.7%	4.5%	4.5%
Detection rate CRC	4.9 per 1,000	4.6 per 1,000	3.9 per 1,000	3.8 per 1,000	2.4 per 1,000	2.3 per 1,000
Detection rate CRC and AA	25.3 per 1,000	29.7 per 1,000	25.6 per 1,000	24.1 per 1,000	15.4 per 1,000	15.2 per 1,000
PPV CRC	9.5%	8.8%	8.3%	8.0%	6.6%	6.1%
PPV CRC and AA	58.7%	57.2%	53.7%	50.9%	42.1%	41.2%

Abbreviations: PPV (Positive predictive value of an unfavourable FIT result); CRC (colorectal cancer); AA (advanced adenoma)
Results of monitor 2014, 2015 and 2016 are derived from the monitor 2016

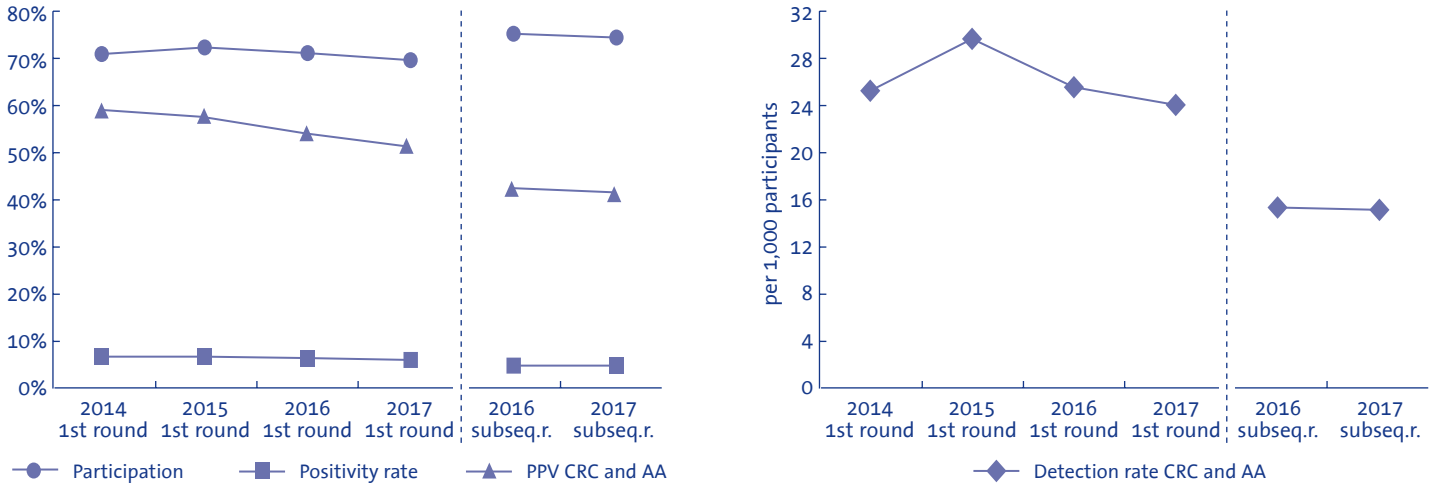

Figure 5: Most important results of 2014, 2015, 2016 and 2017 for first rounds and subsequent rounds

Abbreviations: PPV (Positive predictive value of an unfavourable FIT result); CRC (colorectal cancer); AA (advanced adenoma)