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Impact of stopping sending colorectal cancer screening test kits by regular mail

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ABSTRACT

Objective: From 2009 to 2013, the French colorectal cancer screening program (CRCSP) provided for a medical phase and a phase of systematic mailing of the test kit (SMTK) to people who could not participate in the medical phase. After 2013, the SMTK was abandoned in most districts. This study aims to analyze the impact of this termination.

Study design: This was a descriptive and cohort study.

Methods: The study concerned a cohort of 143,989 people (aged 50–74 years) living in Seine-Saint-Denis (France), invited to participate in the 2013 campaign (with SMTK) and in the 2015 campaign (without SMTK). The impact of SMTK termination was analyzed in terms of the difference between the participation rates and between the delay (expected vs observed) in performing the screening test in 2015. These differences were described based on previous solicitation in the CRCSP. Expected rates and expected delay were estimated in a Monte Carlo simulation.

Results: The participation rate observed (20.0%) was higher than expected (16.1% [15.9–16.3]). People who have never had a SMTK between 2007 and 2013 (80.0% [79.3–80.7] vs 69.6%) and those who participated in all campaigns before 2015 (97.0% [96.7–97.3] vs 82.6%) had an observed rate lower than expected. The delay observed (4.2 months) was longer than expected (2.5 months).

Conclusion: The sudden termination certainly contributed to the extension of the delay. However, it did not have a major impact on the participation rate, partly due to information campaigns on the new screening test. In this cohort, the low participation would be explained better by the behavior in the previous campaigns than by the lack of SMTK.

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Introduction

The advantages of colorectal cancer screening programs (CRCSPs) through fecal occult blood testing have been widely documented. These programs increased considerably the proportion of cancers screened among the annual incidence of colorectal cancers (CRCs)[1] and the control of incidence through diagnosis of precancerous lesions.[2] The high cure rate of these screened cancers is a major determinant of the decline in CRC mortality. Indeed, it was established that screening by fecal occult blood testing every two years reduces deaths from CRC when the participation rate is >50%.[3–6] In addition, the CRCSP is associated with a considerable benefit in terms of reducing the cost of CRC care.[7–9]

Despite this considerable advantage, the participation rate exceeds rarely 50% in most French departments, whereas it was very encouraging (more than 50%) in the pilot CRCSP.[10–13] To optimize this rate, several strategies have been proposed[14–22] and had variable results. The strategy of sending the test to the targeted people was followed by 50–70% participation rates in the United Kingdom, the Netherlands, or Finland but only about 15% in France,[23] where it cost nearly 33.59 euros (39 USD) per test.[24] This led to the idea that, in France, it was necessary to involve the general practitioner (GP) and send the test kit by regular mail to reach a participation rate of at least 45%.[25] This was why the decision to generalize the screening in 2009 (French decree dated September 29, 2006) involved a medical phase (test delivered by the GP during a medical consultation) and then a postal phase (mailing the test kit).[26] This postal phase would reach those who do not consult a doctor or those whose doctor is not motivated to participate in the CRCSP.

A later decree (dated February 22, 2013) made non-mandatory the systematic mailing of the test kit (SMTK) and left this choice to each 'Agence Régionale de Santé.'[25] The consequence was the refusal to finance the SMTK by most departments and a sudden termination of the SMTK.[25]

The present study aimed to analyze the impact of termination of the SMTK in a cohort of people invited to participate in the CRCSP before and after this termination.

Methods

The study was conducted in 2017 using screening data on a cohort of 143,989 people living in Seine-Saint-Denis. Seine-Saint-Denis is a French department (code 93) located in the north-east of the Paris agglomeration. It has an area of 236 km^2 and nearly 1.6 million inhabitants (2015 census); of whom, nearly 29% would be younger than 20 years (2012 census). It may be characterized by a high level of unemployment (18.5% in 2013), a lower educational level than its neighboring departments, and a slightly lower GPD (Gross Domestic Product) per capita than the French average GPD. Department 93 does not benefit from an adequate supply of healthcare services, especially regarding liberal medicine, probably because of some degree of deprivation.

The study concerned people aged >50 years invited to participate in the 2013 campaign (last campaign with SMTK) and reinvited to participate in the 2015 campaign (campaign without SMTK).

The impact of termination of the SMTK was analyzed in terms of difference between the participation rates (expected vs observed) and delay (expected vs observed) to undergo the screening test in 2015. On the basis of a counterfactual analysis, the expected rate and the expected delay were defined as those that would be obtained in the same cohort in 2015, providing SMTK continues. This rate and this delay were described on the basis of the previous behavior in the subgroups that received SMTK in previous campaigns (2007–2013). The data were extracted from the database used for the management of the CRCSP in department 93.

Organizational framework of the CRCSP and the SMTK principle

In department 93, the 'Comité Départemental des Cancers' is the local cancer screening managing center. According to the CRCSP, people receive a first invitation to screening by their 50th birthday; then, the invitation is renewed every two years until the age of 74 years.[10,23] Up to 2013, the screening had to follow two phases: (1) A medical phase during which the people targeted by the campaign received an initial letter of solicitation (L-0) then a reminder letter (L-1) three months after L-0, inviting them to find the screening test kit at the GP's office; (2) a mailing phase during which the test kit was sent regularly by mail accompanied by a second reminder letter (L-2). This phase was organized, in case the screening test was not carried out during the medical phase. In 2014, the mailing phase was stopped. People who did not undergo the test during the medical phase received only L-2 without a screening test kit. In 2015, the introduction of a new screening test (fecal immunochemical test [FIT] in replacement of the guaiac fecal occult blood test [gFOBT]) had major consequences in terms of delay to L-0 letters and change in the mode of delivering the test kits to the GPs.

Operational definition of the variables

Participation in a campaign was defined as carrying out a fecal occult blood test according to the specifications of the French CRCSP.[10,23] Campaign participant status was binary coded (non-participant vs participant).

During the four campaigns (2007–2013), the SMTK was expressed as frequency. This frequency was expressed as the proportion of campaigns with SMTK; it was coded as a discrete variable: (1) new entrant in 2013 and non-SMTK (person included in the program only in 2013 but without SMTK in this campaign); (2) new entrant in 2013 with SMTK (person included in the program only in 2013 with SMTK in this campaign); (3) previously solicited and non-SMTK (person having had at least one invitation before 2013 and having never received a SMTK); and (4) previously solicited with SMTK (person having had at least one invitation before 2013 and having received a SMTK in ≤25%, in 25–50%, in 50–75%, and in >75% of campaigns to which he/she was invited before 2013).

Previous behavior was expressed in terms of regular participation in the CRCSP. It was defined as participation in the four campaigns before 2015. It was coded as a discrete variable: (1) new entrant in 2013 (see aforementioned information); (2) previously solicited and never participated (the

person who participated in none of the previous campaigns to which he/she was invited); and (3) previously solicited and participated in ≤25%, in 25–50%, in 50–75%, and in >75% of campaigns to which he/she was invited before 2013.

The following were also considered as discrete variables: sex (female vs male), age (≤54, 55–60, 61–65, 66–70, and >70 years) and type of health insurance plan (Caisse Primaire d'Assurance Maladie, Mutuelle Générale de l'Éducation Nationale [MGEN], Régime Social des Indépendants, Mutuelle de la Fonction Publique, Régie Autonome des Transports Parisiens [RATP], Société Nationale des Chemins de Fer, and other plans).

Statistical analyses

The participation rate during a given year was the proportion of people who underwent a screening test among those invited to do so between January 1 and December 31. This rate was compared between groups using a Pearson Chi-squared test. In people who underwent the screening test, the delay (in months) between the initial solicitation (date of L-0) and test completion date was summarized by a mean and a confidence interval.

Using the 'Clarify' module,[27,28] the expected participation rates and expected delays were estimated using Monte Carlo simulation (number of simulations M = 1000). The comparison with the observed participation rates was made using the confidence intervals.

To obtain the expected participation rate, a prediction based on the participation rate in 2013 was first made in a multivariate logistic model; then, using the linear predictor obtained, a draw from a Bernoulli distribution was made to estimate the expected participation rate.

Similarly, to obtain the expected delay, a prediction from the test completion delay in 2013 was made in a multivariate linear regression model.

For the construction of multivariate models (logistic and linear), we used all the independent covariates (SMTK frequency, previous behavior in the CRCSP, sex, age, and type of health insurance plan), regardless of the strength of association found in the univariate analyses. In addition, there was a strong correlation ($P < 0.001$) between the SMTK frequency and the regular participation in the CRCSP. Multivariate models were extended to include an interaction term between these two variables (SMTK frequency and regular participation). To account for the change in age between 2013 and 2015, model parameters were estimated with age in 2013, and linear predictors were estimated with age in 2015.

All the analyses were carried out with version 13 of STATA software (College Station, Texas, USA), and $P < 0.05$ was considered for statistical significance.

Results

Cohort selection

In 2013, 46,529 among 209,982 people invited to participate in the CRCSP in department 93 (i.e. 22.2%) underwent the screening test; of whom, nearly 3 of 4 (i.e. 15.6% of the cohort) underwent the test within the first six months after the initial invitation. In 2015, the participation rate increased to 23.4%, but the participation rate within the first six months was significantly lower (13.8% vs 15.6%, $P < 0.001$) (Table 1). Among the people invited in 2015, 143,989 (68.6%) were already invited in 2013. Among the latter, the participation rate was significantly higher in 2015 than in 2013 (20% vs 16%, $P < 0.001$).

Participation before 2013

In 2013, 17,559 people did not receive a postal test and did not perform the screening test; among them, nearly 52% (9286 people) had benefited from the SMTK during the previous campaign (2011–2012) without performing the screening test. Among the 103,186 people who received a SMTK in 2013 without performing the screening test, 70.9% (73,178 people) had also benefited from the SMTK in previous campaign (2011–2012) without performing the test. Similarly, 16,305 people of 21,163 (77%) who performed the test in the 2013 campaign without waiting for the SMTK had performed the test between 2011 and 2012 also without waiting for the SMTK (Fig. 1).

Participation in 2013 and 2015

Only 28.2% (587 of 2081) of those who performed the test in the 2013 campaign after receiving the SMTK could not participate

Table 1 – Participation rates (overall and among people who received a systematic mailing of test kit [SMTK]) in the department, by campaign.

Screening campaign	Overall participation rate			Participation rate among people who received SMTK	
	Number of people invited	Number (%) of people screened	Number (%) of people screened within 6 months	People received SMTK	Number (%) of people screened
Year 2007	148,780	41,566 (27.9)	20,454 (13.7)	89,359	12,420 (13.9)
Year 2008	95,379	26,532 (27.8)	12,869 (13.5)	58,986	8338 (14.1)
Year 2009	268,091	63,810 (23.8)	32,094 (12.0)	173,478	19,373 (11.2)
Year 2010	146,192	31,421 (21.5)	17,472 (12.0)	101,221	8498 (8.4)
Year 2011	224,639	49,562 (22.1)	30,518 (13.6)	148,954	10,880 (7.3)
Year 2012	186,324	45,891 (24.6)	28,097 (15.1)	126,228	11,995 (9.5)
Year 2013	209,982	46,529 (22.2)	32,793 (15.6)	109,568	9103 (8.3)
Year 2014	163,200	25,392 (15.6)	19,681 (12.1)	–	–
Year 2015	195,814	45,820 (23.4)	26,969 (13.8)	–	–

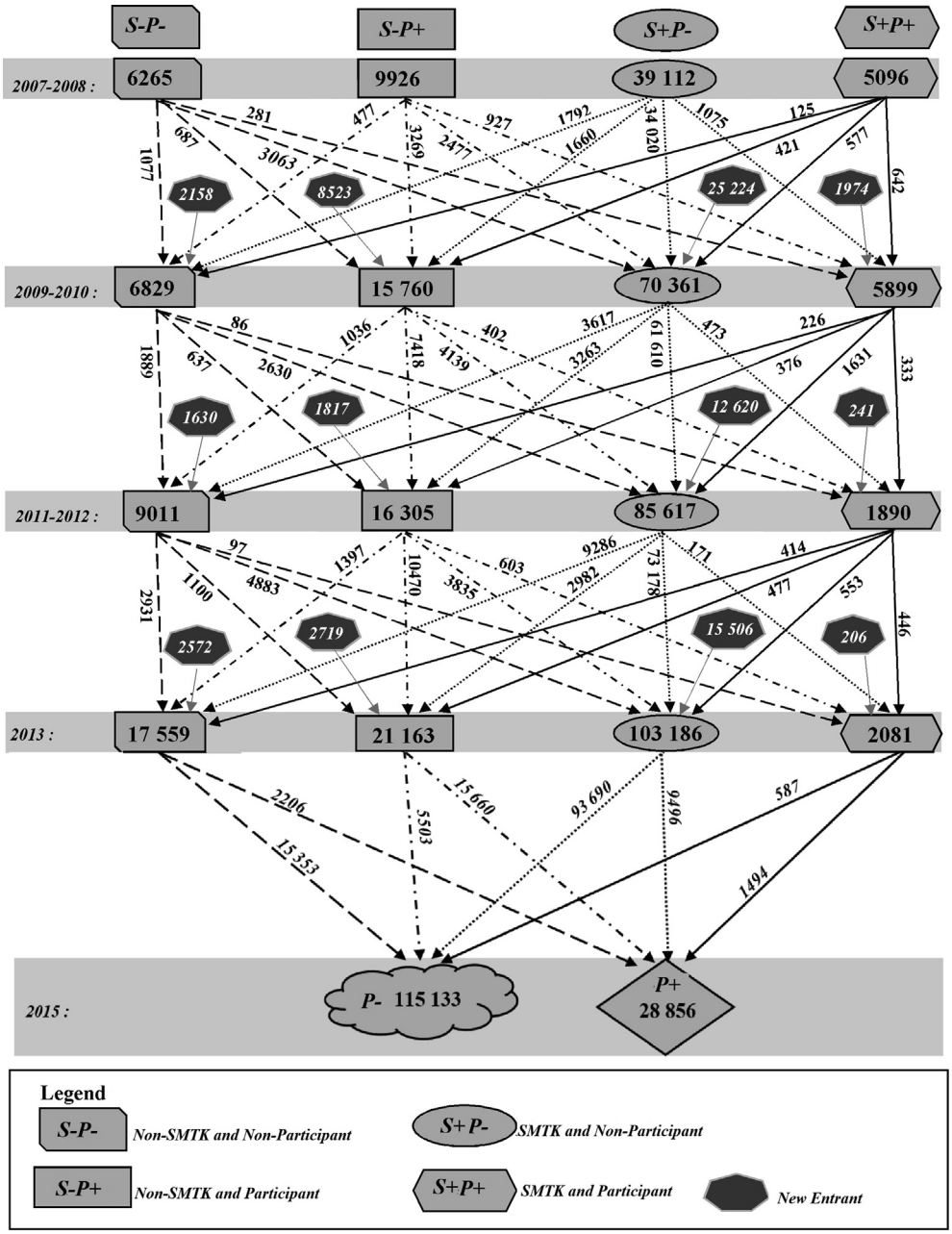

Fig. 1 – Behavior in previous campaigns of 143,989 people invited in 2013 and 2015. SMTK, systematic mailing of the test kit.

in the 2015 campaign. During the 2009–2010 campaign, the participation rate of 45,377 persons (S-P-: 6265, S + P-: 39,112) who did not participate in the 2007–2008 campaign was 8.2%. This rate was 5.8% during the 2011–2012 campaign for the 77,190 people who did not participate in the (S-P-: 6829; S + P-: 70,361) 2009–2010 campaign. This mobilization rate of persons, previously non-participants, achieved a significant increase ($P < 0.0001$) between 2013 (4.6% of 94,628 non-participants in 2011–2012) and 2015 (9.7% of 120,749 non-participants in 2013) (Fig. 1).

The participation rate in 2015 was significantly higher among the 23,244 people who underwent the screening test in the 2013 campaign than among the 120,745 people who did not undergo the test (73.8% vs 9.7%, $P < 0.001$). Regardless of the participation status in 2013, with respect to the SMTK status (with SMTK or without) and seniority in the CRCSP (new entrant or previously solicited), the mobilization in 2015 was higher in the subgroups that participated in the 2013 campaign (Table 2).

Expected and observed participation rates and delays in 2015

After stopping the SMTK, the observed participation rate (20.0%) was on average higher than expected (16.1%, 95% confidence interval [CI]: 15.9–16.3). The distribution of the participants is summarized in Table 3. People who have never received a SMTK between 2007 and 2013 (expected: 97.0%, 95%

Table 2 – Distribution of participation rate (observed) in the 2015 campaign, according to the participant status in the 2013 campaign of 143,989 people invited to both campaigns in 2013 and 2015.

Participant status in 2013	Number invited (participation in 2015)[a]	P-value[b]
Overall participation in 2013		**<0.001**
Non-participant	120,745 (9.7)	
Participant	23,244 (73.8)	
According to SMTK history in 2013		
Not received a SMTK in 2013		<0.001
Non-participant	17,559 (12.6)	
Participant	21,163 (74.0)	
Received a SMTK in 2013		<0.001
Non-participant	103,186 (9.2)	
Participant	2081 (71.8)	
According to SMTK history between 2007 and 2013		
New entrant in 2013 and never received a SMTK		<0.001
Non-participant	3848 (11.8)	
Participant	2948 (66.2)	
New entrant in 2013 and received a SMTK		<0.001
Non-participant	19,748 (10.2)	
Participant	221 (63.8)	
Previously solicited and never received a SMTK		<0.001
Non-participant	13,711 (12.8)	
Participant	18,215 (75.3)	
Previously solicited & received a SMTK in at least 1 campaign between 2007 and 2013		<0.001
Non-participant	83,438 (9.0)	
Participant	1860 (72.7)	

SMTK, systematic mailing of the test kit.
[a] Participation rate in %.
[b] Pearson Chi-squared test.

CI: 96.7, 97.3 vs observed: 82.6%) and those who participated in all campaigns before 2015 (expected: 97.0%, 95% CI: 96.7, 97.3 vs observed: 82.6%) had a lower observed than the expected participation rate. People aged over 70 years did not show a significant difference between observed and expected participation rates in 2015 (expected: 22.9% vs observed: 22.9%) (Table 3).

Only 17,154 people were screened in both campaigns in 2013 and 2015. In these, the expected mean delay was 2.5 months in 2015 (minimum: 0, and maximum: 18.9 months, 95% CI: 2.5–2.5). The mean observed delay was 4.2 months (minimum: 0, maximum: 20.9 months). In 2015, the observed delay to undergo the screening was significantly longer than the expected delay and was significantly variable according to the characteristics (Table 4).

Discussion

The participation rate in the CRCSP is an important indicator of the program efficiency. With an annual participation rate that never exceeded 27.9%, Seine-Saint-Denis is one of the many French departments in which the minimum target of 45% (recommended by experts from the European Union)[10] was never reached. One of the major concerns of the French program seems to be the lack of strategies to reach people furthest away from the program for a variety of reasons. In Seine-Saint-Denis, despite the existence of a regular organization of promotional campaigns, especially in March, '*Mars-Bleu*,' there was no precampaign information session before 2015, intended to mobilize the target population. This could explain the gradual decline in the participation rate between 2007 and 2014.

Despite a late launch of the campaign and logistic difficulties imposed by the new screening test, the participation rate in the 2015 campaign exceeded that of 2013 and 2014. This reflects new campaign management dynamics focused on promoting the performance of the new screening test in populations previously hostile to the CRCSP. The dynamism around the new screening test has already been mentioned after a participation rate increase of about four points in the first cohorts included in the departmental program.[29]

In terms of mobilization of previously non-participants, the difference (4 points) observed between 2013 and 2015 could be consistent with this dynamism around the new screening test. Indeed, it has been documented that gFOBT identified only 50% of cancerous lesions, which would motivate the reluctance of some GPs.[30] In addition, the need to collect several stool samples for three days could create patient-side reluctance.[30,31] In this context, the introduction of a new test in 2015 could only have a positive impact in terms of increased participation. However, with the participation rates of previously non-participants being of the same order of magnitude between 2015 (year of FIT introduction) and 2009–2010 (year of national and official launch of the CRCSP), we can admit that it was not the screening test that attracts people, but the information campaigns about screening are a prelude to any major change in the program.

One should note, however, that about one-third of people invited in 2013 were not invited in 2015. After a high

Table 3 – Distribution of expected and observed participation rates in the 2015 campaign according to history in the CRCSP and sociodemographic characteristics.

Characteristic/history	Number	Expected rate (% [95% CI])	Observed rate (%)
SMTK frequency (2007–2013)			
New entrant in 2013 & non-SMTK	6796	30.6 [29.5; 31.7]	35.4
New entrant in 2013 & SMTK	19,969	6.2 [5.9; 6.6]	10.8
Previously solicited & never SMTK	14,115	80.0 [79.3; 80.7]	69.6
Previously solicited with SMTK in ≤25% of campaigns	1944	42.4 [40.3; 44.6]	43.9
Previously solicited with SMTK in 26–50% of campaigns	14,041	35.4 [34.6; 36.2]	36.5
Previously solicited with SMTK in 51–75% of campaigns	23,500	8.7 [8.3; 9.0]	16.8
Previously solicited with SMTK in 76–100% of campaigns	63,624	1.2 [1.1; 1.3]	7.1
Regular participation in the CRCSP (2007–2013)			
New entrant in 2013 & non-participated in the 2013 campaign	23,596	12.4 [12.0; 12.8]	17.1
New entrant in 2013 & participated in the 2013 campaign	3169	92.4 [91.8; 92.8]	87.1
Previously solicited & never participated	77,454	0.2 [0.1; 0.2]	6.0
Previously solicited & participant in ≤25% of campaigns	5435	1.7 [1.3; 2.0]	21.0
Previously solicited & participant in 26–50% of campaigns	14,699	15.2 [14.6; 15.7]	27.0
Previously solicited & participant in 51–75% of campaigns	6459	72.5 [71.4; 73.6]	56.5
Previously solicited & participant in 75–100% of campaigns	13,177	97.0 [96.7; 97.3]	82.6
Sex			
Women	70,432	18.2 [17.9; 18.5]	22.6
Men	73,557	14.1 [13.9; 14.4]	17.6
Age in 2015			
≤54 yrs	19,481	13.8 [13.3; 14.3]	19.2
55–60 yrs	52,325	13.1 [12.7; 13.4]	17.2
61–65 yrs	32,844	16.2 [15.8; 16.6]	21.2
66–70 yrs	24,001	20.3 [19.8; 20.8]	23.5
>70 yrs	15,338	22.9 [22.3; 23.6]	22.9
Health insurance plan in 2015			
CPAM	124,152	15.6 [15.4; 15.8]	19.5
MGEN	4463	21.8 [20.6; 23.1]	27.6
RSI	6195	12.1 [11.3; 12.9]	15.0
MFP	1047	20.2 [17.9; 22.8]	22.8
RATP/SNCF	1710	20.5 [18.6; 22.4]	26.6
Other plans	6422	24.5 [23.5; 25.6]	28.4

CI, confidence interval; CRCSP, colorectal cancer screening program; SMTK, systematic mailing of test kit; CPAM, Caisse Primaire d'Assurance Maladie; MGEN, Mutuelle Générale de l'Éducation Nationale; RSI, Régime Social des Indépendants; MFP, Mutuelle de la Fonction Publique; RATP/SNCF, Régie Autonome des Transports Parisiens/Société Nationale des Chemins de Fer Français.

participation rate in 2013, these people are likely to have been temporarily or permanently excluded at the end of the campaign. Indeed, in Seine-Saint-Denis, about 10% of the target population reaches the age of permanent exclusion (74 years) during the time interval that separates two campaigns (two years). In addition, 19% of the people invited in a campaign sent a postal reply justifying a definitive or temporary exclusion.[10]

The delay observed between the initial invitation and the completion of the test was relatively long than that expected in all the study subgroups. This long delay would be partly due to the logistic difficulties linked with the adoption of a new screening test. For example, the provision of test kits to the GPs suffered untimely interruptions after the introduction of the new test. In addition, the constraint imposed by the sudden termination of the SMTK could be evoked. Actually, being used to receive the test kit by regular mail, people who used to undergo the test after the SMTK would have decided to retrieve the test at the GP's office only after the usual six months, time after which the 'Comité Départemental des Cancers' used to send the test kit to the non-participants.

The change in the screening test in 2015 was preceded by a period (2014) of information deficit about the date of introduction of the new test, which probably affected the participation in 2014. However, the low participation rate observed in 2014 could be one of the immediate consequences of the sudden termination of the SMTK. Although small, the risk for CRC to go undetected because of lack of mailing is not zero. Indeed, the literature shows that a SMTK increases the CRCSP participation rate by 21%.[23] It has been estimated that 25% of CRCs diagnosed annually in France via the CRCSP (nearly 4000) would remain undiagnosed in the absence of SMTK.[25] On the basis of this estimation and given the mean of 96 cancers detected in the department during a biennial campaign,[10] 16 cancers went undetected in 2015 because of lack of SMTK. However, this hypothesis is not plausible because of the following: (1) the observed participation rate was higher than the expected rate in almost all homogeneous subgroups defined on the SMTK criterion; and (2) people who participated in 2013 only after a mailing were strongly mobilized in 2015 despite the termination of the SMTK.

One should then admit that, in Seine-Saint-Denis, the non-mobilization during a campaign may be better explained by people's behavior in the previous campaigns than by stopping the SMTK. Indeed, the study results have shown that non-participants in 2015 participated less in previous campaigns.

Table 4 – Average delay (expected and observed, in months) between the date of initial solicitation and the date of test completion according to history in the CRCSP and sociodemographic characteristics.

Previous behavior/characteristics	Number	Expected delay [95% CI]	Observed delay
SMTK frequency (2007–2013)			
New entrant in 2013 & non-SMTK	1951	2.9 [2.9; 2.9]	5.3
New entrant in 2013 & SMTK	141	2.9 [2.9; 2.9]	5.3
Previously solicited & never SMTK	9194	2.3 [2.3; 2.3]	3.5
Previously solicited with SMTK in ≤25% of campaigns	666	2.5 [2.5; 2.5]	4.0
Previously solicited with SMTK in 26–50% of campaigns	3389	2.7 [2.7; 2.7]	4.8
Previously solicited with SMTK in 51–75% of campaigns	1395	2.9 [2.9; 2.9]	5.4
Previously solicited with SMTK in 76–100% of campaigns	418	3.2 [3.2; 3.2]	4.0
Regular participation in the CRCSP (2007–2013)			
New entrant in 2013	2092	2.9 [2.9; 2.9]	5.3
Previously solicited & participant in ≤25% of campaigns	252	2.7 [2.7; 2.7]	6.1
Previously solicited & participant in 26–50% of campaigns	1242	2.7 [2.7; 2.7]	5.5
Previously solicited & participant in 51–75% of campaigns	2686	2.6 [2.6; 2.6]	4.8
Previously solicited & participant in 75–100% of campaigns	10,882	2.4 [2.4; 2.4]	3.6
Sex			
Women	9610	2.5 [2.5; 2.5]	4.2
Men	7544	2.5 [2.5; 2.5]	4.2
Age in 2015			
≤54 yrs	1816	2.9 [2.9 2.9]	5.3
55–60 yrs	4792	2.6 [2.6; 2.7]	4.4
61–65 yrs	4163	2.5 [2.5 2.5]	4.0
66–70 yrs	3765	2.4 [2.4; 2.4]	3.9
>70 yrs	2618	2.2 [2.2; 2.3]	3.7
Health insurance plan in 2015			
CPAM	14,202	2.5 [2.5; 2.5]	4.2
MGEN	786	2.5 [2.5; 2.5]	4.2
RSI	481	2.6 [2.5; 2.6]	4.7
MFP	149	2.4 [2.4; 2.6]	3.8
RATP/SNCF	299	2.5 [2.4; 2.9]	3.9
Other plans	1237	2.5 [2.5; 2.5]	4.1

CI, confidence interval; CRCSP, colorectal cancer screening program; SMTK, systematic mailing of test kit; CPAM, Caisse Primaire d'Assurance Maladie; MGEN, Mutuelle Générale de l'Éducation Nationale; RSI, Régime Social des Indépendants; MFP, Mutuelle de la Fonction Publique; RATP/SNCF, Régie Autonome des Transports Parisiens/Société Nationale des Chemins de Fer Français.

As in other secondary prevention programs (e.g. vaccination), the participation in the CRCSP seems to be strongly dependent on sociocultural factors. In the USA where socio-epidemiological studies are less constrained than in France, the literature has reported links between racial and/or ethnic groups and participation rates in screening campaigns.[32,33] Racial/ethnic disparities regarding CRC screening are major challenges for prevention programs. Opportunely, Mobley and Kuo[34] opposed that national disparity estimates simply confound place and race effects. For these authors, cancer control efforts are local and require locally relevant information to assess the needs. This finding should be consistent in analyzing the determinants of participation and interpreting the results because Seine-Saint-Denis might well have the same sociocultural diversity.

To optimize a screening program in the context of sociocultural diversity, any strategy based on SMTK should target populations with a high probability of participation. In this cohort, more than half of the cohort did not participate in any of the previous campaigns to which the individuals were invited, despite the great number of tests sent between 2007 and 2013. The cost of a single test kit being nearly 40 USD[24] and the economic loss caused by mailed and neglected tests could be quite considerable may justify the decision to stop or reorganize the SMTK. However, this loss may be negligible in comparison with the cost of treating cancers that would go undiagnosed without SMTK in potentially participating populations. According to Lejeune et al.[7,35] a campaign without SMTK would save only 2% of the cost of the campaign but remains associated with an 89% increase in the cost of a year of life gained.

In addition, the fight against inequalities in health and access to care is one of the priority issues of the national health strategy.[36] The mailing of the test was included in the medical phase to fight against inequality in the access to screening. This inequality could be very critical in some medically deprived areas. Seine-Saint-Denis may be facing some difficulties regarding the turnover of medical staff with many retirements and no replacement. In the present study, this difficulty in access to screening is reflected by the link between the observed participation rate and the type of health insurance plan (high rate of participation of RATP or MGEN affiliates[37]) or age (low participation of people <61 years). For Pollack et al.[38] the socio-economic level and the type of insurance are factors that influence the decision of a physician to recommend the screening or not. Similarly, several studies have established a link between age and participation.[10,37] Here, people older than 65 years had a high participation rate.

To sustain screening in relatively deprived populations with low access to medical care, a highly selective mailing of

the test kit should be tested as a complementary strategy. This selective mailing should exclude those who did not undergo the test after a previous mailing. This rigor would significantly reduce the cost of the SMTK.

Conclusions

After stopping the SMTK, the observed participation rate in 2015 was higher than the expected rate, partly due to extensive information campaigns on the new screening test. People who did not participate in the 2015 campaign are probably those who did not participate in previous campaigns. Their refusal to participate in 2015 would be better explained by their reaction during the previous campaigns than by the decision to stop mailing the test kit.

One major consequence of SMTK termination was a significant increase in the delay to undergo the test after the initial solicitation. This long delay could also be due to the logistic or organizational difficulties brought by the choice of a new screening test. In light of these results, it seems desirable to test a strategy of selective mailing of the test kit to people who are the less likely to participate after simple invitations.

Author statements

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Ethical approval

Before analysis, all data were anonymized. The screening database had a favorable opinion from the institution that oversees the ethics of data collection ('*Commission nationale de l'informatique et des libertés*').[39] According to the current French legislation, a study that does not change the care of patients did not require the opinion of the Clinical Research Centers Ethics Committee. This article does not contain any studies performed on human participants by any of the authors. This study does not involve human participants, and informed consent was therefore not required. This article does not contain any studies performed on animals by any of the authors.

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Competing interests

No conflict of interest.

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