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Cost-Effectiveness Analysis of a Navigation Program for Colorectal Cancer Screening to Reduce Social Health Inequalities: A French Cluster Randomized Controlled Trial

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ABSTRACT

Background: Patient navigation programs to increase colorectal cancer (CRC) screening adherence have become widespread in recent years, especially among deprived populations. **Objectives:** To evaluate the cost-effectiveness of the first patient navigation program in France. **Methods:** A total of 16,250 participants were randomized to either the usual screening group (n = 8145) or the navigation group (n = 8105). Navigation consisted of personalized support provided by social workers. A cost-effectiveness analysis of navigation versus usual screening was conducted from the payer perspective in the Picardy region of northern France. We considered nonmedical direct costs in the analysis. **Results:** Navigation was associated with a significant increase of 3.3% (24.4% vs. 21.1%; P = 0.003) in participation. The increase in participation was higher among affluent participants (+4.1%; P = 0.01) than among deprived ones (+2.6%; P = 0.07). The cost per additional individual screened by navigation compared with usual screening (incremental cost-effectiveness ratio) was €1212 globally and €1527 among deprived participants. Results were sensitive to navigator wages and to the intervention effectiveness whose variations had the greatest impact on the incremental cost-effectiveness ratio. **Conclusions:** Patient navigation aiming at increasing CRC screening participation is more efficient among affluent individuals. Nevertheless, when the intervention is implemented for the entire population, social inequalities in CRC screening adherence increase. To reduce social inequalities, patient navigation should therefore be restricted to deprived populations, despite not being the most cost-effective strategy, and accepted to bear a higher extra cost per additional individual screened.

Keywords: colorectal cancer screening, cost-effectiveness analysis, patient navigation, social inequalities.

Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer deaths in France. In 2012, there were an estimated 42,152 new cases and 17,722 deaths owing to CRC [1]. Nevertheless, this type of cancer is preventable, and an effective, organized screening has existed in France since 2009 for men and women with average risk who are aged between 50 and 74 years. CRC screening, which is based on a fecal occult blood test (FOBT) every 2 years followed by colonoscopy in cases of positive FOBT, has been proved to reduce CRC mortality [2]. The decrease in CRC mortality could be 14% to 16% among the target screening population if the participation rate were 50% to 60% and the completion rate of colonoscopy after a positive FOBT were 85% to 90% [3]. Nevertheless, although the screening test is covered at 100% by health insurance with no out-of-pocket costs and screening reminders are sent by mail, the national screening rate remains inadequate. This rate was 30% during the period 2013 to 2014, which is much lower than the rate of 45% recommended by current European guidelines [3].

Moreover, low screening participation is closely linked with low socioeconomic status in terms of education level, income,

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and employment status [4–6]. Access to screening for deprived individuals falls more broadly within the context of health inequalities that persist worldwide. Indeed, social inequalities exist between and within countries [7]. In Europe, France is characterized by high social inequalities with respect to mortality, particularly for cancers [8]. These inequalities have worsened in France, including the burden of cancer mortality among people with low education levels [9]. An important step in the issue of health inequalities was taken internationally in 2008 with the publication of a report by the Commission on Social Determinants of Health of the World Health Organization titled "Closing the gap in a generation: Health equity through action on the social determinants of health" [10]. Since then, most European states have undertaken measures to reduce health inequalities [10,11]. Nevertheless, despite the attention given to this problem by political authorities, health inequalities persist. Reducing social inequalities across the entire continuum of care is therefore a fundamental issue worldwide. Screening for CRC is also of concern, and increasing the screening adherence rate is a major public health issue, especially for deprived individuals [11].

Several types of CRC screening promotion strategies have been proposed, ranging from simple postal reminders for health care providers and patients to more sophisticated interventions, including patient navigation. The first patient navigation program was developed in 1990 by Harold Freeman in Harlem, New York City, to assist low-income women in overcoming barriers to breast cancer screening and follow-up care [12]. Since then, patient navigation service programs have become widespread throughout the United States and Canada [13], with the common aim of overcoming financial, logistic, and sociocultural barriers across the care continuum, that is, from screening to therapeutic care. Patient navigators must therefore undertake all possible actions to remove obstacles limiting or delaying the receipt of medical care. The actions of patient navigators are personalized and may include phone calls, making medical appointments, completing medical or administrative paperwork, organizing child care or transportation, language translation, and providing explanations about cancer or screening tests, among others [14].

Navigation programs can be considered at any point along the care continuum, whether at the time of screening, as part of diagnostic or therapeutic management, or during recruitment and retention of patients in clinical trials. The highest evidence for the effectiveness of navigation programs is improvement in screening adherence. Some studies have indeed reported that navigation is associated with improvements in cancer screening for breast, cervical, and colorectal cancers [13,15].

Patient navigator programs offer an interesting way to reduce social inequalities in health and are being implemented in several countries. The question arises of their transferability in France, and more broadly, in Europe, from the perspectives of effectiveness and cost-effectiveness. We therefore set up a prospective randomized trial, the PRogramme d'Accompagnement au Dépistage Organisé (PRADO) study, among the general target population for CRC screening in one region of France, to assess the relevance of addition of a navigation program to the national mass screening program aimed at reducing the social gradient in cancer screening participation. To our knowledge, this is the first patient navigation program conducted in France or in Europe with the objective to increase participation and reduce social inequalities in CRC screening. This article reports the cost-effectiveness analysis conducted from the payer perspective and provides information useful to decision makers when assessing ways to increase CRC screening adherence and reduce social inequalities in health.

Methods

Setting and Population

The PRADO study was a prospective, multicenter, cluster randomized controlled trial that evaluated the impact of patient navigation among the target population for CRC screening. The study was conducted in the three departments of the Picardy region in northern France between April 2011 and April 2013, that is, the duration of a screening campaign round. According to the National Institute of Statistics and Economic Studies (*Institut National de la Statistique et des Etudes Economiques*), the population of Picardy in 2013 comprised 49% men and 51% women, which was equivalent to the national distribution. The population was slightly younger than the overall population of France, with 50% of individuals younger than 40 years compared with 49% nationally, and 22.5% older than 60 years compared with 24% nationally. The economic context was also worse, with an unemployment rate of 11.7% of the working population and a poverty rate of 15.7% compared with 9.8% and 14%, respectively, for the whole of France. The CRC screening adherence rate was 30.1%, which was comparable with the national average of 31%.

Our study area consisted of three French departments collectively comprising 2360 small geographical units for which the socioeconomic level was defined using the Townsend index, which measures material deprivation using indicators related to diet, health, clothing, housing, household facilities, environment, and work.

Clusters were categorized into four strata: urban deprived (UD), rural deprived (RD), urban affluent (UA), and rural affluent (RA). In each department, clusters within each stratum were consecutively randomly assigned to control and intervention arms. A total of 66 clusters were allocated to the intervention arm and 72 clusters to the control arm. The final number of participants included in the study, representing the screening population, was 14,373 in the intervention arm and 14,556 in the control arm. Further details about the study population and strata are presented in Appendix 1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2017.09.020.

Intervention

Participants in the control arm were screened using the screening modalities of the French national CRC screening program, in which participants aged 50 to 74 years are mailed invitations by the local screening structure to see their general practitioner, who gives them a FOBT kit if it is indicated. Patients can perform the FOBT at home and send it to the laboratory. A first postal reminder is sent by the local screening structure to nonparticipants 3 to 4 months after the initial invitation; at 8 months' time, the FOBT kit is mailed to each nonparticipant at home.

In the intervention arm, patient navigation was added to the national screening program described earlier. Navigation was performed by three specifically trained social workers. Each of them was placed in one of the three departmental screening structures. Participants in the two previous screening rounds, designated "attended," were excluded a priori from the population to be contacted by screening navigators. In addition, navigation was confined to those individuals with an available phone number who did not participate spontaneously during the first 4 months after the initial invitation for screening. Finally, the population eligible for navigation comprised 8105 people: 2259 in the UD stratum, 2086 in the RD stratum, 1599 in the UA stratum, and 2161 in the RA stratum (see Appendix 1 in Supplemental Materials).

Navigation began with an information letter sent by the patient navigator about 4 months after the initial screening invitation letter. The information letter contained a toll-free phone number and an email address to contact the patient navigator if the participant wished. Approximately 10 days after this mailing, the patient navigator initiated a structured phone call aimed at identifying barriers to screening. Navigation services essentially included telephone follow-up, home visits, and mailing of the FOBT kit. If a participant could not be reached by telephone after three or four attempts, a postal reminder was sent containing a reply coupon with a prepaid envelope on which participants could provide their phone number or indicate their wish for a home visit.

Effect Estimation

The primary outcome was screening adherence rate (i.e., FOBT completed or not), which was compared between the intervention and usual screening groups. In each arm, social inequalities in screening were also determined as the difference in screening adherence rates between deprived and affluent participants. The results of the study allowed assessment of the effectiveness of navigation in reducing social inequalities under two scenarios: 1) if navigation was proposed everywhere, regardless of the level of deprivation (universalism), effectiveness was assessed as the difference in screening adherence rates between deprived and affluent areas between the intervention and control groups and 2) if navigation was restricted to deprived areas (proportionate universalism), effectiveness was assessed as the difference in screening adherence rates between affluent areas in the control group and deprived areas in the intervention group, and compared with the difference in screening adherence rates between affluent and deprived areas in the control group.

Cost Estimation

The costs considered were nonmedical direct costs and were calculated from the perspective of the payer of the intervention, which could be the French state or the French social security system, which finance the departmental screening structures in which screening navigators would be integrated if the intervention were implemented. Costs related to usual screening were therefore not considered in the analysis. Costs were categorized as either program costs or human costs [16,17]. Table 1 presents the unit costs used for calculation.

The main navigation services provided and their duration were collected prospectively in the navigators' logbooks. Cost data were gathered from the following sources: purchase orders and invoices, reimbursement of travel expenses, and interviews with staff (other than navigators) to retrospectively estimate the time spent for each project task. Time was valued using the base gross salary for each actor of the project (Table 1). All costs were inflated to 2013 prices in euros using the consumer price index.

Program costs included 1) equipment costs (furnishings, office supplies, computers, printers, software, and phones) as well as monthly and/or yearly charges for telephone service, the toll-free phone number, and prepaid envelopes; 2) cost of navigation services, including navigators' travel costs and materials (basic and prepaid envelopes, postage, printer paper, and ink for letters); and 3) costs for assessing participants' socioeconomic and geographical status.

Human costs included 1) wages for screening navigators, with an annual gross salary (hourly wage for navigation services) of €37,774 (€20.1/h); 2) recruitment costs based on the time required for the secretarial staff to produce the advertisement and answer candidates and for managers to review resumes and interview candidates; 3) navigators' training and work meetings, which included billable hours for navigators, trainers, and other participants in meetings, as well as their travel expenses; 4) managerial and administrative support; and 5) navigator turnover. One navigator was replaced during the 2-year intervention and the costs of recruiting and training a replacement were included.

Table 1 – Cost inputs.

Equipment costs	Unit cost* (in 2013 euros)
Basic envelopes	0.0245
Prepaid envelopes	0.426
Postage	0.56
Paper	0.00648
Printer ink	0.05
Human costs	**Hourly wage (in 2013 euros)**
Patient navigator	20.10
Supervisor	21.53
Secretarial staff	14.98
Trainer	49.91
Physician	51.40

* All taxes included.

Incremental Cost-Effectiveness Ratio

A cost-effectiveness analysis of navigation versus usual screening was conducted from the payer perspective. The time horizon was 2 years, that is, the duration of a screening campaign. The incremental cost-effectiveness ratio (ICER) represented the cost per additional individual screened by the intervention compared with the usual screening procedure (i.e., control arm). The ICER was computed by dividing the incremental cost by the incremental effect:

$$\text{ICER} = \frac{C_{\text{Intervention}} - C_{\text{Control}}}{E_{\text{Intervention}} - E_{\text{Control}}},$$

where $C_{\text{Intervention}}$ and C_{Control} refer, respectively, to the average cost per individual in the intervention and control arms, and $E_{\text{Intervention}}$ and E_{Control} refer, respectively, to the effectiveness of the intervention and control arms. Because of the perspective chosen and because navigation was added to usual screening, $C_{\text{Intervention}}$ referred to navigation costs and C_{Control} was 0.

Sensitivity Analysis

Sensitivity of the ICER was assessed by evaluating the impact of variations in some factors that could modify the estimation of costs or effectiveness. First, consequences of changes in the difference of screening adherence rates between the intervention and control arms were evaluated by taking the upper and lower bounds of the confidence interval (CI) of the effectiveness difference. Second, changes in navigator wages were considered by taking the average salaries of a nurse, a less experienced and lower paid social worker, a clinical study technician, and also considering unpaid volunteers. These different profiles could be envisaged to perform navigation with the supposed technical skills of screening and cancer in general, and therefore the wage, the most important being for a nurse and the least important for a volunteer. We then considered changes in supervising costs by considering a total supervision time decreased and then increased by 20%, that is, more or less 4 hours per week (more or less 20% of supervision costs). Finally, consequences of changes in travel costs for training and meetings were assessed by considering no travel costs and an increase of 20% in travel costs. No travel could indeed be envisaged with training and meetings held within the departmental screening structures as well as holding meetings by telephone or video conference.

Statistical Analysis

Given the clustered randomization, comparisons between the two study arms were made using an adjusted χ^2 test, taking into account the intraclass correlation [18]. Two-tailed tests were used with an alpha risk of 5%. We obtained 95% CIs for ICERs using a nonparametric percentile bootstrap technique, a method that requires no assumptions about the sampling distribution of the ICER. Bootstrapped costs and effectiveness were obtained by sampling 10,000 samples of the same size as the study sample with replacement, and by determining the cost and effectiveness of each one; the number was chosen to be at least 1,000 [19].

Results

A total of 66 clusters were allocated to the intervention arm and 72 clusters to the control arm. Table 2 presents the characteristics of the study population, which included 16,250 participants: 8,105 in the patient navigation group and 8,145 in the usual screening group. The two arms were similar in terms of sex and age, with about 51% men and more participants in the age groups of younger than 55 years and aged 56 to 60 years. The percentage of deprived participants was also comparable between the two groups (53.6% in the intervention group and 52.6% in the control group). There were, however, more subjects residing in urban areas in the intervention arm than in those in the control arm (47.6% vs. 43.1%).

Effectiveness

Table 3 presents the participation rate by stratum in each arm. Navigation was globally associated with a significant increase in participation of 3.3% (P = 0.003; 95% CI 1.5%–5.0%; 24.4% in the intervention group vs. 21.1% in the control group).

The difference in participation between affluent and deprived individuals was 1.7% in the control group (22% vs. 20.3%; P = 0.103); this was higher in the intervention group (26.1% for affluent participants vs. 22.9% for deprived participants; P = 0.032) because the increase in participation was higher among affluent participants (+4.1%; P = 0.01) than among deprived ones (+2.6%; P = 0.07) (Table 2).

If the intervention had been restricted to deprived areas (proportionate universalism), the final rate of participation in screening would have been higher among deprived participants (22.9%) than among affluent ones (22%): –0.9% versus 1.7% in favor of affluent individuals in the absence of intervention (i.e., in the control group) (22% vs. 20.3%).

Costs

The total cost for 2 years of intervention was €321,787, of which 70% was related to navigator wages. Table 4 presents the costs for each activity of the program. About 30 participants per week were attended per navigator. The intervention included the possibility of a home visit if the participant wished. Nevertheless, only 13 home visits were necessary; most navigation activities took place by mail and telephone contact. The average cost per person was €39.70 ± €4.38. In each of the four strata, the average cost per participant was between €39 and €40.

Incremental Cost-Effectiveness Ratio

It is evident from Table 5 that the ICER for the intervention compared with usual screening was globally €1212 per additional person screened (95% CI €872–€1978 per additional person screened). Navigation was less cost-effective for deprived participants than for affluent ones, with an ICER 1.6 times higher (€1527 vs. €969 per additional person screened). This was observed in rural areas (€1358 vs. €851 per additional person screened) as well as in urban areas (€1524 vs. €1199 per additional person screened).

Sensitivity Analysis

The results were sensitive to navigator wages and to the effect size of intervention effectiveness whose variations had the greatest impact on the ICER. One-way sensitive analysis presented in Table 6 shows that by taking the lower and upper bounds of the CI for the difference in effectiveness, the ICER ranged from €778

Table 2 – Characteristics of the study population.

Characteristic	Navigation (n = 8105)		Control (n = 8145)	
	n	%	n	%
Sex				
Male	3932	48.5	3973	48.8
Female	4173	51.5	4172	51.2
Age (y)				
≤55	3147	38.8	3139	38.5
56–60	1863	23	1885	23.1
61–65	1606	19.8	1530	18.8
66–70	902	11.1	919	11.3
70–75	587	7.2	672	8.3
Stratum				
UD	2259	27.9	1947	23.9
RD	2086	25.7	2334	28.7
UA	1599	19.7	1567	19.2
RA	2161	26.7	2297	28.2
Cluster				
UD	11	16.7	7	9.7
RD	13	19.7	25	34.7
UA	6	9.1	6	8.3
RA	36	54.5	34	47.2

RA, rural affluent; RD, rural deprived; UA, urban affluent; UD, urban deprived.

Table 3 – Screening adherence rates.

Characteristic	Navigation		Control		P value*	Mean difference (95% CI)
	Sample size	Test performed, n (%)	Sample size	Test performed, n (%)		
Stratum						
All	8105	1975 (24.4)	8145	1718 (21.1)	0.003	3.3% (1.5%–5.0%)
RA	2161	574 (26.6)	2297	503 (21.9)		
UA	1599	407 (25.5)	1567	347 (22.1)		
RD	2086	507 (24.3)	2334	499 (21.4)		
UD	2259	487 (21.6)	1947	369 (19.0)		
Socioeconomic status						
Affluent	3760	981 (26.1)	3864	850 (22.0)	0.01	
Deprived	4345	994 (22.9)	4281	868 (20.3)	0.07	

CI, confidence interval; RA, rural affluent; RD, rural deprived; UA, urban affluent; UD, urban deprived.
* Adjusted χ^2 test (taking into account the cluster randomized design).

(upper bound +5%) to €2738 (lower bound +1.5%) per additional person screened. Considering the different profiles of patient navigator with their corresponding salaries, the ICER decreased 71% with unpaid volunteers (ICER €355 per additional person screened) and increased 19% with nurses who received an annual salary of €47,065 (ICER €1,446 per additional person screened). Within these two extremes, the ICER showed a 24% decrease with a clinical study technician paid €24,708/y, the minimum wage in France, and a 16% decrease with a social worker paid €28,286/y. Finally, changes in supervision time as well as travel costs had a low impact on the ICER.

Discussion

Few studies have evaluated the cost-effectiveness of navigation programs to increase cancer screening adherence. The PRADO study is the first patient navigation experience in Europe aimed at enhancing CRC screening participation and reducing social inequalities.

Our results show that navigation yielded a significant increase of 3.3% in CRC screening participation between the intervention and control arms. This result was obtained at a cost of €1212 per additional individual screened compared with the usual screening. Navigation is therefore globally effective. Nevertheless, the main results of our study revealed that for this program to reduce social inequalities, it must be organized around the principle of proportionate universalism that is reserved for the most vulnerable populations. Indeed, if it is organized to serve the entire population regardless of level of deprivation, the opposite effect of increasing social inequalities will be produced. From the perspective of reducing social inequalities, if this intervention was restricted to deprived individuals, navigation would be less efficient with a cost of €1527 per additional individual screened compared with usual screening. The intervention could, however, reduce social inequalities, with a higher ICER for deprived participants than the global ICER because of lower effectiveness for deprived individuals. Average costs per person were indeed similar among all strata, with values between €39 and €40. Very few home visits were required, with most intervention activities taking place by mail and telephone. Thus, fixed costs represented most of the costs. As might be expected, effectiveness of the intervention as well as navigators' salaries have important impacts on the ICER. Navigation could therefore be more efficient with volunteer navigators insofar as the ICER decreased by 71% compared with paid screening navigators in this study. Nevertheless, it remains to be demonstrated whether the effectiveness of nonprofessional navigators in assisting individuals is the same or close to that of professional health workers. Volunteer navigators, such as those who are survivors of cancer, exist in several countries, most notably in the United States.

One of the main strengths of this study resides in the fact that it is the first European experience of patient navigation. Furthermore, the controlled randomized trial design and large study population allowed us to obtain reliable results for effectiveness and costs, and to therefore make comparisons with other existing programs.

Some limitations should also be considered. First, the relatively short time horizon prevents consideration of overall survival as an outcome, as recommended by current guidelines [20]. Nevertheless, screening adherence can be considered a good intermediate end point insofar as studies have demonstrated that improvement in CRC screening is associated with a reduction in CRC mortality [3].

Table 4 – Cost outputs by activity for the 2-y intervention.

Activity	Costs (€)	
	Navigation (n = 8105)	Control (n = 8145)
Identifying target population	1,703	–
Hiring	1,268	–
Training and meetings including	25,413	–
Travel costs	15,133	–
Training time	7,083	–
Meeting time	3,198	–
Equipment	26,347	–
Intervention delivery		
Mailing	5,996	–
Prepaid envelopes	2,243	–
Mileage	303	–
Navigator wages*	216,629	–
Supervising	40,476	–
Administrative support	1,408	–
Total cost	321,787	–
Cost per individual, mean ± SD	39.70 ± 4.38	–

* Hours paid for training and meetings were excluded; these were accounted for in the "Training and meetings" category.

Table 5 – ICERs (cost per additional individual screened).

Characteristic	Incremental cost (€)	Incremental effectiveness (% increase in participation)	ICER (€) (95% CI)
Stratum			
All	39.70	0.033	1212 (872–1978)
RA	39.67	0.047	851 (551–1852)
UA	39.68	0.033	1199 (583–6184)
RD	39.72	0.029	1358 (694–5722)
UD	39.73	0.026	1524 (727–9010)
Socioeconomic status			
Affluent	39.68	0.041	969 (659–1822)
Deprived	39.73	0.026	1527 (914–4558)

CI, confidence interval; ICER, incremental cost-effectiveness ratio; RA, rural affluent; RD, rural deprived; UA, urban affluent; UD, urban deprived.

The cost-effectiveness analysis was conducted from the perspective of the payer of the intervention, to measure the extra resources required for navigation itself. Screening costs (most notably, the cost of an FOBT, cost of a visit to a general practitioner, and the cost of colonoscopy after a positive FOBT) were therefore not considered in the analysis. These costs are covered entirely by the French social security system for the FOBT and partially for the general practitioner visit and colonoscopy. In the same way, because of the perspective chosen, costs incurred by individuals were also not included in the analysis. These costs include out-of-pocket costs related to general practitioner visits and colonoscopy after a positive FOBT as well as indirect costs. Indirect costs represent the loss of productivity relative to participation in the navigation program and correspond to the cost of participants' time associated with navigation, mainly telephone time; these are therefore limited.

The results of this medico-economic evaluation are in line with those of the few existing studies conducted in North America, despite the differences in the two health systems. Lairson et al. [21] reported the results of a study comparing navigation intervention with usual screening for CRC, regardless of socioeconomic status. Participants in the navigation group received a brochure about screening, a letter with or without an FOBT kit (according to participants' preferences for FOBT or colonoscopy), a phone call from a nurse, and eventually a postal reminder with or without an FOBT kit. Intervention had a significantly positive effect on participation compared with usual screening, with a 25% increase in participation. In that study, compared with usual screening, the ICER of navigation from the payer perspective was US $1172 per additional individual screened.

A few years earlier, Lairson et al. [22] showed the effectiveness of a navigation program for CRC screening in an urban practice with a high proportion of ethnic minorities. Navigation consisted of a letter with an FOBT kit, brief messages that addressed barriers to screening, and a phone call made by a health educator. Navigation yielded a significant increase in the CRC adherence rate of 15% compared with usual screening, at a cost of US $1261 per additional individual screened from the payer perspective.

In 2002, Andersen et al. [23] conducted a four-arm randomized controlled trial among rural women, delivered by paid volunteers, to increase breast cancer screening adherence. One group of women received an intervention based on community activities, another group received individual counseling provided by phone calls and a booklet; a third group participated in both community activities and individual counseling. Effectiveness was significant only for community activities among a subgroup of women who participated regularly in screening. From a societal perspective, the global ICERs of community activities and individual counseling were similar, with a value of more than US $1950 per additional mammography.

Table 6 – One-way sensitivity analysis.

Parameter	Range of values	Incremental cost (€)	Incremental effectiveness (%)	ICER (€, per additional individual screened)
Base-case analysis	–	39.70	0.033	1,212
Effectiveness difference (%)				
Upper 95% CI	0.050	39.70	0.050	778
Lower 95% CI	0.015	39.70	0.015	2,738
Annual navigator wages (€)				
Volunteer	0	11.76	0.033	355
Clinical study technician	24,708	30.34	0.033	926
Less experienced social worker	28,286	33.36	0.033	1,019
Nurse	47,065	47.36	0.033	1,446
Supervising costs				
−20%	32,381	38.70	0.033	1,173
+20%	48,571	40.70	0.033	1,233
Travel costs			0.033	
None	0	37.84	0.033	1,147
+20%	18,160	40.10	0.033	1,215

CI, confidence interval; ICER, incremental cost-effectiveness ratio.

Conclusions

Evaluating cost-effectiveness together with outcomes from a randomized trial yields the additional information needed when deciding whether to implement public health programs. Patient navigation can be an effective way to improve screening adherence for CRC and could be able to reduce social inequalities. Nevertheless, research on patient navigation is only at the beginning stages in France, and it would be premature to recommend to policymakers replication of the intervention as it was performed in this study. Indeed, although there is no established cost-effectiveness threshold, the cost per additional individual screened appears high. To improve the efficiency of the intervention by increasing the effectiveness and/or reducing costs, one approach could be to rely on the medicosocial fabric already in place. These modalities of collective action, such as informational neighborhood meetings, use of neighborhood businesses, working with associations, and so on, could not be used in this study to avoid contamination between the clusters of the intervention arm and that of the control arm. It may also be worthwhile to consider expanding navigation to the care continuum, that is, from screening to therapeutic care. Further research is therefore still needed to find the best way to reach all deprived individuals, including those who cannot be contacted by telephone, as well as to define the best modalities of navigation in terms of services provided. Moreover, long-term evaluation of the efficiency of patient navigation is also necessary. Modeling of costs and effectiveness on a longer time horizon would allow determination of the cost per life-years gained or per quality-adjusted life-years gained with patient navigation compared with usual screening using European data. The use of such homogenized indicators would permit the comparison of navigation to other strategies in the field of health, and thereby permit decision makers to choose whether to invest the extra resources required for navigation according to their willingness to pay.

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Supplemental Materials

Supplemental data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jval.2017.09.020.

REFERENCES

[1] Binder-Foucard F, Belot A, Delafosse P. Estimation nationale de l'incidence et de la mortalité par cancer en France entre 1980 et 2012. Partie 1—Tumeurs solides. Saint-Maurice, France: Institut de veille sanitaire, 2013.

[2] Haute Autorité de Santé. Dépistage et prévention du cancer colorectal. Actualisation du référentiel de pratiques de l'examen périodique de santé (EPS). 2013. Available from: http://www.has-sante.fr/portail/jcms/c_1623732/fr/depistage-et-prevention-du-cancer-colorectal. [Accessed March 8, 2017].

[3] Lansdorp-Vogelaar I, von Karsa L; International Agency for Research on Cancer. European guidelines for quality assurance in colorectal cancer screening and diagnosis. First edition—introduction. Endoscopy 2012;44(Suppl. 3):SE15–30.

[4] Herbert C, Launoy G, Gignoux M. Factors affecting compliance with colorectal cancer screening in France: differences between intention to participate and actual participation. Eur J Cancer Prev 1997;6:44–52.

[5] Ioannou GN, Chapko MK, Dominitz JA. Predictors of colorectal cancer screening participation in the United States. Am J Gastroenterol 2003;98:2082–91.

[6] Pornet C, Dejardin O, Morlais F, et al. Socioeconomic determinants for compliance to colorectal cancer screening: a multilevel analysis. J Epidemiol Community Health 2010;64:318–24.

[7] European Commission. Health inequalities in the EU—final report of a consortium. 2013. Available from: http://ec.europa.eu/health/social_determinants/docs/healthinequalitiesineu_2013_en.pdf. [Accessed March 8, 2017].

[8] Mackenbach JP, Stirbu I, Roskam AJ, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008;358:2468–81.

[9] Menvielle G, Chastang JF, Luce D, et al. Changing social disparities and mortality in France (1968–1996): cause of death analysis by educational level [French]. Rev Epidemiol Sante Publique 2007;55:97–105.

[10] World Health Organization. Closing the gap in a generation: health equity through action on the social determinants of health. Final report of the Commission on Social Determinants of Health. 2008. Available from: http://www.who.int/social_determinants/thecommission/finalreport/en/. [Accessed March 8, 2017].

[11] European Commission. Solidarity in health: reducing health inequalities in the EU. Available from: http://ec.europa.eu/health/social_determinants/policy/commission_communication/index_en.htm. [Accessed March 8, 2017].

[12] Freeman HP, Muth BJ, Kerner JF. Expanding access to cancer screening and clinical follow-up among the medically underserved. Cancer Pract 1995;3:19–30.

[13] Wells KJ, Battaglia TA, Dudley DJ, et al. Patient navigation: State of the art or is it science? Cancer 2008;113:1999–2010.

[14] Dejardin O, Berchi C, Mignon A, et al. Social inequalities in health from observational studies to intervention: Can the patient navigator reduce social inequalities in cancer patients? [French]. Rev Epidemiol Sante Publique 2011;59:45–51.

[15] Paskett ED, Harrop JP, Wells KJ. Patient navigation: an update on the state of the science. CA Cancer J Clin 2011;61:237–49.

[16] Whitley E, Valverde P, Wells K, et al. Establishing common cost measures to evaluate the economic value of patient navigation programs. Cancer 2011;117(Suppl. 15):3618–25.

[17] Ramsey S, Whitley E, Mears VW, et al. Evaluating the cost-effectiveness of cancer patient navigation programs: conceptual and practical issues. Cancer 2009;115:5394–403.

[18] Donner A, Klar N. Methods for comparing event rates in intervention studies when the unit of allocation is a cluster. Am J Epidemiol 1994;140:279–89.

[19] Briggs AH, Wonderling DE, Mooney CZ. Pulling cost-effectiveness analysis up by its bootstraps: a non-parametric approach to confidence interval estimation. Health Econ 1997;6:327–40.

[20] Haute Autorité de Santé. Choices in methods for economic evaluation. 2011. Available from: http://www.has-sante.fr/portail/jcms/r_1499251/en/choices-in-methods-for-economic-evaluation. [Accessed March 8, 2017].

[21] Lairson DR, Dicarlo M, Deshmuk AA, et al. Cost-effectiveness of a standard intervention versus a navigated intervention on colorectal cancer screening use in primary care. Cancer 2014;120:1042–9.

[22] Lairson DR, Dicarlo M, Myers RE, et al. Cost-effectiveness of targeted and tailored interventions on colorectal cancer screening use. Cancer 2008;112:779–88.

[23] Andersen MR, Hager M, Su C, et al. Analysis of the cost-effectiveness of mammography promotion by volunteers in rural communities. Health Educ Behav 2002;29:755–70.