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Effect of financial incentives on breast, cervical and colorectal cancer screening delivery rates: Results from a systematic literature review

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ABSTRACT

Preventive care, such as screening, is important for reducing the risk of cancer, a leading cause of death worldwide. Indeed, some type of cancers are detected through screening programs, which in most countries run for colorectal, breast, and cervical cancers. In this context, general practitioners play a key role in increasing the participation rate in cancer screening programs. To improve cancer screening delivery rates, performance incentives have increasingly been implemented in primary care by healthcare payers and organizations in different countries. The effects of these tools are still not clear.

We conducted a systematic literature review in order to answer the following research question: What is the evidence in the literature for the effects of financial incentives on the delivery rates of breast, cervical and colorectal cancer screening in general practice?

We performed a literature search in Web of Science, PubMed, Cochrane Library and Google Scholar, according to the PRISMA guidelines. 18 studies were selected, classified and discussed according to the health preventive services investigated.

Most of studies showed partial or no effects of financial incentives on breast and cervical cancer screening delivery rates. Few positive or partial effects were found regarding colorectal cancer screening.

Ongoing monitoring of incentive programs is critical to determining the effectiveness of financial incentives and their effects on the improvement of cancer screening delivery rates.

1. Introduction and background

Preventive care, such as screening, is important for reducing the risk of cancer, a leading cause of death worldwide in both more and less economically developed countries [1,2]. Indeed, some type of cancers are detected through screening programs, which in most countries run for colorectal, breast, and cervical cancers [3]. According to this, the number of countries that are introducing national screening programs is growing [4].

In this context, general practitioners (GPs) play a key role in increasing the participation rate in cancer screening programs [1,3].

Their contribute differ in each country or geographic region according to the screening scheme [4].

For example, in most of European countries there are two different cancer screening schemes, namely organized and opportunistic screening [5].

Organized screening programs typically have centrally organized recruitment and follow-up, and the three most widely available programs are precisely for breast, cervical, and colorectal cancer screening [3].

Eligible patients are mailed an invitation to receive a free test. Thus, they are not forced to consult a medical doctor to receive the test, but they can choose, afterwards, which doctor (e.g., a GP or a specialist) should be informed of the results.

By contrast, opportunistic screening, implemented for example in USA, requires a prescription from the GP or the specialist, and it is not free of charge [3,5].

The involvement of GPs in cancer screening varies by countries also in relation to the type of cancer. For example, for colorectal cancer screening, screening on a national level has been implemented in 20 European Union countries, and the involvement of GPs varies depending on the chosen strategy and local health-care policy [6].

For example, in Germany, the Czech Republic, and Slovakia, GPs perform faecal occult blood tests in their offices; in Poland, they recruit patients for colonoscopic screening; in Italy, their involvement varies across the country; and in the UK, the Netherlands, Spain, and Finland, GPs are not directly involved in the provision of

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the program [7,8]. GPs also have varying roles in follow-up for individuals tested positive; in some countries, they are responsible for referral to colonoscopy, whereas in others the referral is organised by the program itself [6].

Despite these differences, clear evidence exists for the importance of GPs in the implementation of the screening programs. Indeed, some studies have identified physician recommendation as an important determinant of a patient's decision to undergo cancer screening [9,10].

For this reason, in most countries, GPs receive explicit financial incentives based on their performance to promote and encourage preventive healthcare services, which include cancer screening practices [11]. This mechanism is known as pay-for-performance (P4P).

P4P has been increasingly used across different healthcare settings to incentivize the provision of targeted services [12]. Financial incentives based on performance have a long history of use in health to increase productivity and achieve specific quality improvement targets [13].

P4P schemes are widespread in the UK, where family practitioners had experience with financial incentives from the limited use of incentive programs that were initiated in 1990 [14]. From 2004, through the Quality and Outcomes Framework (QOF), UK GPs receive payments representing up to 20% of their income [15] for compliance with targets called 'indicators' set across the spectrum of clinical activity [16].

Specifically, GPS has a protocol that is in line with national guidance agreed with NHS for the management of cervical screening, which includes staff training, management of patient call/recall, exception reporting and the regular monitoring of inadequate sample rates. The target value is 45–80% of women aged 25 or over and who have not attained the age of 65 whose notes record that a cervical screening test has been performed in the preceding 5 years [17]. The apparent success of this intervention caused international interest in using financial incentives as a method of refocusing general practice and supporting health promotion [11].

Particularly for cancer screening, performance incentives were paid to providers who completed all applicable cancer screening tests for predetermined percentages of their patients [18,19].

Despite the widespread use of this new remuneration program, there is mixed evidence for their effectiveness.

In some cases, empirical studies showed an increase in cancer screening rates associated with the P4P remuneration schemes [20] but were often unable to determine whether the improvements should be attributed to the incentives themselves or to the education and direction that accompanied the rollout of the P4P program [21,22].

In other studies, authors found that cancer screening rates have not changed significantly since the P4P program implementation [1]. These results may reflect the fact that low-powered incentives might not provide sufficient leverage to generate better practices in the field of prevention and screening [1].

In conclusion, despite the straightforward rationale and the rapidly growing interest in implementing P4P programs, the literature results are mixed [23] and often inconsistent [19,12] with regard to the P4P's effect on cancer screening delivery rates. Particularly for *breast*, *cervical* and *colorectal cancer*, the effects (positive or negative) of these incentives on screening delivery rates are poorly investigated and understood [24].

The present study was designed to fill this gap in the literature.

We conducted a systematic review of the literature in order to answer the following research question: *What is the evidence in the literature for the effects of financial incentives on the delivery rates of breast, cervical and colorectal cancer screening in general practice?*

The selection of these three types of cancer was justified by their strong correlation with mortality and morbidity rates. In particular, *breast cancer* is the leading cause of cancer-related deaths among women worldwide [2].

Cervical cancer was selected because of the development of the human papilloma virus vaccine, which seeks to protect against the virus that is associated with the condition and may be useful for deliberate cancer prevention programs, as has been recommended [25].

Finally, *colorectal cancer* is among the top five leading causes of cancer-related death worldwide when men and women are considered together [26].

In this context, preventive care and cancer screening are important for reducing the mortality and burden of cancer [27].

Despite this, medical practitioners and the public need to be adequately informed about both the benefits and the harms of cancer screening [28].

Indeed, cancer screening has some downsides [29,30]. One of this is the potential for over detection and overtreatment because of the risk that screening will detect clinically irrelevant disease or more familiar false positive and false negative tests [31,30].

While screening may deliver harms it in most cases does benefits and literature evidence showed that show that screening reduces morbidity and mortality rates [32–34]. According to this, financial incentives are used as a tool aimed to increase cancer screening delivery rates.

The purpose of this paper is to give a comprehensive overview of the published evidence on this topic, in particular on the effectiveness of financial incentives. The existing literature was selected, summarized, and mapped according to the research question.

2. Materials and methods

2.1. Search strategy

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [35] with a particular focus on PRISMA for Protocols (PRISMA-P) [36].The PRISMA-P checklist is intended primarily for the preparation of protocols of systematic reviews and meta analyses that summarize aggregate data from studies, particularly the evaluations of the effects of interventions [36] (The complete PRISMA Checklist and PRISMA-P Checklist are provided in the Appendix 1). Our investigation begins with the definition of the problem we want to investigate.

We delineated the problem through the following research questions: *What is the evidence in the literature for the effects of financial incentives on delivery rates of cancer screening in general practice?*

Having delineated a well-defined question, we created a search strategy. First, we determined the choice of the database from which to find papers.

We performed a literature search from February to March 2018 using Web of Science, PubMed, Cochrane Library and Google Scholar.

Papers were extracted from the database using 4 separate keyword pairs (*pay for performance, financial incentives, preventive care, cancer screening*) to find the most articles focused on this topic. In addition, we used 2keywords focusing on the primary care setting (*primary care, general pract**), using the Boolean operator AND to identify all relevant papers in the field and to classify articles according to the covered issue (the complete list of search terms, search strategy and the additional literature cited are provided in Appendix 2 – Table 1 & 2).

The search of the database by selected keywords has been extended to the title, keywords and abstracts (topics range). The literature search was performed without limitations placed on

publication date. We included articles published and written in English. The initial results revealed several articles without direct connection to the precise review requirement because most of the articles contained the words "*pay for performance, financial incentives, preventive care, cancer screening*". Therefore, another round of searching was performed on these articles using the following terms in the search bar in the PDF version of the individual article, according to the specific aim of this review: "*breast cancer screening,* "*cervical cancer screening*", and "*colorectal cancer screening*".

Following the framework used by Van Herck et al, 2010 [37], some inclusion and exclusion criteria were considered (Table 1). First, we were interested in identifying all experimental, quasi-experimental and observational studies [38–40] of explicit financial incentives directed at GPs that had performance-based contracting. Eligible studies assessed the use of financial incentives, such as the measure of quality in preventive health services, particularly in cancer screening practices. All studies involving the incentives aimed at improving the delivery rates of *breast*, *cervical* and *colorectal cancer screening* in primary care practices were considered.

In contrast, studies did not focus on preventive care, which provided incentives for doctors other than GPs and did not demonstrate in a statistically significant way the effects of P4P incentives on the delivery rates of cancer screening when primary care practices were excluded. Meeting abstracts, proceedings papers, letters to the editors and editorials without data were also excluded. In order to reduce the selection bias, all article titles, abstracts and keywords identified from the electronic searches were reviewed in a first step by the three authors separately according to the inclusion/exclusion criteria.

Following the framework used by Caroll et al. each citation was also deemed *unknown*, *irrelevant* or *probably relevant*, based on agreement between at least 2 of the 3 authors [41].

A citation was rated as *unknown* if insufficient information was available in the abstract.

A citation was rated as *irrelevant* if it was clear from the abstract that the paper was not relevant to the aim of this review, according to the exclusion criteria.

Papers were classified as *probably relevant* when the description in the abstract was not always consistent with the contents of the study.

For each citation rated as probably relevant or of uncertain relevance in this initial screening, the entire paper was obtained from the library, and there was a second level of screening to ensure relevance. Disagreements among the 3 authors were resolved by face-to-face discussions.

For articles selected, data sheets were prepared to extract all data of possible relevance.

The extraction was performed independently by authors to insure accuracy. In particular, three authors independently extracted relevant data from selected studies using the same abstraction form, containing the following elements: authors, publication year, journal, countries, aim, method, cancer screening type (*breast, cervical, colorectal*), a summary of the main results for each study.

Missing data were filled in, when possible, by mail correspondence with the study authors.

2.2. Classification of articles by cancer screening type

In preventive care, cancer screening is important for reducing the mortality and burden of cancer [42,9,42–44]. In this context, GPs play an essential role in delivering appropriate recommendations for the screening of *breast*, *cervical*, and *colorectal cancer*.

Articles selected in this study were classified according to the following cancer screening types investigated:

- *Breast cancer screening*: an observed reduction in *breast cancer* mortality can be attributable to the mammography screening effect [45].

Previous studies indicated a 25% reduction in *breast cancer* mortality for women targeted by screening at ages 50–69 [46]. More recent studies have shown that *breast cancer screening* should be rigorously evaluated [5];

- *Cervical cancer screening*: *cervical cancer* is one of the neoplasms that is the most preventable by screening and for which historical hindsight of screening practices is important [47–49].

Evidence for the effectiveness of regular cervical smears for cancer-specific mortality reduction is consistent: population coverage of screening practices is strongly correlated with mortality trends [50–53].

Moreover, among women diagnosed with invasive *cervical cancer*, the most common attributable factor in the development of cancer is the lack of smear test within the 3 years prior to diagnosis [54]; and

- *Colorectal cancer screening: colorectal cancer* is the third most commonly diagnosed cancer among both men and women, particularly in the USA [55]. In addition, in this case, mortality from *colorectal cancer* can be reduced by early diagnosis and by cancer prevention [56]. Screening methods, such as fecal occult blood testing (FOBT), are available, which can reduce deaths in diagnosed cancer cases by earlier-stage detection.

2.3. Classification of articles by effect on cancer screening delivery rates

Following the framework used by Petersen et al. [57], we classified articles according to the effect of financial incentives on breast, cervical and colorectal delivery rates, as follows:

- *Positive effects:* studies in this area demonstrated a statistically significant improvement in *cervical*, *colorectal* and *breast cancer screening* delivery rates or no evidence that the incentives led to an increase in inappropriate care;
- *No effects*: studies showed no statistically significant step change in the variation of delivery rates;
- *Partial effects*: study results were included in this category when the authors observed improvements in some quality measures, such as mammogram rates and cancer screening, but were unable to determine whether or not to attribute the improvements to the P4P program incentives; and
- *Negative effects:* studies demonstrated a statistically significant decrease in cancer screening delivery rates or quality care correlated with the introduction of the P4P schemes.

3. Results

3.1. Studies selected

Our search for eligible studies is summarized in Fig. 1. The initial search of electronic databases and reference lists from relevant studies yielded a total of 19,360 titles.

Of these, only 18 studies met the inclusion criteria previously described.

Because of the heterogeneity between studies, meta-analysis was not possible, and results are presented narratively.

Table 1
Eligible criteria for excluded/included studies [37].

PARTICIPANTS/POPULATION	
Inclusion criteria	*Exclusion criteria*
Healthcare providers in primary care; team of medical practices/facilities	Patients as target group for financial incentives; providers in hospital care
INTERVENTION	
Inclusion criteria	*Exclusion criteria*
The use of an explicit financial incentive directly related to providers' performance with regard to specifically measured quality-of-care targets and directed at a person's income or at further investment in quality improvement; performance measured as achievement and/or improvement	The use of implicit financial incentives, which are not specifically intended to explicitly promote quality (e.g., fee- for-service, capitation, salary)
COMPARATOR	
Inclusion criteria	*Exclusion criteria*
All experimental, quasi-experimental and observational studies were included if these had a comparator group or a comparative period (eg: Physicians at the individual or group level involved and not involved in the incentives program; comparison between patients with cancer enrolled in the cancer p4p program and non enrolled patients; studies in which the evaluation of the effects of P4P strategies was made by comparing the trend of screening rates before and after the introduction of financial incentives)	Studies without a comparator group or comparative period were excluded
OUTCOME	
Inclusion criteria	*Exclusion criteria*
An (intermediate) outcome measure on clinical effectiveness of care measured quantitatively using a validated statistical method (i.e. randomized trials; longitudinal analysis ecc.)	An (intermediate) outcome measure that are not measured quantitatively using a validated statistical method
STUDY DESIGN	
Inclusion criteria	*Exclusion criteria*
Experimental, quasi-experimental or observational studies in English language published in a peer-reviewed journal found in search engines (i.e. Web of Science, PubMed, Cochrane Library and Google Scholar)involving the incentives aimed at improving the delivery rates of breast, cervical and colorectal cancer screening in primary care practices and including a quantitative assessment of the effects of P4P incentives on the delivery rates of cancer screening.	Systematic review, Editorials, perspectives, comments, letters; grey literature; papers on P4P theory, development and/or implementation without evaluation and published in different language from English

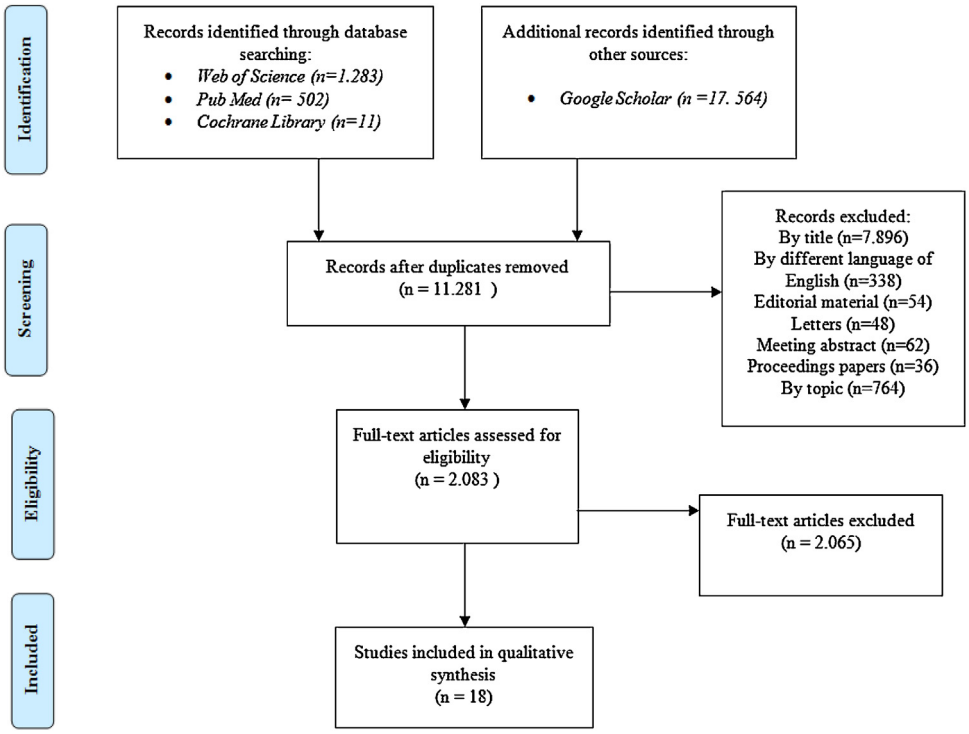

Fig. 1. PRISMA Flow diagram.

3.2. Temporal distribution of articles and countries involved

The articles selected ranged from 1998 to 2017.

About the countries involved, studies selected showed that the USA was the major country in which GPs had experiences with financial incentives as part of their contracts to improve the delivery of preventive healthcare services and, in particular, the compliance with cancer screening guidelines [19].

Since 1993, PacifiCare of California has measured the performance of affiliated medical groups on a battery of clinical and patient-reported measures of quality, and in 2002, it announced a new quality incentive program for its California network. The pro-

gram targeted measures of clinical quality, including *cervical cancer screening* and mammography rates [58].

In July of 2010, the Division of General Internal Medicine (DGIM) at the University of Pennsylvania Health System (UPHS) began implementation of a performance incentive based on the rate of adherence to screening guidelines for *colorectal*, *breast*, and *cervical cancers*. Incentives were paid to providers who completed all applicable cancer screening tests for predetermined percentages of their patients [24].

In Canada, in 2006, a large-scale P4P scheme was introduced in Ontario with the aim of improving cancer screening in primary care [22]. Specifically, for *cervical cancer screening* rates, the program considered the proportion of women aged 35–69 years who received a Pap smear screening in the 30 months before the end of the relevant fiscal year; for *breast cancer screening* rates, it considered the proportion of women aged 50–69 years who received a mammogram in the 30 months before the end of the relevant fiscal year; finally, for *colorectal cancer screening* rates, it considered the proportion of adults aged 50–74 years who either received FOBT in the 30 months before the end of the relevant fiscal year or had a colonoscopy in the previous 10 years. Incentives for all 3 types of screening were introduced broadly in 2006–2007, with more incentives for *colorectal cancer screening* added in 2008-2009. In 2009–2010, physicians could receive a maximum of $8400 if they met the highest targets for all 3 types of screening [22].

A voluntary P4P program called the Practice Incentives Program (PIP) was introduced in Australia in 2001. The Australian government initiated a financial incentive program for increased screening for *cervical cancer* for GPs, who are paid for each patient visit on a fee-for-service basis [59].

Additionally, in 2001, the Bureau of National Health Insurance (BNHI) implemented disease-specific P4P programs for cancer in Taiwan, providing financial incentives to encourage guideline-adhering therapy and reward better patient survival [60].

In France, a P4P program was implemented in 2009 towards GPs through the Contract for Improving Individual Practices (CAPI). In 2009, CAPI included only *breast* and *colorectal cancer screening*. Subsequently, incentives were extended to *cervical cancer screening* in 2012 through the "Rémunération sur Objectifs de Santé Publique" (ROSP) [5].

3.3. Effect of financial incentives on cancer screening delivery rates

Of the 18 studies selected, 6 studies discussed all types of cancer screening [1,19–22,61], 5 articles discussed the effect of P4P on the delivery rate of breast and cervical screening [13,58,62–64], 4 studies discussed the effect of P4P only regarding *cervical cancer screening* [12,59,65,66], 1 study was focused on the effect of P4P only on the delivery rate of *colorectal cancer screening* [24] and 2 studies discussed the effect of P4P on the delivery rate of *breast cancer screening* [5,60].

Overall, 13 studies were focused on *breast cancer screening*, 15 were found in the area of *cervical cancer screening*, and 7 studies were found in the area of *colorectal cancer screening* (Table 2).

We synthesized and discussed articles according to the cancer screening type investigated by the authors, as showed in the following sections.

Table 2
Number of studies for each cancer screening type (total number of studies: 18).

	Cancer screening type		
	Breast	*Cervical*	*Colorectal*
N. of studies	13	15	7

3.4. Effect of financial incentives on breast cancer screening delivery rate

A total of 15 studies evaluated the impact of financial incentives on the delivery rate of *breast cancer screening* in the USA. Starting from 1998, Hillman et al. evaluated the impact of financial incentives on physician compliance with cancer screening guidelines for women 50 years of age and older in a Medicaid health maintenance organization, through a randomized controlled trial among 52 primary care sites in Philadelphia [19]. They evaluated mammography and breast exam rates from 1993 to 1995. Screening rates doubled overall from 24% to 50%. However, no significant differences were found between intervention and control group sites. In synthesis, no significant effect of bonuses on the improvement in cancer screening rates was found.

In 2001, Wee et al. examined whether physician factors, particularly financial productivity incentives, affect the provision of preventive care [62]. They surveyed and reviewed the charts of 4473 patients who observed 1 of 169 internists from 11 academically affiliated primary care practices in Boston. Based on Health Plan Employer Data and Information Set (HEDIS) measures, they evaluated the proportion of mammograms carried out among women 52 to 69 years old and found that financial incentives were not significantly associated with rates of mammography (75.7% rate for patients for whom physicians had financial productivity incentives vs. 73.2% for patients for whom physicians did not receive financial productivity incentives).

In 2005, the effects before and after the introduction of the Quality Incentive Program (QIP) on quality outcome measures, including mammography, were evaluated by Rosenthal et al. [58]. Using administrative reports of physician group quality for California physician groups and Pacific Northwest physician groups, the authors observed improvements in some clinical quality scores: for mammography, 1.9% for California vs. 0.2% for the Pacific Northwest. However, for mammography rates, the change between pre- and post-QIP was irrelevant in both groups. Mullen et al. extended the time period of this study in order to separate the estimated effect of the PacifiCare intervention from that of the larger-scale, coordinated P4P program introduced approximately 6 months into the post period [64]. Authors used data from the performance reports of medical groups contracting on a capitated basis with a large network Health Maintenance Organization, PacifiCare Health Systems, before and after implementation of two P4P programs. Comparing the performance of these groups, authors observed an increase in the *breast cancer screening* rate, from 70.6% in 2002 to 73.7% in 2004.

Gilmore et al. performed an observational study in order to determine whether patients who observed physicians participating in a quality-based incentive program received recommended care over time compared with patients who observed physicians who did not participate in the incentive program, as per 11 evidence-based quality indicators, from 1998 to 2003 [61]. The monetary reward ranged from 1 to 5 percent of the physician's base professional fees in 1998–2001 and was increased to 7.5 percent in 2002–2003. They considered the percentage of women aged 50–69 who received at least one screening mammogram during the reporting period. Comparing the two patient groups, they found that physicians who joined the program had significantly higher performance rates for *breast cancer screening*.

Pearson et al. evaluated the impact on quality of all P4P programs introduced into physician group contracts in 2001–2003 by the five major commercial health plans operating in Massachusetts [64]. The incentives tied to quality performance ranged from a low of $200 to a high of $2500 per primary care physician. Highly incentivized groups did not demonstrate superior quality improvement compared to comparison groups. In particular, improvement

was small for some HEDIS measures, such as *breast cancer screening*.

Gavagan et al. conducted a retrospective review of administrative data in order to evaluate the effect of a physician P4P program, similar to the Medicare Physician Quality Reporting Initiative program, on the quality of preventive care in a network of community health centers [13]. Physicians in 6 of 11 clinics were given a financial incentive twice the size of the current Centers for Medicare and Medicaid Services' incentive for achieving group targets in preventive care that included mammography. The maximum potential incentive per physician was $12,000 annually, representing $4000 each for quality, and productivity. Six years of performance indicators were compared between incentivized and non-incentivized clinics. They found that for mammography, the groups started and ended up with similar rates, although they diverged in 2005–2006, but overall, there was no significant difference in rates between the 2 groups.

Finally, Rosenthal et al. examined the experiences of 27 early adopters and profiled the evolution of their P4P strategies in the USA (2003) [21]. P4P bonuses were typically about $1.40 and ranged from twenty cents to fifteen dollars per member per month. The author concluded that P4P has expanded the reach of physicians' efforts. They are increasingly are focused on outcomes and cost-efficiency measures, rather than clinical process measures alone. The author observed statistically significant improvements in some quality measures, such as mammogram rates and cancer screening, compared with a control group, but was unable to determine whether to attribute the improvements to the incentives themselves or to the education and direction that accompanied the rollout of this particular P4P program.

Seven provider organizations in Massachusetts entered the Blue Cross Blue Shield Alternative Quality Contract (AQC) in 2009, followed by four more organizations in 2010. This contract is based on a global budget and P4P for achieving certain quality outcome measures. In this context, Song et al. found that the AQC was associated with a greater decrease in medical spending growth and larger improvements in ambulatory care quality, including *breast cancer screening* [20].

Kiran et al. performed a longitudinal analysis using administrative data to determine cancer screening rates and incentive costs in each fiscal year from 1999/2000 to 2009/2010 in Ontario [22]. They used a segmented linear regression analysis to assess whether there was a step change or change in screening rate trends after incentives were introduced in 2006/2007. They included all Ontarians eligible for *breast cancer screening*. In 2009–2010, physicians could receive a maximum of $8400 if they met the highest targets for all 3 types of screening (breast, cervical and colorectal) - approximately 3% of their gross income. Authors observed that *breast cancer screening* rates did not change significantly from year to year before or after the incentives were introduced.

In France, Sicsic et al. investigated the determinants of GPs' preferences for financial and non-financial incentives in cancer screening activities using the discrete choice experiment methodology, using a representative sample of 402 GPs recruited in 2014 [1]. The authors concluded that for *breast cancer*, GPs are more sensitive to non-financial incentives.

Moreover, Sicsic and France evaluated the impact of the French P4P program (CAPI) on the early detection of *breast cancer* among 50,752 women between 50 and 74 years old from 2007 to 2011 [5]. They found that *breast cancer screening* rates have not changed significantly since the P4P program implementation. According to the authors' conclusions, this result may reflect the fact that the low-powered incentives implemented in France through the CAPI might not provide sufficient leverage to generate better practices in the field of prevention and screening.

Finally, Kuo et al. evaluated the impact of the nationwide P4P program for *breast cancer* care (BC-P4P) in Taiwan on care quality [60]. The authors conducted a population-based observational study with a cross-sectional design. A total of 4528 patients with stage I or II *breast cancer* diagnosed in 2002 or 2003 who received curative surgery were observed until the end of 2008. The results showed that patients with breast cancer enrolled in the BC-P4P program received better quality care and had better outcomes than non-enrolled patients. Evidence from this study indicates that financial incentives in the payment design had a positive impact on outcomes of breast cancer care.

3.5. Effect of financial incentives on cervical cancer screening delivery rate

The analysis of the effect of financial incentives on *cervical cancer screening* delivery rates has yielded mixed results and has often had irrelevant effects [19].

In the USA, through a comparison between groups of physicians highly incentivized and not, different authors observed no evidence for a clinically significant effect of financial incentives on the performance of preventive care or small improvements in *cervical cancer screening* delivery rates [13], particularly in Massachusetts [63]. Wee et al. examined the proportion of Pap smears carried out among women 20 to 75 years old and found that patients cared by physicians with financial productivity incentives were significantly less likely than those cared by physicians without this incentive to receive Pap smears (74.6% vs 86.3%) [62]. Other authors observed irrelevant effects, but not negative [21], or positive effects, particularly in California, where greater quality improvement after the P4P intervention in *cervical cancer screening* was demonstrated in the study of Rosenthal et al. (with an improvement in the cervical cancer screening rate from 39.2% in 2001 to 44.5% in 2004) [58], in the extension of Mullen et al. (with an improvement from 51% in 2002 to 62.8% in 2004) [64]. Also, in Massachusetts, Song et al. observed a positive effect of the financial incentives. In particular, an increase in the *cervical cancer screening* rate associated with the AQC was found [20]. Also, Lester et al. conducted a longitudinal analysis under a sample of 35 medical facilities of Kaiser [65]. They found that during the two initial years, when financial incentives were attached in California to *cervical cancer screening* (1999–2000), across 35 facilities, the screening rate rose slightly, from 77.4% to 78.0%. In contrast, during the next five years, when the financial incentives were removed, screening rates fell year after year to 74.3%, with a decrease in performance of approximately 1.6% per year. Incentives were then reattached for two years (2006–2007), and screening rates began to increase.

In Hawaii, significantly higher performance rates for cervical cancer screening compared with those of physicians who had not joined in the incentive program were observed in the study of Gilmore et al. [61].

Australian studies document that the initial P4P program implementation was associated with short-term increases in *cervical cancer* screens nationally. In particular, Greene examined the impact of Australia's P4P program for GPs [59]. A panel dataset of 1131 GPs was followed from 2000 to 2009. The *cervical cancer screening* incentive was a reward of A$35 when a GP screens a woman who has not been screened in the prior 4 years. The authors found that there was a short-term increase in *cervical cancer* screens after program implementation. The increase, however, was for all GPs. GPs reported that the incentive did not influence their behavior, largely due to the modest payment and the complexity of tracking patients and claiming payment.

Kiran et al. found no significant step change in the cervical *cancer screening* rates before or after the incentives were introduced in Canada [22].

In France, Constantinou et al. investigated the effect of a nationwide P4P scheme introduced in 2012 for French GPs on *cervical cancer screening* participation by analyzing smear tests used from 2006 to 2014 [12]. They used a longitudinal sample was an unbalanced panel comprising 180,167 women eligible from 1 to 9 years each. Findings showed that following P4P implementation in 2012, the recommended screening participation increased significantly in 2013 and in 2014, but this increase was very modest and likely to be transient. Indeed, the increase in annual smear use, both for the whole sample of eligible women and among women overdue for screening, was observed only punctually in 2013, before decreasing again in 2014.

Finally, Kirschner et al. performed an observational study to assess changes in performance after introducing a participatory P4P program in the general practices in the south of the Netherlands [66]. The authors considered different care and clinical process indicators, of which no significant improvements were seen for the *cervical cancer screening* uptake (71.9% vs 72.5%).

3.6. Effect of financial incentives on colorectal cancer screening delivery rate

Regarding the effect of financial incentives on the improvement of *colorectal cancer screening* delivery rates, the results of studies were mixed.

In the USA, the authors observed, in some cases, irrelevant effects [19–21]. Positive effects were found in the study of Gilmore et al. [61], in which the authors compared rates of *colorectal cancer screening* for patients who observed physicians participating and not participating in the incentive program, considering the percentage of members aged 52–57 who had at least one fecal occult blood test, or at least one barium enema, sigmoidoscopy, or colonoscopy. Also, in this case, the authors concluded that physicians who joined the program had significantly higher performance rates for *colorectal cancer screening* than those who did not join the program.

In Canada, Kiran et al., as required by the Ontario program, determined the proportion of adults aged 50–74 years who either received fecal occult blood testing (FOBT) in the 30 months before the end of the relevant fiscal year. They observed an increase in *colorectal cancer screening* rates of 3.0% per year before the incentives were introduced and 4.7% per year thereafter [22]. Additionally, Morland et al. conducted a study in Canada to determine whether implementation of the performance incentive for *colorectal cancer screening* adherence rates led to an increased proportion of inappropriate orders for screening colonoscopy [24]. The sample investigated was composed of patients aged 50–75 years with a >50% 4-year mortality risk related to multiple comorbidities. Physicians were expected to complete *colorectal cancer screening* for these patients, earning $1000 if at least 50% of their patients had completed all applicable tests and an additional $2000 if at least 80% of their patients had completed all applicable tests. The authors found no evidence that the incentive led to an increase in inappropriate screening colonoscopy orders.

Finally, in France, the study of Sicsic et al. showed that GPs' trade-offs for screening incentives depend on the type of cancer: no single attribute dominates all others for all cancers (including the financial attribute) [1]. Regarding *colorectal cancer screening*, the additional payment had a relatively greater impact. This result could be explained by the fact that the GP is expected to play an important role in explaining the modalities of the test and/or convincing all eligible patients to perform the test, and time has an opportunity cost requiring compensation. Another argument may explain the result: *colorectal cancer screening* is designed for a relatively large population in the GP patient base (men and women aged 50–74 years).

4. Discussion

P4P has been among the most widely used tools to orient medical practice towards the provision and improvement of preventive healthcare services [12]. Despite the widespread use of this new remuneration program, there is mixed evidence for its effectiveness [67,68]. In this systematic review, we found 18 eligible studies that addressed the question of whether explicit financial incentives improve the delivery rates of preventive care. We have focused on the following preventive services: *breast cancer screening*, *cervical cancer screening* and *colorectal cancer screening*. The studies discussed have demonstrated the heterogeneous effects of financial incentives on improving the delivery rates of these health preventive services (Table 3). In particular, for *breast cancer screening*, most of the studies (9) showed partial or no effects; one explanation could be that women may take a proactive role in *breast cancer screening*, making physician incentives less important [62]. For *cervical cancer screening*, 6 studies showed positive effects, 5 no effect, 3 partial effects, and 1 negative effects. Thus, it is important to note that even if *cervical cancer screening* is mostly performed during gynecologist consultations, GPs' roles are essential: most GPs declare that they routinely perform *cervical cancer screening* and that performing this act is part of their job [69]. Few positive or irrelevant effects were found regarding *colorectal cancer screening*. In this context, many guidelines have a positive position on the effectiveness of screening. However, screening rates are still low in some countries, and many barriers are present [70]. Overall, many factors influence the impact of financial incentives on cancer screening delivery rates [67,71]. Among these factors, the low-powered incentives might not provide sufficient leverage to generate better practices in the field of prevention [5].

Our results may be affected by some limitations. First, only papers published in the English language were reviewed; data published in other languages were automatically excluded from this study. Our inability to systematically review literature in other languages may be considered a weakness. Although we had intended to review the non-English literature, professional language translation services proved prohibitively expensive. Analysis was necessarily limited to publicly available papers, and the study was thus potentially subject to publication bias.

Few empirical studies of explicit financial incentives for breast, cervical and colorectal cancer screening were available for this review. Moreover, our systematic review may be affected by negative publication bias because healthcare executives may have some disincentive to publish negative findings of P4P programs on preventive services delivery rates [57].

Finally, the risk of bias has not been assessed using a formal tool such as the Cochrane Risk of Bias Tool [72] or Grading of Recommendations Assessment, Development, and Evaluation (GRADE) [73].

5. Conclusions

Ongoing monitoring of incentive programs has important value and is critical to determining the effectiveness of financial incentive plans. Our search provides contributions for both research and practice.

In particular, this systematic search can help guide policymakers to determine whether the introduction of specific financial incentives can improve the use of these screening tests by physicians, allowing them to increase the screening delivery rates and reduce mortality rates.

Indeed, the final output of this systematic search was a synthesis useful for understanding the most evidence actually observed in the literature regarding the effects of financial incentives on breast,

Table 3
Synthesis of findings by domain (cancer screening type)(number of studies = 18).

Study, Year	Country	Study design (and period)	Amount of the incentive	Number of partecipants	Domain	Synthesis of findings	Overall effect
Hillman et al., 1998 [19]	USA	*Experimental study* - Randomized controlled trial (1993-1995)	Bonuses ranged from $ 570 to $ 1260 per site with an average of $ 775 per audit	52 primary care sites	**BCS; CCS; CLCS**	Screening rates doubled overall from 24% to 50%. However, no significative differences were found between intervention and control group sites.	PARTIAL
Wee et al., 2001 [62]	USA	*Experimental study* - Multivariable logistic regression (1996-1997)	N.S.	11 academically affiliated primary care	**BCS; CCS**	**BCS:** Financial incentives were also not significantly associated with rates of mammography (rate difference, 23%; 95% confidence interval [CI]: 215% to 10%). **CCS:** Results showed that patients cared for by physicians with financial productivity incentives were significantly less likely than those cared for by physicians without this incentive to receive Pap smears (rate difference, 12%; 95% confidence interval [CI]: 5% to 18%).	NO EFFECT/ NEGATIVE
Rosenthal et al., 2005 [58]	USA	*Experimental study* - Natural experiment and a contemporaneous comparison group (2001-2004)	The bonus potential represents about 5% of the professional capitation paid by the plan and about 0.8% of the groups overall revenue on average.	300 large physician organizations	**BCS; CCS**	**BCS:** For mammography rates, the change pre- and post-QIP was irrelevant. **CCS:** Cervical cancer screening was the only measure with a statistically significant response to the program.	NO EFFECT/ POSITIVE
Gilmore et al., 2007 [61]	USA	*Observational study* (1998-2003)	The monetary reward ranged from 1 to 5 percent of the physician's base professional fees in 1998– 2001, and was increased to 7.5 percent in 2002–2003	95 percent of physicians in Hawaii	**BCS; CCS; CLCS**	Physicians who joined the program from 1998 to 2003 had significantly higher performance rates for breast, cervical and colorectal cancer screening than those who did not join the program.	POSITIVE
Rosenthal et al., 2007 [21]	USA	*Observational study* -Series of structured telephone interviews (2003-2006)	P4P bonuses were typically about $1.40 per member per month and ranged from twenty cents to fifteen dollars per member per month.	Respondents for all twenty-seven sponsors	**BCS; CCS; CLCS**	The author observed statistically significant improvements in some quality measures, such as mammogram rates and cancer screening, compared with a control group but was unable to determine whether to attribute the improvements to the incentives themselves or to the education and direction that accompanied the rollout of this particular P4P program.	PARTIAL
Pearson et al., 2008 [63]	USA	*Quasi-experimental design* (2001-2003)	The size of the incentives tied to quality performance on each measure ranged from a low of approximately $200 to a high of approximately $2500 per PCP.	5,350 physicians practicing in 154 physician groups.	**BCS; CCS**	Overall, P4P contracts were not associated with greater improvement in quality compared to a rising secular trend. Highly incentivized groups did not demonstrate superior quality improvement compared to comparison groups	NO EFFECT
Gavagan et al., 2010 [13]	USA	*Mixed methods* -Retrospective review of administrative data and a natural quasi-experiment (2003-2007)	The potential $4000 annual payout based on achieving quality targets represented approximately 3% to 4% of a provider's total salary.	110 physicians and 2 physician assistants	**BCS; CCS**	The authors found no evidence for a clinically significant effect of financial incentives on performance of preventive care in these community health centers	NO EFFECT

Table 3 (*Continued*)

Study, Year	Country	Study design (and period)	Amount of the incentive	Number of partecipants	Domain	Synthesis of findings	Overall effect
Mullen et al., 2010 [64]	USA	*Observational study* -Before-and-after comparisons (2001-2005)	A group could receive a potential bonus of up to $7417 quarterly, or $29,667 annually, if it met all five clinical targets	242 medical groups (172 in the first year and 70 in the second year)	**BCS; CCS**	**BCS:** Breast cancer screening rate increased from 70.6% (2002) to 73.7% (2004). **CCS:** Cervical cancer screening rate increased from 51% (2002) to 62.8% (2004).	POSITIVE
Lester et al., 2010 [65]	USA	*Observational study* -Longitudinal analysis (1997-2007)	$42.000.000 was awarded as incentives across the 35 facilities	35 medical facilities of Kaiser Permanente Northern California	**CCS**	During the two initial years, when financial incentives were attached to cervical cancer screening (1999-2000), the screening rate rose slightly, from 77.4% to 78.0%. During the next five years, when financial incentives were removed, screening rates fell year after year to 74.3%. Incentives were then reattached for two years (2006-2007), and screening rates began to increase.	POSITIVE
Kuo et al., 2011 [60]	Taiwan	*Observational study* -A population-based observational study with cross-sectional design. (2003-2004)	N.S.	1,393 BC-P4P patients	**BCS**	Patients with breast cancer enrolled in the breast cancer-P4P program received better quality care and had better outcomes than non-enrolled patients.	POSITIVE
Kirschner et al., 2012 [66]	The Netherlands	*Observational study* -An observational study with a pre and post measurement (2008-2009)	A bonus with a maxi- mum of 6890 Euros per 1000 patients was determined by comparing practice performance with a benchmark.	Sixty general practices in the south of the Netherlands	**CCS**	No significant improvements of the uptake rate in cervical cancer screening were observed.	NO EFFECT
Song et al., 2012 [20]	USA-Massachusetts	*Quasi experimental design* -Difference-in- differences model (2006-2010)	Provider groups were rewarded with up to 10 percent of their global budget for meeting a set of sixty-four quality measures	1,600 primary care physicians and 3200 specialists	**BCS; CCS; CLCS**	The Alternative Quality Contract (AQC) was associated with an increase in BCS rate from 80.2 (pre-AQC) to 83.7 (post-AQC); from 87.3 to 87.7 for CCS; and from 64.2 to 71.1 for CLCS.	POSITIVE
Greene, 2013 [59]	Australia	*Mixed methods* - Analysis of trends, fixed effects panel regression models and in-depth interviews(2000-2009)	The cervical cancer screening incentive is a reward of A$35 when a GP screens a woman who has not been screened in the prior 4 years. The practice can also earn A$3 per female patient in the practice if 65 percent of the women aged 20–69 in a practice have been screened	1131 GPs	**CCS**	There was a short-term increase in cervical cancer screens after program implementation. However, GPs reported that the incentive did not influence their behavior, largely due to the modest payment and the complexity of tracking patients and claiming payment.	PARTIAL
Kiran et al., 2014 [22]	CANADA	*Observational study* -Longitudinal analysis (1999/2000- 2009/2010)	Physicians could receive a maximum of $8400 if they met the highest targets for all 3 types of screening—about 3% of their gross income	All eligible primary care physicians	**BCS; CCS; CLCS**	**BCS & CCS**: The cervical and breast cancer screening rates did not change significantly from year to year before or after the incentives were introduced. **CLCS:** Colorectal cancer screening was increasing at a rate of 3.0% (2.3% to 3.7%) per year before the incentives were introduced, and screening increased 4.7% (3.7% to 5.7%) per year thereafter.	NO EFFECT/POSITIVE

Table 3 (*Continued*)

Study, Year	Country	Study design (and period)	Amount of the incentive	Number of partecipants	Domain	Synthesis of findings	Overall effect
Sicsic et al., 2016 [1]	FRANCE	*Experimental study* -Discrete-choice experiment (2014)	The payment offered different levels of additional remuneration as a percentage increase of the year fees (0%, 1%, 3%, 5%) based on reaching a specific target of screened patients, patients for which the doctor was the referral GP.	402 GPs	**BCS; CCS; CLCS**	**BCS & CCS:** GPs have higher and more heterogeneous preferences for non-financial incentives in breast and cervical cancers. **CLCS:** GPs appear to be relatively more sensitive to financial incentives when involved in colorectal cancer screening.	NO EFFECT/POSITIVE
Sicsic & Franc, 2017 [5]	FRANCE	*Mixed methods* -Descriptive analysis/ difference-in difference model (2007-2011)	A maximal amount of €245 for achieving a target screening rate among eligible women enrolled with the GP	A list of GPs who have signed the agreement of the CAPI	**BCS**	Breast cancer screening rates have not changed significantly since the P4P program implementation.	NO EFFECT
Constantinou et al., 2017 [12]	FRANCE	*Observational study* -Longitudinal representative data (2006-2014)	It rewards the rate of women aged 25–65 years having performed a Pap smear within the last 3 years, with a total annual amount of e245 per physician when the target objective is achieved	N.S.	**CCS**	The annual probability of smear utilization among women overdue for screening increased significantly in 2012 and in 2013. In 2014, there was a significant decrease when compared to 2013.	POSITIVE
Morland et al., 2017 [24]	CANADA	*Observational study* -Pre-post analysis (2010-2011)	Providers earned $1000 if at least 50% of their patients had completed all applicable tests and an additional $2000 if at least 80% of their patients had completed all applicable tests.	23 attending physicians in 4 academic general internal medicine practices	**CLCS**	The performance incentives for providers based on screening colonoscopy rates do not result in an increase in inappropriate screening of patients aged 50 to 75 years with a >50% 4-year mortality risk.	POSITIVE

cervical and colorectal cancer screening delivery rates, in order to identify elements that deserve special attention.

For researchers, we provide an overview of P4P schemes that are currently used to stimulate delivery rates of some preventive health services in order to gain insight into the effects of P4P on healthcare quality. Regardless, further studies are needed to guide the implementation of financial incentives in this area and to assess their effectiveness.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.healthpol.2019.09.012.

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