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Better together? A mediation analysis of general practitioners' performance in multi-professional group practice

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Abstract

Objectives: To analyse how general practitioners (GPs) respond to insufficient GP supply in their practice area in terms of quantity and quality of care, and how this response can be mediated by enrolment in integrated primary care teams (multi-professional group practices (MGP)).

Methods: We used three representative cross-sectional surveys (2019-2020) of 1,209 French GPs. Using structural equations, we assumed that low GP density influences GPs' work-related stress (mediator 1) as well as their use of e-health tools (mediator 2) and ultimately quantity and quality of care. Quantity (respectively quality) of care were approximated by demand absorption capacities (respectively frequencies of vaccine recommendations). We estimated an additional specification where enrolment in an MGP was a mediator between GP density and the two mediators defined above.

Results: GP density was significantly and positively associated with work-related stress, which was consecutively associated with deteriorated demand absorption capacity. Higher use of e-health tools was associated with greater involvement in vaccine recommendations. Lastly, GPs in MGP tend to use more e-health tools than those practicing outside MGP, with a favourable effect on quality of care.

Discussion: This study demonstrates that a lower level of work-related stress is the key mediator in handling patients' requests. Correcting for the self-selection into MGP, we amend some unstable results contained in the literature: there is no significant mediation effect of enrolment in integrated primary care teams on the quantity of care, but rather an effect on the quality of care. Although probably disappointing for the quantity of care provided, our results pinpoint a novel added value of enrolment in an integrated practice as a response to decreasing GP density.

Keywords: general practitioners, medically underserved area, integrated care, France

JEL Keywords: I11, I18

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1 Introduction

Primary care remains an important concern for the policymakers, as emphasized by the 2018 Astana declaration following the Global Conference on Primary Health Care, which celebrated the fortieth anniversary of the Declaration of Alma-Ata (WHO, 2018). Resulting from this meeting, the 2019 Global Monitoring Report on progress on universal health coverage (WHO, 2019) indicates that reorganization of care provision, and especially the improvement of primary care coordination is one of the key strategies to tackle the inequalities in access to primary care and achieve universal health coverage.

As other developed countries, France is currently facing a shortage of primary care workforce, due to mass retirement of self-employed general practitioners (GPs) that are ensuring more than 90% of primary care associated with population growth and population aging as well as lack of anticipation of this demographic evolution (Anguis et al., 2021). According to the French Ministry of Health, the number of GPs is supposed to decline at least up to 2026. Once adjusted for healthcare demand, the 2021 GP density level should be attained once again by 2036.

In the meantime, a clear trend towards integration of primary care providers is observed: in a 2010 survey, 54% of GPs indicated practicing in a group practice; there were already 61% in 2019 (Chaput et al., 2019). However, most of these group practices only share premises, and/or back-office functions.

Up to now, the most advanced form of integrated healthcare teams in France is the so-called multi-professional primary care group practice (MGP) [in French: "maison de santé pluridisciplinaire"]. The MGPs are created on a voluntary basis and are required to have at least two full-time equivalent GPs and one paramedic. This policy was launched in 2007 and has proven to be extremely popular among physicians: in 2020, more than 1,300 MGPs were actively operating compared to less than 20 in 2008 (Chevillard and Mousquès, 2021).

Current literature mostly demonstrates improvements in the quantity of care provided in integrated healthcare teams, e.g., longer patient lists and more home and office visits (Cassou et al., 2020; Kerrissey et al., 2017; Lalani et al., 2020; Mousquès and Daniel, 2015; Singer et al., 2020). However, evidence is mixed and scarce regarding the gains related to integrated practices in terms of quality of care.

This paper contributes to this literature exploring the impact of existing variability in GPs' accessibility both on quantity and quality of care using data from a representative panel of 1,209 French private practice GPs. In addition, we sought to provide evidence on the efficiency of the MGP policy by estimating the mediation effect of MGP enrolment on quantity and quality of primary care provided. To our knowledge,

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this is the first study to analyse the effects of GP density on quantity and quality of primary care using mediation analysis, which allows to disentangle indirect and direct effects of GP density and the real effect of the MGP policy. To preface our results, we provide limited evidence on the efficiency of the MGP policy – at least the way it has been implemented in France.

2 Conceptual framework

We start by arguing that low GP density might hinder both the quality and the quantity of care provided. This section presents the conceptual framework (based on relevant literature) that sheds light on the potential mechanisms, both direct and indirect, that might explain this relationship.

Extensive literature documents higher workload for GPs practicing in rural or remote areas (Groenewegen et al., 2020; Hassel et al., 2019; Lurquin et al., 2021; Steinhaeuser et al., 2011). In addition, higher workload might result in shorter consultation length (Deveugele et al., 2002; Irving et al., 2017). Growing literature points out work-related stress as one of the important mediators of the GP productivity (Soler et al., 2008; Wallace et al., 2009). According to a recent French study in the Upper Normandy region, GP density below 7.75 per 10,000 inhabitants is positively correlated with all of three dimensions (emotional exhaustion, depersonalization, and personal accomplishment) of Maslach Burnout Inventory (Picquendar et al., 2019; Maslach et al., 1997). Wallace et al. (2009) also argue that lack of GPs is one of the reasons for their professional burnout. Overall, GPs have been found to have relatively high levels of burnout: two recent literature reviews indicate that the burnout incidence is around a third among the GPs (Karuna et al., 2021; Shen et al., 2022). Higher levels of burnout are in turn associated with suboptimal productivity (Shen et al., 2022; Wallace et al., 2009). Recent studies that took place during the Covid-19 pandemic indicate that work-related stress among healtcare professionals was entirely due to subjective factors, i.e., the perceptions of their working conditions (Spányik et al., 2022).

Empirically, practice in underserved areas is frequently associated with worse patients' health outcomes obtained from the use of primary care services, especially regarding time-consuming activities such as prevention (Lane et al., 2021; Silhol et al., 2020; Zyzanski et al., 1998). This is precisely the case for vaccination activity, in which GPs may play a key role in many countries.

In France, vaccination coverage remains suboptimal, especially against seasonal influenza (Robert et al., 2020) and human papillomavirus (Eliès et al., 2022), while almost half of the population is vaccine-hesitant (Larson et al., 2016; Rey et al., 2018). Moreover, a quarter of GPs declare that some of the recommended vaccines are not useful (Verger et al., 2015).

While the evidence is mixed, expanding literature suggests that e-health solutions, e.g., use of electronic health records combined with automated reminders, might be a convenient tool to improve the vaccination rates from 5 up to 20 percentage points (Derrough et al., 2017; Dumit et al., 2018; Groom et al., 2015; Jacobson Vann et al., 2018). For example, an US study indicates that introduction of automated reminders within the electronic health record significantly improves the pertussis postpartum immunization rate

(Morgan et al., 2015). Two recent literature reviews reveal greater levels of HPV vaccine initiation and completion using communication technologies, including electronic health records (Francis et al., 2017; Niccolai and Hansen, 2015). Another review (Okoli et al., 2021) pinpoints an important increase (19%) in seasonal influenza in adult patients and a smaller, but still significant, increase in paediatric patients associated with the use of e-health tools.

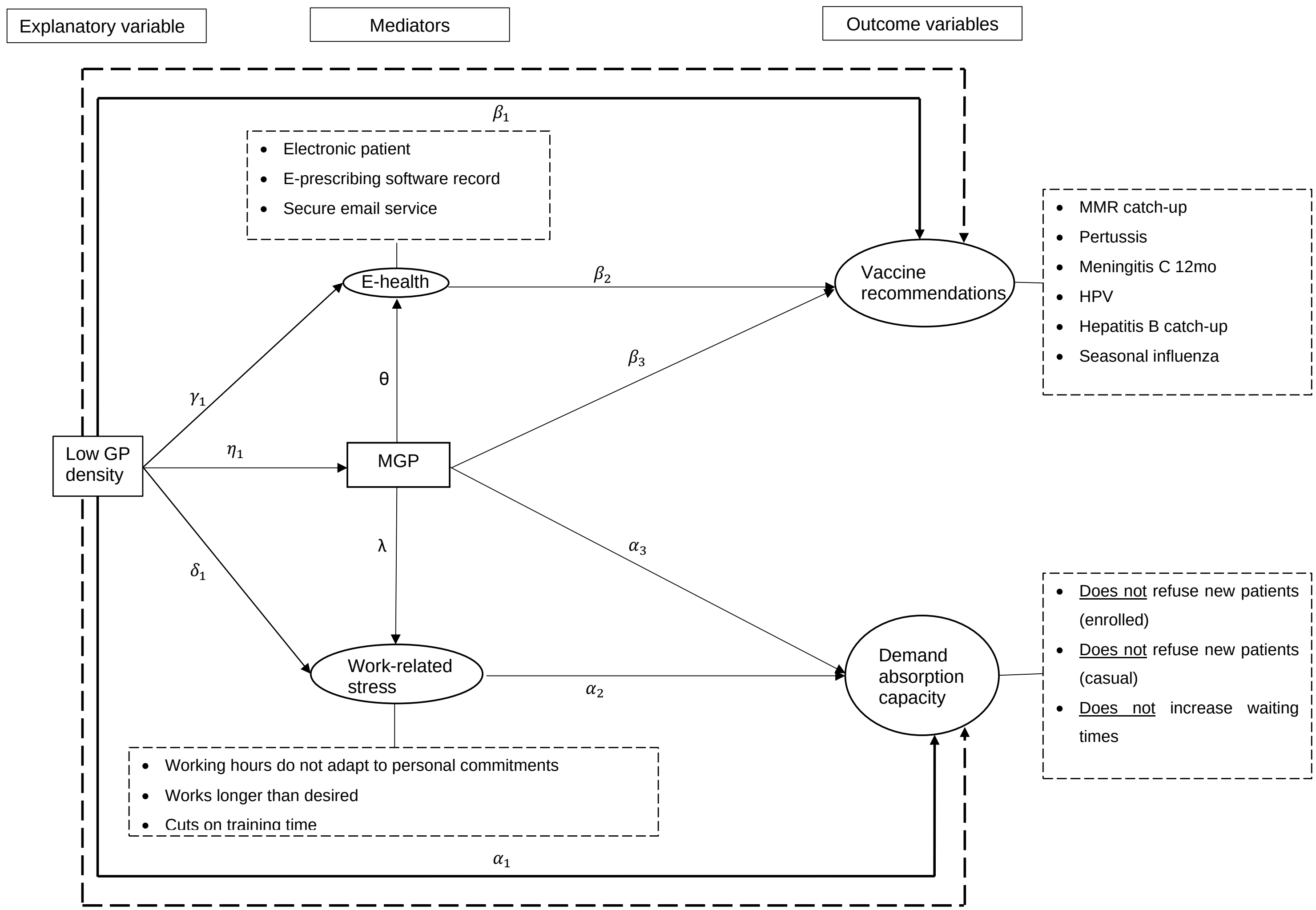
Greater use of e-health tools is also promoted to bridge inequalities in access to primary care (Petrie et al., 2021; Wakerman and Humphreys, 2011). The implementation of e-health technologies, and especially, telemedicine has been even more encouraged since the beginning of Covid-19 pandemic, both by the patients and the health authorities (Davin-Casalena et al., 2021; Woodall et al., 2021). In addition, use of e-health tools appears cost-saving due to better administrative efficiency (Patel et al., 2015).

Finally, interprofessional collaboration is supposed to deal with both the quantity and the quality of care provided. On the one hand, it is beneficial to the GPs wellbeing and is supposed to reduce their workload due to better practice organization (Kerrissey et al., 2017; Singer et al., 2020). On the other hand, better coordination and proximity with specialists and other health professionals allows to improve the quality of care, especially for the patients with complex needs (Colla et al., 2020; De Sutter et al., 2019; Singer et al., 2020; Smith et al., 2021). These points suggest that the practice in an integrated care setting is an 'upstream' (opening) determinant of both the quantity and quality of care. Nonetheless, GPs might have diverse attitudes towards cooperation and prescriptions management with specialists and other health professionals (Carrier et al., 2022).

Following this theoretical framework, we were inclined to test the following chain of pathways (Figure 1): low density leads to (1) increase in work-related stress that influences GPs' productivity; and (2) higher use of e-health tools that in turn affect the quality of care provided. We then add (3) enrollment in MGP as an 'opening' mediator that influences both the other two mediators and the outcome variables.

This is the theoretical framework which will be tested by using an appropriate statistical analysis (see next section).

Figure 1: The direct and indirect effects between GP density and quantity and quality of care



Latent variables (factors) are represented by circles, and measured variables (items) by rectangles; arrows point in the hypothesized direction of influence. The total effect of low GP density on quantity (DV1) and quality of care (DV2) is represented by dashed arrows. The effect of low GP density on each potential mediator is represented by paths δ_1, γ_1 and η_1. The effect of potential mediators on quantity and quality of care is representedby paths α_2, β_2, α_3, and β_3. The direct effect, i.e., the effect not explained by the use of mediators, of low GP density on quantity and quality of care is represented by paths α_1 and β_1.

3 Materials and Methods

3.1 Study population

We used data from the fourth round (2018-2022) of a national panel survey of French private practice (non salaried) GPs, designed to collect information about GPs' medical behaviors, working conditions and opinions on public health policies. Participating GPs were randomly selected from a French National Registry of Health Care Workers as of January 1st, 2018.

Sampling was stratified for gender, age (<50, 50-59, 60+), workload (annual number of office and home visits in 2017; in terciles) and GP density of practice area (low, moderate, high). The survey is representative of GPs practicing in France (except Mayotte). GPs planning to retire or to move before the end of data collection, those exclusively practicing alternative medicine or those having less than 200 patients as a gatekeeper were excluded. Of the 12,022 eligible GPs contacted, 3,304 (27%) completed the inclusion questionnaire and undertook to answer six future cross-sectional surveys (one every nine months). The sample benefits from the French "public statistics" label of the National Authority for Statistical Information (*Conseil National de l'Information Statistique*) that confirms the quality of the processes used to produce the data and their compliance with the best practices, e.g., the burden that the survey implies for the subjects and the degree of consultation with users.

3.2 Procedure and questionnaire

We exploit three waves of the survey with data collected respectively between October 2018 and April 2019 (first questionnaire), December 2019 and March 2020 (dummy variable described below) and October 2020 and November 2020 (second questionnaire). All the questionnaires were pilot-tested for clarity and face validity; they were collected either online or by professional interviewers using computer-assisted telephone interviews. GPs received compensation equivalent to one consultation fee (25 euros) for their participation in each survey.

First questionnaire dealt with GPs' perceptions regarding the evolution of availability of medical services in their practice area. More precisely, it collected information about (1) their perception of the GP density of their practice area (from 1=very insufficient to 4=completely sufficient); (2) perceived difficulties when dealing with patients' requests (3 items): whether they werethese difficulties resulted in refusing new patients (both enrolled or casual) or increasing waiting times; (3) work-related stress (3 items): whether the working hours adapted well to their personal commitments, they worked longer than desired or cut on training time and (4) use of e-health tools (3 items): electronic patient records, e-prescribing software and secured email service. We constructed a dummy variable to isolate the GPs reporting a practice in an area with 'very insufficient' GP density.

Second questionnaire addressed GPs' self-reported vaccine recommendation frequency (1 = never to 4 = always) in six specific vaccine situations, chosen because their current vaccination coverage rates in France do not meet official public health objectives: (1) measles, mumps, and rubella for non-immune adolescents (catch-up), (2) pertussis in the immediate postpartum period for new mothers who did not receive a dose prior to their pregnancy, (3) meningococcal C for 12-month-old infants, (4) human papillomavirus for children aged 11–14, (5) hepatitis B for adolescents (catch-up), and (6) seasonal influenza for adults under 65 with chronic condition.

We use a dummy variable indicating GPs reporting enrollment in MGP. GPs were also asked about their (part-time) practice of alternative medicine, e.g., homeopathy and acupuncture.

We also enriched the survey data by the French Deprivation index (FDEP) calculated at the municipality level in 2015 (Rey et al., 2009). This score was constructed by the French National Institute of Health and Medical Research (Inserm) from National Institute of Statistics and Economic Studies (Insee) data on four dimensions: (1) the unemployment rate in the active population aged 15-64; (2) the percentage of blue-collar workers in the active population aged 15-64; (3) the percentage of high school graduates in the population aged over 15 years old and (4) the median income per consumption unit. The FDEP index varies between -4 and 4: the higher the score, the greater the deprivation. We used a dummy variable to isolate the most deprived municipalities (with positive FDEP index).

3.3 Statistical analysis

For the descriptive analyses, data were weighted to match the nationwide GP population in terms of stratification variables to correct for possible systematic non-response bias.

We used confirmatory factor analysis (CFA) to construct four latent variables of interest: (1) difficulties when dealing with patients' requests (demand absorption capacity, a proxy of quantity of care, DV1), (2) self-reported vaccine recommendation frequency (a proxy for quality of care, DV2), (3) work-related stress (mediator 1, M1), and (4) use of e-health tools (mediator 2, M2). Full list of variables used to construct the latent variables is presented in Tables 1 and 2.

We draw on the conceptual framework described above to motivate our mediation analysis. We assumed that low GP density influences GPs' work-related stress (M1) as well as their use of e-health tools (M2) and ultimately the quantity of care (DV1) and the quality of care (DV2) (Model 1). We therefore estimate the following reduced-form base model (Model 1) for quantity of care (DV1) and the quality of care (DV2):

$$Quantity_i = \alpha_0 + \alpha_1 Density_i + \alpha_2 Stress_i + \alpha_3 X_i + \epsilon_i \tag{1}$$

$$Quality_i = \beta_0 + \beta_1 Density_i + \beta_2 Ehealth_i + \beta_3 X_i + \zeta_i \tag{2}$$

with $Quantity_i$ as the quantity of care provided by the GP i, explained by the GPs density $Density_i$, her work-related stress $Stress_i$ and a vector of covariates X_i (age, gender, deprivation index and occasional practice of complementary medicine). The specification is similar for the quality of care $Quality_i$. We assume that the error terms ϵ_i and ζ_i are uncorrelated.

To estimate the indirect effects, we modify equations (1) and (2) as follows:

$$Quantity_i = \alpha_0 + \alpha_1 Density_i + \alpha_2 Stress_i(Density_i) + \alpha_3 X_i + \epsilon_i \tag{3}$$

$$Quality_i = \beta_0 + \beta_1 Density_i + \beta_2 Ehealth_i(Density_i) + \beta_3 X_i + \zeta_i \tag{4}$$

We assume that the indirect effect of GP density on quantity of care (DV1) is mediated through GPs' work-related stress (M1), while the indirect effect on the quality of care (DV2) is mediated through the use of e-health tools (M2). We disentangle the direct effect from the indirect effect by total differentiation with respect to $Density_i$:

$$\frac{dQuantity_i}{dDensity_i} = \alpha_1 + \left(\frac{\partial Quantity_i}{\partial Stress_i} \times \frac{\partial Stress_i}{\partial Density_i}\right) \tag{5}$$

$$\frac{dQuality_i}{dDensity_i} = \beta_1 + \left(\frac{\partial Quality_i}{\partial Ehealth_i} \times \frac{\partial Ehealth_i}{\partial Density_i}\right) \tag{6}$$

While the left-hand side displays the total effect of equation (5), the right-hand side decomposes the total effect into (1) the direct effect α_1 of GP density on quantity of care, and (2) the indirect effect (in parentheses) as cross-derivatives. Equation (6) is the equivalent of (5) for the of GP density on quality of care.

The mediating factors are estimated in two additional equations below:

$$Stress_i = \delta_0 + \delta_1 Density_i + \delta_2 X_i + \mu_i \tag{7}$$

$$Ehealth_i = \gamma_0 + \gamma_1 Density_i + \gamma_2 X_i + \nu_i \tag{8}$$

Moreover, we estimate a second model where we consider enrollment in MGP as an "opening" mediator (M3) between GP density and the two mediators defined above (Model 2). Consequently, the reduced-form model is adjusted as follows:

$$Quantity_i = \alpha_0 + \alpha_1 Density_i + \alpha_2 Stress_i + \alpha_3 MGP_i + \alpha_4 X_i + \epsilon_i \tag{9}$$

$$Quality_i = \beta_0 + \beta_1 Density_i + \beta_2 Ehealth_i + \beta_3 MGP_i + \beta_4 X_i + \zeta_i \tag{10}$$

with MGP_i acting as a mediator for the two dependendent variables. In addition, MGP_i affects both the work-related stress and the use of e-health tools, so that (3) and (4) become

$$Quantity_i = \alpha_0 + \alpha_1 Density_i + \alpha_2 Stress_i(MGP_i(Density_i), Density_i) + \alpha_3 MGP_i(Density_i) + \alpha_4 X_i + \epsilon_i \tag{11}$$

$$Quality_i = \beta_0 + \beta_1 Density_i + \beta_2 Ehealth_i(MGP_i(Density_i), Density_i) + \beta_3 MGP_i(Density_i) + \beta_4 X_i + \zeta_i \tag{12}$$

so that the decomposition of the total effect is

$$\frac{dQuantity_i}{dDensity_i} = \alpha_1 + \frac{\partial Quantity_i}{\partial Stress_i}\left[\frac{\partial Stress_i}{\partial MGP_i} \times \frac{\partial MGP_i}{\partial Density_i} + \frac{\partial Stress_i}{\partial Density_i}\right] + \left(\frac{\partial Quantity_i}{\partial MGP_i} \times \frac{\partial MGP_i}{\partial Density_i}\right) \tag{13}$$

$$\frac{dQuality_i}{dDensity_i} = \beta_1 + \frac{\partial Quality_i}{\partial Ehealth_i}\left[\frac{\partial Ehealth_i}{\partial MGP_i} \times \frac{\partial MGP_i}{\partial Density_i} + \frac{\partial Ehealth_i}{\partial Density_i}\right] + \left(\frac{\partial Quality_i}{\partial MGP_i} \times \frac{\partial MGP_i}{\partial Density_i}\right) \tag{14}$$

Equations (13) and (14) could be also written as

$$\frac{dQuantity_i}{dDensity_i} = \alpha_1 + \alpha_2\left[\lambda \times \eta_1 + \delta_1\right] + (\alpha_3 \times \eta_1) \tag{15}$$

$$\frac{dQuality_i}{dDensity_i} = \beta_1 + \beta_2\left[\theta \times \eta_1 + \gamma_1\right] + (\beta_3 \times \eta_1) \tag{16}$$

The mediating factors are estimated in three additional equations below:

$$Stress_i = \delta_0 + \delta_1 Density_i + \delta_2 X_i + \lambda MGP_i + \mu_i \tag{17}$$

$$Ehealth_i = \gamma_0 + \gamma_1 Density_i + \gamma_2 X_i + \theta MGP_i + \nu_i \tag{18}$$

$$MGP_i = \eta_0 + \eta_1 Density_i + \eta_2 X_i + \omega_i \tag{19}$$

The issue of the potential endogeneity of variables (MGP in particular) due to omitted variables is addressed through the inclusion of adequate controls in the multiple-stage least squares analysis (since instrumental variables method is not recommended to deal with omitted variables, as it would require a specific instrument for each link assessed in the SEM). The risk of reverse causality is handled by the outline of the structural equation modelling (Collier, 2020; Pearl, 2009; VanderWeele and Shpitser, 2011). For example, note that in our case (Model 2) the endogeneity of practice in MGP to GP density is included in the structural modelling, with the reverse causality excluded (that practice in MGP causes GP density to decline, which is not a plausible assumption). However, we do provide the results that include covariance between practice in MGP and GP density (the causality flows both ways) as a robustness check. We also test a model that includes the effects of work-related stress on quality of care and that of use of e-health tools on quantity of care.

Model fit was assessed by the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the standardized root mean square residual (SRMR). Models with CFI>0.90, TLI>0.90, RMSEA<0.08, and SRMR<0.08 were considered to fit reasonably or well (Hooper et al., 2008).

All analyses were based on two-sided P values and conducted with Stata 14 (StataCorp, College Station, Texas).

4 Results

4.1 Summary statistics

Of 1,209 French GPs still enrolled in 2020, 40% of GPs were female, about a third were younger than 50 years old (Table 1). Twelve percent were enrolled in an MGP and 15% occasionally practiced complementary medicine. Twenty-one percent reported that they practiced in an area with very insufficient GP density compared to 10% that were objectively practicing in an underserved area, i.e., an area where a patient could have had access to less than 2.8 consultations per year (Ministère des solidarités et de la santé, 2021). Among the 10% of GPs that were objectively practicing in an area with very insufficient GP supply, only 38% had the matching perception. The proportion of those reporting to practice in an area with very insufficient GP density was significantly higher (29%) for those practicing in an MGP. More than a half (56%) were practicing in deprived areas; this proportion was significantly higher (70%) for those enrolled in MGP.

More than four GPs out of ten reported that their working hours did not adapt well to their personal commitments or that they had to cut on training time. Seventy percent reported that they had to work longer than desired.

The vast majority of GPs declared using diverse e-health tools: 92% used electronic patient record and secure email services, and 85% used e-prescribing software. These proportions were significantly higher for GPs enrolled in MGP (99%, 99% and 94% respectively).

Around half of GPs were able to accept new patients: 44% for consultations with enrolled patients and 57% for casual consultations (Table 2). Forty-six percent managed to maintain their waiting times compared to 32% of GPs in MGP.

Almost all GPs (92%) claimed to always or often recommend meningococcal C vaccine for 12-month-old infants (97% in MGP) and seasonal influenza for adults with chronic conditions. More than 80% recommended measles, mumps, and rubella catch-up for adolescents, pertussis for new mothers and human papillomavirus vaccines for children aged 11-14. Two-third of GPs declared recommending hepatitis B catch-up for adolescents. Some vaccines, e.g., hepatitis B catch-up, human papillomavirus, a seasonal influenza, were less systematically recommended by the GPs.

Table 1: Sample characteristics, national panel of French GPs (n=1,209)

%	Total	MGP
Thinks that GP density in the area is very insufficient	21.59	29.04**
MGP	11.69	-
Age		
<50	33.68	48.97
50-59	40.67	34.72
≥60	25.65	16.31
Female	39.13	40.62
Occasional practice of complementary medicine	15.83	15.62
French DEPrivation index>0	56.44	69.87***
Work-related stress		
Working hours do not adapt well to their personal commitments	40.96	42.76
Works longer than desired	70.70	76.01
Cuts on training time	43.10	49.03
Use of e-health tools		
Uses electronic patient records	91.59	99.66***
Uses e-prescribing software	84.53	93.77***
Uses secured email service	91.49	98.87***

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

GPs: general practitioners; MGP: multi-professional group practices

Source: DREES, ORS and URPS Provence-Alpes-Côte d'Azur and Pays de la Loire, 4ème Panel d'observation des pratiques et des conditions d'exercice en médecine générale de ville.

Note: weighted data.

Table 2: Dependent variables, national panel of French GPs (n=1,209)

Demand absorption capacity	%	**No**		**Yes**	
Does not refuse new patients (enrolled)	**Total**	55.62		44.38	
	in MGP	49.88		50.12	
Does not refuse new patients (casual)	**Total**	42.97		57.03	
	in MGP	48.6		51.40	
Does not increase waiting times	**Total**	53.66		46.34	
	in MGP	67.61***		32.39***	
Vaccine recommendations	%	**Never**	**Sometimes**	**Often**	**Always**
MMR for non-immune adolescents (catch-up)	**Total**	1.42	13.80	24.90	59.89
	in MGP	0.18	14.81	21.30	63.71
Pertussis postpartum†	**Total**	7.73	10.76	20.05	61.46
	in MGP	5.01	10.81	22.27	61.90
Meningococcal C for 12-month-old infants	**Total**	1.19	6.80	12.17	79.84
	in MGP	0.37***	2.33***	6.03***	91.27***
HPV for children aged 11–14	**Total**	3.31	14.85	42.26	39.58
	in MGP	3.15	7.82	41.10	47.93
Hepatitis B for adolescents (catch-up)	**Total**	1.97	23.25	37.10	37.68
	in MGP	2.20	21.71	39.54	36.56
Seasonal influenza for adults under 65 with chronic condition	**Total**	0.09	6.71	37.88	55.31
	in MGP	0.18	5.75	40.29	53.78

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

GPs: general practitioners; MGP: multi-professional group practices; MMR: Measles, mumps, and rubella; HPV: Human papillomavirus

Source: DREES, ORS and URPS Provence-Alpes-Côte d'Azur and Pays de la Loire, 4ème Panel d'observation des pratiques et des conditions d'exercice en médecine générale de ville.

Note: weighted data.

† Pertussis in the immediate postpartum period for new mothers who did not receive a dose prior to their pregnancy.

4.2 Mediation analysis results

The results of the mediation analysis are presented in Table 3. Total standardized effects are displayed in order to compare across models.

Overall, the quantity of care delivered was negatively affected by perceived GP density as well as work-related stress. The quality of care was not significantly affected by the GP density, while higher levels of quality were linked to greater use of e-health tools. Female GPs were likely to have lower demand absoption capacity and to recommend vaccines more often. Older GPs were more likely to absorb demand more efficiently. Practice of complementary medicine was associated with lower frequency of vaccine recommendations, while greater workload had a positive impact on quality. Adding MGP as a mediator (Model 2) had no signicant impact on the outcome variables.

As for the mediating factors, low perceived GP density was associated with higher levels of work-related stress and more enrollment in MGP. Older GPs were less likely to use e-health tools and enroll in MGP. Finally, there was a positive association between practice in a deprived area and enrollment in a MGP.

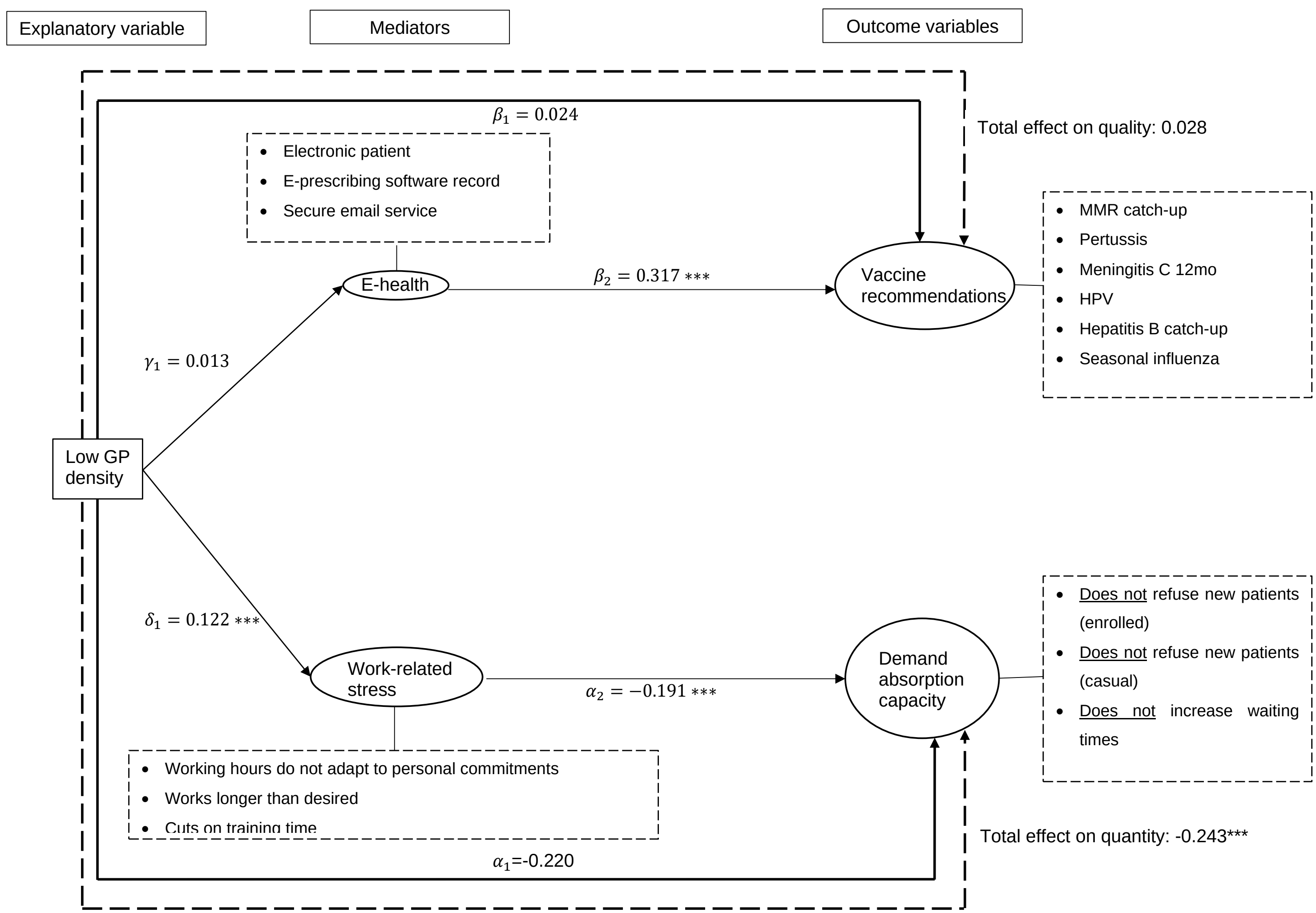
When disentangling between direct and indirect effects, in the absence of potential mediators, our results suggest that the relation between GP density and quantity of care delivered was negative and significant ($\alpha_1 = -0.220$); there was no significant effect found on the quality of care (Figure 2). In the presence of mediators (work-related stress (M1) and use of e-health tools (M2)), GP density was significantly and positively associated with work-related stress ($\delta_1 = 0.122$), which was consecutively associated with a degraded demand absorption capacity ($\alpha_2 = -0.191$). This sequence of correlations shows that the initial correlation between GP density and demand absorption capacity is mediated by work-related stress and this mediating effect can be quantified by the product of these coefficients ($\delta_1 \times \alpha_2 = -0.023$). Moreover, higher use of e-health tools (M2) was associated with greater vaccine recommendations frequency ($\beta_2 = 0.317$). Lastly, after the introduction of enrollment in MGP as a "mediator of mediators" (Figure 3), we found that GPs in MGP tended to use more e-health tools, with a favorable effect on our measure of quality of care, vaccine recommendations. However, we failed to find any significant improvements of practice in MGP on work-related stress. These results hold when accounting for covariance between GP density and practice in MGP as well as when we include the effects of work-related stress on quality of care and that of use of e-health tools on quantity of care.

Table 3: Mediation analysis results, SEM estimation, standardized total effects

Standardized coefficients, total effects		Outcome variables				Mediators				
		Quantity of care		Quality of care		Work-related stress		E-health		MGP
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 2
Mediators	Work-related stress	-0,187*** (0,061)	-0,192*** (0,041)	-	-	-	-	-	-	-
	E-health	-	-	0,166*** (0,047)	0,168*** (0,036)	-	-	-	-	-
	MGP	-	0,043 (0,062)	-	0,022 (0,049)	-	-0,018 (0,043)	-	0,096** (0,036)	-
Explanatory variable	**Perceived GP density**	-0,371** (0,040)	-0,371*** (0,043)	0,034 (0,035)	0,053 (0,039)	0,210*** (0,042)	0,211*** (0,047)	0,037 (0,035)	0,039 (0,039)	0,078** (0,032)
Control variables	Female	-0,179*** (0,042)	-0,171*** (0,044)	0,142*** (0,038)	0,134*** (0,040)	-0,081 (0,046)	-0,062 (0,038)	-0,047 (0,047)	-0,053 (0,039)	-0,055 (0,032)
	Age (ref. <50 years)									
	50-59	0,062 (0,042)	0,070 (0,046)	-0,024 (0,038)	-0,023 (0,045)	0,005 (0,046)	-0,003 (0,037)	-0,166*** (0,050)	-0,155*** (0,039)	-0,179*** (0,033)
	≥ 60	0,132*** (0,044)	0,159*** (0,041)	-0,070 (0,044)	-0,064 (0,036)	-0,054 (0,049)	-0,067 (0,037)	-0,394*** (0,043)	-0,370*** (0,036)	-0,191*** (0,030)
	Complementary medicine (ref.No)	0,056 (0,039)	0,054 (0,041)	-0,087** (0,035)	-0,086** (0,037)	0,029 (0,043)	0,012 (0,035)	-0,049 (0,044)	-0,050 (0,037)	0,022 (0,030)
	Deprivation index>0	-0,024 (0,039)	-0,038 (0,048)	-0,051 (0,035)	-0,061 (0,043)	-0,030 (0,043)	-0,016 (0,035)	0,078** (0,051)	0,066 (0,042)	0,150*** (0,035)
	Workload (ref.Q1)									
	Q2-Q3	-0,038 (0,046)	-0,037 (0,051)	0,061 (0,041)	0,064 (0,043)	0,085 (0,050)	0,095 (0,041)	0,073 (0,051)	0,077 (0,044)	0,054 (0,036)
	Q4	-0,001*** (0,049)	0,016 (0,031)	0,146*** (0,042)	0,145*** (0,037)	0,216*** (0,051)	0,230*** (0,042)	-0,012*** (0,042)	-0,030 (0,045)	-0,025 (0,085)

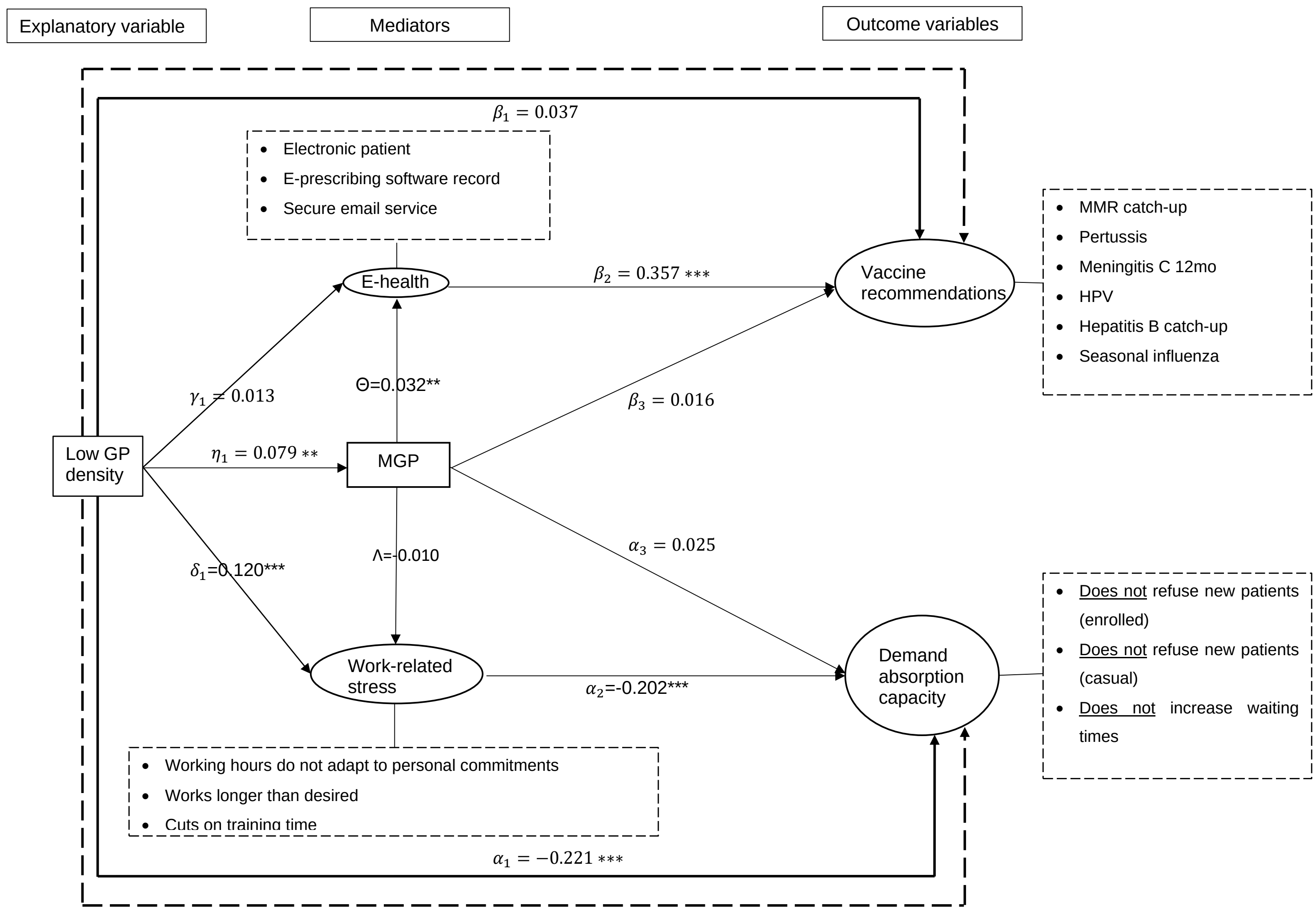
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: non-weighted data
Goodness of fit, Model 1: RMSEA=0,028; CFI=0,933; TLI=0,915; SRMR=0,030; R^2=0,427
Goodness of fit, Model 2: RMSEA=0,029; CFI=0,926; TLI=0,902; SRMR=0,031; R^2=0,462

Figure 2: Unstandardized direct effects of paths of the multiple mediation model on demand absorption capacity and vaccine recommendation frequency (Model 1)



* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Non-weighted data. Coefficients are estimated from linear regression equations.
Model was adjusted for age, gender, deprivation index and occasional practice of complementary medicine. Latent variables (factors) are represented by circles, and measured variables (items) by rectangles; arrows point in the hypothesized direction of influence.
Goodness of fit: RMSEA=0,028; CFI=0,933; TLI=0,915; SRMR=0,030; R^2=0,427

Figure 3: Unstandardized direct effects of paths on demand absorption capacity and vaccine recommendation frequency (Model 2)



* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Non-weighted data. Coefficients are estimated from linear regression equations.
Model was adjusted for age, gender, deprivation index and occasional practice of complementary medicine. Latent variables (factors) are represented by circles, and measured variables (items) by rectangles; arrows point in the hypothesized direction of influence.
Goodness of fit: RMSEA=0,029; CFI=0,926; TLI=0,902; SRMR=0,031; R^2=0,462

5 Discussion & conclusion

To the best of our knowledge, this is the first study to analyse the underlying mediation effects behind the relationship between GP density and quantity and quality of primary care that also analyses integrated primary care teams' option as a possible response to the decreasing density.

We found that lower density is associated with lower demand absorption capacity as a proxy for quantity of care. We confirmed, at the country level, the existence of a negative relationship between GP density and work-related stress, in line with Picquendar et al. (2019). We show that lower level of work-related stress is a key mediator in handling patients' requests (Shen et al., 2022; Wallace et al., 2009).

As the statistical framework (using structural equations) allows correcting for the self-selection into MGP, we also amend some unstable results contained in the related literature: contrary to Cassou et al. (2020) we do not find a significant impact of enrollment in MGP on the demand absorption capacity. A difference between their work and ours might stem from the sample of GPs that are included in both research papers. The study population of Cassou et al. (2020) is restricted to MGPs accredited by Social Security that represent about half of French MGPs, that are subject to stricter requirements from the health authorities to receive an add-on payment. For instance, the accredited MGPs are supposed to have extended hours to ensure the continuity of care, which might explain the increase in the number of patients seen by the GP that they observe.

Even outside the French context, the finding that there is no significant effect of an enrolment in integrated practices on absorption capacity is unusual (but not without precedent, see Nolte and McKee (2009)) The heterogeneity in configuration of the integrated practices that we have in our study might be an explanation: while MGPs require two full-time equivalent GPs and one paramedic to be recognized as such by health authorities, the size and list of professionals available at the practice might vary across the country. Therefore, the size of the integrated practices might be insufficient to fully absorb the demand and/or its composition (e.g., in paramedics) might not be adapted to the characteristics of the practice area, e.g., does not consider the part of the aging population that generates more care demand. Another plausible explanation might be that once enrolled in an MGP, GPs adjust their working hours to achieve better work-life balance. Finally, it is possible that the efficiency gains generated by enrolment in an MGP are not reflected in quantity, but rather in quality (Singer et al., 2020; Zaytseva et al., 2022).

GP density indirectly affects the quality of care. As expected, more MGPs are located in underserved areas (Chevillard et al., 2019). While we do not find a direct effect of practicing in MGP on the quality of care, we found that practicing in MGP is indirectly able to generate better quality of care. Enrolment in MGP was associated with higher use of e-health tools and, consecutively, with higher frequency of vaccine recommendations: e-health tools can be used to systematically identify unvaccinated patients in a practice and send an automated reminder to the GP when the patient visits that a vaccination is due (Derrough et al., 2017; Dumit et al., 2018; Groom et al., 2015; Jacobson Vann et al., 2018; Morgan et al., 2015; Niccolai and Hansen, 2015; Okoli et al., 2021; Rey et al., 2018).

A limitation of our research is the use of survey data, so social desirability or conformity biases cannot be ruled out. Another limitation is that we consider only a set of three mediators (work-related stress, use of e-health tools and enrolment in an MGP), while other factors, such as consultation length or trust in institutions, may be of importance both in prevention activities and vaccination. While the choice of mediators is justified by our conceptual framework, existing literature and data availability, further studies are needed to consider a broader set of mediators and/or outcome variables related to the quality and quantity of care.

To conclude, this study shows that an enrolment in MGP as a response to a decreasing medical density, although disappointing in terms of quantity of care supplied, has the potential to improve the quality of care provided to the patients. While a previous study that investigated the performance of GPs in MGP during Covid-19 pandemics found that GPs in MGP ensured better follow-up of patients with chronic conditions during the lockdown than those practicing outside MGP (Zaytseva et al., 2022), our results strengthen the evidence of better qualitative performance of GPs when considering their regular practice styles, such as their vaccination recommendation practices. Thus, further development of integrated primary care appears beneficial to the patients located in the underserved areas and even more so since one of the requirements to establish an MGP is the participation in public health, prevention, health education and social activities of their choice in their catchment area.

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