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Don't stop me now: The impact of retirement proximity on GP performance

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ABSTRACT

Population ageing has been widely studied for its implications for healthcare demand. Yet much less attention has been paid to the parallel ageing of the medical workforce. Focusing on the Italian primary care setting, this study addresses this gap by examining whether GP performance changes as physicians approach the retirement age of 70. Drawing on human capital theory, retirement proximity may affect GP performance via two competing mechanisms: accumulated experience may enhance performance, while human capital depreciation, reflecting reduced effort or shifting focus, may offset these gains. We test the net effect of these mechanisms on selected utilization-based indicators of GP performance. Using administrative data from a large Italian Local Health Authority, we analyze type II diabetes patients continuously enrolled with GPs from 2018 to 2023. Exploiting variation in retirement proximity across GPs, we apply a staggered difference-in-differences approach to examine treatment effect dynamics. We find no evidence of systematic deterioration in potentially inappropriate use, hospitalizations, emergency department access, or diabetes-related avoidable hospitalizations. However, patients whose GPs are closer to retirement are less likely to receive at least two HbA1c tests per year, whereas their likelihood of receiving at least one HbA1c test remains unchanged. These findings suggest that, as GPs approach the retirement age of 70, utilization-based performance indicators are not systematically affected, although support for adherence to evolving chronic care monitoring standards may be needed.

1. Introduction

Population ageing has emerged as a major concern in several OECD countries over the last decade, raising questions about the financial sustainability of publicly funded health care systems. While much attention has been devoted to the health needs of an ageing population, far less has been said about the ageing of healthcare professionals themselves. This parallel process has important implications not only for the health of providers, but also for retirement trends and workforce capacity within the healthcare system. Yet, despite its potential impact, it has received limited attention in both research and policy debates.

The ageing of the medical profession is particularly pronounced in Italy, which has one of the oldest medical workforces in Europe: in 2023, 44% of physicians were aged 55 or older, compared with an EU average of 32% (OECD, 2025), and 27% were over 65, the highest share in the EU (Eurostat, 2025). This demographic trend is most critical for General Practitioners (GPs), who form the backbone of primary healthcare services. In the Italian National Health Service (NHS), GPs serve as the first point of contact between patients and healthcare services and act as gatekeepers to higher levels of care. In 2021, 75% of General Practitioners (GPs) had more than 27 years of professional service. Projections indicate that within the next six years one-third of the GP workforce will reach retirement, while the expected inflow of new practitioners will offset only 74% of those leaving the profession (Agenas, 2023). The progressive ageing of the medical workforce, with many GPs approaching retirement, poses a major challenge for the sustainability of primary care and for the future resilience of the national health system.

These concerns are amplified by the high workload borne by GPs. In Italy, where patient lists are capped at 1500 and the prevalence of chronic conditions in the adult population is around 41% (Istat, 2025), each GP manages on average more than 600 chronically ill patients who require continuous care and regular follow-ups, thus resulting in chronic disease management absorbing a large share of daily GP activity (Giachello and Ugolini, 2024). The scenario is expected to become increasingly critical, particularly in light of the demographic 'inverted pyramid', which indicates that in the near future the proportion of older individuals will substantially exceed that of younger ones, bringing a heavier burden of age-related diseases.

In order to sustain healthcare supply, several countries have

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implemented policy measures aimed at extending physicians' working lives. In Italy, an exceptional measure was introduced by Decree-Law No. 198/2022 (converted into Law No. 14/2023), allowing GPs, on a voluntary basis, to continue practicing beyond the statutory retirement age of 70, until the age of 72. This measure was subsequently extended by Decree-Law No. 25/2025, which raised the maximum age to 73. Although the policy became operational from 2024, a direct evaluation of its impact requires a sufficiently long post-reform window, which is not yet available. While this initiative may help mitigate short-term supply shortages, it raises the issue of whether GP performance may change as physicians approach retirement. From a human capital perspective, retirement proximity may impact GP performance via two competing mechanisms. On the one hand, nearing retirement age may enhance performance through accumulated expertise. On the other hand, human capital depreciation, reflecting accumulated fatigue or demotivation, may offset these gains as physicians approach retirement. Our analysis examines the net effect of these mechanisms using selected utilization-based indicators of GP performance, including potentially inappropriate healthcare use, diabetes-related acute utilization, and adherence to recommended monitoring.

Empirical evidence from the existing literature remains limited and mixed. Early reviews suggested a negative association between physician experience and quality of care (Choudhry et al., 2005), whereas more recent studies found no evidence of systematic declines (Ajmi and Aase, 2021). A growing literature has examined the effects of GP retirement on patients, typically exploiting the exogenous shock generated when the GP–patient relationship is abruptly interrupted. These studies analyze the discontinuity generated by retirement, considering both the last year of practice and the subsequent years under a new GP (Bischof and Kaiser, 2021; Hjalmarsson et al., 2023; Monsees and Westphal, 2025; Zhang, 2022). By contrast, evidence on how GPs adjust their practice in the years preceding retirement remains scarce (Hedden et al., 2017; Joyce et al., 2015; Simkin et al., 2019). The few existing studies suggest that retiring GPs tend to reduce the amount of care provided but often struggle to disentangle the effects of retirement-related behavioural changes from cohort effects or other confounding factors. More recently, a notable exception is provided by O'Halloran et al. (2021) who analyze GPs' practice styles across a ten-year period before retirement in Denmark, focusing on the number of enlisted patients, revenues, consultation volumes, and treatment behaviors. Using random-effects models with GP-clustered standard errors, they found no significant differences between retiring and non-retiring GPs neither in revenue per patient or in the number of consultations per patient. However, they identified a modest association between practice style and proximity to retirement: GPs nearing retirement provided fewer home visits and prescriptions per patient, but referred more patients to private specialists.

Our study contributes to the existing literature by investigating GP performance in the years preceding retirement. Rather than analyzing the transition period and the consequences of reallocating patients to a new doctor, we examine GPs' behaviour in the final five years of their careers by testing whether proximity to retirement is associated with significant changes in utilization-based performance indicators. We exploit detailed patient-level administrative data from one of the largest Local Health Authorities in Italy, located in the Emilia-Romagna region and serving approximately 1.1 million residents. In this context, GPs operate within a highly regulated publicly funded system characterised by capitation-based remuneration, strict gatekeeping and strong continuity of care. Such institutional features constrain discretionary adjustments in service provision and provide a distinct setting in which incentives and practice constraints differ from those in previous studies. Focusing on a homogeneous cohort of patients with type 2 diabetes, a condition characterised by well-defined clinical guidelines and regular monitoring requirements, we employ a difference-in-differences design that exploits variation in proximity to retirement across GPs, while controlling for patient and year fixed-effects. The variation in treatment timing enables us to examine the dynamic effects of proximity to retirement on patient outcomes.

We find no evidence of generalized deterioration in utilization-based performance indicators as GPs approach retirement. We detect no systematic changes in potentially inappropriate healthcare use, specialist referrals, emergency department access, hospitalizations, or diabetes-related avoidable hospitalizations. The main exception concerns diabetes monitoring: patients whose GPs are closer to retirement are less likely to receive at least two HbA1c tests per year, while the less stringent one-test indicator remains unaffected. This pattern may reflect slower adaptation to more intensive monitoring standards rather than a broad decline in GP performance. The results have important policy implications, suggesting that, in a universal and tightly regulated primary care system, institutional constraints may help preserve broad patterns of care as GPs approach the end of their professional careers. These findings contribute to ongoing policy debates on workforce ageing and retirement regulation in primary care by providing timely evidence on GP behaviour in the years immediately preceding the statutory retirement age of 70, while post-reform data will be needed to assess GP performance beyond this threshold.

2. Data

We exploit individual-level administrative data covering the period 2018–2023. Since the recent policy allowing GPs to remain in service beyond age 70 became operational only in 2024, we do not observe GPs who continued practicing beyond this threshold. The data were obtained from the administrative databases of one of the largest Local Health Authorities in Italy, based in the Emilia-Romagna region and serving approximately 1.1 million residents with universal access to the Italian National Health Service (NHS). The dataset integrates information from multiple administrative sources: hospital discharge records, providing information on inpatient admissions; the outpatient pharmaceutical database, including drugs reimbursed by the NHS (i.e., prescribed by physicians or specialists, or dispensed by hospital pharmacies); the outpatient specialty database, covering specialist visits and diagnostic tests; and an additional laboratory data flow containing information on HbA1c tests. The datasets were linked using a unique anonymized patient identifier and merged with information on GP and practice characteristics.

Based on this integrated dataset, we construct a balanced panel with nearly 68,000 observations for more than 11,000 patients diagnosed with type 2 diabetes before 2018. Patients younger than 18 in 2018 and those who died during the study period are excluded. To avoid biases from disruptions in care, such as frequent GP changes, temporary doctor–patient relationships, or recent breaks with a previous GP, we retain only patients who remained continuously registered with the same doctor throughout the study period, ensuring a stable and exclusive GP–patient relationship. In addition, patients treated with rapid-acting insulin are excluded, as they typically present more severe conditions and are managed by hospital-based diabetes centers. Consequently, our sample consists of patients with milder forms of the disease (i.e., treated with diet, oral antidiabetic agents, or basal insulin), falling under the responsibility of GPs, in line with regional guidelines (Emilia-Romagna Region, 2003). As regards GPs, we exclude those not fully engaged in patient-list primary care, using a cutoff of 401 registered patients. This threshold is intended to remove physicians with very small patient lists, who may have reduced contractual commitments or non-standard practice arrangements and are therefore less comparable to GPs providing ordinary list-based primary care. Following these exclusion criteria, we end up with a final dataset consisting of 67,614 observations on 11,269 type 2 diabetes patients observed over six years, linked to 358 GPs.

2.1. Dependent variables

Table 1 presents the descriptive statistics for our outcome indicators. The treated group consists of patients whose GP reached the five-year pre-retirement window, defined as the period preceding the statutory retirement age of 70, during the years covered by the analysis. These patients account for approximately 47% of the sample and are registered with about 45% of GPs.

We use several utilization-based indicators to capture selected dimensions of GP performance. These indicators should be interpreted as proxies for specific domains of primary care performance, rather than as direct measures of overall quality of care. This interpretation follows the classic framework proposed by Donabedian (1988), which separates structure, process, and outcome indicators, and is consistent with subsequent work on healthcare quality measurement emphasizing the indirect nature of process and utilization-based measures (Quentin et al., 2019). We group the indicators into two conceptually distinct categories: utilization-based appropriateness indicators for non-diabetes-related specialist referrals and utilization-based diabetes care indicators. Their interpretation differs across groups, as discussed below.

Panel a) focuses on utilization-based appropriateness indicators. First, we identify potentially avoidable hospitalizations signaling weaknesses in primary care delivery by extracting from the hospitalization registry all ambulatory care sensitive conditions (ACSCs) other than diabetes. We define this outcome as a binary indicator equal to one if the individual experiences at least one ACSC-related hospitalization during the year, and zero otherwise. As the descriptive statistics show, the incidence of ACSCs is low (1.3%), and the groups are well balanced.

Second, we generate two measures of inappropriate Emergency Department (ED) access. Upon arrival at the ED, patients are triaged and assigned a priority code based on clinical severity. In Italy, a five-level colour-coded triage system is used. Red and yellow codes identify high-acuity cases requiring immediate or urgent care. Green codes correspond to low-acuity conditions for which longer waiting times are clinically appropriate. White codes indicate non-urgent cases that are considered inappropriate for ED care and are subject to a fixed copayment. Consistent with the existing literature (e.g., Levaggi et al., 2020), we consider both green and white codes as potentially inappropriate ED use. More precisely, we define non-urgent cases as 'white code' visits. In addition, we consider minor severity attendances by adding to the white codes those selected as 'green code' visits in which the patient had at most one clinical assessment or left before medical evaluation, and was subsequently discharged to community care (i.e., home discharge or GP follow-up). Both indicators are defined as binary variables, capturing whether an individual experiences at least one non-urgent or minor-severity ED attendance. They may reflect not only clinical overuse, but also patients' difficulties in accessing or trusting their GP, potentially due to gaps in responsiveness or availability of primary care. On average, we find that the incidence of non-urgent ED use is relatively low (approximately 4% and 7% for white codes only and selected white and green codes, respectively), with very similar distributions between retiring and non-retiring groups.

In addition, we assess the appropriateness of GP referrals to specialist care, focusing on non-diabetes-related visits. Importantly, we do not interpret a higher number of referrals per se as inappropriate. Rather, we construct two referral-based indicators that use subsequent specialist contact to proxy potential appropriateness. The first is the number of potentially inappropriate referrals, defined as specialist consultations, excluding endocrinology, that were not followed by any further specialist contact within six months (183 days), suggesting limited clinical relevance. The second is the percentage of potentially appropriate referrals, measuring the share of non-endocrinological referrals that appear potentially clinically relevant based on subsequent specialist use over the total non-endocrinological referrals issued by each GP. These referral-based indicators complement the hospital and ED metrics by capturing potential overuse or inefficiencies in the GP's management of outpatient care. On average the annual number of potentially inappropriate GP referrals is 0.3, whereas the proportion of potentially appropriate referrals is high, at 81.5%, with no substantial differences between the two groups.

Second, Panel b) of Table 1 focuses on a set of utilization-based diabetes care indicators, which we interpret as proxies for selected dimensions of diabetes management rather than as direct measures of overall quality of care. These indicators capture different aspects of the diabetes care pathway, including recommended monitoring, emergency or inpatient use, and potentially avoidable complications. Our diabetic cohort excludes patients treated with rapid-acting insulin, who are more likely to have advanced or clinically complex diabetes requiring intensive management. In this selected population, hospitalizations and ED accesses for endocrine-related conditions are less likely to reflect routine appropriate escalation for highly complex cases and are more plausibly interpreted as rare, potentially avoidable events in the diabetes care pathway. Outcomes are defined as binary indicators equal to one if the individual experiences at least one event during the year, and zero otherwise. On average, their incidence is very low and shows little variation between the treated and control groups: ED accesses for endocrine disease occur for 0.5% of observations overall, compared with 0.5% among treated patients and 0.4% among controls, while hospitalizations for diabetes are virtually zero in both groups. In addition, we consider diabetes-related ACSCs, defined as annual individual-level binary indicators equal to one if the patient experiences at least one diabetes-related ACSC hospitalization during the year, and zero otherwise. We find a low incidence of diabetes-related ACSC hospitalizations (0.3%) in both groups. We also examine compliance with recommended clinical monitoring by constructing two HbA1c-specific indicators: receipt of at least one HbA1c test during the year and receipt of at least two HbA1c tests during the year. The second indicator corresponds more closely to the recommended monitoring frequency for diabetic patients, while the first captures a less stringent level of annual monitoring that may be appropriate for less severe patients under routine follow-up. Both indicators are defined as annual individual-level binary variables. The descriptive statistics show that 83% of diabetic patients

Table 1
Descriptive statistics: outcome indicators (years 2018-2023).

	All	Treated	Controls
	Mean (SD)	Mean (SD)	Mean (SD)
a) Utilization-based appropriateness indicators			
Hospitalization for all ACSCs other than diabetes	0.013 (0.113)	0.013 (0.115)	0.013 (0.111)
Inappropriate ED access (not urgent – white codes)	0.036 (0.186)	0.035 (0.184)	0.036 (0.187)
Inappropriate ED access (minor severity – white and green codes)	0.066 (0.248)	0.067 (0.250)	0.065 (0.247)
No. of potentially inappropriate GP referrals	0.306 (0.905)	0.299 (0.815)	0.314 (0.980)
% of potentially appropriate GP referrals	81.501 (37.775)	81.920 (37.431)	81.120 (38.079)
b) Utilization-based diabetes indicators			
ED access for endocrine disease	0.005 (0.069)	0.005 (0.071)	0.004 (0.067)
Hospitalization for diabetes	0.000 (0.018)	0.000 (0.016)	0.000 (0.019)
Compliance at least 1 HbA1c	0.835 (0.317)	0.834 (0.372)	0.837 (0.370)
Compliance at least 2 HbA1c	0.536 (0.499)	0.542 (0.498)	0.530 (0.499)
Hospitalization for diabetic ACSCs	0.003 (0.054)	0.003 (0.054)	0.003 (0.054)
No. observations	67,614	32,046	35,568
No. patients	11,269	5341	5928

Notes: ACSCs, ambulatory care sensitive conditions.

received at least one HbA1c test during the year, while 54% received at least two HbA1c tests. There are no substantial differences between the two groups.

ACSC hospitalizations, both overall and diabetes-related, as well as diabetes-related hospitalizations and ED accesses for endocrine conditions, are rare events. We include them because they capture severe episodes that should ideally be prevented or minimized through effective primary and community care. This interpretation is particularly relevant for diabetes, a chronic condition that should primarily be managed outside the hospital setting, with inpatient care generally limited to severe acute complications. In this sense, avoidable diabetes-related hospital use is commonly interpreted as a sentinel indicator of potentially inadequate primary care management. In the Italian context, the very low incidence of avoidable diabetes-related hospitalizations is consistent with broader evidence showing that Italy has among the lowest rates of avoidable hospital admissions for diabetes in Europe (OECD/European Commission, 2024). At the same time, the low incidence of these outcomes implies that the corresponding estimates are expected to be less precise, a point we address further by reporting minimum detectable effects (Bloom, 1995).

2.2. Control variables

Table 2 reports the descriptive statistics for our control variables. The last column reports standardized differences, which are used to assess differences between treated and control groups. On average, both the treated and control patients are 70 years old. As proxy for patient case-mix, we use the Modified Chronic Disease Score (M-CDS), a validated morbidity index that summarizes patients' health status and predicts individual mortality risk. The index is computed from 33 pharmaceutical variables recorded in the two years prior to observation (Iommi et al., 2020), and provides a robust proxy for chronic disease burden, ensuring comparability of risk profiles across patients. The mean M-CDS is approximately 4 in both groups, on a scale from 1 to 6, where higher values indicate greater mortality risk. Geographic context is captured through the degree of urbanisation of the municipality of residence, as defined by the Italian National Institute of Statistics (ISTAT). This variable takes one of the following values: "1" for cities or densely populated areas; "2" for towns and suburbs or intermediate-density areas; and "3" for rural or sparsely populated areas. The distribution of this variable is very similar across treated and control groups, with most patients residing in urban or semi-urban areas, while only a minority living in rural or sparsely populated municipalities. To control for patients residing in disadvantaged areas, we use a binary indicator equal to one if the GP practices in an area classified as disadvantaged and is eligible for a specific economic incentive, and zero otherwise. On average, approximately 3% of patients reside in socio-economically disadvantaged areas, with only negligible differences by treatment status.

Table 2
Descriptive statistics: controls (years 2018-2023).

	All	Treated	Controls	Standardized Difference
	Mean (SD)	Mean (SD)	Mean (SD)	
Patient age	70.466	70.670	70.280	0.035
	(11.226)	(11.063)	(11.367)	
M-CDS score	4.311	4.290	4.331	−0.039
	(1.050)	(1.048)	(1.052)	
Degree of urbanization area of residence	1.759	1.798	1.724	0.104
	(0.704)	(0.696)	(0.710)	
Dummy for disadvantaged area of residence	0.031	0.029	0.032	−0.016
	(0.173)	(0.169)	(0.176)	
Dummy = 1 if GP adheres to a group practice	0.939	0.948	0.932	0.067
	(0.239)	(0.223)	(0.252)	
Dummy = 1 if GP belongs to a Community Health Centre	0.154	0.148	0.159	−0.030
	(0.361)	(0.355)	(0.365)	
Dummy = 1 if GP receives nursing support	0.133	0.150	0.118	0.093
	(0.340)	(0.357)	(0.323)	
Dummy = 1 if GPs adheres to incentive GP diabetes program	0.600	0.630	0.572	0.119
	(0.490)	(0.483)	(0.495)	
Dummy = 1 if GP practice is open at least 12 h	0.128	0.111	0.144	−0.099
	(0.334)	(0.314)	(0.351)	
GP's list size	1555.352	1540	1569	−0.151
	(191.770)	(201.830)	(181.150)	
Percentage of diabetic patients in GP's list	0.080	0.081	0.080	0.039
	(0.017)	(0.016)	(0.018)	
No. observations	67,614	32,046	35,568	
No. patients	11,269	5341	5928	

Notes: M-CDS, Modified Chronic Disease score.

We further leverage GP-level data merged with individual patient records, including group practice participation, affiliation with Community Health Centers (CHC), as well as nursing support provided through Nursing Outpatient Clinics (NOCs). CHCs and NOCs are organizational models widely implemented within the Romagna LHA to support primary and community-based care, aiming to improve the appropriateness of healthcare service use and adherence to clinical guideline (Giachello et al., 2026; Lippi Bruni, Ugolini, Verzulli and Leucci, 2023). Team-based primary care models are widespread in the sample: over 90% of patients are enrolled with GPs working in Functional Aggregations (FA), and about 15% within Community Health Centers (CHCs). Approximately 13% of diabetics are managed by their GP in collaboration with a Nursing Outpatient Clinic (NOC), with similar shares across groups. We also consider financial incentives, including the presence of specific incentives for diabetes management, as well as practice opening hours (above or below 12 h per day). On average 60% of patients overall are enrolled with GPs participating in the regional diabetes incentive program, with a slightly higher proportion among the treated group (63%), while less than 15% of patients are enrolled in practices open for at least 12 h per day. Lastly, we control for the number of patients enlisted with the GP as well as for the proportion of patients with type 2 diabetes in each GP's list. GPs nearing retirement tend to have slightly smaller patient lists, which may reflect a gradual workload reduction in the final career phase, even though on average list sizes still exceed the 1500-patient threshold. The proportion of patients with type 2 diabetes in each GP's list is consistently around 8%, with minimal variation by treatment status.

3. Methods

As our baseline estimation, we employ a two-way fixed-effects (TWFE) model. This estimator is used to assess the impact of GPs approaching retirement age (i.e., within five years of the mandatory retirement age of 70) on patient outcomes. Equation (1) specifies the TWFE model estimated separately for each of the eight outcome variables of interest:

$$E\left(y_{ijt}\middle|X_{ijt}\right)=\alpha_0+\alpha_1\,D_{jt}+\alpha_2 Z_{it}+\delta_t+\theta_i+\varepsilon_{ijt} \quad (1)$$

where y_{ijt} denotes patient outcomes for patient i assisted by GP_j in year t. Depending on the specific indicator, the outcome can take different forms: a binary variable (e.g., indicating inappropriate access to the emergency department, hospitalization, or adherence to follow-up); a continuous variable (e.g., the percentage of appropriate visits); or a count variable (e.g., the number of first specialist visits not followed by a control visit). D_{jt} is a binary variable assuming value 1 if GP_j enters the five-year pre-retirement window (i.e., the five-year period preceding the

statutory retirement age of 70) at time t, and 0 otherwise; Z_{it} is a vector of time-varying patient characteristics; θ_i and δ_t are patient and year fixed-effects, respectively; ε_{ijt} is the idiosyncratic error term. Our key parameter of interest is α_1 seeking to capture the impact of proximity to retirement age, i.e. changes in patient outcomes following GPs' entry into the five-year pre-retirement window. Since GPs enter this window at different points in time, the control group consists of all GPs who have not yet reached it in a given year.

Our identification strategy relies on the assumption that, conditional on patient and time fixed effects and observed time-varying controls, the timing of GPs entering the five-year window before the mandatory retirement age is exogenous with respect to patient outcomes. Since treatment timing is mechanically determined by physicians' age and statutory retirement rules, rather than by patients' healthcare needs or changes in case mix, we consider this assumption as plausible in our empirical application. Moreover, by restricting the sample to patients who remain with the same GP throughout the entire observation window, we limit concerns related to endogenous patient sorting across physicians. Under this restriction, GP fixed effects are absorbed into the individual fixed effects, capturing all unobserved time-invariant differences across patients and GPs.

Following recent literature highlighting potential biases in adopting linear fixed-effects models in contexts with non-homogeneous treatment effects across units and time (Borusyak et al., 2024; Callaway and Sant'Anna, 2021; de Chaisemartin and D'Haultfoeuille, 2026; Goodman-Bacon, 2021; Nguyen, 2020; Roth et al., 2023; Sun and Abraham, 2021), we strengthen our analysis by adopting a staggered DiD design, which allows to account for potential treatment effect heterogeneity in the presence of variation in treatment timing. Specifically, we rely on the estimator proposed by Sun and Abraham (2021), which accounts for heterogeneous treatment effects across cohorts. Using this approach, for each treatment group the effect is estimated separately by comparing each cohort with the never treated group. Thus, the weighted average across cohorts is estimated using the share of treated units in each cohort as weights. Following Freyaldenhoven et al. (2021), the period immediately before treatment (−1) is normalized to zero. Therefore, all coefficients are interpreted as changes in the outcome gap between treated and control units relative to the baseline period. Models are estimated using the Stata command xtevent, with reghdfe and sunabraham options (Freyaldenhoven et al., 2025).

4. Results

Table 3 reports the results of the TWFE estimation as specified in Equation (1), together with the minimum detectable effect (MDE) associated with each outcome and its ratio to the outcome mean. The MDE provides a benchmark for assessing the magnitude of the effects that our empirical design is able to detect, especially for low-incidence outcomes (Bloom, 1995). The MDE-to-mean ratio further helps interpret the detectable effect relative to the baseline incidence of each outcome.

As the results in Panel a) show, we do not find evidence that being enrolled with a GP approaching retirement is associated with different rates of hospitalizations for all ACSCs other than diabetes or with inappropriate ED use, neither for non-urgent cases nor minor conditions. In addition, we find no evidence that being enrolled with a GP approaching retirement is associated with significant changes in the number of potentially inappropriate GP referrals or in the share of appropriate referrals. Overall, these findings provide no indication of systematic changes in referral behavior as GPs near retirement.

The estimates reported in Panel b) point to a more nuanced picture for utilization-based diabetes care indicators. We do not find statistically significant effects on ED accesses for endocrine diseases, hospitalizations for diabetes, or hospitalizations for diabetes-related ACSCs. Similarly, we find no detectable effect on the less stringent HbA1c monitoring indicator, defined as receiving at least one HbA1c test during the year. By contrast, the estimates suggest a reduction in the probability of receiving at least two HbA1c tests per year, the indicator that more closely reflects the recommended monitoring frequency for diabetic patients. Overall, these results do not indicate a systematic increase in emergency or inpatient use among diabetic patients of GPs approaching retirement, but they suggest some weakening in the intensity of routine diabetes monitoring. The negative estimates for the indicator requiring at least two HbA1c tests per year may reflect slower adaptation to updated monitoring recommendations rather than a general deterioration in diabetes care. In the regional monitoring framework, the HbA1c indicator required at least one annual test until 2013, whereas from 2014 onward the threshold was raised to at least two tests per year.

Table 3
Two-way fixed effects (TWFE): results on utilization-based appropriateness of care indicators and on utilization-based diabetes care indicators.

a) *Utilization-based appropriateness indicators*					
	Hospitalization for all ACSCs other than diabetes	Inappropriate ED access (not urgent)	Inappropriate ED access (minor severity)	No. of potentially inappropriate GP referrals	% of potentially appropriate GP referrals
GP retiring within 5 years (D_{jt})	0.002 (0.002)	−0.001 (0.004)	−0.002 (0.004)	−0.025 (0.014)	0.409 (0.538)
Patient FEs	Yes	Yes	Yes	Yes	Yes
GP FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	67,614	67,614	67,614	67,614	67,614
MDE	0.005	0.010	0.011	0.038	1.506
MDE/mean (%)	36.7%	27.6%	17.2%	12.5%	1.8%
b) Utilization-based diabetes care indicators					
	ED access for endocrine disease	**Hospitalization for diabetes**	**Compliance at least 1 HbA1c**	**Compliance at least 2 HbA1c**	**Hospitalization for diabetic ACSCs**
GP retiring within 5 years (D_{jt})	0.002 (0.001)	0.000 (0.000)	−0.001 (0.005)	−0.018* (0.009)	−0.001 (0.001)
Patient FEs	Yes	Yes	Yes	Yes	Yes
GP FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	67,614	67,614	67,614	67,614	67,614
MDE	0.003	0.001	0.014	0.026	0.002
MDE/mean (%)	70.1%	188.7%	1.7%	4.9%	74.3%

Notes: Robust standard errors, clustered at the GP level, in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

Therefore, the absence of an effect on the less stringent indicator and the reduction observed only for the two-test threshold may suggest persistence in established clinical routines among GPs approaching retirement. If this interpretation is correct, the observed gap may attenuate over time as the more stringent monitoring standard becomes fully incorporated into routine practice.

These findings should be interpreted in light of the MDE-to-mean ratios, which indicate that statistical power is more limited for low-incidence outcomes, making small changes harder to detect relative to baseline incidence. This issue is most evident for rare hospitalization-based outcomes, particularly for hospitalizations for diabetes and diabetic-related ACSCs, and to a lesser extent, for ED access for endocrine disease and hospitalizations for ACSCs other than diabetes. Non-significant estimates for these outcomes should therefore be interpreted cautiously: they do not rule out small positive or negative effects below the detectable threshold, but rather indicate that we do not detect effects whose absolute magnitude exceeds the reported minimum detectable effects (Bloom, 1995; Bozio et al., 2021).

We next exploit variation in treatment timing and examine potential treatment heterogeneity by adopting a staggered DiD analysis following Sun and Abraham (2021). As Figs. 1 and 2 and Appendix Tables A1-A2 show, the pre-treatment coefficients are generally small and not statistically significant, supporting the plausibility of the parallel trends assumption. For utilization-based appropriateness indicators, we find no systematic evidence that being enrolled with a GP approaching retirement affects inappropriate ED access or potentially inappropriate specialist referrals. For diabetes-related indicators, we similarly find no systematic increase in ED accesses for endocrine disease, hospitalizations for diabetes, or diabetes-related ACSC hospitalizations, nor any detectable effect on the less stringent one-test HbA1c indicator. By contrast, the probability of receiving at least two HbA1c tests declines as treatment exposure increases, with the negative effect becoming stronger for GPs who have been in the pre-retirement window for longer and are therefore closer to retirement age. This dynamic pattern reinforces the interpretation of slower adjustment to the more intensive HbA1c monitoring threshold among GPs closer to retirement, rather than indicating a generalized deterioration in diabetes care. Overall, the staggered DiD results do not indicate systematic changes in potentially inappropriate use or acute diabetes-related utilization, while suggesting a lower likelihood of meeting the more intensive HbA1c monitoring threshold among patients of GPs closest to retirement.

As a sensitivity analysis, we re-estimated both the TWFE and event-study models after excluding 2020, the year most clearly affected by the COVID-19 outbreak in our descriptive analysis. The estimates remain broadly consistent with the main results, indicating that our findings are not driven by pandemic-related disruptions in healthcare utilization or by the sharp temporary changes in access to services observed during that year. Full results for this robustness check are available from the authors upon request.

5. Discussion

Our findings are largely reassuring, as we do not observe a generalized deterioration in utilization-based indicators of GP performance as physicians approach retirement. We find no detectable effects on potentially inappropriate ED access, potentially inappropriate specialist referrals, avoidable hospitalizations, or acute diabetes-related utilization. One exception to this overall pattern is concentrated in diabetes monitoring: patients enrolled with GPs approaching retirement are less likely to receive at least two HbA1c tests per year, whereas no comparable change emerges for the less stringent indicator requiring at least one annual test. The dynamic estimates further show that this reduction becomes stronger as GPs move closer to retirement. This pattern suggests a specific weakening in adherence to the more intensive HbA1c monitoring standard, rather than broad adverse changes in utilization-based care pathways. This interpretation is consistent with the nature

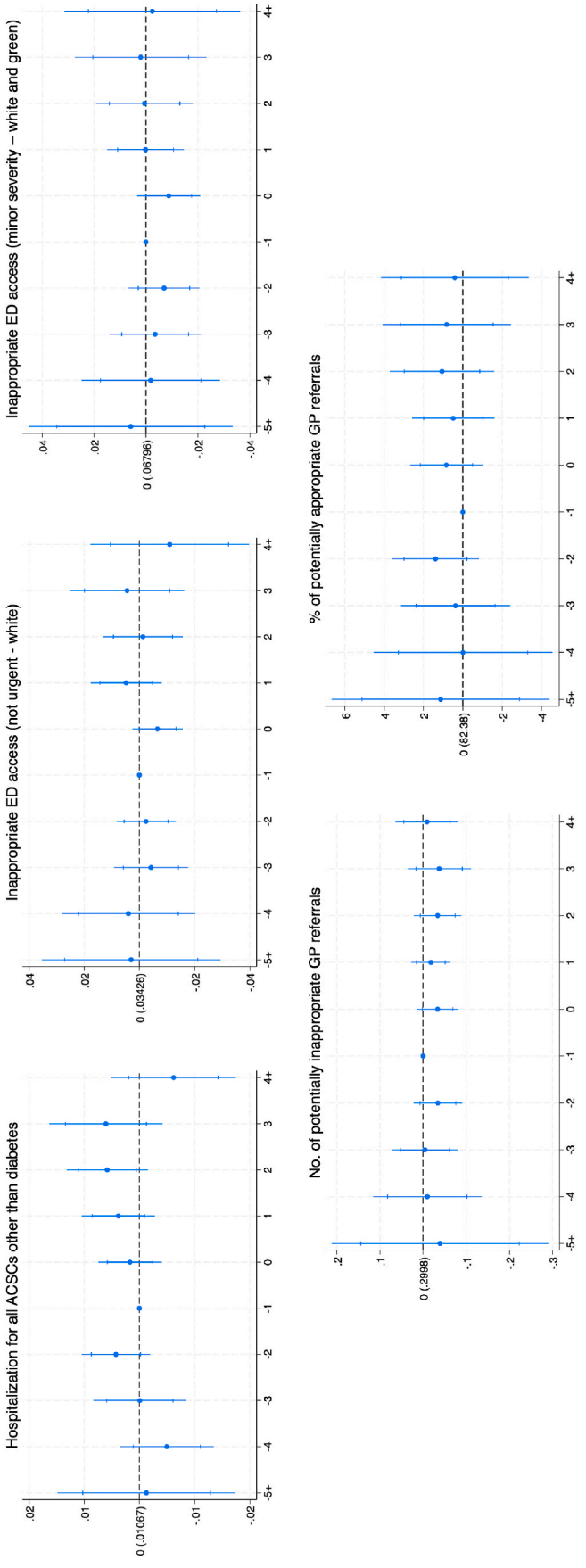

Fig. 1. Dynamic treatment effects (retirement within 5 years): results on utilization-based appropriateness indicators.

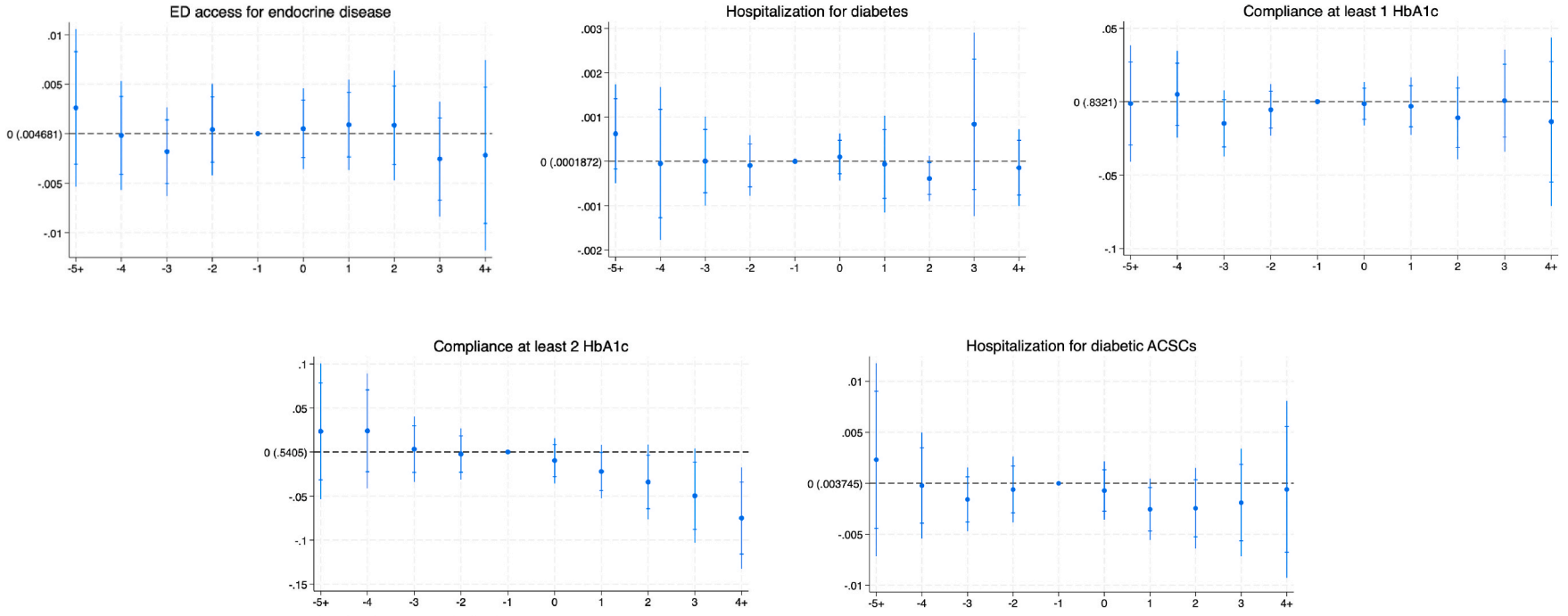

Fig. 2. Dynamic treatment effects (retirement within 5 years): results on utilization-based diabetes indicators.

of our study population. We focus on patients in the early stages of type 2 diabetes, a policy-relevant group requiring continuous, low-intensity management within primary care. In this context, the absence of detectable changes in ED access, ACSC hospitalizations, and the one-test HbA1c indicator suggests that basic follow-up and acute diabetes-related utilization are not substantially affected. By contrast, the decline in the two-test indicator may reflect slower adjustment to a more demanding monitoring standard or persistence in established clinical routines.

Only a few quantitative studies have examined how GPs adjust their practice in the years preceding retirement (Hedden et al., 2017; Joyce et al., 2015; O'Halloran et al., 2021; Simkin et al., 2019). Overall, these studies suggest that, as retirement approaches, GPs may gradually reduce the intensity of their activity, although the evidence remains mixed and often affected by cohort or context specific factors. Our findings complement this literature by showing that, at least in our setting, proximity to retirement is not associated with broad changes in selected utilization-based indicators of primary care performance, although it is associated with lower adherence to the more intensive HbA1c monitoring threshold. In contrast to O'Halloran et al. (2021), who find increased referral activity among GPs nearing retirement, our results provide no evidence of systematic changes in referral behavior. Differences in both the identification strategy and in aspects of the institutional setting may help explain these differing results. From a methodological perspective, O'Halloran et al. (2021) rely on GP-level data and random effects models to examine Danish GPs' practice style across a heterogeneous adult population. By contrast, we focus on a clinically homogeneous cohort of type 2 diabetes patients and adopt a patient-level difference-in-differences design that exploits exogenous variation in retirement proximity induced by statutory retirement rules. This approach allows us to identify causal effects on patient outcomes while reducing confounding from heterogeneity in healthcare needs. Differences in the institutional setting may also play a role. Although both in Italy and Denmark GPs operate within a publicly funded system with universal coverage and have a strong gatekeeping role, institutional differences in retirement rules and practice ownership may shape late-career incentives differently. In Italy, GPs face a statutory retirement age and are remunerated on a capitation basis. In Denmark, by contrast, there is no mandatory retirement age and GPs are remunerated through a mixed system based on fee-for-service and capitation (OECD, 2017). They are also responsible for selling their own practices, with the potential selling price linked to recent revenue performance. These differences in late-career incentives may thus contribute to the divergence in findings.

Our results should be interpreted with caution, given the balanced-panel study design and its implications for external validity. To ensure a stable GP–patient relationship, we excluded patients who changed GP or died during the observation period. This restriction reduces potential confounding from GP switching and ensures that all patients are observed over the entire sample period. Patients who died during the study sample would have shorter exposure time for annually measured outcomes, and their healthcare utilization may also reflect severe health deterioration or end-of-life care needs, rather than routine GP management. However, this choice also implies that our estimates are conditional on patients remaining with the same GP and surviving throughout the whole study period. If patients enrolled with GPs approaching retirement were more likely to switch because they perceived their GP as gradually reducing availability, responsiveness or professional engagement, then the retained sample may disproportionately include more loyal patients. Similarly, conditioning on survival may limit our ability to capture effects among the most clinically vulnerable patients. Therefore, differential attrition could attenuate estimated treatment effects. Our null findings should therefore be interpreted as applying to patients who maintained a stable GP–patient relationship and survived throughout the entire observation window, rather than to the full population initially exposed to GPs approaching retirement.

Another limitation of our analysis concerns the age range over which the effects are identified. Our treatment captures GPs' entry into the five-year window preceding the statutory retirement age of 70. Because the recent policy allowing SSN-contracted GPs to remain in service beyond this threshold was introduced in 2024, while our data end in 2023, we cannot directly assess the effect of this policy change. A direct evaluation of the recent extension would require post-reform data that allow researchers to observe GPs practicing beyond age 70 and to follow their patients' outcomes over a sufficiently long period. Our findings should therefore be interpreted as evidence on whether performance changes as physicians approach the statutory retirement threshold, rather than as a direct evaluation of practice in the 70–73 age band. Pending the availability of sufficiently long post-reform data, the absence of detectable declines provides useful, though indirect, evidence for the policy debate.

A final limitation concerns the interpretation of our outcomes. Although the selected indicators are commonly used to assess primary care performance and chronic disease management, they are utilization-based measures and do not capture the full multidimensional concept of quality of care. Our findings should therefore be interpreted as evidence on selected utilization-based dimensions of GP performance, rather than on overall quality of care.

Notwithstanding these limitations, our study extends the existing limited evidence on GPs' behavior in the years preceding retirement by showing that proximity to retirement is not associated with broad adverse changes in utilization-based indicators of GP performance. This finding is relevant for countries facing shortages of primary care physicians, as it suggests that retaining late-career GPs does not necessarily entail broad deterioration in utilization-based performance indicators. At the same time, the decline in adherence to the more intensive HbA1c monitoring threshold shows that retaining older GPs should be accompanied by support for continuous professional updating and by monitoring systems able to identify specific areas where clinical routines may lag behind evolving care standards.

6. Conclusions

The regulatory changes introduced in Italy in 2023 extended the statutory retirement age for GPs from 70 to 72 years (Law No. 14/2023), and subsequently to 73 years on a voluntary basis until the end of 2026 (Law Decree No. 25/2025). Our analysis provides indirect empirical support for a key assumption underlying the policy, namely that extending working life does not undermine clinical performance. Since our data end in 2023, before the reform became operational, these findings should be interpreted as evidence on pre-retirement performance, rather than as a direct evaluation of practice beyond age 70. Pending post-reform evidence, our results are consistent with the view that extending GP careers may represent a viable short-term response to GP shortages, while also highlighting the importance of monitoring specific dimensions of chronic disease management as physicians approach retirement.

We find no evidence of systematic worsening in utilization-based indicators of GP performance. In particular, we do not detect changes in potentially inappropriate specialist referrals, inappropriate ED use, hospitalizations, or diabetes-related ACSC hospitalizations among patients of GPs approaching retirement. The only significant change concerns diabetes monitoring: patients whose GPs are closer to retirement are less likely to receive at least two HbA1c tests per year, while the less stringent indicator requiring at least one annual test remains unaffected. This pattern suggests that proximity to retirement may be associated less with a broad decline in care than with slower adaptation to more intensive monitoring standards or persistence in established clinical routines.

Beyond its systemic implications, our evidence is therefore cautiously reassuring from a patient perspective. Concerns that GPs approaching retirement may systematically reduce the appropriateness

of referrals, increase potentially avoidable hospital use, or weaken basic chronic disease follow-up are not supported by our findings. At the same time, the reduction in adherence to the more intensive HbA1c monitoring threshold suggests that policies extending GP working lives should be accompanied by mechanisms that support continued alignment with evolving clinical recommendations, particularly in chronic disease management.

The shortage of GPs, and more broadly, of healthcare professionals, has become increasingly tangible and has entered both public and policy discourse. This has prompted a series of regulatory and financial responses. Notably, the National Recovery and Resilience Plan (Governo italiano, 2021) and Ministerial Decree No. 77/2022 introduced new standards for community-based care, while also expanding training pathways and increasing the number of GP scholarships. However, it will take time before the current cohorts of medical trainees are fully integrated into the system. In the meantime, extending GP careers may help relieve immediate workforce pressures, provided that it is not treated as a stand-alone solution but accompanied by continued investment in professional updating, workforce renewal, and chronic care monitoring.

Statement EA not required

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study, based on routine administrative information, was carried out in compliance with Emilia-Romagna Regional Authority data processing regulations and the Italian Data Protection Act, which has been harmonized with the European General Data Protection Regulation 2016/679 by means of the Legislative Decree 101/2018. Administrative data were anonymized prior to the analysis at the LHA statistical office, where each patient is assigned a unique identifier. This identifier does not allow to trace the patient's identity and other sensitive information. Anonymized administrative data may be used for retrospective studies, with no specific written patient consent, when the aim is health-care quality evaluation and improvement, which was the primary objective of this analysis. Given the characteristics of the study, no ethical approval was required.

CRediT authorship contribution statement

Marta Giachello: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Cristina Ugolini:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – review & editing. **Rossella Verzulli:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – review & editing.

Declaration of competing interest

The authors have no conflict of interest to declare.

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Appendix

Table A1
Event study estimates of treatment effects (retirement within 5 years): results on utilization-based appropriateness indicators.

	Hospitalization for all ACSCs other than diabetes	Inappropriate ED access (not urgent – white codes)	Inappropriate ED access (minor severity – white and green codes)	No. of potentially inappropriate GP referrals	% of potentially appropriate GP referrals
Years prior to treatment					
5+	−0.001	0.003	0.006	−0.039	1.130
	(0.006)	(0.012)	(0.014)	(0.093)	(2.035)
4	−0.005	0.004	−0.002	−0.010	−0.010
	(0.003)	(0.009)	(0.010)	(0.047)	(1.671)
3	−0.000	−0.004	−0.004	−0.004	0.367
	(0.003)	(0.005)	(0.007)	(0.029)	(1.019)
2	0.004	−0.002	−0.007	−0.034	1.386
	(0.002)	(0.004)	(0.005)	(0.021)	(0.812)
1	-	-	-	-	-
Years since treatment					
0 (retirement within 5 years)	0.002 (0.002)	−0.007 (0.003)	−0.009 (0.004)	−0.034 (0.018)	0.836 (0.675)
1	0.004	0.005	0.000	−0.018	0.482
	(0.002)	(0.005)	(0.005)	(0.017)	(0.767)
2	0.006*	−0.001	0.001	−0.034	1.059
	(0.003)	(0.005)	(0.007)	(0.020)	(0.975)
3	0.006	0.004	0.002	−0.037	0.818
	(0.004)	(0.008)	(0.009)	(0.027)	(1.197)
4+	−0.006	−0.011	−0.002	−0.009	0.406
	(0.004)	(0.011)	(0.013)	(0.027)	(1.382)
Obs.	67,614	67,614	67,614	67,614	67,614

Notes: Robust standard errors, clustered at the GP level, in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

Table A2
Event study estimates of treatment effects (retirement within 5 years): results on utilization-based diabetes indicators.

	ED access for endocrine disease	Hospitalization for diabetes	Compliance at least 1 HbA1c	Compliance at least 2 HbA1c	Hospitalization for diabetic ACSCs
Years prior to treatment					
5+	0.003	0.001	−0.001	0.023	0.002
	(0.003)	(0.000)	(0.014)	(0.028)	(0.003)
4	−0.000	−0.000	0.005	0.024	−0.000
	(0.002)	(0.001)	(0.011)	(0.024)	(0.002)
3	−0.002	0.000	−0.015	0.003	−0.002
	(0.002)	(0.000)	(0.008)	(0.013)	(0.001)
2	0.000	−0.000	−0.006	−0.002	−0.001
	(0.002)	(0.000)	(0.006)	(0.011)	(0.001)
1	-	-	-	-	-
Years since treatment					
0 (retirement within 5 years)	0.000 (0.001)	0.000 (0.000)	−0.002 (0.005)	−0.010 (0.009)	−0.001 (0.001)
1	0.001	−0.000	−0.003	−0.022*	−0.003*
	(0.002)	(0.000)	(0.007)	(0.011)	(0.001)
2	0.001	−0.000*	−0.011	−0.034*	−0.002
	(0.002)	(0.000)	(0.010)	(0.015)	(0.001)
3	−0.003	0.001	0.001	−0.050*	−0.002
	(0.002)	(0.001)	(0.013)	(0.019)	(0.002)
4+	−0.002	−0.000	−0.014	−0.075***	−0.001
	(0.004)	(0.000)	(0.021)	(0.021)	(0.003)
Obs.	67,614	67,614	67,614	67,614	67,614

Notes: Robust standard errors, clustered at the GP level, in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

Data availability

The authors do not have permission to share data.

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