Appendix to "Has NHS England's announcement on direct access investigations led to increased use of radiology tests?"

Igor Francetic [1,2], Stephen Bradley [3], Samuel WD Merriel [1]

[1]University of Manchester, UK
[2]University of Applied Sciences and Arts of Southern Switzerland, Switzerland
[3]University of Sheffield, UK

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Data

We studied monthly direct access activity of all GP practices across England for the period between November 2021 and January 2024. The dataset reports monthly volumes of GP direct access activity to individual NHS trusts for every GP practice in England . Small counts (1 to 3 referrals per month) were masked by NHS England; to avoid dropping the corresponding observations (all small counts, i.e. not missing at random), we imputed a count drawing randomly from a uniform distribution bounded between 1 and 3. The data were obtained directly from the NHS England upon request by email to the Diagnostic Imaging Dataset Publication Team, with January 2024 being the latest complete month available at the time of the data request. The timeframe allows us to observe 12 months prior to the policy announcement and up to 14 months after. For GP practices we record their relevant Integrated Care Board (ICB) and NHS region.

We also sourced data on various characteristics of the receiving NHS trusts that may influence the extent to which they can accommodate GP practice responses to the policy. From the National Imaging Data Collection 2022/2023 we obtain the counts of imaging assets reported by NHS Acute and Specialist Trusts recorded as of 31st March 2023. In line with the policy goal, we focus on count of MRI, CT, and Ultrasound scans owned across all Trust sites. From the NHS Workforce Statistics, we obtain data on total staff full time equivalent (FTE) employed at the receiving NHS Trusts in roles linked to diagnostic imaging for cancer, namely clinical radiology, medical oncology. We measured Trust staffing in these roles as of October 2022, i.e. prior to the policy announcement. From these two indicators we derive the staff to assets ratio, representing the total number of staff FTE in these roles per scan (summing MRI, CT, and Ultrasound scans).

Methods

Main analysis

We used a regression approach to obtain adjusted average differences in monthly GP-level direct access activity after the policy announcement, from November 2021 to January 2024. Our outcome variable is the monthly volume of direct access referrals per NHS Trust. Our main exposure is time relative to the policy announcement month (November 2022). We estimate both overall differences, dividing time in two periods (pre- and post-policy announcement), and changes month by month compared to the month prior to policy announcement. In the latter case, our coefficients or interest are represented by binary variables indicating the months to and since the policy announcement, using October 2022 as the reference period.

In both cases, we adjust for potential seasonal fluctuations in GP direct access activity by controlling for a monthly seasonal component. This allows us to compare GP-Trust pair differences, before and after the policy announcement, at the same time of year.

The capacity of NHS Trusts to allow for an increase in volume of imaging activity is not uniform. To account for these differences, we control for Trust-level count of CT, MRI, and Ultrasound scans as of 31st March 2023, at the end of the fiscal year when the policy was announced. Similarly, we control for Trust-level staff FTE in clinical radiology and medical oncology roles (all grades) as of October 2022, prior to policy announcement. These roles are directly involved with the execution and interpretation of diagnostic scans aimed at detecting cancer. We fix these covariates at pre-policy levels to exclude confounding due to changes in these characteristics that occurred in response to the policy.

GPs have different levels of patient volumes, serve patient populations with different characteristics, risk factors, and disease incidence. GPs also have different practice styles and thresholds for referring patients to diagnostic testing. All these characteristics – some of which are hard to measure explicitly - may confound estimates of average changes in direct access activity after the policy announcement. To overcome this source of confounding, we estimate models that allow for GP-specific intercepts, which sterilize time-invariant differences (over our relatively short study period) between GP practices. Similarly, ICBs may influence cancer diagnostic activity within their boundaries regardless of the policy. We take differences between ICBs into account by allowing for ICB-specific intercepts.

The trends are simply aimed at tracking how direct access activity changed since the policy announcement in the short run, highlighting factors that acted as barriers or facilitators.

Exploring heterogeneity

We ran two additional analyses splitting the trends by two interesting dimensions of heterogeneity.

Firstly, to highlight how changes in GP direct access activity after the policy announcement varied across England, we repeat the analysis separately by NHS region.

Secondly, we explore whether GP responses varied depending on the capacity of Trust-level diagnostic services by dividing receiving trusts in tertiles of clinical radiology and medical oncology staff per total of MRI, CT and Ultrasound scans.

Note: Please direct any queries to the corresponding author, Igor Francetic (igor.francetic@manchester.ac.uk).