Allocating Talent in Organizations:
Evidence from Quasi-Random Exits of Physicians

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This paper

- How well can organizations allocate tasks across heterogeneous workers when individual quality is not perfectly observed? (Holmstrom and Milgrom, 1991; Holmström, 2017)

- One way to approach this is to investigate whether, after the loss of talent, organizations reallocate work in ways that preserve quality composition, or shocks pass through mechanically

- We develop an empirical framework that uses **quasi-random personnel exits** and **observational measures of quality** to study such **ability-targeting inside organizations**

- Applies the framework to data on Brazilian hospitals, where patient assignments and physician outcomes are observed at scale
  - Computes risk-adjusted observational survival rates as a measure of physician quality
  - Uses unexpected deaths of physicians as exogenous shocks to the available set of clinical talent

Preview of framework and core result

- Think about the quality composition of an organization as the **weighted average of its workers' *intrinsic* quality**

- **Once someone leaves**, what happens to this measure depends on how good that worker was, their task share, and who takes over their tasks

- Our framework contrasts **realized change** in **quality composition** to the **mechanical change** created by the exit *absent any quality-targeted reallocation*
  - Simple test of how "blind" organizations are to differences in worker quality

- This relationship can be summarized by a single parameter, estimated in a DiD relating exit-induced quality shocks to changes in the quality composition of workers
  - $\beta = -1$ under one-to-one pass-through and $\beta = 0$ under full quality-preserving reallocation

$\Longrightarrow$ We find $\widehat{\beta} = -0.38$

Outline

Brazilian Universal Healthcare System — SUS

- Brazil's healthcare system (SUS) ensures **universal access to healthcare**
  - Largest publicly funded healthcare system in the world
- SUS provides both preventive and curative care free of charge through public institutions and a network of contracted private facilities

Data

- **Universe of inpatient admissions** from 2008 to 2024 (*SIH-Datasus*)
  - Observe clinical and sociodemographic characteristics of patients, procedures, discharge, and mortality
  - We also observe the identity of the physician responsible for the case
- **Physician-level administrative data** (*Federal Council of Medicine/CNES-Datasus*)
  - Demographics, professional background, workplaces, and exact date of death

Sample

- We have data on 315,902 physicians, of whom 8,198 die during the period
  - Many deaths did not come as a surprise
  - We focus on **physicians *actively working* in the month of death**: 1,021 deaths affecting 1,200 hospitals (out of 7,700)

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  - Because deaths are rare and *mechanically* more likely in hospitals with larger physician workforces ($\approx$ 100)
- **Analysis is at the *hospital–area-of-care level*** as hospitals operate through semi-autonomous clinical service lines
  - Areas of care are defined by ICD-10 subchapters, such as ischemic heart diseases

Measuring physician quality

- We estimate ***risk-adjusted* physician survival value-added** within areas of care *s*:

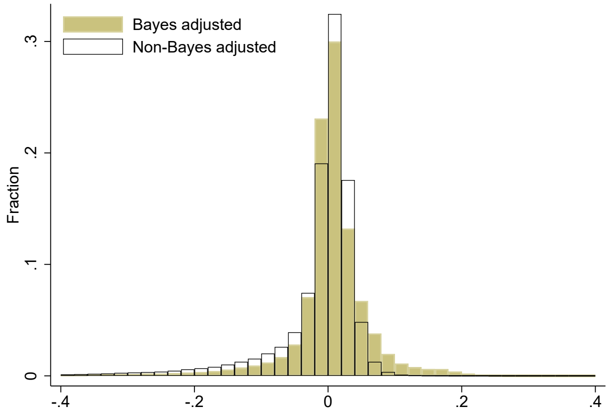
$$\text{Survival}_{it} = \theta_{js} + X_{it}'\Theta + \varepsilon_{it}.$$

- Controls include patient demographics, clinical characteristics, recent admissions, comorbidities, hospital fixed effects, and quarter-year fixed effects

- We refer to θ_{js} as *observational value-added*
  - Our approach doesn't require observational VA to equal true clinical quality, but it must provide an informative signal of it (we provide evidence that this is the case)

- Use **empirical Bayes** to account for differences due to sampling error

Variation in observational value-added



- SD $\approx$ 7.7 percentage points
- Balanced across alive and deceased physicians

Outline

Framework: average clinical effectiveness

The starting point is the **quality composition of physicians** in a hospital–area, measured as their *patient-share-weighted average quality*:

$$\bar{\mu}_t = \sum_{j=0}^{N} \alpha_{jt}\mu_j.$$

- μ_j is physician j's underlying *value-added for patient survival*
- α_{jt} is the share of cases assigned to physician j in period t
- We ask what happens to $\bar{\mu}_t$ when physician $j = 0$ exits

Framework: decomposing the effect of an exit

One can show the **change in quality composition** $\Delta\bar{\mu}$ following $j = 0$ exit can be decomposed into:

$$\Delta\bar{\mu} = \underbrace{\sum_{j=1}^{N} \left(\alpha_{j\text{post}} - \frac{\alpha_{j\text{pre}}}{1 - \alpha_{0\text{pre}}} \right) \mu_j}_{\text{internal reallocation}} + \underbrace{\alpha_k \mu_k}_{\text{external replacement}} - \underbrace{\alpha_{0\text{pre}} \left(\mu_0 - \bar{\mu}^{-0}_{\text{pre}} \right)}_{\text{quality shock}} \tag{1}$$

1. **Internal reallocation**: how the caseload left is redistributed among incumbent physicians relative to a random reallocation benchmark
2. **External**: changes due to a new physician, with its magnitude reflecting the replacement's quality and the share of the caseload she absorbs
3. **Quality shock:** the mechanical effect of the exit before any quality-targeted response, given by the deceased's quality relative to peers $\times$ his baseline caseload share

Framework: mechanical shock versus organizational response

- After some algebra, the change in quality composition of physicians can be written as:

$$\Delta\bar{\mu} = (\gamma - 1) \times \alpha_{0,pre} \left(\mu_0 - \bar{\mu}^{-0}_{pre}\right).$$

- γ captures the hospital's overall endogenous response

- Benchmarks:
  - $\beta = \gamma - 1 = -1$: one-to-one mechanical pass-through
  - $\beta = \gamma - 1 = 0$: full mitigation of the quality shock

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$\Longrightarrow$ For a given hospital–area, the **change in quality composition of physicians** before and after a physician's death is proportional to the size of the quality shock, scaled by $\beta = \gamma - 1$

From framework to data

- In the data, we observe a panel of hospital–area cells, together with the timing and intensity of the turnover-induced shocks. DiD framework:

$$\bar{\mu}_{hst} = \beta \times \alpha_{0hs,pre} \left(\mu_{0a} - \bar{\mu}^{-0}_{hs,pre}\right) \cdot \mathbb{1}\{t \geq \tau\} + \mathbf{FE}_{hs} + \mathbf{FE}_{ts} + \mathbf{X}'_{hat}\Omega + \varepsilon_{hst}. \qquad (2)$$

  - $\bar{\mu}_{hst}$ is the **quality composition of physicians** in hospital-area *hs* in quarter *t*
  - Treatment is the interaction between the **quality shock** and the **post-death indicator**
  - Unit fixed-effects $\mathbf{FE}_{hs}$
  - Time fixed-effects $\mathbf{FE}_{ts}$ (area-specific so variation is within area across hospitals)
  - **X** controls for interactions between time FE and $\alpha_{0hs,pre}$ to hold fixed the size of the vacancy so identification comes only from variation in the quality content of the vacancy

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- As μ is unobserved, **we use θ to obtain an estimable expression of equation** (2) where $\mu_{hst} = \lambda\theta_{hst} + \eta_{hst}$ $\rightarrow$ error in the estimating eq. will be a function of both ε and η

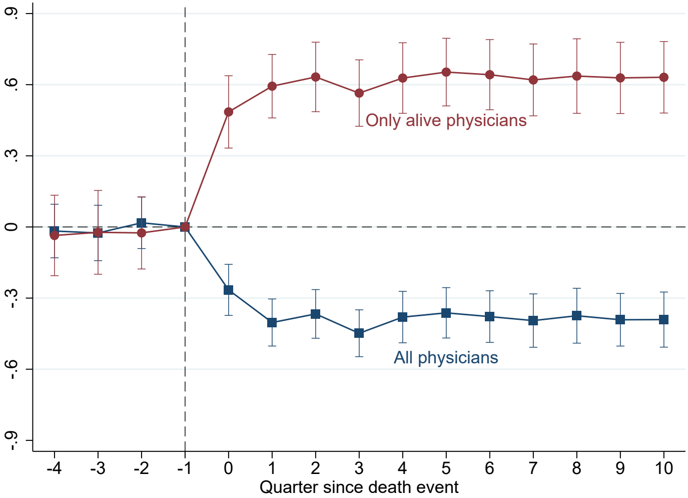
Identification

- Standard parallel-trends condition: **common trends in residual quality composition**
  - Unobserved determinants of average clinical value-added would have evolved similarly across areas differentially exposed to the quality shock
- Additional condition: **common trends in residual forecast errors**
  - More- and less-exposed areas should not experience differential shocks to the unobserved component of true quality that is invisible in observational value-added
  - We test for this by estimating effects on proxies for the forecast error (avg physician characteristics net of empirical quality) and find null effects (Abaluck et al., 2021)
- Check for pre-trends in an analogous event-study specification of (2) with leads and lags

Outline

Main result: quality shocks do not pass through one-to-one

Figure: Effects of Quality Shocks on Quality Composition of Physicians

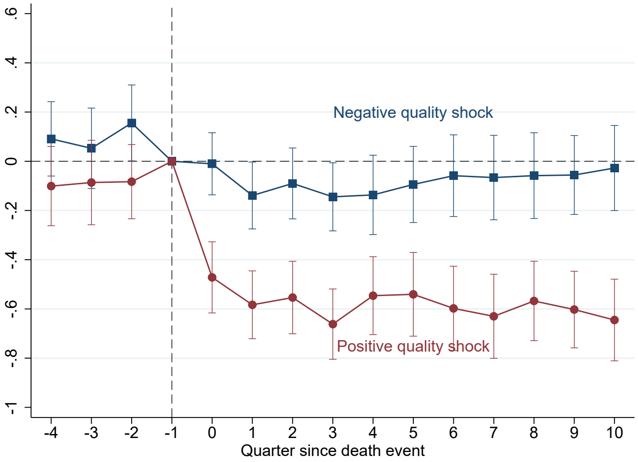


All physicians: $\widehat{\beta} = \widehat{\gamma} - 1$
(pass-through)

Only **alive** physicians: $\widehat{\gamma}$
(endogenous response)

Positive versus negative quality shocks

Figure: Effects of Quality Shocks on Quality Composition of Physicians (Negative versus Positive Quality Shocks)



Summary of mechanisms

- Quality shocks have no effects on patient volume, so results indeed reflect reallocation
- Reallocation is **almost entirely internal** (even in local labor markets favoring hiring)
  ▸ Results
- Response seems to strengthen with **knowledge about the worker** ▸ Results
  - $\widehat{\beta} = -0.75$ if the deceased had < 1 year of tenure and $\widehat{\beta} = -0.35$ if had $+3$ years
- Negative shocks are fully mitigated in hospitals with established **formal quality-control practices**, but not in hospitals with limited practices ▸ Results
- Negative shocks are fully mitigated in hospitals where the baseline **caseload per physician is below the median**, but not in hospitals with high caseload ▸ Results

Outline

How informative is the observed variation in survival rates about true value added?

- Model relating realized survival y_{hst} to observational physician effects $\bar{\theta}_{hst}$:

$$y_{hst} = \lambda\bar{\theta}_{hst} + \mathbf{FE}_{hs} + \mathbf{FE}_{ts} + \mathbf{Z}'_{hst}\Phi + \bar{\eta}_{hst} + \epsilon_{hst} \tag{3}$$

  - λ is the reliability coefficient and η is the forecast error in $\mu_{hst} = \lambda\theta_{hst} + \eta_{hst}$
  - $\mathbf{Z}'$ is a vector of risk adjusters and controls

- We use **death-induced quality shocks as an IV to the average observational value-added of physicians**

How informative is the observed variation in survival rates about true value added?

Table: Effects on Realized Survival

	Reduced-Form		IV	
	(1)	(2)	(3)	(4)
Observational survival			**1.133*****	**1.140*****
			[0.095]	[0.090]
Quality shock $\times$ $1\{$post event$\}$	-0.432***	-0.434***		
	[0.050]	[0.048]		
Kleibergen-Paap F-statistics			107.49	107.49
Risk adjustment		✓		✓
Basic controls	✓	✓	✓	✓
Pre-period mean	0.948	0.948	0.948	0.948
Observations	2,470,122	2,470,122	2,415,174	2,415,174

- With $\widehat{\lambda} \simeq 1$, the quality-composition measure maps strongly into realized survival $\rightarrow$ measure has high reliability + endogenous responses to the exit of top performers must have averted deaths

Averted deaths

- To gauge magnitudes, consider a one SD negative quality shock: $\sigma = 0.012$
- Absent any targeted reallocation ($\beta = -1$), survival would fall by:

$$100 \times \hat{\lambda} \times 1 \times \sigma \approx 1.36$$

- For negative shocks we estimate $\hat{\beta}_{\text{neg}} \approx -0.14$, so the realized change is

$$100 \times \hat{\lambda} \times 0.14 \times \sigma \approx 0.19$$

- **Targeted reallocation *averts*** a $1.36 - 0.19 \approx 1.17$ percentage points or **a 20% increase in mortality**

Outline

Summing up

- We use unexpected physician deaths to compare mechanical quality-composition shocks with realized post-exit quality changes
- Hospitals are not blind to physician quality: they mitigate most negative shocks through targeted reallocation
- This response is asymmetric and operates primarily through incumbent physicians
- The response is stronger when hospitals have more information, greater organizational capacity, and more labor slack
- Because physician quality composition predicts realized survival, endogenous reallocation saves lives

Thank You

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References I

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Holmström, B. (2017). Pay for performance and beyond. *American Economic Review*, 107(7):1753–1777.

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Internal versus external replacement

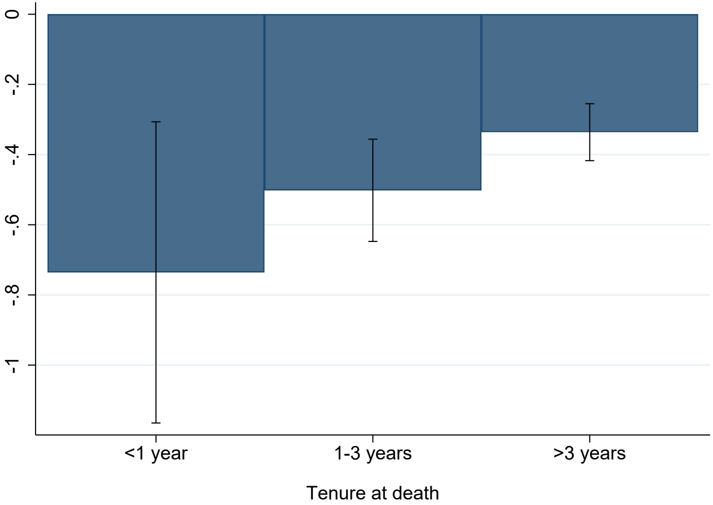
Decompose observable value added in a service **among alive physicians** as the contribution of incumbents and new hires and estimate the effects on each margin ($\widehat{\gamma}$)

	Total adjustment (1)	Internal reallocation (2)	External replacements (3)
Quality shock $\times$ 1{post event}	0.648***	0.644***	0.006
	[0.053]	[0.056]	[0.019]
Basic controls	✓	✓	✓
Pre-period mean	-0.001	-0.001	0
Observations	2,461,168	2,461,168	2,461,168

- The mitigating response is almost entirely internal: hospitals reallocate patients among incumbents rather than replacing the deceased physician externally

Back to mechanisms summary

Response strengthens with the deceased physician's tenure



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Organizational capacity: formal quality-control practices

	Negative quality shocks			Positive quality shocks		
Formal quality control practices?	Established (1)	Partial (2)	Limited (3)	Established (4)	Partial (5)	Limited (6)
Quality shock $\times$ $1\{\text{post event}\}$	0.111 [0.191]	-0.151** [0.066]	-0.217** [0.097]	-0.529*** [0.157]	-0.585*** [0.088]	-0.493*** [0.112]
Basic controls	✓	✓	✓	✓	✓	✓
Pre-period mean	0.003	-0.003	-0.002	0.004	-0.003	-0.002
Observations	385,055	1,542,211	445,907	379,365	1,524,446	443,682

- Negative shocks are almost fully mitigated in hospitals with established formal practices, but not in hospitals with limited practices

Back to mechanisms summary

Organizational capacity: labor slack

	Negative quality shocks		Positive quality shocks	
Baseline caseload	Low (1)	High (2)	Low (3)	High (4)
Quality shock $\times$ $1\{$post event$\}$	0.012 [0.117]	-0.244*** [0.053]	-0.677*** [0.079]	-0.427*** [0.075]
Basic controls	✓	✓	✓	✓
Pre-period mean	-0.002	0	-0.002	0
Observations	1,194,863	1,178,310	1,177,812	1,169,681

- Negative quality shocks are fully mitigated when baseline workload is low, but generate sizable losses when workload is high
- Effective reallocation requires spare capacity

◂ Back to mechanisms summary