

ASHECON ANNUAL MEETING 2026

Practice-Style Spillovers from Bundled Payment Reform: Evidence from the CJR Model

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Motivation: The Spillover Problem in Payment Reform

The CJR Model (2016)

- Mandatory bundled payment for hip & knee replacement (LEJR) in **67 randomly selected MSAs**
- Hospitals in treated MSAs accountable for all costs over a **90-day episode**
- Strong incentives to reduce expensive post-acute care (SNF/IRF)
- Prior evidence: CJR shifted discharges from SNF **toward home health agencies (HHA)**

The Identification Challenge

- **Physicians operate across MSA boundaries** — practicing at both CJR-treated and control hospitals
- If physicians carry CJR-induced practice habits into control sites, the control group is **contaminated**
- Standard DiD conflates spillovers with the absence of treatment → **attenuation bias**

This Paper's Questions

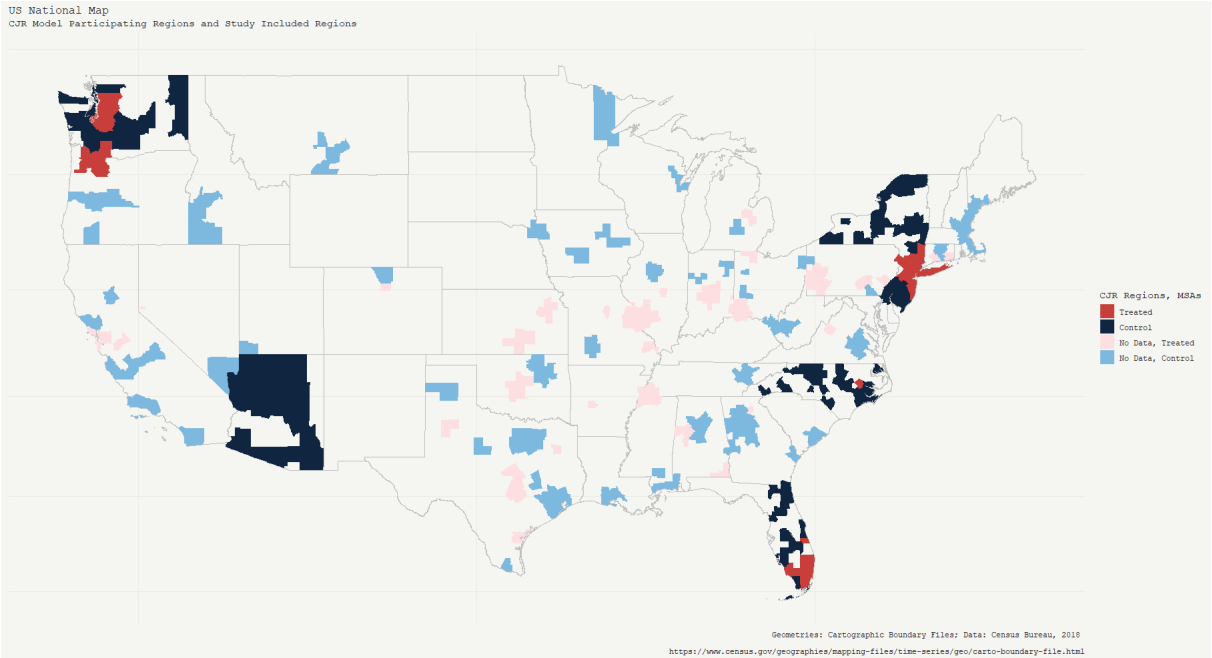
- **Q1:** Did physicians practicing in CJR-treated MSAs change discharge patterns in control MSAs?
- **Q2:** How far do spillovers travel through physician networks?
- **Q3:** How large is the resulting attenuation bias in conventional CJR estimates?

Key Findings (Preview)

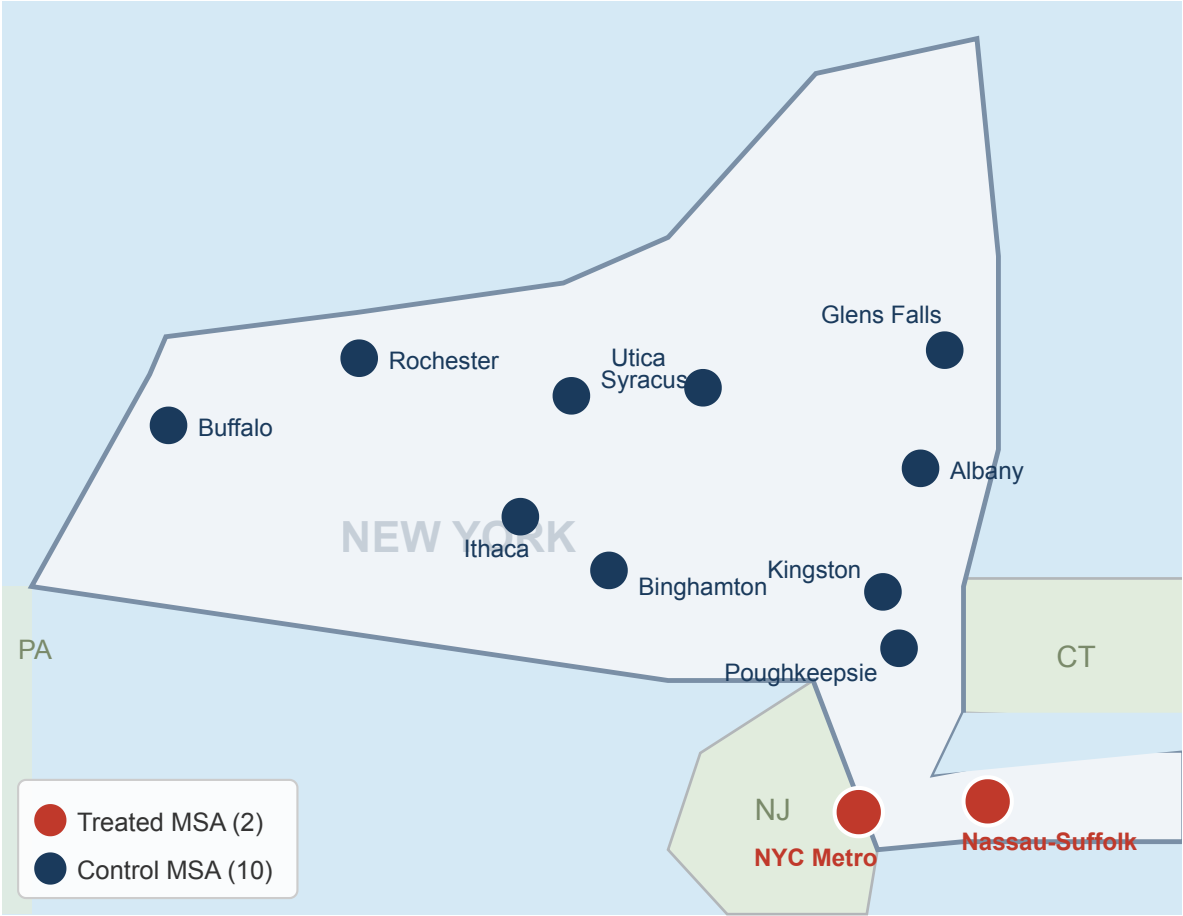
- Primary MDs: **−5.1 pp home, +11.4 pp HHA** (Medicare)
- Spillovers extend to private patients not targeted by CJR
- Effects decay rapidly: strong at 1° separation, absent at 3°+
- Conventional DiD understates CJR effects by **40–50%**

Geographic Setting: CJR MSAs & the New York State Sample

National CJR Model — 67 of 196 Eligible MSAs (2016)



New York State: 2 Treated, 10 Control MSAs

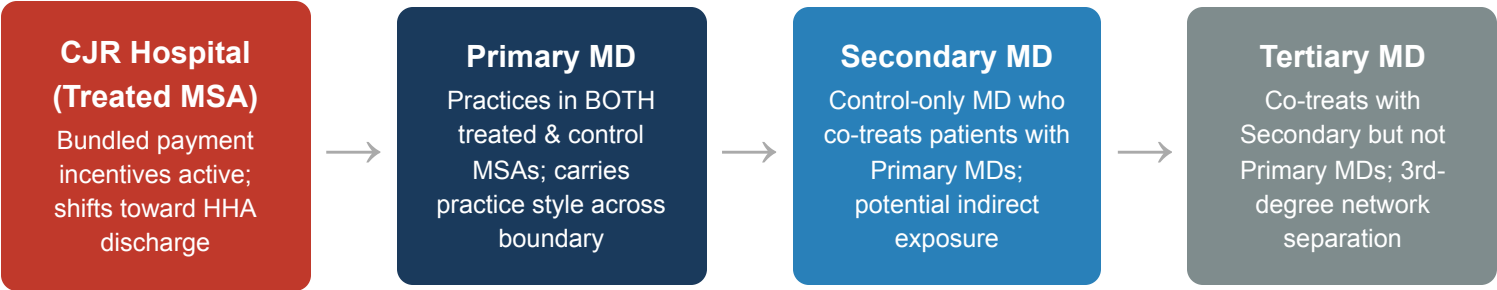


■ CJR Treated (data) ■ Control (data) ■ Treated (no data) ■ Control (no data)

CJR treated 67 of 196 eligible MSAs nationally. This study uses the New York State subsample where proximity of treated and control MSAs creates ideal conditions for identifying physician network spillovers.

12 of 196 eligible MSAs in NY State | Treated MSAs randomized by CMS in 2015 | HCUP SID NY 2013–2017

Conceptual Framework: Physician Network Layers



1 Primary MD Identification: Surgeons with NPI in MS-DRG 469/470 cases in CJR-treated MSAs who also performed LEJR procedures in control MSAs during 2013–2017

2 Secondary MD Identification: Control-MSA physicians who co-operated with Primary MDs in the same hospital-stay encounters but never practiced in treated MSAs

3 Analysis Target: Patients of Primary/Secondary MDs *in control MSAs*. Treatment indicator = whether their MD's network connects to CJR-treated hospitals

Data: HCUP SID New York State, 2013–2017

- All-payer inpatient encounters; universe of LEJR procedures in NY State hospitals
- Restrict to MS-DRG 469/470 (hip/knee replacement) with valid NPI identifiers
- Hospitals excluded if < 150 LEJR cases over study period
- Payers: Medicare FFS (age ≥65) and privately insured (separate analyses)
- NY State: **2 treated MSAs, 10 control MSAs**

Identification: Difference-in-Differences

- *Treated*: Patients of Primary/Secondary MDs in control MSAs (post-2016)
- *Control*: Patients of Tertiary/peripheral MDs in control MSAs
- Hospital + year fixed effects; cluster SE at hospital level
- Controls: age, sex, race, admission type, DRG FE, urban-rural code, hospital size

Pre-Period Patient Characteristics (2013–2014)

- Average age: 69.4 (primary MD patients) / 67.0 (secondary) / 67.3 (control)
- ~60% female, ~94–96% white, ~87–93% elective admissions across groups
- Primary MD patients in smaller hospitals (avg. 233 beds) vs. secondary (406) and control (360)
- Small primary MD sample (N=613 pre-period) due to multi-site practice rarity

Event Study Specification

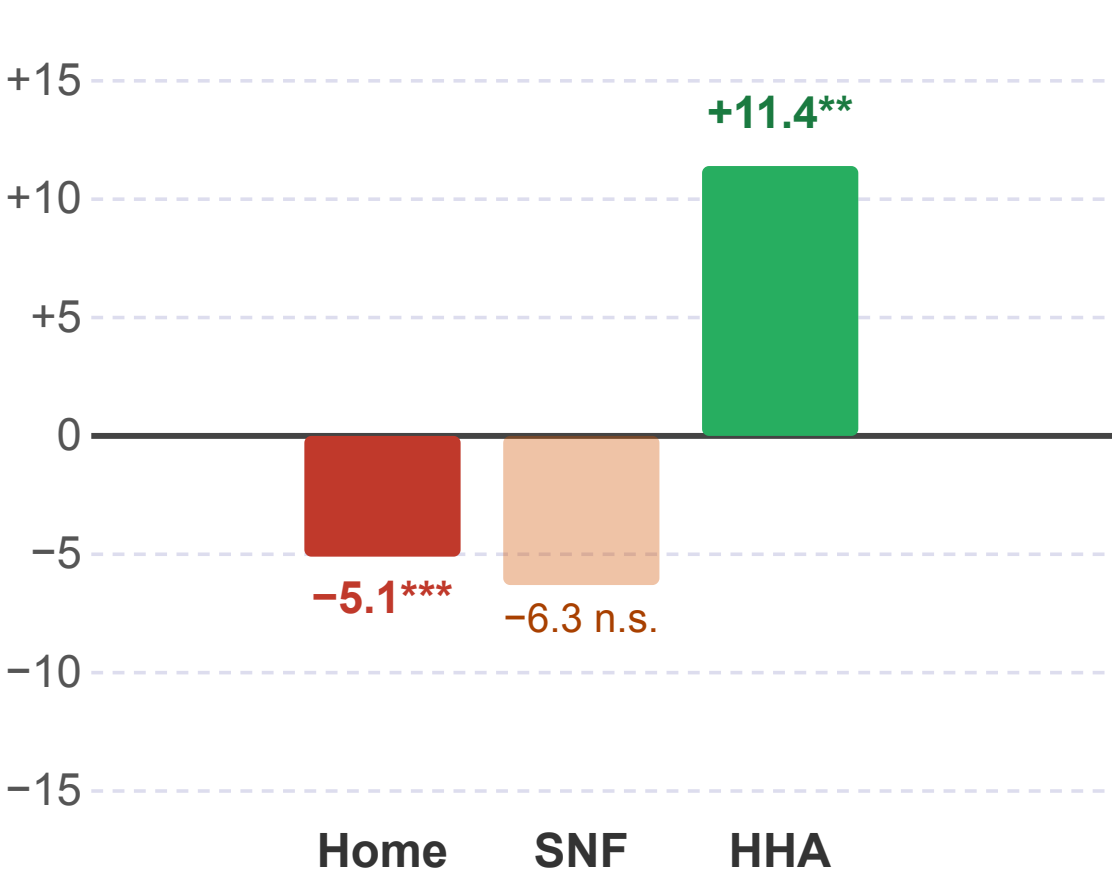
- Year-specific treatment indicators (2013 = reference)
- Tests parallel trends pre-implementation (2013–2015)
- Reveals timing and persistence of spillover effects
- Clean DiD: Re-estimate excluding network-connected MDs from control

Finding 1: Primary Physicians Carry CJR Practice Changes Across Boundaries

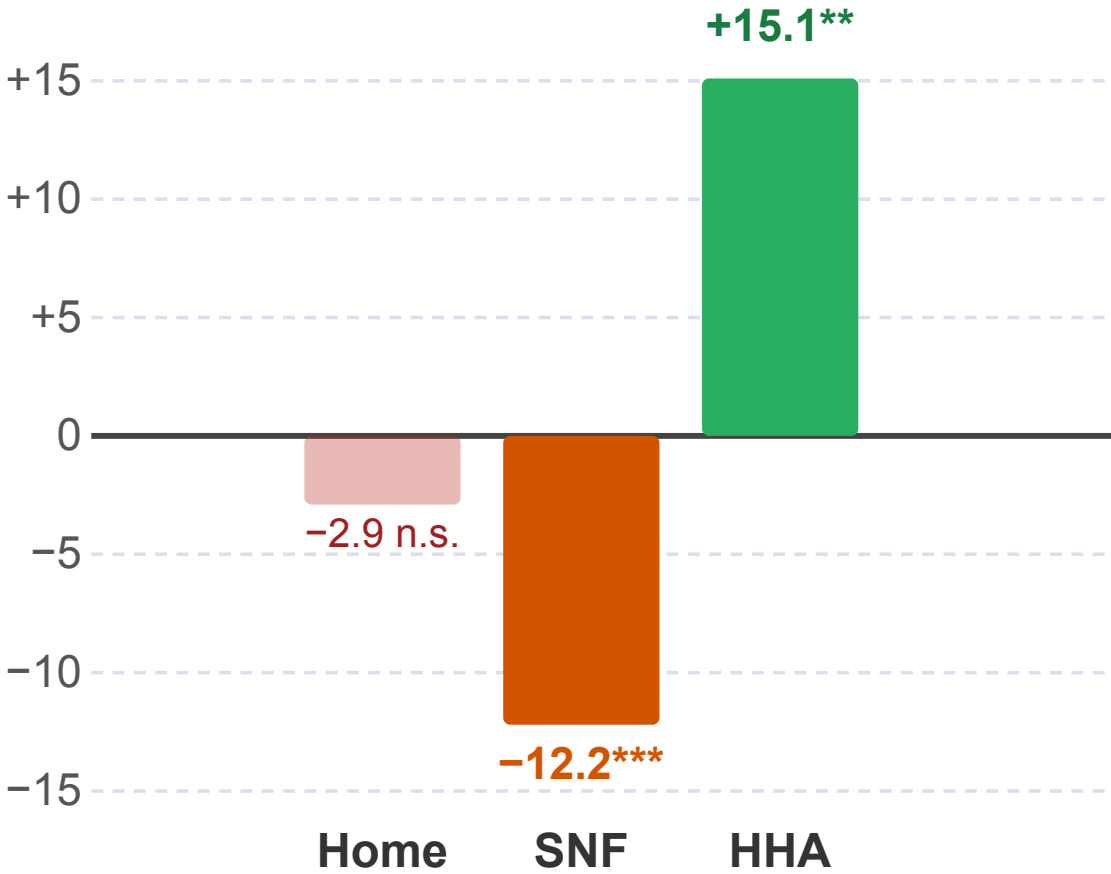
Pooled DiD — primary MD patients in control MSAs · Medicare (left) · Private Insurance (right)

Medicare: -5.1 pp home (p<0.01) · -6.3 pp SNF (n.s.) · **+11.4 pp HHA** (p<0.05) | **Private:** -2.9 pp home (n.s.) · -12.2 pp SNF (p<0.01) · **+15.1 pp HHA** (p<0.05)

Medicare (FFS) — Discharge Share Change (pp)



Privately Insured — Discharge Share Change (pp)



Faded bars = statistically insignificant. Both charts use same scale (10 px/pp). Primary MDs = surgeons practicing in BOTH CJR-treated AND control MSAs. Hospital + year FE; individual controls; SE clustered at hospital level.

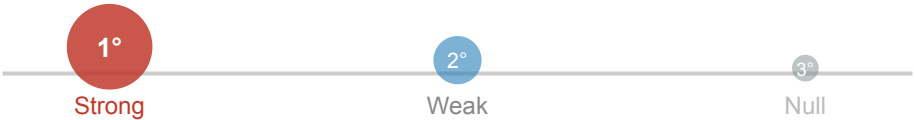
Finding 2: Spillovers Decay Sharply with Network Distance

Secondary MDs: modest/imprecise | Tertiary MDs: no systematic change

Pooled DiD Estimates by Physician Network Layer

Physician Group	Medicare	Private
	Home / SNF / HHA	Home / SNF / HHA
Primary MDs (Multi-site; direct CJR exposure) N = 613 pre-period patients	-5.1*** / -6.3 / +11.4** Significant shift toward HHA ✓ Strong, consistent pattern	-2.9 / -12.2*** / +15.1** Larger than Medicare effects ✓ Strong, cross-payer spillover
Secondary MDs (Control-only; co-operates with Primary) Indirect exposure through co-treatment	-0.6 / +2.6 / -2.0 All statistically insignificant ~ Weak indirect evidence	-5.8 / +3.6 / +2.2 Directional but imprecise Some private evidence (2016-17)
Tertiary+ MDs (Control-only; 3rd+ degree from CJR) No direct or indirect CJR connection	-5.9** / +1.5 / +4.3 Home sig. but HHA/SNF null ✗ No systematic pattern	-3.9 / +2.2* / +1.7 Mixed marginal signals ✗ No systematic pattern

Effect magnitude by network distance



Interpretation: Bounded Diffusion

- Spillovers are **concentrated at the first degree of separation** — physicians who directly practiced in CJR-treated hospitals
- Mechanism: physicians internalize institutional incentives and apply learned practice style in all their patient encounters
- Second-degree transmission (secondary MDs) is directionally consistent but **statistically imprecise**, consistent with attenuated peer learning
- Tertiary and peripheral physicians show **no coherent systematic pattern** — the isolated home discharge estimate lacks corresponding HHA/SNF response

Implication for the Control Group

- Primary AND secondary MD patients in control regions should *not* serve as counterfactuals for CJR program evaluation
- Including them **attenuates DiD estimates** by mixing treated-like behavior into the control group
- Next: quantify this attenuation by re-estimating with a cleaner control

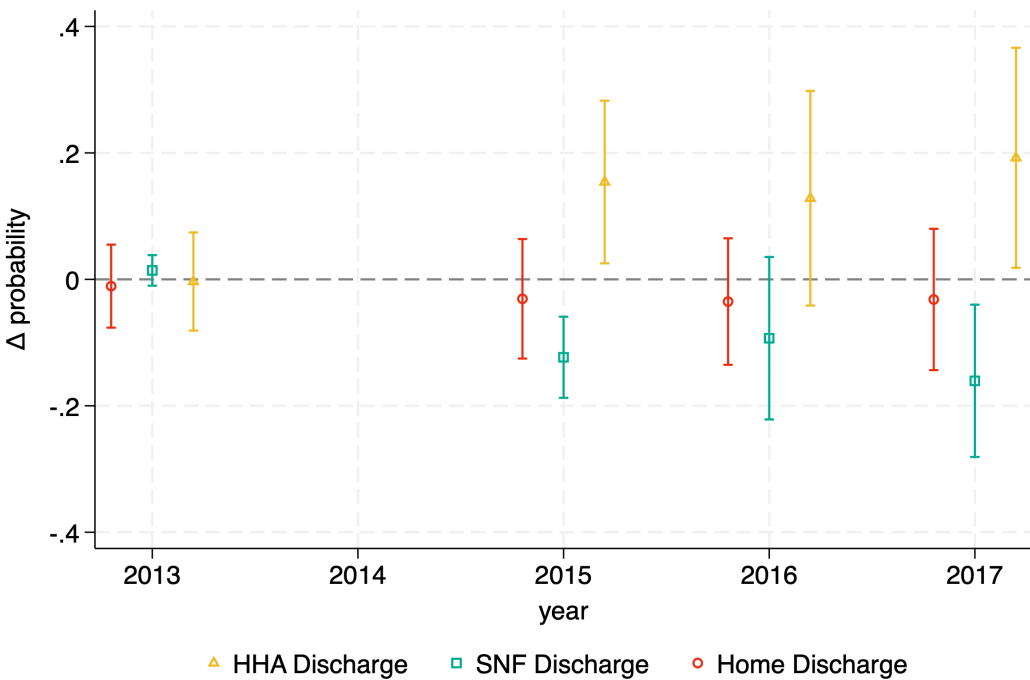
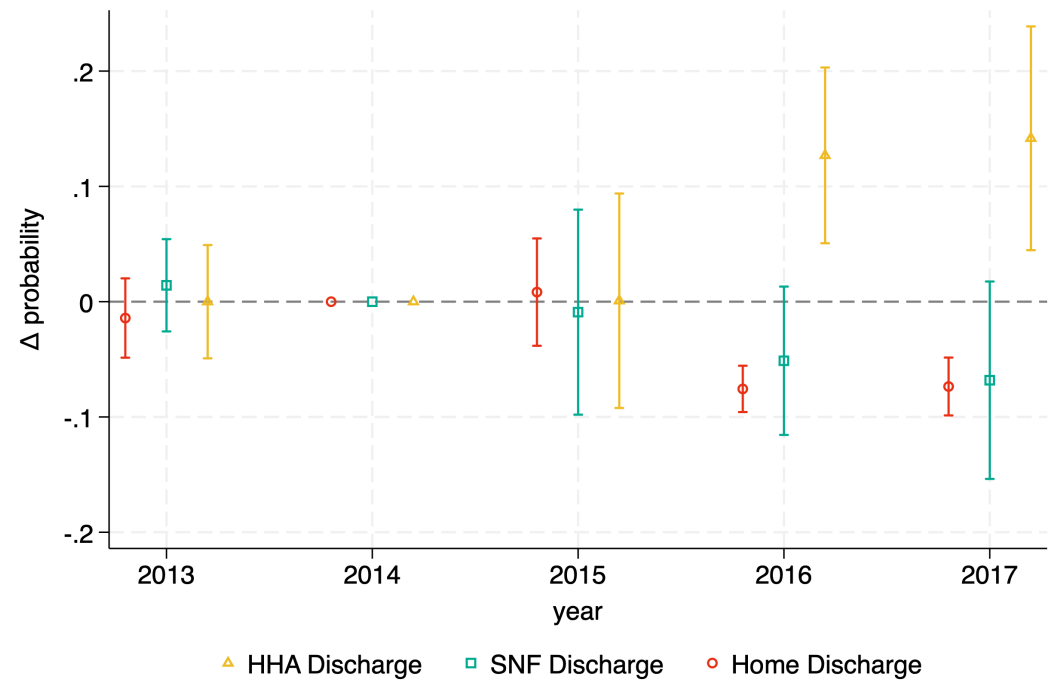
All values in percentage points. *p<0.10, **p<0.05, ***p<0.01. Secondary MD values: Medicare (-0.6, +2.6, -2.0); Private (-5.8, +3.6, +2.2). Tertiary+: Medicare (-5.9**, +1.5, +4.3); Private (-3.9, +2.2*, +1.7).

Event Study: Pre-Trends & Post-Implementation Dynamics

Primary physician patients in control MSAs — Medicare (left) and Private (right)

Primary MDs — Medicare Patients

Primary MDs — Private Insurance Patients



Pre-trends (2013–2014): Flat — no pre-existing differential trends, supporting parallel trends assumption

Post-implementation: Home -7.6 pp (2016), -7.4 pp (2017); HHA +12.7 pp (2016), +14.2 pp (2017) for Medicare

Anticipatory effects (2015): Private insurance patients show pre-implementation adjustment following CJR announcement

Event study reference year: 2013. 95% CI shown. Solid lines = filled symbols (cleaner control later). For secondary MD event studies, see Appendix.

Finding 3: Conventional DiD Understates CJR Effects by 40–50%

Re-estimation after excluding network-connected physicians from control group

The Problem: Contaminated Control

- Primary + secondary MD patients in control MSAs *changed behavior* due to CJR spillovers
- Including them as "control" mixes treatment-like outcomes into DiD denominator
- Result: DiD coefficient = true effect – spillover to control = **attenuated estimate**

The Solution: Cleaner Control

- Exclude primary + secondary MD patients from control group
- Re-estimate DiD: treated region vs. remaining control patients (tertiary+ only)
- Cleaner control group still shows good pre-period balance on observables

Comparison: Conventional vs. Clean DiD Estimates

Outcome	Conventional DiD (original control)	Clean DiD (exclude Primary + Secondary)	
Medicare			
Home discharge	-4.3**	-7.8***	+81%
HHA discharge	+5.7*	+6.8**	+19%
Private Insurance			
Home discharge	-9.3***	-14.2***	+53%
HHA discharge	+10.8***	+12.8**	+19%

Overall attenuation: 40–50% understatement with conventional DiD

Home discharge estimates are 53–81% larger under clean identification.
Comparison with Chen et al. (2022) further confirms NY State sample efficiency gain.

*p<0.10, **p<0.05, ***p<0.01. SNF estimates near zero and insignificant in both specifications (not shown). N(clean): Medicare 102,541; Private 80,596. N(original): Medicare 130,681; Private 101,985.

Finkelstein et al. 2018 (JAMA) cost data combined with this paper's clean DiD correction

131,285 Medicare LEJR episodes in 67 CJR MSAs · Institutional PAC savings:

Conventional total: $131,285 \times \$307 = \sim \$40\text{M} / \text{year}$

Average correction $\approx 45\% \rightarrow \$307 \times 1.45 = \$445/\text{episode}$

True direct total: $131,285 \times \$445 = \sim \$58\text{M} / \text{year}$ **+\$18M unrecognized**

~5,600 primary MD spillover Medicare patients/year in NY (28,140 removed over 5 yrs)

National scale (129 control MSAs): $\approx 72,000/\text{year} \times \sim \$200/\text{patient} \approx \textbf{+\$14M / year}$

Conventional: \$40M/yr → Corrected direct: \$58M/yr → With spillovers:

Over 5-year CJR program: ≈\$160M in program value beyond conventional estimates

A bar chart comparing three scenarios: Conventional, Corrected, and With Spillovers. The y-axis represents monetary value in millions of dollars (\$0 to \$80M). The 'Conventional' bar is a single grey bar reaching \$40M. The 'Corrected' bar is a stacked bar with a grey base of \$40M and an orange top section, totaling \$58M. The 'With Spillovers' bar is a stacked bar with a grey base of \$40M, an orange middle section, and a green top section, totaling \$72M. A bracket on the right indicates an +80% increase from the Conventional scenario to the With Spillovers scenario.

Scenario	Value (\$M)
Conventional	\$40M
Corrected	\$58M
With Spillovers	\$72M

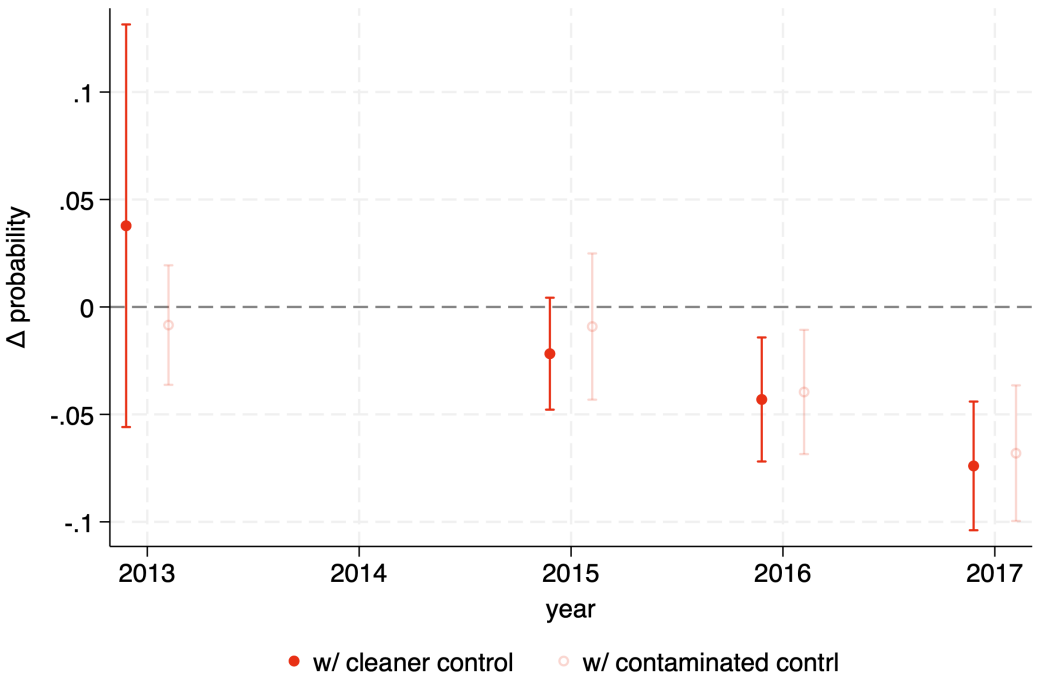
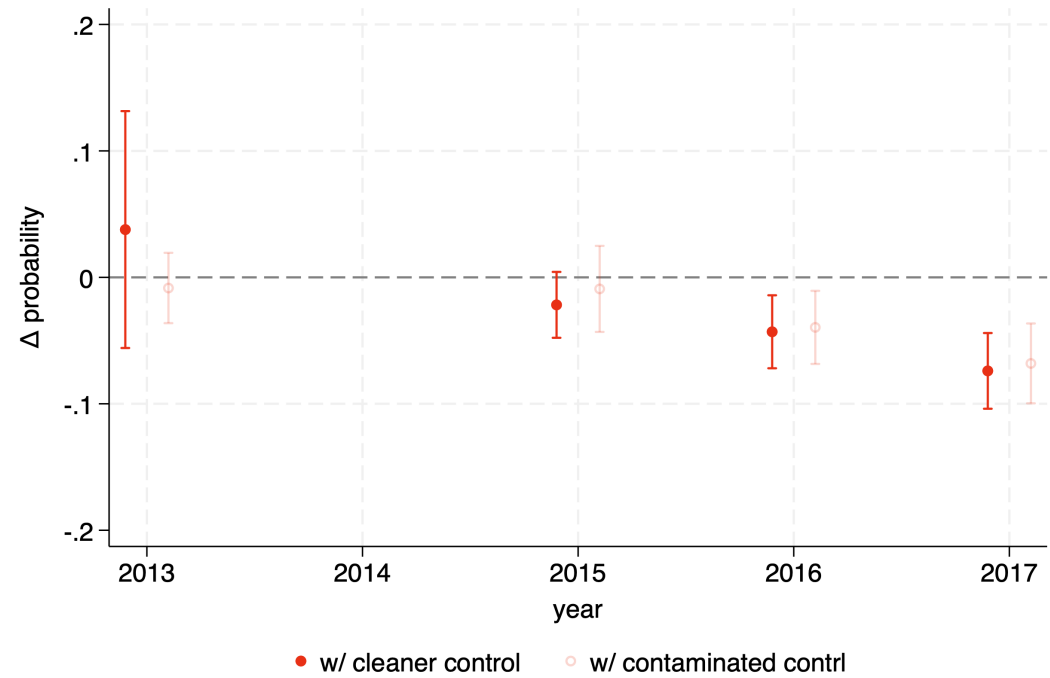
Sources: Finkelstein et al. 2018 JAMA (PAC cost data). Clean DiD correction: avg of Home (+81%/+53%) and HHA (+19%) estimates; 45% used as conservative middle. Spillover scale: 28,140 removed NY Medicare patients over 5 yrs → ~5,600/yr → national projection at uniform density (129/10 control MSAs). Figures in 2014 USD.

Event Study: Clean vs. Contaminated Control Group

Filled = cleaner control | Hollow = original (contaminated) control — Medicare (left), Private (right)

Medicare — Home Discharge (Clean vs. Contaminated)

Private — Home Discharge (Clean vs. Contaminated)



Flat pre-trends: Filled and hollow markers overlap pre-2016, validating the parallel trends assumption for both control definitions

Post-2016 divergence: Filled markers (clean) are systematically larger in magnitude — attenuation becomes visible starting 2016

Intensification: Effects strengthen in 2017 consistent with hospital learning and introduction of downside financial risk in CJR Year 2

Interpretation: Mechanisms and Scope of Spillovers

Why Do Primary MDs Carry Practice Changes?

- **Habit formation:** Physicians practice style is partially habit-driven; new discharge patterns adopted under CJR incentives become defaults applied broadly
- **Cognitive bundling:** Discharge decisions are made by the individual physician — incentives at one hospital reshape their overall clinical approach
- **Institutional learning:** CJR hospitals invested in care pathways and discharge planning infrastructure that physicians internalize

Why Are Private Effects Larger than Medicare?

- CJR directly targets Medicare FFS — but physicians apply learned patterns to *all* patients regardless of payer
- Private patients are **younger, healthier** with greater latitude for HHA vs. institutional care
- Consistent with Chen et al. (2022): private patients in treated regions also show larger effects
- Suggests physicians generalize policy incentives beyond the targeted population

Why Does Diffusion Stop at 2nd Degree?

- Spillovers require a **direct experiential link** to CJR practice — not just observing colleagues
- Secondary MDs observe but don't participate in CJR-driven episodes; signal is attenuated
- Consistent with Molitor (2018): practice style transmission requires sustained co-treatment exposure, not just proximity
- No evidence of norm diffusion without direct institutional tie

Evaluating Payment Reforms

- **Place-based evaluations face systematic control group contamination** when physicians span geographic boundaries
- Conventional DiD understates effects by 40–50% in this setting — a bias large enough to reverse program conclusions
- Effect understatement may cause decision-makers to prematurely wind down or redesign programs
- Future evaluations should map physician networks before selecting control units

Spillovers Carry Unreported Program Benefits

- Spillovers to non-targeted patients represent **additional program benefit** not captured in standard evaluations
- Private patients (not targeted by CJR) received efficiency gains — social value exceeds direct program scope
- Implications for cost-effectiveness analyses: true benefit-to-cost ratio is larger than conventionally estimated
- Payment reforms may generate **network externalities** justifying broader intervention

Designing Future Reforms

- Geographic randomization of payment reforms is valid for selection purposes, but introduces **network-based spillovers** as a fundamental evaluation challenge
- Consider physician-level or network-based randomization as alternatives
- Rollout designs that expand CJR to all MSAs eliminate this problem but sacrifice experimental variation
- Applies broadly: any place- or institution-based intervention with mobile professionals

1 Practice-style spillovers are real and large. Primary MDs practicing in both CJR-treated and control MSAs shifted discharge patterns in control settings: -5.1 pp home, +11.4 pp HHA (Medicare), and +15.1 pp HHA (private insurance). Effects mirror directly-treated hospital patterns.

2 Diffusion decays rapidly with network distance. Significant effects at 1st-degree separation (primary MDs); weak/imprecise at 2nd (secondary MDs); null at 3rd+ (tertiary). Spillovers are bounded by direct collaborative ties, not just proximity.

3 Conventional DiD understates CJR effects by 40–50%. Cleaner control estimates are 53–81% larger for home discharge and moderately larger for HHA. Standard evaluations that retain network-connected physicians in the control group produce materially attenuated program effect estimates.

4 Methodological contribution for policy evaluation. When mobile professionals connect treated and control units, standard geographic control groups are contaminated. Network mapping before designing control groups is essential for unbiased evaluation of place-based reforms.

Study in Brief

- Setting: CJR bundled payment model, NY State
- Data: HCUP SID 2013–2017 (NY)
- Method: DiD with hospital + year FE
- 2 treated MSAs, 10 control MSAs in NY

Broader Message

- Place-based evaluations face a fundamental challenge: professionals are mobile
- Network structure should inform both *study design* and *interpretation*
- Program benefits — and costs — can diffuse far beyond the intended scope
- True program impact is larger than conventionally measured

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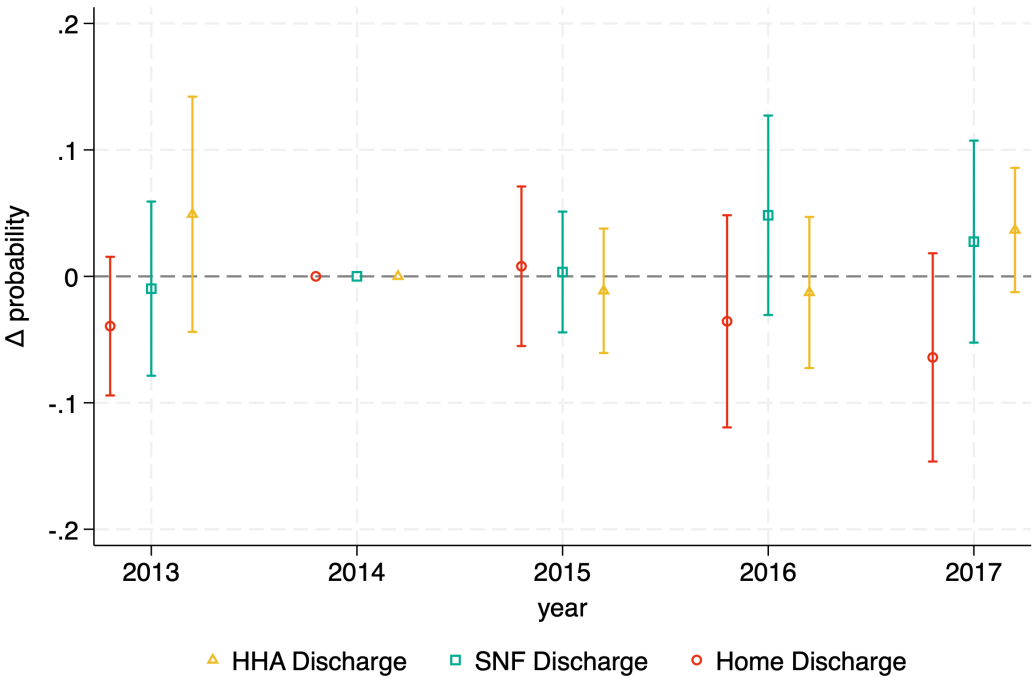
Appendix A: Pre-Period Patient Characteristics (2013–2014)

Characteristic	Primary MD Patients (Multi-site MDs)	Secondary MD Patients (Control-only, co-treating)	Control Group (Tertiary+ MDs)
Average age at admission	69.35	66.95	67.28
Female (%)	~60%	~60%	~60%
White (%)	~94–96%	~94–96%	~94–96%
Elective admission (%)	~86%	~93%	~90%
Average hospital beds	232.7	406.4	360.3
Medicare share (%)	67%	57%	59%
Home discharge (%)	69%	26%	16%
SNF/IRF discharge (%)	27%	29%	38%
HHA discharge (%)	4%	44%	47%

Note: Pre-period = 2013–2014. Primary MD hospital size notably smaller due to concentration in specialized/boutique orthopedic practices. Large differences in pre-period discharge shares reflect hospital casemix differences, not patient selection bias. All groups: metropolitan or larger setting 85–92%.

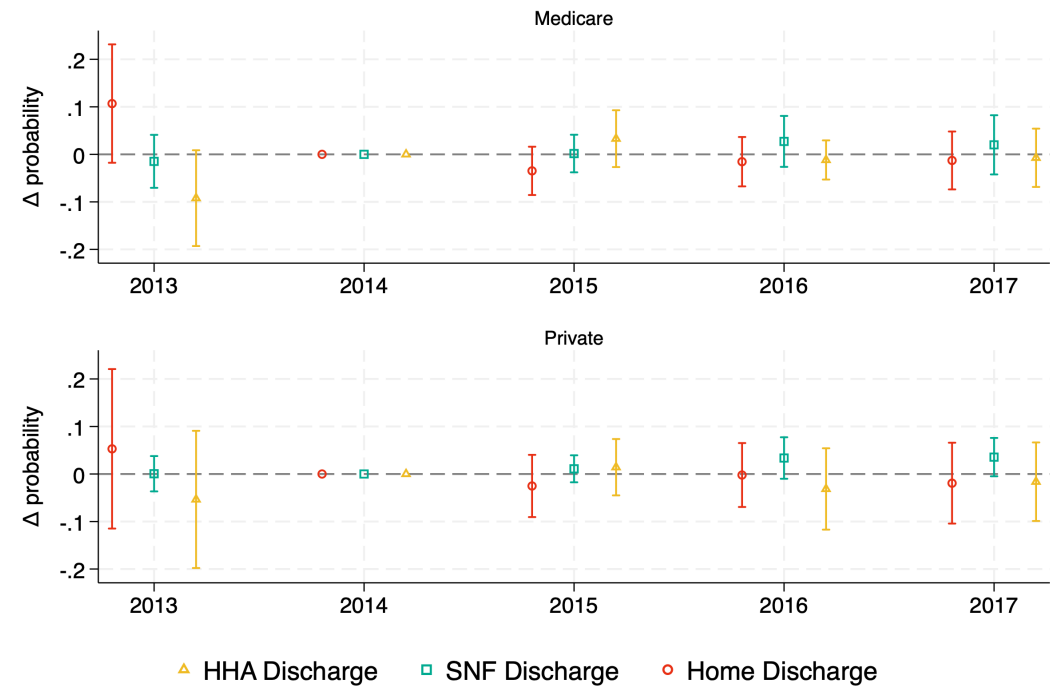
Appendix B: Event Study — Secondary and Tertiary Physicians

Secondary MDs — Medicare Patients



Secondary MDs: Point estimates remain small and imprecise for Medicare throughout. Private patients show some 2016–2017 directional evidence but wide CIs preclude strong inference.

Tertiary + Peripheral Physicians



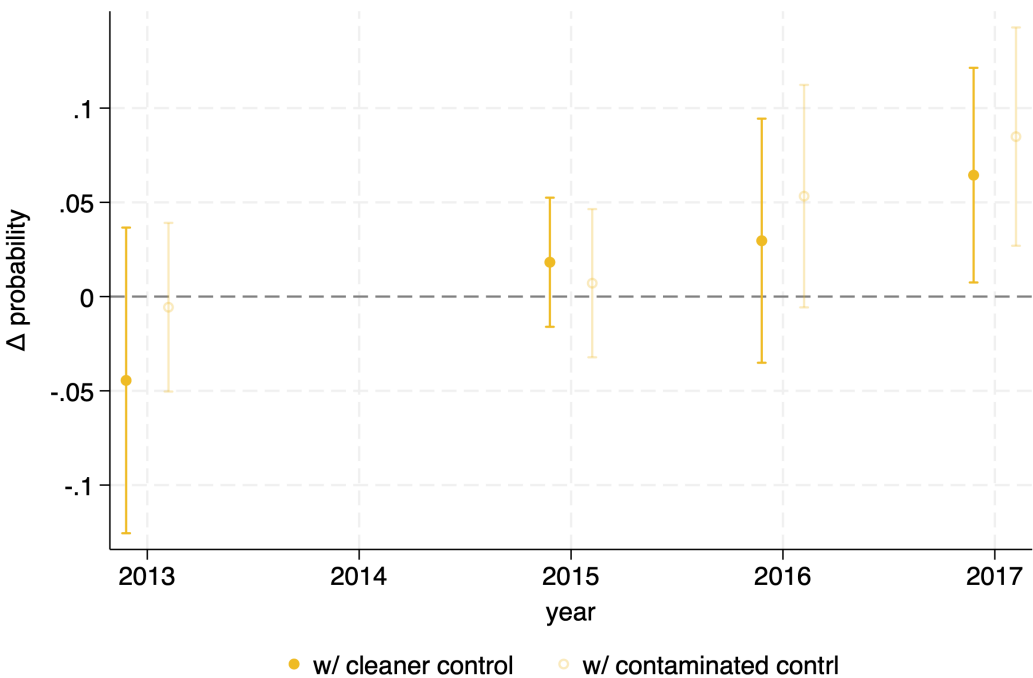
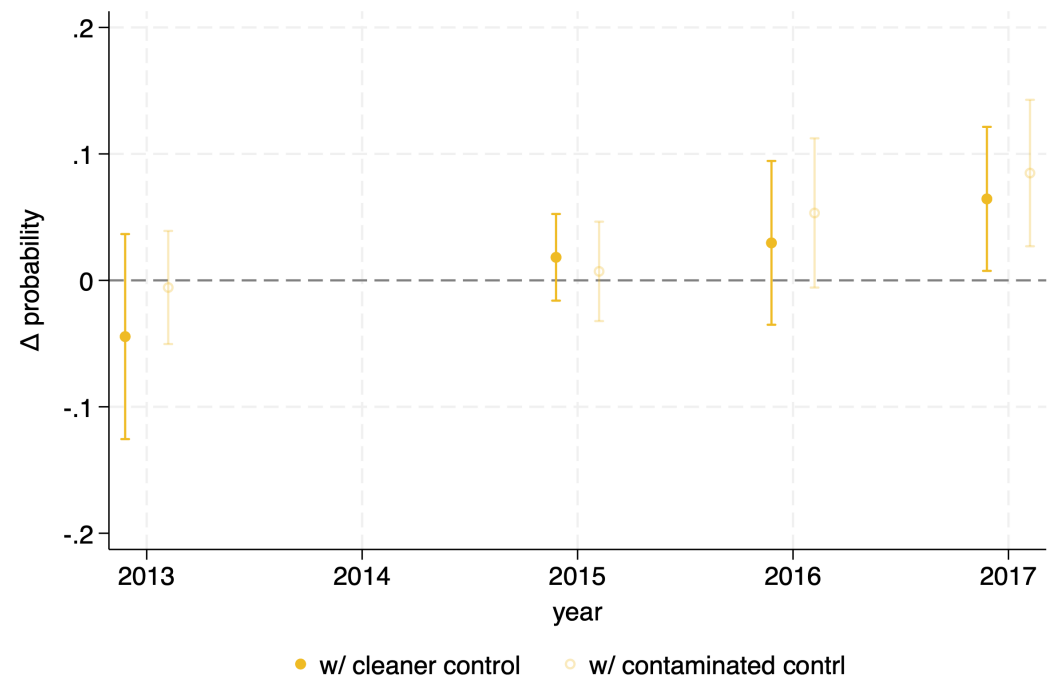
Tertiary+ MDs: No systematic patterns across either payer group. The isolated 2017 home discharge estimate lacks corresponding HHA/SNF response — inconsistent with genuine CJR-induced practice change.

These figures confirm that spillovers are concentrated at direct network ties (primary MDs) with weak/null transmission at 2nd and 3rd degree separation.

Appendix C: Clean DiD Event Study — HHA Discharge

Medicare — HHA Discharge (Clean vs. Contaminated)

Private — HHA Discharge (Clean vs. Contaminated)



Clean DiD (filled): Medicare HHA increases +3.0 pp (2016), +6.4 pp (2017). Effect intensifies, consistent with physician and institutional learning under CJR.

Contaminated control (hollow): Smaller magnitude throughout. The gap between filled and hollow markers grows over time as the control group becomes progressively more contaminated.

Private insurance HHA: Clean estimate of +12.8 pp (pooled) reflects substantial shift toward home-based care among non-targeted population — a major unreported benefit of CJR.

Pooled DiD: Medicare HHA +6.8 pp** (clean) vs +5.7 pp* (conventional). Private HHA +12.8 pp** (clean) vs +10.8 pp*** (conventional). See also SNF event studies in additional appendix materials.