Direct & spillover effects of provider vaccination facilitation

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EEA - August 28th, 2023

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Immunization programs and take-up

- (Childhood) Immunization programs are among the most effective preventative public health measures.

- Practice styles vary across providers
  E.g. Currie et al(2016), Simeonova et al (2020), Fadlon & Van Parys (2020), Currie & Zhang (2021)

- Network effects in health investment
  Carpenter & Lawler (2019), Fadlon & Nielsen(2019), Humlum et al (2021)

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We ask two questions:

1. **Do providers vary in their propensity to facilitate vaccinations?**
2. **Do provider propensities matter for patients?**

We find meaningful variation in PVF and that PVF affects vaccine take-up

1. **Meaningful variation in PVF**
   - We estimate a model of vaccine compliance with family and provider contributions
   - A 1 standard deviation increase in PVF increases compliance by 1.7 percentage points
2. **Impacts of PVF on Vaccine take-up in adolescence**
   - Direct effect of PVF on HPV vaccination take-up in adolescence
   - Mitigating effect on the impact of an unsubstantiated documentary
   - Spillovers of high PVF providers to cousins of patients

From Danish registry data we construct two samples:

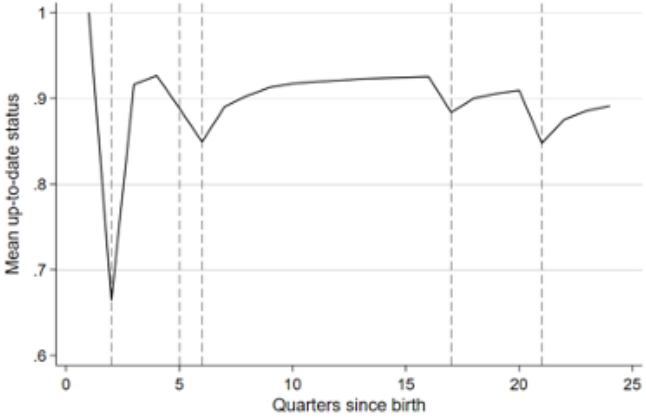
1. **Danish administrative registry data**:
   - Family links, patient-provider links, health insurance claims data
2. **We construct two primary samples**:
   - All children born 1997-2013 observed througout their first 6 years of life:
     - N= 1.083Mn
     - Eligible for the early part of the childhood vaccination program
     - Use this sample to estimate PVF
   - All children born 1997-2007 observed +/- 2 years around their 12th Birthday
     - N=346,366
     - All are eligible for the late part of the program
     - Use this sample to estimate impact of PVF
   - All individuals are linked to their PCP
     - Practice level
     - in 2019 roughly 50% were single physician-practices
     - app. unique 3700 practices over time

We construct a metric for vaccine compliance with the recommendations

Vaccination schedule in DK:

- Early part: 0-5 years
  - *Di-Ki-Te-Pol-Hib*
  - MMR (+booster)
- Later part: 12 years
  - HPV
  - MMR booster
- Administered at the PCP

$$Y_{iq} = \frac{\#\text{Vaccines taken}_{iq}}{\#\text{Vaccines rec.}_{iq}}$$



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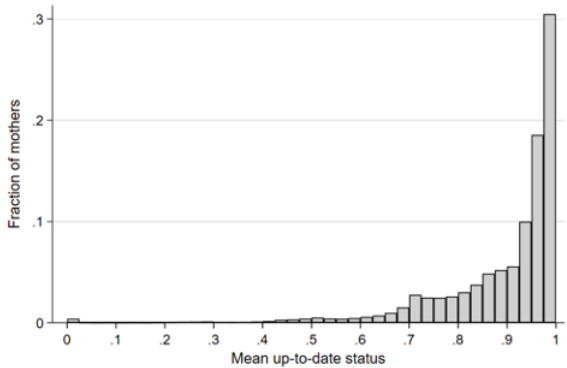


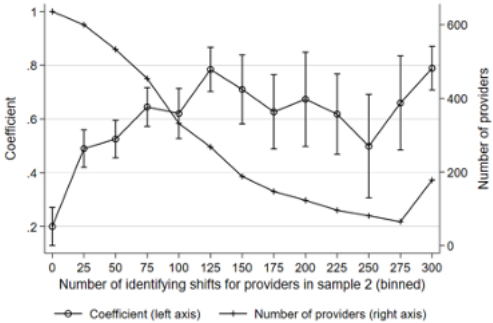
We model PVF linearly

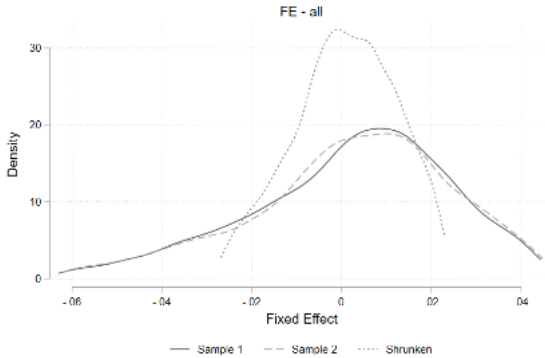
- **Provider Vaccination Facilitation:**
  - Two-way fixed effects:
    - Abowd, Kramarz, & Margolis (1998), Card, Heining, & Kline (2013), Finkelstein et al (2016), Goldschmidt & Schmieder, 2017; Drenik et al (2023)
  - Model of vaccine compliance:
    - $Y_{iq} = \alpha_{m(i)} + \gamma_{j(i,q)} + \delta_{q(i)} + X_i + \varepsilon_{iq}$
    - where Y_{iq} is compliance with vaccination program
  - Simplifying assumptions:
    - additivity and separability of $\gamma_{j(i,q)}$ and $\alpha_{m(i)}$
    - No sorting on individual specific gains: $E[\gamma_{j(i,q)}\varepsilon_{iq}|\alpha_{m(i)}, \delta_{q(i)}, X_i] = 0$

We correct for measurement error and assess validity

1. **Measurement error: Limited mobility bias**
   - Split sample correction (Goldsmith & Steiger 2017, Drenik et al 2023):
     - Randomly split data into two groups
     - Estimate FEs on both samples separately
     - Predict FEs from sample 1 with FEs from sample 2
2. **Validity:**(in the paper)
   - Restrict ID'ing shifts to specific groups and/or separations
     - Residential relocators, practice closures, only boys, only girls, post 2007 cohorts
   - Match quality
     - Models including match effect yield identical results and match effects quantitatively small
   - Dynamic Sorting
     - High degree of mean reversion when switching provider (app. 90%)
     - When switching provider and aging in to new requirement, upcoming change in PVF predicts change in take-up (Chetty et al 2014)

Shrinkage and the distribution of PVF



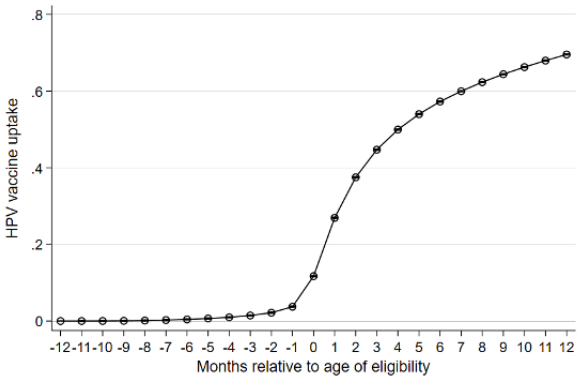


$$\hat{\sigma}_{\gamma_j} = 1.7\text{pp}$$

We ask two primary questions

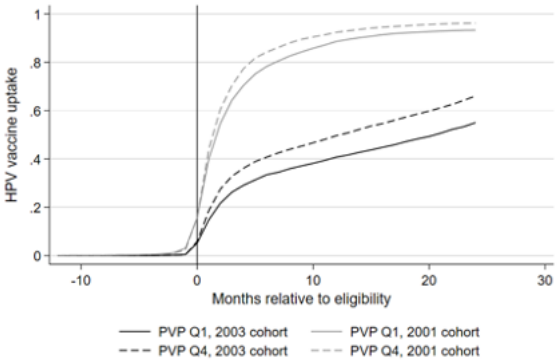
1. **Do providers vary in their propensity to facilitate vaccinations?**
2. **Do provider propensities matter for patients?**

Higher PVF leads to higher HPV vaccine take-up



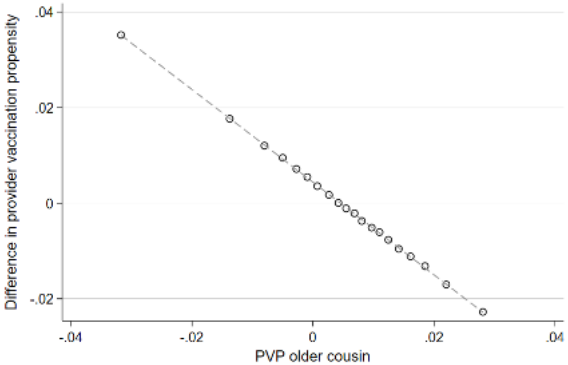
12 months after HPV eligibility			
Provider vaccination propensity	1.074***	1.067***	1.020***
	(0.131)	(0.130)	(0.125)
Mean childhood vaccination	0.314***	0.311***	0.316***
	(0.009)	(0.009)	(0.009)
Observations	346,493	346,493	346,493
R-squared	0.024	0.025	0.175
Mean outcome variable	0.704	0.704	0.704
F-stat	176.3	176	-
Municipality FE	Yes	Yes	Yes
Birthyear x birthmonth	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes
Father controls	No	Yes	Yes

PVF mitigates impact of a (unsubstantiated) critical documentary



		12 Month HPV vaccination	
Quartile of PVP x Born 2003	Q2xBorn2003	0.024	
		(0.017)	
	Q3xBorn2003	0.053***	
		(0.015)	
	Q4xBorn2003	0.050***	
		(0.014)	
PVP x Born 2003			1.934***
			(0.708)
Observations		107,780	107,780
R-squared		0.652	0.648
Municipality FE		Yes	Yes
Mother controls		Yes	Yes
Father controls		Yes	Yes
Mean outcome variable		0.583	0.583
2SLS		No	Yes

PVF affects patients network



	Cousins			
	HPV 12			
	(5)	(6)	(7)	(8)
Own provider vaccination propensity	1.031***	1.122***	1.027***	1.114***
	(0.184)	(0.175)	(0.184)	(0.176)
Older cousin's PVP			0.302**	0.272**
			(0.115)	(0.111)
Observations	107,695	107,695	107,695	107,695
R-squared	0.018	0.033	0.018	0.033
Municipality FE	Yes	Yes	Yes	Yes
Birthyear x birthmonth	Yes	Yes	Yes	Yes
Mother controls	No	Yes	No	Yes
Father controls	No	Yes	No	Yes
Mean outcome variable	0.671	0.671	0.671	0.671
F-stat own PVF	157.2	154.6	157.2	154.6
F-stat Cousin PVF	-	-	954.1	959.9

We find meaningful variation in PVF and that PVF affects vaccine take-up

1. **Meaningful variation in PVF**
   - A 1 standard deviation increase in PVF increases compliance by 1.7 percentage points
   - High PVF-providers are more likely to comply with child-well-visits, other types of preventative care and their patients have fewer ACSCs
   - The vaccine status of relatives of providers correlates positively with PVF
2. **Impacts of PVF on Vaccine take-up in adolescence**
   - Direct effect of PVF on HPV vaccination take-up in adolescence
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   - Spillovers of high PVF providers to cousins of patients