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Old boys' network in general practitioners' referral behavior?

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Motivation

Referral behavior of general practitioners' (GPs)

- Large variation in referral rates from GPs to specialists
- Potential quality-cost trade-off as follow-up cost vary substantially

- Importance of GPs referral behavior in health policy
- Relevance for managed care or referral guidelines

Are referrals medically and economically appropriate?

Motivation

This study . . .

- identifies the **determinants of GPs' referral rates** based on comprehensive (Upper-)Austrian administrative **panel** data
- has the focus on **social networks**
  - Patients might benefit from referrals within social networks (e.g. GPs use the informational advantage within social networks)
  - Referrals within social networks might be detrimental (e.g. referrals are driven by rent-seeking motives in old boys networks)
- judges the **appropriateness** of referrals based on
  - destination, health status, outpatient expenditures, timeliness

Austrian institutional background

- **Mandatory health insurance** $\rightarrow$ residents cannot chose between insurers
- Different insurers for different professions
- Residents choose a GP (74% in the same zip code area)
- GP may recommend specialists
- **GP does not receive fee for referring a patient**
- **GP is not responsible for the cost of specialist care**

Data

- **Administrative data** from the Upper Austrian Sickness Fund (OÖ GKK, all private employees and co-insured relatives)
- **75% of the population** (not included: farmers, civil servants, self-employed, ...)
- Doctor information from the Medical Association of Upper Austria (university, hospital, sex, age, medical field, zip code)
- **Only referrals from GPs to specialists**!
- Number of referrals: 1,502,333 for a period of 9 years
- Number of doctors: 724 GPs and 401 specialists

Standard Approach to explain referrals

Determinants of the referral rate$_{it}$

$$rate_{it} = \theta GP_{it} + \lambda practice_{it} + \nu patient_{it} + \pi \mathbf{network_{it}} + \rho_t + \xi_{it}$$

with

GP_{it}	...	characteristics of the GP
$practice_{it}$	...	practice characteristics
$patient_{it}$	...	patient characteristics
$\mathbf{network_{it}}$	...	**network characteristics**
ρ_t	...	period dummies
ξ_{it}	...	error term

Determinants of referral rates - standard controls

OLS (pooled cross-section)

GP characteristics		
Experience	−0.426**	(0.154)
Experience squared	−0.008	(0.004)
Single	2.586	(1.525)
Divorced	−0.423	(0.821)
Widowed	1.454	(1.674)
Graz	0.520	(0.670)
Vienna	0.241	(0.472)
Practice characteristics		
City	3.830***	(0.800)
Practice size	0.496**	(0.167)
Number of GPs	−0.184*	(0.079)
Number of specialists	0.166**	(0.058)
Patient characteristics		
Share of females	0.038	(0.062)
Mean age of patients	0.223**	(0.077)
Share of unemplyed	−0.520**	(0.166)
Share of retired	−0.356***	(0.063)
Share of others	−0.117*	(0.049)
Observations	4,823	
R^2	0.383	

(*p<0.10, **p<0.05, ***p<0.01)

Referral rates increase if...

- experience (age) of GPs ⇓
- size of practice ⇑
- practice is in city
- number of other GPs in the same ZIP Code area ⇓
- number of specialists in the same ZIP Code area ⇑
- age of patients ⇑
- share of patients with labor-market status 'non-employed' ⇑

Results are consistent with literature

The measurement of social networks

Personal networks if GP and specialist

- graduated from the same **University**
- studied at the same time (**Fellow students**)
- worked in the same teaching **Hospital**
- were **Co-worker** in the same hospital (working at the same time)

Affinity-based networks if GP and specialist

- have the **Same sex**
- are in the **Same age group**

Identification

- Additional Control: Share of specialists within a 50-km radius around the GP who belong to the respective network?

Determinants of referral rates - network controls

OLS (pooled cross-section)

	Male	Female
Same gender	0.170***	−0.099
	(0.027)	(0.138)
Same age group	−0.024	−0.044
	(0.018)	(0.063)
University	0.015	−0.078
	(0.021)	(0.131)
Fellow Students	0.029	−0.049
	(0.028)	(0.137)
Hospital	−0.030	0.001
	(0.023)	(0.058)
Co-Workers	0.108**	−0.133
	(0.042)	(0.130)
Other Controls	yes	yes
Observations	4329	494
R^2	0.400	0.643

*p<0.10, **p<0.05, ***p<0.01, Dependent: referral rate, Controls: shares of network specialists within a 50km radius

Only for male GPs we see more referrals ...

- if the share of specialists with the same sex is high
- if the share of specialists, who were co-workers in the same hospital, is high

Warning: the standard model does not allow the conclusions of referrals within networks!

Application of the "gravity model"

The gravity model has proved very successful in trade theory for the econometric modeling of exports or imports.

Gravity equation for GPs referral behavior

$$y_{ijt} = \beta_1 x_{it} + \beta_2 s_{jt} + \alpha_i + \gamma_j + \lambda_t + \delta \mathbf{z_{ij}} + u_{ijt}$$

y_{ijt}	...	Referrals or revenues
x_{it}, s_{jt}	...	Total revenues, total patients, experience
α_i	...	GP fixed effects
γ_j	...	Specialist fixed effects
λ_t	...	Period fixed effects
$\mathbf{z_{ij}}$	...	**Pair variable**s (distance, **social network variables**)

i ... GP $\quad$ j ... Specialist $\quad$ t ... Time

Gravity model for **Referral Rates**

	No FE	GP FE	Specialist FE	Both FE
University	**0.120****	0.056	**0.127****	0.021
	(0.056)	(0.051)	(0.062)	(0.054)
Fellow students	−0.168	**-0.189***	−0.052	−0.029
	(0.103)	(0.096)	(0.106)	(0.092)
Hospital	**1.615*****	**1.498*****	**1.572*****	**1.207*****
	(0.209)	(0.202)	(0.224)	(0.201)
Co-workers	**1.533*****	**1.455*****	**1.341*****	**1.081*****
	(0.353)	(0.346)	(0.350)	(0.334)
Identical age group	0.044	0.052	0.029	0.036
	(0.044)	(0.045)	(0.043)	(0.043)
Same sex	**0.458*****	**0.541*****	0.259	**0.104***
	(0.077)	(0.052)	(0.168)	(0.062)
GPs' experience	0.046***	0.132	0.050***	0.209
	(0.012)	(0.160)	(0.015)	(0.189)
Specialists' experience	0.001	−0.009	−0.074**	−0.153***
	(0.005)	(0.006)	(0.035)	(0.030)
Distance	−0.074***	−0.116***	−0.098***	−0.191***
	(0.003)	(0.003)	(0.005)	(0.007)
GPs' patients	0.245***	0.236***	0.162***	0.227***
	(0.045)	(0.036)	(0.054)	(0.035)
Specialists' patients	0.611***	0.574***	0.426***	0.427***
	(0.043)	(0.043)	(0.028)	(0.029)
Mean	1.82	1.82	1.82	1.82
Observations	1,502,333	1,502,333	1,502,333	1,502,333

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors

Gravity model for **Revenues**

	No FE	GP FE	Specialist FE	Both FE
University	**9.876*** **	**6.559** **	**9.161*** **	3.737
	(3.130)	(2.905)	(3.459)	(3.028)
Fellow students	−8.949	**-10.264***	−2.495	−1.489
	(5.648)	(5.374)	(5.749)	(5.103)
Hospital	**80.121*** **	**75.445*** **	**77.826*** **	**60.599*** **
	(10.692)	(10.370)	(11.446)	(10.353)
Co-workers	**99.202*** **	**94.475*** **	**86.928*** **	**72.820*** **
	(19.548)	(19.232)	(19.253)	(18.587)
Identical age group	2.453	2.714	1.702	1.914
	(2.466)	(2.492)	(2.406)	(2.380)
Same sex	**30.327*** **	**36.739*** **	11.680	3.767
	(4.043)	(2.700)	(8.538)	(3.071)
GPs' experience	2.435***	6.079	2.666***	9.884
	(0.602)	(5.770)	(0.765)	(17.577)
Specialists' experience	−0.094	−0.619**	−5.980***	−10.037***
	(0.281)	(0.288)	(1.799)	(1.609)
Distance	−3.846***	−6.067***	−5.038***	−9.895***
	(0.148)	(0.185)	(0.240)	(0.363)
GPs' patients	11.744***	10.861***	7.858***	10.382***
	(2.375)	(2.246)	(1.489)	(1.492)
Specialists' patients	24.791***	22.857***	17.676***	17.704***
	(2.261)	(2.246)	(1.489)	(1.492)
Mean	93.64	93.64	93.64	93.64
Observations	1,502,333	1,502,333	1,502,333	1,502,333

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors

The appropriateness of social networks

High-quality referrals: [Foot et al., 2010] and [Blundell et al., 2010] offer criteria for the appropriateness of referrals.

- **Destination:** Are patients referred to the most appropriate destination?
  - Follow-up consultation (another specialist in the same field)
  - Subsequent referral (referral to a specialist in a different field)
- **Process and Competency:** Health status before and after the referral
  - Days of hospitalization
  - Days of sick leave
- **Timeliness:** Does the referral take place without delay?
- **Outpatient expenditures**
- q quarters – with $q \subseteq \{1, 2, 3, 4\}$ – after the initial referral

Follow-up consultations: another specialist in the same field

	Q1	Q2	Q3	Q4
University	0.003	0.006	0.033	0.003
	(0.037)	(0.044)	(0.049)	(0.052)
Fellow students	−0.059	−0.071	**−0.107***	**−0.119***
	(0.049)	(0.056)	(0.064)	(0.067)
Hospital	−0.094	−0.116	**−0.151***	**−0.176****
	(0.060)	(0.072)	(0.081)	(0.083)
Co-worker	**−0.134***	**−0.177****	**−0.257*****	**−0.266*****
	(0.071)	(0.080)	(0.088)	(0.093)
Identical age group	0.044	0.028	0.062	0.062
	(0.032)	(0.037)	(0.040)	(0.042)
Same sex	**−0.140****	**−0.145***	−0.121	−0.127
	(0.067)	(0.081)	(0.085)	(0.089)
Other controls	yes	yes	yes	yes
Mean	0.857	1.237	1.511	1.694
Observations	220,698	220,698	220,698	220,698

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, dependent variable: follow-up consultations in the same medical field.

Subsequent refs: re-referred to a specialist in another field

	Q1	Q2	Q3	Q4
University	0.030	−0.023	0.018	0.005
	(0.043)	(0.032)	(0.030)	(0.032)
Fellow students	−0.104	**0.092***	0.054	0.029
	(0.065)	(0.048)	(0.046)	(0.048)
Hospital	0.010	0.052	0.017	0.040
	(0.068)	(0.050)	(0.049)	(0.052)
Co-worker	**−0.166***	**−0.123***	−0.092	−0.026
	(0.099)	(0.071)	(0.071)	(0.071)
Identical age group	0.060	−0.022	−0.037	−0.028
	(0.037)	(0.026)	(0.024)	(0.027)
Same sex	−0.025	−0.059	−0.022	0.061
	(0.070)	(0.051)	(0.043)	(0.061)
Other controls	yes	yes	yes	yes
Mean	1.238	0.673	0.633	0.778
Observations	220,698	220,698	220,698	220,698

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, dependent variable: follow-up consultations in another medical field.

Subsequent hospital days

	Q1	Q2	Q3	Q4
University	0.007	0.008	0.011	0.016
	(0.017)	(0.021)	(0.025)	(0.026)
Fellow students	−0.023	**−0.045***	**−0.059***	**−0.072****
	(0.020)	(0.026)	(0.030)	(0.033)
Hospital	0.008	−0.008	−0.034	−0.040
	(0.023)	(0.031)	(0.035)	(0.036)
Co-workers	−0.030	0.028	0.031	0.018
	(0.032)	(0.055)	(0.057)	(0.059)
Identical age group	−0.003	0.012	0.017	0.013
	(0.013)	(0.017)	(0.019)	(0.020)
Same sex	0.048	0.004	−0.010	−0.012
	(0.037)	(0.041)	(0.045)	(0.047)
Other controls	yes	yes	yes	yes
Mean	0.457	0.659	0.792	0.894
Observations	215,174	215,174	215,174	215,174

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, dependent variable: subsequent hospital days.

Subsequent days of sick leave

	Q1	Q2	Q3	Q4
University	0.020	0.037	0.059	0.054
	(0.035)	(0.043)	(0.048)	(0.051)
Fellow students	0.015	−0.036	−0.034	−0.023
	(0.044)	(0.054)	(0.058)	(0.064)
Hospital	−0.008	−0.031	0.018	0.021
	(0.065)	(0.072)	(0.079)	(0.083)
Co-workers	0.001	0.010	0.044	0.077
	(0.072)	(0.090)	(0.096)	(0.111)
Same age group	**0.051***	0.033	0.028	0.016
	(0.028)	(0.036)	(0.038)	(0.041)
Same gender	−0.043	0.022	−0.007	0.001
	(0.067)	(0.093)	(0.103)	(0.108)
Other controls	yes	yes	yes	yes
Mean	0.910	1.315	1.594	1.815
Observations	171,788	171,788	171,788	171,788

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, dependent variable: subsequent days of sick leave.

Timeliness: period between the referral and specialist visit

	Referral duration (percent)
University	0.398
	(2.593)
Fellow students	3.847
	(3.590)
Hospital	**7.966****
	(3.861)
Co-workers	−2.976
	(4.836)
Identical age group	−1.477
	(2.205)
Same sex	3.825
	(4.918)
Other controls	yes
Mean	0.04 quarters
Observations	211,140

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, dependent variable: periods between referral and specialist visit.

Assessment of patients' well-being

- For referrals within personal social networks (studying together, working (together) in the same hospital) we observe ...
  - fewer follow-up consultations,
  - fewer subsequent referrals,
  - fewer subsequent days in hospital,
  - but longer waiting times.

- Obviously, patients benefit from referrals within social networks but they have to wait longer.

Motives of GPs network preferences

Potential explanations for these results:

- Patients referred in networks were healthier?
- Extra care of specialists for patients referred within a social framework?
- Statistical discrimination: Specialists from the own personal network are chosen because their quality is better known.
- Rent-seeking (old boys' networks): GPs may shift rents to doctors within their network.

Falsification test: outcomes one quarter before referral

Dependent variables	Hospital days	Days of sick leave
University	−0.002	0.007
	(0.015)	(0.035)
Fellow students	0.012	0.046
	(0.021)	(0.047)
Hospital	0.025	−0.083
	(0.027)	(0.055)
Co-worker	0.011	−0.024
	(0.028)	(0.080)
Same age group	−0.016	−0.042
	(0.013)	(0.028)
Same sex	−0.013	**−0.119***
	(0.024)	(0.068)
Other controls	yes	yes
Mean	0.418	0.345
Observations	215,174	215,174

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors

... it is not the selection of healthier patients referred within social networks

Subsequent outpatient expenditures

	Q1	Q2	Q3	Q4
University	2.327	1.980	2.399	2.577
	(3.178)	(3.402)	(3.466)	(3.501)
Fellow students	−5.908	−6.155	−6.737	−7.011
	(4.498)	(4.721)	(4.795)	(4.866)
Hospital	2.799	3.872	3.820	3.813
	(4.974)	(5.228)	(5.303)	(5.316)
Co-worker	−0.505	−1.488	−1.406	−1.306
	(7.149)	(7.688)	(7.810)	(7.854)
Identical age group	−2.606	−2.597	−2.645	−2.462
	(2.628)	(2.754)	(2.786)	(2.809)
Same sex	**−8.980***	−8.772	−8.611	−8.674
	(5.335)	(5.905)	(6.030)	(6.119)
Other controls	yes	yes	yes	yes
Mean	173.38	199.62	208.90	213.66
Observations	215,174	215,174	215,174	215,174

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors

... it is not extra care of specialists for patients referred within social networks

A further test for statistical discrimination

Hypothesis

- GPs can better judge specialists' quality within social networks
- High quality specialists within social networks receive more referrals.

Quality measures for specialists

- The share of a specialist's patient stock *working in a hospital* who were not referred by a GP
- The share of a specialist's patient stock *holding an academic degree* who were not referred by a GP
- Dividing observations into terciles
  - Low quality specialists
  - Mid quality specialists
  - High quality specialists

Information asymmetry (share of hospital staff)

	Base	City FE	ZIP code FE
Mid quality	**−0.311*** **	**−0.217** **	−0.039
High quality	−1.557***	−1.346***	−0.908***
Same age group × mid quality	0.007	0.017	0.028
Same age group × high quality	−0.062	−0.063	−0.043
Same sex × mid quality	**−0.324*** **	**−0.169** **	**−0.197** **
Same sex × high quality	**−0.446*** **	**−0.451*** **	**−0.471*** **
University × mid quality	0.123	0.104	0.068
University × high quality	0.048	0.059	0.069
Fellow student × mid quality	0.225	0.240*	0.144
Fellow student × high quality	0.077	0.133	0.112
Hospital × mid quality	**1.617*** **	**1.574*** **	**1.410*** **
Hospital × high quality	**0.691*** **	**0.754*** **	**0.479** **
Co-worker × mid quality	**4.313*** **	**4.260*** **	**4.011*** **
Co-worker × high quality	**1.809*** **	**1.691*** **	**1.514*** **
Mean	1.82	1.82	1.82
Observations	1,502,333	1,502,333	1,502,333

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, standard errors omitted, FE . . . fixed effects, dependent variable: referral rates.

Information asymmetry (share of university graduates)

	Base	City FE	ZIP code FE
Mid quality	0.023	**0.327*** **	**0.435*** **
High quality	**−0.358****	**0.308***	**0.728*** **
Same age group × mid quality	0.029	0.014	0.017
Same age group × high quality	0.023	0.003	0.018
Same sex × mid quality	−0.045	−0.120	**−0.137***
Same sex × high quality	0.086	0.110	0.000
University × mid quality	0.095	0.074	0.129
University × high quality	−0.102	−0.102	0.004
Fellow student × mid quality	0.124	0.156	0.037
Fellow student × high quality	0.126	0.154	0.078
Hospital × mid quality	**1.355*** **	**1.359*** **	**1.321*** **
Hospital × high quality	0.463	0.467	0.379
Co-worker × mid quality	**2.417*** **	**2.475*** **	**2.492*** **
Co-worker × high quality	1.050	1.119	0.863
Mean	1.82	1.82	1.82
Observations	1,502,333	1,502,333	1,502,333

*p<0.10, **p<0.05, ***p<0.01, OLS(pooled cross-section), robust standard errors, standard errors omitted, FE . . . fixed effects, dependent variable: referral rates.

Conclusions

Within personal networks we find ...

- increased referral rates (especially for *hospital*, *co-workers*)
- clearly improved patient outcomes
- that better specialists are chosen ("stat. discrimination")

For affinity-based networks we find ...

- increased referral rates (especially for *same sex*)
- seemingly advantageous patient outcomes (selection?)
- that worse specialists are chosen

Implications for the organization of referrals

- Health care providers should collect information to assess quality and necessity of referrals.
- Implement mechanisms to reduce information asymmetry.