Can use of Electronic Health Records in General Practice improve quality of care for diabetes patients? Evidence from a natural experiment in Denmark

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  - Related literature
  - The Danish DMP
- Data
- Identification
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- Conclusion

Background

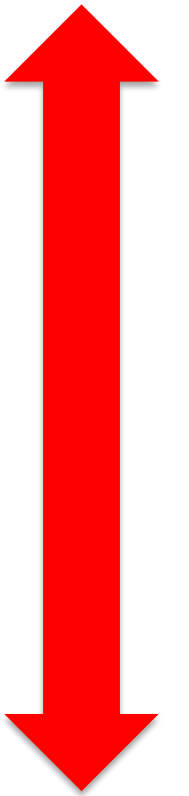
- Related literature
- The Danish Disease Management Progam (DMP)

Some related litterature

High powered

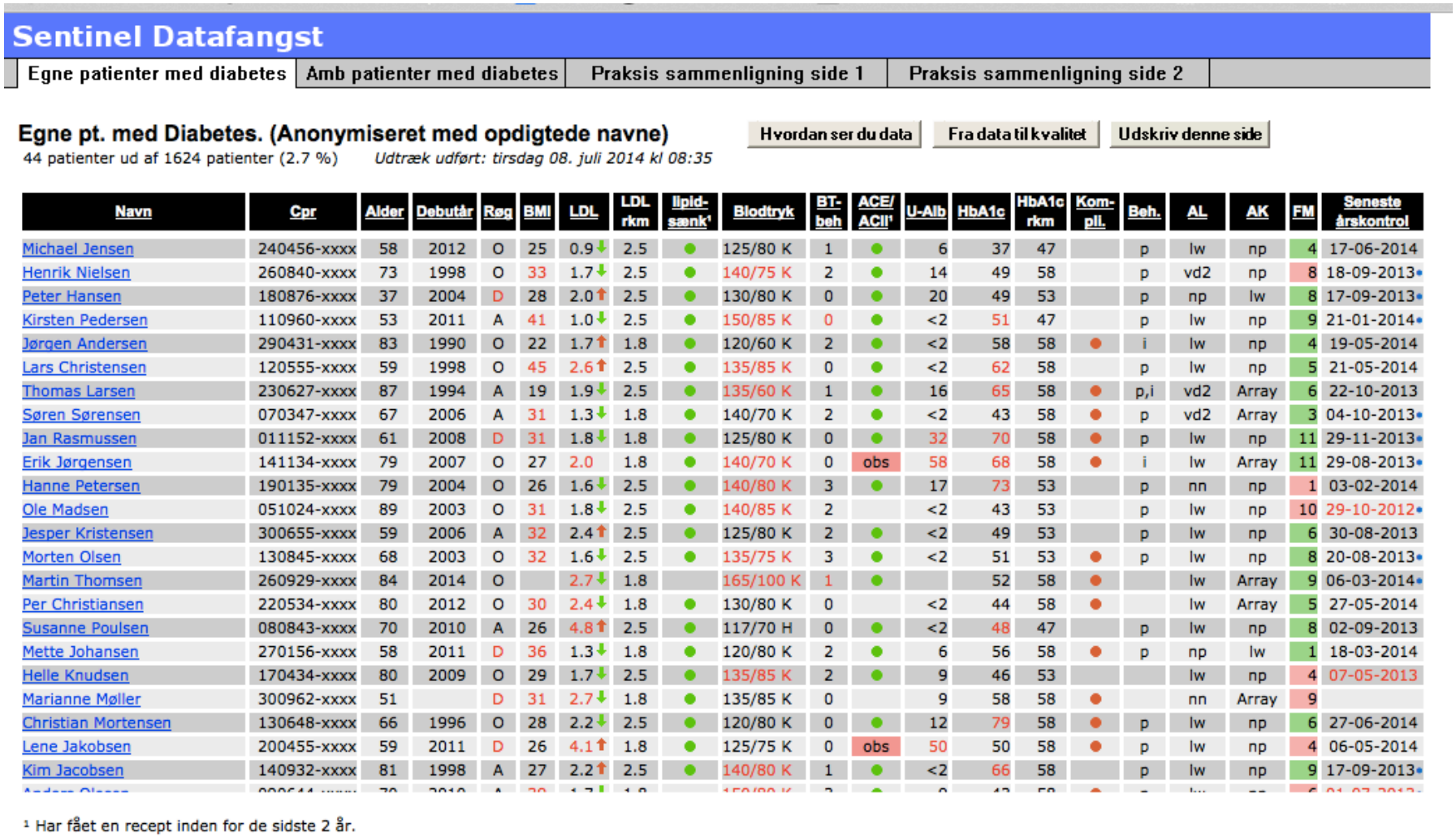
- Dusheiko et al., **Does Higher Quality of Diabetes Management in Family Practice Reduce Unplanned Hospital Admissions**? *Health Services Research* 46:1, Part I (February 2011)
- Harrison et al., **Effect of a national primary care pay for performance scheme on emergency hospital admissions for ambulatory care sensitive condition: controlled longotuditunal study**. *BMJ*, 2014; 359

- Iezzi et al., **The role of GP's compensation schemes in diabetes care: evidence from panel data**. *Journal of Health Economics* 30: 104-120 2014
- Reed et al., **Implementation of an Outpatient Electronic Health Record and Emergency Department Visits, Hospitalizations, and Office Visits Among Patients With Diabetes**. *JAMA*. 2013;310(10):1060-1065



Low powered

The DMP - EHR



Sentinel Datafangst

Egne patienter med diabetes | Amb patienter med diabetes | Praksis sammenligning side 1 | Praksis sammenligning side 2

Egne pt. med Diabetes. (Anonymiseret med opdigtede navne)

Hvordan ser du data | Fra data til kvalitet | Udskriv denne side

44 patienter ud af 1624 patienter (2.7 %) *Udtræk udført: tirsdag 08. juli 2014 kl 08:35*

Navn	Cpr	Alder	Debutår	Røg	BMI	LDL	LDL rkm	lipid-sænk[1]	Blodtryk	BT-beh	ACE/ACII[1]	U-Alb	HbA1c	HbA1c rkm	Kom-pli.	Beh.	AL	AK	FM	Seneste årskontrol
Michael Jensen	240456-xxxx	58	2012	O	25	0.9↓	2.5	●	125/80 K	1	●	6	37	47		p	lw	np	4	17-06-2014
Henrik Nielsen	260840-xxxx	73	1998	O	33	1.7↓	2.5	●	140/75 K	2	●	14	49	58		p	vd2	np	8	18-09-2013
Peter Hansen	180876-xxxx	37	2004	D	28	2.0↑	2.5	●	130/80 K	0	●	20	49	53		p	np	lw	8	17-09-2013
Kirsten Pedersen	110960-xxxx	53	2011	A	41	1.0↓	2.5	●	150/85 K	0	●	<2	51	47		p	lw	np	9	21-01-2014
Jørgen Andersen	290431-xxxx	83	1990	O	22	1.7↑	1.8	●	120/60 K	2	●	<2	58	58	●	i	lw	np	4	19-05-2014
Lars Christensen	120555-xxxx	59	1998	O	45	2.6↑	2.5	●	135/85 K	0	●	<2	62	58		p	lw	np	5	21-05-2014
Thomas Larsen	230627-xxxx	87	1994	A	19	1.9↓	2.5	●	135/60 K	1	●	16	65	58	●	p,i	vd2	Array	6	22-10-2013
Søren Sørensen	070347-xxxx	67	2006	A	31	1.3↓	1.8	●	140/70 K	2	●	<2	43	58	●	p	vd2	Array	3	04-10-2013
Jan Rasmussen	011152-xxxx	61	2008	D	31	1.8↓	1.8	●	125/80 K	0	●	32	70	58	●	p	lw	np	11	29-11-2013
Erik Jørgensen	141134-xxxx	79	2007	O	27	2.0	1.8	●	140/70 K	0	obs	58	68	58	●	i	lw	Array	11	29-08-2013
Hanne Petersen	190135-xxxx	79	2004	O	26	1.6↓	2.5	●	140/80 K	3	●	17	73	53		p	nn	np	1	03-02-2014
Ole Madsen	051024-xxxx	89	2003	O	31	1.8↓	2.5	●	140/85 K	2		<2	43	53		p	lw	np	10	29-10-2012
Jesper Kristensen	300655-xxxx	59	2006	A	32	2.4↑	2.5	●	125/80 K	2	●	<2	49	53		p	lw	np	6	30-08-2013
Morten Olsen	130845-xxxx	68	2003	O	32	1.6↓	2.5	●	135/75 K	3	●	<2	51	53	●	p	lw	np	8	20-08-2013
Martin Thomsen	260929-xxxx	84	2014	O		2.7↓	1.8		165/100 K	1	●		52	58	●		lw	Array	9	06-03-2014
Per Christiansen	220534-xxxx	80	2012	O	30	2.4↓	1.8	●	130/80 K	0		<2	44	58	●		lw	Array	5	27-05-2014
Susanne Poulsen	080843-xxxx	70	2010	A	26	4.8↑	2.5	●	117/70 H	0	●	<2	48	47		p	lw	np	8	02-09-2013
Mette Johansen	270156-xxxx	58	2011	D	36	1.3↓	1.8	●	120/80 K	2	●	6	56	58	●	p	np	lw	1	18-03-2014
Helle Knudsen	170434-xxxx	80	2009	O	29	1.7↓	2.5	●	135/85 K	2	●	9	46	53			lw	np	4	07-05-2013
Marianne Møller	300962-xxxx	51		D	31	2.7↓	1.8	●	135/85 K	0		9	58	58	●		nn	Array	9	
Christian Mortensen	130648-xxxx	66	1996	O	28	2.2↓	2.5	●	120/80 K	0	●	12	79	58	●	p	lw	np	6	27-06-2014
Lene Jakobsen	200455-xxxx	59	2011	D	26	4.1↑	1.8	●	125/75 K	0	obs	50	50	58	●	p	lw	np	4	06-05-2014
Kim Jacobsen	140932-xxxx	81	1998	A	27	2.2↑	2.5	●	140/80 K	1	●	<2	66	58		p	lw	np	9	17-09-2013

[1] Har fået en recept inden for de sidste 2 år.

The DMP - EHR

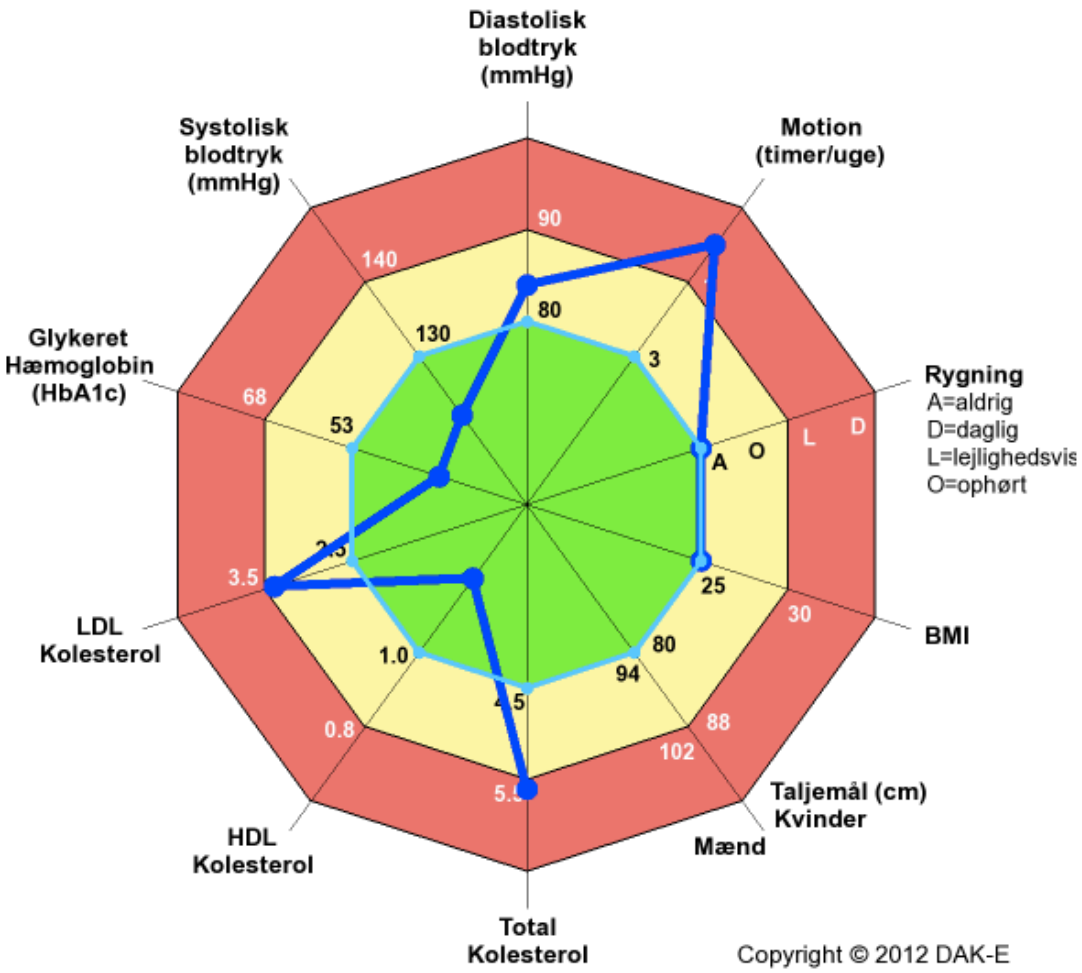
Michael Jensen. Født: 220449-xxxx, 65 år.

Behandlingsrekommandation | Udskriv denne side

Diabetes risikoprofil

Diabetes Data

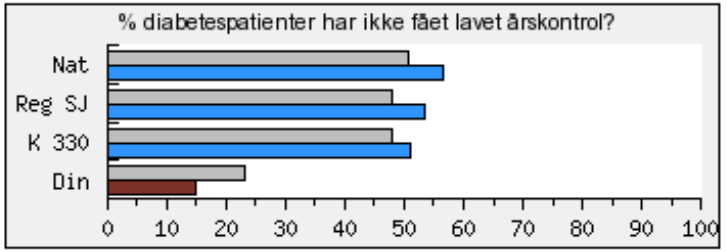
Betegnelse	Tidligere Tal	Aktuelle Tal	Aftalte Tal	Optimale Tal
Glykeret Hæmoglobin	45	36		53
Systolisk blodtryk	100	122		130
Diastolisk blodtryk	69	84		80
Total Kolesterol	6.1	5.6		4.5
LDL Kolesterol	4.4	3.4		2.5
HDL Kolesterol	1	1.8		1.0
Rygning	A	A	A	A
BMI	28	25		25
Motion	0	0		3
Taljemål				94
Vis Kurve	☐	☑	☐	☑
Fremhæv Kurve	☐	☑	☐	☐



The DMP - Feedback Reports

Resultatindikatorer

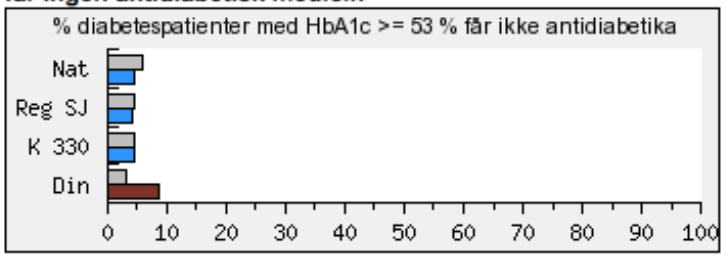
Hvor mange diabetespatienter (der har haft diabetes i over 1 år) har ikke fået lavet årskontrol?



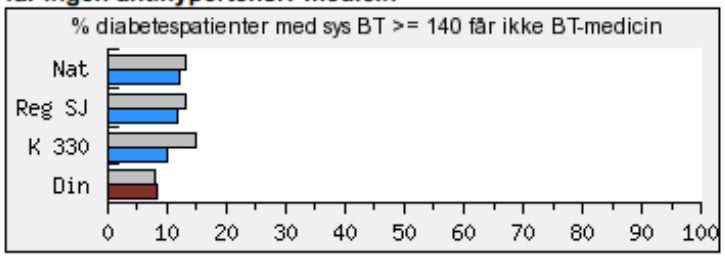
Nat = Nationalt
Reg SJ = Region Sjælland
K 330 = Slagelse Kommune, hvis søjlerne mangler skyldes det at der skal være mind
Din = Din praksis

De grå søjler viser værdierne for 1 år siden.

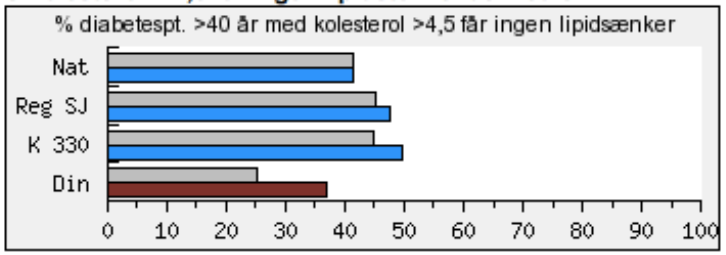
Hvor mange diabetespatienter med HbA1c >= 53 får ingen antidiabetisk medicin



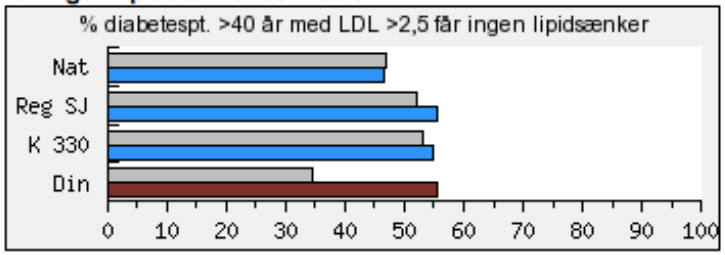
Hvor mange diabetespatienter med et systolisk BT >= 140 mm Hg får ingen antihypertensiv medicin



Hvor mange diabetespatienter over 40 år med et S-kolesterol > 4,5 får ingen lipidsænkende medicin



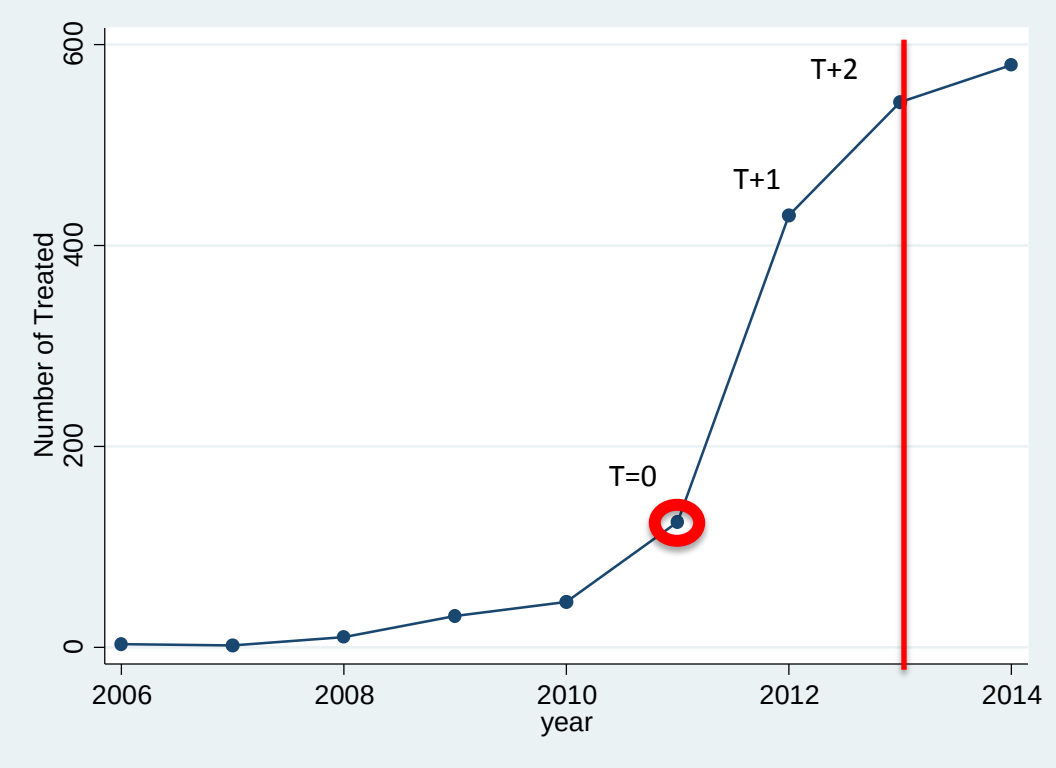
Hvor mange diabetespatienter over 40 år med LDL > 2,5 får ingen lipidsænkende medicin



Treatment definition

- We observe the monthly percentages of visits in the clinic for which the GP used the EHR system.
- If usage exceeds 70%, EHR gives access to quality feedback reports.
- Thus, we consider treated GPs whose median usage in a given year is above 70%.
- The control group consists of GPs who never used EHR.

Enrolment


Number of Treated
0
200
400
600
2006
2008
2010
2012
2014
year
T=0
T+1
T+2

Enrolment

Year	Number of treated
2013	543
2012	430
2011	125
2010	45
2009	31
2008	10
2007	2
2006	3

Year	Number of treated	Number of control	Number of obs.
2012	377	579	956
2011	70	579	649

Data

Population

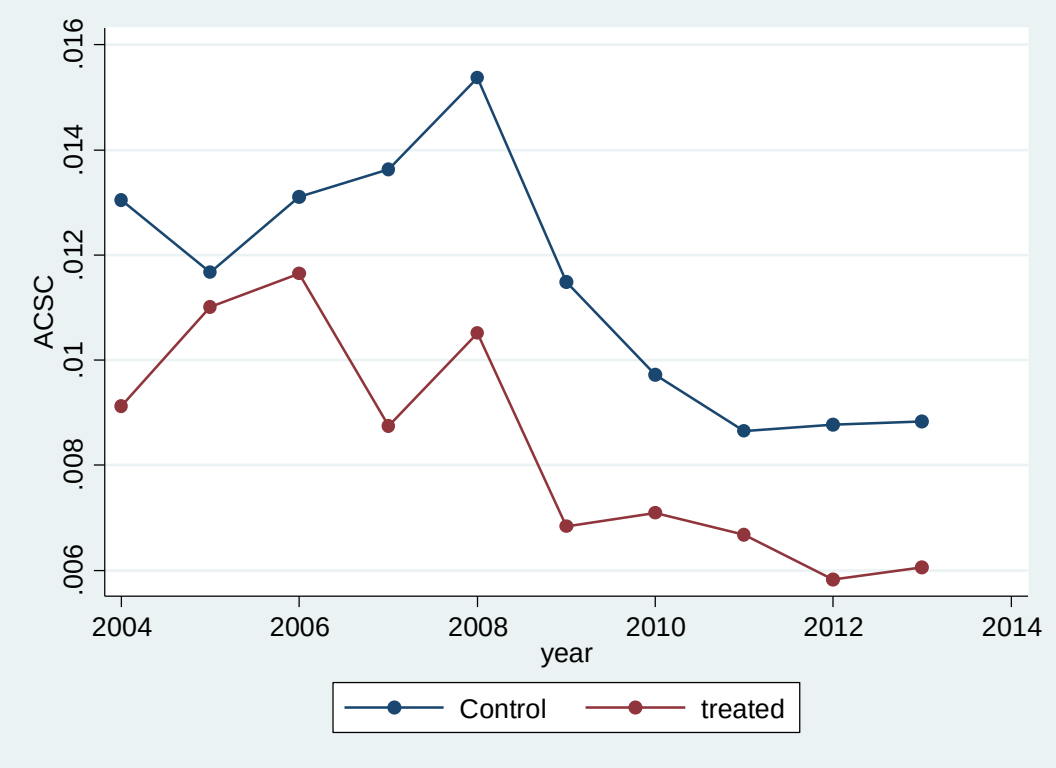
Our data ranges from 2004 to 2013 and includes:

- Circa 2000 GP's (all GP's in Denmark).
- Circa 200.000 diabetes patients (defined by registerdata).
- Several patient characteristics.
- Several hospitalization related outcomes.

Composition bias

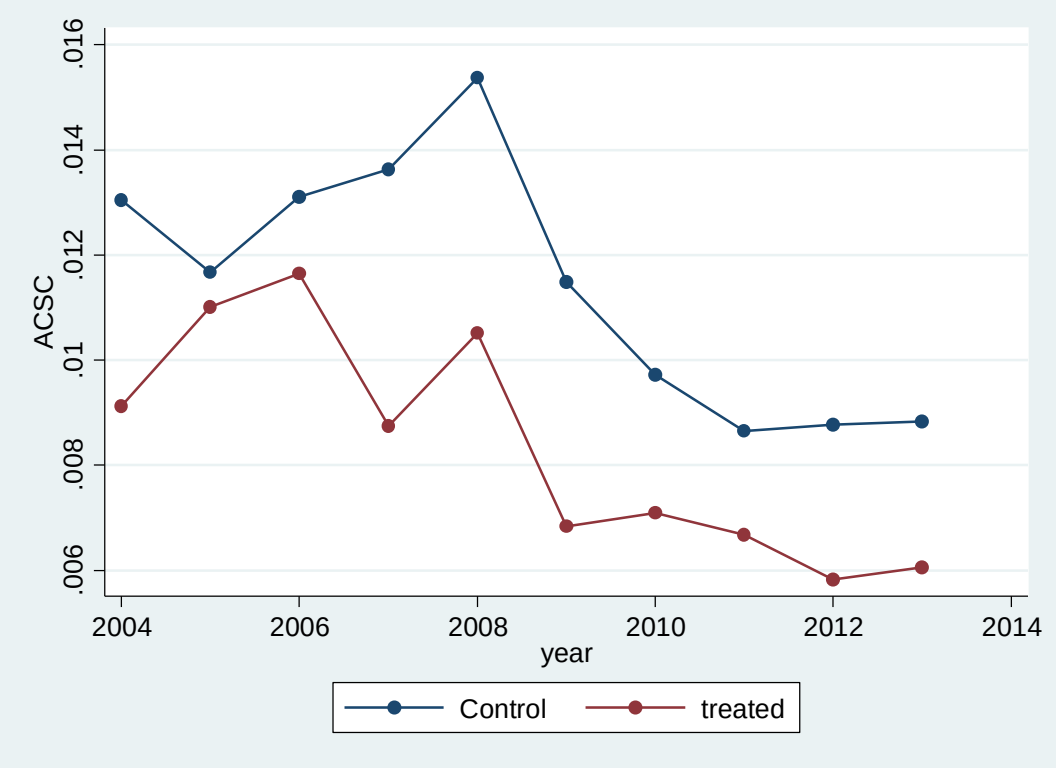
- We restrict the dataset to include only GPs which are present in our data fro 2004 to 2013.
- Outcomes are measured only for diabetes patients listed with the same GP in the pre-treatment period
- => we escape the problem of composition bias
- => we analyze how EHR affect the quality of treatment for diabetes patients that are (probably) already known to the GP at date of enrolment

Ambulatory Care Sensitive Conditions



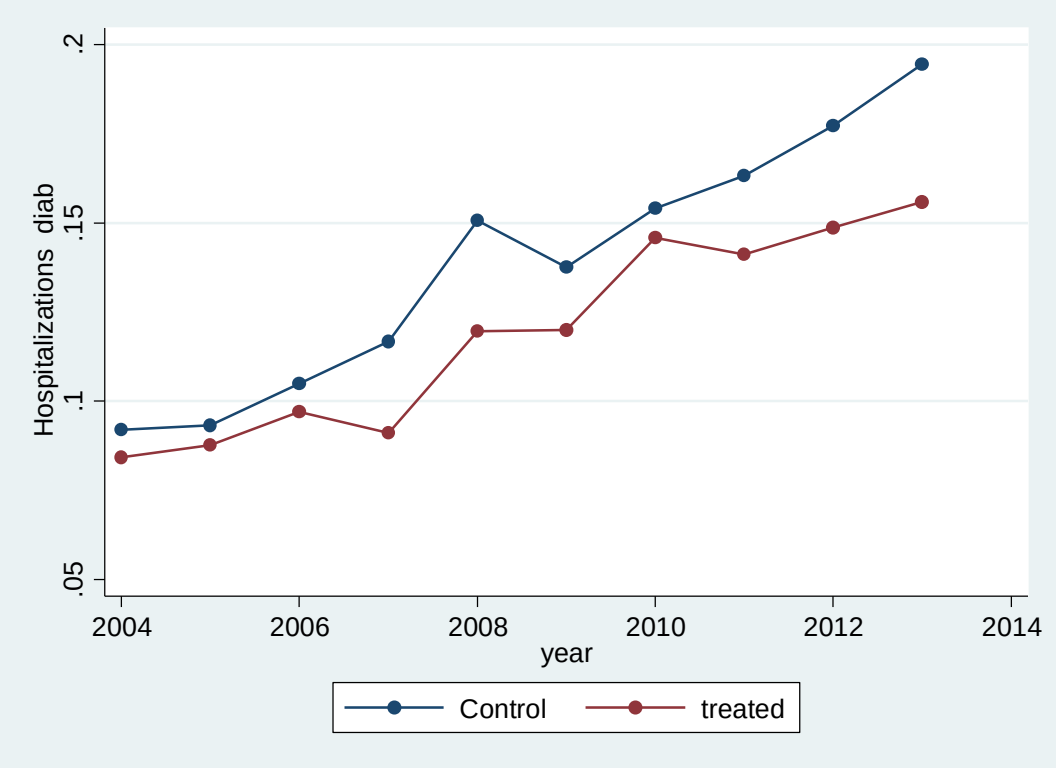
Yearly mean number of ACSC by treatment status

Ambulatory Care Sensitive Conditions



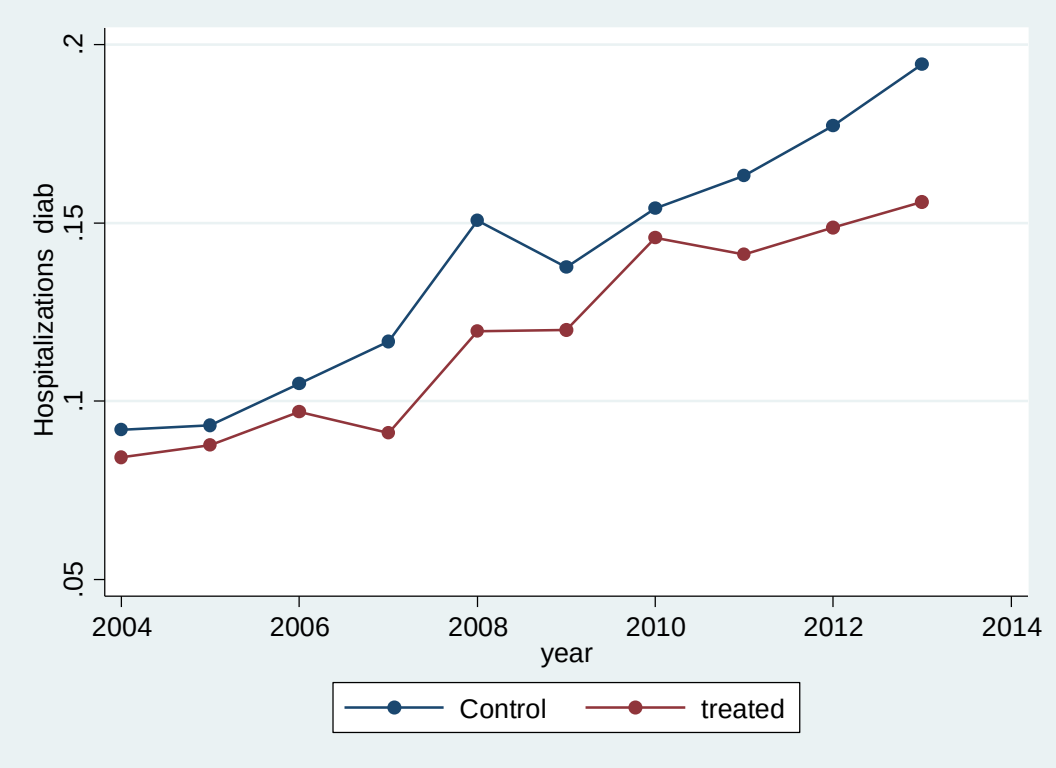
Yearly mean number of ACSC by treatment status

Diabetes related Hospitalizations



Yearly mean number of diabetes related hospitalizations by treatment status

Total number of Hospitalizations



Yearly mean number of hospitalizations by treatment status

Choice of covariates

Hypothesis about selection:

- Practices with special interest/high quality in diabetes management
- Practices with IT skills
- Practices with excess capacity to implement
  - Practices with less deprived patients
  - Larger practices
- Geographical variation

Covariates

Category and variables	Source
High quality diabetes GPs	
Use of specific diabetes services and prophylactic visits – 6 variables	National Health Insurance Register
Number visits per patient –1 variable	National Health Insurance Register
Diabetes medication per patient (in DKK) – 1 variable	National Prescription Register
Pre-treatment outcomes – 7 years/variables	Hospital admission register
IT-skills	
Use of email consultations – 1 variable	National Health Insurance Register
Excess capacity	
List size – 1 variable	National Health Insurance Register
DADI index indicators for diabetes pts – 7 variables	Socio demographic registers from Statistics Denmark
Geographical variation	
Regional location – 1 variable	National Health Insurance Register

Socio-demographic covariates

Variables in DADI index
1. Share of unemployed between 20 and 59 years of age
2. Share of 25-59 years of age without secondary education
3. Share of 25-65 years of age with low income
4. Share of 18-59 years of age on public benefits
5. Share with non-western ethnicity
6. Share of 30+ years of age living alone
7. Share of 70+ with low income

Selection into treatment ACSC

Variable name	Marginal effect	S.e.
X_tp_consultations2010	0.02***	0.01
X_tp_influenza_vacc2010	0.09*	0.07
X_tp_preventive2010	0.01*	0.01
X_tp_email2010	0.02**	0.01
X_tp_hba1c2010	-0.02**	0.01
X_listsize2010	0.00***	0.00
X_charlson2010	0.02*	0.04
X_tp_homevisits2010	0.02*	0.04
X_tp_tlf2010	-0.01*	0.00
X_socio_12010	5.53*	8.92
X_socio_22010	1.97*	2.77
X_socio_32010	-1.49*	6.11
X_socio_42010	-5.56*	5.67
X_socio_62010	-0.63*	2.86
X_socio_72010	-0.17*	2.19
X_socio_82010	-1.57*	2.40
Y_ACSC_diab2004	-0.75*	0.56
Y_ACSC_diab2005	0.46*	0.51
Y_ACSC_diab2006	0.05*	0.46
Y_ACSC_diab2007	-1.18**	0.59
Y_ACSC_diab2008	-0.70*	0.51
Y_ACSC_diab2009	-1.04*	0.65
Y_ACSC_diab2010	0.01*	0.61

Identification strategy

Identification problem

- Because of self-selection in the time of enrolment we cannot directly compare enrolled with non-enrolled GPs
- Given our relatively long panel data (2004-2013) two identification strategies are possible: **DiD**, and **Matching** (controlling for pre-treatment outcomes).

DiD vs Matching

- **DiD** control for time invariant unobservables
- **Matching** control for all the temporary shocks which affected the pre-treatment outcomes.
- However, **Matching** can also capture part of time invariant unobservables if several pre-treatment outcomes are included
- Lechner (2013), Imbens and Wooldridge (JEL, 2009), and Chabé-Ferret (JoE, 2015) suggest that **Matching** is more robust than **DiD** when several pre-treatment periods are included

Non-parametric PSM

- We use the distance-weighted radius matching estimator with bias adjustment as proposed in Lechneret et al. (2011)
- We use the three more recent pre-treatment outcomes for the Mahalanobis distance
- Inference is based on the asymptotic standard errors.

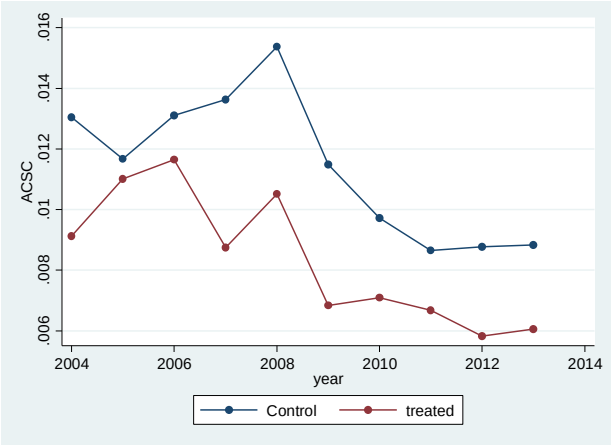
Parametric model – continous treatment

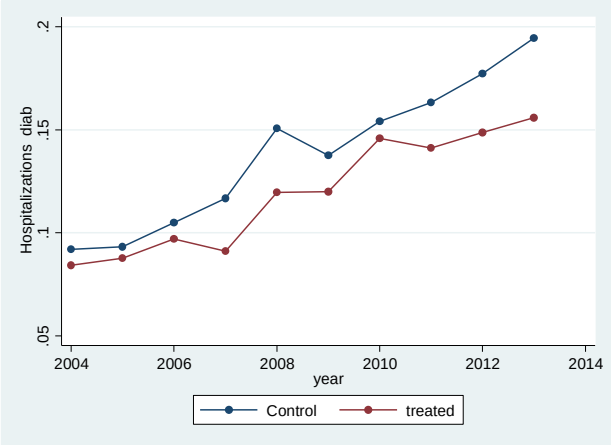
- As a robustness check we run a linear model with the yearly median EHR usage as the main treatment variable:

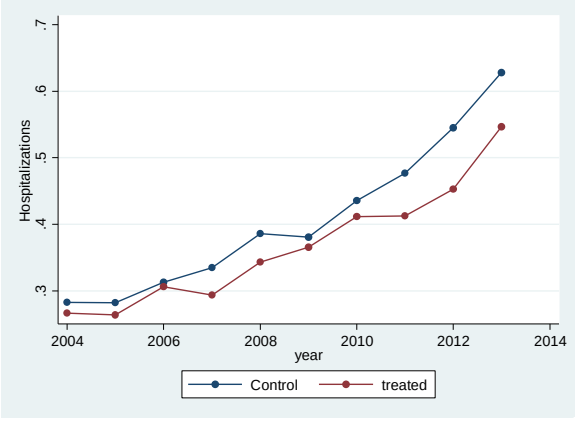
- $Y_{t+k} = c + \gamma_{EHR} EHR_{median} + \delta_1 Y_{t-1} \ldots \delta_7 Y_{t-7} + \mathbf{X'\beta} + \varepsilon_i$
- k=0,1,2

Results

Graphical inspection







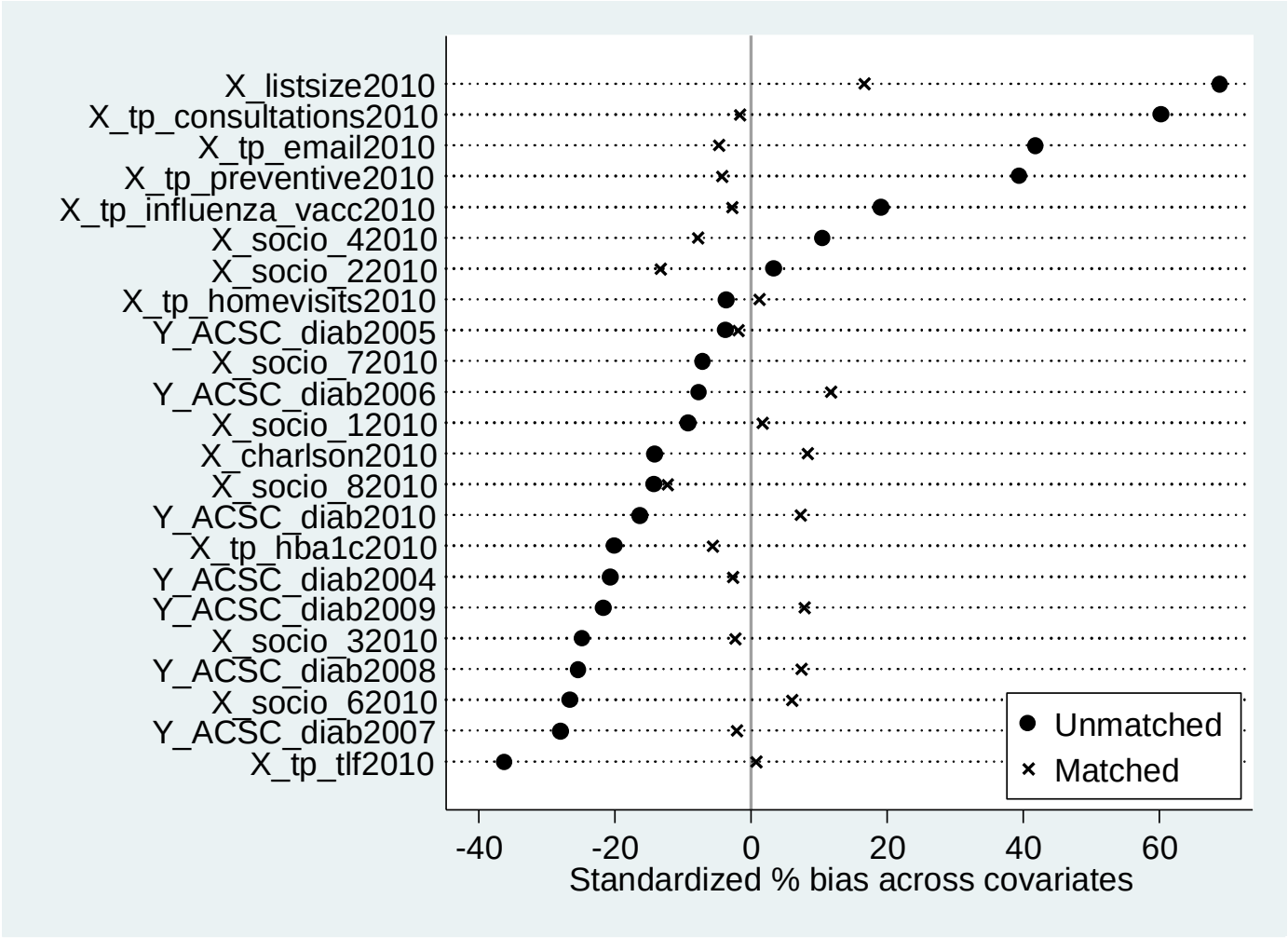
Before Matchning comparison

Variable name	Treated	Control.	SBias	t-stat	P-value
X_tp_consultations2010	7.16	6.18	60.30***	4.52	0.00
X_tp_influenza_vacc2010	0.35	0.32	19.10	1.36	0.17
X_tp_preventive2010	1.45	1.11	39.50***	3.07	0.00
X_tp_email2010	0.94	0.62	41.90***	3.33	0.00
X_tp_hba1c2010	1.06	1.25	-20.10	-1.56	0.12
X_listsize2010	2,551	1,680	68.90***	6.70	0.00
X_charlson2010	0.71	0.75	-14.10	-1.00	0.32
X_tp_homevisits2010	0.18	0.19	-3.70	-0.24	0.81
X_tp_tlf2010	5.12	5.94	-36.20**	-2.68	0.01
X_socio_12010	0.00	0.00	-9.20	-0.65	0.52
X_socio_22010	0.01	0.01	3.30	0.24	0.81
X_socio_32010	0.00	0.00	-24.80*	-1.72	0.09
X_socio_42010	0.00	0.00	10.60	0.76	0.45
X_socio_62010	0.00	0.00	-26.60*	-1.74	0.08
X_socio_72010	0.01	0.01	-7.10	-0.50	0.61
X_socio_82010	0.01	0.01	-14.20	-0.98	0.33
Y_ACSC_diab2004	0.01	0.01	-20.70	-1.57	0.12
Y_ACSC_diab2005	0.01	0.01	-3.80	-0.28	0.78
Y_ACSC_diab2006	0.01	0.01	-7.60	-0.56	0.58
Y_ACSC_diab2007	0.01	0.01	-28.00*	-1.89	0.06
Y_ACSC_diab2008	0.01	0.02	-25.40	-1.82	0.07
Y_ACSC_diab2009	0.01	0.01	-21.70	-1.39	0.17
Y_ACSC_diab2010	0.01	0.01	-16.30	-1.14	0.26
Y_inpatient_diabetes2004	0.08	0.09	-12.10	-0.86	0.39
Y_inpatient_diabetes2005	0.09	0.09	-8.40	-0.66	0.51
Y_inpatient_diabetes2006	0.10	0.10	-10.50	-0.76	0.45
Y_inpatient_diabetes2007	0.09	0.12	-36.50**	-2.47	0.01
Y_inpatient_diabetes2008	0.12	0.15	-37.70**	-2.43	0.02
Y_inpatient_diabetes2009	0.12	0.14	-22.70	-1.51	0.13
Y_inpatient_diabetes2010	0.15	0.15	-6.50	-0.42	0.67
Y_inpatient2004	0.27	0.28	-11.80	-0.82	0.41
Y_inpatient2005	0.26	0.28	-14.70	-1.09	0.28
Y_inpatient2006	0.31	0.31	-4.90	-0.38	0.71
Y_inpatient2007	0.29	0.33	-27.80*	-1.92	0.06
Y_inpatient2008	0.34	0.39	-26.30*	-1.77	0.08
Y_inpatient2009	0.37	0.38	-10.10	-0.69	0.49
Y_inpatient2010	0.41	0.44	-11.20	-0.77	0.44

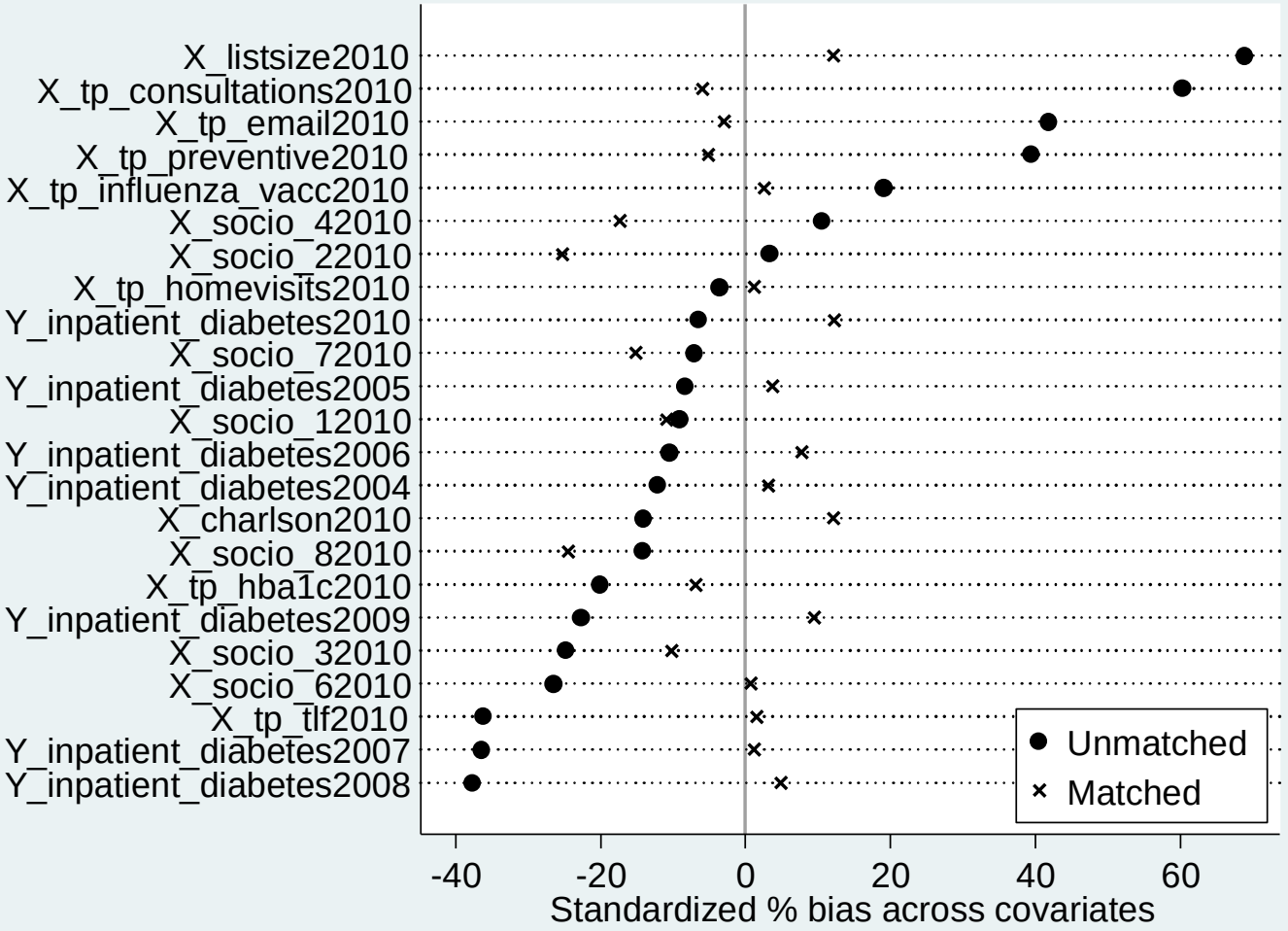
After Matchning comparison

Variable name	Treated	Control.	SBias	t-stat	P-value
X_tp_consultations2010	7.10	7.13	-1.60	-0.09	0.93
X_tp_influenza_vacc2010	0.35	0.35	-2.70	-0.18	0.86
X_tp_preventive2010	1.44	1.47	-4.30	-0.25	0.81
X_tp_email2010	0.93	0.96	-4.70	-0.24	0.81
X_tp_hba1c2010	1.08	1.14	-5.60	-0.34	0.74
X_listsize2010	2407	2196	16.60	0.97	0.33
X_charlson2010	0.72	0.69	8.30	0.58	0.57
X_tp_homevisits2010	0.18	0.18	1.20	0.11	0.92
X_tp_tlf2010	5.13	5.11	0.70	0.05	0.96
X_socio_12010	0.00	0.00	1.70	0.11	0.92
X_socio_22010	0.01	0.01	-13.30	-0.74	0.46
X_socio_32010	0.00	0.00	-2.30	-0.15	0.88
X_socio_42010	0.00	0.00	-7.80	-0.46	0.65
X_socio_62010	0.00	0.00	6.00	0.52	0.60
X_socio_72010	0.01	0.01	-7.20	-0.44	0.66
X_socio_82010	0.01	0.01	-12.30	-0.75	0.46
Y_ACSC_diab2004	0.01	0.01	-2.70	-0.18	0.86
Y_ACSC_diab2005	0.01	0.01	-1.90	-0.12	0.90
Y_ACSC_diab2006	0.01	0.01	11.80	0.80	0.42
Y_ACSC_diab2007	0.01	0.01	-2.10	-0.16	0.88
Y_ACSC_diab2008	0.01	0.01	7.30	0.51	0.61
Y_ACSC_diab2009	0.01	0.01	7.90	0.86	0.39
Y_ACSC_diab2010	0.01	0.01	7.30	0.56	0.57

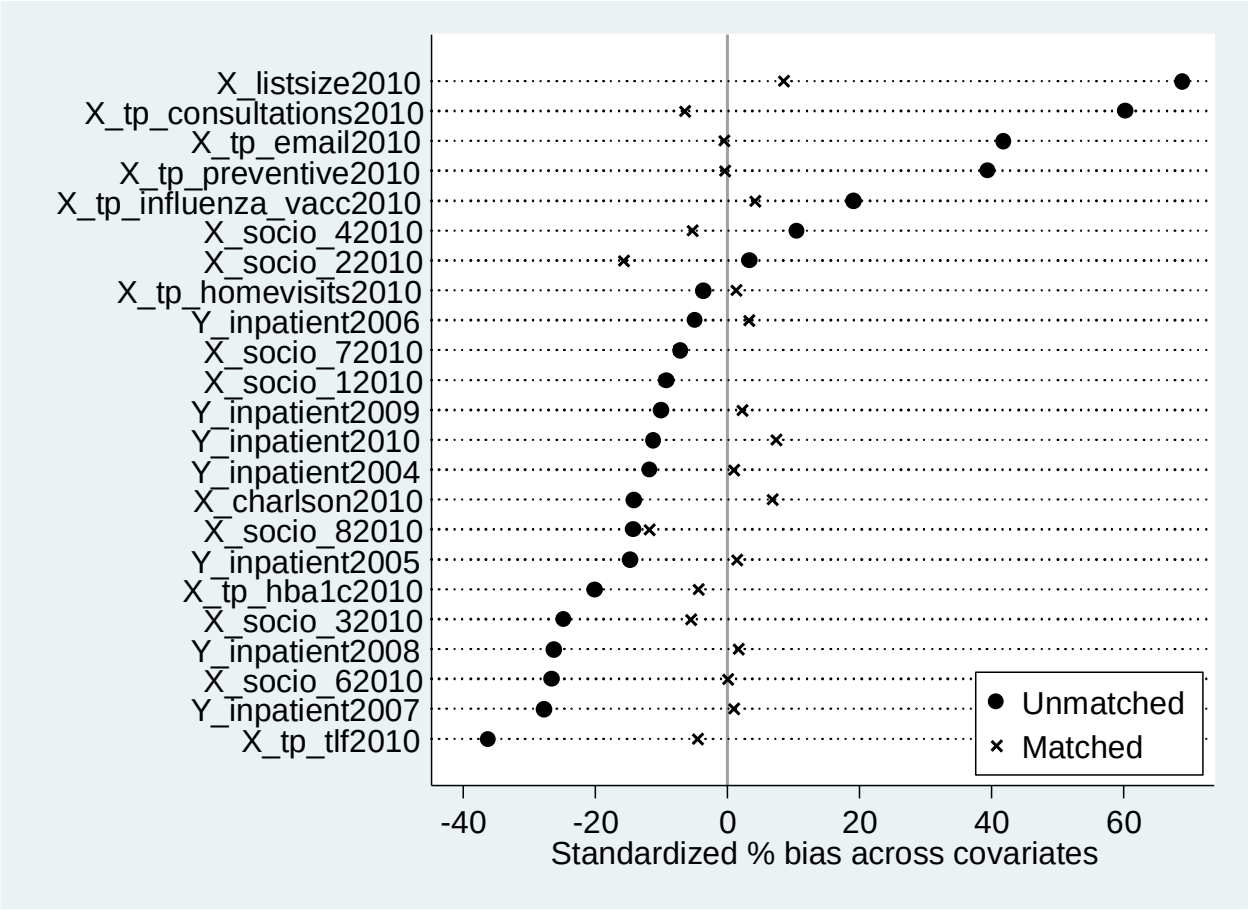
Bias reduction: ACSC



Bias reduction: Diab. Hosp.



Bias reduction: Hosp.



Results Matching

Outocome	ATT	P-value
Y_ACSC_diab2011	-0.001	0.45
Y_ACSC_diab2012	-0.004**	0.02
Y_ACSC_diab2013	-0.002	0.27
Y_inpatient_diabetes2011	-0.012	0.17
Y_inpatient_diabetes2012	-0.020*	0.09
Y_inpatient_diabetes2013	-0.025**	0.03
Y_inpatient2011	-0.039*	0.05
Y_inpatient2012	-0.072***	0.00
Y_inpatient2013	-0.062**	0.03

Outocome	γ_{median}	P-value
Y_ACSC_diab2011	-0.002	0.29
Y_ACSC_diab2012	-0.003	0.11
Y_ACSC_diab2013	-0.002	0.35
Y_inpatient_diabetes2011	-0.007	0.48
Y_inpatient_diabetes2012	-0.020	0.10
Y_inpatient_diabetes2013	-0.030**	0.02
Y_inpatient2011	-0.059***	0.00
Y_inpatient2012	-0.077***	0.00
Y_inpatient2013	-0.060*	0.09

Conclusion

- Effects are stronger for total hospitalizations.
- The parametric model gives very similar results
- The size of the effects are comparable with more high powered schemes.
- **Maybe we do not have to pay GP's to perform ?**

Discussion

- What incentives do the GPs want ?
- High versus low powered incentive schemes ?
- Intrinsic versus extrinsic motivation ?
- The Danish dilemma

To be done

- Robustness checks
  - Placebo tests: assess ATT on pre-treatment outcomes to validate CIA
  - Compare with DiD estimators
  - More covariates ?
- Reductions in hospitalizations ... which diagnosis?
- Spill-over on cardiovascular co-morbidities?
- Cardiovascular ACSC's and total costs as oucomes?