

Healthcare Quality by Specialists under a Mixed Compensation System: an Empirical Analysis

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Motivation

- ▶ Healthcare expenditures : important and rising share of GDP.
- ▶ Demand side: ageing of the population, income elasticity > 1 , covid-19 pandemic.
- ▶ Supply side: new costly technologies.
- ▶ Are healthcare resources allocated efficiently?
- ▶ Physician spending in Canada: 13.6% of total healthcare spending + Physicians influence expenditures in healthcare sector (*e.g.*, hospitals, medication).
- ▶ Design of efficient physician payment mechanisms: a priority for policy makers.

Motivation

- ▶ In Canada, three basic physician payment mechanisms: Fee-For-Service (FFS), Salary, Capitation, + Mixed Compensation (MC).
- ▶ To adequately measure effects of these mechanisms on quantity and quality of health services: one needs a reform (nat. exp.).
- ▶ In Quebec, before 1999, 92% of specialists in hospitals under FFS.
- ▶ In 1999, the Quebec government introduced a major MC system for specialists in hospitals.

Motivation

Characteristics of MC in Quebec:

- ▶ Combines a basic wage (or **per diem**) + **reduced FFS** (on average: 41% of the standard fee per service in 2000).
- ▶ During a per diem, doctors can perform clinical and nonclinical services (*e.g.*, teaching, admin. tasks) not paid under FFS.
- ▶ MC is **optional** at the department level of a hospital (requires unanimity by vote).
- ▶ In 2021, 46% of specialists in hospitals under MC.

Motivation

- ▶ The reform is likely to reduce the **quantity of clinical services** by MC specialists due to the per diem (income effect) and the lower fee per service (substitution effect).
- ▶ Dumont, Fortin, Jacquemet and Shearer (2008): MC specialists reduce the quantity of clinical services by 6.15%.
- ▶ Also MC specialists increase the quantity of nonclinical services (paid by the per diem) by 8%.
- ▶ Fortin, Jacquemet and Shearer (2021) use a structural model to show that MC reduces the clinical services by 5.2% in pediatrics.

Motivation

- ▶ Effect of MC on the **quality of clinical services** is not clear.
- ▶ An altruist MC specialist may substitute quality for quantity: less quantity but more quality.
- ▶ An egocentric MC specialist may decrease both quantity and quality (less quantity and avoidance of medical practice).
- ▶ Effect of MC on quality of healthcare services needs empirical evidence.
- ▶ Echevin and Fortin (2014: EF), using data from CHUS: MC increases length of stay (LOS) in hospital but no effect on quality, using risk of rehospitalisation as an indicator.

Aim of the paper

- ▶ Analysis of the impact of the reform on quality by MC specialists, using output-based indicators, generalizing EF in many dir.
- ▶ Multi-spell multi-state (MSMS) duration model with three states: (re)hospitalization, home, death with four transitions.
- ▶ Three quality indicators: rehospitalization rate, death rate from hospital, death rate from home.
- ▶ We introduce unobserved heterogeneity correlated across states.
- ▶ Not limited to a single hospital (EF: Sherbrooke): large number of hospitals (140) covering Quebec as a whole.
- ▶ Introduction of control variables such as diagnoses and comorbidity index to account for selection biases.

Data

- ▶ Administrative files of RAMQ.
- ▶ Patient-based sampling from 1996 to 2016. We follow 320,441 patients, starting with their first admission to hospital after 1996.
- ▶ For each stay in hospital: date of arrival, diagnosis, length of stay (LOS) before leaving for home or death.
- ▶ Patient's Individual characteristics: age, gender, date of death (when applies)
- ▶ Match with department of treating doctor + MC or FFS.

Data

Table: Transition Average Probabilities

	Home	Readmission	Death	Censure
Hospital	0.975		0.025	0.000
Home		0.020	0.031	0.949

Readmission: return within 30 days to a same department and a same diagnosis.

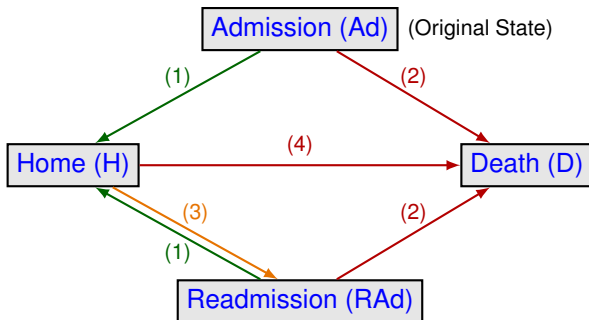
Death from home: within one year after leaving the hospital.

Table: Descriptive statistics

Statistics		(Re)Ad to Home	(Re)Ad to Death	Home to ReAd	Home to Death	Censored at Home
Length of Stay	Mean	8.02	10.80	13.77	107.23	299.92
	Sd	19.17	25.69	8.50	105.06	121.62
Mixed Comp.	Mean	0.39	0.35	0.45	0.34	0.39
	Sd	0.49	0.48	0.50	0.47	0.49
Treatment	Mean	0.62	0.54	0.67	0.52	0.62
	Sd	0.49	0.50	0.47	0.50	0.49
Post Reform	Mean	0.81	0.82	0.78	0.83	0.81
	Sd	0.39	0.38	0.42	0.37	0.39
Female	Mean	0.57	0.47	0.52	0.47	0.58
	Sd	0.49	0.50	0.50	0.50	0.49
Age	Mean	48.76	72.70	46.44	72.54	48.86
	Sd	24.03	14.90	24.75	14.50	23.83
Comorbidity Index (CCI)	Mean	1.05	4.10	1.76	4.21	0.93
	Sd	1.93	3.10	2.51	3.27	1.76
Number of stays		691,360	17,401	14,130	21,046	656,184
Number of patients		317,279	17,401	9,694	21,046	311,083
Stay/Patient		2.18	1.00	1.46	1.00	2.11

Multiple-spell multiple state duration model

Figure:



Multiple-spell multiple state (MSMS) duration model

The MSMS proportional hazard of a transition r , conditional on $x_{(r)}(T)$ and $v_{(r)}$, can be written as:

$$\lambda_{(r)}(t|x_{(r)}(T), v_{(r)}) = \lambda_{(r)0}(t) \exp(x'_{(r)}(T)\beta_{(r)}) v_{(r)},$$

where $\lambda_{(r)0}(t)$ is the (piecewise linear) baseline hazard of the transition r , common to all individuals,

where $\exp(x'_{(r)}(T)\beta_{(r)})$: expl. variables including MC which takes into account MC treating doctors after they adopt MC payment system

where $v_{(r)}$: unobserved and time-invariant heterogeneity at the individual level. Mixed weighting of the values taken by iid random var. drawn from a standard normal distr.

Selection biases in the MSMS duration model

- ▶ Problem of endogeneity: the system of payment (FFS vs MC) is a choice at the department level.
- ▶ Some doctors who prefer to treat patients with complex problems: are likely to choose MC.
- ▶ Some doctors who prefer nonclinical activities: are likely to choose MC.
- ▶ We have no exclusion restrictions to construct control functions.
- ▶ Fixed effects at the hospital level (up to 80) + fixed effects for specialties (up to 12).
- ▶ Control variable: Charlson comorbidity index.
- ▶ Parallel trends test for each transition (before reform) as in DiD.

Table: Impact of the reform on patients' risk of transition (Overall)

Cond. Hazard (log)	Model 1		Model 2		Model 3		Model 4		Model 5		Parallel trends
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	P-value
1- Admission → Home											
Mixed Compensation	-0.082***	0.004	-0.071***	0.003	-0.067***	0.004	-0.082***	0.004	-0.047***	0.003	0.071
ϕ	0.002	0.003	-	-	0.002	0.003	-0.005	0.003	-	-	
2- Admission → Death											
Mixed Compensation	0.017	0.021	0.020	0.021	0.027	0.021	0.008	0.021	0.004	0.022	0.954
ϕ	-0.346***	0.019	-	-	-0.346***	0.019	-0.344***	0.017	-	-	
3- Home → Readmission											
Mixed Compensation	0.222***	0.026	0.236***	0.025	0.218***	0.026	0.231***	0.026	0.186***	0.026	0.189
ϕ	-0.189***	0.015	-	-	-0.190***	0.015	-0.283***	0.015	-	-	
4- Home → Death											
Mixed Compensation	0.069***	0.021	0.051***	0.019	0.070***	0.021	0.060***	0.021	0.048***	0.020	0.887
ϕ	-0.598***	0.016	-	-	-0.597***	0.016	-0.789***	0.016	-	-	
<i>(simulated in M1, M3, M4) log(likelihood)</i>	-2,350,172		-2,307,238		-2,308,277		-2,328,629		-2,302,170		
Number of Patients	320,441		320,441		320,441		320,441		320,441		
Number of observations	1,400,121		1,400,121		1,400,121		1,400,121		1,400,121		
Unob. Hetero.	Yes		No		Yes		Yes		No		
Hospital FE	10 largest		10 largest		No		10 largest		80 largest		
Comorbidity Index	Yes		Yes		Yes		No		Yes		
Institution size (number of specialists)	Yes		Yes		Yes		Yes		Yes		
Specialty FE	Yes		Yes		Yes		Yes		Yes		
Diagnostic FE	Yes		Yes		Yes		Yes		Yes		
Region FE	Yes		Yes		Yes		Yes		Yes		
Linear & quadratic trends	Yes		Yes		Yes		Yes		Yes		
Year FE	Yes		Yes		Yes		Yes		Yes		
Female (patient)	Yes		Yes		Yes		Yes		Yes		
Age (patient)	Yes		Yes		Yes		Yes		Yes		

Table: Impact of the reform on patients' risks of transition (by specialty)

Cond. Hazard (log)	Model 1		Model 2		Model 3		Model 4		Model 5		Parallel trend
	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	P-value
3- Home → Ad(RAd)											
MC: Cardiology	-0.011	0.091	0.022	0.089	-0.037	0.087	-0.022	0.090	-0.099	0.091	0.521
MC: Gen. Surgery	0.481***	0.082	0.496***	0.081	0.506***	0.082	0.528***	0.081	0.415***	0.082	0.949
MC: Thor. Surgery	0.339	0.283	0.353	0.281	0.292	0.280	0.349	0.283	0.316	0.282	NA
MC: Gastro.	0.118	0.130	0.050	0.125	0.026	0.129	0.214*	0.129	-0.046	0.125	0.728
MC: Obs. & Gyn.	0.729***	0.093	0.746***	0.092	0.696***	0.093	0.755***	0.093	0.644***	0.095	0.658
MC: Pulmonology	0.021	0.112	0.086	0.102	0.083	0.112	0.017	0.111	0.020	0.102	0.310
MC: Inter. Med.	0.416***	0.080	0.408***	0.078	0.367***	0.080	0.437***	0.080	0.401***	0.080	0.069
MC: ORL & CFS	0.363*	0.216	0.389	0.213	0.379	0.215	0.427	0.216	0.256	0.213	0.476
MC: Pediatrics	0.782***	0.107	0.861***	0.102	0.763***	0.106	0.805***	0.106	0.899***	0.103	0.984
MC: Psychiatry	0.442***	0.077	0.395***	0.073	0.444***	0.076	0.436***	0.077	0.482***	0.075	0.639
MC: Urology	-0.255	0.200	-0.228	0.196	-0.326	0.199	-0.217	0.199	-0.314	0.197	0.729
MC: Others	-0.044	0.048	0.010	0.044	-0.011	0.047	-0.027	0.047	-0.077*	0.045	0.737
ϕ	-0.187***	0.015	-	-	-0.188***	0.015	-0.280***	0.015	-	-	
(simulated in M1, M3, M4) log(likelihood)	-2,349,294		-2,306,282		-2,307,227		-2,327,548		-2,301,265		
Number of Patients	320,441		320,441		320,441		320,441		320,441		
Number of observations	1,400,121		1,400,121		1,400,121		1,400,121		1,400,121		
Unob. Hetero.	Yes		No		Yes		Yes		No		
Hospital FE	10 largest		10 largest		No		10 largest		80 largest		
Comorbidity Index	Yes		Yes		Yes		No		Yes		

(Continued)

Cond. Hazard (log)	Model 1		Model 2		Model 3		Model 4		Model 5		Parallel trend
	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	P-value
4- Home → Death											
MC: Cardiology	-0.054	0.060	-0.045	0.056	-0.023	0.059	-0.086	0.059	-0.047	0.060	0.780
MC: Gen. Surgery	0.350***	0.050	0.305	0.045	0.363***	0.050	0.388***	0.049	0.294***	0.047	0.883
MC: Thor. Surgery	0.139	0.147	0.101	0.136	0.065	0.146	0.143	0.145	0.209	0.138	0.509
MC: Gastro.	0.028	0.112	-0.019	0.100	-0.069	0.110	0.219**	0.110	-0.054	0.102	0.737
MC: Obs. & Gyn.	0.237*	0.140	0.224*	0.131	0.236*	0.139	0.517***	0.135	0.209	0.131	0.391
MC: Pulmonology	-0.110	0.092	-0.091	0.078	-0.070	0.091	-0.043	0.090	-0.130*	0.079	0.738
MC: Inter. Med.	0.174***	0.050	0.153***	0.045	0.146***	0.050	0.225***	0.050	0.165***	0.048	0.447
MC: ORL & CFS	0.031	0.142	0.106	0.129	-0.012	0.141	0.022	0.139	0.123	0.129	0.482
MC: Pediatrics	1.415***	0.485	1.314***	0.491	1.337***	0.485	1.389***	0.489	1.419***	0.490	NA
MC: Psychiatry	0.293*	0.178	0.249	0.174	0.288	0.178	0.303*	0.177	0.306*	0.176	NA
MC: Urology	0.204*	0.116	0.171	0.105	0.167	0.115	0.212*	0.115	0.218**	0.108	0.375
MC: Others	-0.063*	0.032	-0.071	0.029	-0.046	0.032	-0.141***	0.032	-0.065**	0.030	0.421
ϕ	-0.603***	0.016	-	-	-0.602***	0.016	-0.797***	0.016	-	-	
<i>(simulated in M1, M3, M4) log(likelihood)</i>	-2,349,294		-2,306,282		-2,307,227		-2,327,548		-2,301,265		
Number of Patients	320,441		320,441		320,441		320,441		320,441		
Number of observations	1,400,121		1,400,121		1,400,121		1,400,121		1,400,121		
Unob. Hetero.	Yes		No		Yes		Yes		No		
Hospital FE	10 largest		10 largest		No		10 largest		80 largest		
Comorbidity Index	Yes		Yes		Yes		No		Yes		

Robustness Checks

- ▶ Short-term vs. long-term effects for each transition: < 2 years, 2-4 years, 5-9 years, ≥ 10 years.
 - ▶ For each transition, the sign of the effect never change from the short term to the long term. However, the effect in absolute value increases over time.
- ▶ Early vs Late Adopters
 - ▶ When significant, the sign of the effect of Home to Readmission (+) does not change. The sign of the effect of Home to Death does not change (+).

Conclusion

- ▶ Our results suggest that MC reform reduces the quality of clinical services provided by MC specialists in hospitals.
- ▶ Risk of hospital readmission increases (18.6%).
- ▶ In particular, Gen. Surgery, Obs. & Gyn., Inter. Med., Pediatrics, Psychiatry.
- ▶ Risk of death from home increases (4.8%).
- ▶ In particular, Gen. Surgery, Inter. Med., Pediatrics, Urology, but not Others (≤ 0).

Conclusion

- ▶ From these results and previous results, MC reform reduces both quality and quantity of clinical services.
- ▶ N.B. May decrease unnecessary clinical services: positive aspect (but this effect is likely to be modest given the shortage of clinical services in Quebec).
- ▶ N.B. Increases nonclinical services such as administrative tasks and teaching: positive aspect.
- ▶ All in all, not clear that MC reform has a positive effect on patients.