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Research

Association between change in physician remuneration and use of peritoneal dialysis: a population-based cohort analysis

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Abstract

Background: Health care payers are interested in policy-level interventions to increase peritoneal dialysis use in end-stage renal disease. We examined whether increases in physician remuneration for peritoneal dialysis were associated with greater peritoneal dialysis use.

Methods: We studied a cohort of patients in Alberta who started long-term dialysis with at least 90 days of preceding nephrologist care between Jan. 1, 2001, and Dec. 31, 2014. We compared peritoneal dialysis use 90 days after dialysis initiation in patients cared for by fee-for-service nephrologists and those cared for by salaried nephrologists before and after weekly peritoneal dialysis remuneration increased from $0 to $32 (fee change 1, Apr. 1, 2002), $49 to $71 (fee change 2, Apr. 1, 2007), and $71 to $135 (fee change 3, Apr. 1, 2009). Remuneration for peritoneal dialysis remained less than hemodialysis until fee change 3. We performed a patient-level differences-in-differences logistic regression, adjusted for demographic characteristics and comorbidities, as well as an unadjusted interrupted time-series analysis of monthly outcome data.

Results: Our cohort included 4262 patients. There was no statistical evidence of a difference in the adjusted differences-in-differences estimator following fee change 1 (0.89, 95% confidence interval [CI] 0.44–1.81), 2 (1.15, 95% CI 0.73–1.83), or 3 (1.52, 95% CI 0.96–2.40). There was no significant difference in the immediate change or the trend over time in peritoneal dialysis use between fee-for-service and salaried groups following any of the fee changes in the interrupted time-series analysis.

Interpretation: We identified no statistical evidence of an increase in peritoneal dialysis use following increased fee-for-service remuneration for peritoneal dialysis. It remains unclear what role, if any, physician payment plays in selection of dialysis modality.

Peritoneal dialysis (performed at home) is associated with similar overall survival and at least equivalent quality of life compared to in-centre hemodialysis,[1–5] and is associated with much lower health care costs.[6] However, peritoneal dialysis is used much less frequently than hemodialysis.[7] In the United States, less than 10% of patients with incident end-stage renal disease initiate dialysis with peritoneal dialysis,[8] whereas in Canada, 20%–25% of patients do.[9]

Internationally, health care policies ranging from strict "peritoneal-dialysis–first" approaches to financial incentives to dialysis facilities that encourage greater peritoneal dialysis use[10,11] aim to increase peritoneal dialysis use. For example, the US adopted a prospective payment system in 2011 providing equal payment regardless of dialysis modality (thus reimbursing peritoneal dialysis higher than its cost), which was associated with a 30%–40% relative increase in incident peritoneal dialysis use.[8,12–14] This together with other research[11,15,16] suggests that facility-level reimbursement can affect peritoneal dialysis use, particularly in profit-driven systems.

Physicians may also respond to economic incentives, although there has been less research examining the effect of physician-level dialysis remuneration on the type of dialysis initiated. It is possible that low physician payment for peritoneal dialysis may be a barrier to its use. Studies have shown that increased payment for in-centre hemodialysis compared to peritoneal dialysis was associated with a reduction in

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peritoneal dialysis use[17] and that changing from a fee-for-service remuneration system (which paid more for hemodialysis than peritoneal dialysis) to a capitation system (which paid physicians equally for peritoneal dialysis and hemodialysis) may have slowed the decline in peritoneal dialysis use.[18]

We used a natural experiment in which remuneration for peritoneal dialysis changed over a 15-year period in Alberta to examine the association between increasing payment for peritoneal dialysis and peritoneal dialysis use.

Methods

Setting

In this population-based analysis, we examined changes in a provincially determined fee schedule during 2 discrete periods: Jan. 1, 2001–Mar. 31, 2004 and Apr. 1, 2005–Dec. 31, 2014 (Figure 1). Patients cared for by fee-for-service nephrologists were the intervention group, and those cared for by salaried nephrologists (among whom there was no change in payment over time) were the comparison group. Including salaried nephrologists allowed us to control for local trends in peritoneal dialysis not related to fee changes, as the behaviour of salaried physicians should not have been influenced directly by fee schedule changes.

Patients receiving outpatient care in preparation for dialysis are cared for by a primary nephrologist. We defined a patient's "most responsible nephrologist" as the nephrologist with the highest number of outpatient claims in the 90–365 days before dialysis initiation. The payment model for each patient's assigned nephrologist was determined at dialysis initiation.

Study period 1 (Jan. 1, 2001–Mar. 31, 2004)

Before Apr. 1, 2002, there was no billing code for peritoneal dialysis. Fee change 1 occurred on Apr. 1, 2002, introducing a weekly fee remunerating fee-for-service nephrologists $32.16 per patient receiving peritoneal dialysis. There were 21 fee-for-service nephrologists across Alberta and 16 salaried nephrologists in 1 urban centre as of 2001.

Exclusion period (Apr. 1, 2004–Mar. 31, 2005)

In April 2004, the salary program expanded to another urban centre, and the weekly fee was increased. Owing to simultaneous interventions, as well as the change in payment models for nephrologists, we excluded patients who started dialysis between Apr. 1, 2004, and Mar. 31, 2005 from the statistical analysis.

Study period 2 (Apr. 1, 2005–Dec. 31, 2014)

At the start of study period 2, the fee for peritoneal dialysis was $49.15 per week. Fee change 2 occurred on Apr. 1, 2007, when the fee increased to $70.94 per week. Fee change 3 occurred on Apr. 1, 2009, when a single weekly fee code was introduced for all patients receiving dialysis (hemodialysis or peritoneal dialysis) at $135 per week. There were 20 fee-for-service nephrologists across Alberta and 46 salaried nephrologists practising in 2 large urban centres as of 2005.

Data sources

We used data from the Northern and Southern Alberta Renal Program registries (which include clinical information for all patients receiving dialysis in Alberta and those with advanced chronic kidney disease seeing nephrologists[19]) along with data from the Alberta Kidney Disease Network[20] to identify patients starting long-term dialysis or receiving a renal transplant, the date of dialysis initiation and the dialysis modality. We obtained patient demographic and clinical details, and nephrologists' remuneration method and other characteristics from Alberta Health administrative data.[20]

Study population

Eligible participants were all adult (age ≥ 18 yr) Albertans who started long-term dialysis between Jan. 1, 2001, and Dec. 31, 2014. Patients who recovered kidney function within 90 days of starting dialysis were excluded, but patients were included if the dialysis was intended to be long-term but they died or received a kidney transplant within 90 days. We included those who died or received a transplant to be consistent with intention-to-treat-principles and to reduce any bias that

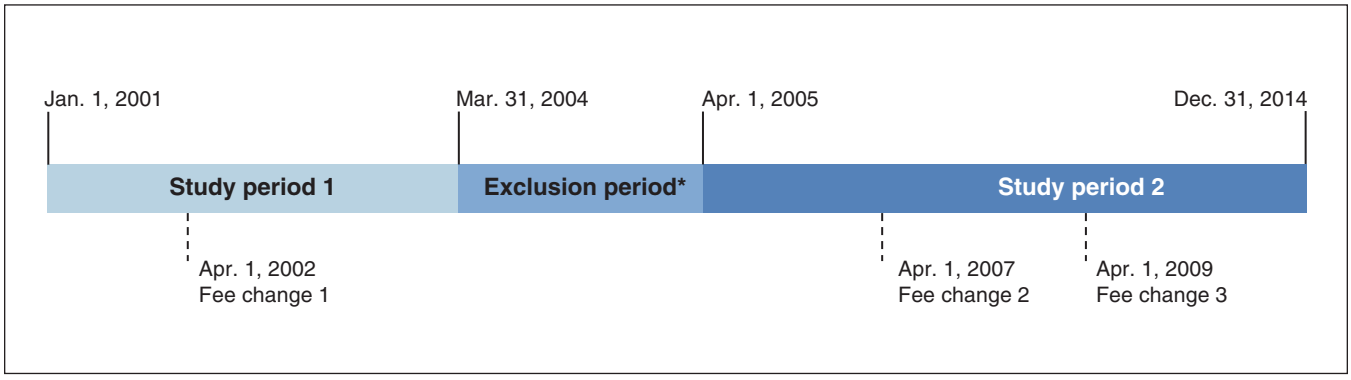

Figure 1: Division of the entire study period for analysis purposes. Fee change 1 = introduction of weekly billing code for patients receiving peritoneal dialysis at $32.16. Fee change 2 = increase in weekly billing code for patients receiving peritoneal dialysis from $49.15 to $70.94. Fee change 3 = introduction of weekly billing code for all dialysis modalities at $135. Note that, during the exclusion period, the weekly billing code for patients receiving peritoneal dialysis was increased from $32.16 to $49.15, but we did not analyze this increase owing to the simultaneous expansion of the salaried program. *Patients who started dialysis during this period were excluded.

might occur if mortality was different between fee-for-service and salaried nephrologists. We used a 90-day period to allow for those who may have started hemodialysis acutely to transfer to peritoneal dialysis.[21] We also excluded patients who had received a renal transplant before Jan. 1, 2001; had their first nephrology visit within 90 days before starting dialysis, since there is little opportunity for physician–patient interaction or modality education, and, under these circumstances, most patients receive hemodialysis;[19] had a primary nephrologist who could not prescribe peritoneal dialysis because of the hospital he or she was affiliated with; and had missing dialysis information at 90 days.

Outcomes

The primary outcome was peritoneal dialysis use 90 days after dialysis initiation, as identified with the Northern and Southern Alberta Renal Program registries.[19] All patients receiving hemodialysis or a kidney transplant or who died within 90 days were recorded as not using peritoneal dialysis. (For the interrupted time-series analysis described in Appendix 1, available at www.cmajopen.ca/content/8/1/E96/suppl/DC1, the outcome was the monthly proportion of patients starting dialysis who were using peritoneal dialysis at 90 d).

We defined patient and physician variables at the patient level on the date of dialysis initiation. Patient variables included age, sex and chronic comorbid conditions identified by applying previously validated administrative data algorithms.[22] We used residential postal code to measure the distance to the closest hemodialysis facility and the closest peritoneal dialysis training centre, and to determine median neighbourhood household income quintile as a marker of socioeconomic status.[20] To determine neighbourhood income for an individual patient, we used a demographic registry file to identify a patient's postal code nearest to their dialysis start date and then matched the patient's postal code to the corresponding neighbourhood income quintile defined in the Canadian census nearest to the patient's dialysis start date (e.g., 2001, 2006) or in the 2011 National Household Survey (because the long-form census was not conducted in 2011).[23–26] Physician-level variables included clinical workload, years billing since 1994 and practice location, all defined by means of claims data.

Statistical analysis

We determined differences in characteristics between groups and within-group differences before and after fee changes with the *t* test or 1-way analysis of variance for continuous variables and the χ^2 test for categorical variables (Fisher exact test was used when ≥ 20% of cells had an expected value < 5). For each study period, we plotted the monthly proportion of patients starting dialysis who were using peritoneal dialysis at 90 days for the fee-for-service and salaried groups.

We performed individual patient-level analysis using a difference-in-differences logistic regression with a generalized estimating equation model. Generalized estimating equation accounts for inherent correlation in the data due to clustering of patients at the physician level.[27] Study period 2 was broken into 2 subperiods for the difference-in-differences approach: Apr. 1, 2005–Mar. 31, 2009 to assess fee change 2, and Apr. 1, 2007–Dec. 31, 2014 to assess fee change 3. We report the difference-in-differences estimator with and without adjustment for age, sex, income quintile, comorbidities, dialysis initiation as inpatient, distance between patient postal code and nearest hemodialysis facility, and distance between patient postal code and nearest peritoneal dialysis training centre. The differences-in-differences estimator is the odds ratio for peritoneal dialysis use in the fee-for-service group after versus before a fee change, divided by the odds ratio for peritoneal dialysis use in the salaried group after versus before a fee change. A difference-in-differences estimator greater than 1 implies that there was a greater increase in the odds of peritoneal dialysis use for a patient in the fee-for-service group than for a patient in the salaried group following a fee change. A differences-in-differences estimator less than 1 implies the opposite.

In secondary analyses, we conducted an interrupted time-series analysis using unadjusted segmented linear regression. Since it is possible that patients might have started dialysis with peritoneal dialysis but transferred to hemodialysis within the first 90 days, we performed a sensitivity analysis to examine the impact of changing the outcome from peritoneal dialysis use at 90 days to peritoneal dialysis use on the day patients initiated long-term dialysis. We also completed a sensitivity analysis repeating the interrupted time-series analysis using quarterly rather than monthly periods. We performed all analyses using SAS 9.4 (SAS Institute) and Stata 14.2 (StataCorp).

Ethics approval

Ethics approval was obtained from the Conjoint Health Research Ethics Board of the University of Calgary.

Results

Our cohort included 4262 patients who started long-term dialysis in Alberta between 2001 and 2014, all of whom received care from a nephrologist for at least 90 days before starting dialysis (Figure 2). There were 879 patients in study period 1 and 3120 patients in study period 2; 263 patients started dialysis during the 1-year exclusion period.

Overall, the cohorts of patients seen by fee-for-service and salaried nephrologists were similar, as were the groups seen before and after the fee changes, with only small differences noted across certain baseline characteristics (Tables 1 and 2). The characteristics of fee-for-service and salaried nephrologists were similar before and after the fee changes (within payment model groups), but there were significant differences in clinical workload and practice location between fee-for-service and salaried nephrologists in each period (Appendix 1, Supplementary Tables S1 and S2).

Figure 3 shows the proportion of patients using peritoneal dialysis at 90 days each month over time. In study period 1, 42 patients (21.3%, 95% CI 15.4%–27.3%) in the fee-for-service

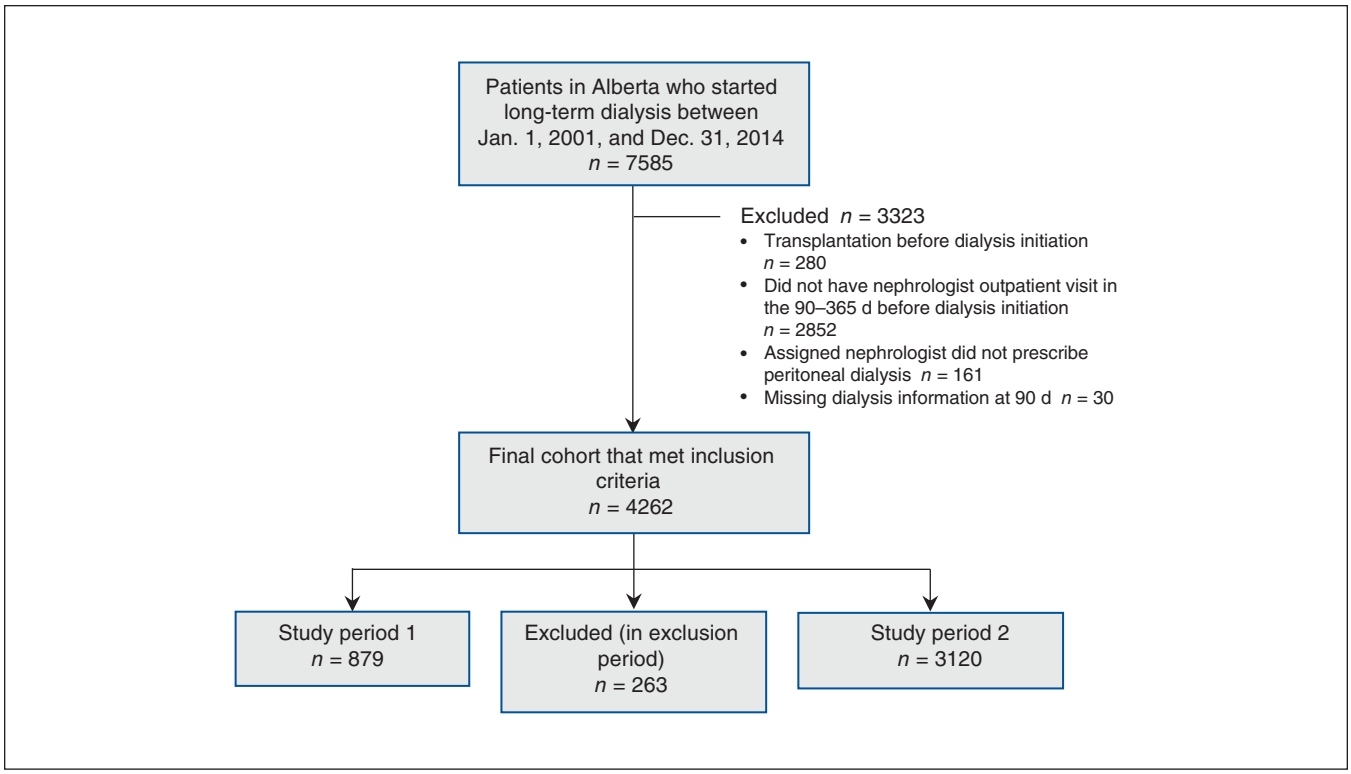

Figure 2: Flow diagram showing participant selection.

group were receiving peritoneal dialysis 90 days before fee change 1, and 58 patients (17.9%, 95% CI 13.5%–22.2%) after; the corresponding values for the salaried group were 27 (21.8%, 95% CI 14.1%–29.4%) and 54 (23.2%, 95% CI 17.5%–28.8%). In study period 2, 72 patients (22.8%, 95% CI 18.0%–27.6%) in the fee-for-service group were using peritoneal dialysis 90 days before fee change 2, 76 patients (22.7%, 95% CI 18.1%–27.3%) between fee changes 2 and 3, and 277 patients (26.0%, 95% CI 23.3%–28.7%) after fee change 3. The corresponding values for the salaried group were 90 (32.3%, 95% CI 27.6%–37.9%), 70 (29.7%, 95% CI 23.6%–35.7%) and 249 (28.0%, 95% CI 25.0%–31.0%).

The 95% CIs for all difference-in-differences estimators reported included 0, which indicates there was no statistically significant difference in the effect of a fee change on peritoneal dialysis use at the individual patient level between the fee-for-service and salaried groups, whether adjusting for covariates or not (Table 3).

Sensitivity analysis

When we used peritoneal dialysis use on the day patients initiated long-term dialysis as the outcome, interrupted time-series results remained unchanged, with no significant effect of any fee change on the aggregated monthly proportion of patients using peritoneal dialysis. At the individual patient level, the differences-in-differences estimators from the generalized estimating equation logistic regression remained nonsignificant for the effects of fee changes 1 and 2 but became significant for the effect of fee change 3, both unadjusted (differences-in-differences estimator 1.42, 95% CI 1.01–2.01) and adjusted (differences-in-differences estimator 1.65, 95% CI 1.12–2.43) for covariates.

When the interrupted time-series analysis was repeated using quarterly rather than monthly intervals, the results were unchanged.

Interpretation

There was no statistical evidence of an increase in the use of peritoneal dialysis 90 days following the implementation of fee changes that raised nephrologist remuneration for peritoneal dialysis. Our results were the same with 2 complementary quasi-experimental methodologies: an individual patient-level differences-in-differences logistic regression model, which accounted for potential clustering of patient outcomes at the physician level, and controlled for clinical and demographic covariates, and an aggregate-level interrupted time-series analysis, which allowed for visual representation and statistical analysis of the detailed trends in peritoneal dialysis use over time (Figure 3, Appendix 1).

Our results are generally consistent with those of previous studies showing that physician-level remuneration likely has little, if any, impact on use of peritoneal dialysis.[17,18] Although Erickson and colleagues[17] found a decrease in peritoneal dialysis use in the US after a switch from capitation to tiered fee-for-service, the magnitude was small (absolute difference of 0.7% over 3 yr) and may not be meaningful from a policy perspective.[17] Importantly, in our work and related research,[17,18] the amount paid for care of a patient receiving peritoneal dialysis never exceeded that of a patient receiving hemodialysis.

Table 1: Characteristics of patients in the fee-for-service and salaried groups during study period 1 (Jan. 1, 2001–Mar. 31, 2004)*

Characteristic	Fee-for-service, no. (%) of patients†		Salaried, no. (%) of patients†	
	Before fee change 1 *n* = 197	After fee change 1 *n* = 325	Before fee change 1 *n* = 124	After fee change 1 *n* = 233
No. of months	15	24	15	24
Age, yr, mean ± SD‡	62.6 ± 15.9	64.6 ± 15.7	62.7 ± 15.8	59.5 ± 16.1
Female sex	88 (44.7)	154 (47.4)	51 (41.1)	98 (42.1)
Income quintile§				
1 (lowest)	53 (26.9)	72 (22.2)	34 (27.4)	64 (27.5)
2	36 (18.3)	73 (22.5)	27 (21.8)	41 (17.6)
3	33 (16.8)	60 (18.5)	17 (13.7)	49 (21.0)
4	30 (15.2)	46 (14.2)	25 (20.2)	38 (16.3)
5 (highest)	38 (19.3)	54 (16.6)	14 (11.3)	28 (12.0)
Unknown¶	7 (3.6)	20 (6.2)	7 (5.6)	13 (5.6)
Comorbidities				
Alcohol use disorder	14 (7.1)	15 (4.6)	3 (2.4)	14 (6.0)
Cancer, nonmetastatic	14 (7.1)	16 (4.9)	5 (4.0)	11 (4.7)
Chronic heart failure‡	79 (40.1)	148 (45.5)	40 (32.3)	82 (35.2)
Chronic pulmonary disease‡	45 (22.8)	113 (34.8)**	37 (29.8)	62 (26.6)
Dementia	4 (2.0)	10 (3.1)	4 (3.2)	7 (3.0)
Diabetes	115 (58.4)	183 (56.3)	74 (59.7)	130 (55.8)
Myocardial infarction	15 (7.6)	31 (9.5)	10 (8.1)	21 (9.0)
Peripheral vascular disease	21 (10.7)	38 (11.7)	6 (4.8)	19 (8.2)
Stroke/transient ischemic attack	36 (18.3)	71 (21.8)	24 (19.4)	40 (17.2)
Dialysis initiation as inpatient	62 (31.5)	88 (27.1)	39 (31.4)	64 (27.5)
Distance between patient postal code and nearest hemodialysis facility, km‡††				
< 50	166 (84.3)	290 (89.2)	102 (82.3)	192 (82.4)
50–150	31 (15.7)	33 (10.2)	17 (13.7)	29 (12.4)
> 150	0 (0.0)	2 (0.6)	5 (4.0)	12 (5.2)
Distance between patient postal code and nearest peritoneal dialysis training centre, km‡††		**		
< 50	134 (68.0)	249 (76.6)	80 (64.5)	138 (59.2)
50–150	45 (22.8)	64 (19.7)	18 (14.5)	41 (17.6)
> 150	18 (9.1)	12 (3.7)	26 (21.0)	54 (23.2)

Note: SD = standard deviation.
*All covariates defined based on the date of dialysis initiation. χ^2 test was used for categorical variables (Fisher exact test when ≥ 20% of cells had an expected value < 5), and 2-sided 2-sample *t* test for continuous variables.
†Except where noted otherwise.
‡Significant at $p < 0.05$ for difference between fee-for-service and salaried groups after policy change.
§Estimated with the use of the postal code.
¶These patients had postal codes without neighbourhood income data available.
**Significant at $p < 0.05$ for within-group difference before and after fee change.
††Significant at $p < 0.05$ for difference between fee-for-service and salaried groups before policy change.

In a sensitivity analysis, we found a significant differences-in-differences effect of fee change 3 on peritoneal dialysis use at day 90 of greater than 1, which suggests that peritoneal dialysis use increased more in patients assigned to fee-for-service nephrologists after the equalization of peritoneal dialysis and hemodialysis remuneration than it

Table 2: Characteristics of patients in the fee-for-service and salaried groups during study period 2 (Apr. 1, 2005–Dec. 31, 2014)*

Characteristic	Fee-for-service, no. (%) of patients†			Salaried, no. (%) of patients†		
	Before fee change 2 *n* = 316	Between fee changes 2 and 3 *n* = 335	After fee change 3 *n* = 1065	Before fee change 2 *n* = 279	Between fee changes 2 and 3 *n* = 236	After fee change 3 *n* = 889
No. of months	24	24	69	24	24	69
Age, yr, mean ± SD‡	64.1 ± 15.5	62.91 ± 15.7	63.4 ± 14.6	63.1 ± 15.1	63.2 ± 14.1	61.3 ± 15.6
Female sex	132 (41.8)	116 (34.6)	424 (39.8)	111 (39.8)	84 (35.6)	333 (37.5)
Income quintile§			¶			
1 (lowest)	85 (26.9)	87 (26.0)	300 (28.2)	80 (28.7)	56 (23.7)	238 (26.8)
2	73 (23.1)	78 (23.3)	235 (22.1)	60 (21.5)	57 (24.2)	208 (23.4)
3	62 (19.6)	66 (19.7)	187 (17.6)	41 (14.7)	42 (17.8)	153 (17.2)
4	53 (16.8)	60 (17.9)	154 (14.5)	53 (19.0)	41 (17.4)	133 (15.0)
5 (highest)	43 (13.6)	42 (12.5)	135 (12.7)	45 (16.1)	36 (15.2)	124 (13.9)
Unknown**	0 (0.0)	2 (0.6)	54 (5.1)	0 (0.0)	4 (1.7)	33 (3.7)
Comorbidities						
Alcohol use disorder	19 (6.0)	22 (6.6)	69 (6.5)	113 (40.5)	21 (8.9)	68 (7.6)
Cancer, nonmetastatic	14 (4.4)	15 (4.5)	63 (5.9)	11 (3.9)	16 (6.8)	65 (7.3)
Chronic heart failure††	150 (47.5)	147 (43.9)	447 (42.0)	100 (35.8)	93 (39.4)	351 (39.5)
Chronic pulmonary disease	101 (32.0)	105 (31.3)	328 (30.8)	85 (30.5)	96 (40.7)	265 (29.8)
Dementia	14 (4.4)	15 (4.5)	43 (4.0)	6 (2.2)	8 (3.4)	38 (4.3)
Diabetes	185 (58.5)	201 (60.0)	760 (71.4)¶	151 (54.1)	139 (58.9)	565 (63.6)¶
Myocardial infarction	42 (13.3)	53 (15.8)	167 (15.7)	33 (11.8)	46 (19.5)	140 (15.7)
Peripheral vascular disease	26 (8.2)	34 (10.1)	108 (10.1)	24 (8.6)	28 (11.9)	105 (11.8)
Stroke/transient ischemic attack	69 (21.8)	65 (19.4)	264 (24.8)	55 (19.7)	52 (22.0)	211 (23.7)
Dialysis initiation as inpatient‡††	126 (39.9)	130 (38.8)	440 (41.3)	89 (31.9)	81 (34.3)	320 (36.0)
Distance between patient postal code and nearest hemodialysis facility, km‡						
< 50	286 (90.5)	299 (89.2)	957 (89.9)	239 (85.7)	209 (88.6)	776 (87.3)
50–150	28 (8.9)	29 (8.7)	89 (8.4)	37 (13.3)	23 (9.7)	102 (11.5)
> 150	2 (0.6)	7 (2.1)	19 (1.8)	3 (1.1)	4 (1.7)	11 (1.2)
Distance between patient postal code and nearest peritoneal dialysis training centre, km‡†††‡‡			¶			
< 50	229 (72.5)	216 (64.5)	790 (74.2)	199 (71.3)	164 (69.5)	645 (72.6)
50–150	66 (20.9)	84 (25.1)	193 (18.1)	34 (12.2)	35 (14.8)	99 (11.1)
> 150	21 (6.6)	35 (10.4)	82 (7.7)	46 (16.5)	37 (15.7)	145 (16.3)

Note: SD = standard deviation.
*All covariates defined based on the date of dialysis initiation. χ^2 test used for categorical variables (Fisher exact test when ≥ 20% of the cells had an expected value < 5); for continuous variables, analysis of variance when comparing time intervals within group, and 2-sided 2-sample *t* test when comparing between groups.
†Except where noted otherwise.
‡Significant at $p < 0.05$ for difference between fee-for-service and salaried groups after policy change 2.
§Estimated with the use of the postal code.
¶Significant at $p < 0.05$ for within-group difference between the 3 time periods.
**These patients had postal codes without neighbourhood income data available.
††Significant at $p < 0.05$ for difference between fee-for-service and salaried groups before policy change 1.
‡‡Significant at $p < 0.05$ for difference between fee-for-service and salaried groups in the period between policy changes 1 and 2.

did in patients assigned to salaried nephrologists. Although the effect size was small and the complementary interrupted time-series analysis was nonsignificant, this may suggest that the effects of remuneration on peritoneal dialysis use appear only when payment is at least equal. It remains unclear whether paying physicians more for peritoneal dialysis than for hemodialysis has a meaningful effect on dialysis modality selection.

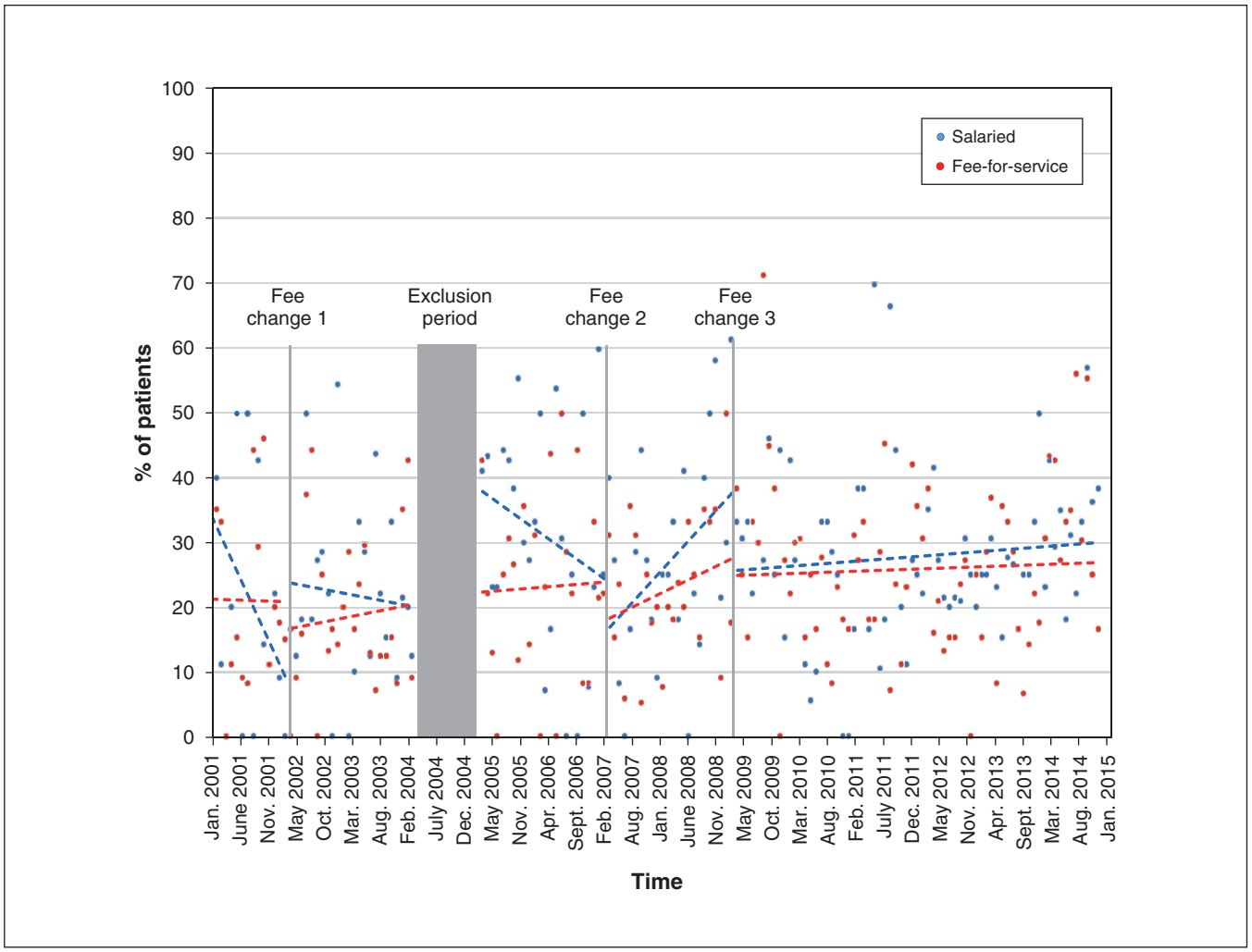

Figure 3: Proportion of patients starting long-term dialysis who were receiving peritoneal dialysis at 90 days in each month. For illustrative purposes, separate dashed regression lines for the fee-for-service and salaried groups before and after each fee change are displayed on top of the raw data.

This is not to say that remuneration does not affect physician behaviour in nephrology and other medical specialties. The 2004 US Medicare reimbursement reform, which incentivized hemodialysis through the tiered fee-for-service system, was associated with an increase in the frequency of physician visits for patients receiving hemodialysis and has been associated with small but statistically significant changes in outcomes, including reduced hospital admissions for fluid overload and overall mortality.[28–30] There is also evidence that physician remuneration may affect the rates of obstetrical and cardiac procedures.[31,32] The authors of a review and economic analysis of the impact of financial incentives on medical treatment concluded that physicians do increase health care supply as payment increases but that the response is stronger with elective procedures than with less-discretionary services,[33] such as dialysis. Therefore, it is possible that, at the individual patient level, there are stronger factors driving dialysis modality selection that lead both physicians and patients to a decision with little perceived ambiguity, thus reducing the price elasticity.

Limitations

Our study has several strengths, including the use of population-level data, robust complementary analyses and use of a control group. Although we expect that our results are generalizable to other Canadian provinces with similar nephrologist payment policies, not-for-profit dialysis facilities and independent fee-for-service physicians, the factors driving dialysis modality selection may be different in for-profit dialysis facilities, where facility-level reimbursement has been shown to influence peritoneal dialysis rates.[12,13]

We assessed our outcomes using health administrative data and clinical databases, and misclassification is possible. Furthermore, the study was not randomized, and there were some differences in baseline characteristics between groups and within groups before and after a fee change, although we controlled for these in our adjusted individual patient-level analysis. Our wide CIs reflect the fact that this study had inadequate power to detect small but potentially important effects of fee changes on peritoneal dialysis use. Furthermore, despite the large number of patients, there were only 21 and

Table 3: Results of individual patient-level analysis of peritoneal dialysis use 90 days after initiation of long-term dialysis before and after fee changes*

Model†	OR		
	Fee-for-service post–pre	Salaried post–pre	Differences-in-differences estimator (95% CI)‡
Fee change 1 (Apr. 1, 2002)			
Unadjusted	0.81	1.12	0.72 (0.35–1.48)
Adjusted§	0.83	0.94	0.89 (0.44–1.81)
Fee change 2 (Apr. 1, 2007)			
Unadjusted	1.10	0.88	1.24 (0.86–1.80)
Adjusted§	1.03	0.89	1.15 (0.73–1.83)
Fee change 3 (Apr. 1, 2009)			
Unadjusted	1.17	0.90	1.31 (0.87–1.80)
Adjusted§	1.31	0.87	1.52 (0.96–2.40)

Note: CI = confidence interval, OR = odds ratio.
*The same subset of data served for the periods after fee change 2 and before fee change 3.
†Fee change 1: weekly fee-for-service remuneration for peritoneal dialysis introduced at $32.16; fee change 2: weekly fee-for-service remuneration for peritoneal dialysis increased from $49.15 to $70.94; fee change 3: weekly fee-for-service remuneration for all patients receiving dialysis $135.
‡The differences-in-differences estimator is the odds ratio for peritoneal dialysis use in the fee-for-service group after versus before a fee change, divided by the odds ratio for peritoneal dialysis use in the salaried group after versus before a fee change.
§Adjusted model controlled for patient-level covariates shown in Tables 1 and 2.

20 fee-for-service nephrologists in study periods 1 and 2, respectively. It is possible that a larger number of nephrologists representing a spectrum of behaviour toward incentives is required to detect the true effect of increasing remuneration.

Finally, the actual remuneration for a patient receiving hemodialysis is more complex than billing codes. Payment for hemodialysis is directed to 1 rounding nephrologist who covers all patients in the unit (including those of his or her colleagues), with each nephrologist providing different amounts of rotating coverage. Thus, the perceived financial incentive (or disincentive) of dialysis modality is difficult to measure and also involves group dynamics. It is possible that our study was underpowered to detect small differences in peritoneal dialysis use. As such, researchers in other jurisdictions could conduct similar natural experiments when undergoing changes in physician remuneration for dialysis or other procedures to clarify the circumstances in which changes in fee codes might be expected to lead to changes in physician behaviour.

Conclusion

Increasing payment to fee-for-service nephrologists for providing care to patients using peritoneal dialysis was not associated with a statistically significant increase in the use of peritoneal dialysis 90 days after initiation of long-term dialysis. Policy-level interventions aimed at increasing peritoneal dialysis use should explore interventions and strategies to address other barriers to the use of this modality or consider studying the value of larger financial incentives to encourage physicians to prescribe peritoneal dialysis as their method of choice for renal replacement therapy.

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