Geographic Variation in Fracture Incidence in US Patients Receiving Hemodialysis

James B. Wetmore,[1] Jiannong Liu,[1] Heidi S. Wirtz,[2] Thy P. Do,[2] David T. Gilbertson,[1] Brian D. Bradbury,[2] Allan J. Collins[1]

[1]Chronic Disease Research Group, Minneapolis, MN and [2]Center for Observational Research, Amgen, Inc., Thousand Oaks, CA

Introduction

- Fracture burden is high in patients on hemodialysis (HD), but whether fracture incidence varies geographically is unknown.

- Given the high morbidity and mortality associated with fracture in dialysis patients, we sought to determine whether fracture risk is associated with end-stage renal disease (ESRD) network, a proxy for regional variation in care.

Methods

- The United States Renal Data System ESRD database was used. Specific elements were:
  - ESRD Medical Evidence Report
  - ESRD Death Notification
  - Kidney transplant information
  - Medicare coverage information
  - Medicare Part A (inpatient, outpatient, skilled nursing facility, home health, and hospice) claims
  - Medicare Part B (physician/supplier) claims
- Four annual cohorts, 2007-2010, of prevalent dialysis patients were created.
- Patients were required to be:
  - US patients receiving in-center HD
  - Aged 18 years or older
  - Covered by Medicare Parts A and B as primary payer for at least 1 year on January 1 of the year
- Patients were followed from January 1 of the calendar year to the earliest date of death, kidney transplant, modality switch, or loss of Medicare coverage.

- Fractures were identified using ICD-9-CM diagnosis codes and HCPCS procedure codes from inpatient and physician claims. Fractures of pelvis/hip, femur, lower leg, rib/sternum, shoulder/upper arm, and forearm/wrist were included.
- For each type of fracture, only the first event was counted in each cohort year.
- Geographic region was defined by ESRD network.
- Fracture rates were calculated as observed number of events divided by follow-up time per 100 patient-years.
- Poisson regression models were used to calculate rate ratios (RRs), unadjusted and adjusted, between each network and the national rate.
- Factors used for adjustment were age, race, sex, primary ESRD cause, body mass index, dialysis duration, and 9 comorbid conditions.
- Variation in fracture rates among networks was illustrated by presenting the difference between observed fracture rates and the unadjusted and adjusted RRs.

Results

- In total, 333,718 patients were included in the study; most appeared in multiple years (Table 1).
- Numbers of patients increased each year, from 191,681 in 2007 to 218,105 in 2010.
- Mean age was 62.3 years; 56.2% were white, 55.2% were male, and 45.7% had diabetes as primary cause of ESRD. Mean dialysis duration was 3.9 years.
- Percentage of patients by network was stable over time.
- The observed national fracture rate within the four years was 6.1 per 100 patient-years.
- The observed fracture rate varied substantially by network (Figure 1), from a low of 4.6 per 100 patient-years to a high of 7.6 per 100 patient-years.
- Correspondingly, the unadjusted RRs (Figure 2, left panel) varied from a low of 0.78 to a high of 1.30.
- Overall variation in RRs across networks did not change materially after adjustment for patient characteristics (Figure 2, right panel), varying from 0.78 to 1.14, a nearly 1.5-fold difference.

Table 1. Number and percentage of patients in each network each year.

Network	2007 N	2007 %	2008 N	2008 %	2009 N	2009 %	2010 N	2010 %
Total	191681	100	201856	100	210772	100	218105	100
1 (CT, ME, MA, RI, VT)	6228	3.3	6490	3.2	6811	3.2	7073	3.2
2 (NY)	11543	6.0	11982	5.9	12384	5.9	12674	5.8
3 (NJ, PR, US VI)	7944	4.1	8292	4.1	8621	4.1	8986	4.1
4 (DE, PA)	7725	4.0	8235	4.1	8399	4.0	8535	3.9
5 (DC, MD, VA, WV)	11705	6.1	12159	6.0	12601	6.0	13012	6.0
6 (GA, NC, SC)	20550	10.7	21745	10.8	22772	10.8	23515	10.8
7 (FL)	10726	5.6	11200	5.6	11784	5.6	12415	5.7
8 (AL, MS, TN)	11653	6.1	12176	6.0	12831	6.1	13351	6.1
9 (IN, KY, OH)	14284	7.5	15113	7.5	15685	7.4	15979	7.3
10 (IL)	8680	4.5	9126	4.5	9493	4.5	9514	4.4
11 (MI, MN, ND, SD, WI)	12546	6.6	13148	6.5	13443	6.4	13783	6.3
12 (IA, KS, MO, NE)	7672	4.0	7980	4.0	8160	3.9	8277	3.8
13 (AR, LA, OK)	8045	4.2	8487	4.2	8883	4.2	9247	4.2
14 (TX)	18867	9.8	20235	10.0	21531	10.2	22441	10.3
15 (AZ, CO, NV, NM, UT, WY)	8181	4.3	8700	4.3	9003	4.3	9476	4.3
16 (AK, ID, MT, OR, WA)	4879	2.6	5125	2.5	5413	2.6	5504	2.5
17 (So CA)	8175	4.3	8588	4.3	9064	4.3	9534	4.4
18 (No CA, HI, Guam, Samoa)	12278	6.4	13075	6.5	13894	6.6	14789	6.8

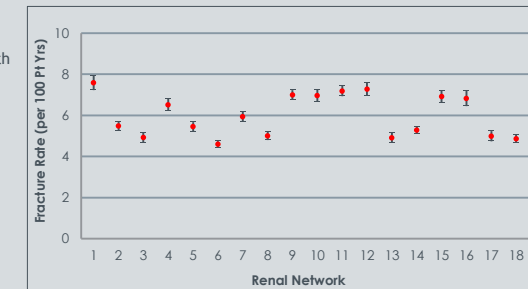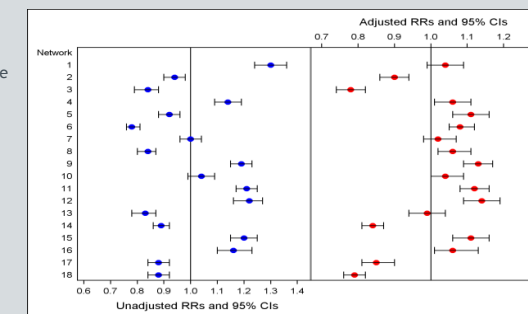Figure 1. Network-level fracture rate with 95% confidence intervals.

Figure 2. Forest plot of network-level unadjusted and adjusted rate ratios with 95% confidence intervals.

Discussion

- Fracture rates among HD patients varied substantially, about 1.5-fold, across ESRD networks.

- The significant geographic variation that appears to exist independent of patient case-mix suggests a role for the effects of differing treatment practices, in particular those relating to CKD-MBD.

- Detailed examination of regional treatment practices may help to explain some of these differences, and further strengthen the association between CKD-MBD and fracture risk in the dialysis population.

Limitations

- Fractures were derived from Medicare claims, meaning that the event times may not be precisely accurate.

- Not all types of fractures were included in this study, so the overall fracture burden might be underestimated. However, this should not confound the geographic comparison undertaken.

- We have not yet explored detailed factors that may be responsible for the geographic variation we observed.

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funded by a grant from Amgen

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