How well does hospital billing data estimate readmissions and revision risks after spinal fusion surgery compared to hospital billing linked to claims data?

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Background

Hospital databases, with detailed medical device and surgical intervention information, may be used to study medical devices but are limited to patient encounters within a single institution. Healthcare claims databases can follow insured patients over time and across health care settings, but are lacking information about specific medical devices used and surgical details. Linking hospital and claims databases may strengthen the data quality for longitudinal follow-up of surgical patients.

Objective

To assess the incremental detection of revision surgery and all-cause readmissions from hospital billing data linked to claims data versus hospital billing data alone (which is the usual data in a study using a hospital billing database) among patients that had cervical, lumbar or thoracic spinal fusion surgeries.

Methods

Study Design & Data:

This study was performed as a quality assessment using a hospital administrative database in isolation and a linked hospital + healthcare claims database.

The hospital administrative data source used was PINC AI™ Healthcare Data (PHD) maintained by Premier. The PHD is a US hospital-based, payer agnostic database that contains data on inpatient and outpatient discharge, healthcare utilization, and patient demographics, as well as detailed billing information from over 1,000 contributing hospitals.

PHD was linked to an administrative healthcare claims database (Komodo) using Datavant tokenization (Premier + Komodo, PK). Komodo consists of an aggregate of claims from 150 healthcare providers.

Study Population:

The study included patients with cervical, thoracic, or lumbar fusion surgeries with spinal pathologies related to degenerative spine disease, tumor, or trauma (index event=earliest fusion surgery during timeframe) between January 1, 2018, and September 20, 2021.

Patients were required to

- be age 65 or older at index,
- have Medicare Advantage insurance,
- have continuous insurance enrollment for one year pre- and ≥90 days post-index,
- have fusion of one spinal anatomy (cervical, thoracic, lumbar), and
- have complete Komodo claims (based on Komodo's algorithm) at least 3 months after index.

Outcomes

- 90-day all-cause readmission
- 90-, 180-, 365-, and 730-day revision . Revision surgery was defined as new procedure for fusion or other spinal intervention (laminectomy/decompression, device removal or device insertions) in the same anatomy as the index surgery and with a diagnosis code for device complication, pseudarthrosis, back pain, or spinal pathology of interest (i.e., degenerative spine disease, tumor, or trauma).

Analysis:

- All data were analyzed descriptively
- The analysis was performed for the overall cohort and by spinal anatomy.
- The analysis was conducted in: (1) hospital database only and (2) linked database.
- The cumulative incidence and 95% confidence intervals were estimated for 90-day all-cause readmission and 90-, 180-, 365-, and 730-day revision surgery outcomes.

Results

Overall, 865 patients were included in this study. Fusion of the lumbar spine was observed most frequently (60%), followed by cervical (31%), and thoracic (9%). Table 1 presents the patient and provider characteristics extracted from the PHD for patients overall and by spinal region.

Table 1. Patient and provider characteristics from the PHD

Variables	Overall N	Overall %	Cervical N	Cervical %	Lumbar N	Lumbar %	Thoracic N	Thoracic %
All	865	100.0%	267	100.0%	516	100.0%	82	100.0%
Age category								
65 - 74	401	46.4%	137	51.3%	227	44.0%	37	45.1%
75 Plus	464	53.6%	130	48.7%	289	56.0%	45	54.9%
Female	367	42.4%	96	36.0%	234	45.3%	37	45.1%
Race								
Asian	6	0.7%	1	0.4%	4	0.8%	1	1.2%
Black	72	8.3%	35	13.1%	30	5.8%	7	8.5%
Other	44	5.1%	9	3.4%	31	6.0%	4	4.9%
Unknown	10	1.2%	2	0.7%	7	1.4%	1	1.2%
White	733	84.7%	220	82.4%	444	86.0%	69	84.1%
Payer category[1]								
Medicare Traditional	56	6.5%	18	6.7%	35	6.8%	3	3.7%
Medicare Advantage	752	86.9%	225	84.3%	453	87.8%	74	90.2%
Other	57	6.6%	24	9.0%	28	5.4%	5	6.1%
Year of surgery								
2018	257	29.7%	90	33.7%	146	28.3%	21	25.6%
2019	234	27.1%	77	28.8%	134	26.0%	23	28.0%
2020	205	23.7%	58	21.7%	127	24.6%	20	24.4%
2021	169	19.5%	42	15.7%	109	21.1%	18	22.0%
Elixhauser Score								
0	20	2.3%	7	2.6%	13	2.5%	0	0.0%
1 to 2	174	19.9%	53	19.9%	113	21.9%	8	9.8%
3 to 4	309	35.7%	97	37.4%	193	37.4%	19	23.2%
5+	362	41.8%	110	41.2%	197	38.2%	55	67.1%
Elective	558	64.5%	163	61.0%	385	74.6%	10	12.2%
Setting of care								
Inpatient	814	94.1%	254	95.1%	480	93.0%	80	97.6%
Outpatient	49	5.7%	13	4.9%	34	6.6%	2	2.4%
Other	2	0.2%	0	0.0%	2	0.4%	0	0.0%
Urban - Yes	822	95.0%	258	96.6%	488	94.6%	76	92.7%
Teaching status - Yes	476	55.0%	167	62.5%	267	51.7%	42	51.2%
Provider region								
Midwest	206	23.8%	68	25.5%	120	23.3%	18	22.0%
Northeast	158	18.3%	45	16.9%	96	18.6%	17	20.7%
South	365	42.2%	116	43.4%	216	41.9%	33	40.2%
West	136	15.7%	38	14.2%	84	16.3%	14	17.1%
# of hospital beds								
000-099	12	1.4%	5	1.9%	6	1.2%	1	1.2%
100-199	108	12.5%	28	10.5%	70	13.6%	10	12.2%
200-299	121	14.0%	30	11.2%	79	15.3%	12	14.6%
300-399	141	16.3%	40	15.0%	89	17.2%	12	14.6%
400+	483	55.8%	164	61.4%	272	52.7%	47	57.3%

[1]In PHD, 57 patients were assigned nonMedicare insurances and are assigned Other. Other may include commercial, Medicaid, self-pay, charity or unknown insurances.

Overall, the risk of all-cause readmission (90-day) was 20.2% in the hospital data and 29.2% in the linked data. Similar results were observed within spinal regions.(**Figure 1**).

Figure 1. PHD and PK Database estimates of 90-day readmission risk by spinal anatomy
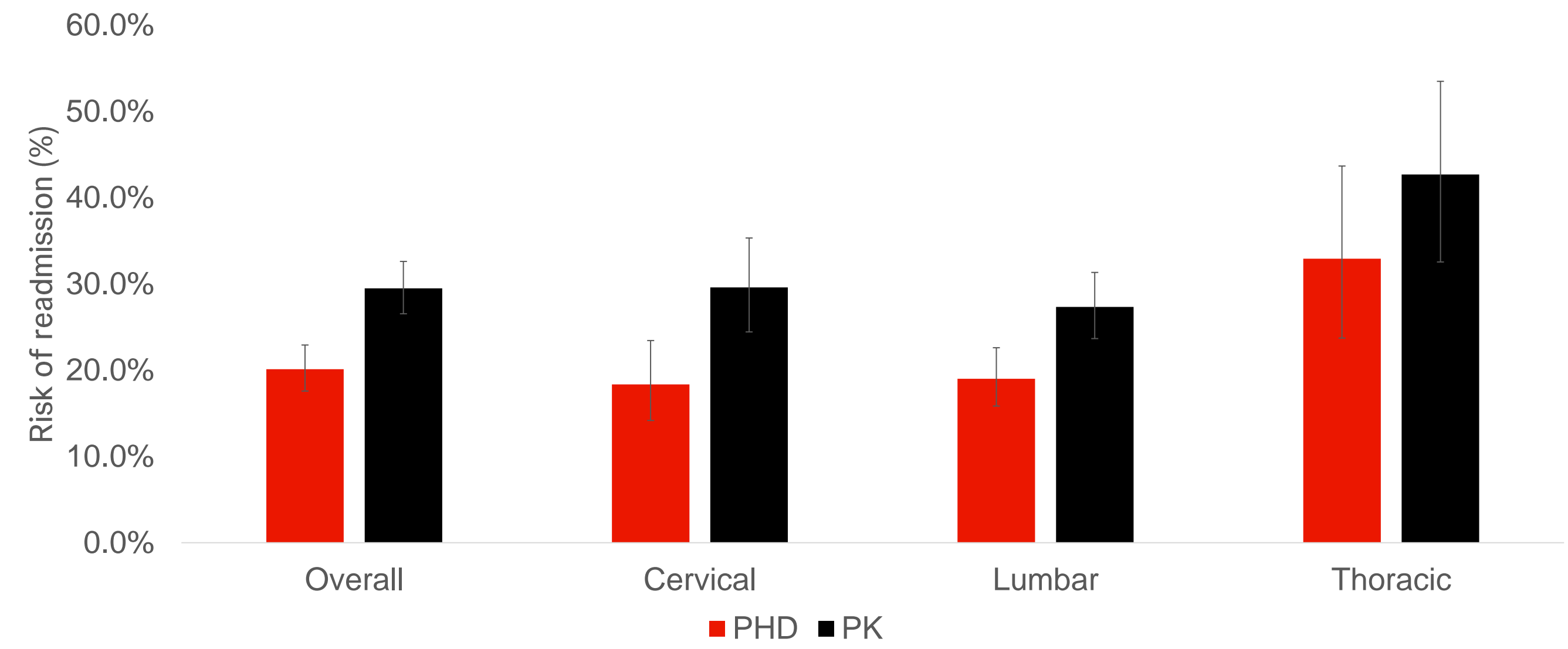
Results - continued

Overall, the risk of revision at 90 days was 2.1% (95% Confidence Interval (CI): 1.3%, 3.3%) in hospital and 2.3% (95% CI: 1.5%, 3.5) in linked data and at 730 days was 3.7% (95% CI: 2.4%, 5.7%) versus 4.7% (95% CI: 3.1%, 6.8%) in hospital alone and linked data, respectively (**Figure 2, Table 2**). Consistency in the revision estimates between data sources varied by anatomy (**Figure 3 to 5, Table 2**).

Figures 2 to 5. PHD and PK cumulative incidence of revision, overall, cervical, lumbar, thoracic[1], respectively

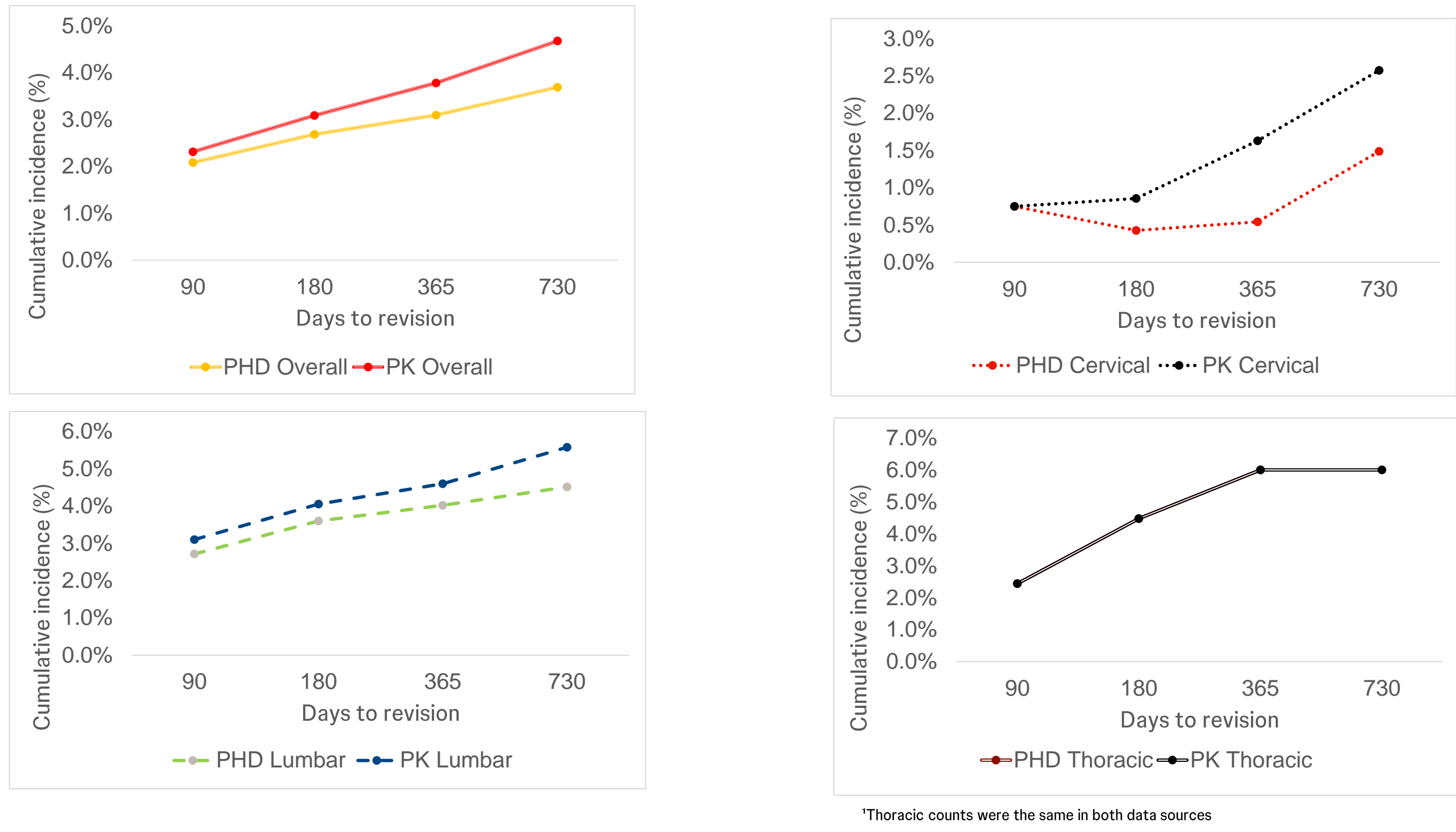*Thoracic counts were the same in both data sources

Table 2. PHD and PK cumulative incidence of revision, overall and by spinal anatomy with 95% CIs

Anatomy	Time to revision (days)	n	Premier cumulative incidence of revision n(%; 95% CI)	PK cumulative incidence of revision n(%; 95% CI)
Overall	90	865	18 (2.1%, 1.3%, 3.3%)	20 (2.3%; 1.5%, 3.5%)
Overall	180	745	20 (2.7%; 1.7%, 4.1%)	23 (3.1%; 2.1%, 4.6%)
Overall	365	582	18 (3.1%; 2.0%, 4.8%)	22 (3.8%; 2.5%, 5.7%)
Overall	730	540	20 (3.7%; 2.4%, 5.7%)	25 (4.7%; 3.1%, 6.8%)
Cervical	90	267	2 (0.7%; 0.2%, 2.7%)	2 (0.7%; 0.2%, 2.7%)
Cervical	180	234	1 (0.4%; 0.0%, 2.4%)	2 (0.9%; 0.2%, 3.1%)
Cervical	365	184	1 (0.5%; 0.0%, 3.0%	3 (1.6%; 0.6%, 4.7%)
Cervical	730	133	2 (1.5%; 0.2%, 5.3%)	4 (2.6%; 0.9%, 7.7%)
Lumbar	90	516	14 (2.7%; 1.6%, 4.5%)	16 (3.1%; 1.9%, 5.0%)
Lumbar	180	444	16 (3.6%; 2.2%, 5.8%)	18 (4.1%; 2.6%, 6.3%)
Lumbar	365	348	14 (4.0%; 2.4%, 6.6%)	16 (4.6%; 2.8%, 7.3%)
Lumbar	730	333	15 (4.5%; 2.7%, 7.4%)	17 (5.6%; 3.2%, 8.1%)
Thoracic	90	82	2 (2.4%; 0.7%, 8.5%)	2 (2.4%; 0.7%, 8.5%)
Thoracic	180	67	3 (4.5%; 1.5%, 12.4%)	3 (4.5%; 1.5%, 12.4%)
Thoracic	365	50	3 (6.0%; 2.1%, 16.2%)	3 (6.0%; 2.1%, 16.2%)
Thoracic	730	50	3 (6.0%; 2.1%, 16.2%)	3 (6.0%; 2.1%, 16.2%)

Conclusions

This study found higher observed risks of all-cause readmission within 90 days and revision of spinal fusion within 90, 180, 365 and 730 days than for hospital data alone. This was particularly evident for all-cause readmission, as patients would not necessarily be expected to use the same hospital for spine and non-spine conditions. For revision, the difference between hospital only and hospital linked to claims was smaller, consistent with the expectation that patients undergoing revision are likely to return to the same hospital as the index surgery. This study is potentially limited by the completeness of the claims data.

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