Post-acute rehabilitation and medical oversight of hip fracture patients

Kristen B. Pitzul, PhD

Canadian Association of Health Services and Policy Research

May 26th, 2017

IHPME

Background

- Fragility hip fractures (hip fractures) are defined as a fracture that occurs spontaneously or from minimal trauma.[1,2]

- Hip fractures result in substantial morbidity[3-5], mortality[6], and health care use across the entire continuum of care[7,8]

- After acute care discharge, evidence-based guidelines suggest that hip fracture patients should receive rehabilitation [9,10]

- Canadian predictions anticipate hip fractures will cost 2.4 billion dollars by the year 2041.[11]

[1] Allander et al. 1998; [2] Brown and Josee 2002; [3] Magaziner et al. 2003; [4] Borgstorm et al. 2013; [5] Chong et al. 2010; [6] Mundi et al. 2014; [7] Polder et al. 2003; [8] van Balen et al. 2002; [9]NICE guidelines 2011; [10] SIGN guidelines 2009 [11]Wiktorowicz et al. 2001

Background: What we don't know about Hip Fractures & Health Care Use

Which hip# patients should receive rehabilitation in which setting?

Long-term care

Community

Hospital

Long-term care

Institutionalized rehab
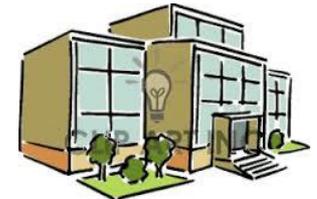
Home-based rehab

Variation in Immediate Post-Acute Discharge Destination

Immediate discharge destination, by LHIN
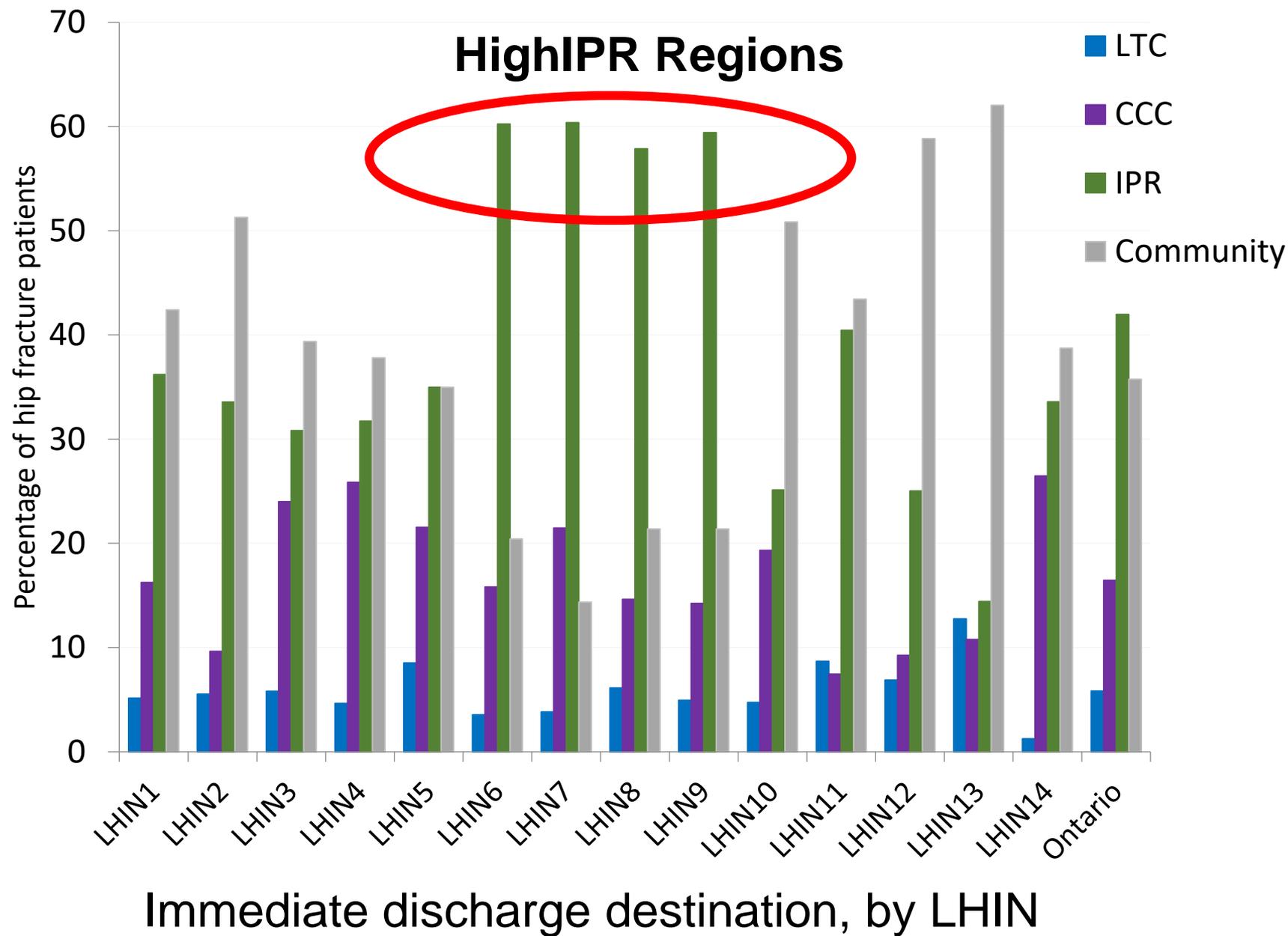
Matched cohorts within HighIPR and LowIPR regions

```
┌──────────┐  ┌──────────┐
│ Patient  │  │ Patient  │
│ IPR      │  │ Comm     │
└──────────┘  └──────────┘
      │              │
      └──────┬───────┘
             ▼
┌────────────────────────┐
│ Matched Patient        │
│ group IPR vs.          │
│ Comm                   │
└────────────────────────┘
             │
             ▼
┌────────────────────────┐
│ Proportion of patients who │
│ died or re-hospitalized up │
│ to 1 year              │
└────────────────────────┘
```
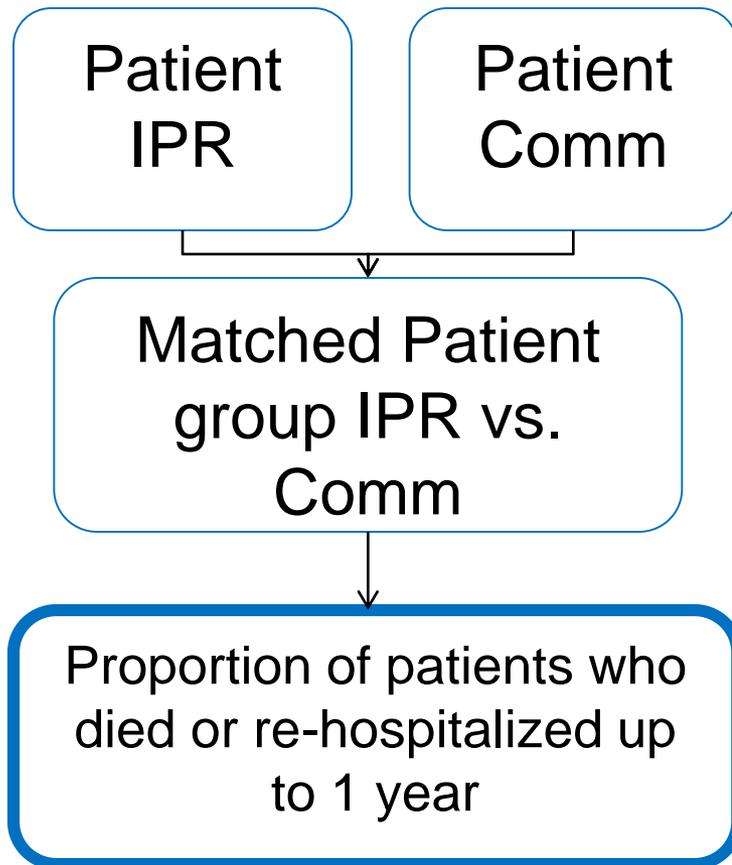
- Propensity scores generated on a number of characteristics related to the outcome

- Hard matched on age, sex, and year of index, and $\pm$ 0.2 of standard deviation of propensity score

- Standardized differences (sig $\geq$0.2)

Outcomes after matching

Table 3. Post-matching outcome, IPR vs. Comm, HighIPR Region

	HighIPR Regions (N=1,371)		
Death or re-hospitalization	IPR	Comm	SD
Within 30 days	10.4%	27.0%	0.4
Within 1 year	29.4%	41.2%	0.3

Table 4. Post-matching outcome, IPR vs. Comm, Other Region

	Other Regions (N= 4,509)		
Death or re-hospitalization	IPR	Comm	SD
Within 30 days	10.8%	42.4%	0.8
Within 1 year	30.7%	46.9%	0.3

Objective

Compare the amount of post-acute rehabilitation and medical oversight (i.e., physician visits) received by matched hip fracture patients discharged to either inpatient rehabilitation or the community within 30 days of discharge from acute care.

Approach and Cohort
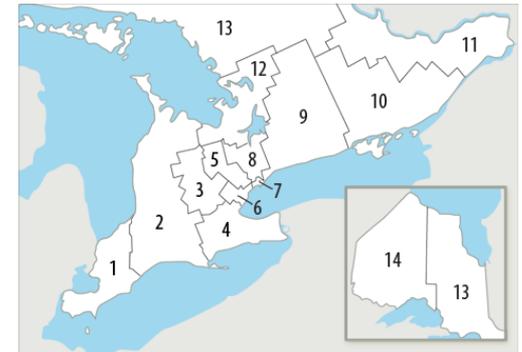
- Retrospective cohort of community-dwelling persons aged 66 and over admitted to an acute care institution for hip fracture in Ontario between fiscal 2008-2012.

- Provincial-level administrative databases were used to capture patient characteristics, post-acute utilization, patient outcomes, and health system costs and resources

Methods

- Patients discharged to IPR or to the community were propensity-score matched on a number of characteristics related to re-admissions *within health regions*

- Those who had a visit to LTC, CCC, or who died were removed

- Outcomes within 30 days of acute care:

    - Visits to home-based rehabilitation: Flagged via home care database

    - Visits to physicians: Flagged using OHIP billings (any location)

    - Intensity: number of home-based rehabilitation visits, number of days stayed in inpatient rehabilitation, and number of visits to physician

- Significance defined using standardized differences $\geq$0.2

Cohort Characteristics after exclusions

	HighIPR Comm	HighIPR IPR	SD	LowIPR Comm	LowIPR IPR	SD
Total N alive	1,671	1,687		4,996	5,348	
Age at index (Median (IQR))	82 (75-87)	82 (75-87)	0.02	82 (77-87)	83 (78-87)	0.05
sex (% female)	(71.8%)	(70.3%)	0.03	(75.9%)	(75.2%)	0.02
Previous hip fracture	(7.4%)	(4.9%)	0.10	(6.7%)	(5.8%)	0.04
Falls (1 year prior)	(44.6%)	(44.3%)	0.01	(45.6%)	(45.3%)	0.00
Home care (1 year prior)	(22.6%)	(22.8%)	0.00	(20.9%)	(22.0%)	0.03
Charlson Score 0	(58.5%)	(56.8%)	0.04	(62.7%)	(60.4%)	0.05
1	(23.4%)	(23.8%)	0.01	(21.3%)	(21.8%)	0.01
2	(10.8%)	(11.5%)	0.02	(10.2%)	(10.7%)	0.02
3+	(7.2%)	(7.9%)	0.02	(5.8%)	(7.1%)	0.05
Diagnosis of dementia at index	(7.2%)	(7.8%)	0.02	(3.0%)	(3.2%)	0.01
Index acute LOS (Mean $\pm$ SD)	12.26 $\pm$ 10.3	11.95 $\pm$ 9.1	0.03	12.63 $\pm$ 11.7	12.74 $\pm$ 9.3	0.01
IPR LOS (Mean $\pm$ SD)	n/a	25.97 $\pm$ 19.2	n/a	n/a	25.83 $\pm$ 20.0	n/a

Results: Had Rehab yes/no
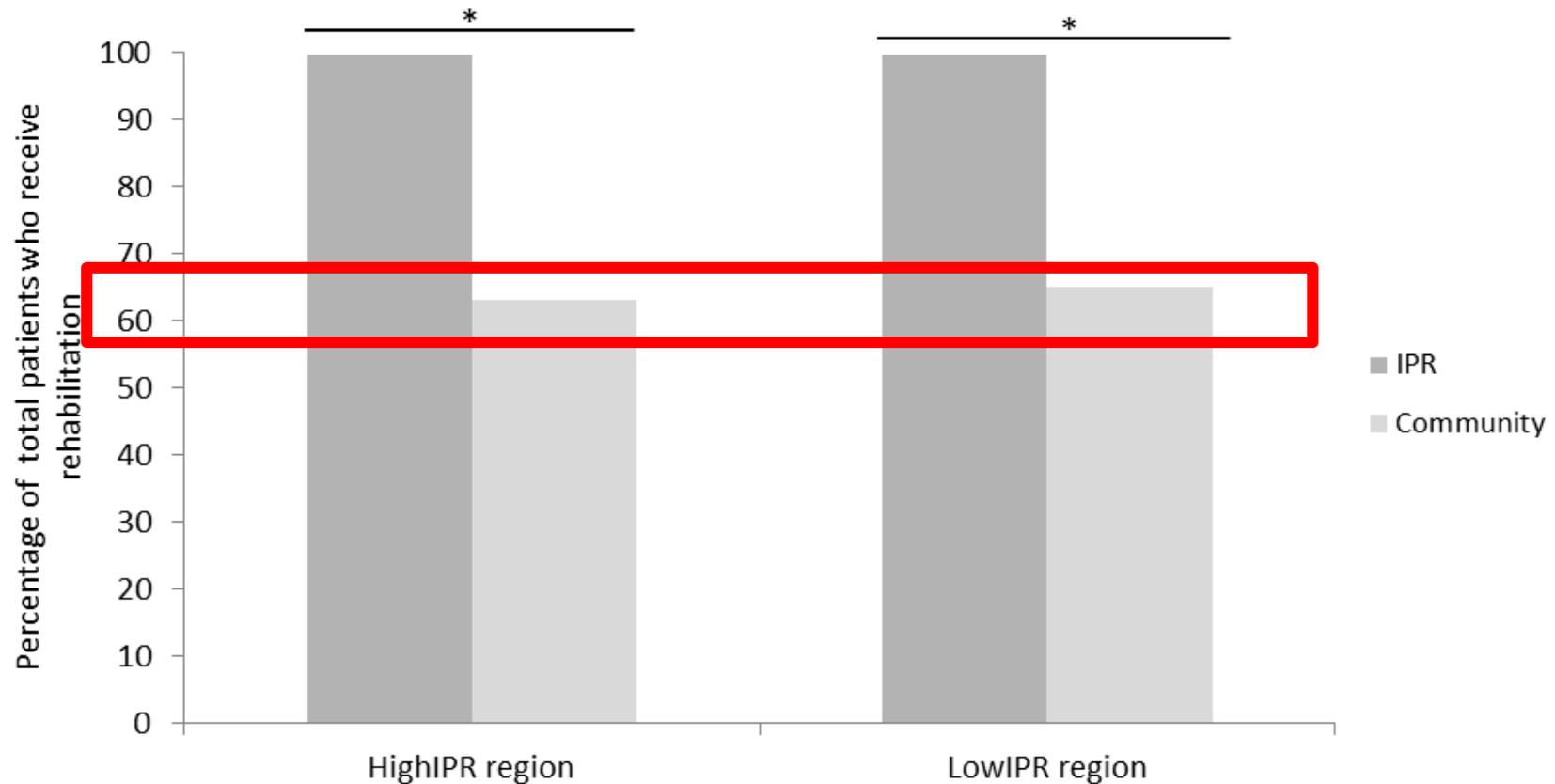
Proportion of matched patients that received post-acute rehabilitation within 30 days of acute care discharge

Results: Physician visits yes/no
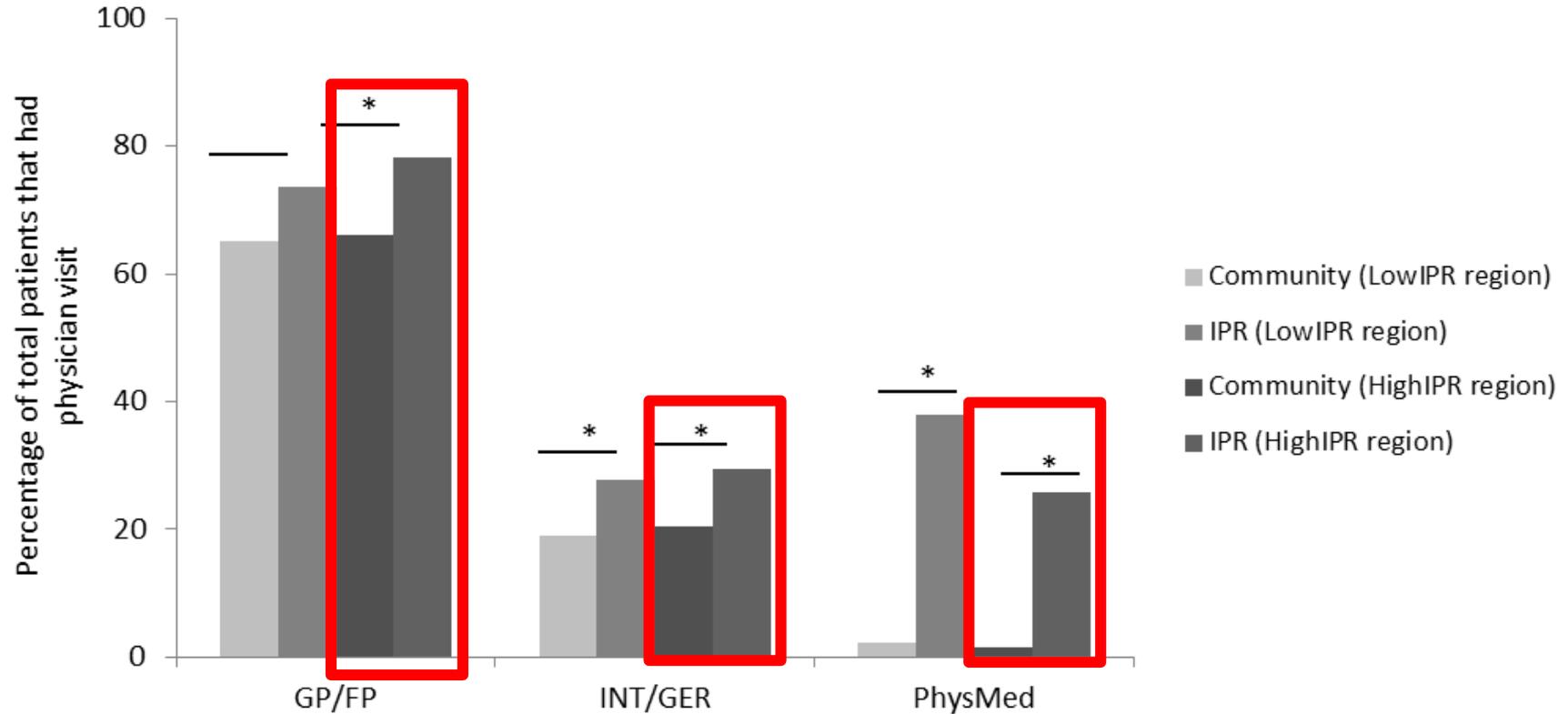
Proportion of matched community (Comm) and inpatient rehabilitation (IPR) hip fracture patients that have received a visit from either a general practitioner (GP/FP), internal or geriatric medicine specialist (INT/GER), or a physical medicine and rehabilitation specialist (PhysMed), within 30 days of acute care discharge.

Rehabilitation Intensity

Number of rehabilitation visits and proportion of patients who re-hospitalized within 30 days of acute care discharge

		HighIPR Comm	HighIPR IPR	SD	LowIPR Comm	LowIPR IPR	SD
Total N		1,055	1,683		3,253	5,338	
Intensity (N visits)	Median (IQR)	4 (2-5)	24 (16-30)	2.9	4 (3-5)	24 (17-30)	3.1
Re-hospitalization		19.0%	9.9%	0.3	27.9%	8.9%	0.5

Rehab Intensity: Quartiles
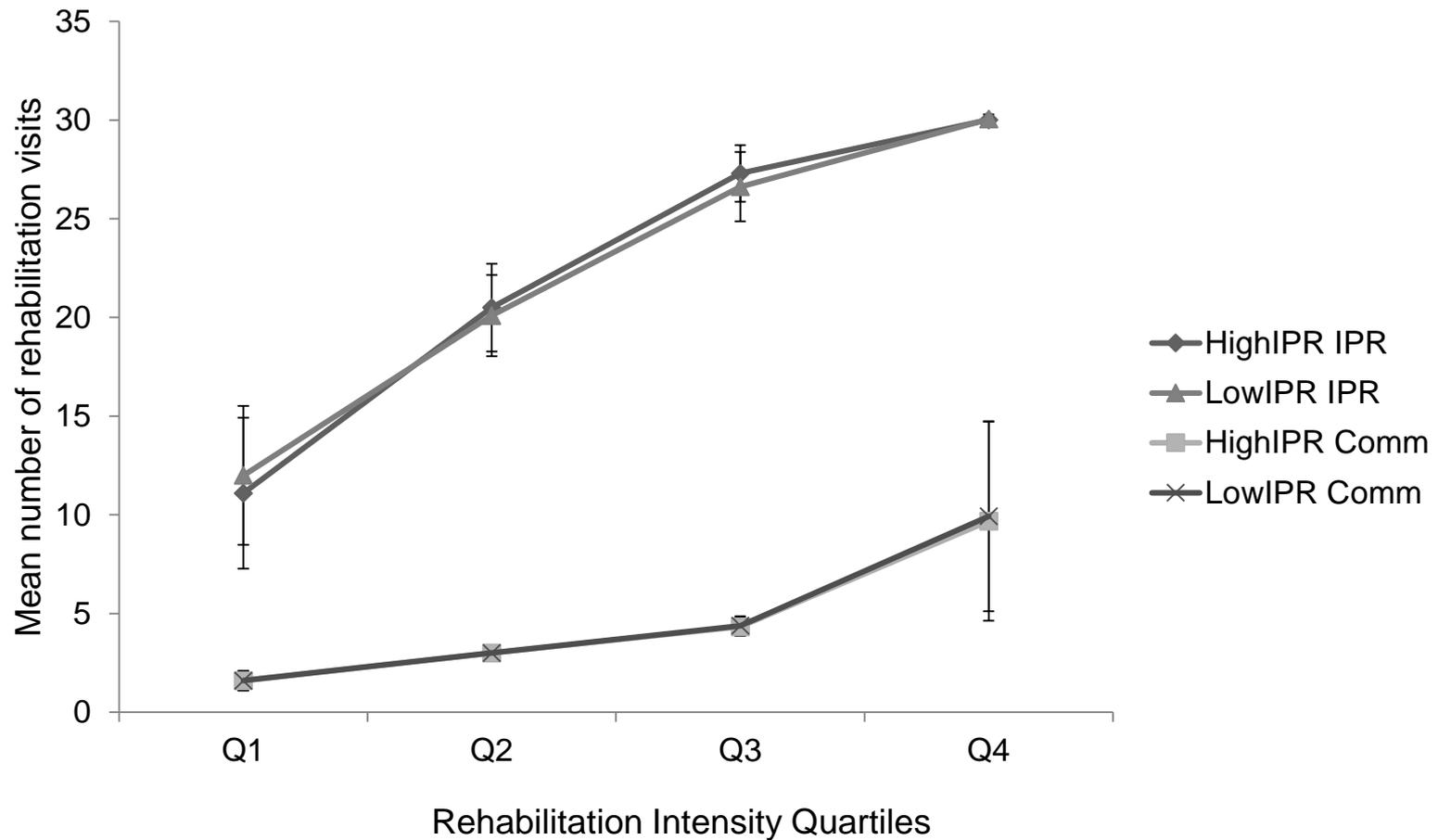
IPR & Comm: Similar Rehab Intensity

For a subset of matched community and IPR patients who had similar rehabilitation intensity:

	HighIPR Comm	HighIPR IPR	SD	LowIPR Comm	LowIPR IPR	SD
Re-hospitalized, (%N)	26.5%	18.7%	0.19	24.0%	15.4%	0.22
GP/FP	61.9%	79.5%	0.39	58.8%	76.6%	0.39
Physiatrists	4.2%	19.9%	0.50	6.1%	34.0%	0.74

Results Summary

- Total hours of rehabilitation within the first 30 days of acute care discharge should be increased for hip fracture patients discharged directly from acute care to the community to achieve similar intensities as patients treated in inpatient rehabilitation.

- Medical oversight likely plays a role in decreased re-hospitalizations for hip fracture patients during this post-acute period.

- Future research should focus on the system resources required to provide these community patients increased rehabilitation intensity, as well as further investigate the role of medical oversight

Strengths(✓) and Limitations(✗)

✓ Large N: statistical power

✓ Novel approach to understanding delivery of rehabilitation services at the system level

✗ Administrative databases: Unknown or unmeasurable covariates, non-research purposes

✗ Propensity-scores only control for measurable variables

✗ Limited to publically-financed services

Implications

- **Health Policy & Health Service Delivery:**

  - Quality of care delivered in the post-acute period must be considered by health system stakeholders and improved for hip fracture patients.

  - It is imperative that health system performance should be discussed throughout the entire continuum of care.

- **Clinicians:**

  - Consider the availability of publically-funded rehabilitation and physician visits delivered by specialists when discharging hip fracture patients directly to the community.

  - Suggestions for other sources of rehabilitation (i.e., privately-funded rehabilitation) should be made to these community patients at time of acute care discharge, and throughout the post-acute care period.

Acknowledgements

Thesis Committee

Susan Jaglal, PhD

Walter Wodchis, PhD

Michael Carter, PhD

Hans Kreder, MD MPH

Funding

IHPME, ICES, TRI

Geoff Andersen, MD PHD

Jennifer Voth, PhD

Andrew Calzavara, MSc

Suzanne Cadarette, PhD

Sarah Munce, PhD

ICES MSK group

TRI Team Optimize

Team Jaglal

Extra Slides

Study 3: HBR vs. Comm no Supp

	HighIPR HBR	HighIPR Comm no supp	SD
Total N	1,021	650	
Age at index (Median(IQR))	80 (73-85)	84 (79-89)	0.52
Sex (female)	705 (69.0%)	495 (76.2%)	0.16
Income Quintiles			
1(lowest)	176 (17.2%)	112 (17.2%)	0.00
2	213 (20.9%)	137 (21.1%)	0.01
3	161 (15.8%)	113 (17.4%)	0.04
4	221 (21.6%)	121 (18.6%)	0.08
5(highest)	247 (24.2%)	160 (24.6%)	0.01
Falls 1 year prior to index	442 (43.3%)	304 (46.8%)	0.07
Home care 1 year prior to index	188 (18.4%)	190 (29.2%)	0.26
Previous hip fracture (1991-)	69 (6.8%)	55 (8.5%)	0.06
Dementia at index	57 (5.6%)	64 (9.8%)	0.16
Charlson Score, Grouped			
0	625 (61.2%)	353 (54.3%)	0.14
1	219 (21.4%)	172 (26.5%)	0.12
2	105 (10.3%)	76 (11.7%)	0.05
3+	72 (7.1%)	49 (7.5%)	0.02
Total acute LOS (Median(IQR))	9 (6-15)	9 (5-15)	0.06
Case Management	635 (62.2%)	237 (36.5%)	0.53
Nursing	453 (44.4%)	71 (10.9%)	0.81
Other Allied Health	35 (3.4%)	<=5 (0.6%)	0.20
Personal Support and/or Homemaking	466 (45.6%)	88 (13.5%)	0.75
other Homecare	42 (4.1%)	6 (0.9%)	0.20

Study 3: HBR vs. Comm no Supp

	LowIPR HBR	LowIPR Comm no supp	SD
Total N	3,111	1,885	
Age at index (Median(IQR))	82 (76-86)	84 (79-88)	0.30
Sex (female)	2,367 (76.1%)	1,424 (75.5%)	0.01
Income Quintiles 1(lowest)	670 (21.5%)	423 (22.4%)	0.02
2	650 (20.9%)	365 (19.4%)	0.04
3	647 (20.8%)	404 (21.4%)	0.02
4	593 (19.1%)	330 (17.5%)	0.04
5(highest)	543 (17.5%)	352 (18.7%)	0.03
Falls 1 year prior to index	1,347 (43.3%)	930 (49.3%)	0.12
Home care 1 year prior to index	487 (15.7%)	557 (29.5%)	0.34
Previous hip fracture (1991-)	193 (6.2%)	140 (7.4%)	0.05
Dementia at index	66 (2.1%)	86 (4.6%)	0.14
Charlson Score, Grouped 0	2,015 (64.8%)	1,115 (59.2%)	0.12
1	635 (20.4%)	431 (22.9%)	0.06
2	298 (9.6%)	212 (11.2%)	0.05
3+	163 (5.2%)	127 (6.7%)	0.06
Total acute LOS (Median(IQR))	9 (6-15)	8 (5-16)	0.09
Case Management	1,983 (63.7%)	790 (41.9%)	0.45
Nursing	1,418 (45.6%)	202 (10.7%)	0.84
Other Allied Health	60 (1.9%)	7 (0.4%)	0.15
Personal Support and/or Homemaking	1,486 (47.8%)	248 (13.2%)	0.81
other Homecare	27 (0.9%)	<=5 (0.3%)	0.08

A) High IPR regions

Discharged Alive N=12,470

LTC 4.8%	Comm 51.4%	HC 65.8%	No Rehab 50.5%	Died N<6
CCC 16.3%	Comm 65.6%	HC 75.6%	Rehab 70.3%	Died 12.1%
IPR 59.3%	Comm 66.1%	HC 83.7%	Rehab 78.6%	Died 8.4%
Comm 19.6%	HC 86.6%	Rehab 75.6%	Died 15.1%	
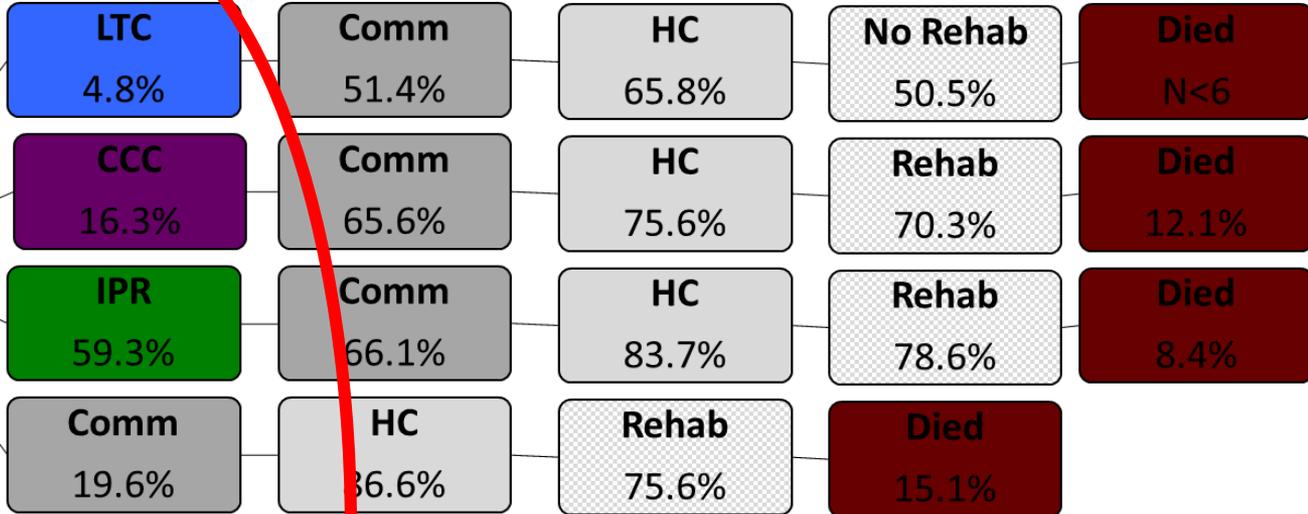
B) All Other region

Discharged Alive N=20,056

LTC 6.5%	Comm 50.3%	HC 66.0%	Rehab 50.7%	Died 9.6%
CCC 16.6%	Comm 66.3%	HC 82.8%	Rehab 7.2%	Died 11.9%
IPR 31.6%	Comm 75.5%	HC 87.1%	Rehab 78.3%	Died 7.9%
Comm 45.4%	HC 89.2%	Rehab 79.1%	Died 11.4%	
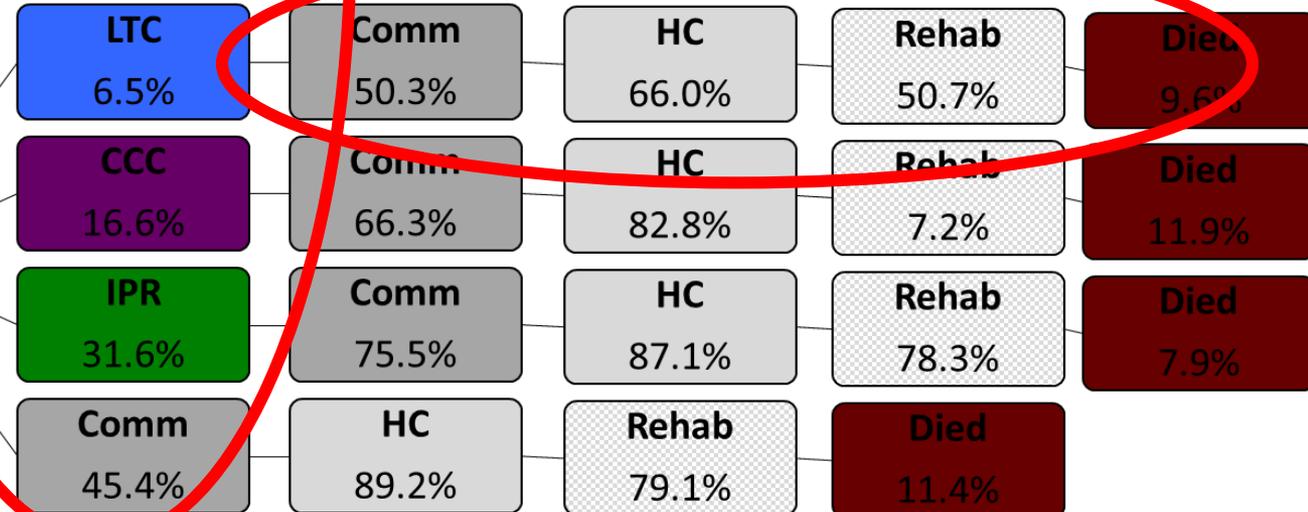
Most Common Post-Acute Care Pathways, by Health Region

Care Pathways

- Care pathways: A method of characterizing health care resource use from a systems' perspective

    - Dependent on both health system structure and patient characteristics
    - The use of various health care settings are sequentially ordered

Ontario's LHINs
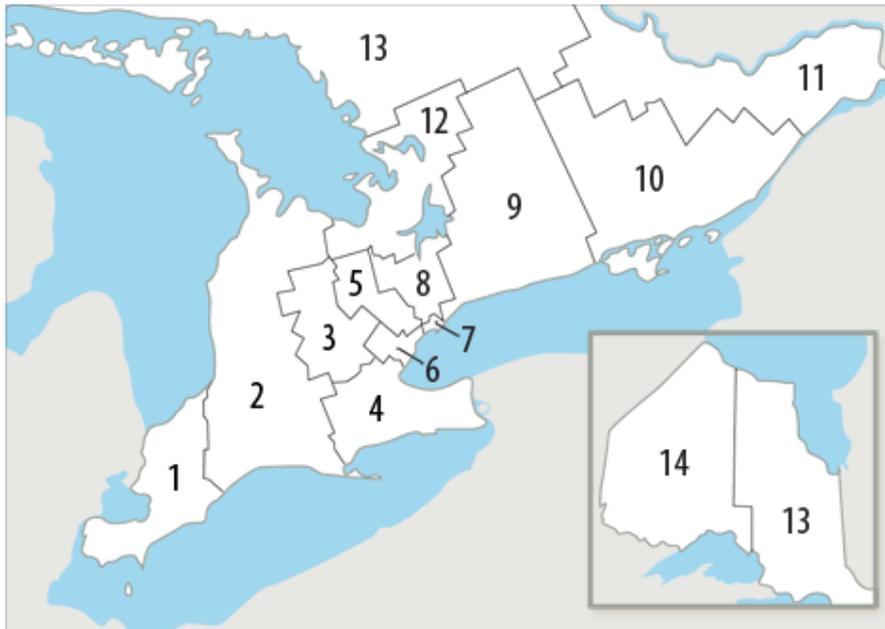
1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

```
┌─────────────────────────────┐
│ Hip fracturesextracted from │
│          database           │
│         N=58,149            │
└─────────────────────────────┘
              │
              │         ┌──────────────────────────────┐
              │────────▷│ Remove duplicate records     │
              ▼         │ (N=6,090)                    │
┌─────────────────────┐ └──────────────────────────────┘
│     N=52,059        │
└─────────────────────┘
              │         ┌──────────────────────────────┐
              │         │ Remove patients with         │
              │────────▷│ Paget's disease and          │
              │         │ pathological fractures       │
              ▼         │ (N=32)                       │
┌─────────────────────┐ └──────────────────────────────┘
│     N=52,072        │
└─────────────────────┘
              │         ┌──────────────────────────────┐
              │         │ Remove patients younger      │
              │────────▷│ than 66 years of age         │
              │         │ (N=6,377)                    │
              ▼         └──────────────────────────────┘
┌─────────────────────┐
│     N=45,650        │
└─────────────────────┘
              │         ┌──────────────────────────────┐
              │         │ Remove patients who came     │
              │────────▷│ from LTC (N=8,844); CCC      │
              │         │ (N=335); or IPR (N=170)      │
              ▼         └──────────────────────────────┘
┌─────────────────────┐
│     N=36,301        │
└─────────────────────┘
              │         ┌──────────────────────────────┐
              │         │ Standard ICES data           │
              │         │ cleaning:                    │
              │────────▷│ Non-Ontario residents;       │
              │         │ Missing age or sex; Age less │
              │         │ than 0 or greater than 105;  │
              ▼         │ Death date prior to index    │
┌─────────────────────┐ │ admission date, valid        │
│  FINAL N=36,029     │ │ unique encoded identifier    │
└─────────────────────┘ │ (N=272)                      │
                        └──────────────────────────────┘
```

49 unique pathways for post-acute resource use
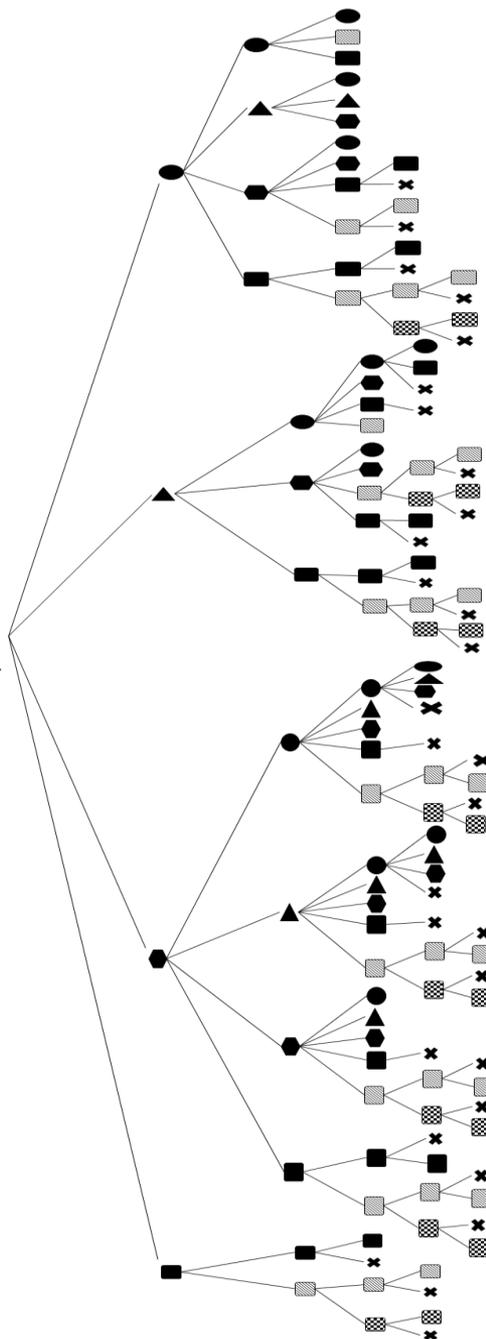
Long term Care (LTC)

Complex Continuing Care (CCC)

Inpatient Rehabilitation (IPR)

Community

Community with home care services

Community with home-based rehabilitation

Mortality

HOSPITAL

Evidence for PS (Re-hospitalizations)

Variable	Evidence Strength	Available in data?	Time points
Gender (decrease for females)	Multiple studies	yes	30 day, 0-180 days,, 1 year, 90 day*
Pre-existing pulmonary disease (COPD)	Multiple studies	yes	30 day
LOS at index	Multiple studies	yes	30 day, 0-180 days, 3 year
Age	Multiple studies	yes	28 day, 0-180 days, 3 year
ASA III-IV	Multiple studies	no	30 day
time to sx <36hrs	one study	yes	1 year
Charlson at index	one study	yes	3 year
Diabetes at index	one study	yes	3 year
Neurological disorders at index	one study	yes	3 year
Dementia dx at index	one study	yes	1 year
Cancer dx at index	one study	yes	1 year
Kidney disease dx at index	one study	yes	1 year
Hypertension dx at index	one study	yes	6 month
fluid and electrolye disorders at index	one study	yes	30 day
renal failure at index	one study	yes	30 day
Cardiac arrhythmia at index	one study	yes	30 day
CHF at index	one study	yes	30 day
BMI >=35 kg/m	one study	no	30 day
Alcohol consumption	one study	no	1 year
smoking status	one study	no	1 year
Blood transfusion	one study	no	1 year
Pacemaker treatment	one study	no	6 month
vitamin supplementation (protective)	one study	no	90 day
Functional status at the end of rehab (Katz index)	one study	no	3 & 12 months
Ethnicity	one study	no	0-180 days
Comorbidity at the end of rehab	one study	limited	3 & 12 months

* in patients with community-acquired pneumonia

Generating the PS

- You regress all the variables related to your outcome of interest onto your treatment (in this case, IPR).

- The "raw propensity" is the probability of belonging to IPR, conditional on the variables in your regression.

- Propensity= logit of the raw propensity

   = log(rawprop/(1-rawprop).

   =log odds of discharge to IPR

Matching

1:1 instead of 1:2 or 1:many and without replacement

- Sample size considerations, extra variance calculation

- Greedy (as opposed to optimal)
  - Match each exposed persons with unexposed person with closest PS

- On values with a caliper width of 0.2 of the standard deviation of the logit of the propensity score
  - Shown to reduce biases by up to 99%

Matching Characteristics

Demographics
•Age, sex, year of index

Characteristics 1 year prior to index
• Homecare use, falls, charlson score

Characteristics during index acute care
•number of comorbidities, congestive heart failure, cardiac arrhythmia, chronic pulmonary disease, cancer, renal failure, fluid or electrolyte disorder, chronic kidney disease, delirium, dementia, other neurological disorder, diabetes, pressure ulcer, malignant neoplasm, frailty risk factors >1

Process measures during index acute care
• length of stay, had geriatric or internal medicine consult at admission, had surgery within 36 hours of admission

Post-matching Outcome: Death (Paper 2)

Post-matching death, IPR vs. Comm, HighIPR Region

Death	HighIPR Regions		
	IPR	Comm	SD
Within 30 days	1.1%	4.7%	0.2
31-90 days	3.1%	4.6%	0.1
Within 90 days	4.2%	9.1%	0.2
91 days-1year	9.8%	9.8%	0.0
Within 1 year	19.2%	14.0%	0.1

Post-matching death, IPR vs. Comm, Other Region

Death	Other Regions		
	IPR	Comm	SD
Within 30 days	1.3%	4.0%	0.2
31-90 days	2.7%	3.8%	0.1
Within 90 days	4.0%	7.8%	0.2
91 days-1year	7.4%	8.8%	0.1
Within 1 year	11.4%	16.6%	0.2

Combined Cohort Costs (Paper 2)

Post-matching total mean ($\pm$SD) costs, IPR vs. Comm, by region

	HighIPR Regions			Other Regions		
	IPR	Comm	SD	IPR	Comm	SD
30 days	28,565$\pm$ 8,985	21,189 $\pm$ 9,973	0.78	27,794 $\pm$ 8,449	22,622 $\pm$ 9,670	0.57
1 year	57,251 $\pm$ 39,530	44,266 $\pm$ 61,535	0.25	55,228 $\pm$ 36,835	48,899 $\pm$ 42,566	0.16

Death Cohort Costs (Paper 2)

Post-matching total mean (±SD) costs, IPR vs. Comm, by region

	HighIPR Regions			Other Regions		
	IPR	Comm	SD	IPR	Comm	SD
30 days	28,490 ± 8,400	20,967 ± 9,903	0.82	27,827 ± 8,533	22,466 ± 9,341	0.60
1 year	57,251 ± 39,530	44,266 ± 61,535	0.25	55,228 ± 36,835	48,899 ± 42,566	0.16