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Incidence of Peripheral Intravenous Catheter-Related Complications in a U.S. Hospital Discharge Database

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BACKGROUND

- The burden of peripheral intravenous (PIV) related bloodstream infections (BSI) is currently under-evaluated.
- Identifying PIV-related complications in real world data is challenging due to the broad use, inconsistent coding, and voluntary reporting of these devices.

OBJECTIVE

- To estimate the incidence of PIV-related complications among hospitalized patients.

METHODS

Study Design

- In this retrospective analysis of Premier Perspective Database™ U.S. hospital discharge records, we studied hospital admissions between 7/1/2013 and 6/30/2015 to estimate PIV-related complications rates.
- The Premier Perspective Database™ covers 20% of U.S. hospital discharges. It contains de-identified data including clinical coding, hospital cost, and patient billing from more than 600 hospitals (45 million discharges) throughout the U.S.
- Based on clinical expert input, we selected admissions having 1 of the following 7 primary diagnoses that were unlikely to cause a complication of interest: congestive heart failure (CHF), chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), diabetes mellitus with complications (DM), myocardial infarction (MI), pneumonia, and major trauma (i.e., hip, spinal, or cranial fracture).
- All admissions were assumed to include PIV use.
- We excluded readmissions with the same primary diagnosis and admissions with evidence of potential non-PIV causes of complications (i.e., dialysis, surgery, or central venous catheter use).

Study Measures

We examined the following measures within each primary diagnosis group and among all groups combined:

- Baseline measures included patient age, sex, and race; insurance plan type; admission type; hospital geographic region, location, teaching load, and size.
- Evidence of a PIV-related complication was defined as the presence of an ICD-9-CM code in the admission record for at least one of the following selected complications:
  1. Bloodstream infection, including: septicemia, sepsis, severe sepsis, septic shock, septicemic, bacteremia, disseminated fungal infection, disseminated candida infection, disseminated fungal endocarditis.
  2. Upper extremity cellulitis and abscess at the following sites: upper arm and forearm; hand except fingers and thumb; and unspecified sites.
  3. Upper extremity superficial phlebitis and thrombophlebitis at the following sites: upper extremity superficial vein; upper extremity, unspecified; and unspecified site.
  4. Infections, not elsewhere classified (NEC), including: acute infection following transfusion, infusion, or injection of blood and blood products; infection following other infusion, injection, transfusion, or vaccination; and infection and inflammatory reaction due to vascular device, implant, and graft (includes peripheral venous vascular catheter).
  5. Extravasation, including: extravasation (infiltration) of other vesicant chemotherapy or agent.

Statistical Analysis

- Descriptive statistics were generated for all patient demographic, payer, and admitting hospital characteristics and for rates of PIV-related complications of interest during the index hospitalization.
  - Means and standard deviations (SD) were reported for continuous variables, and percentages for categorical variables.
- All results were reported for each primary diagnosis group and for the overall combined group.

RESULTS

Patient, Payer, and Hospital Characteristics

- We identified 588,375 qualifying admissions (N=15,637–187,904) **(Table 1)**.
- 71.2% white; and the main payer type among admissions was Medicare (66.2%), followed by commercial insurance (14.7%) **(Table 2)**.
- Hospital admissions were mainly non-elective (95.2%) and were distributed across all geographic regions **(Table 2)**.
- Less than half of the admissions occurred in teaching hospitals (39.5%), most were in urban settings (83.5%), and about a quarter of admissions (24.3%) occurred in very large hospitals with more than 500 beds **(Table 2)**.

Table 1. Baseline Characteristics

			CHF	CKD	COPD	DM	MI	Pneumonia	Trauma	All
A	**No. of admissions with selected primary diagnoses[a] during ID period (7/1/2013 - 6/30/2015)**		267,643	32,733	151,420	148,539	186,115	250,693	118,206	1,155,349
B	**Admissions without evidence of dialysis among A**	no.	250,407	29,949	149,107	135,280	177,643	239,238	115,949	1,097,573
		% of A	93.6%	91.5%	98.5%	91.1%	95.4%	95.4%	98.1%	95.0%
C	**Admissions without evidence of surgery among B**	no.	189,862	23,292	133,803	84,438	35,711	199,219	15,847	682,172
		% of A	70.9%	71.2%	88.4%	56.8%	19.2%	79.5%	13.4%	59.0%
D	**Admissions without evidence of a central line among C**	no.	189,791	23,284	133,789	84,414	35,694	199,180	15,841	681,993
		% of A	70.9%	71.1%	88.4%	56.8%	19.2%	79.5%	13.4%	59.0%
E	**First qualifying admission[b] among D**	**no.**	**154,816**	**21,312**	**108,017**	**66,456**	**34,233**	**187,904**	**15,637**	**588,375**
		% of A	57.8%	65.1%	71.3%	44.7%	18.4%	75.0%	13.2%	50.9%
		% of Total E	26.3%	3.6%	18.4%	11.3%	5.8%	31.9%	2.7%	100%

CHF: congestive heart failure; CKD: chronic kidney disease without dialysis; COPD: chronic obstructive pulmonary disease; DM: diabetes with complications; MI: myocardial infarction; Trauma: hip, spinal, or cranial fracture.

[a] We only included the first qualifying admission (index hospitalization) for all patients. Readmissions for the same condition were excluded.

Selected PIV-Related Complication Rates

- Overall 1.8% of patients (n=10,354) had a PIV-related complication, and rates varied by primary diagnosis: 0.98% (COPD) to 2.67% (pneumonia) **(Table 3)**.
- BSI was most common (82.2% of all selected PIV-related complications), overall ranging from 0.67% (CKD) to 2.46% (pneumonia) **(Table 3; Figure 1)**.
- Rates of cellulitis, phlebitis, infections NEC, and extravasation were lower than BSI and varied by primary diagnosis **(Table 3; Figure 1)**.

RESULTS (continued)

Table 2. Patient Demographics, Payer Characteristics, and Admitting Hospital Characteristics

	CHF N=154,816	CKD N=21,312	COPD N=108,017	DM N=66,456	MI N=34,233	Pneumonia N=187,904	Trauma N=15,637	All N=588,375
Age, year, mean (SD)	73.6 (13.8)	68.7 (16.2)	68.7 (12.0)	50.5 (20.7)	75.0 (13.6)	62.2 (25.3)	63.7 (27.3)	66.1 (20.6)
Female, %	51.1	48.4	56.0	47.8	50.6	53.5	55.2	52.4
Race, %								
White	69.8	52.8	78.8	57.6	74.2	73.7	77.7	71.2
Black	16.8	32.0	10.4	25.1	10.2	11.4	6.3	14.7
Other	13.4	15.1	10.9	17.4	15.6	14.9	16.0	14.1
Payment Source, %								
Managed care/commercial	9.9	12.8	11.6	24.8	11.9	17.5	16.8	14.7
Medicaid/charity	3.8	5.8	5.6	11.5	3.1	7.2	6.2	6.2
Medicare	77.7	68.6	71.3	38.2	76.9	61.8	60.7	66.2
Other	8.6	12.8	11.5	25.5	8.1	13.5	16.3	12.9
Admission type, %								
Emergent (vs. elective)	95.2	95.7	95.2	96.1	95.5	94.7	96.1	95.2
Hospital region,%								
Northeast	19.3	21.2	17.3	18.2	21.7	16.7	22.4	18.3
Midwest	21.5	19.2	21.5	19.4	20.7	21.9	18.9	21.2
West	11.3	10.6	8.7	12.0	12.9	11.4	15.3	11.1
South	47.9	49.0	52.5	50.5	44.6	50.1	43.4	49.4
Teaching hospital, %	41.2	46.3	35.7	43.0	39.4	37.3	50.9	39.5
Location of hospital, %								
Urban (vs. rural)	84.3	89.3	80.9	87.1	81.7	82.1	89.0	83.5
Number of beds, %								
501+ (vs. ≤ 500)	25.9	30.9	20.6	27.3	22.4	22.8	35.7	24.3

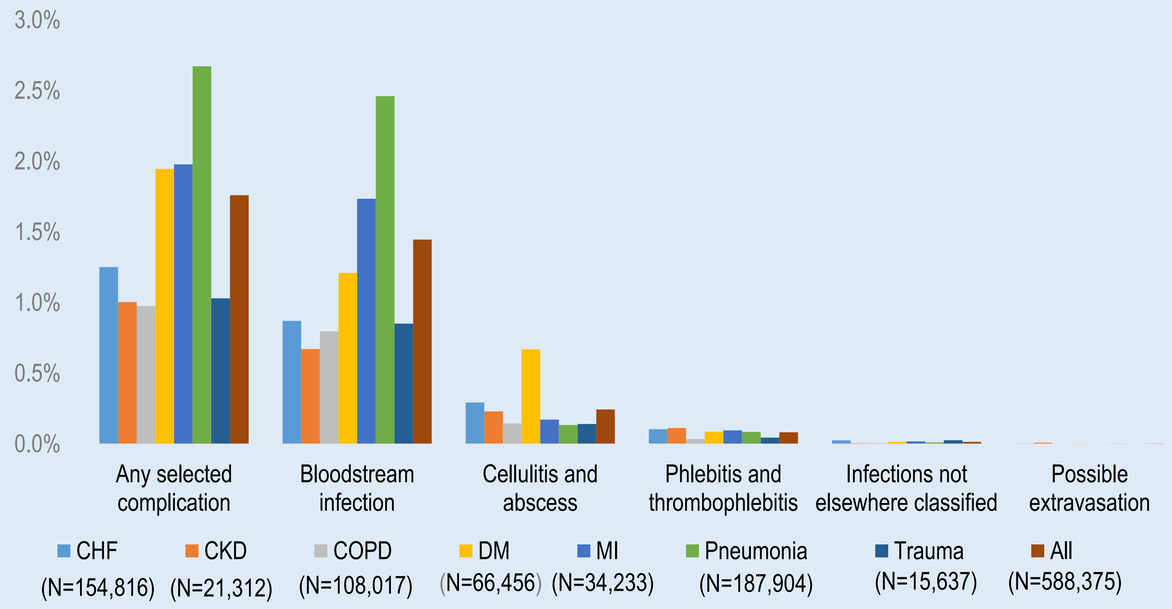
CHF: congestive heart failure; CKD: chronic kidney disease without dialysis; COPD: chronic obstructive pulmonary disease; DM: diabetes with complications; MI: myocardial infarction; Trauma: hip, spinal, or cranial fracture.

Table. 3 Selected Complication[a] Rates Related to Peripheral IV

		CHF N=154,816	CKD N=21,312	COPD N=108,017	DM N=66,456	MI N=34,233	Pneumonia N=187,904	Trauma N=15,637	All N=588,375
Patients with any complication[a,b]	no.	1,936	214	1,053	1,293	677	5,020	161	10,354
	%	1.251	1.004	0.975	1.946	1.978	2.672	1.030	1.760
Bloodstream infection, %									
Among entire cohort		0.871	0.671	0.796	1.210	1.735	2.461	0.851	1.446
Among patients with a complication		69.7	66.8	81.7	62.2	87.7	92.1	82.6	82.2
Cellulitis and abscess, %									
Among entire cohort		0.293	0.230	0.145	0.670	0.172	0.134	0.141	0.244
Among patients with a complication		23.5	22.9	14.9	34.4	8.7	5.0	13.7	13.9
Phlebitis and thrombophlebitis, %									
Among entire cohort		0.104	0.113	0.035	0.087	0.096	0.085	0.045	0.082
Among patients with a complication		8.3	11.2	3.6	4.5	4.9	3.2	4.3	4.6
Infections not elsewhere classified, %									
Among entire cohort		0.025	0.005	0.006	0.014	0.018	0.011	0.026	0.014
Among patients with a complication		2.0	0.5	0.6	0.7	0.9	0.4	2.5	0.8
Possible extravasation, %									
Among entire cohort		0.003	0.009	0.002	0.003	0.000	0.003	0.000	0.003
Among patients with a complication		0.2	0.9	0.2	0.2	0.0	0.1	0.0	0.1

CHF: congestive heart failure; CKD: chronic kidney disease without dialysis; COPD: chronic obstructive pulmonary disease; DM: diabetes with complications; MI: myocardial infarction; Trauma: hip, spinal, or cranial fracture. [a] Complications include bloodstream infection, upper extremity cellulitis and abscess, upper extremity superficial phlebitis and thrombophlebitis, PIV-related infections not elsewhere classified (i.e., infection or inflammatory reaction following infusion, injection, transfusion, vaccination, vascular device, implant, or graft), or possible extravasation. [b] Patients might have more than one complication.

Figure 1. Selected Complication Rates Related to PIV



CHF: congestive heart failure; CKD: chronic kidney disease without dialysis; COPD: chronic obstructive pulmonary disease; DM: diabetes with complications; MI: myocardial infarction; Trauma: hip, spinal, or cranial fracture.

LIMITATIONS

- We assumed all patients received a PIV upon admission to a U.S. hospital based on clinical expert input; however, to the degree this assumption does not hold, our sample may include patients not at risk for a PIV complication.
- We attempted to exclude admissions with evidence of a major confounding factor that could have independently led to a PIV complication; however, we were unable to remove all potential confounders, due to coding or identification limitations, leading to possible over-reporting of PIV complication rates.

CONCLUSIONS

- A large number of PIV complications were identified with rates consistent with prior research.[1]
- Further study of hospital discharge records may provide insight into the clinical and economic impact of these complications.
- The risks posed by PIVs are currently underemphasized but may be significant as many patients have a PIV during their hospital stay. Our study suggests the risk of PIV-related infections should be considered in addition to CVC and proven interventions mobilized to mitigate these risks.

ACKNOWLEDGMENTS

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REFERENCES

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