

# Rapid Incidence and Emergence of Catheter-Related Blood Stream Infections Among CVC-Dependent HD Patients

Kenneth Massey,<sup>1</sup> Krithika Rajagopalan,<sup>2</sup> Roxanna Seyedin<sup>2</sup>  
*<sup>1</sup>CorMedix Inc, <sup>2</sup>Anlitiks Inc*

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# Background

- Kidney failure patients receiving hemodialysis (HD) via a central venous catheter (CVC) are at high risk of developing catheter-related bloodstream infections (CRBSIs),<sup>1,2</sup> resulting in increased mortality, hospitalizations, and long-term complications (LTCs).<sup>3-6</sup>
- To date, the overall CRBSI incidence, speed of emergence of CRBSIs and associated clinical burden is not well-established.

# Objectives

- To develop a claims-based algorithm to assess real-world inpatient/outpatient (IP/OP) CRBSIs among CVC-dependent HD (CVC-HD) patients
- To examine the incidence and speed of CRBSI emergence

# Methods

**Study Design:** Retrospective analysis using merged data from United States Renal Data System (USRDS), CROWNWeb (Consolidated Renal Operations in a Web-enabled Network), and Medicare claims spanning the period from 2013-2018

**Study Population:** Identification of the study population was conducted in the following steps (**Figure 1**):

- 1** All kidney failure patients initiating CVC-HD during 2014-2017 with at least 1-year pre-index CVC-HD and at least 1-year CVC-HD follow-up were selected.
- 2** Post-CVC insertion date, patients with CRBSI occurrence post-CVC insertion were identified based on first CRBSI occurrence date (i.e., index date) in inpatient or outpatient (IP/OP) settings. CRBSI definition and patient selection are outlined in **Table 1**.
- 3** Incidence of 1-year post-CRBSI LTCs such as stroke, myocardial infarction (MI), heart failure (HF), peripheral vascular disorder (PVD), and dysrhythmia were examined.

# Methods (cont'd)

**TABLE 1. INCLUSION/EXCLUSION CRITERIA**

Setting	Definition & Patient Selection
Inpatient Setting	<p><u><i>Inclusion Criteria</i></u></p>
	<p>Patients with <math>\geq 1</math> inpatient ICD-9/10-CM diagnostic claim for</p> <ul style="list-style-type: none"> <li>• CRBSI (999.32/T80211x), <b>or</b></li> <li>• catheter infection (999.31/ T80219x, T80218x) and sepsis/bacteremia, <b>or</b></li> <li>• sepsis/bacteremia without occurrence of pneumonia, gangrene, or UTI within <math>\pm 3</math> days of hospitalization</li> </ul>
Outpatient Setting	<p><u><i>Exclusion Criteria</i></u></p>
	<p>Patients with <math>\geq 1</math> inpatient ICD-9/10-CM diagnostic claim for</p> <ul style="list-style-type: none"> <li>• pneumonia, gangrene, or UTI <math>&gt; 3</math> days from sepsis/bacteremia</li> </ul>
Outpatient Setting	<p><u><i>Inclusion Criteria</i></u></p>
	<p>Patients with <math>\geq 1</math> outpatient claim for</p> <ul style="list-style-type: none"> <li>• oral/intravenous antibiotic prescription within <math>\pm 1</math> day of the first outpatient emergency/urgent care visit post-CVC insertion</li> </ul>

ICD-9/10-CM, International Classification of Diseases, Tenth revision, Clinical Modification; CRBSI, catheter-related bloodstream infection; UTI, urinary tract infection; CVC, central venous catheter; HD, hemodialysis

# Methods (cont'd)

## Outcome Measures

- **Demographics:** Age, gender, race, body mass index, comorbidities, Elixhauser Comorbidity Index
- **CVC-HD Cohort**
  - **CRBSI Incidence**
    - **CRBSI:** proportion of patients with CRBSI in any setting (IP or OP settings), incidence rates of CRBSI, and proportion of patients with (post-CVC) 30- and 90-day CRBSIs
    - **Days to CRBSI:** mean (SD) days to CRBSI, median (IQR) days to CRBSI
  - **CRBSI Cohort**
    - **Post CRBSI LTCs:** proportions patients with CRBSI who experienced a cardiovascular event (stroke, MI, HF, PVD, or dysrhythmia)

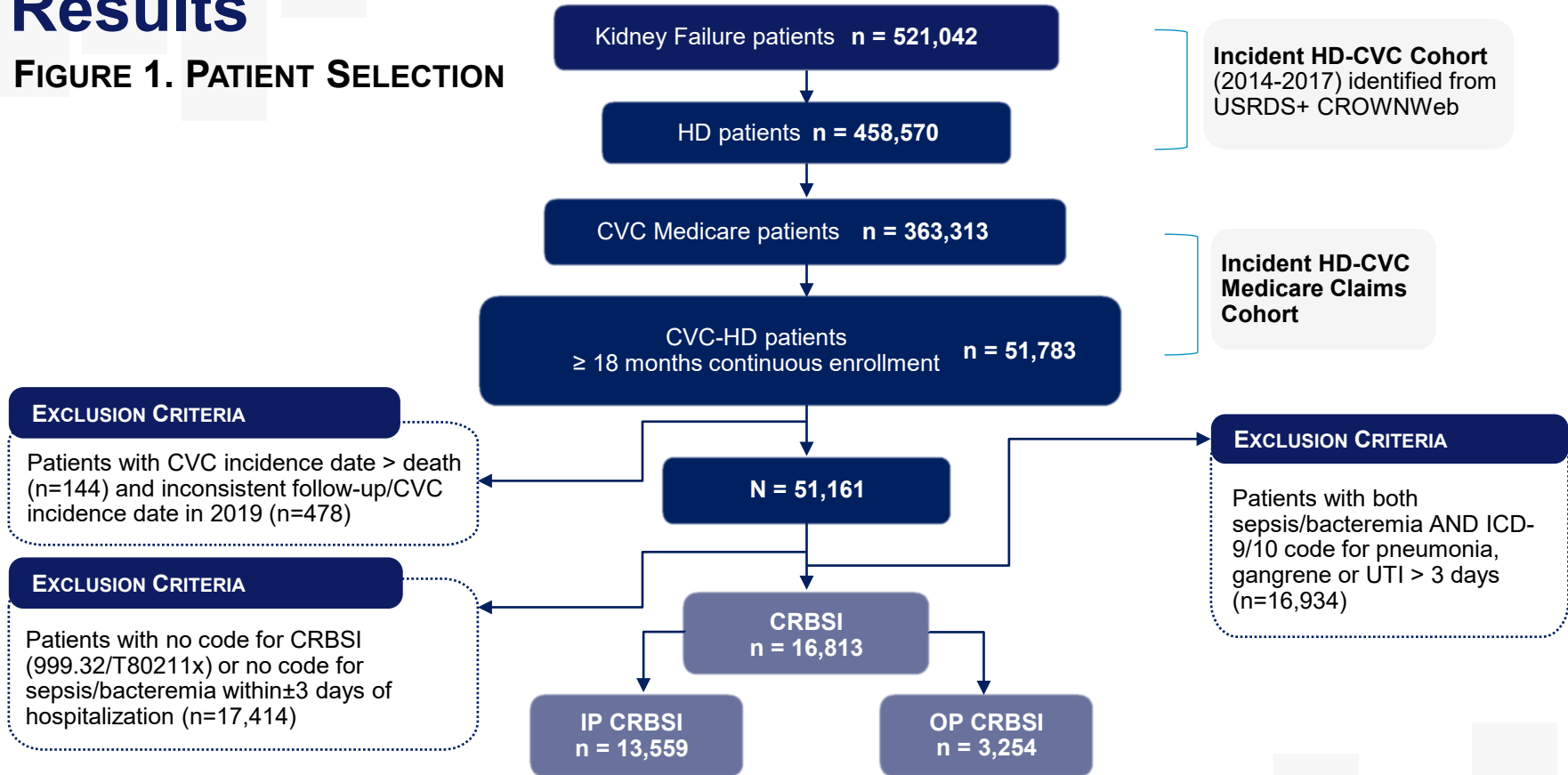
# Methods (cont'd)

## Statistical Methods

- Patient demographics were described using frequencies and proportions for categorical variables and mean and standard deviations (SD) for continuous variables.
- Incidence of CRBSI and LTCs were reported. Additionally, the mean and median for time (i.e., days) to the occurrence of CRBSI were reported. Time to CRBSI was assessed via Cox proportional hazards models.
- Analyses were performed using R and analyzed using Rapid Analyzer™.

# Results

## FIGURE 1. PATIENT SELECTION



CVC, central venous catheter; HD, hemodialysis; UTI, urinary tract infection; CRBSI, catheter-related bloodstream infection; IP, inpatient; OP, outpatient

# Results (cont'd)

**TABLE 2. PATIENT DEMOGRAPHICS**

- Patient demographics for the study population are presented in **Table 2**.
- Mean age for the CVC-HD cohort was 63.4 (± 15.35) years; 46.5% (n=7,822) were female and 29.1% (n=4,898) were African American.

	CRBSI (n=16,813)	%
<b>Mean Age, in years (SD)</b>	63.42 (15.35)	
<b>Female</b>	7,822	46.5
<b>Race</b>		
African American	4,898	29.1
Other / Unknown	879	5.2
White	11,036	65.6
<b>Comorbidities</b>		
CHF	3,005	17.87
COPD	6,793	40.40
CVA / TIA	3,471	20.64
Diabetes	4,200	24.98
GFR MDRD Stage 5	11,565	68.79
Hypertension	5,588	33.24
Metastatic Cancer	459	2.7
Polycystic Disease	71	0.4
AIDS/HIV	267	1.6
Other Causes of ESRD	11,320	67.3
<b>Elixhauser Comorbidity Index</b>		
< 0	7,121	42.4
0	72	0.4
1 – 5	819	4.9
6 – 13	5,269	31.3
14 +	3,532	21.0
<b>Body Mass Index</b>		
Underweight	437	2.60
Normal	3,651	21.72
Overweight	3,542	21.07
Obese	6,035	35.89
NA	3,148	18.72
<b>AVF Maturing</b>		
Yes	2,627	15.62
No	14,186	84.38
<b>AVG Maturing</b>		
Yes	364	2.16
No	16,449	97.84

CRBSI, catheter-related bloodstream infection; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disorder; CVA, cerebrovascular accident; TIA, transient ischemic attack; GFR MDRD, Glomerular Filtration Rate at Stage 5; AIDS, Acquired Immunodeficiency Syndrome; HIV, Human Immunodeficiency Virus; ESRD, end-stage renal disease; AVF, arteriovenous fistula; AVG, arteriovenous graft; NA, not available; SMD, standardized mean difference; SD, standard deviation

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# Results (cont'd)

## CRBSI INCIDENCE

- Of the 51,161 CVC-HD patients, 32.8% (n=16,813) developed a CRBSI (4.5 cases per 1,000-catheter days).
- Mean (SD) and median (IQR) time to CRBSI was 165 ( $\pm$  220) and 107 ( $\pm$  294) days, respectively.
- In total, 80.6% (n=13,559) of CRBSIs were diagnosed inpatient and 19.4% (n=3,254) were diagnosed in outpatient settings. Overall, 33% and 47% developed CRBSI within 30- and 90-days of CVC insertion, respectively (**Table 3**).

**TABLE 3. KAPLAN MEIER SURVIVAL ESTIMATES, AT 1-YR FOLLOW-UP, TIME TO CRBSI\***

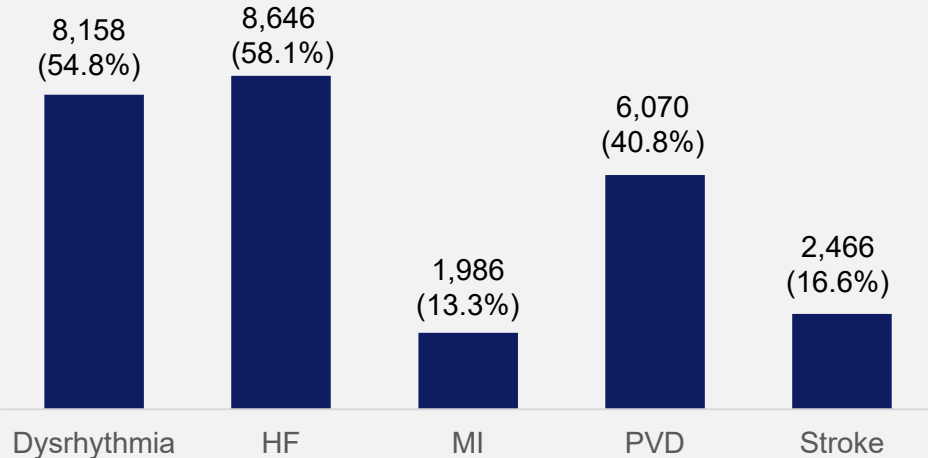
Interval (days)	CRBSI (n=14,889)	%
0 – 30	4,840	32.5
0 – 90	6,922	46.5
0 – 180	9,132	61.3
0 – 270	10,707	71.9
0 – 365	12,023	80.8

CRBSI, catheter-related bloodstream infection

\*Percentages reflect proportion of CRBSI patients with post-CRBSI LTCs among 14,889 patients. Case (CRBSI) and control (non-CRBSI) groups were 1:1 propensity score matched at index date on elixhauser comorbidity index scores.

# Results (cont'd)

**FIGURE 2. FREQUENCY & PROPORTION OF POST-CRBSI LTCs\***



## Post CRBSI LTCs

Frequently reported LTCs were HF (58%), dysrhythmia (55%), PVD (41%), stroke (17%), and MI (13%) (Figure 2).

LTCs, long-term complications; HF, heart failure; MI, myocardial infarction; PVD, peripheral vascular disorder; CRBSI, catheter-related bloodstream infection

\*Percentages reflect proportion of CRBSI patients with post-CRBSI LTCs among 14,889 patients. Case (CRBSI) and control (non-CRBSI) groups were 1:1 propensity score matched at index date on elixhauser comorbidity index scores.

# Limitations

- The identification algorithm for CRBSI, which uses proxy determinates of disease, has the potential to misclassify the cause of bacteremia in patients.
- Due to the methodology, we were unable to determine whether patients had CVC still inserted at the time of the CRBSI occurrence; however, the majority of CRBSI events occurred within 6 months following CVC insertion.

# Conclusions

- Of all CVC-HD patients, **1 in 3 developed CRBSIs** in total, with **47% of infections developing within 90 days** of CVC insertion.
- CRBSI occurrence resulted in high rates of **cardiovascular events**, including dysrhythmia, HF, MI, PVD, and stroke.
- Early and high incident CRBSI rates underscore the importance of interventions that can prevent CRBSIs among CVC-HD patients.

# References

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# Disclosures

**Massey:** *CorMedix Inc: Employment*

**Rajagopalan:** *CorMedix Inc: Consultancy* **Seyedin:** *CorMedix Inc: Consultancy*