A Need for Infection Prevention Among Patients With ESKD on Maintenance Dialysis: A First Step in Understanding How SARS-CoV-2 Impacts This Population

Shivani Aggarwal,^{1,2} Emily A Hu,^{3*} Jennifer R Dusendang,³ Yuval Koren,³ Catia Ferreira,⁴ Lisa Glasser,⁵ Sudhir Venkatesan,⁶ Carla Talarico,⁷ Della Varghese⁷





Why did we perform this research?

- In 2019, approximately 808,330 (0.2%) individuals in the US had end-stage kidney disease (ESKD)¹
- ESKD is the result of irreversible critical decline in the kidney functions of filtering waste products and excess fluid from the blood, requiring dialysis and/or kidney transplant
- The hospitalization rate for patients undergoing dialysis is higher than for patients with other chronic kidney disease and the general population²
- Although infections are one of the main causes of hospitalization in patients with ESKD,² post-pandemic infection burden and outcomes for patients with ESKD are not well understood and recognized
- Objective: To characterize infection burden and outcomes in patients with ESKD requiring maintenance dialysis (MD) to identify novel opportunities for prevention strategies

How did we perform this research?

Data sources

*Former employee

Loopback Analytics electronic medical records (EMR) databasea

Electronic records from >30 million US patients spanning 30 health systems (>500 US hospitals)



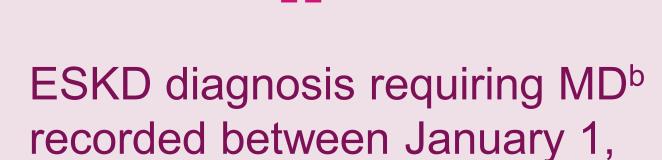


The Inovalon MORE² Registry[®]

Aggregated US claims data spanning ≥20 years, including data from over 350 million patients across 69 billion events

Target study population





- 2020, and March 31, 2023
- Aged ≥12 years at initial diagnosis
- Subgroup confirmed to have received MD for ≥3 consecutive months within the study period

Data analysis





Outcomes collected Patient characteristics

- and comorbidities
- ✓ Dialysis characteristics
- ✓ Overall infection burden^d ✓ Common pathogens
- ✓ Proportion of patients with pneumonia and sepsis

diagnosis code for ESKD requiring MD (ICD-10-CM codes N18.6 and/or Z99.2) recorded in EMRs. Follow-up continued for 6 months post-ESKD diagnosis, or until lost to follow-up, whichever occurred first. dSelect infections within 6 months of ESKD diagnosis were defined by specific diagnosis codes or positive laboratory test

The US Centers for Medicare and Medicaid Services cover dialysis for ESKD through Medicaid, Medicare Advantage, and Medicare Fee for Service. Records from only the first two are captured in the MORE² Registry®



Patients with ESKD requiring MD have a high infection burden from both viral and bacterial pathogens

*E-poster and supplementar materials



Copies of this poster and supplementary materials obtained through the QR code or link are for personal use only and may not be reproduced without permission

Presented at IDWeek | October 16–19, 2024 | Los Angeles, CA, USA

What did we find?

Figure 1. Study population of patients diagnosed with ESKD between January 1, 2020 and March 31, 2023

Patients with diagnosed with ESKD requiring MD

Patients with ≥1 IP/OP EMR diagnostic code for ESKD requiring MD

N=65,515

Patients aged ≥12 years at initial diagnosis

Patients with ESKD and confirmed MD claims

Patients with linked EMRs and medical claims

N=4,315Patients with confirmed MD (≥3 consecutive treatment months

Table 1. Demographic and clinical characteristics of patients with ESKD

Table 1. Demographic and chincal characteristics of patients with Lond			
Characteristics	Patients with ESKD requiring MD ^a (N=65,515)	Patients with ESKD and confirmed MD ^b (N=4,315)	
Age at prevalent diagnosis, years			
Median (Q1–Q3)	62.2 (51.1–71.3)	56.7 (46.1–64.7)	
Sex, n (%)			
Female	25,982 (39.7)	1,712 (39.7)	
Male	38,155 (58.2)	2,583 (59.9)	
Other or missing	1,378 (2.1)	20 (0.5)	
Race, n (%)			
White	28,503 (43.5)	1,198 (27.8)	
Black or African American	9,929 (15.2)	665 (15.4)	
Asian	5,248 (8.0)	439 (10.2)	
Other or unknown	21,835 (33.3)	2,013 (46.7)	
Hispanic or Latino, n (%)	10,241 (15.6)	1,114 (25.8)	
Facility type, n (%)			
Academic	50,947 (77.8)	3,767 (87.3)	
Community	14,568 (22.2)	548 (12.7)	
Payer type, ^c n (%)			
Commercial	N/A	1,148 (26.6)	
Medicaid	N/A	2,447 (56.7)	
Medicare Advantage	N/A	720 (16.7)	
Common comorbidities,d n (%)			
Diabetes with chronic complications	29,490 (45.0)	1,915 (44.4)	
Congestive heart failure	18,994 (29.0)	962 (22.3)	
Peripheral vascular disease	12,977 (19.8)	586 (13.6)	
Chronic pulmonary disease	10,456 (16.0)	404 (9.4)	
Myocardial infarction	9,069 (13.8)	445 (10.3)	
Cerebrovascular disease	8,448 (12.9)	375 (8.7)	
Any malignancy, including leukemia and lymphoma	5,723 (8.7)	205 (4.8)	
Dialysis type, n (%)			
Hemodialysis	31,156 (47.6)	1,943 (45.0)	
Central venous catheter	18,039 (27.5)	986 (22.9)	
Arteriovenous fistula	4,518 (6.9)	343 (7.9)	
Arteriovenous shunt/graft	1,017 (1.6)	78 (1.8)	
Catheter (type missing) Peritoneal	7,582 (11.6)	536 (12.4) 289 (6.7)	
Unknown (data missing)	3,352 (5.1) 31,007 (47.3)	2,083 (48.3)	

aldentified by EMRs alone; bldentified by EMRs and claims; beaver type was determined by claims; dRenal disease is the most common comorbidity among patients with ESKD (97.8%) and patients with ESKD with confirmed MD (96.7%)

For additional demographic and clinical characteristics information see supplementary materials

Abbreviations

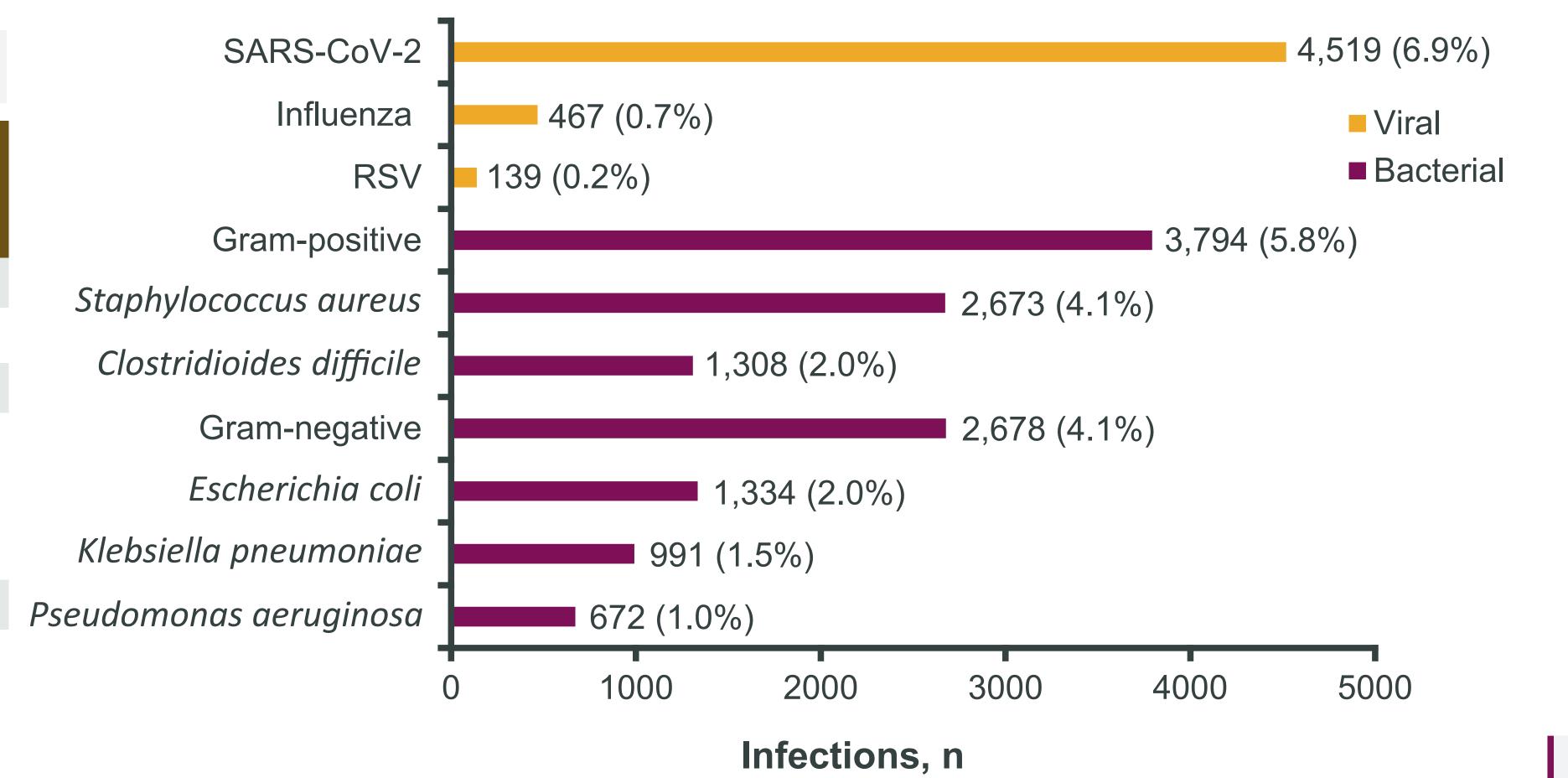
COVID-19, coronavirus disease-2019, EMR, electronic medical record; ESKD, end-stage kidney disease; IP, inpatient; MD, maintenance dialysis; **n**, number of participants; **OP**, outpatient; **Q**, quarter; **RSV**, respiratory syncytial virus; **SARS-Cov-2**, severe acute respiratory syndrome coronavirus 2; SD, standard deviation; US, United States

- Overall, 65,515 patients were identified as diagnosed with ESKD requiring MD (by EMRs alone) and a subgroup of 4,315 patients with ESKD were confirmed to have received MD treatments by linking EMRs and medical claims data (Figure 1, Table 1)
- Patients with ESKD and confirmed MD tended to be younger than those identified by EMRs alone
- Comorbidity burden was high; nearly half of the patients had diabetes (Table 1). Patients had a median Charlson comorbidity score of 4.0 in both groups (supplementary materials)
- Hemodialysis via central venous catheter was the most common type of dialysis received, recorded in 27.5% of patients with ESKD requiring MD and 22.9% of patients with ESKD and confirmed MD (Table 1)
- Among all patients diagnosed with ESKD requiring MD, several types of infections were recorded during follow-up. SARS-CoV-2 and S. aureus were the most the most common pathogens identified, affecting 6.9% and 4.1% of patients, respectively (Figure 2)
 - Viral and bacterial co-infection was observed in 17.0% of bacterial cases (Table 2)
- Viral and gram-positive bacterial infection co-occurrence was more common than concurrent viral and gram-negative bacterial infections (66.2% vs 49.9%, respectively; Table 3)
- Among all patients with ESKD requiring MD, 11.6% had pneumonia and 10.9% had sepsis within 6 months of ESKD diagnosis (Figure 3)

Figure 2. Infections recorded within 6 months of ESKD diagnosis in patients with ESKD requiring MD^a (N=65,515)



Table 3. Viral and bacterial infection co-occurrence recorded within 6 months of ESKD



^aIdentified by EMRs alone. Patients were counted more than once if multiple viral or bacterial types were identified during the follow-up period

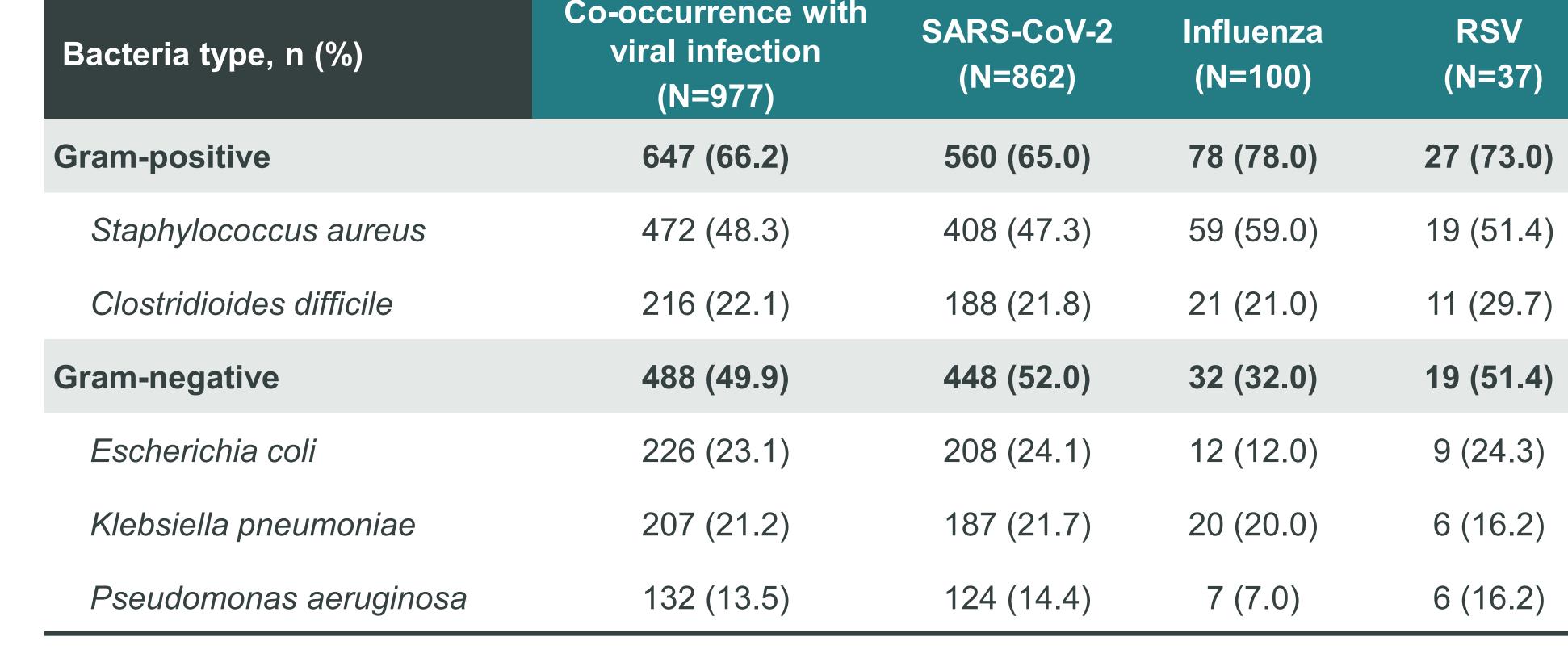
Table 2. Proportion of patients with ESKD requiring MD^a who were identified as having viral and bacterial infections within 6 months of ESKD diagnosis

Viral infection type, n (%)	Co-occurrence with bacterial infection (N=5,749)	No bacterial infection (N=59,766)
Any viral infection	977 (17.0)	4,079 (6.8)
SARS-Cov-2	862 (15.0)	3,657 (6.1)
Influenza	100 (1.7)	367 (0.6)
RSV	37 (0.6)	102 (0.2)

aldentified by EMRs alone. Patients were counted more than once if multiple viral or bacterial types were identified during the follow-up period. Testing rates for specific pathogens were not considered in this analysis

Limitations

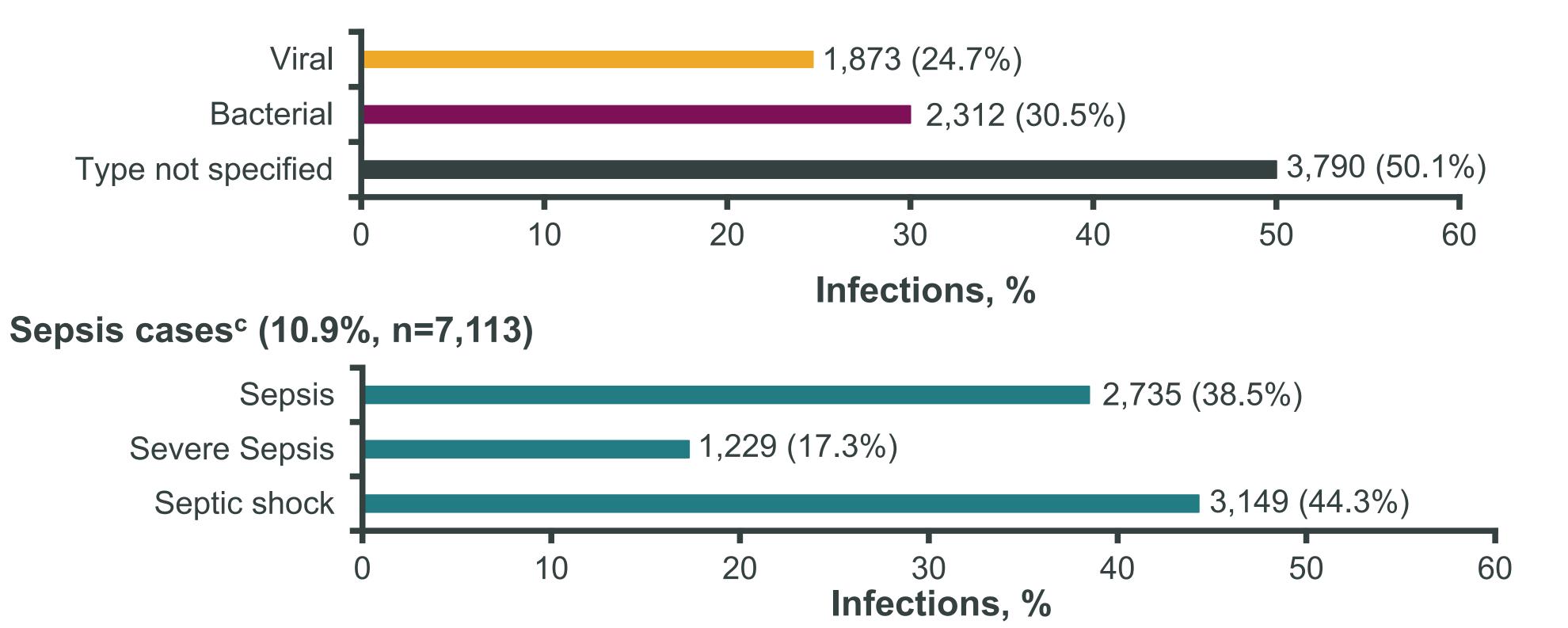
- Because the majority of patients (>85%)³ receive MD at large dialysis organizations, patients with ESKD in the EMR may not have complete treatment journeys with respect to dialysis care
- Notable reductions in the circulation of seasonal respiratory viruses during the study follow-up period, associated with the COVID-19 pandemic,⁴ likely led to a lower incidence of patients with ESKD who were diagnosed with non-SARS-CoV-2 viral infections
- Patients with ESKD from the EMR may not be generalizable to the US population of patients with ESKD
- There may be selection bias in the linked population of patients with ESKD with confirmed MD between the Loopback Analytics EHR and the Inovalon MORE² Registry[®], as demonstrated by the younger median age and lower comorbidity burden of the linked population



aldentified by EMRs alone. Patients were counted more than once if multiple viral or bacterial types were identified during the follow-up period. Testing rates for specific pathogens were not considered in this analysis

Figure 3. Pneumonia and sepsis within 6 months of ESKD diagnosis in patients with ESKD requiring MD^a (N=65,515)

Pneumonia cases^b (11.6%, n=7,569)



aldentified by EMRs alone; bViral/bacterial pneumonia was determined by the first occurrence during follow-up. Patients were counted more than once if both viral and bacterial pneumonia were identified during the follow-up period; clevel of sepsis was determined by the occurrence of the highest severity during follow-up. Percentages are calculated among total patients with

How do these real-world data inform clinical practice?

- The high infection burden coupled with the high comorbidity burden among patients with ESKD requiring MD suggests a need for additional preventative strategies in these patients
- Linking EMR data to claims allows for confirmation that maintenance dialysis was performed among patients diagnosed with ESKD, and may assist in better quantifying healthcare costs and patient outcomes
- Ongoing evaluation of outcomes such as hospitalization rates, cardiovascular events, and survival among patients with ESKD by infection type is needed to inform clinical practice in this vulnerable population

Acknowledgements

The study was funded by AstraZeneca. Medical writing support for the development of this poster, u the direction of the authors, was provided by Katherine Wood and Michael Simpson of Ashfield MedComms, an Inizio company, and funded by AstraZeneca

SA was contracted to Graticule, Inc. from Landmark Science for this stud EAH, JRD, and YK are/were employees of/may hold stock in Graticule • CF, LG, SV, CT and DV are employees of/may hold stock in AstraZeneca

Disclosures

References

- 1. United States Renal Data System 2022 Annual Data Report. Available at: https://usrds-adr.niddk.nih.gov/2022 2. Daratha KB, et al. Clin J Am Soc Nephrol 2012;7:409–16 3. Sloan CE, Hoffman et al. *JAMA Health Forum* 2021;2(11):e213626
- 4. Chow, et al. *Nat Rev Microbiol* 21, 195–210 (2023)