

Seasonal Peaks in Community-Acquired Gram-Negative Rods Bloodstream Infection

A Nationwide Cohort Study of US Veterans

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Background

- Seasonal increases of Gram-negative rod (GNR) bloodstream infection (BSI) in summer have been increasingly recognized.
- Prior studies were limited by geographic region, short study duration, lack of reliable denominator data and access to patient demographic profiles.
- Recognition of seasonal variability of infections can improve analysis of quasi-experimental and randomized trial data while also informing surveillance and prevention programs.

Objective

- We aimed to examine the seasonal variability of community-acquired (CA) GNR BSI incidence rates on population-based cohort of US Veterans Health Administration (VHA) over 11-year period.

Materials and Methods

Study Population:

- All patients who were admitted to acute care units of 130 VHA hospital between 1/2003 and 12/2013 with positive blood culture with *E. coli*, *Klebsiella* spp., or *P. aeruginosa* within 48 hours of admission, and no recent healthcare exposure.
- VHA is the largest integrated healthcare system of United States with over 8 million enrolled patients and 130 acute care hospitals in all continental states and Puerto Rico.

Healthcare Exposure Definitions:

- BSI episodes with following criteria were excluded from analysis:
 - Admitted to acute care within 90 days prior to BSI episode
 - Resident of a nursing home or rehabilitation facility
 - On renal replacement therapy
 - Received wound care or specialized nursing care within 30 days prior to the onset of BSI

Denominator

- Number of unique patients who used VHA for any healthcare needs during the same month (patient-month)

Statistical Analyses:

- Autoregressive integrated moving average (ARIMA) models with seasonal structure (ARIMA(0,1,1) \times (0,1,1) $_{12}$) were used to assess seasonality while accounting for autocorrelation.
- Time series were decomposed by ARIMA models to seasonal components, trend components and white noise components.
- Seasonal components were assessed as incidence rate ratio (IRR).

Results

Table 1. Demographics of VHA Patient Population by Year

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Patients*	4,357	4,532	4,623	4,705	4,719	4,784	4,945	5,083	5,193	5,281	5,355
Male	91.8%	92.0%	91.7%	91.5%	91.3%	90.9%	90.9%	90.8%	90.7%	90.4%	90.2%
Mean Age	61.5	61.7	61.7	61.8	61.6	61.4	61.1	61.0	60.9	60.7	60.6

* In thousands

Table 2. Characteristics of Community-Acquired BSI Episodes

	Total	<i>E. coli</i>	<i>Klebsiella</i> spp.	<i>P. aeruginosa</i>
Number of Episodes	19,777	13,572 (68.6%)	4,791 (24.2%)	1,414 (7.1%)
Age (mean/SD)	69.1/12.2	69.8/12.3	68.5/12.1	68.5/11.9
Male Gender	96.4%	95.3%	97.3%	97.9%
Mean Monthly Incidence Rates*	7.01	4.77	1.72	0.52

* Per 100,000 Patient-Months

Figure 1. Seasonal Cycle Plot of CA GNR BSI Incidence Rates over 11 years

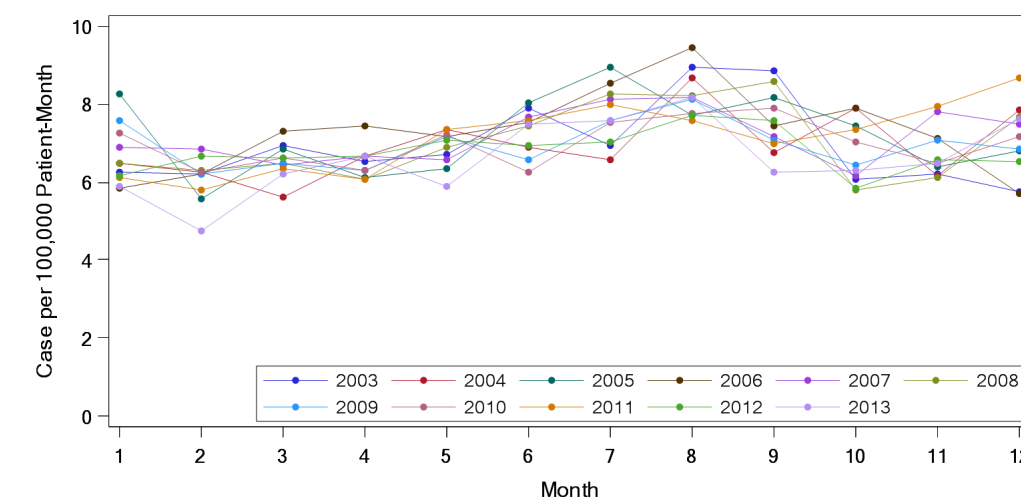
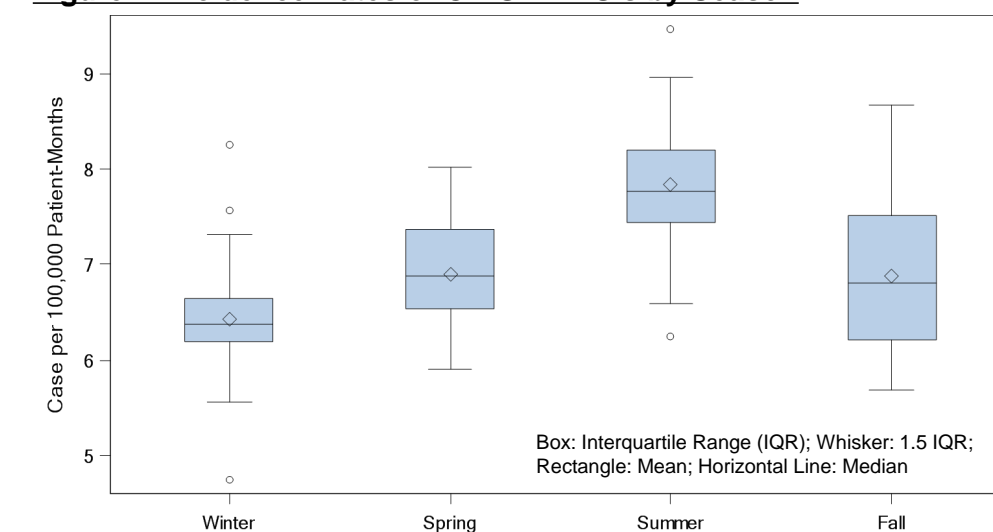


Figure 2. Incidence Rates of CA GNR BSIs by Season



Results (cont.)

Figure 3. Predicted CA GNR BSI Incidence Rates by Seasonal ARIMA Models

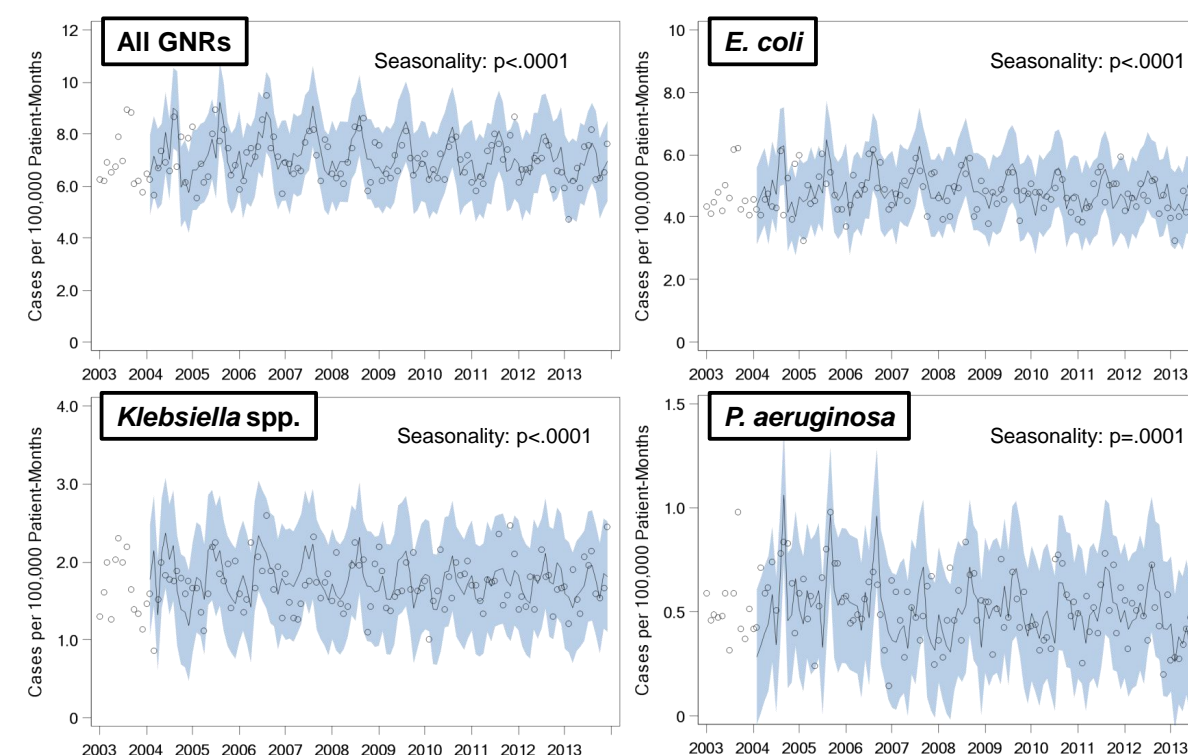
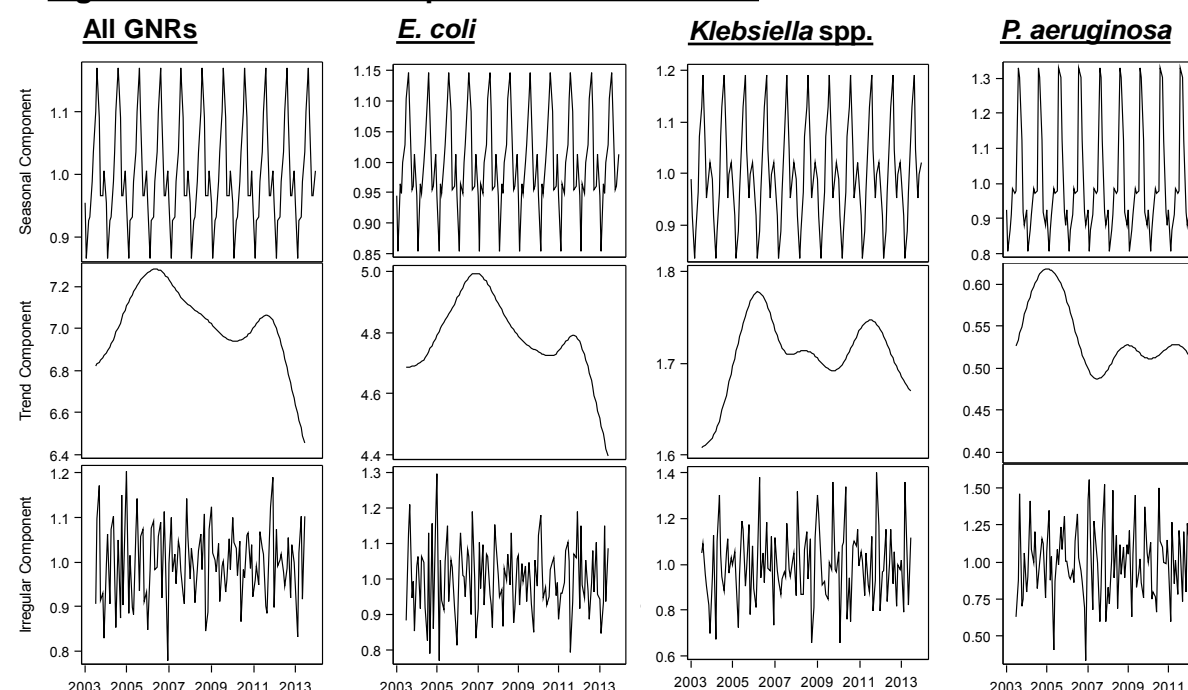


Figure 4. Seasonal Decomposition of Time Series



Discussion

- Within nationwide cohort of US veterans over 11 years, we observed significant seasonality in CA GNR BSI incidence rates.
- CA GNR BSI incidence rates peaked in August with nadir in February.
- Similar seasonal patterns were observed commonly among three species of GNRs.
- IRR of summer to winter:
 - All GNR 1.22
 - E. coli* 1.20
 - Klebsiella* spp. 1.23
 - P. aeruginosa* 1.37

Limitations

- Retrospective cohort study design
- No information regarding the primary sources of BSIs was available.
- Over 95% of BSI episodes were in male patients

Conclusions

- Within nationwide cohort of US veterans, we observed significant seasonality in incidence rates of CA GNR BSIs.
- Incidence rates in summer were >20% higher than winter, with peak in August and nadir in February
- Same seasonal patterns were observed across 3 species of GNRs.
- Quasi-experimental studies and surveillances for GNR BSIs need to consider seasonality to assess trends accurately.

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