County Level Association Between the Rate of Fluoroquinolone-Resistant Gram-Negative Bacteria and Fluoroquinolone Utilization in Kansas

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Background

- 8th-worst state nationally for outpatient antibiotic prescribing with 690 prescriptions per 1000 population
- Statewide fluoroquinolone (FQ) use is disproportionately higher than other antibiotic drug classes
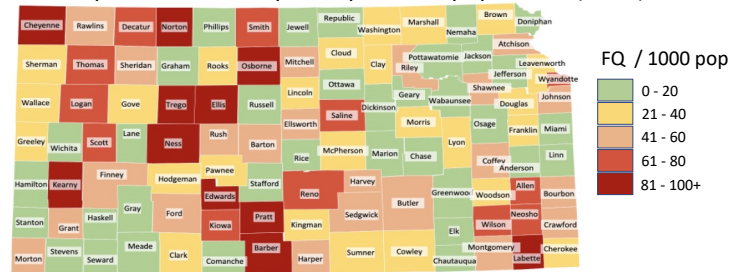- Statewide antibiograms can be developed by health departments for antimicrobial stewardship monitoring

Methods

- Retrospective study design
- Utilized 2018-2019 county-level data for FQ-resistant *Escherichia coli, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* gathered from Kansas facility antibiograms
- Use and resistance was categorized by county level based on the Kansas statewide antibiogram
- Outpatient 2019 FQ utilization data was obtained from IQVIA, 92% outpatient antibiotics captured
- Categorized into county level FQ rate based on prescriptions dispensed per 1000 population
- Linear regression to compare antibiotic resistance (AR) to FQ use by county
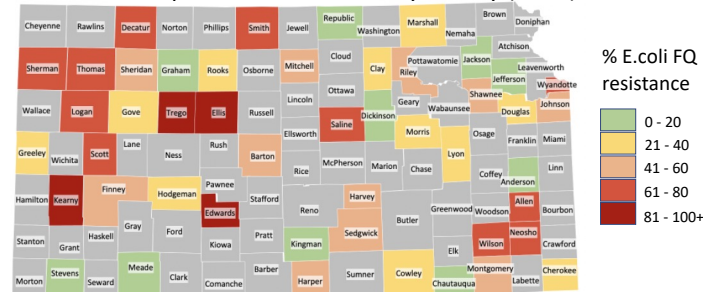
Kansas Population Density (2019)

Persons/sq mile
- Under 6.0
- 6.0 – 19.9
- 20.0 – 39.9
- 40.0 – 149.9
- 150.0 and over
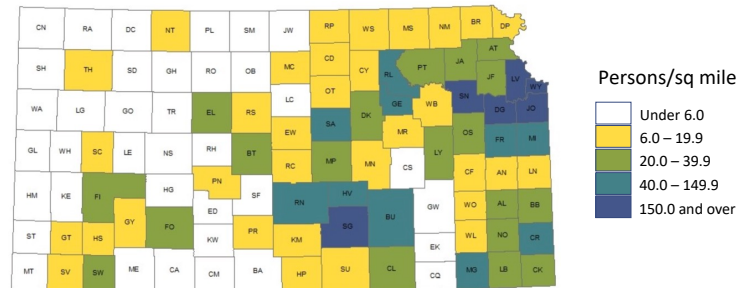
Fluoroquinolone Prescriptions per 1000 population (2019)

FQ / 1000 pop
- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100+

E. coli Fluoroquinolone resistance by county (2019)

% E.coli FQ resistance
- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100+

P. aeruginosa FQ-resistance compared to FQ-utilization

Regions	Antibiotic use			Antibiotic Resistance			Significance	
	Mean (SD)	Median	Range	Mean (SD)	Median	Range	R^2 (%)	P
All state (n=37 counties w/ combo AR + AU data)	51.03 (25.49)	50.1	4.6 (Stevens) to 105.6 (Trego)	0.17 (0.09)	0.16	0 (Stevens) to 0.38 (Logan)	2%	0.352
Urban counties (n=5)	52.42(1 (12.41)	53.80	37.3 (Douglas) to 68.7 (Wyandotte)	0.17 (0.07)	0.15	0.11 (DG) to 0.28 (WY)	85%	0.025
Non-urban counties (n=32)	49.84 (26.93)	49.15	4.6 - 105.6	0.17 (0.1)	0.16	0 (Stevens) to 0.38 (Logan)	2%	0.485

E. coli FQ-resistance compared to FQ-utilization

Regions	Antibiotic use			Antibiotic Resistance			Significance	
	Mean (SD)	Median	Range	Mean (SD)	Median	Range	R^2 (%)	P
All state (n=49 counties w/ combo AR + AU data)	45.82 (25.52)	42.99	4.6 (Stevens) to 105.6 (Trego)	0.20 (0.09)	0.19	0.08 Jackson) to 0.49 (Gove)	4%	0.184
Urban counties (n=5)	52.42(1 (12.41)	53.80	37.3 (Douglas) to 68.7 (Wyandotte)	0.21 (0.06)	0.20	0.14 (DG) to 0.28 (SG)	61%	0.120
Non-urban counties (n=44)	45.72 (27.21)	42.25	4.6 - 105.6	0.20 (0.08)	0.19	0.08 (Jackson) to 0.49 (Gove)	5%	0.133

K. pneumoniae FQ-resistance compared to FQ-utilization

Regions	Antibiotic use			Antibiotic Resistance			Significance	
	Mean (SD)	Median	Range	Mean (SD)	Median	Range	R^2 (%)	P
All state (n=41 counties w/ combo AR + AU data)	46.65 (25.74)	43.4	4.6 (Stevens) to 105.6 (Trego)	0.04 (0.04)	0.03	0 (Kingman) to 0.17 (Harper)	0.5%	0.672
Urban counties (n=5)	52.42(1 (12.41)	53.80	37.3 (Douglas) to 68.7 (Wyandotte)	0.05 (0.02)	0.05	0.02 (Shawnee) to 0.08 (SG)	31%	0.331
Non-urban counties (n=36)	48.12 (28.52)	43.00	4.6 - 105.6	0.04 (0.04)	0.02	0.00 (Jefferson) to 0.17 (Harper)	0.2%	0.783

Results

- 66 of 123 facilities contacted for antibiogram data responded with results
- 47 were critical access hospitals, and the rest were acute care hospitals or clinics
- Total isolates: 31,573 *E. coli*, 5,942 *K. pneumoniae* and 5,017 *P. aeruginosa*
- All 106 counties had FQ prescription data.
- 49 counties had AR data
- Of these, FQ rates ranged from 4.6 to 105.6/1000 population
- No statistical significance associated between counties for FQ-resistant *E. coli, K. pneumoniae* or *P. aeruginosa* with FQ-utilization rates (p=0.184, 0.572, 0.352, respectively)
- There was statistical significance for urban *P. aeruginosa* FQ-resistance and FQ utilization (p=0.025), but not for urban *E. coli* (p=0.120) or urban *K. pneumoniae* (p=0.331)

Conclusions

- A strong correlation was demonstrated between FQ consumption and rates of FQ-resistant *P. aeruginosa* within urban counties
- No significant correlations were found between FQ consumption rates and *E.coli* or *K. pneumoniae*
- This study demonstrates additional applications for state-level antibiogram data, particularly when paired with antibiotic use data

Selected References

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