Introduction:
Urinary tract infections (UTIs) are one of the most common causes of ambulatory visits. In severe cases or when outpatient treatment is not possible, patients are hospitalized. Although much of the epidemiology of UTIs has been well described, the striking seasonality of UTIs has not been a major focus of inquiry.

More cases of UTIs occur in the summer. However, the cause of this seasonality is unknown. Proposed mechanisms include changes in behavior, and/or changes in temperature that occur during the summer relative to the winter. Understanding the factors driving the seasonality of UTIs may help better understand risk factors for UTIs. Furthermore, understanding differences in seasonality of UTIs between men and women and across age groups may help identify possible causes and demographic targets for intervention.

Methods:
• Hospital data from Healthcare Costs and Utilization Project National Inpatient Sample (NIS) is a 20% nationally representative sample of discharges in the United States for years 1998 to 2011
• Cases of discharges with a primary diagnoses of 599.0
• Counts were converted to incidence by division of the age-sex specific mid-year Census estimate
• Incidence was normalized to a z-score within each age and sex strata to enable cross-sex and age comparisons of relative effects
• Generalized Additive Mixed Models (GAMM) are a semi-parametric method for the estimation of a time series commonly used in climate modeling
• Trend was estimated using a GAMM thin plate smoother
• Seasonality was estimated using a cyclic cubic spline with up to 12 knots
• To account for the lack of independence of our data, we incorporated an AR(1) correlation structure
• The degree of seasonal variance was measured by the observed maximum, minimum and range of the GAMM seasonal smoother
• The relationship between seasonal variance and age was estimated with a least squares regression

Results:
• Incidence in all age groups in both sexes is increasing from 1998–2011 with the largest absolute increase occurring in older women. Figure 1
• GAMM trend estimates do not vary significantly by age within men or women; however, women have nearly twice the increase in incidence relative to men, Figure 2
• GAMM seasonal smoothers show seasonality among both men and women with a summer peak and winter trough, Figure 3
• Among women, there is a significant decrease in the smoother’s range with increasing age. Both the maximum values and minimum values trend towards 0, Figure 2 and Figure 3
• Among men, there is no significant change in the smoother extreme values or range, Figure 2 and Figure 3
• The seasonal range among women decreases by 1.75% (2.36%–1.13%) of a standard deviation per year of age compared to a non-significant 0.55% among men, Table 1

Conclusions:
• UTI hospitalization is increasing among both men and women; however, the rate among women is increasing nearly twice as fast
• Seasonality is present in both men and women but diminishes rapidly as women age. Among men, the seasonal changes in incidence do not vary with age.
• UTIs are more common in the summer. However, this summer increase is less dramatic for men and older women.
• Most of the increase in UTI incidence has been due to increases in hospitalizations of older women.
• Future investigations of seasonality should concentrate on younger women and males.