

Seasonal Variation in Emergency General Surgery

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Objective: The aim of this study was to assess the seasonal variation in emergency general surgery (EGS) admissions.

Background: Seasonal variation in medical conditions is well established; however, its impact on EGS cases remains unclear.

Methods: The National Inpatient Sample (NIS) database was queried over an 8-year period (2004–2011) for all patients with diagnosis of acute appendicitis, acute cholecystitis, and diverticulitis. Elective admissions were excluded. The following data for each admission were recorded: age, sex, race, admission month, major operative procedure, hospital region, and mortality. Seasons were defined as follows: Spring (March, April, May), Summer (June, July, August), Fall (September, October, November), and Winter (December, January, February). X11 procedure and spectral analysis were performed to confirm seasonal variation.

Results: A total of 63,911,033 admission records were evaluated of which 493,569 were appendicitis, 395,838 were cholecystitis, and 412,163 were diverticulitis. Seasonal variation is confirmed in EGS ($F=159.12$, $P<0.0001$) admissions. In the subanalysis, seasonal variation was found in acute appendicitis ($F=119.62$, $P<0.0001$), acute cholecystitis ($F=37.13$, $P<0.0001$), and diverticulitis ($F=69.90$, $P<0.0001$). The average monthly EGS admission in Winter was $11,322 \pm 674$. The average monthly EGS admission in Summer was higher than that of Winter by 13.6% ($n=1542$; 95% CI: 1180–1904, $P<0.001$).

Conclusions: Hospitalization due to EGS adheres to a consistent cyclical pattern, with more admissions occurring during the Summer months. Although the reasons for this variability are unknown, this information may be useful for hospital resource reallocation and staffing.

Keywords: acute appendicitis, acute cholecystitis, diverticulitis, emergency general surgery, national inpatient sample, regression, spectral analysis

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Infectious and inflammatory diseases comprise some of the most common causes of hospital admissions in the United States. Surgical treatment in some of these inflammatory diseases is the primary treatment option, whereas in the other, failure of medical management would indicate the surgical intervention as the only treatment option left. Accordingly, a significant proportion of an acute care surgeon's operative time is dedicated to the treatment of inflammatory diseases such as acute appendicitis, acute cholecystitis, and diverticulitis.¹

The concept of seasonal variation is well established in the medical literature. Sepsis, cardiac arrest, and stroke are known to have a seasonal peak in Winter.^{2–4} Seasonal variation has been identified with multiple inflammatory and noninflammatory conditions. However, only a few surgical diseases have been confirmed to have seasonal variation.⁵ Studies have evaluated the seasonal pattern for acute appendicitis, with controversial results,^{6–8} whereas acute cholecystitis has not been the subject of any seasonal variation analyses. Various etiologies have been proposed to explain the seasonal pattern in surgical inflammatory diseases in the literature.^{5,8–10}

With the increase in the emergency general surgery (EGS) cases,¹¹ the acute care surgery model has been implemented to surge the efficacy of both elective surgeries and emergency surgeries.¹ However, EGS is covered by trauma service in many hospitals across the United States, which also is known to have a seasonal variation in admissions.¹² The knowledge of a seasonal variation in the EGS admissions would have important implications in resource utilization in hospitals, public health, and clinical research.^{13–16} Accordingly predicting the demand for hospital resources and the presence of backup personnel during the peak season is an essential component of distributing limited health care resources and optimizing patient care.

The aim of this study was to identify the seasonal variation in EGS. We hypothesized that EGS admissions follows a seasonal pattern.

METHODS

Data Source

We obtained hospital discharge data from the Nationwide Inpatient Sample (NIS) database to include January 1, 2004, through December 31, 2011. The NIS—the largest source of all-payer hospital discharge information in the United States—is a unique, powerful tool that includes data from approximately 7 to 8 million hospital stays per year across 1000 hospitals located in 35 states, approximating a 20% stratified sample of hospitals in the United States.¹⁷ The NIS provides information on patient characteristics, socioeconomic factors, admission profiles, hospital profiles, state codes, admission month, discharge diagnoses, procedure codes, total charges, discharge disposition, and time of discharge.

Patients

We used diagnostic codes from the *International Classification of Diseases, Ninth Revision (ICD-9)* to identify all patients who were discharged with diagnostic codes specific to acute appendicitis (540, 540.0, 540.1, 540.9, 541, and 542), acute cholecystitis (574.0, 574.00, 574.01, 574.3, 574.30, 574.31, 574.6, 574.60, 574.61, 574.8, 574.80, 574.81, 575.0, and 575.12), and diverticulitis (562.11 and 562.13) regardless of an associated operative procedure during the admission. We included only patients with emergent admissions. Patients with missing admissions month data were excluded from analysis. We used the term “emergency general surgery” to refer to nonelective acute appendicitis, acute cholecystitis, and diverticulitis admissions only. EGS has a spectrum that encompasses far more than

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