Article:

- Country: USA
- Funding Sources: No funding conflicts.

Purpose:

- Research Question(s):
  - Primary Question: How did the patterns of CT use change over the time period from 1996 to 2007 in key populations by patient demographics, visit characteristics, hospital factors, and presenting complaints?
  - Secondary Question: How are changes in CT use from 1996 to 2007 associated with subsequent decisions to hospitalize or transfer to another facility?
- Hypothesis: “We hypothesized that there was more than a 2-fold increase in the prevalence of CT use in the ED during the study period and that a RR (relative risk) reflecting this magnitude of change represented a clinically significant result.”

Design:

- Study Design:
  - Retrospective cohort analysis

- Dependent / outcome Variable(s):
  - Primary outcome: Whether at least 1 CT was performed during an ED visit (MRI or CT 2001-2004)
  - Secondary outcome: Hospital admission, admission to observation, or transfer to another hospital

- Independent / research Variable:
  - Patient demographics:
    - Age, sex, self-reported race, ethnicity, insurance status
  - Visit characteristics:
    - Year, time of arrival, triage category, presenting complaint (two investigators independently placed reason visit codes for complaints and resolved discrepancies with consensus opinion – top 20 presenting complaints covered 80% of all ED visits and 85% of all CT scans), category of complaint (medical or injury), number and types of tests, any procedure, emergency procedure (CPR or ETT), number of medications dispensed, resident or physician extender as provider, disposition
o Hospital factors:
  - Location (urban or rural), region (South, Northeast, West, Midwest),
  - hospital ownership (government-nonfederal, for profit, and nonprofit),
  - hospital type (teaching)

SETTING / SUBJECTS:

∞ Research Setting: ED

∞ Subjects:
  o Study population: Data from the ED component of the National Hospital
    Ambulatory Medical Care Survey (NHAMCS), a nationally representative sample
    of all ED visits in non-institutional general and short-stay hospitals excluding
    federal, military, and VA hospitals (368,680 ED visits at 601 hospitals
    representing an estimated 1,289,529,680 ED visits nationally during that the time
    period from 1996 to 2007)

  o Inclusion / Exclusion criteria: Excluded federal, military, and VA hospitals (as
    they are not part of the database)

METHODS:

∞ Data Collection: Data on patient demographics, visit characteristics, hospital factors for
  all ED visits during a randomly assigned 4-week reporting period each year were
  collected by staff at the sampled hospitals, under the guidance of NHAMCS
  representatives and entered into the NHAMCS database.

DATA ANALYSIS:

∞ Level of Data:  Categorical: Data was converted to categorical variables for analysis
∞ Statistics Used:
  o Descriptive statistics: Used to present overall CT use across years, patient
    demographics, visit characteristics, and hospital factors
  o Multivariable logistic regression models: Used to evaluate associations between:
    ∞ 1) CT use during an ED visit AND year, patient demographics, visit
        characteristics, and hospital factors
    ∞ 2) CT use during an ED visit AND presenting complaint
    ∞ 3) CT use during an ED visit AND hospitalization (or obs) or transfer to
        another facility
  ∞ Models were tested for colinearity – no covariates with an inflation factor
    >10 were found and none were removed from the model
  ∞ Final model exploring association between CT use and year, patient
    demographics, visit characteristics, and hospital factors
    ∞ Included covariates of year of study, age, sex, race, ethnicity,
      insurance, arrival time, triage category, category of complaint
      (medical or injury), types of tests performed (blood tests,
      urinalysis, pregnancy test, radiograph, ultrasonography), if treated
      by physician extender or resident, hospital location, region,
      ownership, and type
• Blood testing and urinalysis included because they may influence CT ordering decision
• Pregnancy testing included because it may influence decision to order CT
• Radiography and ultrasonography included because it is possible that CT was increasingly replacing these modalities during the study years
• Final model had acceptable goodness of fit ($p$ value for F-adjusted mean residual test statistic of 0.93)
• Harrell’s C statistic (measure of the predictive accuracy of the model) was 0.79 (0.5-1.0) – representing moderate concordance between predicted probabilities and observed responses
• Model exploring CT use and hospitalization or transfer included additional covariates
  • Number of tests performed, whether any procedures was performed, whether emergency procedure was conducted, number of medications provided, disposition to ICU versus non-ICU bed after CT
  • Acceptable goodness of fit ($p$ value for F-adjusted mean residual test statistic of 0.14)
  • Harrell’s C statistic of 0.88 – representing good concordance with predicted probabilities
  • All odds ratios and 95% confidence intervals generated with the logistic regression models were converted to risk ratios
  • Given the large number of covariates, the $P$ value was adjusted for multiple comparisons with the Bonferroni correction from a level of 0.05

**RESULTS:**

• **Brief answers to research questions:**
  • CT use increased 330% from 3.2% of all encounters in 1996 to 13.9% in 2007
  • Most dramatic increase in older patients (9.1% to 29.1% of patients older than 79
  • CTs more frequently used for whites, but rates of growth were similar across race
  • Largest increase in patients presenting with abdominal pain (10x in 2007 vs 1996)
  • Also large increases in use for pts presenting with flank pain, chest pain, and SOB
  • By 2007, >25% of pts with following complaints were CT’d: focal neurologic symptoms, flank pain, convulsions, vertigo/dizziness/syncope, headache, abdominal pain, general weakness
  • Likelihood of hospitalization or transfer after CT declined throughout study period but leveled off after 2003

• **Limitations:**
  • Don’t know why CT was obtained for any individual
  • Does not follow up patient outcomes, only dispositions
  • Does not control for confounding trends in hospital admission rates and CT use
  • Unable to obtain number and specific type of CT performed during ED visit
IMPLICATIONS FOR PRACTICE:

- **Applicable to this clinical practice:**
  - About one quarter of all CT scans performed in the US in 2007 were conducted in the ED
    - Is this reducing frequency of hospitalization or transfer?
    - Does this improve downstream resource utilization or clinical outcomes?
  - This is a relevant population and is applicable to our practice
  - Highlights need for more CT decision rules

LEVEL OF EVIDENCE / DECISION FOR USE:

- Background Consider Replication **X** Ready for use

- **Level of Evidence:**
  - Ia Evidence obtained from meta-analysis of randomized controlled trials
  - Ib Evidence obtained from at least one RCT
  - IIa Evidence obtained from at least one well-designed controlled study without randomization
  - IIb Evidence obtained from at least one other type of well-designed quasi-experimental study
  - **X** III Well-designed non-experimental studies
  - IV Expert committee reports, opinions of experts
