

Overcrowding in the Emergency Department – Does Volume of Emergency Room Patients Affect Ordering of CT Scans?

F Moser, M Maya, S Young, L Blaszkiewicz

Citation

F Moser, M Maya, S Young, L Blaszkiewicz. *Overcrowding in the Emergency Department – Does Volume of Emergency Room Patients Affect Ordering of CT Scans?*. The Internet Journal of Emergency Medicine. 2008 Volume 6 Number 1.

Abstract

CAT scans are among the most expensive, non-invasive tests that can be readily ordered in an Emergency Department. As such it becomes important to understand if there are non-medical factors involved in requesting performance of scans by ED doctors. In an attempt to discern if crowding in the ED or Hospital had any effect on this, data was collected for a six week period in April and May of 2006. After an exhaustive review of the data - including a multiple regression analysis - no effect of ED or hospital census on scan ordering could be discovered. A minor negative effect (scans were less likely to be positive if it was busy in the ED and the hospital) by a combination of these variables on the percent of scans judged positive was derived. If there are non-medical influences of scan ordering it does not appear to be crowding.

INTRODUCTION AND OBJECTIVES

The ease of access and the reliability of results have made use of high technology imaging studies commonplace in hospital emergency departments. However the utilization of expensive resources in hospital emergency departments is becoming an increasing economic problem. Reduction in reimbursements and an increase in the number of uninsured are squeezing the hospital on the financial side while the demand for the tests increases.

One question has been whether the tests are being ordered to speed the patient's transit through the emergency room by sending the patient for a test and deferring a thorough history and physical. The doctor or triage nurse can simply say "headache, CAT scan of the brain" or "abdominal pain, CAT scan of the abdomen". Ultrasound or Doppler scans can be performed just as easily. It is the general impression of radiologists that the vast majority of these studies are non-revealing. They are either normal or demonstrate findings consistent with the patient's age. It is increasingly disturbing when overlapping tests such as ultrasounds and CAT scans are ordered and they are both negative. There have been many guidelines for ordering of studies published but strict adherence to them is rare. "The ER is all about looking for injury, so the physician's first inclination is to order imaging to search for it," one expert has opined as the reason for this mode of practice.

If it is true that the ED doctors or triage nurses order more tests when they are squeezed for time and physical resources the number of tests ordered should increase disproportionately with the number of patients seen in the emergency department. It is also possible that hospital crowding could affect ordering of tests in the ED. Patients will wait longer in the ED for a hospital bed when the hospital is full. ED doctors might then order more tests to either discharge the patient quicker or get the patients medical work-up started faster.

I have decided to specifically examine head CAT scans. This is a defined exam done for specific purposes and could be easily classified into either abnormal or normal (new normal or normal for age would be considered normal). Correlating hospital and ER census to the number of scans performed or to the rate of abnormal scans might help us determine whether they have been ordered for medical reasons or for functional reasons within the emergency room setting.

DATA ANALYSIS AND METHODS

Data was obtained for Cedars-Sinai Medical Center for a continuous period from the last three weeks of April through the month of May 2006. The daily census tabulations for the hospital and the Emergency Department were obtained from the hospital (Appendix 1). Head CAT Scans were retrospectively counted on a daily basis from the Imaging

Department’s PACs system. They were tabulated for number of studies performed. The reports were examined and classified as either requiring action by a physician or considered normal. Scans were considered positive regardless of whether the findings were pertinent to the indication for the scan or incidental to the admission. (Appendix 2)

The findings were then analyzed and examined in several fashions. Ordinary graphs of the daily patterns over the month were obtained and correlations between number of scans ordered and the rate of positives with ED and hospital census were derived. Correlations were calculated in both simple and multiple regression models.

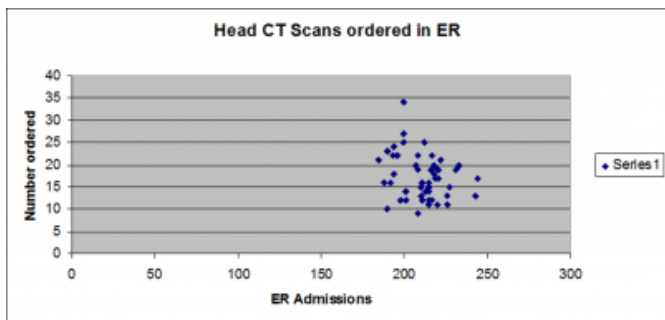
RESULTS

HEAD CAT SCANS ORDERED

The number of Head CAT scans ordered daily was relatively consistent as expressed in Figure 1. Except for one outlier day the number of scans ordered was between 10 and 27. The ED census varied from 185 to 244. There was no correlation found between the number of scans ordered and either the ED census and or the hospital census.

Figure 1

Figure 1



PERCENT POSITIVE

The percentage of positive scans was variable. On one day no positive scans were ordered and on another 65% of the scans ordered were positive. On the majority of days the percent of positive scans was between 15% and 35%. (Table 2) There was no correlation between the percent of scans positive and the ED census in a simple fashion or the number of scans ordered.(Table 3) Looking at the ED census alone no correlation could be found using a quadratic model either.

Figure 2

Figure 2

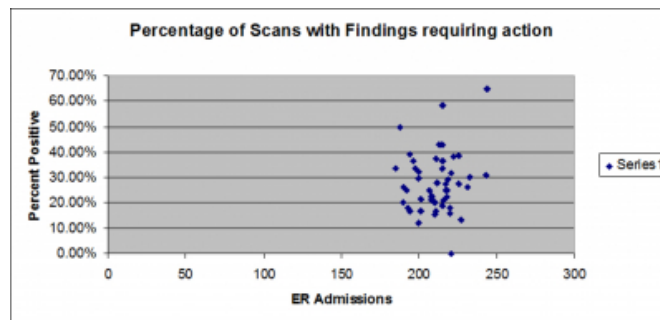
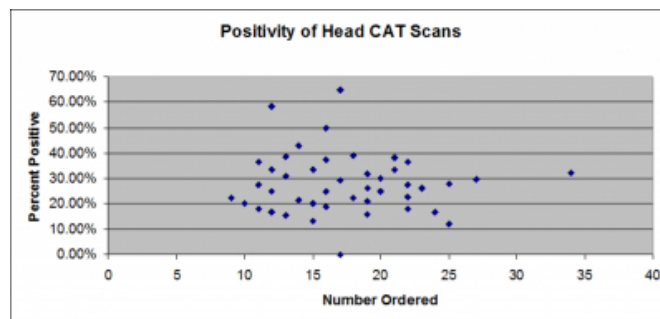


Figure 3

Figure 3



EFFECT OF HOSPITAL CENSUS

In order to determine the relationship of the hospital census and head CAT scans an attempt was made to correlate CAT scans ordered in the emergency department and Hospital Census. When beds are scarce in the hospital the patterns of scans ordered might vary. When this was examined, however, no correlation could be discerned. (Table 4) It was also the case with the number positive scans (Table 5).

Figure 4

Figure 4

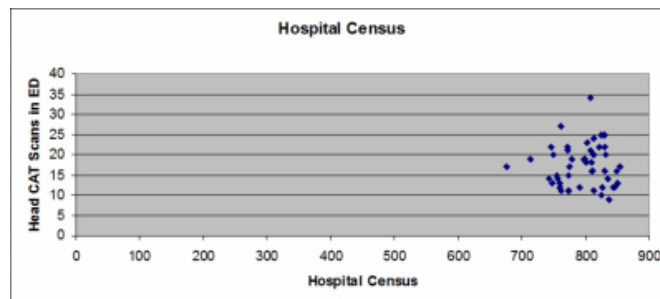
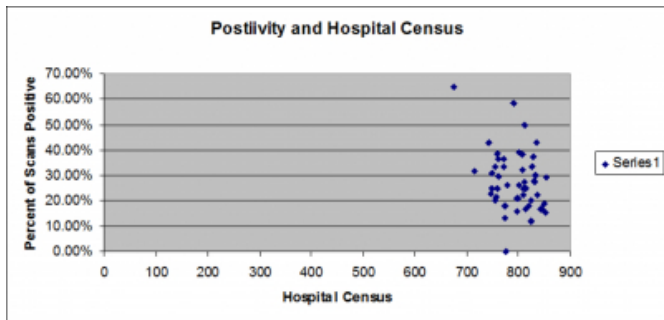


Figure 5

Figure 5



MULTIPLE REGRESSION MODEL

Although no correlation could be discerned using a single or polynomial factors with the same variables attempts were made to derive a multiple regression model. This was done using the Emergency Department census and Hospital Census together as the variables. Using the natural logarithmic of the variable the greatest correlation derived was only a very slight one. This correlation was based on a multiple regression model of the quadratic of the Emergency Department census and the hospital census. (Table 1) This model is represented by the equation:

$$\text{Percent Positive} = 164 - 60 \ln(\text{ed census}) + 5.6 \ln(\text{ed census}^2) - 0.6 \ln(\text{hospital census})$$

It is a very weak correlation with an R²= 0.17. It is, however, the only correlation of any statistical significance at all that could be derived given the measured variables. An attempt to predict the rate of positive scans on days for which data was collected, but not included in the analysis, fell short of expectations.

CONCLUSIONS

The use of expensive high-technology examinations in medical practice and in the emergency room in particular continues to increase. The reasons are most likely multifactorial. This analysis was an attempt to explain potential non medical factors in Head CAT scans in a busy Emergency Department. No correlation could be found between the Emergency Department census, the number patients in the hospital with Head CT ordered, or the percentage of scans that were found to be positive.

Since scans are ordered by individual doctors a better study might have been done by looking at the correlation based on the individual doctors or by the time of day the scan was ordered. This might be performed in a future study.

A minimal negative correlation was found with the ED census and hospital census. It might be so little as to have no meaning.

It is entirely possible that there are no casual factors in the decisions to order an expensive, high technology examination in the Emergency Department. It is a pleasing concept that these decisions are made for medical reasons only. It is also possible that there are other variables that were not included in the analysis that are important. One might be the capacity of the scanners available to the Emergency Department. Further work on this problem will be necessary.

Figure 6

Table 1

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.41						
R Square	0.17						
Adjusted R	0.11						
Standard E	0.11						
Observatio	48.00						

	Coefficients	Standard Err.	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	163.56	90.81	1.80	0.08	-19.45	346.57	-19.45	346.57
X Variable	-59.65	34.23	-1.74	0.09	-128.63	9.34	-128.63	9.34
X Variable	5.58	3.20	1.74	0.09	-0.87	12.03	-0.87	12.03
X Variable	-0.59	0.36	-1.65	0.11	-1.31	0.13	-1.31	0.13

References

1. Wasay, Dudey and Bakshi “Dizziness and Yield of Emergency Head CT Scan: Is it Cost Effective?” Emerg Med J 2005; 22:312-314.
2. Stewart, K. “Seven Ways to Help Your Hospital Stay in Business” Family Practice Management May 2003.
3. Dr. M Hunink quoted in Diagnostic Imaging Online December 10, 2003.
4. Stein SC, Burnett MG, Glick HA. “Indications for CT Scanning in Mild Traumatic Brain Injury: A Cost-Effectiveness Study.” J Trauma. 2006 Sep; 61(3):558-66. Review. Erratum in: J Trauma. 2007 May; 62(5):1309. PMID: 16966987 [PubMed - indexed for MEDLINE]
5. Smits M, Dippel DW, Hunink MG. “Cost Effectiveness of Using Computed Tomography (CT) for Minor Head Injury Compared with Several Other Management Strategies.” J Trauma. 2007 May; 62(5):1314-5; PMID: 17495745 [PubMed - indexed for MEDLINE]
6. Norlund A, Marké LA, af Geijerstam JL, Oredsson S, Britton M; “OCTOPUS Study. Immediate Computed Tomography or Admission for Observation after Mild Head Injury: Cost Comparison in Randomised Controlled Trial.” BMJ. 2006 Sep 2; 333(7566):469. Epub 2006 Aug 8. PMID: 16895945 [PubMed - indexed for MEDLINE]
7. Hirano LA, Bogardus ST Jr, Saluja S, Leo-Summers L, Inouye SK. “Clinical Yield of Computed Tomography Brain Scans in Older General Medical Patients.” J Am Geriatr Soc. 2006 Apr; 54(4):587-92. PMID: 16686867 [PubMed - indexed for MEDLINE]
8. Eguare E, Tierney S, Barry MC, Grace PA. “Management of Head Injury in a Regional Hospital.” Ir J Med Sci. 2000 Apr-Jun; 169(2):103-6. PMID: 11006663 [PubMed -

Overcrowding in the Emergency Department – Does Volume of Emergency Room Patients Affect Ordering of CT Scans?

indexed for MEDLINE]

9. Chen EH, Mills AM, Lee BY, Robey JL, Zogby KE, Shofer FS, Reilly PM, Hollander JE. "The impact of a Concurrent Trauma Alert Evaluation on Time to Head

Computed

Tomography in Patients with Suspected Stroke." Acad Emerg Med. 2006 Mar;13 (3):349-52. Epub 2006 Feb 22. PMID: 16495426 [PubMed - indexed for MEDLINE]

Author Information

Franklin G. Moser, M.D., M.M.M., F.A.C.R.

Director, Clinical and Interventional Neuro-Radiology Director, Imaging Operations Vice-Chairman, Imaging for Radiology Research, Cedars-Sinai Medical Center S. Mark Taper Imaging Foundation

Marcel Maya, MD

Neurovascular and Neuro-Interventional Radiology Director, Radiology Residency, Cedars-Sinai Medical Center S. Mark Taper Imaging Foundation

Sun Young, MD

Chief Resident, Cedars-Sinai Medical Center S. Mark Taper Imaging Foundation

Laura Blaszkiewicz, RN

Radiology Research RN II, Cedars-Sinai Medical Center S. Mark Taper Imaging Foundation