

Brain imaging in the diagnostic evaluation of syncope: Are we “Choosing Wisely”?

Chad G. Murphy, M.D.

University of Illinois College of Medicine in Peoria

Abstract:

In 2012, the “Choosing Wisely” campaign was launched to raise awareness of financial medical waste and unnecessary diagnostic testing. Both the American College of Emergency Physicians (ACEP) and The American College of Physicians (ACP) have provided guidelines to direct the use of brain imaging in the evaluation of simple syncope. *Purpose:* To determine how well a local community hospital system is adhering to the “Choosing Wisely” recommendations regarding brain imaging in the diagnostic investigation of syncope. *Methods:* Retrospective chart review of patients greater than 18 years of age

presenting to the Emergency Department (ED) and inpatient settings at Unitypoint Health Methodist and Unitypoint Health Proctor between January 1st and December 31st 2016 with complaint of syncope. Interest in total number of non-indicated brain imaging studies obtained, cost of said studies, length of stay (LOS) both for ED only stays and inpatient stays, as well as whether imaging was ordered by physicians or mid-level providers. *Results:* Out of a total of 326 patients presenting with complaint of syncope 87 brain CTs and 2 brain MRIs were performed without indication amounting to a total billing charge of \$278,178. ED LOS was 68 minutes and 42 seconds longer (253.3 vs. 184.6) for patients who received non-indicated brain imaging vs. patients who did not. This was a statistically significant difference with a P value of < 0.0001. There was no statistically significant difference between the groups in regards to inpatient LOS. 51% of brain imaging studies obtained by mid-level providers were not indicated, 43% by physicians were not indicated. *Conclusion:* The Unitypoint Health system is performing many non-indicated brain imaging studies and lengthening emergency room stays in order to do so.

Introduction:

In 2010 the New England Journal of Medicine published “Medicine’s Ethical Responsibility for Healthcare Reform – The Top Five List” by Dr. Howard Brody. In his essay, he called upon the medical societies of America to compose “top five” lists identifying diagnostic recommendations which would reduce health care expenditure without negatively affecting patient care^[6]. In his piece Dr. Brody called upon U.S. physicians to recognize their role in the rapidly accelerating cost of healthcare services and suggested that the medical societies of America take part. The societies were to list recommendations regarding the most expensive diagnostic tests or treatments that were commonly ordered, but have been shown by current evidence to provide little to no benefit in regards to patient care. These recommendations would not be intended to stir up controversy or arouse debate, but rather, were to be well established and heavily supported by current literature.

In 2012, the ABIM (American Board of Internal Medicine) and consumer reports launched the “Choosing Wisely” campaign. The purpose of this campaign was to increase public and professional awareness of unnecessary medical spending and testing by forming affiliations with multiple medical societies and creating the diagnostic recommendation lists suggested by Dr. Brody in 2010.

The campaign to date has become affiliated with dozens of medical societies which have published “top five” lists and in many cases have expanded to “top ten” lists. One such recommendation found on the lists of two different medical societies concerns the utilization of brain imaging in the diagnostic evaluation of syncope. The American College of Physicians recommends that, “In the evaluation of simple syncope and a normal neurological examination, don’t obtain brain imaging studies (CT or Magnetic Resonance Imaging [MRI]).”^[2]. The American College of Emergency Physicians suggests

that practitioners “Avoid CT of the head in asymptomatic adult patients in the emergency department with syncope, insignificant trauma and a normal neurological evaluation.” [1]

Syncope is a common medical dilemma with some estimates suggesting that it may account for 1% to 3% of all emergency room visits and 6% of hospital admissions in the United States [10,18]. Hospital admissions for syncope cost an estimated \$5300 on average, or two billion dollars annually [17]. Additionally, syncope can be a source of frustration for patients and practitioners alike in that an etiology may not be determined in approximately one third to one half of patients [10, 7, 12]. The unsatisfactory nature of a “non-answer” may be driving practitioners to continue the practice of costly brain imaging. Multiple studies demonstrate brain CTs are one of the most commonly ordered diagnostic tests in syncope investigation despite poor yields [5, 6, 7, 12, 13, 15]. Unnecessary testing for syncope may amount to 6 billion dollars wasted annually in the United States [13]. In this context, it is not difficult to understand why two separate medical societies felt that it was necessary to reserve a spot on their lists for this issue.

Definitions:

Syncope as defined by the European Heart Association (EHA) is “a transient loss of consciousness due to transient global hypo-perfusion characterized by rapid onset, short duration, and spontaneous complete recovery”. [4] The American Heart Association’s (AHA) definition of syncope is in close agreement with that of the EHA [21]. Unfortunately, the ACP and the ACEP do not include a standard definition of syncope in their top five lists, and the literature referenced by these societies refer to both the EHA/AHA definition as well as a more colloquial use of the word. Thus, in this study, syncope will be defined in its more general sense as a sudden and temporary loss of consciousness with spontaneous resolution, often described as “blacking out” or “fainting”.

Purpose:

The purpose of this study is to determine how well healthcare providers within the local UnityPoint Health hospital system are adhering to the “Choosing Wisely” recommendations in regards to the use of brain imaging in the diagnostic evaluation of syncope and to identify an area of potential cost savings. This reduction in healthcare spending will not affect patient outcomes, as has been demonstrated by multiple studies [5, 6, 7, 10, 12, 13, 15, 19] and included in the recommendations of internationally recognized diagnostic guidelines of cardiology societies [4, 16]

Two secondary outcomes of interest are 1) the length of stay for those individuals who had brain imaging performed versus those individuals who had no brain imaging performed. This will be in regards to patients who remained only in the emergency room during their evaluation and to patients who were admitted to the inpatient setting. 2) The rates of brain imaging performed per encounter by physicians (medical doctors and doctors of osteopathic medicine) versus mid-level providers (physicians assistants and advanced nurse practitioners).

Methods:

Retrospective chart review. Consent was not obtained from participants, as no subject identifiers were included in the data collected.

Inclusion Criteria: patients greater than or equal to 18 years of age who presented to the Emergency Department (ED) or who were admitted to inpatient services at UnityPoint Health - Methodist as well as UnityPoint Health – Proctor in Peoria, Illinois over the twelve-month period extending from January 1st 2016 to December 31st 2016. Patients were identified based on the entry of the ICD 10 code “R55” as the primary diagnosis from the hospital patient database.

Exclusion criteria: patients younger than 18 years of age, diagnosis of “near-syncope”, patients misidentified as being syncopal, persistent loss of consciousness, altered mental status, or coma. Acutely intoxicated patients (alcohol or other illicit substances), LOC associated with substance use, and

hypoglycemia. Patients who recovered consciousness after pharmacologic or electrical intervention were also excluded. Reasons for exclusion were collected, but were not associated with PHI.

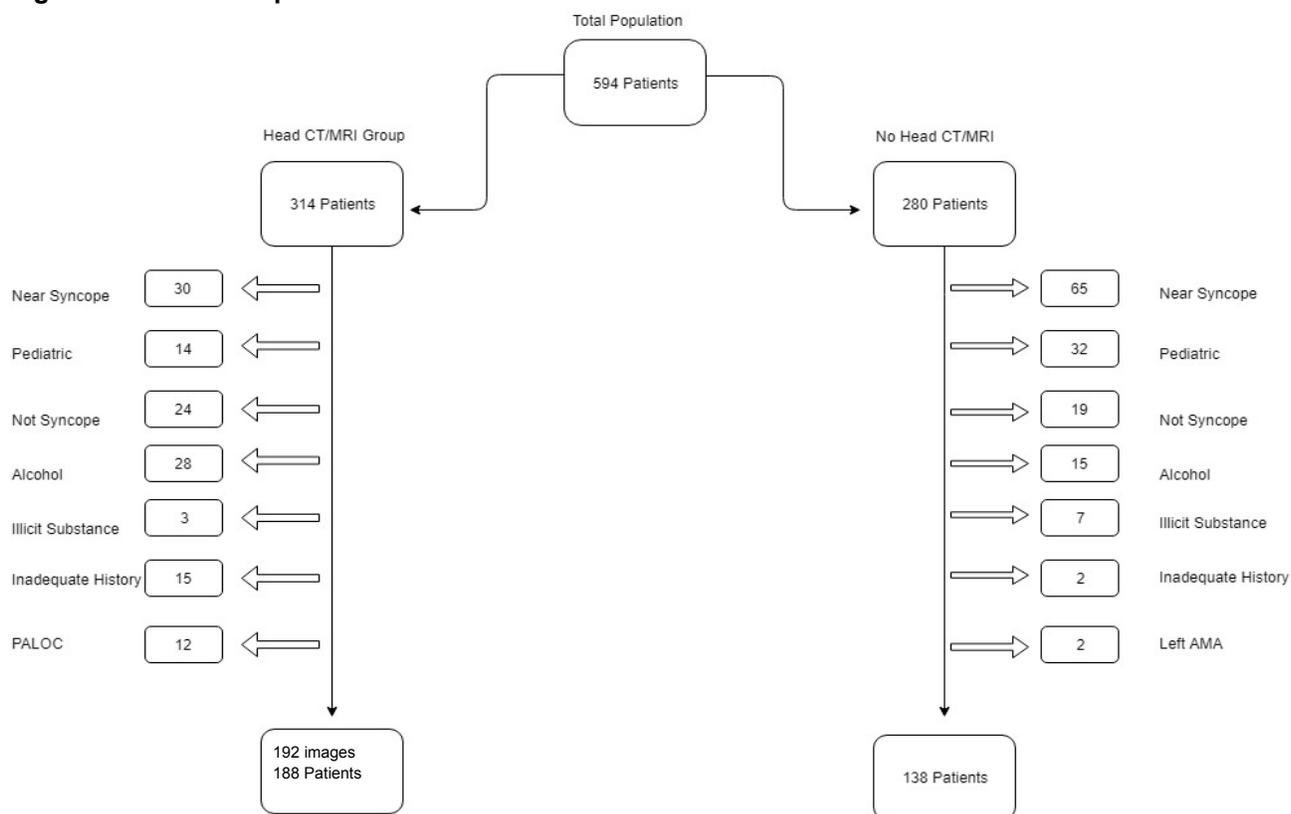
Data collected; patient age range (for example 20-29, 30-39), gender, duration of stay from admission to discharge, whether or not brain imaging was performed, where the imaging was ordered (emergency department vs. inpatient setting), and if the brain imaging was ordered by a physician or a mid-level provider. In reviewing each encounter, the HPI, physical examination findings, comorbidities, medications, prior imaging studies, laboratory findings, as well as prior encounters were reviewed and used to determine whether imaging was not indicated, but this data was not recorded.

The average length of stay for patients who had brain imaging performed when one was not indicated was compared to the average length of stay for patients who did not receive brain imaging both in the emergency department and the inpatient settings. The rate of brain imaging obtained per encounter by physicians was compared to that of mid-level providers.

The performance of brain imaging was deemed “not indicated” in the presence of a normal neurologic evaluation, insignificant head trauma and the absence of concerning patient history. Brain imaging obtained for the diagnostic evaluation of a non-classical syncopal episode was labeled “other” as the evaluation of the indication for these images falls outside the scope of this study.

Population and Demographics:

Figure 1. - Patient Population



Where “PALOC” is defined as persistent altered level of consciousness

Where “AMA” is defined as against medical advice

Figure 2. - Imaging Breakdown

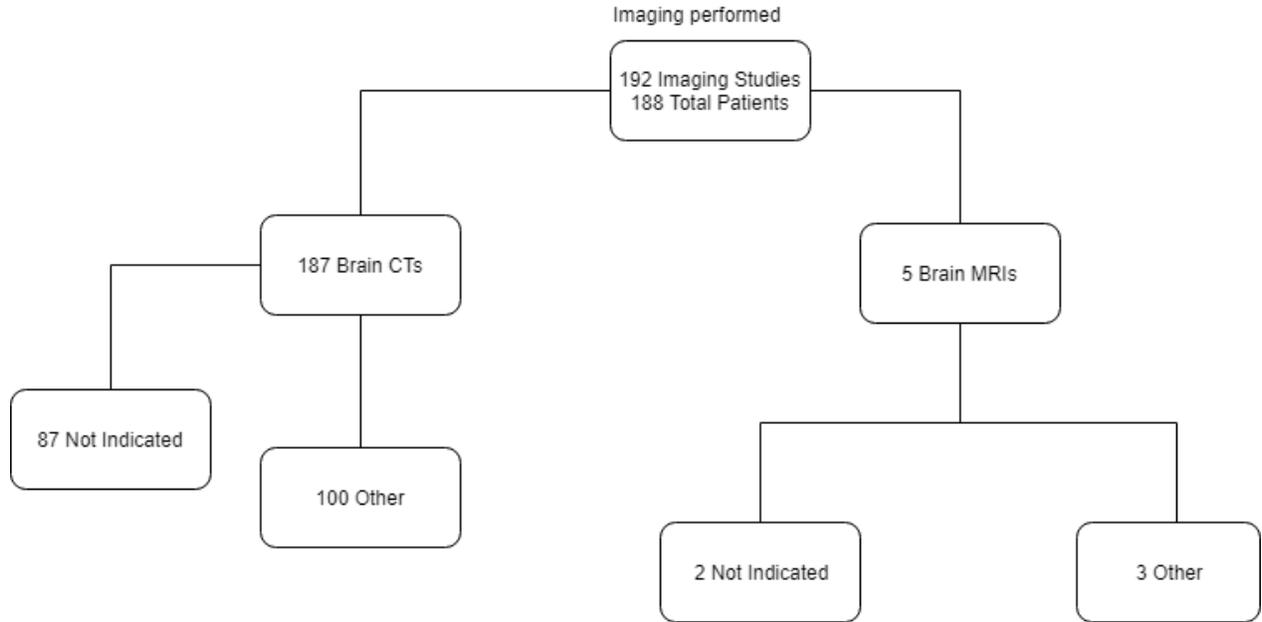


Figure 3. - Age Demographics Chart

Brain Imaging		No Brain Imaging		Combined Pop.
Age	Total Patients	Age	Total Patients	
<20	5	<20	5	10
20-29	23	20-29	30	53
30-39	13	30-39	15	28
40-49	19	40-49	12	31
50-59	25	50-59	20	45
60-69	26	60-69	13	39
70-79	29	70-79	15	44
80-89	32	80-89	19	51
>=90	16	>=90	9	25

Figure 4. - Age Demographics Graph 1

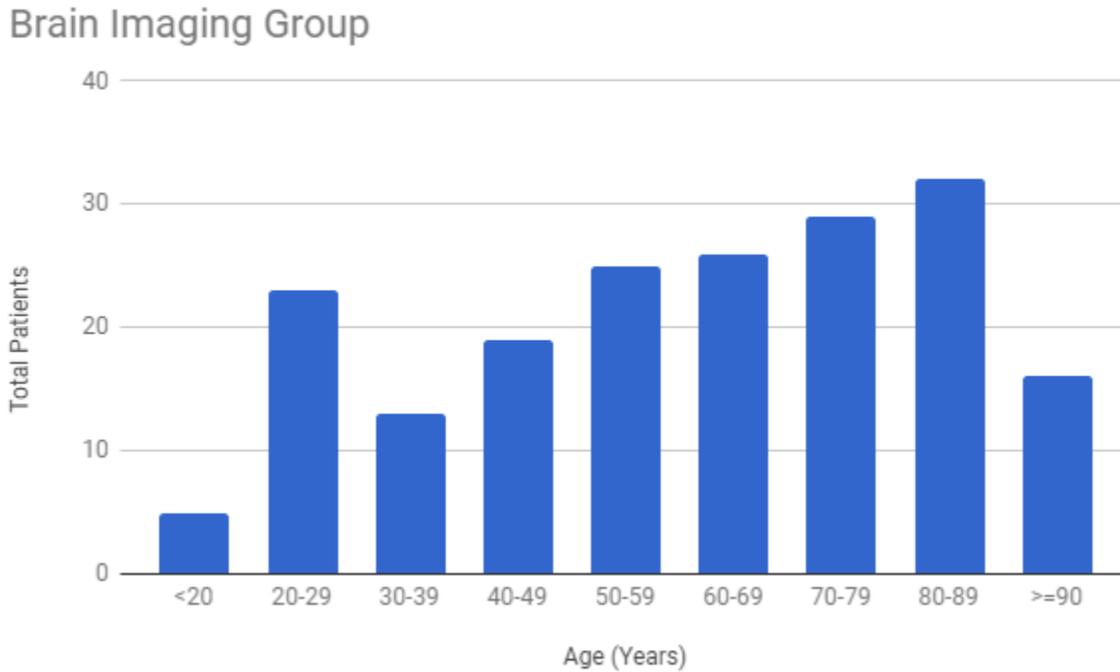


Figure 5. - Age Demographics Graph 2

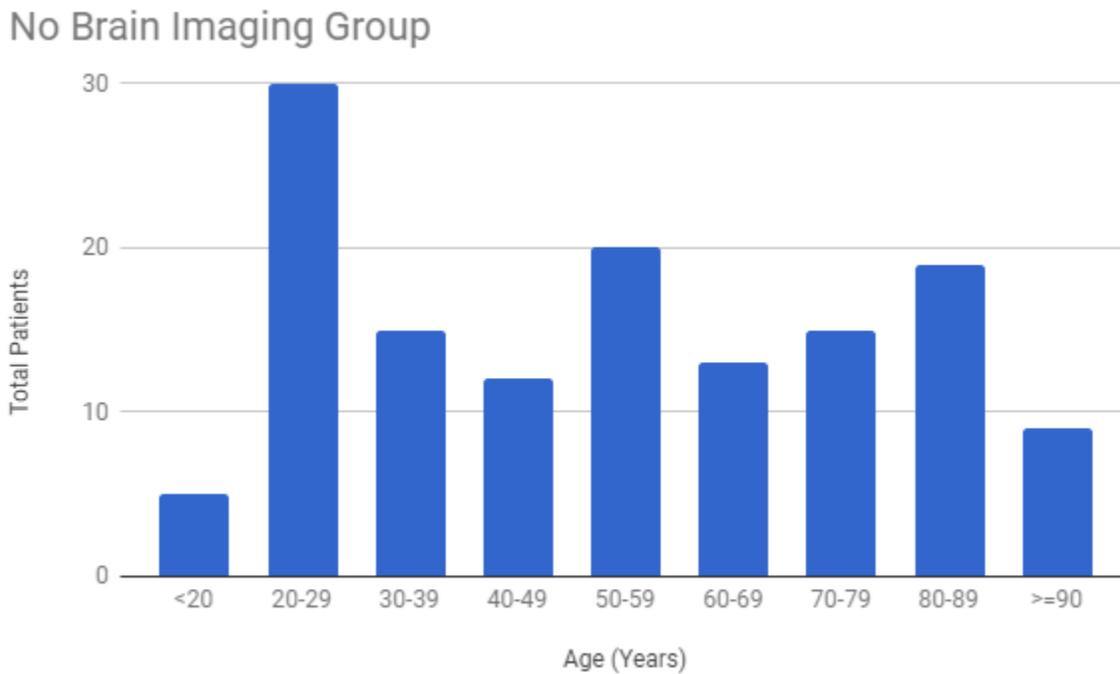
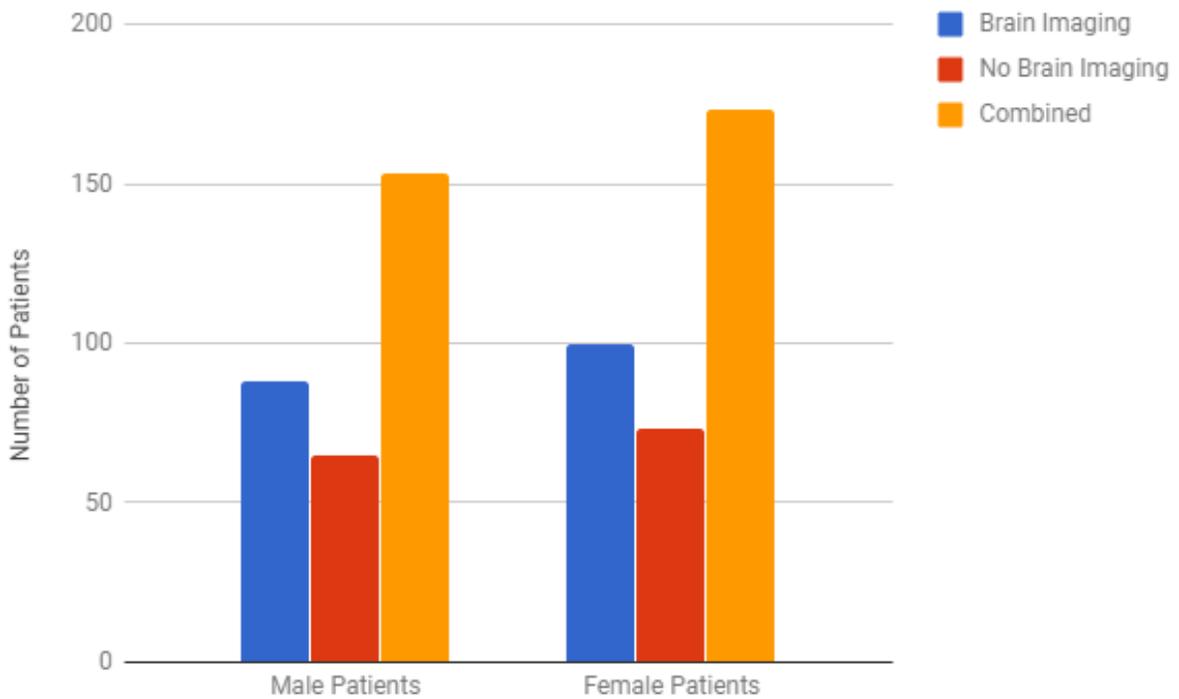


Figure 6. - Sex Demographics Chart

Brain CT	Total Patients	No Brain CT	Total Patients	Combined Pop.
Male Patients	88	Male Patients	65	153 (43%)
Female Patients	100	Female Patients	73	173 (57%)

Figure 7. - Sex Demographics Graph



Results:

There were a total of 188 patients who received head imaging studies. 4 patients received both a brain CT and a brain MRI. 1 patient received only a brain MRI. And 183 patients received only a brain CT [Figure 1 and 2]. Out of the 187 brain CTs performed, 87 were not indicated and 100 fell into the “other” category. Of the 5 MRIs obtained, 2 were not indicated and 3 fell into the “other” category. The Unitypoint Health system in Peoria, Illinois billed each patient \$3086.00 for a non-contrast brain CT and \$4848.00 for a non-contrast brain MRI. At (\$3086 x 87 CTs) + (\$4848 x 2 MRIs) the total charge to patients was \$278,178.

The average length of stay for a patient who remained within the emergency department and received a non-indicated brain imaging study was 253.3 minutes (4.22 hours) compared to those who did not receive brain imaging at 184.6 minutes (3.08 hours) [Figure 8 and 9.] A 37% difference or 68 minutes and 42 seconds longer. These two samples were compared using a Wilcoxon Two-Sample test with a P-value for statistical significance set at < 0.05. These two samples produced a P- value of < 0.0001. This is a statistically significant difference in length of stay between the two groups.

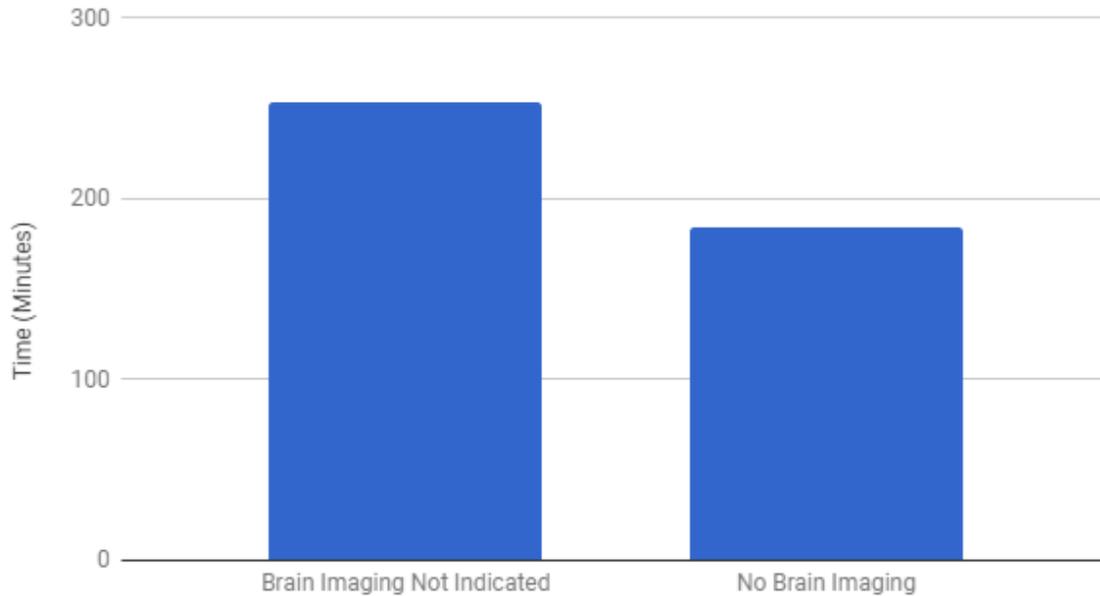
Figure 8. - ED Length of Stay Charts

Length of Stay (Minutes) - ED with Brain Imaging					
N	Minimum	Maximum	Mean	Std Dev	Median
46	86	437	253.33	88.46	230

Length of Stay (Minutes) - ED without Brain Imaging					
N	Minimum	Maximum	Mean	Std Dev	Median
98	20	382	184.63	80.53	165.5

Figure 9. - ED Mean Length of Stay Graph

ED Length of Stay



The average length of stay for a patient who was admitted to the inpatient setting and received brain imaging was 49.4 hours (2962.9 minutes) compared to those who did not receive brain imaging was 47 hours (2820 minutes) [Figure 10 and 11]. This is a 5.1% difference or 142 minutes and 54 seconds. These two samples were compared using a Wilcoxon two sample test generating a P value of 0.8691. There was no statistically significant difference in length of stay between these groups.

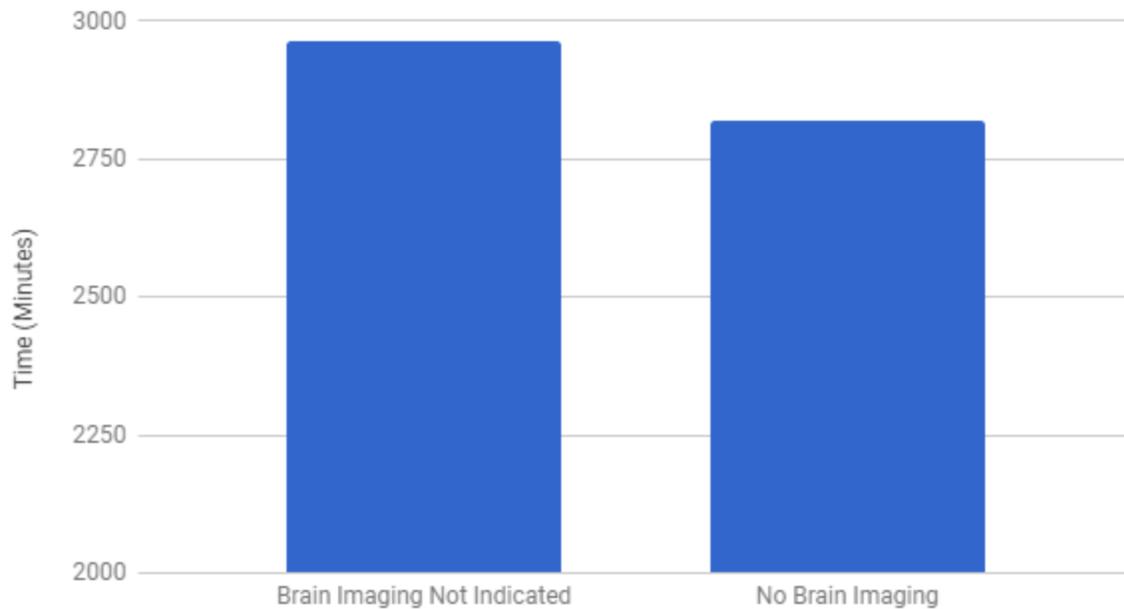
Figure 10. - Inpatient Length of Stay Charts

Length of Stay (minutes) - Inpatient with brain imaging					
N	Minimum	Maximum	Mean	Std Dev	Median
41	1129	17451	2962.9	2593.0.	2560

Length of Stay (Minutes) - Inpatient without brain imaging					
N	Minimum	Maximum	Mean	Std Dev	Median
40	887	7246	2820.43	1588.7	2543.5

Figure 11. - Inpatient Mean Length of Stay Graph

Inpatient Length of Stay

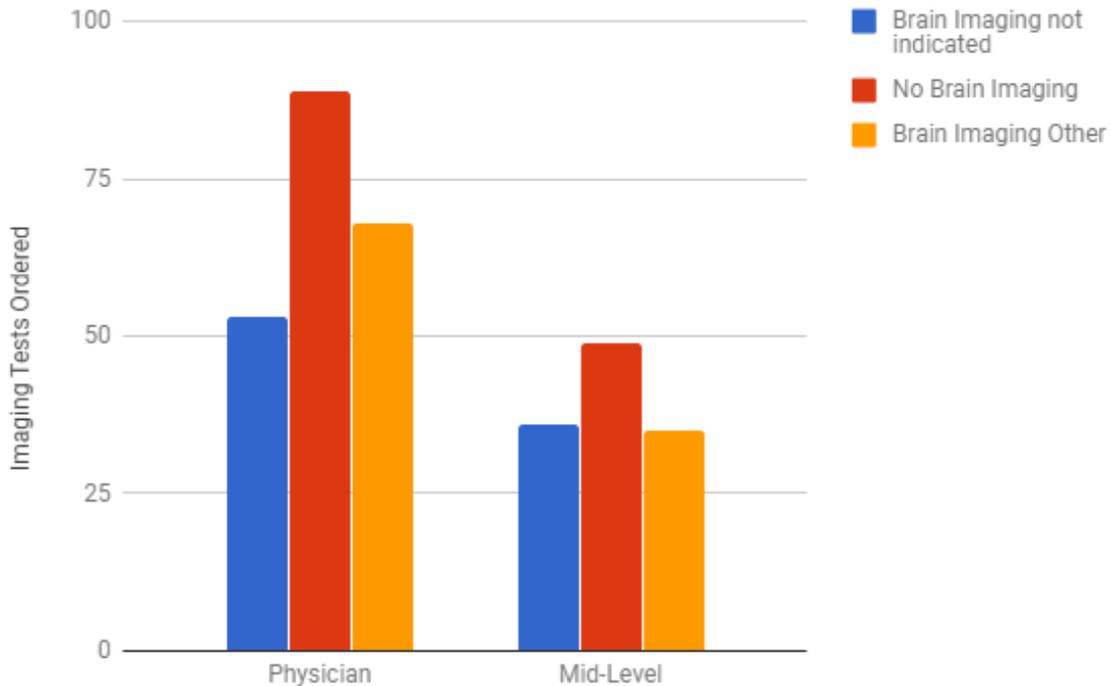


57.7% of the entire study population had brain imaging ordered, 46.3% of all obtained brain imaging studies were not indicated [Figure 2.]. Of the study population, physicians ordered 53 images which were not indicated, 68 images which fell into the “other” category, and 89 patients did not have brain imaging ordered. Mid-level providers ordered 36 images which were not indicated, 35 images which fell into the “other” category, and 49 patients did not have brain imaging ordered. 43% of all brain imaging studies obtained by physicians were not indicated and 51% of all brain imaging studies obtained by mid-level providers were not indicated [Figure 12 and 13].

Figure 12. - Physician vs. Mid-level Chart

	Physician	Mid-Level
Brain Imaging Not Indicated	53	36
No brain imaging	89	49
Brain imaging other	68	35

Figure 13. - Physician vs. Mid-level Graph

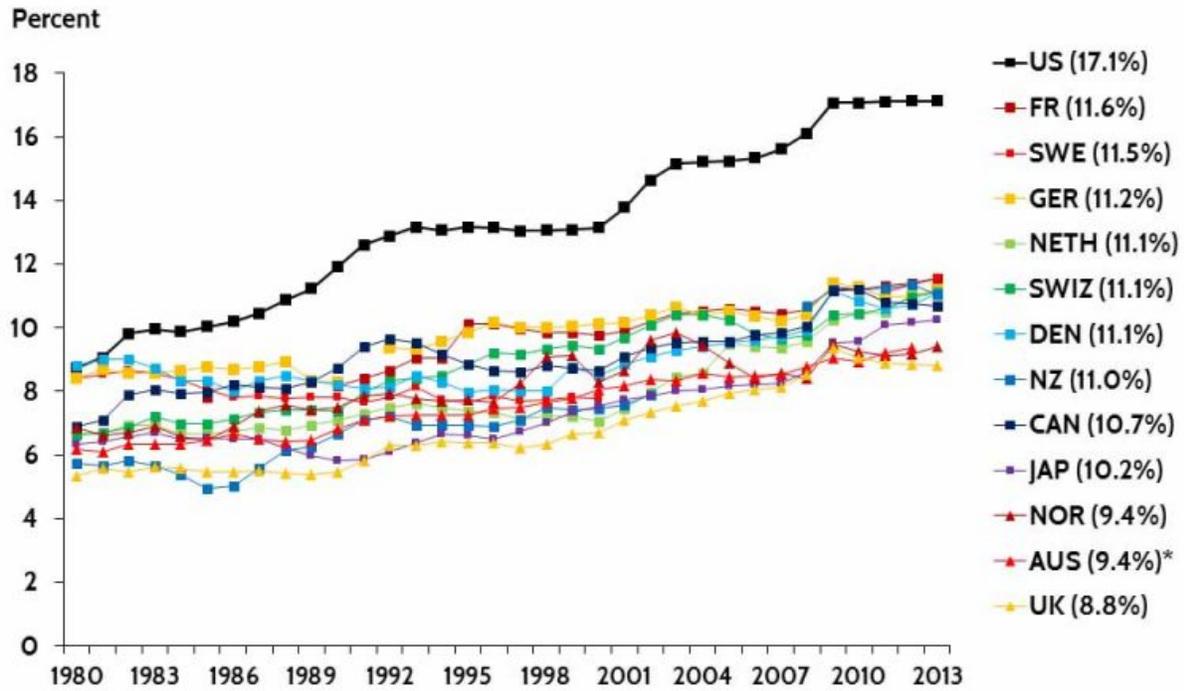


Discussion:

Healthcare spending in the United States exceeds that of other high income countries ^[18]. Americans do not appear to have an increased rate of hospital visits or physicians visits, but do utilize expensive technologies more so than other high income nations and suffer from higher healthcare prices ^[18]. According to Organization for Economic Cooperation and Development in 2012, the United States spent 17.1% of its total GDP on healthcare with the next closest high income nation, which spent only 11.6% of its total GDP [Figure 12]. In 2015, the U.S. spent \$9,086 dollars per capita on healthcare, almost double that of many of the other high income nations; this is despite the U.S. being the only high income nation lacking a publicly funded universal health care system ^[18] [Figure 14]. Specifically in regards diagnostic imaging, the United States orders these tests at a rate that far exceeds that of most other high income nations ^[18] [Figure 15].

Figure 13.

Exhibit 1. Health Care Spending as a Percentage of GDP, 1980–2013



* 2012.

Notes: GDP refers to gross domestic product. Dutch and Swiss data are for current spending only, and exclude spending on capital formation of health care providers.

Source: OECD Health Data 2015.

Figure 14.

Exhibit 2. Health Care Spending, 2013

	Total health care spending per capita ^e	Real average annual growth rate per capita		Current health care spending per capita, by source of financing ^{e,f}		
		2003–2009	2009–2013	Public	Private	
					Out-of-pocket	Other
Australia	\$4,115 ^a	2.70%	2.42% ^c	\$2,614 ^a	\$771 ^a	\$480 ^a
Canada	\$4,569	3.15%	0.22%	\$3,074	\$623	\$654
Denmark	\$4,847	3.32%	-0.17%	\$3,841	\$625	\$88
France	\$4,361	1.72%	1.35%	\$3,247	\$277	\$600
Germany	\$4,920	2.01%	1.95%	\$3,677	\$649	\$492
Japan	\$3,713	3.08%	3.83%	\$2,965 ^a	\$503 ^a	\$124 ^a
Netherlands	\$5,131 ^d	4.75% ^d	1.73% ^d	\$4,495	\$270	\$366
New Zealand	\$3,855	6.11% ^b	0.82%	\$2,656	\$420	\$251
Norway	\$6,170	1.59%	1.40%	\$4,981	\$855	\$26
Sweden	\$5,153	1.82% ^d	6.95% ^d	\$4,126	\$726	\$53
Switzerland	\$6,325 ^d	1.42% ^d	2.54% ^d	\$4,178	\$1,630	\$454
United Kingdom	\$3,364	4.00%	-0.88%	\$2,802	\$321	\$240
United States ^e	\$9,086	2.47%	1.50%	\$4,197	\$1,074	\$3,442
OECD median	\$3,661	3.10%	1.24%	\$2,598	\$625	\$181

^a 2012. ^b 2002–2009. ^c 2009–2012.

^d Current spending only; excludes spending on capital formation of health care providers.

^e Adjusted for differences in the cost of living.

^f Numbers may not sum to total health care spending per capita due to excluding capital formation of health care providers, and some uncategorized spending.
Source: OECD Health Data 2015.

Figure 15.

Exhibit 5. Diagnostic Imaging Supply and Use, 2013

	Magnetic resonance imaging		Computed tomography		Positron emission tomography	
	MRI machines per million pop.	MRI exams per 1,000 pop.	CT scanners per million pop.	CT exams per 1,000 pop.	PET scanners per million pop.	PET exams per 1,000 pop.
Australia	13.4	27.6	53.7	110	2.0	2.0
Canada	8.8	52.8	14.7	132	1.2 ^a	2.0
Denmark	–	60.3	37.8	142	6.1	6.3
France	9.4	90.9	14.5	193	1.4	–
Japan	46.9 ^b	–	101.3 ^b	–	3.7 ^b	–
Netherlands	11.5	50.0 ^b	11.5	71 ^b	3.2	2.5 ^a
New Zealand	11.2	–	16.6	–	1.1	–
Switzerland	–	–	36.6	–	3.5	–
United Kingdom	6.1	–	7.9	–	–	–
United States	35.5	106.9	43.5	240	5.0 ^a	5.0
OECD median	11.4	50.6	17.6	136	1.5	–

^a 2012. ^b 2011. ^c 2010.

Source: OECD Health Data 2015.

It is estimated that one half to one third of all health care spending in the United States is wasteful [3, 11]. This waste is divided into six categories [11]:

- 1) **Failures of care delivery** (no process in place to avoid human error)
- 2) **Failures of care coordination** (when patients “fall through the cracks” and receive fragmented care)
- 3) **Overtreatment** (providing care that cannot possibly help the patient or performing expensive diagnostic tests when simpler methods would suffice)
- 4) **Administrative complexity** (primary issue being redundancy, secretaries having secretaries if you will)
- 5) **Pricing failures** (lack of consistent pricing structures and charging whatever the market will bear)
- 6) **Fraud and abuse**

The performance of brain imaging in the diagnostic evaluation of syncope when such a diagnostic test is not indicated falls into three categories of waste:

- 1) **Failure of care delivery** - failure to follow best practice guidelines [4, 16, 17] with no system in place to prevent these imaging tests from being ordered
- 2) **Overtreatment** - subjects patients to testing that is extremely unlikely to be of benefit due to the known poor diagnostic yield
- 3) **Pricing Failure** - the price of brain imaging can vary wildly and appears to be based on what the market will bear [8]

\$278,178 is what was billed to the patients, but what was actually paid out of pocket? What was paid by the system? Unfortunately this is a difficult question to answer given the number of variables in determining the cost. Such variables include geographical location, comorbidity, insurance, age, deductible, the list goes on. What is more unfortunate is that the healthcare system has serious issues with billing transparency [19] which makes organizing the variables into a recognizable pattern oftentimes impossible. The Unitypoint Health system services a population of about 370,000 people and generated bills totalling about \$280,000 dollars in 2016 in non-indicated brain imaging alone, what is being wasted on a population of 326 million people?.

In regards to length of stay, there was a significant difference between the two emergency department groups of about 68 minutes. It may be that the difference in length of stay is mainly due to the length of time it takes to order, obtain, and interpret a brain CT. Consider, this is 68 minutes of additional nursing, physician, and sometimes scribe labor, 68 minutes during which medications, fluids, and supplies can be used. In the emergency department, time is money.

Between the two inpatient groups there was no significant difference in length of stay. It may be that the lack of difference exists because of the higher complexity of admitted patients and the lack of contribution CT imaging makes to the overall course of diagnostic investigation. That is to say, in the majority of these cases, the patient course would have remained the same regardless of if brain imaging was obtained or not.

Medical financial waste is one of the largest problems the American economy faces today. It is for this reason that the “Choosing Wisely” campaign was founded and why its message is so important. Though health care providers are not directly responsible for the bulk of the problem of medical financial waste, they do need to recognize their contributions to it and their capacity to reduce it [3, 11, 14]. The Unitypoint Health system in Peoria is performing many non-indicated brain imaging studies, generating unnecessary medical bills, and lengthening emergency room stays in order to do so. By better adhering to the recommendations of the ACP and the AACP, we could be spending less money and improving the patient care experience.

Limitations/Future Opportunities:

Quality of documentation is an inherent limitation in a retrospective chart review. It is possible that there were individuals who would have been appropriate to include or exclude, but were not due to a lack of documentation. Another limitation would be that all chart review was performed by a single individual. Ideally it would have been performed in duplicate by more than one party with a third party discussing and reconciling differences in an effort to reduce inter-observer bias. Though this study was multi-centered, it was within the same hospital system. There may be system practices in place which would not be present in another hospital system. The evaluation of imaging which fell into the “other” category fell outside the scope of this study. It may well be that some of these imaging tests were not indicated, which could further be contributing to wasted healthcare dollars.

References:

- 1) ACEP - Avoid head CT for asymptomatic adults with syncope | Choosing Wisely. (2014, October 27). Retrieved October 4, 2015, from <http://www.choosingwisely.org/clinician-lists/acep-avoid-head-ct-for-asymptomatic-adults-with-syncope/>
- 2) American College of Physicians - Brain imaging studies | Choosing Wisely. (2012, April 4). Retrieved October 6, 2015, from <http://www.choosingwisely.org/clinician-lists/american-college-physicians-brain-imaging-to-evaluate-simple-syncope/>
- 3) Berwick, Donald M., and Andrew D. Hackbarth, Eliminating Waste in US Health Care, *JAMA* 307, no. 14 (April 11, 2012): 1513–6.
- 4) *European Heart Journal* (2009) 30, 2631–2671; doi:10.1093/eurheartj/ehp298
- 5) Gallagher EJ. Hospitalization for fainting: high stakes, low yield. *Ann Emerg Med.* 1997 Apr;29(4):540-2.
- 6) Giglio P, Bednarczyk EM, Weiss K, Bakshi R. Syncope and head CT scans in the emergency department. *Emerg Radiol.* 2005 Dec;12(1-2):44-6.
- 7) Grossman SA, Fischer C, Bar JL, Lipsitz LA, Mottley L, Sands K, Thompson S, Zimetbaum P, Shapiro NI. The yield of head CT in syncope: a pilot study. *Intern Emerg Med.* 2007 Mar;2(1):46-9.
- 8) Healthcare Bluebook. (n.d.). from <https://www.healthcarebluebook.com/>
- 9) Howard Brody, M.D., Ph.D. *N Engl J Med* 2010; 362:283-285 January 28, 2010DOI: 10.1056/NEJMp0911423
- 10) Kapoor WN (1990) Evaluation and outcome of patients with Syncope. *Medicine* 69:160 – 174
- 11) Lallemand, N. (2012). Reducing waste in health care a third or more of what the US spends annually may be wasteful. How much could be pared back-and how-is a key question. Bethesda, Md.: Project HOPE.
- 12) Martin, T., Hanusa, B., & Kapoor, W. (1996). Risk Stratification of Patients With Syncope. *Annals of Emergency Medicine*, 459-466.
- 13) Mendu ML, McAvay G, Lampert R, Stoehr J, Tinetti ME. Yield of diagnostic tests in evaluating syncopal episodes in older patients. *Arch Intern Med.* 2009 Jul 27;169(14):1299-305.
- 14) Morra, Dante, Sean Nicholson, Wendy Levinson, David N. Gans, Terry Hammons, and Lawrence P. Casalino, US Physician Practices Versus Canadians: Spending Nearly Four Times as Much Money Inter- acting with Payers, *Health Affairs* 30, no. 8 (2011): 1443–50.
- 15) Pires LA, Ganji JR, Jarandila R, Steele R. Diagnostic patterns and temporal trends in the evaluation of adult patients hospitalized with syncope. *Arch Intern Med.* 2001Aug13-27;161:1889-95.
- 16) Rogers, G., & O'flynn, N. (2011). NICE guideline: Transient loss of consciousness (blackouts) in adults and young people. *Br J Gen Pract British Journal of General Practice*, 40-42.
- 17) Shukla GJ. Cardiology patient page. Syncope. *Circulation.* 2006 Apr 25;113(16):e715-7.
- 18) Squires, D., & Anderson, C. (2015, October 08). U.S. Health Care from a Global Perspective. Retrieved from <http://www.commonwealthfund.org/publications/issue-briefs/2015/oct/us-health-care-from-a-global-perspective>
- 19) S. R. Collins and K. Davis, Transparency in Health Care: The Time Has Come, The Commonwealth Fund, March 15, 2006
- 20) Sun BC, Emond JA, Camargo CA Jr (2005) Direct medical costs of syncope-related hospitalizations in the United States. *Am J Cardiol* 95:668 – 671
- 21) Syncope (Fainting). (n.d.). Retrieved November 14, 2015, from http://www.heart.org/HEARTORG/Conditions/Arrhythmia/SymptomsDiagnosisMonitoringofArrhythmia/Syncope-Fainting_UCM_430006_Article.jsp#.VmOxu9BLVtE