

ATTITUDES TOWARDS AN EVIDENCE-BASED CLINICAL DECISION SUPPORT TOOL
TO REDUCE EXPOSURE TO IONIZING RADIATION

by

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Dedication

This work is dedicated to the students I have had the pleasure of teaching, and the patients who have granted me the privilege to care for them. May this work inspire nurses to ask questions that will improve the lives of the patients they serve.

Abstract

Patients who suffer minor brain injuries experience unnecessary ionizing radiation in the form of a non-contrast head CT scan despite the dearth of evidence supporting standard CT scans for all brain injuries. Exposure to ionizing radiation increases the incidence of certain types of cancer. This evidence-based practice change project assesses the attitude of clinicians towards evidence-based clinical decision support tools, specifically the Canadian CT head rule. The use of highly sensitive clinical decision support tools is supported in the literature to help healthcare providers mitigate the risk associated with unnecessary use of CT scan imaging studies. The project was conducted in an academic medical center in the Northeast, utilizing healthcare providers caring for adult patients admitted to the hospital who sustained a minor brain injury due to a fall during their inpatient stay. The standard practice at this institution was to evaluate patients with minor brain injuries with non-contrast head CT scan. The Evidence-Based Practice Attitude Scale was utilized in conjunction with one-on-one instruction regarding the Canadian CT Head Rule. Participants were asked to complete a pre-test comprised of four clinical scenarios regarding patients with minor brain injuries according to what they believed to be standard practice. Subsequently, they were asked to complete the same clinical scenario questions by applying the clinical decision tool. Analysis utilized descriptive statistics, correlations of attitude domains, and knowledge increase. The healthcare provider's attitude towards innovation is an antecedent toward the likelihood of adopting evidence-based practices guidelines into clinical practice, and there was an increase in knowledge regarding the use of clinical decision support tools.

Keywords: clinical decision support; Canadian CT Head Rule; Head CT Scan; minor brain injury

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Chapter One: Overview of the Problem of Interest

Implementation of an Evidence-Based Clinical Decision Support Tool for Prudent Radiological Imaging

A large degree of variation in clinical practice exists among clinicians evaluating and treating individuals with mild head injury. The Institute of Medicine (IOM, 1999) issued a report entitled *To Err is Human*. This report made clinicians and the public aware of the variable consistency in the quality of healthcare delivery. The American College of Emergency Physicians estimates more than 1 million emergency room visits are made for minor brain injury primarily due to falls and motor vehicle accidents (Jagoda et al., 2008). Imaging is commonly used to assess for intracranial damage in patients presenting with head injury. Computerized Tomography (CT) imaging is a diagnostic test that can be of immediate benefit to patients and is readily available at most hospitals in the United States. The purpose of this chapter is to introduce an evidence-based change project (EBCP) that assesses the attitudes of clinicians toward evidence-based clinical guidelines and increases knowledge in the use of the Canadian CT Head Rule. The clinical decision support (CDS) tool is designed to help guide clinicians in the prudent use of Head Computerized Tomography (HCT) scans in people ages 16-64 that have sustained minor head injuries.

Background

The rate of CT use in people with head injuries continues to increase with estimates ranging from 23% to 40% from 1980 to 2006 (Amis et al., 2007; Brenner & Hall, 2007; Broder, Bowen, Lohr, Babcock, & Yoon, 2007; Menoch, Hirsh, Khan, Simon, & Sturm, 2012; Mettler et al., 2009). Ionizing radiation exposure as in the case of CT scans offers an enhanced diagnostic ability, but also poses a host of unintended consequences including increased cancer risk from

radiation; incidental findings of no clinical significance leading to additional tests and procedures, and increased cost to the health care system (Miglioretti & Smith-Bindman, 2011). According to the National Council on Radiation Protection and Measurement radiation exposures in the US increased 600 fold over the past 20 years, and Head CT scans accounted for 28% of all CT scans performed (Mahesh, 2009). Currently, all patients that sustain minor head injuries receive a non-contrast head CT scan at this urban academic tertiary care facility located in New York City. This practice is passed down from senior resident to junior residents, is reinforced by the nursing staff and has no supporting evidence in value from the literature. Currently there is no clinical decision support tool based on evidence that is utilized within the facility to guide clinicians in ordering head CT scans in patients with minor head injuries.

Concern over the increasing use of CT scans in pediatric populations raises the question of possible health impact of ionizing radiation exposure. A large multi-center cohort study revealed 43% of 27,362 children who were less than one year of age had their first exposure to ionizing radiation (CT scans: head 63%, chest 21%, abdomen and pelvis 8%) (Bernier, Rehel, Brisse, Wu-Zhou, Caer-Lorho, Jacob et al., 2012). The American Board of Internal Medicine (ABIM) in conjunction with the American College of Emergency Physicians (ACEP) and the American College of Radiology (ACR) launched the Choosing Wisely campaign in 2011 to implement evidence-based practices in an attempt to reduce the overall exposure to ionizing radiation in health care settings (ACEP, 2012; ACR, 2012). In 2014 the Alliance for Radiation Safety in Pediatric Imaging also issued the Image Gently protocol to reduce ionizing radiation in children, as the risk of cancer is increased the younger the age of the exposure (AAPM, 2014).

Significance

The IOM (2011) concluded a causal relationship between ionizing radiation exposures in similar dose ranges for CT scans and cancer that was consistent with varied literature further demonstrating similar findings (IOM, 2011; Preston et al., 2007; Royal, 2008; UNSCEAR - United Nations Scientific Committee on the Effects of Atomic Radiation - Annex B, 2010). The ionizing radiation doses that have demonstrated the causal relationships to increase of cancer of cancer are specifically related to higher dose exams such as the CT scan. This causal relationship was identified in epidemiological studies correlated to atom bomb survivors. Pearce and colleagues (2012) conducted a retrospective cohort study of people without previous cancer who received CT scan under twenty-two years of age; 74 of 178,604 patients were diagnosed with leukemia; 135 of 176 587,000 patients were diagnosed with brain tumors with a positive association between radiation dose from CT scans and leukemia and brain tumors. The authors concluded their interpretation by noting that brain cancer and leukemia are relatively rare and absolute risk is small in the 10 years after the first scan for patients younger than 10 years old (one case of leukemia and one case of brain tumor per 10,000 CT scans was estimated to occur) (Pearce et al., 2012).

PICO Question

Devising an evidence-based practice project for the purpose of implementing a clinical decision support tool to guide clinicians in the prudent use of CT scan for minor head injuries requires the articulation of a clinical question in PICO format. PICO is an acronym that stands for (Patient/ population, Intervention, Comparison, and Outcome). In devising an evidence-based practice study the categories require an accurate and thorough description: “P” describes the problem and population in whom the intervention will be applied, “I” describes the main

intervention, “C” describes comparisons, which may be those not receiving the intervention who remain in the treatment as usual group or could be a comparison within the same population prior to or post implementation. “O” describes the outcomes of the intervention group (Melnyk, & Fineout-Overholt, 2011).

PICO Question. The PICO question guiding the current inquiry is “Does the attitude of the clinician towards evidence- based practice affect the likelihood of adoption of a clinical decision support tool intended to guide clinicians in screening patients with minor brain injuries for evidence- based criteria supporting the need non-contrast HCT scan?”

Population. The specific population to be utilized will be healthcare providers practicing in an acute care academic facility in a densely populated urban environment. Healthcare providers consist of interns, residents, attending physicians, nurse practitioners, and registered nurses. Currently the practice within this facility has patients with minor head injuries indiscriminately receiving a CT scan of the head. The most common cause of minor head injury in the hospitalized patient is falls. There are no formal criteria in place to determine who should receive a CT scan so clinicians are inclined to do what is customary.

Intervention. The intervention consists of conducting an attitude assessment toward evidence- based clinical decision support tools in general. Participants will then be asked to answer four clinical scenario questions regarding patients with minor head injuries based on what they would do at the present time. Next, the clinicians will be given an educational presentation regarding an evidence-based clinical decision rule to help prudently select the patients that would derive the most benefit from a non-contrast Head CT scan. This rule is the Canadian CT Head Rule (CCHR). Participants will then be asked to answer the same four clinical scenario questions using the CCHR, and finally they will be asked what their likelihood

of adoption of the tool would be given various criteria as identified on the Evidence Based Practice Attitude Assessment Scale (EBPAS). The CCHR has 100% sensitivity and detecting intracranial injuries requiring neurosurgical intervention (Eagles et al., 2008; Haydel et al., 2000; Stiell et al., 2005; Stiell et al., 2001). The tool will be presented through individual teaching session with each clinician.

Comparison. The comparison for this evidence-based practice (EBP) EBP change project will be the change in clinical knowledge from base line, and increased likelihood of adoption into clinical practice.

Outcome. There are two anticipated outcomes for this project. First clinicians will demonstrate 50% increase in clinical knowledge regarding the selection of patients with minor head injury that would benefit from a CT scan. Second, clinicians will identify the key criteria necessary to increase the likelihood of adoption of the tool into clinical practice.

Summary

Head CT scans are a very valuable diagnostic tool and the risk usually outweighs the benefit when the test is justifiable. The CCHR is highly sensitive for positive CT findings of clinically important brain injuries. Utilizing an evidence-based practice guideline can help inform the discussion regarding the risks and benefits of radiological imaging. The Canadian CT rule identifies 100% of injuries requiring neurosurgical intervention and reduces unnecessary exposure to ionizing radiation. The clinical assessment of patients with minor brain injuries is variable and dependent on the individual clinician. It is customary practice to obtain Head CT scans in-patient with minor head injuries, however this practice is not supported by the literature, and may pose harm to the patient due to excessive ionizing radiation exposure that has been correlated with increased incidence of certain types of cancer.

Chapter Two: Review of the Literature

Computerized Tomography (CT) imaging is a diagnostic test that can be of immediate benefit to patients, and is readily available at most hospitals in the United States (US). There is a large degree of variation in quality and consistency in clinical practice among clinicians across the US (Institute Of Medicine [IOM], 1999) when using CT imaging as a diagnostic tool. One area in which a large degree of variation in clinical practice exists is among clinicians evaluating and treating individuals with mild head injury. Head CT scans are commonly used to assess for neurologically important or clinically significant findings in patients presenting with head injury.

Ionizing radiation exposure as in the case of CT scans poses a host of unintended consequences including increased cancer risk from radiation; incidental findings of no clinical significance leading to additional tests and procedures, and increased cost to the health care system (Miglioretti & Smith-Bindman, 2011). According to the National Council on Radiation Protection and Measurement, radiation exposures in the US increased 600 fold over the past 20 years, and Head CT scans accounted for 28% of all CT scans performed (Mahesh, 2009).

Currently, the majority of patients that sustain minor head injuries receive a non-contrast head CT scan (HCT) at this large urban academic multi-campus tertiary care facility located in New York City. This practice of using HCT scans for diagnosis is passed down from senior resident to junior residents, is reinforced by the nursing staff, but it is not supported by the evidence. The literature remains silent on an optimum time to image a patient after a minor head injury. Currently there is no evidence-based clinical decision support tool that is utilized within this tertiary facility located in N.Y. to guide clinicians in ordering head CT scans in patients with minor head injuries.

The purpose of this chapter is to introduce a review of the literature that supports an evidence-based practice (EBP) change project that focuses on the utilization of a clinical decision support (CDS) tool to help guide clinicians in the prudent use of HCT scans in patients with minor brain injuries.

Methodology

Sampling strategies. A thorough review of the literature was initiated to identify interventions that reduced the use of CT scans in treating head injuries. One common theme that surfaced was the use of clinical decision support tools that had sufficient sensitivity to detect all clinically important brain injuries, and all brain injuries requiring neurosurgical intervention. The search strategy began in Google Scholar to gain a broad prospective of possible keywords, and then narrowed to 3 databases (Pub Med, Cochrane Library, Ovid) for articles written in the past 10 years using the keywords minor head injury, CT head rule, and Clinical Decision Support. The search was further limited by selecting English language, and human only studies. The exclusion criteria were extended to children, anticoagulation therapy, S100B, cancer, statistical modeling techniques, alternative imaging, and moderate and severe brain injury.

The literature review identified the most widely cited clinical decision support tool with the highest degree of sensitivity was the Canadian CT Head Rule (CCHR). The New Orleans CT head (NOC) rule was also identified to have comparable sensitivity, but when Stiell, et al., (2005) did a comparison study of CCHR to NOC only the CCHR reduced the rate of head imaging.

Next, the search results were edited to remove duplicates, and CDS rules for CT head with less than 100% sensitivity for detecting all clinically important brain injuries and brain injuries requiring neurosurgical intervention. This process resulted in four articles supporting the

use of a CDS tool to reduce CT head scans in patients 16-64 years of age with minor head injury (see Appendix A). Landmark studies regarding the sensitivity and specificity of the CCHR were also included (even though they were older than 10 years of age) because they describe the process of how the individual criteria comprised in this CDS tool were selected, the validation results, and the economic analysis (Stiell, Wells, Vandemheen, Clement, Lesiuk, Laupacis, McKnight, et al., 2001). The CCHR is the most widely validated CDS tool providing the best strategy for helping clinicians obtain the greatest yield from a head CT scan in patients with minor head injuries without missing clinically important injuries requiring neurosurgical intervention.

Similarly, the concept of CDS tool was initially searched in Google Scholar to gain a broad perspective on keywords that would be narrowed to the same databases, and further narrowed to CT scans and minor head injury with the purpose of surveying the literature on the effect of clinical outcomes. One systematic review was identified that included the results of 70 studies that reflected 68% improvement in clinical practice by using CDS tools (Kawamoto, Houlihan, Balas, & Lobach, 2005). Another study specifically concluded the implementation of evidence-based CDS tool in the emergency department was associated with a significant decrease in use of CT scans while increasing the yield of CT scans for the evaluation of acute pulmonary emboli (Raja et al., 2012).

Data evaluation. The literature review yielded strong evidence validating radiation risks associated with CT scanning and four articles supporting the implementation of a CDS tool to help clinicians consistently evaluate patients with mild brain injuries thereby reducing the rate of Head CT scans while not missing any clinically important brain injuries or patients requiring neurosurgical interventions.

Literature Review Findings

A landmark study by Steill, et al (2001) conducted a prospective cohort study in emergency departments of 10 large Canadian hospitals with the intent of developing a highly sensitive CDS tool (titled CCHR) to detect clinically significant brain injury in patients presenting with minor head injuries. The subjects were described as consecutive adults (n=3,121) mean age of 38.7 with Glasgow coma scale (GCS) thirteen to fifteen. The CT head rule was reduced to five high risk factors (including failure to reach a GCS of 15 within two hours, suspicion for open skull fracture, any sign of basilar skull fracture, and more than one episode of vomiting or greater than 64 years of age). The a priori sample size was estimated to be 2500 patients based on the desired precision of 100% sensitivity for clinically important brain injury with 95% CI of 97 -100% for predicting the need for neurological intervention. Thirty-two percent (n=800) of patients underwent CT scanning. The CCHR was found to be highly sensitive with the potential to significantly standardize and improve emergency management of patients with minor head injury.

Subsequently Steill and colleagues (2005) conducted a prospective cohort study including nine emergency departments in large Canadian Community and University hospitals. A convenience sample of adults who presented with blunt head trauma resulting in witnessed loss of consciousness, disorientation, or definite amnesia and a GCS of 13-15 initially screened using the CCHR (n=2707), and a subgroup (n=1822) screened using the NOC. The primary outcome was neurosurgical intervention and clinically important brain injury evaluated by CT and structured follow-up telephone interview. Both the CCHR and the NOC were found to have 100% sensitivity for predicting the need for neurosurgical intervention.

Among patients with GCS score of 15, the rate of CT scanning was 52.1% (95% CI, $p < .001$) for CCHR and 88% for NOC (95% CI, $p < .001$). This study's findings support the use of using the CCHR in reducing the number of CT scans ordered while identifying all patients with clinically important brain injuries.

In a secondary data analysis by Clement et al., (2006) of a cohort study ($n=4,551$) from 10 hospital emergency department of patients with mild brain injury (GCS=15) including patients with loss of consciousness, disorientation, or definite amnesia in which the primary outcome was the need for neurosurgical intervention, the CCHR predicted 100% of clinically important brain injuries.

Similarly, in a prospective multicenter study ($n=3,181$) consecutive adult patients with minor head injury (GCS 13-15) was conducted with the primary outcome validating the CCHR and NOC to detect any neuro-cranial traumatic finding on CT scan, and secondary outcome of neurosurgical intervention and clinically important CT finding. Of the participants with GCS of 13-15 .05% ($n=17$) patients required neurosurgical intervention, 9.8% ($n=312$) had neuro-traumatic findings on CT scan. The CCHR demonstrated a 37% reduction in the rate of CT scans, and the NOC demonstrated a 3% reduction in CT scans. Both CDS tools identified all cases requiring neurosurgical intervention (Smits et al., 2005).

In a study to evaluate the applicability of the CCHR on head trauma patients at a German university hospital ($n=122$), patients who were examined using head CT scan presenting with minor head trauma, were retrospectively evaluated according to the criteria of the CCHR. The CDS rule was found to have 98.9% sensitivity detecting all patients who would have needed neurosurgical intervention if the CCHR criteria was prospectively utilized, and would have led to

a 45% reduction in the rate of CT scans (Schlegel et al., 2005). No patients with a clinical important brain injury would have been missed.

Limitations of Literature Review Process

Some limitations of this literature review include a lack of prospective randomized controlled trials with sufficiently large sample sizes comparing treatment as usual head-to-head with CDS tools. Validity studies are needed across a variety of practice areas in which patients with minor head injury would present. In addition, CDS tools need to be validated among nurse practitioners and other non-physician providers that may evaluate patients with minor head injuries in the US. Furthermore, the review was limited by a 10-year date range, and was specifically tailored for CDS tools related to minor head injuries and the use of CT scans.

Discussion

Patients treated by nurse practitioners deserve the same level of care provided by their physician colleagues. Currently, there is a dearth of nursing literature on the subject of CDS tools used in helping advanced practice nurses, to prudently select which patients with minor head injury would benefit from a head CT scan. As nurse practitioners continue to press legislators for full practice authority as a means of increasing access to care and containing cost the literature shows that advanced practice clinicians were more likely to order diagnostic imaging studies than their physician colleagues (2.8% compared to 1.9% respectively) after a visit requiring evaluation and management (Hughes, Jiang, & Duszak, 2015). There is a need for EBP literature within the discipline of nursing that supports CDS tools for prudent imaging.

Conclusion of findings. The literature supports the practice of using CDS tools for patients who are being evaluated for minor head injury. Specifically, they should receive a preliminary screening using the criteria of the CCHR with standard physical examination, and

only if warranted referred for CT scan. Nurse practitioners will continue to increase in number and scope of practice authority. It is incumbent upon clinicians to apply evidence-based practice standards such as clinical decision rules to provide safe and effective care for the patients in their charge. Failure to provide evidence-based care increases the cost of health care, causes harm to patients, and violates the fiduciary responsibility entrusted to the profession.

Advantages and disadvantages of findings. Both prospective and retrospective studies have demonstrated a reduction in CT scans in patients with minor head injury with the use of the CCHR without missing clinically important brain injuries, and injuries requiring neurosurgical intervention. The reductions of CT scan usage in evaluating patients with minor head injury would also reduce the risk of ionizing radiation exposure that has been found to correlate with increased cancer rates. Prudent CT scan use also offers the added benefit of cost-savings and improved patient satisfaction (Clement et al., 2006; Smits et al., 2010). The literature is lacking in prospective randomized controlled trials that include nurse practitioners and registered nurses and the use of CDS tools for patients with minor brain injuries.

Utilization of findings in practice. Patients with minor head injuries (identified by having a GCS 13-5, who have not suffered loss of consciousness or amnesia) rarely require admission to the hospital or neurosurgical intervention. Controversy continues to abound regarding the appropriate use of CT scan in the evaluation of these patients. The ionizing radiation doses that have demonstrated the causal relationships to increased risk of cancer are specifically related to higher dose exams such as CT scan.

Summary. A review of the literature identified the CCHR as a highly sensitive CDS tool indicated for patients with minor head injury. Consistently evaluating patients with minor head injury according to the criteria of this tool allows clinicians to prudently order HCT scans for

their patients based on strong evidence while balancing the risk of excessive ionizing radiation exposure. The CCHR identified all clinically important brain injuries requiring neurosurgical intervention.

Chapter Three: Theory and Concept Model for Evidence-based Practice

Healthcare continues to revolutionize along the continuum of personalized, predictive, preventive, and participatory care. This chapter will present the concept of clinical decision support (CDS). CDS helps healthcare providers mitigate the risk associated with caring for increasingly complex patients by providing an evidence-based method to standardize care while assuring consistent care and quality outcomes.

Concept Analysis

Healthcare providers have a fiduciary responsibility to the people they serve. This responsibility is underpinned by the principles of beneficence and non-maleficence. The literature demonstrates CDS can enhance the safety and quality of patient care while enhancing clinician efficiency (Abdrbo, Hudak, Anthony, & Douglas, 2009; Abraham & Rosenthal, 2008; G. L. Alexander, 2008). Abdro et al. (2009) report Health Care Providers that utilize CDS are more likely to comply with clinical guidelines and evidence-based protocols with respect to indications for radiological studies. Increased use of CDS is expected to increase due to external financial incentives and disincentives.

The primary reason for the lack of adoption and integration of CDS into workflow is poor user interface and user experience. Health Care Providers have also cited concerns regarding clinical autonomy, inefficiency, legal and ethical ramifications associated with strict adherence to evidence-based protocols and overriding CDS (Alexander, 2008). Another reason for the lack of adoption and integration of CDS is the cultural aloofness between the discipline of information technology (IT) and the healthcare professions. When these two cultures come together a sociotechnical confluence of misaligned goals and objectives occurs (Biondich, Downs, Carroll, Shiffman, & McDonald, 2006). Despite the validation that CDS may potentially

produce a statistically significant quality improvement in the delivery of healthcare variability abounds among types and methods of CDS, and their implementations make it difficult to capture effectiveness. (Bryan & Boren, 2008)

Concept definition. The concept of clinical decision support (CDS) is defined in the literature as a tool to assist healthcare professionals in decision-making tasks by linking health observations to empirical knowledge to influence clinician choice of action (Abraham & Rosenthal, 2008; Biondich, Downs, Carroll, Shiffman, & McDonald, 2006; Byrne, Sherry, & Mercincavage, 2010). According to the Healthcare Information and Management Systems Society (HIMSS) CDS “is the process for enhancing health-related decisions and actions with pertinent organized clinical knowledge and patient information to improve health and healthcare delivery” (HIMSS, 2011, p. 2). The US government also defines CDS by its intended function (to provide Health Care Providers and patients with knowledge and person-specific information that is intelligently filtered and appropriately presented to enhance healthcare). They go on to elaborate on CDS to include computerized alert systems, integrated clinical guidelines, patient and provider reminders, condition specific order sets, documentation templates, diagnostic support, focused patient data reports and summaries, as well as contextually relevant reference materials available at the point of care.

Operational Definition. The operational definition for CDS for the purpose of this evidence-based practice change project is based on the definitions found in the literature. Specifically, CDS is a tool to help healthcare professionals make evidence-based decisions that enhance the quality of care by linking health observations to empirical knowledge. The CDS tool has been shown in the literature to reduce the incidence of Head CT scans for minor head

injuries by 30% consistent with the specificity and sensitivity studies used to validate the Canadian Head CT rules (Fong, Chong, Villaneuva, & Segal, 2008).

Theoretical Framework

The Theory of Diffusion of Innovations (TD of I) was first articulated by Rogers in 1962, and since that time the theory has been applied in various disciplines ranging from political science, communications, history, economics, education, and public health and is particularly utilized the area of technology adoption (Sahin, 2006). The Diffusion of Innovations theory is a five stage-based model with four key concepts (innovation, communication channels, time, and social system) integral in the theory. In TD of I the words “technology” and “innovation” synonymously, and are defined as “specifically designed for instrumental action that reduces the uncertainty in a cause-and-effect relationship involved in achieving a desired outcome” (Rogers, 2003, p. 13). Technology is further categorized into two parts: software and hardware. Hardware is “the tool that embodies the technology in the form of a material or physical object” and “software is the information base for the tool” (Rogers, 2003, p. 259).

Rogers (2003) defines adoption as a “decision to fully use innovations as the best course of action available”, and rejection as a “decision to not adopt an innovation” (p. 177). Diffusion is “the process which an innovation is communicated through certain channels over time among the members of the social system” (Rogers, 2003, p. 5).

An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption” (Rogers, 2003, p. 12). The key word here is perceived as new regardless of the time the innovation was conceived. One of the primary barriers that inhibit the adoption of innovation is uncertainty.

Uncertainty is defined as the “consequence that occurs in an individual or social system as a result of the adoption or rejection of the innovation” (Rogers, 2003, p. 436).

Communication is the “process in which participants create and share information with one another in order to reach a mutual understanding,” and channel is the means of communication (Rogers, 2003, p. 5). Diffusion is a form of communication that is a “very social process that involves interpersonal communication relationships” (Rogers, 2003, p. 19). Interpersonal channels of communication are likely to be successful to the “degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education, socioeconomic status, and the like . . .” (Rogers, 2003, p. 19).

The innovation diffusion process is reliant on a time rate in which the various stages of adoption are categorized as innovators, early adopters, early majority adopters, late majority adopters, and the laggards (Rogers, 2003). Characteristics of innovators include: venturesome to try new ideas, able to cope with unsuccessful innovations, more comfortable with uncertainty, and usually possess complex technical knowledge (Rogers, 2003). Characteristics of early adopters include: leaders and social systems, seen as key members giving advice, role model types, developed interpersonal networks, and help reduce uncertainty in social systems. Characteristics of early majority types include: strong interpersonal networks, less likely in the leadership role, deliberate in adopting innovation typically neither first nor last, more contemplative than innovators and early adopters (Rogers, 2003). Late majority adopters comprise 1/3 of members of a social system who are known to hold out until a majority of their peers have adopted the innovation. Other characteristics of this group include conformity to adoption motivated by economic necessity and peer pressure. This group is most persuaded by close interpersonal relationships (Rogers, 2003; Sahin, 2006).

Laggards are traditional skeptics regarding innovations with small interpersonal networks typically not in leadership roles lack awareness of innovations, and typically have very long decision periods. Rogers (2003) defines the primary difference between early adopters (innovators, early adopters, early majority) and late adopters (late majority, and laggards) “in terms of socioeconomic status, personal variables, and communication behaviors” with positive regard toward innovativeness (Sahin, 2006, p. 8).

This theory is best suited to the implementation of a clinical decision support tool, as it will help guide the dissemination process. In disseminating the clinical decision support tool it will be important to identify the key thought leaders and early adopters in the various departments throughout the institution. These thought leaders can be stratified according to the characteristics of the individual stage of adoption as described by Rogers.

Application to practice change. In presenting a clinical decision support tool prior to an implementation process it will be important to identify the incentives for the various shareholders that are asked to consider a change in standard practice. For example, department heads may be concerned with length of stay and departmental finances. Academic deans and clinical instructors may be concerned with teaching diagnostic reasoning skills and applying evidence-based practice. Nursing leadership may be concerned with patient satisfaction scores and quality outcome measures. The doctor on-call overnight may be looking for an evidence-based means of evaluating patients with minor head injuries with little expended effort. Some department heads may be reluctant to have an outsider evaluate their department’s practice, identify a shortcoming, and insist on a new change of practice.

Evidence- Based Practice Change Theory

The PEACE framework developed by nurses of New York Presbyterian Hospital is a five-step process that will be used to implement a clinical decision support tool that will enable clinicians to prudently select patients with minor head injury that are likely to benefit from a CT scan of the head. The elements of this framework are represented by each letter in the mnemonic (P) problem Identification, (E) evidence review, (A) appraisal of the evidence, (C) change practice or conduct research, (E) evaluation of practice change or research findings (Tahan, 2011).

Problem identification. The problem identification step articulates the issue or problem. The problem identified from an accurate analysis of current nursing literature and practice. The clinical problem either stems from a clinical situation, quality initiative, data indicators, a patient enhanced safety opportunity, a new approach to care delivery, behavior change, procedure, protocol, validation of current practice, development of a position paper about a certain topic, or other areas of practice interest. The question is articulated according to the standard POICOT format.

Evidence review. The literature and relevant evidence and research findings are reviewed to establish in the literature the existence of a problem and should include systematic reviews, integrative reviews, and meta-analyses as well as case reports. The findings are summarized and populated into an evidence review and appraisal guide. And the evidence is further classified according to the standard levels of evidence and state of quality.

Appraisal of evidence. The literature findings are appraised according to research critique and summarized in the review and appraisal matrix as indicated in the evidence review stage. The evidence is specifically appraised based on its applicability to patient care delivery

and the nursing practice environment and its potential for improvement of outcomes. Other factors that are considered in the appraising of evidence include available clinical expertise, patient preferences, as well as cost-benefit analysis, and availability of alternative practices.

Change Practice or Conduct Research. Once the evidence review is completed and the appraisal of evidence is sufficient for practice change recommendations for the change shall be submitted to the nurse practice counsel for review and approval before implementation.

Dissemination of the practice change can be made evident in administrative policies and procedures, clinical standards and guidelines, care activity processes, or educational programs.

If the practice change precedes consideration for education of staff is made in education is conducted accordingly in collaboration with the division of nursing education and the nurse education Council. A change in practice may proceed as a pilot first and after evaluation decision can be made to roll out other areas as appropriate. If the evidence is insufficient then research can be considered (Tahan, 2011).

Application to practice change.

PEACE Framework for EBNP change: New York Presbyterian Hospital

The pressing problem in this urban based academic medical facility consistent with the Institute of Medicine report is the variability in health care delivery (IOM, 1999). Specifically, a large degree of variation exists among clinicians evaluating and treating individuals with mild head injury. Head CT scans are routinely used to assess patients for clinically significant injuries requiring neurosurgical intervention in patients that present with head trauma.

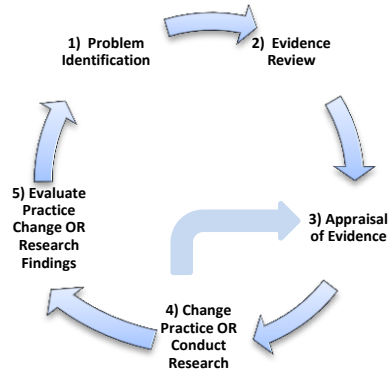


Figure 1. PEACE Model for Evidence-based Nursing Practice

The evidence supports the premise regarding exposure to ionizing radiation as in the case of CT scans poses a host of unintended consequences including increased cancer risk from radiation; incidental findings of no clinical significance leading to additional tests and procedures, and increased cost to the health care system (Miglioretti & Smith-Bindman, 2011). Currently, the majority of patients that sustain minor head injuries receive a non-contrast head CT scan, despite a lack of evidence regarding improved clinical outcomes. This practice is passed down from senior resident to junior residents, is reinforced by the nursing staff despite evidence supporting the deleterious effects of unnecessary exposure to ionizing radiation.

The current literature was appraised and reduced to four articles supporting the implementation of a CDS tool. The CDS tool selected was the CCHR as it was found to be the most widely validated in clinical practice to help clinicians consistently evaluate patients with mild brain injuries. The CCHR reduced the rate of HCT scans while not missing any clinically important brain injuries or patients requiring neurosurgical interventions.

Summary

The concept of CDS will continue to play a prominent role in the increasingly complex arena of health care delivery. CDS tools are an EBP guideline that can help healthcare providers mitigate the risk associated with caring for complex patients by providing a systematic method to

evaluate patients with minor head injuries while assuring consistent care and quality outcomes. The TD of I provides the proper structure to guide the implementation of new practices in a variety of clinical situations. As financial resources continue to dwindle objective theory based evaluative criteria will continue the drive towards more efficient care strategies.

Chapter Four: Pre-implementation Planning

The literature supports that patients being evaluated for minor head injury should receive a preliminary screening using the criteria of the CCHR and standard physical examination and if warranted referred for CT scan. The medical literature strongly supports the use of CDS tools and specifically the CCHR to evaluate patients with minor head injuries prior to non-contrast Head CT scan.

Project Purpose

Patients who suffer a minor brain injury while admitted to the hospital are being exposed to unnecessary ionizing radiation when they receive head imaging in the form of a non-contrast head CT (NCHCT) scan. The purpose of this EBP change project is to evaluate attitudes toward evidence-based clinical decision support tool that would standardize the clinical assessment of patients who have suffered a minor brain injury while hospitalized due to falling. Prudently selecting patients for NCHCT scan would reduce exposure to unnecessary ionizing radiation mitigating the risk of associated cancers. Clinicians caring for patients on in-patient units will be recruited to voluntarily participate in a one-on-one education session.

The assessment tool will measure participants' global attitudes towards the adoption of evidence-based practices (EBPs). The construct of appeal assesses the extent to which the participant would adopt an EBP if it were intuitively appealing, known to be correctly utilized, and used by colleagues who were happy with it (Aarons, 2004; Aarons et al., 2010). Prior to receiving the educational offering clinicians were asked the first 8 questions EBPAS intended to measure the constructs of openness and divergence. Next, they were asked to answer 4 multiple choice questions reflective of clinical scenarios in which the patient sustains a minor head injury. In each question there was an option to order a non-contrast HCT scan. Then clinicians were

presented with the contents of the Canadian CT Head Rule (CCHR) and supporting evidence. Then the participants were asked to complete the same four clinical scenario questions using the CCHR as a reference tool while they completed the multiple choice test. Finally, the participants were asked to complete the subsequent seven questions of the EBPAS intended to measure likelihood of adoption. The desired outcome was that clinicians that have been made aware of a highly sensitive simple clinical decision support tool will report higher appeal and increased likelihood of adoption into clinical practice. Furthermore, they would demonstrate an increase in knowledge over baseline with respect to the criteria of the CCHR in evaluating patients with minor brain injuries.

Project Management

Prior to the implementation of an EBP change project, it was important to perform an organizational assessment of readiness for change. The chosen organization for this EBP change project was an academic medical center located in an urban setting in the northeast. Clinicians who care for patients who have suffered minor brain injuries include physicians, registered nurse, and nurse practitioners. The medical center was a tertiary care facility in the planning phase of applying for Magnet designation.

Organizational readiness for change. The falls rate fluctuates month-to-month; the cost associated with post fall care continues to rise, and remains uncompensated. Within the organization is the House Staff Quality Council that seeks to proactively implement quality improvement initiatives to enhance patient outcomes. It was imperative to garner support from key thought leaders in each department as well as the their respective directors of quality initiatives (Harrison, Légaré, Graham, & Fervers, 2010). The development of this EBP change project involves input from many individuals.

Inter-professional collaboration. In planning for the implementation of this project ongoing meetings were held with physicians, nurses and administrators at various levels throughout the organization. The aim of these meetings was to ascertain the anticipated risks to the organization as well as potential benefits that may be derived. There was consensus and support for implementing evidence-based practice standards particularly to an area of high visibility with respect to quality improvement measures, namely falls. In addition meetings were also held with the Director of Quality for the College of Medicine as there is much joint collaboration between the hospital and the college. Despite the place of work being the hospital some staff is employed by the college rather than the hospital.

Risk management assessment. This EBP project involves a change in the process by which patients with minor brain injuries are evaluated resulting in prudent imaging. A comprehensive needs assessment was performed using a strengths, weaknesses, opportunities, and threats (SWOT) analysis.

Strategy to overcome barriers. The primary challenge to overcome will be customary practice and inertia. Many clinicians hold a preconceived notion that the care provided must naturally be evidence-based, but this is clearly supported by the literature (Greenhalgh, Howick, & Maskrey, 2014). Secondly, individual time constraints can often prohibit the dissemination of new information as didactic obligations routinely suffer due to pressing clinical obligations. A strategy to overcome this barrier is to provide the educational information in a one-on-one format by an interpersonal discussion. The EBPAS will be administered immediately before and after the presentation of the CDS tool. The duration of the entire intervention should not exceed 60 minutes.

Organizational approval process. The organization was accommodating about this EBP project and encouraged EBP change projects led by nursing, as it will enhance their Magnet designation accreditation process. Organizational permission to perform the EBP change project was granted by the hospital director of quality improvement.

Information technology. Technology has become ubiquitous in the delivery of health care. The literature search supporting this EBP change project was electronically performed to access web based databases. The setting for this EBP changer project operates on an electronic platform that utilized a combination of pre-formatted template and free text notes to document the care provided. Despite the institution being functionally paperless several forms remain in use to facilitate workflows. Microsoft Office technology (Word, PowerPoint, and Excel) was utilized through out the phases of this EBP change project. Documents such as the pre-presentation and post-presentation questionnaire were created using Microsoft Word. Data analysis was performed using Microsoft Excel. A template post falls assessment was created in the electronic health record (All Scripts) that was made available for clinicians to copy into their personal templates for use in evaluating patients with minor brain injuries.

Materials Needed for Project

It was estimated that 100 copies each of the EBPAS questionnaire, knowledge content pre-test and posttest, and CCHR guide with selected bibliography. These items were printed in batches of ten as the project progressed. A desktop computer and printer were utilized to print more copies on demand as needed. In addition paper products will be printed on 8 ½” by 11” paper. It is estimated that all participant documents will utilize 5 sheets of paper. Therefore, approximately 500 sheets of paper were needed. Due to the format for presenting the

intervention and conducting the survey private to semi-private spaces were utilized containing a table and two chairs (clinicians private offices, nurses station, and break rooms).

Plans for Institutional Review Board Approval

The project was exempted from human subject research requirements as the director of human research protection program (See Appendix A) deemed it.

Plan for Project Evaluation

The plan will describe the demographics of the participants and recruitment strategy. In addition the outcome measures, and evaluation tools will be discussed including the plan for data analysis.

Demographics. The participants will be physicians (MD/ DO), RNs, and NPs caring for patients between the ages 16-64 years old and are admitted to the hospital. The participants will only be identified by their specific role in caring for the patient specifically: RN, NP, attending physician, resident, and fellow. Participants will not be identified according to the unit in which they work or their subspecialty service. Also, data regarding gender of the participant will be collected. The data will be reported in terms of profession, years of practice and gender of the participant. Furthermore, the mean years of practice were reported as well as the range of years in practice for each profession. This data was represented in graphs, figures and tables.

The specific population to be utilized will be healthcare providers practicing in an acute care academic facility in a densely populated urban environment. Healthcare providers consist of interns, residents, attending physicians, nurse practitioners, physician assistants, and registered nurses.

Recruitment. The recruitment began two weeks prior to project implementation. Potential participants were identified by a friendly broker (that had access to hospital wide falls

rates), and colleague referrals. The patient care directors notified their staff of the opportunity to attend a brief in-service session regarding attitudes toward EBP. In addition participants referred their colleagues who were interested in applying evidence-based standards to practice. Key department heads known to the author had been identified as participant referral sources. Finally, an announcement was made at the monthly House Staff Quality Council meeting. Participants met the criteria of professional licensure (MD/DO, NP, RN), and were in the role of caring for adult patients. Completion of the survey and attendance served as permission for participation. Recruitment occurred on an ongoing basis.

The project timeline spanned over a 4 –week period. During this time frame five participants per day attended an individual one-on-one session. No informed consent was necessary for this project, but participants were provided with a brief cover letter explaining the project (Appendix B).

Once the education sessions were completed, the data was analyzed using a pivot table in MS Excel. All documents related to the project were be stored in the cloud. Results were be converted to a MS Power Point and poster presentation that was delivered to the House Staff Quality Council, nursing grand rounds, and the annual nursing research symposium.

Outcome 1 measurement. Translating evidence into practice improves and standardizes the quality of care delivered in the real world. Many factors at various levels influence the implementation of evidence-based practice guidelines and innovations in healthcare. One specific factor affecting the implementation of EBP guidelines is the clinician’s attitude toward change and innovation. Attitudes are subject to emotional influences, life experience, and time. Attitudes towards innovation can be an antecedent in deciding to implement the new practice (Aarons & Glisson, 2010; Aarons & Sawitzky, 2006a, 2006b)

Evaluation tool. The EBPAS is fifteen-question survey designed to assess the clinician's feelings about using new types of therapy, interventions, or treatments including clinical decision support tools. Participants are asked to complete a five-point Likert scale: (0=Not at all, 1= To a slight Extent, 2= To a Moderate Extent, 3= To a Great Extent, 4= To a Very Great Extent) indicating the degree to which they agree with each item. The first eight questions measure the clinician's domains of: Appeal (intuitive attraction of EBP), Requirements (likelihood of adopting given mandate), Openness (disposition toward innovation), and Divergence (perceived disagreement between research-based/academic developed interventions in usual practice), toward clinical decision support tools (Aarons, 2004; Aarons et al., 2010). The factor of openness is associated with a clinician's disposition to try and evidence-based clinical decision support tool. Divergence in contrast reflects the extent to which a clinician perceives EBPs as less important than clinical experience and lacking utility. The subsequent seven questions are only presented if the participant receives training in a particular therapy measuring global attitude and likelihood of adoption.

The EBPAS was shown to have good content validity based on literature review and consultation with subject matter experts. The EBPAS demonstrated good reliability (Cronbach's $\alpha = .79$). Subscale scores excluding divergence ranged ($\alpha = .78- .93$), and divergence reliability ranged ($\alpha = .59-.66$). The EBPAS was utilized in 1,089 clinicians from 100 different clinics in 26 states and reliably measured attitudes toward adopting EBP standards Aarons & Glisson, 2010; Aarons & McDonald, 2007). The tool is available for use with permission of the author, and has been obtained (Appendix C).

Data analysis. Data will be aggregated for each participant after the data collection period has been completed. An internal benchmark of 30% of participants will be very likely to adopt the

CCHR into clinical practice. The literature supports a 30% decrease in non-contrast Head CT Scans when patients with minor head injury are screened with the criteria of the CCHR (Boyle, Santarius, & Maimaris, 2004; Fong et al., 2008; Holmes, Goodacre, Stevenson, Pandor, & Pickering, 2012; Schlegel et al., 2005). Each question on the EBPAS has associated factor-loading values that explain how much the individual item influences the variable. The score for each subscale is computed using a mean score for each set of items that loading the given subscale. Three questions (12 employer required (.99), 11 supervisor required (.88), and 13 state required (.78); Cronbach's α .90) measure requirement variable. Four questions (16 makes sense (.89), 9 intuitively appealing (.83), 14 colleagues happy with (.56), and 15 enough training (.55); Cronbach's α .80) measure the appeal variable. Four questions (2 will follow a manual (.61), 4 will try intervention developed by researcher (.81), 1 like to use new interventions (.62), 8 would try intervention different than usual (.66); Cronbach's α .78) measure the openness variable. Four questions (5 research based interventions are not useful (.65), 7 would not use manual interventions (.76), 6 clinical experience more important (.42), and 3 know better than researchers how to care for clients (.34); Cronbach's α = .59) measure the divergence variable (Aarons 2004).

This data was depicted using a bar chart reflecting role along the x-axis and total mean scores along the y-axis. The pre-education variables of openness and divergence were reflected on one bar chart and the post-education variables were presented on a second bar chart.

Outcome 2 measurement. The second outcome measure will be a reflection of increased content knowledge in the clinician with respect to applying the CCHR in the clinical scenario questions.

Evaluation tool. In addition to assessing clinician attitudes towards evidence-based practices a knowledge assessment will be conducted in a pretest posttest format. The knowledge assessment is comprised of four clinical scenario questions and is based on the matched criteria of the CCHR. In the pretest, participants will be asked to answer four multiple-choice questions (with 5 possible answer choices) according to their current standard practice. In the posttest, participants will be presented with the same clinical scenarios in multiple-choice questions (with 5 possible answer choices) and asked to answer the questions in accordance with the CCHR decision tool presented.

Data analysis. The knowledge assessment of content was analyzed using descriptive statistics. Specifically comparison of means depicted on bar graph and further stratified by profession, sex, and years in practice.

Data management. Hard copy data will be scanned and cloud stored with original documents shredded once the digital copies are confirmed in the cloud. Prior to scanning papers will be stored in a locked file cabinet at the facility. Data will be analyzed via Microsoft Excel on a desktop computer. The Excel spreadsheet was coded to include the scoring criteria of the EBPAS as well as the knowledge assessment test. The author manually transcribed data.

Summary

The plan for this evidence-based practice change project begins with an implementation of an attitude assessment scale regarding of evidence-based practices and a knowledge assessment pre-test and posttest related to patients with minor brain injuries. Participants were then presented with the criteria of the clinical decision support tool (CCHR) and asked to apply the tool to clinical scenarios (Appendix D). The data was analyzed using descriptive statistics and factor loading criteria using MS Excel and visually represented. The duty to use clinical

decision support tools in the delivery of evidence-based care is an ethical obligation of clinicians to help insure the safety of their patients. This EBP change project introduced clinicians to the concept of evidence-based clinical decision tools that may enhance future clinical practice.

Chapter Five: Implementation Process

The Institute of Medicine issued a report entitled *To Err is Human* ([IOM], 1999). This report made clinicians and the public aware of the variable consistency in the quality of healthcare delivery. Currently, all patients that sustain minor head injuries receive a non-contrast head CT scan at an urban academic tertiary care facility located in New York City. This practice is passed down from senior resident to junior residents, is reinforced by the nursing staff and has no supporting evidence in value from the literature. Currently there is no clinical decision support tool based on evidence that is utilized within the facility to guide clinicians in ordering head CT scans in patients with minor head injuries. Patients with minor head injuries are indiscriminately getting a CT scan of the head. The most common cause of minor head injury in the hospitalized patient is falls. There are no formal criteria in place to determine who should receive a CT scan so clinicians are inclined to do what is customary.

Planned Setting and Population

The specific population asked to voluntarily participate will be healthcare providers practicing in the acute care academic facility in New York City. Healthcare providers consist of interns, residents, attending physicians, nurse practitioners, physician assistants, and registered nurses.

Participants

Participants must be in a position of providing care for hospitalized adult patients. Participants were instructed to only apply the clinical decision rule to the population of patients between the ages of sixteen to sixty-four who have sustained a minor head injury while hospitalized. Participants must meet the criteria of professional licensure (MD/DO, NP, PA, RN).

Recruitment

Two weeks prior to project implementation, participants were identified by a friendly broker (director of quality) that has access to hospital wide falls rates. The director of quality provided names of the patient care directors who served as points-of-contact (initially via email) to notify their staff of the opportunity to attend a brief in-service session regarding attitudes toward EBP. The project manager attended morning huddles to reiterate and present the opportunity to participate in the project. Participants were able to schedule a convenient time to participate. In addition, participants referred their colleagues who are interested in applying evidence-based standards to clinical practice. Key department heads known to the author have were identified as participant referral sources. Finally, an announcement was made at the monthly House Staff Quality Council meeting. Completion of the survey and attendance served as permission for participation. Recruitment was on an ongoing basis.

Implementation Process

The project timeline took place over a 6 –week period. During this period, weekly educational sessions were offered in concert with individual one-on-one sessions (Monday-Saturday). The time of the sessions were determined in close proximity to the start of the timeline to allow for maximum convenience and flexibility for attendees. Participants self-selected to participate based on agreeing to a one-on-one session. Prior to the beginning of the education session, the PM answered any logistic questions. No informed consent was necessary for this project and it was exempt from the human subjects criteria (Appendix A). To ensure confidentiality no information that can identify the participant was collected. The only demographic data that was collected was (range of time in practice, gender, and role).

During the educational session, a brief overview was presented regarding evidence-based practice and translational science. Participants were then asked to complete the first eight questions of the EBPAS. Next, participants were presented with the CCHR, including the evidence supporting its sensitivity and clinical utility in evaluating patients with minor head injuries, and the impact it may have on reducing unnecessary head CT scans. Then, participants were also presented with the risks associated with CT scans. Next, participants were asked to turn their papers over and answer the subsequent seven questions. Finally, papers were collected into an envelope, and participants were given the opportunity to schedule a one-on-one brief session to learn how to import an electronic CCHR assessment template into their electronic health record (EHR) profiles.

Once the surveys are collected, they were stored in a locked drawer in the project manager's office. At the end of each week during the data collection period the surveys were scanned and stored in a cloud (Drop Box) and the original documents were shredded. At the end of the data collection period, the answers for all the questions were manually entered into a Microsoft Excel spreadsheet for analysis. The data was analyzed using descriptive statistics and visual representations of the outcomes were developed. Findings will be disseminated in a formal capstone project, and summarized to meet publishing guidelines of a peer-reviewed journal for broader distribution.

Plan Variation

The implementation varied from the original plan in only two respects. The data collection period was cut to 4 weeks from the initially intended 6 weeks as the target number of participants was reached. The data management process was also changed from initial plan in

that the answers from the surveys were entered weekly into the database prior to scanning and shredding the originals.

Summary

The IOM (2011) concluded a causal relationship between ionizing radiation exposures in similar dose ranges for CT scans and cancer that was consistent with varied literature further demonstrating similar findings (IOM, 2011; Preston et al., 2007; Royal, 2008; UNSCEAR - United Nations Scientific Committee on the Effects of Atomic Radiation - Annex B, 2010). The ionizing radiation doses that have demonstrated the causal relationships to increased incidences of cancer are specifically related to the increased radiation dose associated with CT scan.

The plan for this EBP practice change was to offer an education program on the use of clinical decision support tools to guide prudent imaging in patients with minor head injuries. The tools were presented through job aids, computerized templates (which served as the clinical decision support tools) and one-on-one presentations. The onus to use clinical decision support tools in the delivery of evidence-based care is an ethical obligation of clinicians to help insure the safety of their patients. This EBP change introduced clinicians the concept of evidence-based clinical decision tools that may enhance future clinical practice.

Chapter Six: Evaluation and Outcomes of the Practice Change Initiative

Patients with minor head injuries sustained while hospitalized often undergo non-contrast head CT (NCHCT) scan with the hopes of identifying a significant brain injury despite the absence of symptoms, and despite substantiation in evidence-based literature guiding practice. Helping clinicians prudently select patients for NCHCT scan would reduce exposure to unnecessary ionizing radiation mitigating the risks of associated cancers. This evidence-based practice change project (EBPCP) evaluated the attitudes of clinicians towards evidence-based clinical decision support tools that would standardize the clinical assessment of patients who have suffered a minor brain injury due to falling while hospitalized.

Participant Demographics

Clinicians that participated in this study were comprised of nurse practitioners (NP), physician assistants (PA), attending physicians, post-graduate year 1 (PGY1), post-graduate year 2 (PGY2), post-graduate year 3 (PGY3), and registered nurses (RN) (n=100) who care for adult patients (ages 16-64) admitted to the hospital (figure 1).

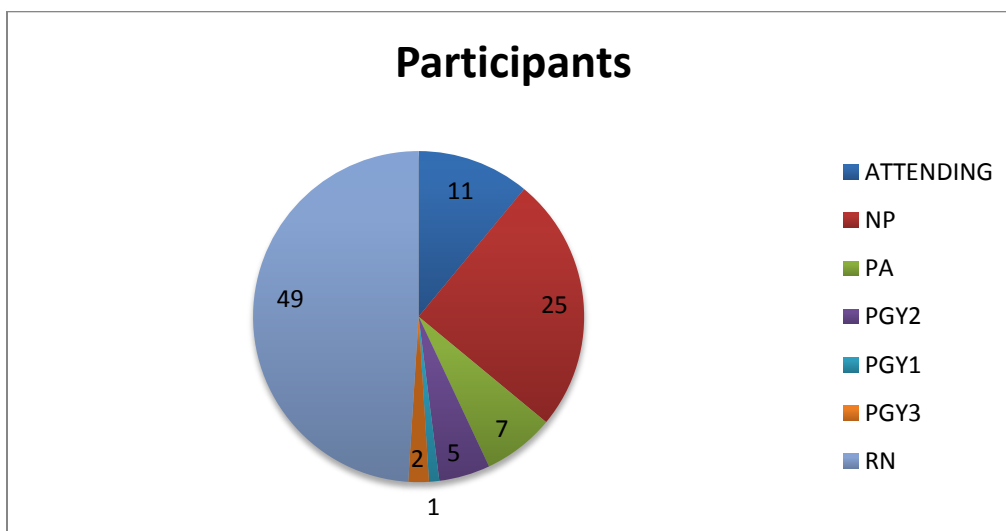


Figure 1. Participants by professional designation

The clinicians were further identified by their years of experience in their respective roles (table 1).

Table 1.

Professional designation and Mean Years of Experience

Role	Mean Years of Experience
ATTENDING	3
NP	3
PA	3
PGY1	1
PGY2	1.5
PGY3	3
RN	2.25

Participants were not identified according to the unit in which they work or their subspecialty service in order to ensure anonymity. Data regarding sex was also collected and aggregated (figure 2).

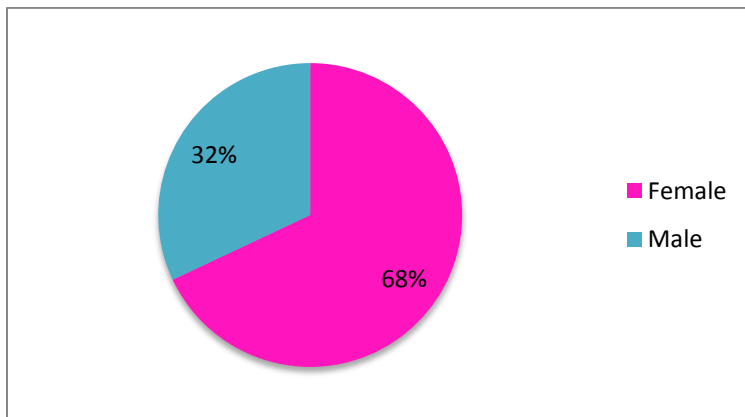


Figure 2. Participants stratified by sex.

Intended Outcome(s)

There were two outcomes for consideration in this EBP change project. The first outcome was an assessment of clinician attitudes and the second outcome was the change in knowledge of content related to the Canadian CT Head Rule (CCHR).

Outcome 1. Clinician attitudes toward change and innovation affect the implementation of EBP clinical decision support tools. Attitudes are known to be subject to emotional influences, life experience, and time and place. Attitudes towards innovation can be an antecedent in deciding to implement the new practice (Aarons & Glisson, 2010; Aarons & Sawitzky, 2006a, 2006b)

Outcome 2. The second outcome measure was a reflection of increased content knowledge in the clinician with respect to applying the CCHR in the clinical scenario questions. This was measured by asking the clinicians to utilize the clinical decision tool and answer the same questions of the pre-test rather than according to current standard or perceived standard practice.

Evaluation Plan

Evaluation tool. The Evidence Based Practice Attitude Scale (EBPAS) is fifteen-question survey designed to assess the clinician's feelings about using new types of therapy, interventions, or treatments including clinical decision support tools. Participants were asked to complete a five-point Likert scale: (0=Not at all, 1= To a slight Extent, 2= To a Moderate Extent, 3= To a Great Extent, 4= To a Very Great Extent) indicating the degree to which they agree with each item. The first eight questions measure the clinician's domains of: Openness (disposition toward innovation), and Divergence (perceived disagreement between research-based/academic developed interventions in usual practice), toward clinical decision support tools. The factor of openness is associated with a clinician's disposition to try an evidence-based clinical decision

support tool. Divergence in contrast reflects the extent to which a clinician perceives EBPs as less important than clinical experience and lacking utility.

The subsequent seven questions were presented after the participants received training in the CCHR. The attitude domains included appeal (intuitive attraction of EBP), and duress (required) mandate to utilize. These domain measures indicate global attitude and likelihood of adopting the EBP guideline (Aarons, 2004; Aarons et al., 2010).

The EBPAS was shown to have good content validity based on literature review and consultation with subject matter experts. The EBPAS demonstrated good reliability (Cronbach's $\alpha = .79$). Subscale scores excluding divergence ranged ($\alpha = .78- .93$), and divergence reliability ranged ($\alpha = .59-.66$). The EBPAS was utilized in 1,089 clinicians from 100 different clinics in 26 states and reliably measured attitudes toward adopting EBP standards (Aarons & Glisson, 2010; Aarons & McDonald, 2007). The tool is available for use with permission of the author, and has been obtained (Appendix C).

In addition to assessing clinician attitudes towards evidence-based practices a knowledge assessment was evaluated in a pretest posttest format. The knowledge assessment was comprised of four clinical scenario questions based on the matched criteria of the CCHR. In the pretest participants were asked to answer four multiple-choice questions (with 5 possible answer choices) according to their current standard or perceived standard of practice. After the participants were presented with the criteria and supporting information of the CCHR they were asked to complete the posttest. The posttest was comprised of the identical questions and answer choices of the pretest, however the participants were asked to answer the questions in accordance with the CCHR decision tool presented.

Frequencies and percentages of the responses were described. The mean scores of the pretests and posttests were aggregated and compared to quantify the differences in knowledge after the educational intervention. The domains of the attitude assessment were presented and stratified by professional role.

Findings

Data analysis. Data were aggregated for each participant after the data collection period ended. In this analysis items were constrained to load only on their respective subscale with no cross loadings. Cronbach's alpha reliability was good (alpha= .79), with subscale alphas ranging from 0.66-0.93 which was consistent with other studies using the EBPAS (table 3) (Aarons, 2004; Aarons & Sawitzky, 2006a; Aarons & Sommerfeld, 2009). The EBPAS total score was computed by reverse scoring the Divergence scale items then computing overall mean and reliability. Correlational analysis was conducted using Microsoft Excel (Table 2). A positive correlation was identified between the domains of openness and appeal (.70), and between the divergence and required domains (.65). All participants were likely to adopt the tool into clinical practice more than a moderate extent (3 & 4) if it was required by either their employer, supervisor, or state. Half (50%) of participants reported they would adopt the tool into clinical practice if it was being used by colleagues who were happy with it.

Table 2. Evidence-based Practice Attitude Scale (EBPAS) subscale, item means (M), standard deviations (SD), factor loadings, and Cronbach's alpha

EBPAS subscales and total	M	SD	Factor Loadings (<i>significant</i> <i>p<.05</i>)	Cronbach's Alpha
1. Requirements	2.4	0.9		.93
Employer	3.0	1.2	.99	
Supervisor	2.6	1.1	.88	
State	2.5	1.0	.78	
2. Appeal	2.6	0.6		.74
Makes Sense	3.2	0.7	.89	
Intuitive appeal	3.0	0.7	.83	
Enough training	2.0	0.4	.55	
Colleagues happy	1.6	0.7	.56	
3. Openness	1.5	0.2		.81
Willing to use new tools & interventions	1.7	0.5	.61	
Like new types of tools	1.8	0.5	.62	
Developed by researchers	0.9	0.8	.81	
Different than usual	1.7	0.6	.66	
4. Divergence	1.4	0.3		.66
Research based treatments not useful	2.1	0.6	.65	
Will not use clinical decision support tools	2.5	0.6	.76	
Clinical experience more important	0.9	0.5	.42	
Know better than researchers	0.7	0.4	.34	
EBPAS Total	2.0	0.7		.79

The participants scored comparably in the domains of openness and divergence across the sample. The largest discrepancy between opens and divergence was in the post graduate year 3 (PGY3) participants in which they were notably more divergent than open to the use of evidence-based practice tools before the intervention (figure 3). The scores represent median score by role on the EBPAS. (Participants were asked to complete a five-point Likert scale: (0=Not at all, 1= To a slight Extent, 2= To a Moderate Extent, 3= To a Great Extent, 4= To a Very Great Extent). The responses were uniformly ranked between agreement to a slight extent and agreement to a moderate extent.

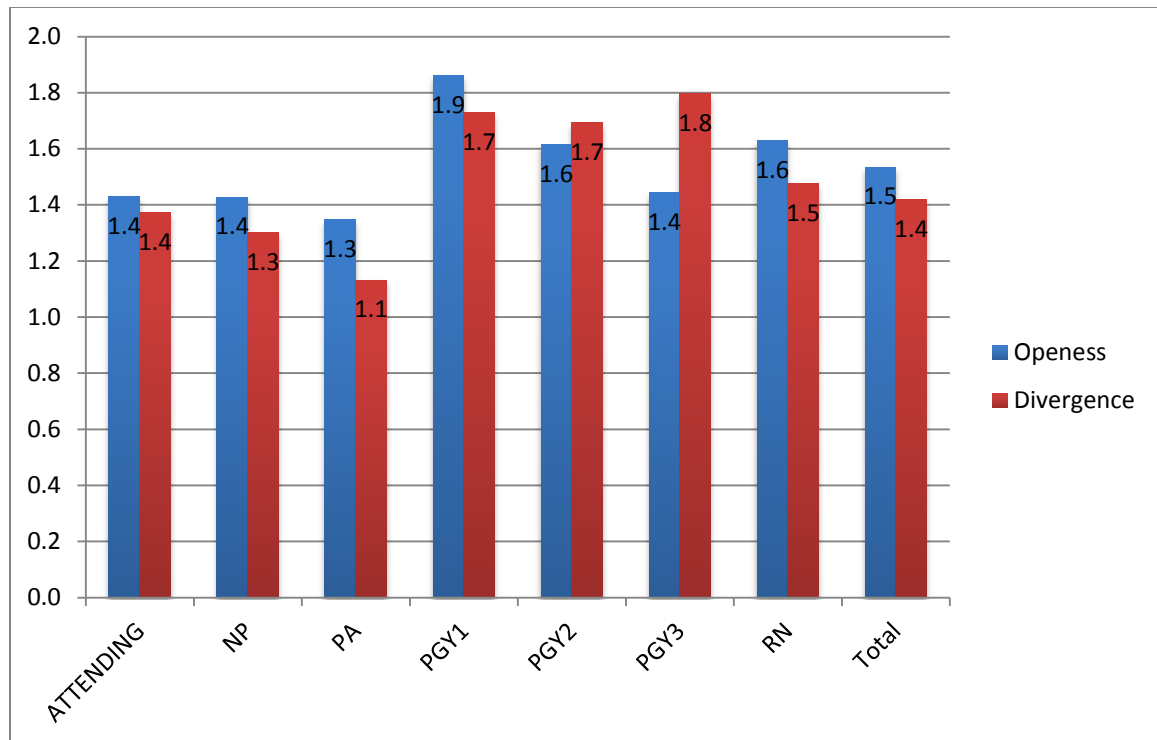


Figure 3. Comparison of Openness domain and Divergence domain by role

In the post intervention EBPAAS participants were answering the question how likely would you be to adopt this tool into your clinical practice given various criteria with respect to appeal of the tool and a requirement by various authorities to use it. All clinicians were comparably likely to adopt the tool based on appeal or requirement domains. Attending physicians and post graduate year 1 (PGY1) participants reported likelihood to a very great extent to adopt the tool. PGY3, NP, and RN participants were least likely to adopt the tool indicating to a moderate extent in the domains of appeal and requirement. Overall all participants reported moderate likelihood of adoption the CCHR into clinical practice if they found the tool appealing and required (figure 4).

Multiple factors influence the adoption of innovation into clinical practice. These factors include the characteristics of the clinical decision support tool as well as the unique characteristics of the practice environment. A majority of participants (83%) were likely to adopt

the use of the CCHR into clinical practice if they found it intuitively appealing and were required by employer, state, or supervisor.

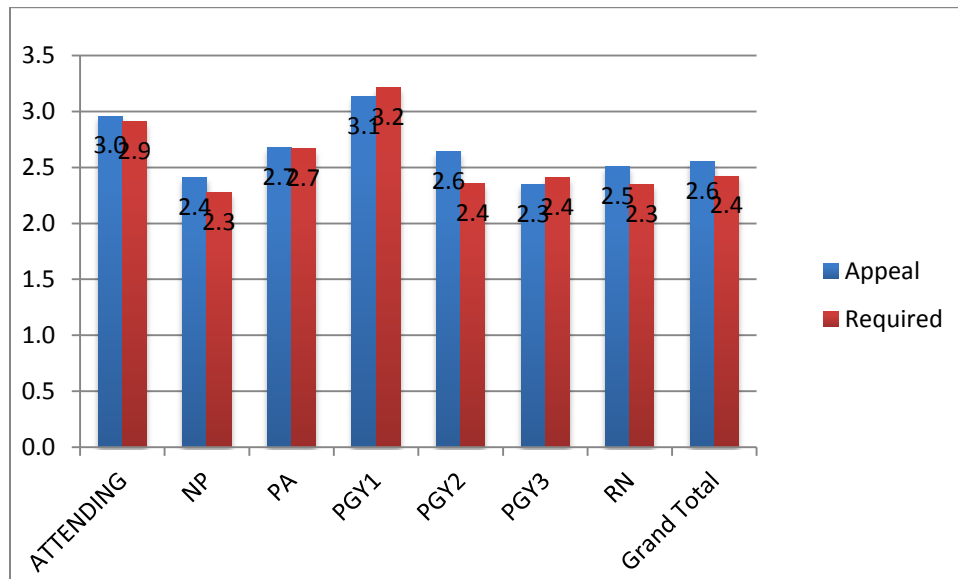


Figure 4. Comparison of Appeal domain and Required domain by role

There was also no difference with respect to years of practice and the domains of openness and divergence; all answers were equally distributed between a slight extent (1 on EBPAS) and a moderate extent (2 on EBPAS). Similarly, likelihood of adoption was to a great extent (3 on EBPAS) given appeal and requirement. All the requiring entities (supervisor, employer, state) were equally compelling with respect to likelihood of adoption.

The knowledge assessment of content was analyzed using descriptive statistics. Specifically comparison of means depicted on bar graph and further stratified by profession, sex, and years in practice. Overall there was a 40% increase in content knowledge of the CCHR as measured on the clinical scenario multiple choice questionnaire (figure 6).

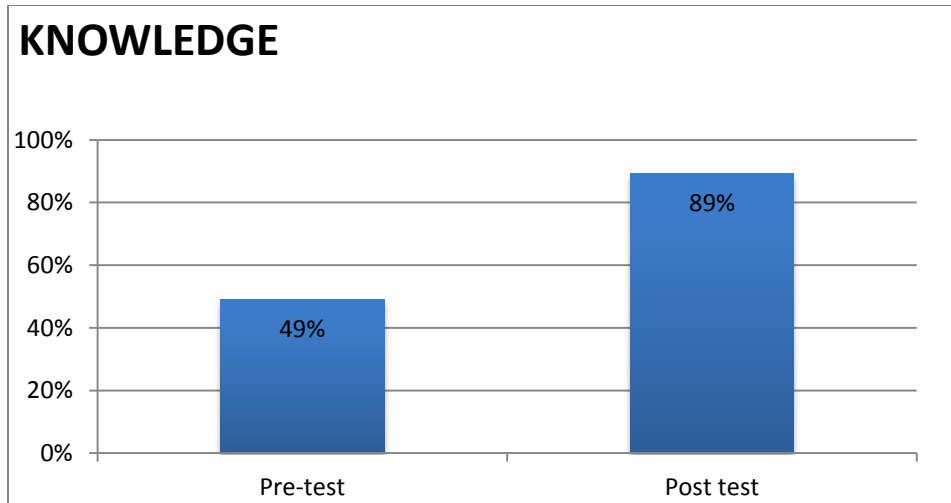


Figure 5. Aggregate comparison of knowledge pre-test and post test

PGY3 participants demonstrated the greatest increase in knowledge scoring 50% higher on the posttest when asked to apply the CCHR to clinical scenarios. PGY2 participants demonstrated no change from pretest to posttest. PAs and RNs had identical increases in scores from pre-test to posttest of 43%, however the PAs did start with a higher pre-test score than RNs. The highest pretest score was among Attending physician participants (59%), and the lowest pretest score was PGY3 participants (25%). PGY2 and Attending physician participants scored had the highest posttest scores (100%) (figure 7).

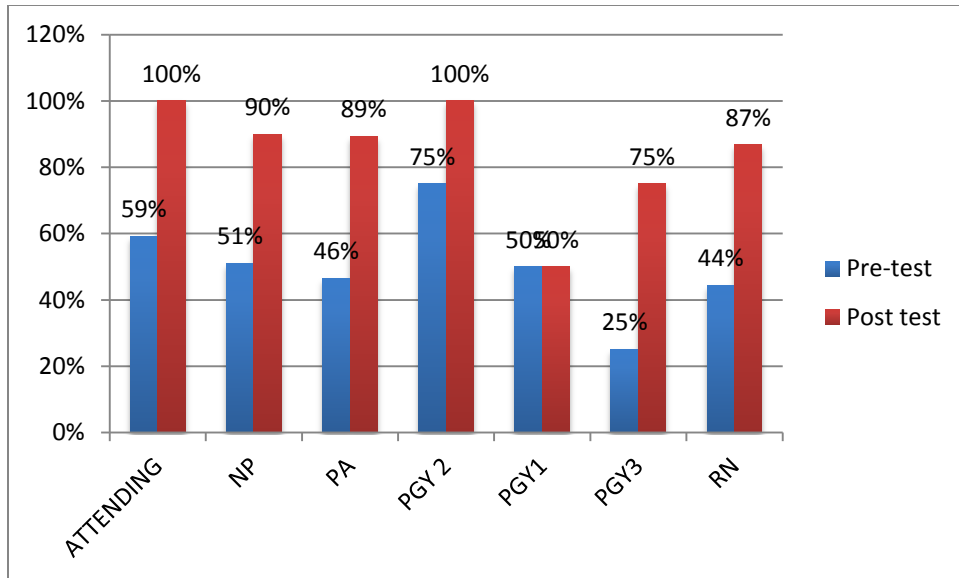


Figure 6. Pre-test and Post test scores by role

The number of years of experience had the greatest influence on posttest scores of content knowledge when participants were asked to apply the criteria of the CCHR to the clinical scenario questions (table 3).

Table 3. Role and Years of Experience, knowledge pretest and posttest mean scores

ROLE		Average of Pre-test	Average of Post test
ATTENDING		59%	100%
	2	50%	100%
	3	63%	100%
	4	75%	100%
>5		50%	100%
NP		51%	90%
	2	61%	89%
	3	75%	100%
	4	50%	90%
	5	38%	88%
>5		41%	91%
PA		46%	89%
	2	50%	100%
	3	38%	88%
	5	50%	75%
>5		50%	88%
PGY 2		75%	100%
	1	75%	100%
PGY1		50%	50%
	1	50%	50%
PGY2		75%	100%
	3	75%	100%
PGY3		25%	75%
	3	25%	75%
RN		44%	87%
	1	38%	84%
	2	45%	100%
	3	50%	75%
	4	50%	81%
	5	50%	75%
>5		46%	89%

Participants with both the least (1 year or less) and most experience (greater than 5 years) had the largest percentage increase from knowledge pre-test to posttest.

Summary

A clinician's attitude towards innovation is an antecedent toward the likelihood of adoption into clinical practice. Equally important are the appeal of the evidence-based clinical guideline, and the requirement by an authority to utilize the evidence in daily practice. The participants in this project were able to comprehend and apply the CCHR to clinical scenarios of patients with minor head injury by prudently selecting the patients that would benefit from NCHCT scans. The domain of required use was the primary factor influencing likelihood of adoption into clinical practice.

Chapter Seven: Implications for Nursing Practice

The results of this evidence-based practice project have many implications for the guidance of clinicians in the prudent imaging of patients with minor brain injuries. The focus of this chapter is to discuss the potential effects on nursing practice. The limitations of this project and recommendations are also presented.

Practice Implications

The American Association of Colleges of Nursing (AACN) has outlined eight Essentials Doctoral Education that make up the foundational core competencies of education for advanced nursing practice. In this chapter, the implications of this project are discussed with reference to each of the core competencies. The most striking revelation deduced from the implementation of this practice change project is the power of the institution's cultural inertia with respect to the perceived mandate that all patients with minor brain injuries require non-contrast head CT Scan (NCHCTS). It is essential to have a culture of intellectual curiosity and openness to innovation. Throughout the practice change process, several implications for nursing practice were identified in relation to the prudent selection of patients for head imaging.

Essential I: Scientific underpinnings for practice. Despite the best evidence showing the benefits of choosing wisely the patients that should be evaluated with NCHCTS after a minor brain injury, the increased lifetime risk of developing cancer, and the uncompensated costs associated with hospital acquired conditions the consistent use of evidence-based clinical decision support tools such as the Canadian CT Head Rule (CCHR) remains low. There is evidence in the literature that clinical decision tools can be successfully implemented through various interventions. Doctorally prepared advanced practice nurses are able to play a role in the translation of evidence into practice and are well suited to address the issues. In this specific

project participants did demonstrate an increase in knowledge and were likely to adopt the CCHR into clinical practice. Automated implementation in the annual hospital training computer based training with high level administrative support would reinforce this finding, or result in gains in other areas related to the project.

Essential II: Organization and systems leadership for quality improvement and systems thinking. Institutions that have encouraged a culture of clinical inquiry and inculcated evidence-based practice into daily operations are more likely to utilize evidence- based clinical decision tools. Prudent selection of patients who should be exposed to Ionizing radiation for diagnostic purposes has been endorsed by many professional organizations and is listed as an essential practice change in the Choosing Wisely campaign. Through quality improvement measures, as well as organizational and systems approaches to address and overcome potential obstacles, a framework may be established for the implementation of practices that support the use of evidence- based clinical decision support tools. This evidence-based practice project demonstrated that systematic changes are more likely to be adopted if the guideline to evaluate the patient is readily available at the point of care is intuitively appealing and required.

Clinical decision rules that are perceived as intuitively appealing are more likely to be utilized in clinical practice. As with any change in practice it is essential to survey the organization's readiness to change, and in this case a survey of attitude toward prospective innovations. Adopting a change in practice requires administrative support, endorsement of key thought leaders, and a sufficient number of early adopters to propel the critical mass necessary for sustained change.

Essential III: Clinical scholarship and analytical methods for EBP. Translating research into practice requires the clinical scholar to appraise the literature and synthesize the

findings into externally valid evidence-based practices. This iterative process allows future generations of clinicians and researchers to ensure continuous quality improvement. Evidence-Based programs such as helping clinicians prudently select the right patient for Ionizing radiation exposure for diagnostic clarity may be improved through the analysis and discussion of challenges, and the dissemination of findings and conclusions. Further exploration regarding the alignment of incentives among key stakeholders use of evidence-based clinical decision rules is essential. In any evidence-based project the incentives that motivate change, and the degree of openness to innovation can have a significant impact on the success of the practice change, as can the level of administrative support. It therefore becomes imperative to design and analyze different approaches to assess the attitudes of wide range potential participants.

Essential IV: Information systems/technology and patient care technology for the improvement and transformation of healthcare. Various modes of information technology may be incorporated into the implementation of a clinical decision rule for patients with minor brain injuries. Social media campaigns using sites such as YouTube, Facebook and Twitter, and health care institution patient education web sites aimed at clinicians as well as patients can serve to create a dialogue about the risks and benefits of NCHCTS. In addition, mandated clinical screening questions at the point order entry, and template guided post fall clinical evaluation tools within the electronic health record.

Many hospitals require their employees to complete an annual computer based training regarding the various policies of the hospital. Imbedding a computer-based training regarding evidence-based clinical decision rules for minor head injuries would serve to remind and educate clinicians of the importance of this issue.

Essential V: Healthcare policy for advocacy in healthcare. The federal government has taken a renewed interest in CT scanning regulations in response to the reports describing nearly 400 patients who received radiation overdoses during CT imaging of the brain, resulting in hair loss and skin changes (Miglioretti & Smith-Bindman, 2011; Redberg, 2009; Smith-Bindman, 2012; Smith-Bindman et al., 2009). Public health projections regarding radiation-induced cancer risk from CT scan pose a substantial threat at the population level, and one estimate projects up to 29,000 Americans may develop future cancers secondary to CT scans performed in 2007 (Harvey & Pandharipande, 2012; Smith-Bindman et al., 2009). These studies do not account for competing risk factors with respect to risk benefit associated with clinical indication for the CT scan, and they utilize extrapolated data projections from atomic bomb survivors. Media coverage has peaked public interest, and if measures to insure prudent imaging are not implemented Americans will continue to experience more risk than benefit associated with the inappropriate utilization of ionizing radiation for diagnostic purposes (Bogdanich, 2011; Bogdanich, W., McGinty, 2011; Redberg, R., Smith-Bindman, 2014).

The American College of Radiologists (ACR) would support legislation as they have also stood behind the Choosing Wisely campaign that advocates for the use of clinical decision support tools for ordering clinicians as well as benefit management companies performing pre-authorization assessments. The ACR also endorses legislation to limit self-referral, and diagnostic reference levels to distinguish between acceptable and inappropriate practices at a facility. The dose reduction techniques and optimization, tracking documentation reporting radiation doses for every CT study performed, as well as the establishment of a national dose registry will help define the best practices and allow for inter-facility comparisons of dose indices (Radiology, 2008). The ACR would be a key player in the accreditation and regulation

of facilities using ionizing radiation and could yield power over facilities that utilize this technology. However, without significant tort reform a clinician's fear of litigation often drives the culture of defensive medical practice.

Essential VI: Interprofessional collaboration for improving patient and population health outcomes. Healthcare delivery has increasingly become a collaborative effort. It is essential that healthcare professionals across various disciplines come to understand the risks associated with unnecessary exposure to ionizing radiation particularly in the case of minor brain injuries. The best efforts can be undermined if the perspective of all clinicians caring for the patient are not considered, as disparate opinions presented to a patient may cause fear and anxiety and undermine the trust dynamic that is essential for a therapeutic alliance. Interprofessional collaboration can reinforce evidence-based clinical practice changes while aiding in the dissemination of findings. Only through continued interprofessional education can patient engagement be fostered and reinforced. An accurate, clear, and consistent message to clinicians and patients is essential particularly as the desire for personalized care is realized.

Essential VII: Clinical prevention and population health for improving the nation's health. It has been demonstrated in the literature that the use of evidence-based clinical decision support tools can reduce unnecessary exposure to ionizing radiation, which has been associated with an increased incidence of cancer. With respect to population health, the use of highly sensitive clinical decision rules can greatly reduce the unnecessary risks and costs associated with eminence-based (appealing to authority figures based on tradition not supported by the evidence) interventions. Millions of dollars are spent each year on research to identify best practices yet despite these efforts clinicians continue to practice according to tradition. Through

the publication of this specific evidence-based change project, prudent imaging practices can be adopted by other clinicians and institutions.

Essential VIII: Advanced nursing practice. The integration of knowledge and the application of synthesized research findings into clinical practice can improve the clinical outcomes of patients with minor brain injuries by reducing their unnecessary exposure to ionizing radiation. This inductive and deductive process undertaken by nurses who subject themselves to a doctoral education serves to benefit patients at large while advancing nursing practice. A clinical doctorate scholar translates evidence into practice by implementing and evaluating specific outcome measures then disseminating the results so that quality outcomes can be achieved, and practice may be advanced.

Project Limitations

The greatest challenge in attempting any change is the ability to alleviate fears of the unknown. It is essential to have administrative support, as well as the endorsement of key thought leaders throughout the organization for any proposed change to be considered. Participants expressed tremendous resistance in applying the clinical decision rule to the post-test clinical scenarios due to fears of being held liable for missing a clinically important finding. One participant after selecting a correct response based on the CCHR could not keep herself from writing in what she would do in addition, to ensure nothing was missed. Another clinician read into the question regarding the age of the patient being an exclusionary criteria stating “what if she turns 65 tomorrow” despite the rule indicating inclusion criteria of patients ages 16-64 years of age.

In addition, despite informing participants that the hospital had no mandate requiring NCHCTS for patients with minor head injury, and inviting them to search the intranet-based

policies several participants insisted it was an oversight and wanted to image patients regardless of the evidence-based clinical decision tool. The primary reason was the proximate cause of any future cancer development would unlikely be tied back to the NCHCTS they received after falling in the hospital. Other reasons for imaging despite the evidence included a belief that the patient expected the scan, and NCHCTS was a means of making amends for allowing the patient to fall while in their charge.

An additional challenge in the implementation of this evidence-based practice change project was the IRB approval process. The institution does not have a publicized or widely known procedure for approving quality improvement projects, which this was eventually deemed. Despite the low risk nature of this project it was essential to complete the entire eIRB process in which many questions were not applicable to this work. It was only after calling the IRB director directly that the project was reviewed and waived from human subject restrictions criteria.

Future Work

At the facility, the Evidence-Based Practice Attitude Scale (EBPAS) along with the contents of the CCHR will be converted into an electronic format and more widely distributed. Further data analysis will identify which clinicians and units are most open to innovation. A pilot implementation based on this data will be conducted to evaluate if the consistent use of the CCHR reduces the rate of NCHCTS.

The findings of this project will be published in a peer reviewed nursing journal as there is a dearth of information regarding clinical decision rules in this literature. Furthermore, a poster presentation will be developed for presentation at a professional organization conference aimed at advanced practice nurses. Assessing attitudes prior to the implementation of an

innovation is a prudent means of introducing practice changes so that a receptive audience can be identified which may help overcome institutional inertia.

Summary

Prudent selection of patients to receive NCHCTS can be accomplished with the use of evidence-based clinical decision support tools. Assessing clinicians' attitudes toward innovations such as the Canadian CT Head Rule can inform dissemination strategies for successful implementation. Many professional organizations have synthesized the literature regarding the importance of reducing unnecessary exposure to ionizing radiation due to the increased risk of cancer, low clinical yield, and risk of incidental findings. There is a dearth of writing in the nursing literature regarding the attitudes of nurse practitioners toward evidence-based practice and even less regarding the use of evidence-based clinical decision support tools to guide clinical practice.

Chapter Eight: Final Conclusions

Healthcare continues to revolutionize along the continuum of personalized, predictive, preventive, and participatory care. Evidence-based practice requires a deliberate and critical use of applicable scientific literature to guide clinical practice. The emphasis of translational science is the application knowledge to everyday problems.

The purpose of this chapter is to summarize the evidence-based change project regarding the attitudes of clinicians towards clinical decision tools. There are many factors that affect an individual's willingness to adopt evidence-based practices. The attitude of the clinician has been correlated with likelihood of utilization. The Canadian CT Head Rule is an evidence-based clinical decision rule that has been shown to greatly reduce the risk of unnecessary exposure to ionizing radiation commonly misused in the diagnostic evaluation of patients with minor brain injuries.

Clinical Problem

Patients who suffer a minor brain injury while admitted to the hospital are being exposed to non-essential ionizing radiation when they receive head imaging in the form of a non-contrast head CT scan. The purpose of this EBP change project was to evaluate attitudes toward an evidence-based clinical decision support tool that would standardize the clinical assessment of patients who have suffered a minor brain injury while hospitalized due to falling and reduce exposure to unnecessary ionizing radiation mitigating the risk of associated cancers. Imaging is commonly used to assess for intracranial damage in patients presenting with head injury.

Computerized Tomography (CT) imaging is a diagnostic test that can be of immediate benefit to patients and is readily available at most hospitals in the United States. Head CT scans are a very valuable diagnostic tool and the benefit must outweigh the risk when the test is

justifiable. The ionizing radiation doses that have demonstrated the causal relationships to increased incidences of cancer are specifically related to the higher dose exam such as CT scan. Ionizing radiation exposure as in the case of CT scans offers an enhanced diagnostic ability, but also poses a host of unintended consequences including increased cancer risk from radiation; incidental findings of no clinical significance leading to additional tests and procedures, and increased cost to the health care system (Miglioretti & Smith-Bindman, 2011). The Institute of Medicine (IOM) reports a large degree of variation in quality and consistency of clinical practice among clinicians across the US when using CT imaging as a diagnostic tool.

Literature Evidence

The evidence was appraised based on its applicability to patient care delivery and the nursing practice environment and its potential for improvement of outcomes. Other factors that were considered in the appraising of evidence include availability of clinical expertise, patient preferences, as well as cost-benefit analysis, and availability of alternative practices.

Patients with minor head injuries (identified by having a GCS 13-15, who have not suffered loss of consciousness or amnesia) rarely require admission to the hospital or neurosurgical intervention. Controversy continues to abound regarding the appropriate use of CT scan in the evaluation of these patients. The ionizing radiation doses that have demonstrated the causal relationships to increased risk of cancer are specifically related to higher dose exams, such as CT scan. A review of the literature identified the CCHR as a highly sensitive CDS tool indicated for patients with minor head injury that would allow clinicians to consistently order CT scan for their patients based on strong evidence without risking patient care outcomes.

Both prospective and retrospective studies have demonstrated that a reduction in CT scans with the use of the CCHR in patients with minor head injury can occur without missing

clinically important brain injuries, and injuries requiring neurosurgical intervention. The reductions of CT scan usage in evaluating patients with minor head injury would also reduce the risk of ionizing radiation exposure that has been found to correlate with increased cancer rates. Prudent CT scan use also offers the added benefit of cost-savings and improved patient satisfaction (Clement et al., 2006; M. Smits et al., 2010). The literature supports that patients who are being evaluated for minor head injury should receive a preliminary screening using the criteria of the CCHR and standard physical examination, and if warranted, referred for CT scan. Nurse practitioners will continue to increase in number and scope of practice authority. It is incumbent upon them to apply evidence-based practice standards such as clinical decision rules to provide safe and effective care for the patients in their charge. Failure to provide evidence-based care increases the cost of health care, causes harm to patients, and violates the fiduciary responsibility entrusted to the profession. The vast majority of patients that sustain minor head injuries receive a non-contrast head CT scan at this large urban academic multi-campus tertiary care facility located in New York City. This practice is passed down from senior resident to junior residents, is reinforced by the nursing staff, and is not supported by the evidence in the literature.

Change Theories and Models

The Theory of Diffusion of Innovation and the PEACE model for evidence-based nursing practice change were utilized to guide the implementation of this project. The Diffusion of Innovations theory is a five stage-based model with four key concepts (innovation, communication channels, time, and social system) integral in the theory. In disseminating the clinical decision support tool it was important to identify the key thought leaders and early adopters in the various departments throughout the institution.

The PEACE framework developed by nurses of New York Presbyterian Hospital, is a five-step process that was used to guide the assessment of attitudes toward a clinical decision support tool that would enable clinicians to prudently select patients with minor head injury that are likely to benefit from a CT scan of the head. The concept of clinical decision support (CDS) continues to play a prominent role in the increasingly complex arena of health care delivery.

Project Management

Prior to the implementation of an EBP change project, it was important to perform an organizational assessment of readiness for change. The development of this EBP change project involved input from many individuals of varying professions. It was imperative to garner support from key thought leaders in each department as well as the their respective directors of quality initiatives. The primary challenge to overcome in the implementation of this project was practice inertia. Many clinicians held a preconceived notion that the care provided was evidence-based and supported by written policies.

Project Implementation

The plan for this evidence-based practice change project began with an implementation of an attitude assessment scale regarding of evidence-based practices and a knowledge assessment pre-test and posttest related to patients with minor brain injuries. Participants were then presented with the criteria of the clinical decision support tool (CCHR) and asked to apply the tool to clinical scenarios. The data were analyzed using descriptive statistics and factor loading criteria using MS Excel and then visually represented. The duty to use clinical decision support tools in the delivery of evidence-based care is an ethical obligation of clinicians to help insure the safety of their patients. This EBP change project introduced clinicians to the concept of evidence-based clinical decision tools that may enhance future clinical practice.

Findings

A clinician's attitude towards innovation is an antecedent toward the likelihood of adoption into clinical practice. Equally important are the appeal of the evidence-based clinical decision support tool, and the requirement by an authority to utilize the evidence in daily practice. The participants in this project were able to comprehend and apply the CCHR to clinical scenarios of patients with minor head injury by prudently selecting the patients that would benefit from NCHCT scans. The domain of required use was the primary factor influencing likelihood of adoption into clinical practice. Participants indicated they would adopt the practice change if a governing authority (employer, supervisor, state law) required it.

Practice Implications

Healthcare delivery has increasingly become a collaborative effort. It is essential that healthcare professionals across various disciplines come to understand the risks associated with unnecessary exposure to ionizing radiation particularly in the case of minor brain injuries. The integration of knowledge and the application of synthesized research findings into clinical practice can improve the clinical outcomes of patients with minor brain injuries by reducing their unnecessary exposure to ionizing radiation. This inductive and deductive process undertaken by nurses who subject themselves to a doctoral education serves to benefit patients at large while advancing nursing practice. Institutions that have encouraged a culture of clinical inquiry and inculcated evidence-based practice into daily operations are more likely to utilize evidence-based clinical decision tools.

Final Conclusions

The use of CDS tools are an EBP that can help healthcare providers mitigate the risk associated with caring for complex patients. CDS tools provide a systematic method to evaluate

patients with minor head injuries while assuring consistency of care and quality outcomes. This practice of assuring consistency and good patient outcomes is foundational to the concept of standard-of-care.

As financial resources continue to dwindle, objective theory-based evaluative criteria will continue the drive towards more efficient care strategies. As the population swells and ages, the demand for healthcare services will continue to raise the cost of healthcare. The current model of care is financially unsustainable. The economy demands are more efficient utilization of resources. An example of efficient resource utilization is the use of evidence-based clinical decision support tools to guide diagnostic practices.

Implementing a clinical practice change requires sensitivity to prevailing attitudes to help overcome the cultural inertia that values eminence based practice (appealing to tradition and authority figures) over evidence-based practice. Clinicians have a moral obligation to engage their patients in a sufficient discourse regarding the risks and benefits associated with common practices such as the use of ionizing radiation imaging. In order for a patient to provide informed consent they must be told of the potential risks and benefits of having a procedure as well as the risks and benefits of not having the procedure.

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Appendix A

IRB Waiver



Weill Cornell Medical College

Institutional Review Board

Mailing Address:
1300 York Avenue
Box 89
New York, NY 10065

Telephone: 646-962-8200
E-mail: irb@med.cornell.edu

June 23, 2015

Raymond Zakhari, MD

Protocol Number: 1504016142
Protocol Title: Health care providers awareness of a clinical decision support tool affects likelihood of use

Dear Dr. Zakhari:

The Office of Research Integrity has conducted a review of the abovementioned submission and determined that the activities described in this protocol do not constitute human subjects research as it has been determined that this is a QA/QI initiative. As a result, 45 CFR part 46 does not apply. Therefore, neither IRB approval nor a notice of exemption are required for you to proceed with your project.

Please withdraw this submission in eIRB.

Sincerely,

A handwritten signature in cursive script that reads "Rosemary Kraemer".

Rosemary Kraemer, Ph.D., C.I.P.
Director, Human Research Protections Program

Appendix B

Cover Letter

Dear Healthcare Provider,

Thank you for volunteering to participate in this quality improvement project assessing attitudes regarding the adoption of Evidence-Based Evidence-based Practice guidelines. I am Nurse Practitioner in the department of internal medicine and psychiatry, and currently pursuing a doctoral degree at Chatham University, Pittsburgh, Pennsylvania. New York Presbyterian Hospital and Weill Cornell Medical College have granted permission for this project to be conducted.

You will be asked to complete a questionnaire before and after a brief one-on-one presentation about a clinical decision rule. In addition you will be asked to complete a 4 question multiple choice knowledge content assessment before and after the presentation. The entire process should not take more than 1 hour. This survey poses no risk to you, and will be anonymous. The only demographic data that will be collected will be your role in the medical center. Once the scores are taken from the surveys they will be shredded. There will be no way to link a specific survey to a specific participant. There is no penalty for not participating, nor is not participating linked in any way to your performance evaluation.

If you are interested in scheduling a session you may reach me at: 212-746-5704 OR 917-484-2709 OR raz9001@nyp.org OR raymond.zakhari@chatham.edu. Thank you for your time.

Yours truly,

Raymond Zakhari

Appendix C

Permission to Use Evidence-based Practice Attitude Scale

Aarons, Gregory <gaarons@ucsd.edu>
Fri 6/5/2015 5:55 PM

This email provides permission to use the EBPAS in your research. I have attached files with the EBPAS, scoring instructions, and US National norms and updated psychometrics. As we discussed in our phone call earlier today, it may be necessary to adapt the EBPAS to indicate your particular evidence-based intervention, rather than EBP in general. Let me know if you have any questions. Best of luck with your research.

Sincerely,
Greg Aarons

Gregory A. Aarons, PhD
Professor of Psychiatry | Director: Child and Adolescent Services Research Center
University of California, San Diego | 9500 Gilman Dr. (0812) | La Jolla, CA 92093-0812
+1 858-966-7703 x3550 | <http://psychiatry.ucsd.edu/About/faculty/Pages/gregory-aarons.aspx>

Zakhari, Raymond
Thu 6/4/2015 11:55 AM
Sent Items

To:
gaarons@ucsd.edu;
Hi Dr. Aarons

I am doctoral student at Chatham University seeking to survey attitude toward the adoption of a clinical decision support rule (the Canadian Head CT Rule) at New York Presbyterian Hospital Weill Cornell.

Can I have permission to use your tool in my capstone project?

I found your tool at this site:
<http://www.nccmt.ca/registry/view/eng/34.html>

Thank you
Raymond Zakhari, NP

Appendix D
Attitude Assessment, Pre-test, Intervention, Posttest

Evidence-Based Practice Attitude Scale

Aarons, G.A. (2004). Mental health provider attitudes towards adoption of evidence-based practice: the evidence-based practice attitude scale; *Mental Health Services Research*, 6(2), 61-74

The following questions ask about your feelings about using clinical decision rules, new therapies/ interventions, and innovations in clinical practice.

Please specify by checking the Respondent Type that most closely matches your position:

<input type="checkbox"/> RN, <input type="checkbox"/> NP, <input type="checkbox"/> PA, <input type="checkbox"/> Attending Physician, <input type="checkbox"/> Resident, <input type="checkbox"/> Fellow

Circle the number **indicating to which extent you agree** with each item using the following scale:

0=Not at All | 1= To a Slight Extent | 2= To a Moderate Extent | 3= To a Great Extent | 4= To a Very Great Extent

1	I like to use new types of tools/ interventions to help my patients	0	1	2	3	4
2	I am willing to try new types of tools/ interventions even if I have to follow a treatment manual	0	1	2	3	4
3	I know better than academic researchers how to care for my patients	0	1	2	3	4
4	I am willing to use new and different types of Evidence-based tools/ interventions developed by researchers	0	1	2	3	4
5	Research-based tools/ interventions are not clinically useful	0	1	2	3	4
6	Clinical experience is more important than using an evidence-based tool or treatment	0	1	2	3	4
7	I would not use clinical decision support tools	0	1	2	3	4
8	I would try a new Evidence-Based tool/ intervention even if it were very different from what I am used to doing	0	1	2	3	4

Content Pre-Test

Answer the following questions according to your current standard of practice:
(What would you ordinarily do if you encountered the following patient scenarios?)

- 1) A 64-year-old woman is admitted to the hospital for dehydration due to gastroenteritis. She had syncope at home and had a head CT scan in the ER. Later that day she slips and falls on a wet floor while going to the bathroom. She reports hitting her head. The fall was not witnessed. On your exam she is alert and oriented, and has no obvious injuries. Her vital signs are better but still orthostatic and reports feeling lightheaded. **Which of the following would you want done FIRST?**
 - A. Order/ request a Stat Non-Contrast CT scan of the head
 - B. Continue to rehydrate the patient
 - C. Order hourly neuro checks
 - D. Both B and C
 - E. All of the Above

- 2) A 45-year-old man calls the nurse reporting that he fell out of bed while sleeping. He reports hitting his head as the reason he woke up. On exam he is alert and oriented, and responding appropriately to your questions and following commands. He reports he is a little groggy. There are no obvious signs of injury. He has a goose egg forming on his forehead. **Which of the following would you want done FIRST?**
 - A. Order/ request a Stat Non-Contrast CT scan of the head
 - B. Provide the patient with an Ice Pack
 - C. Offer the patient acetaminophen which is already ordered for PRN Pain
 - D. Both B and C
 - E. All of the Above

- 3) A 70-year-old woman admitted to psychiatry for depression with psychosis. She slips and falls in the bathroom and hits her head while rising from sitting. She denies any injuries when the nurse helps her stand and walks her back to bed. Her vital signs are consistent with her baseline. She denies any pain. **Which of the following would you want done FIRST?**
 - A. Order/request a Stat Non-Contrast CT scan of the head
 - B. Order/ perform hourly neuro-checks
 - C. Offer an ice pack to the area she hit on her head
 - D. Both B and C
 - E. All of the above

- 4) You are called regarding a 45-year-old male patient s/p arthroscopic knee surgery. The nurse reports the patient fell down a flight of stairs hitting his head as he was sneaking out to smoke. He initially denies any pain other than his knee. The patient is assisted to his room, and offered Percocet and an ice pack for pain. On your rounds 2 hours later you find the patient sleeping in his room, he opens his eyes when you call his name, but seems disoriented in his conversation. He tells you he vomited twice after taking the Percocet, and cannot recall that he fell. **Which of the following would you want done FIRST?**
 - A. Order/ Request a Stat Non-Contrast CT scan of the head
 - B. Reorient the patient and allow him to continue sleeping
 - C. Offer him something for nausea and pain
 - D. Both B and C
 - E. Consult Neurology

Minor Brain Injuries (MBI)

Eye Opening	1 None	2 Pain	3 Voice	4 Spontaneous	E=		
Verbal Response	1 None	2 Only sounds, No Words	3 Words, but not coherent	4 Disoriented Conversation	5 Normal Conversation	V=	
Motor Response	1 None	2 Decerebrate	3 Decorticate	4 Withdraws from pain	5 Localizes to pain	6 Normal Movement	M=

Canadian CT Head Rule

<ul style="list-style-type: none"> Does the patient have GCS < 15, 2-hours post injury? 	<p>If you answer YES to any 1 of these questions then order:</p> <p>Non Contrast Head CT Scan</p>
<ul style="list-style-type: none"> Do you suspect open or depressed skull fracture? 	
<ul style="list-style-type: none"> Any Sign of basilar skull fracture? <ul style="list-style-type: none"> <i>Hemotympanum</i> <i>Raccoon Eyes?</i> <i>Battle's Signs</i> <i>CSF oto-/ rhinorrhea</i> 	
<ul style="list-style-type: none"> Did the patient have > 1 episode vomiting? 	
<ul style="list-style-type: none"> Is the patient > age 64? 	<ul style="list-style-type: none"> If all questions are NO: <p>The Canadian CT Head Rule (CCHR) has 100% sensitivity for detecting clinically important brain injury, and brain injuries requiring neurosurgical intervention.</p>
<ul style="list-style-type: none"> Does the patient have retrograde amnesia > 30 minutes? 	
<ul style="list-style-type: none"> Did the patient have a dangerous mechanism of injury? <ul style="list-style-type: none"> <i>Pedestrian Struck by motor vehicle</i> <i>Ejected from motor vehicle</i> <i>Fall > 3 ft. or 5 stairs?</i> 	

- Over 90% of Head CT scans for mild head injury are negative, and only 1% require neurosurgical intervention
- Elderly patients with coagulopathy may develop focal neurosurgical (subdural) lesions despite normal initial scan
- Early CT scans may not demonstrate intra-cerebral contusions that take time to become apparent. (Serial scanning is not recommended)
- CT Scanning will not demonstrate diffuse axonal injury in most patients (MRI is preferred)
- Patients may suffer significant post concussive symptoms despite normal CT Scan.
- Routine use of CT scanning does not guarantee better identification of significant intracranial injuries. (No definitive agreed upon time as to when to scan).
- Head CT Scan may delay definitive management of more significant injuries in multi system trauma patients.

The Canadian CT Head Rule (CCHR) is an Evidence-based clinical decision rule that can be reliably used to help clinicians decide which patients with minor head injury would benefit from (and not be harmed by) a Non-Contrast Head CT Scan)

Stiell IG, Wells GA, Vandemheen K, Clement C, Lesiuk H, Laupacis A, et al. The Canadian CT Head Rule for patients with minor head injury. *Lancet* 2001; 357(9266):1391-6.; 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; 62(5):1314-5.; Khan F, Baguley IJ, Cameron ID, Khan F, Baguley IJ, Cameron ID. 4. Rehabilitation after traumatic brain injury. *MJA* 2003; 178(6): 290-5.

CCHR Reference Card

The Canadian CT Head Rule
(Age >16 years or < 65 years)

Age > 64?

Is GCS < 15 at 2 hours post injury?

Suspected open or depressed skull fracture?

Any signs of basilar skull fracture?

- Blood coming from ear canal
- Raccoon Eyes
- Battle's Signs
- CSF leaking from ear or nose

More than 1 episode of vomiting?

Retrograde amnesia to the even more than 30 minutes?

Dangerous mechanism of injury?

- Fall > 3 ft., or 5 Steps
- Pedestrian struck by motor vehicle
- Pedestrian ejected from motor vehicle

IF YOU ANSWERED NO TO ALL THESE QUESTIONS HEAD CT SCAN IS NOT INDICATED

Glasgow Coma Score		
Eye Opening (E)	Verbal Response (V)	Motor Response (M)
4=Spontaneous 3=To voice 2=To pain 1=None	5=Normal conversation 4=Disoriented conversation 3=Words, but not coherent 2=No words.....only sounds 1=None	6=Normal 5=Localizes to pain 4=Withdraws to pain 3=Decorticate posture 2=Decerebrate 1=None
		Total = E+V+M

Content Post-Test

Using the Canadian CT Head Rule (CCHR) answer the following questions:

- 1) A 64-year-old woman is admitted to the hospital for dehydration due to gastroenteritis. She had syncope at home and had a head CT scan in the ER. Later that day she slips and falls on a wet floor while going to the bathroom. She reports hitting her head. The fall was not witnessed. On your exam she is alert and oriented, and has no obvious injuries. Her vital signs are better but still orthostatic and reports feeling lightheaded. **Which of the following would you want done FIRST?**
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 - D. Both B and C
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- 3) A 70-year-old woman admitted to psychiatry for depression with psychosis. She slips and falls in the bathroom and hits her head while rising from sitting. She denies any injuries when the nurse helps her stand and walks her back to bed. Her vital signs are consistent with her baseline. She denies any pain. **Which of the following would you want done FIRST?**
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 - C. Offer an ice pack to the area she hit on her head
 - D. Both B and C
 - E. All of the above

- 4) You are called regarding a 45-year-old male patient s/p arthroscopic knee surgery. The nurse reports the patient fell down a flight of stairs hitting his head as he was sneaking out to smoke. He initially denies any pain other than his knee. The patient is assisted to his room, and offered Percocet and an ice pack for pain. On your rounds 2 hours later you find the patient sleeping in his room, he opens his eyes when you call his name, but seems disoriented in his conversation. He tells you he vomited twice after taking the Percocet, and cannot recall that he fell. **Which of the following would you want done FIRST?**
 - A. Order/ Request a Stat Non-Contrast CT scan of the head
 - B. Reorient the patient and allow him to continue sleeping
 - C. Offer him something for nausea and pain
 - D. Both B and C
 - E. Consult Neurology

Attitude Assessment Post Test

For questions 9 through 15: How likely would you be to adopt the Canadian CT Head Rule in your practice of evaluating patients with minor head injuries based on the following criteria?						
9	It was intuitively appealing?	0	1	2	3	4
10	It "made sense to you"?	0	1	2	3	4
11	It was required by your supervisor?	0	1	2	3	4
12	It was required by your employer?	0	1	2	3	4
13	It was required by your state?	0	1	2	3	4
14	It was being used by colleagues who were happy with it?	0	1	2	3	4
15	You felt you had enough training to use it correctly?	0	1	2	3	4

Aarons, G.A. (2004). Mental health provider attitudes towards adoption of evidence-based practice: the evidence-based practice attitude scale; *Mental Health Services Research*, 6(2), 61-74