EVIDENCE-BASED GUIDELINES FOR LACERATION REPAIR IN URGENT CARE SETTING

A DOCTORAL PROJECT

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By

Hengky Lim

Doctoral Project Committee Approval:

David E. Kumrow, EdD, Project Chair
Catherine Cummins, MD, Committee Member

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ABSTRACT

There is a significant increase in number of lacerations as injury related visits to emergency departments and urgent care centers in America. Health care providers are also challenged with providing evidence-based laceration management for patients seen at urgent care centers. This challenge is due to lack of evidence-based clinical practice guidelines for urgent care providers coming from different clinical backgrounds and with varied skill sets and experiences. The aim of this quality improvement project was to develop an evidence-based clinical practice guideline in order to reduce risks of infection and unnecessary antibiotic therapy. An extensive review of literature were performed on empiric scholarly studies retrieved from electronic database of Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus, PubMed, Cochrane Library, Wiley Science, Science Direct, and Google Scholar between 1995 and 2015. The levels and quality of evidence were assigned based on Johns Hopkins Nursing evidence-based practice (JHNEBP) evidence appraisal. Plan-Do-Study-Act (PDSA) model was used as a framework to guide this project. The evidence and recommendations in this project were reviewed and evaluated multiple times by the expert panel until a consensus were reached. Published laceration repair guidelines and expert consultation revealed valid and reliable findings from studies that addressed practices to reduce infection risks and standards to use to delineate the role of antibiotic prophylaxis. Wound closure time, locations, and characteristics were noted to be critical factors to consider when repairing...
a laceration. In addition, evidence on irrigation solutions, irrigation pressure, debridement, and absent of irrigation were found to have potential effects on wound infection post laceration repair. Clinical implications were discussed, including financial, legal and health outcomes. Further study is recommended to perform a test of change following the establishment of the project’s clinical practice guideline prior to its full implementation in the urgent care center.
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BACKGROUND

Problem Statement

Lacerations constitute a significant amount of trauma-related visits and are responsible for 8% of the 95 million visits to emergency departments (EDs) in the United States of America (U.S.A.) every year (Wassem et al., 2012). Laceration refers to a skin wound produced by the separation of connective tissue resulting in an injury which is often irregular or jagged (Cunha, 2014). The repair of a laceration aims to prevent wound infection, restore function of the body part, and achieve an acceptable cosmetic outcome (Hollander, Singer, Valentine, & Shofer, 2001; Zehtabchi, Tan, Yadav, Badawy, & Lucchesi, 2011). Life-threatening morbidity from traumatic lacerations is rare, but improper care or variation in laceration management may lead to wound infection, unnecessary antibiotic prophylaxis, and unnecessary scarring (Hollander et al., 2001).

Urgent care (UC) is the provision of immediate medical service focused on the delivery of ambulatory care for non-life threatening medical conditions including most non-complicated lacerations (American Academy of Urgent Care Medicine [AAUCM], 2014). The number of urgent care clinics has been growing in recent years and currently, urgent care centers provide a substantial amount of health care in the United States (AAUCM, 2014). According to the National Urgent Care Chart Survey, laceration repairs account for 4.2 million patient visits to urgent care clinics annually (Murphy & Williams, 2010). There are various practitioners, including physicians, nurse practitioners and physician assistants, with different background, training and skills in providing laceration repair employed at urgent care facilities. This bring variations in practice on how they manage lacerations, especially as there is no specific evidence-
based guideline in place for laceration management in UCs (Hollander et al., 2001; Kuwabara, Imanaka, & Ishizaki, 2004; Wassem et al., 2012; Zehtabchi et al., 2011).

Healthcare providers such as physicians, nurse practitioners, and physician assistants spend a substantial portion of their time doing laceration repairs both in EDs and UCs. The absence of evidence-based (EB) guidelines in laceration management creates significant variation in clinical practice, and this variation in practice may contribute to complications such as dehiscence, infection, and surgical scars (Hollander et al., 2001). Consistency in wound cleaning technique, wound closure time, and consistent decisions on use of antibiotic therapy may lead to better patient outcomes (Kuwabara, Imanaka, & Ishizaki, 2004; Wassem et al., 2012; Zehtabchi et al., 2011). Thus, evidence-based laceration repair guidelines for UC providers may allow standardization of practice among providers and improve patient outcomes.

**Significance of the Problem**

The lack of evidence based clinical practice guidelines (CPG) for laceration repair can lead to variations in clinical practice that may result in early post-wound complications such as infection, pain, swelling, bleeding, hematoma, and dehiscence (Pfenninger & Fowler, 2011). Long term or permanent complications may include hypertrophic scars, keloid formation, hyperpigmentation, hypopigmentation, nerve damage, and poor cosmetic outcomes (Pfenninger & Fowler, 2011). These complications may cause financial, psychosocial, and even legal implications for both patients and healthcare providers.
Background Summary

Every year, lacerations represent a significant number of trauma-related visits to EDs and UCs in the United States. Given the different backgrounds and skills of UC providers, a comprehensive evidence-based approach or CPG to laceration management is essential (Nicks, Ayello, Woo, Nitzki-Georgeo, & Sibbald, 2010). Consistency in wound management and the use of an antibiotic prescribing algorithm among providers can minimize short term and long term complications. Thus, EB CPG is crucial to manage laceration and improve patient outcomes.

Theoretical Framework

The theoretical framework serves the required purpose of guiding the clinical project and can provide a foundation and establish the scope of a project. The theoretical framework assists in recognizing how important concepts are related to one another (Bonnel & Smith, 2014).

In 1939, Dr. Walter A. Shewhart published and displayed the Plan, Do, and Inspection method for improvement (Best & Neuhauser, 2006). In 1950, Deming, an American statistician, modified the cycle to Plan, Do, Study, Act, and put the concept to work (Moen & Norman, 2006). In Japan, this model was called Japanese Total Quality Management (TQM) and its use contributed to the rise of Japan as a leading manufacturing nation and economic powerhouse.

The Plan Do Study Act (PDSA) Model is a model that has been used for decades as an effective tool for quality improvement in a variety of work settings. Figure 1 portrays the diagram of both a brief outline of the evolution of the scientific method and its integration into improvement science with the Deming wheel and the PDSA cycle.
evolving in the last 100 years (Moen & Norman, 2006). It is a model for testing ideas for quality improvement effectively and efficiently. Use of PDSA encourages monitoring the effect of changes over time using simple measures. This method recommends improving minor changes initially, followed by successive quick cycles of monitored changes. Thus, a change can lead to major improvement. The method is well established and validated for use in small, dynamic organizations (National Academy for State Health Policy [NASHP], 2013).

![Figure 1. The evolution of scientific method and its integration of improvement science (Moen & Norman, 2006).](image)

The PDMA is comprised of four major steps. In the first step a plan is developed to identify the problem, the project objectives, and processes necessary to introduce the change with an expected output or goals (National Health Services Improving Quality [NHS IQ], 2013). In this step, participants in change also create aim statement(s), recognize the stakeholders, assemble the team, examine current approaches, and may
complete a review of literature of evidence-based solutions (Minnesota Department of Health, 2013).

The second step is the Do phase to create and test the evidence-based practice guideline, such as completing a small scale pilot study that involves a small group in a limited time period and geographical area (Institute for Healthcare Improvement [IHI], 2014). During implementation, collection of data starts and participants track key metrics along with problems and unexpected observations. Pilot study data analysis then occurs (IHI, 2014).

The third step is the Study in which results from the new-implemented pilot project are evaluated to see whether it has resulted in the expected performance improvement (IHI, 2014). Participants summarize what was learned during the pilot study, areas found that should involve further improvements, and the scope of the whole initiative (IHI, 2014). In this step, the Do and Study phases may be repeated with a revised process, incorporating additional improvements if the time and costs allow.

The final step of PDSA is the Act. This is the full-scale implementation of the evidence-based guideline. In this step, participants continue to examine and re-examine the process using the PDSA cycle, by systematizing the improvement for a new evidence-based practice guideline and future plans (IHI, 2014). Figure 2 depicts the outline of the PDSA process.
**Goal and Objective**

The goal of this project is to promote optimal healing in non-complicated laceration repairs through the use of evidence-based (EB) clinical practice guidelines (CPG) by UC providers. The primary objective of this project is to develop an evidence-based clinical practice guideline for non-complicated laceration repair that can direct laceration repair practices of healthcare providers in the UC setting. The anticipated outcome of this project will be the use of the EB CPG for non-complicated laceration repair by providers with a subsequent reduction in wound infection rates, unnecessary antibiotic therapy, healthcare costs, and increase patient health outcomes.
Effect of the Project

Once the EB CPG has been implemented and incorporated into care by providers, the project may affect patients with non-complicated laceration repair as well as involved UC practitioners, such as physicians, nurse practitioners, and physician assistants using the new protocol. Patients will be affected because they will experience standardized and more consistent care for their laceration treatment. If adoption of this CPG is sufficient, the project will change the current UC practice from individualized provider preference in non-complicated laceration repair to a consistent practice that adheres to a standardized protocol for non-complicated laceration repair.

Statement of Purpose

The purpose of this quality improvement (QI) project is to develop an evidence-based clinical practice guideline (CPG) for laceration repair to use in the UC setting. Implementation of this EB CPG should reduce risks of infection and unnecessary antibiotic therapy through improved consistency in laceration management among UC providers. In addition, it should also decrease costs of healthcare and increase patient health outcomes.
LITERATURE REVIEW

This chapter discusses the literature pertaining to acute wound management, focusing on non-complicated laceration repair. Outcomes of interest are reduced infection and preventing unnecessary use of antibiotic therapy. Although there were numerous studies on laceration repair in emergency room and family practice journals, there were few studies describing the use of evidence-based clinical practice guideline for non-complicated laceration repair in the UC.

Research publications were found from searches of CINAHL Plus, PubMed, Cochrane Library, Wiley Science, Science Direct, and Google Scholar electronic databases. Key search terms included *lacerations* or *wound repair, treatment, management, irrigation, closure, and/or infection*. Other key search terms included *clinical practice guidelines, costs, patient satisfaction and patient outcomes*. The majority of academic and scholarly journals included were from emergency, family or pediatric medicine specialty practice-focused publications. The publication period of included articles was from 1995 to 2015. The inclusion criteria were both male and female adults and children seen in emergency departments and in urgent care and outpatient centers. Studies were excluded if they related to complicated lacerations repair, surgical repair in an operating room, and wound repair with secondary intention.

**Research and Non-research Evidence Appraisal Tools**

There are many critical appraisal tools that can be utilized for the development of a clinical practice guideline, including instruments from Appraisal of Guidelines for Research and Evaluation (AGREE), Association of perioperative Registered Nurses (AORN), and Johns Hopkins Nursing Evidence-based Practice (JHNEBP). The
permission to use the JHNEBP research and non-research evidence appraisal instruments was obtained (see appendix F). The JHNEBP tools were used in this project to appraise evidence from scholarly articles or studies. The JHNEBP was selected because it was built from an evidence based nursing model. The appraisal tools were adapted from the JHNEBP model that were highlighted in the *Journal of Nursing Administration* and the *Advisory Board Practice Exemplar* series. Moreover, Sigma Theta Tau International (STTI) granted a Research Utilization Award to research conducted using the JHNEBP model in 2005 (Brooks-Staud, 2005). The JHNEBP model and guidelines book is listed in the bestsellers category located in American Association of Critical Care Nurses (AACN) website (AACN, n.d.) and in STTI published references as a research resource textbook (STTI, n.d.). The JHNEBP research appraisal tools are well recognized and made available as a research toolkit on both American Nurse Association (ANA) website (ANA, n.d.) and the Institute for Johns Hopkins Nursing website (The Institute for Johns Hopkins Nursing, n.d.). Furthermore, the Association of perioperative Registered Nurses (AORN) research evidence appraisal tool was also adapted from the JHNEBP model and guidelines to assist perioperative nurses to evaluate research and quality of evidence (Chiang, Herwaldt, Blevins, Cho, and Schweizer, 2014).

The JHNEBP model and tools are widely utilized both in national and international arenas. A study by Schaffer, Sandau, and Diedrick (2012) on the evaluation of key features and practical applications of six frequently discussed evidence-based practice models, including the Academic Center for Evidence-Based Practice (ACE) Star model, the Advancing Research and Clinical Practice through Close Collaboration (ARCC) model, the Iowa model, JHNEBP model, the Promoting Action on Research
Implementation in Health Services Framework (PARIHS), and the Stetler model showed that the JHNEBP model and ACE Star model were more likely to be utilized in nursing education for their emphasis on the process of finding and evaluating evidence. In a systematic study by Sanluang, Aungsuroch, Chaiyawat, and Avant (2014), the JHNEBP model was utilized in critical synthesis of literature review to evaluate how internal organizational factors influence nurses’ research utilization in improving nursing practice outcomes. The JHNEBP model provided good comprehension and demonstrated low to moderate strength on the impact of the relationship between internal organization factors and nurses’ research utilization.

In JHNEBP research and non-research evidence tools, there are five levels indicating degrees of evidence hierarchy. The highest level of evidence support, Level I, includes evidence obtained from meta-analysis of randomized controlled trials (RCT) or just a RCT. The second level, Level II, includes evidence acquired from quasi-experimental study. Level III relates to evidence obtained from non-experimental study, qualitative study, or meta-synthesis. Level IV is non-research evidence appraisal obtained from systematic review and CPGs. Level V is non research evidence obtained from expert opinion, case studies and literature review. In addition, the quality ratings of scientific evidence, summative review, and expert opinion are categorized into A: high quality, B: good quality and C: low quality or significant flaws. Pertinent evidence ascertained from the studies reviewed for this project is documented in a table of evidence (Appendix A).
The literature review is presented in several major subject areas, including laceration closure time, antibiotic use in simple laceration, cleansing techniques, location and wound characteristics, healthcare costs, and patient outcomes.

**Evidence-Based Clinical Practice Guidelines**

Clinical practice guidelines are “statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options” (IOM, 2011). It is important these guidelines are evidence-based and have been developed using a transparent and unbiased process of systematic reviewing and appraising relevant literature, and using best clinical research evidence or findings (IOM, 2011). Properly established guidelines can be utilized to improve consistency in clinical practice, reduce healthcare costs, and optimize high quality patient care, when based on systematic review of current evidence and recommendations for clinical practice (Shekelle, 2015).

**The Use of CPG on Healthcare Costs**

The United States has the highest healthcare costs among other nations, accounting for over 16% of its gross domestic products, and growing healthcare expenditures totaling $2.2 trillion in 2007 (National Center for Health Statistics, 2009). The accelerating health care costs and desire to achieve best patient outcomes further highlight the importance of establishing guidelines based on efficient use of resources and best practice considerations. However, clinical decisions are often influenced by individual motives of stakeholders involved instead of following evidence based practice guidelines (Anderson et al., 2014). This situation is made worse with lack of evidence based CPGs and/or strong scientific evidence to support recommendations for best
practice. For example, healthcare providers may use prophylaxis antibiotic for clean non-complicated lacerations out of pressure and fear of legal retribution from the patient. The use of prophylaxis antibiotic for non-complicated lacerations that have been properly cleaned and approximated will increase healthcare expenditure and risk of adverse antibiotic reactions with no significant change in patient outcomes. Moreover, the effort to always use normal saline or other antiseptic cleaning solutions instead of potable tap water to irrigate a non-contaminated wound may increase costs without a best informed decision that tap water provides adequate cleansing.

A systematic review was conducted by Gutierrez, Zurakowski, Chen, and Mooney (2013) to determine the financial implication of managing splenic injuries, with and without using clinical practice guidelines. The study utilized the Pediatric Health Information System database to identify children with splenic injury from 44 children’s hospitals who were hospitalized between June 2005 and June 2010. The results showed the median costs of CPG centers were lower versus non-CPG centers for imaging ($163 versus $641, \( P < .001 \)), laboratory ($629 versus $1,044, \( P < .001 \)), and hospital stay ($9,868 versus $10,830, \( P < .001 \)). The authors run multiple linear regression that indicated utilization of a CPG (\( P=.007 \)) is a significant independent predictor of total cost, regardless of patient age, gender and length of stay in the hospital. The study concluded the utilization of CPG in managing children with isolated splenic injuries significantly reduce treatment costs by limiting imaging and laboratories studies without affecting patient outcomes (Gutierrez et al., 2013).

Another systematic review was conducted by Zaroma-Flores, Busen, Smout, and Velasquez (2015) to determine the effective use of clinical practice guidelines in reducing
costs, unnecessary diagnostic tests, and medications for treatment of bronchiolitis in a high-risk Hispanic pediatric population. The authors performed a retrospective chart review of 322 pediatric hospitalizations, comparing before (169) and after (153) CPG implementation for bronchiolitis. The results showed the use of CPG significantly lower adjusted charges per day (mean $2,253.80 versus $2,612.30, P = .024). The study concluded the use of CPG for bronchiolitis significantly decreases health care cost and resource utilization, including use of antibiotics, steroids, bronchodilators and chest radiographs, without affecting patient outcomes, length of stay and readmission rate (Zaroma-Flores et al., 2015).

In 2011, a clinical practice guideline was published by the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) recommending against use of perioperative antibiotic for pediatric tonsillectomy (Milder et al., 2015). A large quasi-experimental study was performed that included 9265 children who had routine tonsillectomy from January 2009 through August 2012 to determine the effect of the AAO-HNS guideline on patient outcomes after tonsillectomy without the use of an antibiotic. The findings from this study that involved 5359 participants who received treatment using the new CPG from the AAO-HNS showed perioperative antibiotic use decreased by 86.5% (P<.001). The study demonstrated the use of AAO-HNS clinical practice guideline decreased perioperative antibiotic use for children undergoing tonsillectomy without changes in follow up visits, ED visits or re-admissions (Milder et al., 2015).

In summary, the utilization of clinical practice guidelines in various healthcare settings and conditions have shown to significantly reduce healthcare costs in many
ways, including, diagnostic imaging, laboratories, unnecessary medications. These cost reductions did not affect patient health outcomes, length of stay, and readmission rate (Gutierrez et al., 2013; Milder et al., 2015; Zaroma-Flores et al., 2015).

The Use of CPG on Patient Outcomes

Clinical practice guidelines have been utilized for many decades for various reasons in order to support the clinical decision making processes, to promote efficient use of resources, to reduce inappropriate variation in practice, and to reduce healthcare cost. However, the use of clinical practice guidelines can also be utilized to improve patient outcomes. A study was performed by the American College of Cardiology and the American Health Association to determine the health outcomes and cost-effectiveness of implementation of the 2014 hypertension guidelines of the Eight Joint National Committee (Moran et al., 2015). The study utilized the Cardiovascular Disease Policy Model to simulate medication treatment, monitor costs, and quality adjusted life years (QALYs). The researchers then evaluated health outcomes and cost-effectiveness based on age, hypertension level, and the presence of chronic illnesses. The results showed the implementation of new 2014 hypertension guidelines would reduce approximately 56,000 cardiovascular events and reduce 13,000 cardiovascular related deaths annually. The authors concluded the implementation of 2014 CPG for hypertension resulted in improved patient health outcomes and cost savings (Moran et al., 2015).

In a study by Hines et al. (2015), the authors evaluated the predictors of non-adherence to National Comprehensive Cancer Network (NCCN) practice guidelines and the effect of non-adherence on patient prognosis related to overall survival of patients with colorectal cancer (CRC). The sample included patients with CRC who were treated
at Memorial University Medical Center from 2003 to 2010. The study revealed the risks associated with non-adherence to treatment guidelines were moderate/severe comorbidity, uninsured, old age, and late stage tumor. The results showed non-adherence to NCCN treatment guideline resulted in 3.6 times the risk of death (Hazard Ratio, 3.55; 95% CI, 2.16-5.85) in the year 1, and an 80% increased risk of death (Hazard Ratio, 1.8; 95% CI 1.14-2.83) in years 2 to 5. The authors concluded patients who received non-adherent treatment according to NCCN guideline had a poor prognosis and a much higher risk of death in the first year of being diagnosed with CRC (Hines et al., 2015).

Clinical practice guidelines have been used by many disciplines to address various agendas, including quality improvement, patient outcomes, reduce costs, resource utilization, and practice variation. The results and conclusions from studies on utilization of clinical practice guidelines across different topics have consistently showed improved patient outcomes or better prognosis as well as reduce healthcare costs (Gutierrez et al., 2013; Hines et al., 2015; Milder et al., 2015; Moran et al., 2015; Zaro-Flores et al., 2015).

**Laceration Closure Time**

The effect of wound closure time on infection rate has been controversial for decades. Historically, the concept of “golden period” for wound closure dates back to 1898 when Professor Paul Leopold Friedrich evaluated the replication of bacteria using guinea pigs (Crowley, Kanakaris, & Giannoudis, 2007). He concluded that 6 hours was the critical limit where in immense growth of bacteria was detected (Crowley, Kanakaris, & Giannoudis, 2007). There is also a standard for practice guideline by the British Orthopedic Association (BOA) and British Association of Plastic, Reconstructive and
Aesthetic Surgeons (BAPRAS) that recommend the maximum delay for performing surgery involving vascular impairment should be no longer than 6 hours maximum (BOA/BAPRAS, 2009). These guidelines are based on the assumption that the longer a wound repair is delayed after the laceration has occurred, the higher the risk of infection. If closure has been delayed for longer than 12 hours, the rates of infections are considered especially problematic (Zehtabchi et al., 2012). However, the existing literatures and evidence have not been consistent to support this recommendation (Hollander et al., 2001; Quinn et al., 2014; Zehtabchi et al., 2012).

In a systematic review of literature, Zehtabchi et al. (2012) compared the effect of wound closure times on the rate of infection. Wounds with a delayed repair (>12 hours) had infection rates from 1.4% to 32% (Zehtabchi et al., 2012). One of the four studies included (with only 18 patients in the delayed wound group) showed rates of infection almost five times more in wounds with wait times longer than 12 hours, RR 4.8, 95% CI, 1.9 – 12.0. Zehtabchi et al. (2012) concluded that the existing evidence does not reinforce the element of laceration closure time on the rate of infection in non-complicated laceration. However, the evidence of the four trials was low in quality based on the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) criteria, because of a high risk of bias (Zehtabchi et al., 2012).

In a subsequent prospective observational study, Waseem et al. (2012) evaluated the effect of laceration closure time on wound infection rate. In 297 ambulatory care patients treated and followed up for wound care, 3.4% or 10 patients developed wound infections. The group with infections had their wounds repaired with a median time of 876 minutes as compared to 330 minutes in non-infection group ($p = .03$). Waseem et al.
(2012) concluded that while progression of wound infection post wound closure was infrequent, longer wound closure time appeared to contribute to infection rates.

In a large cross-sectional study, Hollander, Singer, Valentine, and Shofer (2001) evaluated predictors of wound infection in 5521 patients and found that wound closure time was significantly related to higher wound infection rates. However, wound closure times in the study were low, mostly less than 6 hours with a median time of closure of 2.1 hours. Patient’s age, presence of foreign body, laceration width and history of diabetes mellitus were associated with greater risk of infection (Hollander et al., 2001).

In a recent multicenter prospective cohort study, Quinn, Polevol, and Kohn (2014) conducted a prospective cohort study to determine risk factors of wound infection in laceration repair and the relationship between time to wound closure and infection rate. Quinn et al. found that of 3957 patients with lacerations who participated, 2663 patients completed an outcome assessment and 69 patients developed wound infection (2.6%, 95% CI 2.0-3.3%) (2014). Wound age closure time was not significantly associated with infection, and the authors posit this was possibly due to proper wound irrigation and decontamination. The authors determined the crucial elements for wound infection were wound contamination, location on the lower extremity, length greater than 5 cm, and comorbid diabetes (Quinn et al., 2014).

While Waseem et al. (2012) reported an association between wound infection and wound closure time, Zehtabchi et al. (2012), Hollander et al. (2001), and Quinn et al. (2014) concluded that wound age was not a sole or significant indicator of infection risk in simple laceration repair. While there is possibility that longer lacerations closure time could cause higher infection rates, there is no strong evidence or RCTs study to support
this claim yet. It should be noted that none of these studies included lacerations older than 24 hours.

**Antibiotic Use in Simple Laceration Repair**

The use of antibiotic prophylaxis for simple lacerations with recent available antibiotics has not been well studied. In preparation for such an assessment, Zehtabchi et al. (2012) assessed the need and practicability of carrying out a randomized clinical trial (RCT) to assess the function of antibiotic therapy in simple hand lacerations. The project consisted of three phases: the effect of antibiotics prophylaxis in non-complicated hand lacerations; the evaluation of indications for prophylactic antibiotic therapy; and the study of patient readiness to participate in a RCT for non-complicated hand lacerations (Zehtabchi et al., 2012). In first phase study, data were obtained from a survey conducted by National Hospital Ambulatory Medical Care (NHAM) in 2007. The second phase was conducted with emergency physicians in three east coast academic hospitals. The third phase was done with patients cared for at the emergency department of the same three hospitals. The results follow:

- **Phase 1**: simple hand lacerations represent 1.8 million (1.6%) ED visits in 2007. Of these, 71% lacerations were repaired, and 27% were put on antibiotics prophylaxis, predominately cephalexin (73%).
- **Phase 2**: 16% of clinicians report prescribing prophylactic antibiotics, predominately cephalexin (84%); the most important factor in the providers’ decision to put patients on antibiotics was degree of wound contamination.
- **Phase 3**: 64% of 490 patients surveyed stated interest in taking part in a research study to assess the practice of antibiotics prophylaxis in laceration
repair; the patients’ primary concern was the need to decrease wound infection.

The authors concluded that the lack of clinical practice guidelines in laceration management, inconsistency in provider practices, and patient concerns about wound infection warrant a strong RCT to study the use of antibiotic therapy in non-complicated lacerations (Zehtabchi et al., 2012).

Zehtabchi (2007) reviewed RCTs to determine whether the use of antibiotic prophylaxis affected infection rates in non-complicated hand lacerations (with appropriate wound cleaning and closure in less than 12 hours post injury). In the three RCTs included for analysis, the post prophylactic antibiotic therapy showed relative risks (RR) of infections of 1.05 (95% CI, 0.09 to 11.38), 0.73 (95% CI 0.37 to 1.46), and 1.07 (95% CI 0.07 to 16.80) (Zehtabchi, 2007). Thus, there were no statistically significant differences in the rate of wound infections for the control or antibiotic groups. The author concluded there was no difference in clinical outcome whether antibiotics were used as part of the treatment plan for non-complicated wound in hand injuries. The author also suggested clinicians exercise their clinical judgments based on individual cases.

Whittaker, Nancarrow, and Sterne (2005) conducted a prospective, randomized, double-blind, controlled trial to determine the role of prophylactic antibiotic in non-contaminated hand wounds or lacerations. One hundred and seventy patients who met inclusion criteria were enrolled and assigned to one of three groups. Group A was given intravenous (IV) flucloxacillin 1 gram on initial visit followed by 5 days of oral placebo, 1 tablet by mouth daily. Group B received flucloxacillin 1 gram IV on initial visit
followed by oral flucloxacillin 500 mg once daily for 5 days. Group C received 1 tablet of placebo by mouth daily for 5 days without antibiotics. The study results showed that infection rates in Group A were 13%, Group B were 4%, and Group C were 15%. However, there was no statistical difference in infection rates between the three groups. The authors concluded that there was no difference in the rate of wound infections in non-contaminated incised hand injuries between the three regimens (Whittaker et al., 2005).

Berwald, Khan, and Zehtabchi (2014) performed a randomized, double-blind, placebo-controlled trial to determine the feasibility of the role of prophylactic antibiotic treatment for ED patients with non-complicated hand lacerations. One hundred and twenty three patients who met inclusion criteria were approached, and seventy eight enrolled. Patients were randomized into three groups: a placebo (control) group, a second group who received cephalexin 500 mg, and the third group treated with clindamycin 300 mg every 6 hours for 7 days. Over the 5-month study period, 78 participants were enrolled with a consent rate of 63% (95% CI, 55%-71%), 6% lost to follow up (95%, CI 2%-14%), and 1% infection rate (95%, CI 0.01%-8%). The author concluded that this pilot study supported the feasibility of using a RTC, double-blind, controlled trial to investigate the role of prophylactic antibiotics in preventing infection for patient with simple hand lacerations. Having a placebo control in the type of study needed to determine effectiveness of or need for prophylactic antibiotics is critical. Furthermore, patients may not agree to participate in a placebo study. The results of the Berwald, Khan, and Zehtabchi study demonstrated that sufficient numbers of patients did agree to participate so that findings would be meaningful. Thus, the author recommended
a large sample RTC investigation to improve reliability of findings needed in determining whether prophylactic antibiotics are necessary in non-complicated hand wounds (Berwald et al., 2014).

Zehtabchi et al. (2012) reported the absence of clear guidelines and inconsistency in clinical practice related to prophylactic antibiotics therapy use for simple lacerations. He called for a RCTs to establish standards for the proper use of antibiotic therapy. Whittaker, Nancarrow, and Sterne (2005), Zehtabchi (2007), and Berwald et al. (2014) suggest that the evidence from their studies and review of randomized controlled trials do not support utilization of antibiotic prophylaxis following non-complicated laceration repair.

**Cleansing Techniques**

Wound cleansing of traumatic injuries is commonly performed in order to minimize the risk of wound infection and to accomplish the best cosmetic outcomes. However, there is great variability in cleansing techniques and solutions used among institutions and healthcare providers (Dulecki & Pieper, 2005). Dulecki and Pieper (2005) reviewed published studies employing irrigation solutions, irrigation pressure, and irrigation versus no irrigation.

**Irrigation Solutions.**

In a systematic review of literature, Dulecki and Piper (2005) determined that the infection rates were not significantly affected by the types of irrigation solutions (1% povidone iodine, pluronic F-68, normal saline) used to irrigate laceration wounds. Furthermore, three studies included in the review found there was no significant
difference in infection rate and post-irrigation bacterial counts on wounds irrigated with normal saline (NS) versus those irrigated with tap water (Dulecki & Pieper, 2005).

In a more recent systematic review of literature, Nicks, Ayello, Woo, George, and Sibbald (2010) also found the infection rates were not significantly affected by the use of normal saline, tap water, and the antiseptic irrigation solutions such as, povidone iodine, chlorhexidine, and hydrogen peroxide. However, they noted that these antiseptic solutions with bactericidal and detergent properties may be harmful to healthy tissue and delay wound healing (Nicks et al., 2010). This finding is supported by previous research (Main, 2008; Watret & Armitage, 2002).

**Irrigation Pressure**

Wound irrigation effectiveness to remove bacteria, debris, and dead tissue from the wound is affected by the adequacy of mechanical force from irrigation solutions. Dulecki and Pieper (2005) concluded that approximately five to eight per square inch (psi) of continuous pressure of irrigation solutions is effective and results in less damage to tissue than greater irrigation pressures. Following their systematic review, Nicks et al. (2010) determined the following:

- Successful irrigation was obtained with 50 to 100 milliliter (ml) per centimeter (cm) of wound length, and that optimal volume of irrigation depends on the degree of wound contamination as well as environmental exposures.
- Constant flow of solution with pressures of 8 to 12 psi across the wound surface was effective to reduce inflammation and infection.
• Extremely high pressure wound irrigation may cause more tissue damage and increased wound infection rates.

This last finding is supported by Hollander et al. (2001).

**Debridement**

Debridement is the process of removing dead tissue using a surgical scalpel or scissors to facilitate wound closure. Ischemic or gangrenous wounds can be excised and approximated immediately if there is no intrinsic, extrinsic, or mechanical damage that requires surgical intervention or healing by secondary intention (Lee & Hansen, 2007 as cited in Nicks et al., 2010). However, to date the effect of debridement on simple lacerations in relation to infection rates has not been documented.

**Irrigation versus No Irrigation**

Wound cleaning with irrigation has been a standard of practice for many decades. Based on the evidence reviewed by Dulecky and Piper (2005), the authors found that proper wound cleaning prior to closure of clean non-contaminated highly vascular areas, such as face and scalp, are less likely to develop infection. However, the literature showed that too much pressure in wound irrigation on the scalp and face may increase the infection rates due to further tissue damage (Nicks et al., 2010). In a systematic review of literature conducted by Dulecki and Pieper, the authors concluded children had the same, if not better outcomes, post laceration repair even if their laceration were not cleaned prior to approximation (Hollander, Singer, & Valentine, 1998 as cited in Dulecki & Piper, 2005). Other researchers also report non-contaminated wound repair without irrigation was a fast, inexpensive, and effective alternative considering its infection rate
compared to other wound care practices (Maharaj et al., 2002 as cited in Dulecki & Peiper, 2005).

**Wound Characteristics and Locations**

The characteristics and locations of wounds play an important role in infection rates. Quinn, Polevoi, and Kohn (2014), in a study of 3957 patients, reported that 13 out of 195 patients with open wounds over 5 centimeters had wound infections with relative risks of 2.9 with a 95% confidence interval 1.6 to 5.2 as compared to wounds less than 5 centimeters. Hollander et al. (2001) reported that out of 5,521 patients with lacerations, 194 (3.5%) patients had wound infection. Wounds in the infection group were longer, deeper, wider, jagged and/or have noticeable debris than non-infected wounds (Hollander et al., 2001).

According to Quinn et al. (2014), wound infection was less likely for lacerations that were located on the head or neck with a 1.9% infection rate compared with wounds on the trunk or lower extremity with a 7.6% infection rate. In the study of 1,142 lacerations, Lammers, Hudson, and Seaman, 2003 as cited in Nicks et al. (2010), found a total infection rate of 7.2%, and rates vary based on location of the wound. In this study infection rates on the scalp were 1.7%, and lacerations on the leg and/or thigh were 23%. The wound infection rates on the ear or nose were 3.6%, on the face were 3.9%, on the arm or forearm 15.3%, on the hand or finger 5.7%, on the chest or abdomen 11.8%, on the back were 8.3%, and infection rates on the foot or toe were 12.5% (Nicks et al., 2010). Waseem et al. (2012) evaluated 352 patients with lacerations and reported infection rates based on laceration locations: scalp 0%, face 10%, trunk 0%, extremity 40%, hand 50%. Thus, Quinn et al. (2014), Hollander et al. (2001), Nicks et al. (2010),
and Waseem et al. (2012) all support that higher rates of wound infection are more likely to occur on extremities, especially lower extremities as compared to wound location on neck, face and scalp.

**Summary**

This literature review included systematic review of quantitative studies, randomized control trials and large observational studies. Some research studies looked at wound closure time and use of prophylactic antibiotic in relation to infection rates. Other studies focused on wound location, characteristics, and cleansing techniques. Although some of the findings are controversial, such as the conclusions that there were no significant differences in infection rate for wound outcomes for children without wound irrigation and for treating clean-appearing wound without irrigation, these practices may provide efficient and effective alternatives to other wound care practices prior to repair. The majority of the findings are consistent with each other in terms of laceration closure time (less than 12 hours), no use of antibiotic prophylactic for simple laceration, cleansing techniques, and the effect of wound location and characteristics on management practices. The evidence on utilization of EB CPG showed guidelines have the potential to decrease cost of care and improve patient outcomes.
METHODS

The literature review focused on identifying the effectiveness of different modalities and their efficacy in non-complicated laceration management in relation to wound infection and antibiotic use. This section describes how the materials and evidence were collected to develop a clinical practice guideline for non-complicated laceration repair. The use of PDSA methodology provided the foundation in all phases of the project, and careful attention was paid to details. The strength of evidence and quality ratings for evidence appraisal were discussed. In addition, the maintenance of ethical standards through Institutional Review Board and UC facility were addressed.

Project Design Framed in PDSA Model

This section describes the steps taken to create EB CPG framed in the PDSA model. The steps in PDSA model are categorized in two main timeframes, in-program and post-program. In-program means the steps are to be done while the Doctor of Nursing Practice (DNP) student is still in the DNP program. Post-program means the finished DNP project is to be tested, refined, and implemented at a licensed UC setting after the student graduates from the DNP program.

Plan (In-Program)

Step 1. Determine the topic of EB CPG.

Step 2. Request faculty members to be the chair and committee member.

Step 3. Form an expert panel.

Step 4. Perform searches on electronic database for scholarly and research articles related to laceration or wound repair.
Step 5. Perform systematic review of literature (3 months) and utilize table of evidence (1 month) for coordination and synthesis of evidence.

Step 6. Utilize John Hopkins Nursing Evidence-Based Practice (JHNEBP) evidence appraisal to assign the levels and quality ratings of evidence (2 weeks).

Step 7. Create prototype of EB CPG (1 month).

Step 8. Seek ongoing individual consultation (one to two times a month) with an expert panel consisting of a family practice physician and two ED physicians.

Step 9. Modify EB CPG prototype as soon as possible (less than 1 week) and send out to expert panel for review.

Step 10. Gather agreement through emails, phone calls and/or face to face meetings from the expert panel to finalize changes to EB CPG.

Step 11. Immediately finalize EB CPG.

**Do (Post-Program)**

Step 1. Obtain permission from a designated UC to perform test of change by utilizing EB CPG.

Step 2. Design a test of change to be implemented at a single UC setting (pre-post intervention chart review: three months prior and three months after education and in-service for providers on EB CPG is completed).

Step 3. Consult with statistician on design of data collection form and data analysis.
Step 4. Develop data collection (pre and post) and outcomes measure tools (2 weeks).

Step 5. Provide in-service/education to UC providers at designated UC setting through organizational meeting and online EB CPG lecture presentation (1 month).

Step 6. Retrospective chart reviews, three months pre and post EB CPG implementation. Review charts on demographics, comorbidities, wound characteristics, infection rate, wound outcome, and antibiotic use (2 weeks).

Step 7. Document clinical issues and unexpected observations.

Step 8. Data collection and analysis using SPSS and/or Excel.

**Study (Post-Program)**

Step 1. Complete the data analysis using SPSS and/or Excel.

Step 2. Measure, evaluate and compare result of data analysis to predicted outcomes (2 weeks).

Step 3. Summarize what was learned and revise EB CPG to address clinical issues or outcomes. Incorporate additional improvements as appropriate (2 weeks).

**Act (Post-Program)**

Step 1. Full implementation of revised EB CPG in the UC.

Step 2. Continue to examine and monitor infection rates and antibiotic use with laceration repair.
Step 3. Changes or improvements to be made will be incorporated into the future guideline.

Step 4. Begin to plan for the next cycle.

**Evidence-Based Clinical Practice Guideline Development**

The guidelines for treatment of non-complicated laceration were developed based on research findings obtained through a review of literature, other practice guidelines, and experts’ recommendations. Literature searches were conducted in CINAHL Plus, PubMed, Cochrane Library, Wiley Science, Science Direct, and Google Scholar electronic databases. Key search terms consisted *lacerations* or *wound repair, treatment, management, irrigation, closure, and/or infection*. Other keywords included *clinical practice guidelines, costs, and patient outcomes*. The majority of academic and scholarly journals included were from emergency, family or pediatric medicine. The publication period of included articles was from 1995 to 2015 or from the past 20 years. A table of evidence (TOE) was utilized in the development of the CPG and focused on analyzing findings from randomized control trials (RCT).

Various evidence-based clinical practice guidelines were reviewed and critically appraised from emergency medicine, family practice, military, hospitals and private institutions. In emergency medicine, there were two parts guidelines on wound care and laceration repair for nurse practitioners in emergency care published in 2010 and 2011 (Flarity & Hoyt, 2010; Hoyt, Flarity, & Shea, 2011). The guidelines have comprehensive content but lack of specific details on levels and quality rating of the evidence. In family practice, there was a guidelines on essentials of skin laceration repair published in journal of American Family Physician in 2008 but it needed an update or revision (Forsch, 2008).
There were updated guidelines (2014) for lacerations repair from The Royal Children’s Hospital, Melbourne and Mount Sinai Hospital, New York but they lack of assigned levels and quality of their recommendations (Chwistek, 2014; The Royal Children’s Hospital, n.d). There were two CPGs from United States Army Institute of Surgical Research (USAISR) on initial management of war wounds and guidelines to prevent infection in combat related injuries. Both guidelines from USAISR were outdated (last reviewed 2012) because it required to be reviewed annually (USAISR, 2012a; USAISR, 2012b). Other CPGs from health clinics and private institutions were either outdated or lack of assigned levels and quality rating of evidence. According to Johns Hopkins Nursing evidence-based practice, the hierarchies of evidence using CPGs is level IV. Since some of the recommendations in this project are based on level IA evidence, these outdated CPGs will not be utilized. Nonetheless, these guidelines were critically evaluated and considered as a valuable resources to avoid pitfalls in developing evidence-based CPGs in this project.

**Clinical Practice Guidelines Development**

The EB CPG for non-complicated laceration repair was developed by the project investigator (PI) and was reviewed by a panel of three experts. The PI is a doctoral student at the Southern California State University (CSU) DNP Consortium. He graduated with a Masters in Nursing as Family Nurse Practitioner and is board certified since 2012. He currently works as a NP in multiple emergency departments and urgent care centers located in Los Angeles and Orange County and serves as a preceptor for NP students receiving clinical training in urgent care medicine.
The EB CPG was reviewed by a panel of three experts with over 10 years’ experience in family, urgent care and emergency medicine. The first expert is an emergency physician with over 10 years’ experience as an attending physician in an emergency room at a trauma center. He is a graduate from the Northwestern University Feinberg School of Medicine. He was an Assistant Professor at Yale University in New Haven prior becoming the medical director in 2003 at Garfield Medical Center’s Emergency Department in Monterey Park. Currently, he works as the Medical Director in the Emergency Department at Palmdale Regional Medical Center in Palmdale, California. He also practices at Providence Holy Cross Medical Center and Northridge Hospital Medical Center as an emergency physician. Additionally, he owns a number of urgent care centers that treat minor illnesses and work injuries.

The second expert is an emergency physician with over 10 years’ experience as an attending physician in several EDs in Southern California. He is a graduate from Northwestern University Feinberg School of Medicine. He has been an emergency physician at Methodist Hospital in Arcadia since 2005 and is also on staff at San Gabriel Valley Medical Center and Kaiser Permanente at Los Angeles. He teaches residents and NP students during their practicum in emergency room and urgent care centers and also owns a number of urgent care centers that treat minor illnesses and workman compensation injuries.

The third expert is a physician with over 35 years of experience in practicing medicine. He completed his medical training and residencies in Iran, Germany, and the United States. His experience includes working as a reconstructive micro-vascular hand surgeon in occupational trauma and war injuries in Iran. He also completed clinical
fellowships in Esthetic Surgery in Düsseldorf, Germany. Moreover, he completed his Fellowship in Children and Adult Burn and reconstructive surgery at University of Texas Medical Branch and Shriners Burn Hospital for Children in Galveston, Texas. He is also Board Certified in Urgent Care medicine and owns a family and urgent care center in Corona, California.

The purpose and development criteria for the creation of EB CPG were discussed with the panel members. The hierarchies of evidence leveling and quality ratings that the panel members were to be applied to articles used in this project are those assigned following John Hopkins Nursing Evidence-Based Practice (JHNEBP) evidence appraisal (Newhouse et al., 2007). The criteria were reviewed with the panel members who were then given relevant articles that the project director accepted based upon his search criteria and literature review. The expert panel then reviewed and evaluated articles as to the level of evidence and quality of the studies. The final EB CPG was made when a consensus was reached by the expert panel after multiple attempts.

**Evaluation**

The expert panel performed a thorough review on the literature, reliability and feasibility of the CPG. The literature discussed wound closure time, locations, characteristics, cleansing, and use of antibiotic prophylactic. Moreover, the effect of using CPG on health care costs and patients’ satisfaction were reviewed. Their suggestions for improvements were incorporated into the CPG until the final EB CPG was agreed upon by the panel members. The evaluation was done primarily using an evaluation tool (see Appendix B) completed by the expert panel, who discussed the
scores given to the articles through phone conversations, in a face to face meeting and/or via emails.

**Evidence-Based Clinical Practice Guideline**

In the past, a clinical practice guideline was defined in various ways by a variety of disciplines. In health care, the CPG are viewed as a set of systematically developed recommendations to assist clinicians in making practice decisions in specific clinical encounters for both patients and practitioners (Lim et al., 2008). These recommendations are created based on findings from systematic reviews of the literature and critical appraisals to determine the level of quality based upon the research studies reviewed. CPGs have been shown to improve the quality of patient care and reduce healthcare costs (Lim et al., 2008).

The result of this DNP project is the development of a CPG with EB recommendations for a non-complication laceration repair conducted in an urgent care setting (see Appendix C). The standards of care are based on a systematic review of related literatures, clinical practice guidelines, and expert consultation.

**Operational Definitions**

*Evidence Based Clinical Practice Guideline.* The EB CPG for laceration repair based on systemic review of literature and validated by an expert panel. Laceration repair guidelines are recommendations for best practices within a discipline for healthcare providers to use when repairing skin lacerations (Barclay, 2008).

*Healthcare Providers.* Healthcare providers are physicians or emergency practitioners, internists, nurse practitioners (NP), and physician assistants (PA) who see patients who have medical problems commonly seen in UC settings (Vorvick, 2009).
Infection Rate. Infection rate (IR) is defined as relative risk in a group of patients with infected lacerations compared to non-infected lacerations.

Non-complicated Lacerations. Non-complicated lacerations include wounds that are not caused by an animal or human bite, do not involve a fractured bone, and are not associated with severing of the nerves or blood vessels (Zehtabchi, 2007). Non-complicated wounds exclude wounds with evidence of foreign body or visible debris, devitalized wounds edges, and/or severe soft tissue damage.

Prophylactic Antibiotics. Antibiotic prophylaxis or treatment is the use of any antibiotic ordered at initial and/or follow-up visit to a UC a related laceration visit.

Wound Infection. Wound is diagnosed as infected when a wound drains purulent or yellow discharge or presents with redness, warmth, swelling, or increased tenderness (Medicinenet, 2014). The healthcare providers will document these findings in electronic health record as part of the standard physical examination on day 2 for wound check and day 7-10 during suture removal. The assumption will be made that providers have basic knowledge in wound evaluation and can accurately evaluate the characteristics of wound discharge, erythema, edema, and/or tenderness.

Assumptions

There are several assumptions that were made by virtue of completion of this project. First, the quality improvement project changes the practices within the standard of care to best practices based on an advanced medical science and experience. Second, the QI project meets ethical requirements for the protection of human participants, thus IRB approval is not necessary in development stage of the project. Third, the measurement tools used for chart review as well as the EB CPG are assumed to be
reliable and valid indicators of the constructs studied. Fourth, the data from the chart review are assumed to be accurately recorded and analyzed for this study. Fifth, it is assumed the healthcare providers follow the EB CPG to the best of their ability in laceration treatment for their patient. Sixth, it is assumed that the sample of charts reviews represents typical patients with non-complicated lacerations in urban practice settings, and that the result of the test of change, therefore, has a reasonable degree of generalizability to a similar population. Seventh, it is assumed that the data on patient’s age, preexisting health conditions and wound characteristics are accurately recorded.

**Description of Setting**

The proposed setting of the planned quality improvement project when implemented is a for-profit UC clinic that offers non-emergent services to all ages of patients and provides service related worker’s compensation evaluations in Southern California. The pre and post chart review will take place in the nurse practitioner’s office, by accessing patients’ information from their electronic health record. The in-service for healthcare providers will take place in the conference room and the EB CPG will be emailed to all providers.

**Audits**

Baseline data will be obtained from electronic health records with a maximum number of 70 patients who meet the inclusion criteria in the past three months. The data collection process will begin one month post EB CPG in-service to healthcare providers and continue for the following three month period of time or until 70 subjects are secured. The first 70 patients seen in the UC with minor lacerations will be selected using the electronic health records. A convenience sample will be used to obtain the sample.
priori power analysis will be conducted to estimate sufficient sample sizes to achieve adequate power during study design. A power analysis program will be utilized to determine power given the values of $\alpha$, sample size and effect size. Consultation with an independent statistician on design of data collection and analysis will be fully utilized at this phase. The patient charts that are included are selected consecutively (backwards for baseline data or the pre-intervention group of 70 and prospectively for post-CPG data) from patients who visit the UC for laceration treatment and meet the inclusion criteria.

To maintain confidentiality, identification factors, such as name, social security and birth date will not be recorded. No patient contact will be made. The healthcare providers who are involved are from the designated UC.

Patients must meet the criteria of being between 18-65 years of age and have a non-complicated laceration. Patient of either sex (men and women) are eligible. Patients who are immunocompromised or presented with existing health conditions that will increase the risk of wound infection will be excluded, such as diabetes, cancer, and human immunodeficiency virus. Patients who are unable to return for wound re-evaluation and suture removal will be excluded from retrospective charts review of pre and post test of change.

**Measures of Outcomes**

The followings are the tools to assess the impact of EB CPG in terms of quality improvement for laceration repair. These instruments are utilized to gather data from electronic chart reviews. The first instrument is used to collect demographic information (see Appendix D) to obtain the following key data from electronic chart review: age, gender, and ethnicity. The second instrument involves a tool about wound characteristics
that are documented by providers (see Appendix E): wound size, depth, edge, color, and exudate. It will also include degree of edema and tenderness. In addition, wound infection (yes or no) is defined based upon provider assessment on initial wound check on day 2 and suture removal between day 7 and 10. Moreover, antibiotic use post-laceration repair will be documented (yes or no), including most commonly use types of antibiotics, such as cephalexin 500 mg (Keflex), trimethoprim/sulfamethoxazole 800 mg (Bactrim DS), and clindamycin 300 mg (Cleocin). This tool provides a quick and accurate checklist to describe symptoms and collect information about the diagnosis, treatments ordered, and follow up visits.

**Data Collection Process**

Permission to conduct the quality improvement project will be obtained from the designated UC facility when the project is initiated. The process of collecting data from electronic charts will be done in the nurse practitioner’s office using the demographic and wound lacerations questionnaires. A retrospective chart review will be conducted to collect data on patients seen for non-complicated laceration repair in the three months prior to the required in-service education given to introduce EB CPG to healthcare providers. Chart review of patients seen for laceration repair in the next three months will then be performed to obtain relevant demographic and wound laceration information. The system support of designated electronic health record will assist to filter and identify potential patients using the international classification of disease (ICD) code between 872.00 and 893.2 for initial lacerations, and between V58.3 and V58.32 for follow up and sutures removal.
**Protection of Human Subjects**

According to Hastings Center Special Report, the IRB review is not necessary for a non-research QI project that meets ethical requirements to protect human participants in QI activities, considering scientific value and validity, fair subject selection, favorable benefit/risk ratio, informed consent, respect for participants, and independent review (Baily, Bottrell, Lyn, & Jennings, 2006). The project Chair and committee members reviewed the project proposal to safeguard the protection of participant rights and to ensure that the QI project was to be conducted in an ethical manner. Permission will be obtained from designated UC to utilize their facility to conduct the quality improvement project. Subsequently, permission to conduct the project will be obtained from the IRB at CSULB by seeking approval as an exempt study.

**Data Analysis**

All data will be analyzed using the Statistical Package for Social Sciences (SPSS™) Version 20.0 for Windows or Excel. The analysis will be based on a consultation with an academic statistician. Descriptive statistics will be utilized to report demographic data, such as age, gender, and ethnicity of the patients. The level of significance will be reported for all analyses. Because this is a quality improvement project without an intention to make inferences, the data will be analyzed using the following statistics:

- Relative risk (baseline vs. post-CG) with 95% confidence intervals for wound follow infection rates (at 7-10 day post wound assessment);
- Chi-square test for proportions of patients with specific wound characteristics (e.g., age, gender, ethnicity) and those receiving post-wound antibiotics (yes/no).
Limitations

The project will utilize convenience data by selecting the first 70 charts that meet inclusion criteria, pre and post EB CPG implementation. Healthcare providers may not always follow the EB CPG contributing to variations in outcomes. Furthermore, patients may not return for wound check and/or suture removal which will contribute to attrition. A high attrition rate may limit generalizability of the findings to those who adhere to instructions about the requirement of a follow up assessment.

Summary

This chapter outlines the methodology of a quality improvement (QI) project for EB CPG for laceration repair. In brief, literature review, expert panel, and JHNEBP evidence appraisal tool will be utilized in this QI project to create an EB CPG for laceration repair. The EB CPG development process outlined in a PDSA model and timeframes (in-program and post-program) are discussed in detail. The operational definitions and assumptions are identified. The setting in which the test of change will be conducted and the chart audit procedure and plan for analysis are described. Data collection tools will provide a quick and accurate method to retrieve information related to descriptive conditions, diagnosis, treatments and wound repair outcomes on the initial and follow up visits. Information on protection of human subject is discussed. Full IRB review is not required considering the nature of non-research QI project that meets ethical requirement for the protection of human participant.
DISCUSSION

The goal of this DNP project is to create evidence based clinical practice guidelines (EB CPG) for non-complicated laceration repair in an urgent care setting. This quality improvement project utilized the PDSA model to plan, create, monitor and improve successive change cycles of EB CPG. The use of this framework can lead to a major improvement overtime in the approach to treating non-complicated laceration repairs at UC centers.

In healthcare, evidence based clinical practice guideline includes recommendations based on best evidences from unbiased systematic review and appraisal of literature envisioned to improve patient outcomes (IOM, 2011). Many studies supported the use of EB CPG in treating patients’ health conditions and found that the use of CPG resulted in optimal health outcomes and significant decrease in healthcare expenditures (Gutierrez et al., 2013; Hines et al., 2015; Milder et al., 2015; Moran et al., 2015; Zaroma-Flores et al., 2015).

Laceration Closure Time

Clinicians are encouraged to approximate lacerations that occur within the first 12 hours of injury, and the evidence revealed that wound closure time less than 6 hours significantly lowers infection rate. However, wound closure time is not a single significant factor of wound infection risk in a simple laceration repair, although there were no studies on wound that were repaired after 24 hours.

Experts recommend facial wound closure even after 24 hours of injury given careful considerations, such as scar formation and infection risk. Although there is the possibility that longer lacerations closure time could cause higher infection rates, there is
no strong evidence or RCTs study to support this claim. Moreover, these studies did not include lacerations older than 24 hours. None of the studies has involved a prospective RCT looking specifically at 6 hours and 12 hours or more delay in wound repair as the factor related to wound infection rate. It was noted that the reason for not exploring longer closure times was the ethical concern related to delaying a patient’s treatment for the purpose of a study. The experts recommended closure of a wound as soon as possible, ideally within the first 12 hours. However, under certain circumstances, such as facial wound with no signs or symptoms of infection, the recommendation is to close the wound even after 24 hours post injury given proper wound preparation, cosmetic consideration, and risk of open wound infection.

**Role of Prophylactic Antibiotic Therapy**

There was no evidence that antibiotic prophylaxis provides any benefit or lower infection rate in non-complicated lacerations that are repaired less than 12 hours after injury with appropriate wound cleaning and closure. The clinical judgment of using antibiotic prophylaxis in laceration repairs should be based on individual cases and given careful consideration based on wound location, characteristics and degree of contamination.

Both literature and the experts acknowledged the increasing and alarming rate of antibiotic resistant infections, because of inappropriate prescribing and over utilization and non-adherence to antimicrobial therapy. According to national summary data from CDC, at least 2 million people acquired serious infections every year from one or more antibiotic resistant bacteria that resulted in more than 23,000 deaths (CDC, 2013). Moreover, the total economic cost of antibiotic resistance as part of U.S. health care costs
was estimated as high as $20 billion; lost productivity to society was found to be as high as $35 billion a year in 2008 (CDC, 2013). The RCTs evidence in the literature reviewed consistently supported the avoidance of unnecessary antibiotic therapy for non-complicated laceration repairs. The literature and the experts also encourage antimicrobial stewardship by improving antibiotic prescribing and stopping inappropriate use of antibiotics.

**Wound Locations**

Wound location plays an important role in wound infection rates. Lacerations on highly vascular areas, such as face, neck and scalp, are less likely to be infected. In addition, wound infection are more likely to occur on extremities especially lower extremities, such as thigh, lower leg, foot and toes.

The literature showed notable consistent findings of the effect of injury location on wound infection rates. Wound infections were more likely to occur in lacerations that were located on the lower extremity than on the head or neck (Quinn et al., 2014). In one study, the infection rates for a wound on a leg and/or thigh were 23%, significantly higher than infection rates for scalp wounds at 1.7% (Nicks et al., 2010). Moreover, Wassem et al., (2012) reported wound infection rates on scalp at 0% and for the face at 10% as compared to extremity rates of 40% and hand rates of 50%.

Experts argued that wound locations on less vascular areas have a higher infection risk because of a lack of nutrition and perfusion from blood circulation that is critical for healing process. Highly vascular areas contain platelets that help with clotting factor during initial injury. These areas have an abundance of neutrophils and macrophages to assist in cleansing bacteria from the wound and lysing devitalized tissue. Vascular areas
promote healthy granulation due to an adequate supply of nutrients and oxygen carried by the blood vessels.

Experts mentioned that wound locations on extremities in areas that are highly exposed to contaminants in daily activities may present with higher risk of infection. This situation does not immediately warrant antibiotic prophylaxis, but proper wound care instruction and close follow up should be given.

**Wound Characteristics**

The evidence in the literature showed that wounds with noticeable contaminants, longer than 5cm, deeper, wider and jagged posed higher risks of developing wound infection. In a study by Hollander et al. (2001), 194 out of 5,521 patients with lacerations had wound infection (3.5%) that were associated with lacerations that were longer, deeper, wider, jagged, and/or had obvious contaminants compared to the lack of these findings in the 5,327 patients who had non-infected wounds. In addition, Quinn, Polevoi & Kohn (2014) reported in their study of 3957 patients, 13 out of 195 patients with open wound over 5 centimeter had wound infections with relative risks of 2.9 with a 95% confidence interval 1.6 to 5.2.

Experts indicated wound characteristics greatly affect wound infection rate but they do not change the standard of practice, such as proper wound cleaning and debridement. However, wound characteristics greatly affect clinicians’ decision to prescribe prophylactic antibiotic. Clinicians were advised to consider proper wound preparation, debridement, and close follow up in 48 to 72 hours after laceration repair without antibiotic prophylaxis in this clinical situation. Experts stated the main reason
was during the first 48 to 72 hours in the inflammatory phase, neutrophils, macrophages, and lymphocytes were the leading factors in bactericidal and cell immunity process.

**Irrigation Solutions**

The wound infection rates is not affected by types of irrigation solutions, such as normal saline, tap water, and antiseptic solutions, such as providone iodine, chlorhexidine, and hydrogen peroxide. Nonetheless, antiseptic solutions for wound irrigation can be harmful to healthy tissue and delay wound healing.

The literature review demonstrated the infection rates were not significantly affected by types of irrigation solutions, such as normal saline, potable tap water, and antiseptic solutions (Dulecki & Piper, 2005; Fernandez, Griffiths, & Ussia, 2006; Nicks et al., 2010). Moreover, in a Cochrane review of RCTs (2013), the evidence demonstrated no significant difference in wound infection rate and post-irrigation bacterial counts on wounds irrigated with normal saline versus those irrigated with tap water. The literature noted that antiseptic solutions with bactericidal properties can be harmful to healthy tissue and delay wound healing due to cytotoxic effects, therefore proper dilution and use on only non-exposed tissue are recommended (Dulecki & Piper, 2005; Main, 2008; Watret & Armitage, 2002).

Experts acknowledge antiseptic solutions should be used with caution considering the benefits outweigh risks of possible allergic reaction and toxicity harm to exposed wound bed. Experts also noted the tap water as a practical, efficient, and affordable irrigation solution if used with caution as to the quality and source of water.
Irrigation Pressure

Wound irrigation is an effective method to remove microorganisms and debris using mechanical force from irrigation solutions. The clinician should apply a constant flow of irrigation solution with a pressure of 8 to 12 per square inch (psi) on the wound surface; this has been demonstrated to be effective in reducing infection and inflammation. The optimal volume is between 50 milliliter and 100 milliliter per centimeter of wound length considering degree of contamination and level of environmental exposures. The clinician should be aware that extremely high pressure wound irrigation can cause tissue damage and increase risk of infection.

Experts concur with the evidence that appropriate volume and irrigation pressure decrease infection rates due to mechanical displacement of debris or bacteria that are not visible to unassisted vision. In the medical field, a bulb syringe is widely used to irrigate traumatic wounds. However, it delivers low pressure and is ineffective in decreasing bacteria load on wound bed. Literature has shown that irrigation pressure from 5 to 8 psi can be achieved using a 19-gauge angiocatheter with a 35 to 60 milliliter syringe (Dulecki & Pieper, 2005). Nicks et al. (2010) reported irrigation pressures ranging from 11 to 31 psi can be obtained utilizing 19 gauge needles. The study recommends pressure of 8 to 12 psi as most effective to irrigate the wound bed. The literature noted that high pressure may push bacteria into deeper compartment and cause more trauma that results in increased wound infection rates (Hollander et al., 2001; Nicks et al., 2010).

Debridement

Debridement is the act of removing dead tissue with a surgical scalpel or scissor to facilitate wound closure and reduce infection rates. Devitalized tissues can be
removed, and the wound can be closed immediately if there is no further damage that requires surgical intervention from vascular or plastic surgeons (Nicks et al., 2010).

Experts recommend epidermal debridement as appropriate and caution clinicians to carefully weigh the benefits and risks in performing deep tissue debridement using a surgical blade as it can easily cause more harm to deep tissue or vascular structure. Moreover, debridement is not often performed on non-complicated recent traumatic lacerations.

**Irrigation versus No Irrigation**

There is no difference in post laceration repair outcomes with or without irrigation on non-contaminated highly vascular areas, such as neck, face, and scalp. Lacerations or wounds on children are less likely to be cleaned prior to closure; however, this will have the same if not better outcomes (Hollander, Singer, & Valentine, 1998, as cited in Dulecki & Piper, 2005). The literature noted that clean-appearing lacerations can be repaired without irrigation. The laceration repair strategy was demonstrated to be a quick, economical and effective alternative compared to infection rates noted with other wound care practices (Maharaj et al., 2002, as cited in Dulecki & Peiper, 2005). However, the research was weak due to absence of a control group.

Experts acknowledged that wound preparation such as irrigation and cleaning has been the standard of practice and recommended in all clinical setting, even when visible contaminants are not present. Experts recommend irrigating all wounds regardless of age (including children) and location of the wound.
Clinical Implications

Financial Implication

Clinical practice guidelines have a multitude of financial benefits in clinic practice. Clinicians who make clinical decision and practice by considering evidence and practice guidelines have a tremendous effect in reducing healthcare costs. Potential cost savings come from unnecessary medications (antibiotics), lower wound infection rates, less follow up visits, and reductions in the utilization of laboratories and imaging studies. Research (Gutierrez et al., 2013; Milder et al., 2015; Zaroma-Flores et al., 2015) demonstrates the use of CPG helps reduce the expenses for patients and health insurance in purchasing antibiotic prophylaxis, frequent follow up visits, and complications requiring referral to specialists, such as infectious disease, plastic and/or orthopedics.

Patient Health Outcomes

Clinical practice guidelines have been developed and utilized for many various reasons, including the need to support clinical decision making, to promote efficient use of resources, to reduce inappropriate practice variation, and reduce healthcare expenditures. The overarching goal of implementation of CPGs is to improve prognosis and patient health outcomes (Moran et al., 2015). In the clinical setting, the use of EB CPG for non-complicated lacerations improves healing process, better cosmetic outcomes, and lower risk of wound infections. Moreover, patients who experienced better health outcomes will be more satisfied as well.

Legal Implication

The legal implication of EB CPG in clinical practice can be viewed from several perspectives. Based on literature, the objectives and intended use of CPG need to be
clearly stated in the introduction. This includes the intended user, because it will affect
the subsequent standing of a CPG in the legal arena. In addition, outdated CPGs do not
reflect current best practices and can become legal grounds for litigation when they are
utilized if review procedures and validity are not specified. Moreover, the CPG should
incorporate recommendations that allow reasonable deviations without depriving the
guidelines from initiatives for further improvement (Tingle, 2002).

Evidence-based clinical practice guidelines aim to recapitulate and assimilate best
evidence from the literature into recommendations and practice guidelines. This benefits
stakeholders such as patients and clinicians in lowering risks of liability and improving
patient safety. On the other hand, attorneys often use national guidelines in negligence
lawsuits arguing that clinicians who did not follow practice guidelines are considered
medically negligent (Fletcher, 2008).

**Conclusion**

Simple traumatic lacerations represent a significant number of visits to urgent
care centers each year. The lack of evidence-based clinical practice guidelines for non-
complicated laceration repair has resulted in various clinical approaches with suboptimal
patient outcomes. This quality improvement project has gone through extensive review
of literature, guidelines, and consultation of experts to develop evidence-based clinical
practice guidelines. The levels of evidence and quality ratings in review of literature
were assigned according to the John Hopkins Nursing Evidence-Based Practice evidence
appraisal criteria. Based on expert opinion and an extensive review of the literature,
recommendations that focus on decreasing wound infection rates and unnecessary use of
antibiotic prophylaxis have now been identified.
The recommendations focus on use of antibiotic prophylaxis, wound closure time, wound locations, and wound characteristics. Furthermore, evidence on wound preparation such as irritation solutions, irrigation pressure, and debridement were found to have significant effects on infection rates post laceration repair. The literature and experts do not recommend use of antibiotic prophylaxis in simple lacerations. Wound closure time is recommended within the first 12 hours. Locations of the wound on highly vascular areas such as scalp, neck and face are less likely to get infected. Moreover, wounds on upper extremities have lower infection rates compared to wounds on lower extremities. Lacerations of more than 5 centimeters or longer, deeper, wider, jagged edge and/or have noticeable debris have a higher risk to develop infection. The recommended irrigation solutions are normal saline or potable tap water with irrigation volume between 50 and 100 milliliter per centimeter of wound length and constant pressure flow of 8 to 12 psi. Debridement of ischemic or gangrenous tissue is recommended to facilitate laceration repair and healing process. The literature mentioned no difference in outcomes whether with or without wound irrigation on non-contaminated lacerations in children, but experts recommend irrigating all wound regardless of age and location of the wound as this has been the standard of practice in wound care.

Evidence-based clinical practice guidelines are very powerful educational tools for clinicians in guiding their clinical practice. The results include improved quality of care and reduced health care expenditures. The literature and experts in guidelines recommend clinicians utilize the EB CPG as a guide for care in their clinical practice. However, EB CPG should never replace clinical judgment considering differences in physical, psychosocial, and comorbidities of every individual patient. Nonetheless, the
majority of patients seen for non-complicated laceration repairs in a UC are suitable and can be treated following this EB CPG. Thus its use will improve consistency of clinical practice and health outcomes.
REFERENCES


Tingle, J. (2002). Do guidelines have legal implications? *Archives of Disease in Childhood, 86*(6), 387–388. http://doi.org/10.1136/adc.86.6.387


## APPENDIX A

### TABLES OF EVIDENCE

#### Systematic Review, Non-experimental Observational Studies and RCTs

<table>
<thead>
<tr>
<th>Purpose, (Author(s), year)</th>
<th>Design and Key Variables</th>
<th>Sample and Setting</th>
<th>Measures, Operational Definitions of Variables</th>
<th>Results or Findings</th>
<th>Authors’ Conclusion; Study Limitations &amp; Notes</th>
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<tbody>
<tr>
<td>Determine if prophylactic abx lowered IR of simple hand lacerations (Zehtabchi, 2007)</td>
<td>Systematic review of RCTs.</td>
<td>4 randomized trials met inclusion criteria, 3 RCTs met acceptable marginal standard of quality.</td>
<td>3 trials utilized wound infection to measure the outcome at suture removal and 5, 7, or 10 days post-injury. 1 trial evaluated restorative process of the wound. All trials did not report cosmetic outcomes.</td>
<td>RR of infection after abx use 1.05 (95% CI 0.09 to 11.38), 0.73 (95% CI 0.37 to 1.46), 1.07 (95% CI 0.07 to 16.8). IR in control group vs abx group failed to reach statistical significant.</td>
<td>No evidence on the harm or benefit practice of abx prophylaxis for simple hand lacerations. Utilization of clinical decision making/judgment must be made on individual basis. Limitations: vulnerable randomization techniques, lack of concealments, &amp; potential lack of blinding.</td>
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<tr>
<td>Determine impact of wound age on IR on simple laceration</td>
<td>Systematic review of prospective observational studies &amp; prospective study</td>
<td>IR was the measure of primary outcome &amp; cosmetic result was secondary outcome.</td>
<td>IR was the measure of primary outcome &amp; cosmetic result was secondary outcome.</td>
<td>RR of infection when lac repaired &gt; 12 hour was 4.8 (95% CI 1.9 to 12.0). In three other original subgroups &lt;4 hour was 5.7% (95% CI 2.8 to 11.3), 4-12 hour.</td>
<td>Neither supports the claim of “golden period” or the role of wound closure time in simple lacer. Need for RTC study. Note: all pts received prophylactic abx (randomized</td>
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<td>Purpose, (Author(s), year)</td>
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<td>(Zehtabchi, Tan, Yadav, Badawy, &amp; Lucchesi, 2012)</td>
<td>DV: Wound IR</td>
<td>#1 7/2005-3/2007 425 pts ≥ 18 years old w/ traumatic lac, exclude pts on abx  #2 1/1987-12/1987 2812 pts ≤ 18 years old w/ simple lac, exclude human/animal bites.  #3 6/1986-9/1986 372 pts mean age 24.4 ± 11 w/ simple lac, exclude bites, tendon, bone, major vessels.  #4 age &amp; study period not reported. Pts w/ hand &amp; forearm lac.</td>
<td>Wound infection defined in study#1 redness &amp; pus, study#2 frank pus, lymphangitis, cellulitis, increasing tenderness or erythema &gt;2mm, study#3 incomplete healing as dehiscence or evidence of infection, study#4 discharge pus or inflammation requiring abx.</td>
<td>was 15.4% (95% CI 4.3 to 42.2), &gt; 12 hour was 31.6% (95% CI 15.4 to 54.0).</td>
<td>to IM PCN INJ w/ or w/o 5 day oral clindamycin.</td>
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<td>Determine the optimum time for lac repair. (Waseem et al., 2012)</td>
<td>Prospective observational study.</td>
<td>Convenience sample. Initially 352 pts approached, 297 met inclusion criteria &amp; followed. Age 18 or above, M = 224 (75.4%), F = 73 (24.6%).</td>
<td>Infection referred as evidence of purulent drainage, abscess, or cellulitis &gt; 1 cm outside wound border needing abx rx</td>
<td>10 pts (3.4%) developed wound infection: 5 on hands, 4 on limbs excluded hand, 1 on face. 1 AA, 7 Hispanic, 2 Caucasian (p = 0.0005).</td>
<td>Progression of infection post lac approximation was unlikely even w/o controlling various CV.  The infection group had much longer wound age (median time) prior to closure compared to non-infection group.  Limitations: No control over practice variations among ED physicians despite written protocol for lac mgt.</td>
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<td>Purpose, Design and Key Variables</td>
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<td>Identify risk factors related w/ infection &amp; lacerations, &amp; see if a relationship exists between wound age &amp; IR. (Quinn et al., 2014)</td>
<td>Prospective observational cohort study.</td>
<td>3957, enrolled 110 pts/mth at trauma center, 57 pts/mth at community hospital, 58 pts/mth at urban teaching hospital. 2663 completed f/u.</td>
<td>Structured data form designed &amp; reviewed w/ treating physicians. Hospital (2) data form was exported from the EMR &amp; another hospital (1) transcribed the form manually from paper record. 30 days post tx, pts followed by phone &amp; structured interview. Wound infection: defined as pts treated w/ oral/intraVen abx. Use of 100-point scale for scar evaluation.</td>
<td>2663 pts completed outcome assessment, 69 had wound infection (2.6%, 95% CI 2.0% to 3.3%). Wounds that infected tend to get a poor cosmetic outcome &amp; tend to need scar repair (RR 2.6, 95% CI 1.7 to 3.9). Diabetes pts (RR 2.70, 95% CI 1.1 to 6.5), wounds on lower extremity (RR 4.1, 95% CI 2.5 to 6.8), soiled wounds (RR 2.0, 95% CI 1.2 to 3.4) &amp; wounds &gt; 5 cm tend to develop an infection (RR 2.9, 95% CI 1.6 to 5.2). The IR for wound repaired within 12 hours post injury 3%. Limited transferability due to small sample size in term of sex, mechanism of injury, wound location, type of anesth &amp; sutures. +result between wound closure time &amp; infection rate. +Utilize the flowchart (procedure &amp; enrollment) &amp; table (pt characteristics). Diabetes, contaminated wound, size over &gt; 5 cm &amp; lac site are imp elements to predict infection in lac repair. Wound closure time was not important factors for wound infection but proper irrigation &amp; cleansing may have influence the outcome. Limitations: Study didn’t mention any limitations.</td>
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<td>Determine need &amp; feasibility to perform RCT on role of abx therapy in non-complicated hand lac. (Zehtabchi et al., 2012)</td>
<td>Descriptive analysis secondary data &amp; survey study design. (1) projection on burden of emergency department, nationally d/t non-complicated hand lac &amp; use of abx prophylaxis (2) abx prophylaxis indication (3) pt willingness in RCT &amp; preferred outcome.</td>
<td>Phase 1: secondary data analysis 2007 NHAMC survey</td>
<td>Phase 1: LACREP survey to identify pts w/ lac repair &amp; NHAMCS Classification to identify prescribed non-topical anti-infectives.</td>
<td>(95% CI 2.3% to 3.8%) has no difference compared to wound repaired after 12 hours of initial lac 1.2% (95% CI 0.03% to 6.4%).</td>
<td>Substantial number of non-complicated hand lac in ED. Absence clear guidelines, practice disparity &amp; pt concern in prevention of wound infection warrant the prospective RCT on use of abx prophylaxis in simple hand lac. Limitations: Potential bias &amp; problems w/ results based on aggregated measures. Low internal validity can be triggered from using closed ended questions in the survey with consideration to other affective variables. Better indicator for need of RCT on abx prophylactic in simple hand lac better justify w/ high IR. Large study with multiple variables, including various confounding variables.</td>
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<td>Phase 2: survey study on ED physicians mentioned in setting below.</td>
<td>Phase 2: Standardized survey instrument to identify common practices in ED lac repair relative to abx prophylactic.</td>
<td>Phase 2: 16% regularly given abx therapy (95% CI, 9%-27%), cephalaxin 84% (95% CI, 67%-93%) &amp; clindamycin 13% (95% CI, 5%-29%).</td>
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<td>Phase 3: survey study on ED pts. Age ≥ 18 years old in setting below.</td>
<td>Phase 3: Standardized survey instrument to identify outcome priority &amp; willingness to enroll in RCT on abx prophylactic in simple hand lac.</td>
<td>Phase 3: 64% (95%, CI 59%-68%) interested in RCT on hand lac repair &amp; abx prophylactic efficacy. Primary concern infection prevention 77% (95% CI, 73%-81%).</td>
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<td>Setting ED of Kings County Hospital Center &amp; Downstate Medical Centre at Brooklyn, NY, and George Washington University Medical Centre, Washington, DC, between July 1 &amp; August 31, 2010.</td>
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<td>Phase 1: in 2007, 1.86 mil (1.6%) included non-complicated hand lac &amp; 1.32 mil (71%) had lac repair. Over 355,000 27% (95% CI, 19%-35%) given abx prophylactic.</td>
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<td>Study the outcome of abx prophylaxis on the IR in non-contaminated hand lacerations. (Whittaker, Nancarrow, &amp; Sterne, 2005)</td>
<td>Prospective, randomized-double blind, placebo-controlled trial. IV: Group A – IntraVen flucloxacillin &amp; oral placebo. Group B – IntraVen flucloxacillin &amp; oral flucloxacillin. Group A – oral placebo.</td>
<td>170, withdrawn 13 Group A n = 56 Group B n = 46 Group C n = 55</td>
<td>Assuming IR of 5% w/o abx &amp; 3% w/ abx, each group contain 50 pts for sufficient power to prove statistical significance. Pre-operative microbiology swab for bacteriological analysis. <strong>Wound infections</strong>: noticeably purulence, increase erythema or edema, or dehiscence, or a pathologic microbial development on wound culture. <strong>Wound problems</strong>: minor erythema or serous drainage w/o pathologic microbial development on wound culture. <strong>Healthy wounds</strong>: no definition given.</td>
<td>The overall IR for all three groups was 10% The IR group A was 13%, group B was 4%, group C was 15%</td>
<td>No statistical significant difference in IR among groups A, B, and C. Authors suggest more study using the same wound definition w/ greater pt numbers to define whether a true significant difference exists.</td>
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<td>Assess feasibility of a RCT to determine role of abx</td>
<td>RCT, double blind, placebo controlled pilot</td>
<td>Convenience sample of 123 approached, 78 enrolled adult ≥ 18 years old w/ simple hand lac, excluding</td>
<td>Wound infection determined by 2 ED physician and use of abx. 123 pts approached, 78 consented 63% (95% CI, 55%-71%). 5 lost to f/u 6% (95% CI, 2%-14%). 1 pt had infection</td>
<td>The feasibility of RCT, double-blind, controlled trial could reveal the role of prophylactic abx in preventing wound</td>
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<td>Prophylaxis for pts w/ simple lac at ED. (Berwald, Khan, &amp; Zehtabchi, 2014)</td>
<td>IV: cephalexin 500mg, clindamycin 300mg, placebo. DV: wound IR</td>
<td>Immunocompromised, recent 2 weeks use of abx, bites, crushed, &gt; 12 hours, pregnant/breastfeeding Setting: 2 urban academic emergency departments for 5 months.</td>
<td>Patient satisfaction measured by appearance of wound at 30 days using 1 to 10 visual scale. Feasibility determined by % of subjects agreed to enrollment &amp; completed f/u.</td>
<td>1% (95% CI, 0.01%-8%). Pts satisfaction w/ cosmetic appearance of the wound did not differ between groups.</td>
<td>Infection for pts w/ simple hand lac. Limitation: convenience sample w/ possible bias. The need for larger sample size</td>
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<td>Determine chars of traumatic lac associated w/ wound infection. (Hollander et al., 2001)</td>
<td>Cross-sectional prospective study. IV: pts &amp; wound chars. DV: wound IR.</td>
<td>Convenient sample. No randomization. 5,521 pts w/ traumatic lac. Excluded pts who initial care by surgical subspecialist. M = 69%, F = 31%. Age 0-98 years. Setting: emergency department of University Medical Center at Stony Brook, NY, between October 1992 &amp; August 1996.</td>
<td>Wound infection is presence of stitch abscess, cellulitis &gt; 1cm, or purulent drainage. Standardized (closed-question) data collection tool on first visit &amp; f/u for removal of stitches. Blinding to f/u practitioners. Data included: pts demo, wound chars, wound preparation &amp; closure technique.</td>
<td>195 pts had infection (3.5%). Risk factors: age (OR/year, 1.01; 95% CI = 1.0 – 1.02); h/o DM (OR 6.7; 95% CI = 1.7 – 26.4); fb (OR 2.6; 95% CI = 1.3 – 5.2). Location head/neck lower infection risk (OR 0.28; 95% CI = 0.18 – 0.45).</td>
<td>Increased infection risk associated w/ increasing pts age, h/o DM, irregular wound borders, noticeable contamination, deep wound &gt; subcutaneous tissue, &amp; evidence of fb. Wound lac other than on head/neck associated w/ increased risk of infection. Limitations: No standardized wound tx/method. Unreliable self-diagnosis of infection from self-report f/u through phone calls in significant minority of pts. +Standardized closed-question data collection. +EB lac repair methods needed for high risk pts.</td>
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<td>Provide overview of comprehensive evidence-based approach to acute wound management for any emergency physician or acute care practitioners. (Nicks, et al., 2010)</td>
<td>Systematic Review of literature</td>
<td>Systematic review from research studies. Authors did not specify how many or what type of study.</td>
<td>Complete pt history to determine the outcome risks for all wounds. + Tetanus, medication &amp; allergy hx.</td>
<td>A structure structured MEDLINE search was performed regarding acute wound management including established wound care guidelines. The data obtained provided the framework for evidence-based recommendations and current best practices for wound care.</td>
<td>Acute wound management varies based on the wound location and characteristics. No single approach can be applied to all wounds; however, a systematic approach to acute wound care integrated with current best practices provide the framework for exceptional wound management. Limitations: none mentioned.</td>
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</table>

AA = African American, abx = antibiotic, anesth = anesthesia, approx. = approximately, AS = absorbable sutures, chars = characteristics, CI = confidence interval, CV = confounding variables, demo = demographic, DM = diabetes mellitus, DR = dehiscence rate, DV = dependent variable, ED = Emergency Department, EI = experimental intervention, F = female, f/u = follow up, HAT = Hair Apposition Technique, h/o = history of, IC = immunocompetent, IM = intramuscular, imp = important, INJ = injection, IntraVen = intravenous, IV = independent variable, IR = infection rate, lac = laceration, LMMHC = Lincoln Medical & Mental Health Center, M = male, mil = million, mgt = management, mth = month, NAS = non-absorbable sutures, NHAMC = National Hospital Ambulatory Medical Care Survey, NY = New York, OR = odd ratio, ped = pediatric, pt = patient, pts = patients, RCT = Randomized Controlled Trial, rx = prescription, SI = standard intervention, temp = temperature, TSS = target sample size, tx = treatment, USA = United States of America, VAS = visual analog, vs = versus, WES = wound evaluation score scale, w/ = with, w/o = without.
### Observational and RCTs to be Utilized

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<tr>
<th>Purpose, (Author(s), year)</th>
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<tr>
<td>Identify the most productive efficient lac repair by investigating variations of resources used &amp; wound IR. (Kuwabara, Imanaka, &amp; Ishizaki, 2004)</td>
<td>Retrospective study.</td>
<td>Convenient sample. 479 pts w/ simple lac. M 62.7%, Age &lt; 65 &amp; &gt; 65. Inclusion criteria &amp; minimum age not specified.</td>
<td>Wound infection defined as presence of redness, pain, heat, discharge or re-opening 5-7 days post-repair.</td>
<td>Wound IR in institution A = 1.9%, B = 1.3%, C = 3.0%. ($p = .555$) median age for pt &lt; 65 y.o. significantly different between A, B, &amp; C ($p = .008$), injury sites &amp; causes ($p &lt; .001$), Treatment protocol: suture materials ($p &lt; .001$), abx, painkiller &amp; antacids use ($p = .001$).</td>
<td>Variations in level of resources use for simple lac repair among 3 institutions w/ no significant difference in wound IR. Encourage practice guidelines for simple lac repair. Limitations: No info collection on treatment variation among clinicians in same institution. No investigate long-term cosmetic problems. + practice guidelines result in quality lac repair outcomes &amp; increase productivity/efficiency.</td>
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<td>Define important elements of care &amp; excellent predictors during ped lac repair for</td>
<td>Cross-sectional observational study.</td>
<td>Convenient sample. Enrolled 952 pts w/ eligible lac, 537 pts approached, and only 408 completed surveys in this study.</td>
<td>Data supplement based on SI, self-administered survey.</td>
<td>Provider performance (OR = 11.6; 95% CI = 6.2 – 21.6) Cosmetic appearance (OR 2.7; 95% CI = 1.7 – 4.2). Anxiety &amp; pain level not specified or</td>
<td>Provider performance factors (communication, caring attitude, confidence &amp; hygiene) are the strongest predictor of excellent parent satisfaction.</td>
</tr>
</tbody>
</table>

---
<table>
<thead>
<tr>
<th>Purpose, (Author(s), year)</th>
<th>Design and Key Variables</th>
<th>Sample and Setting</th>
<th>Measures, Operational Definitions of Variables</th>
<th>Results or Findings</th>
<th>Authors’ Conclusion; Study Limitations &amp; Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>parent satisfaction. (Lowe et al., 2012)</td>
<td>anxiety &amp; pain, cosmetic appearance.</td>
<td>Age &lt; 18 years, ethnicity, &amp; edu level (limited –see note) Setting Children Hospital ED at urban tertiary care, USA, between July 2010 &amp; December 2012.</td>
<td>attitude, confidence &amp; hygiene).</td>
<td>utilized in measuring satisfaction.</td>
<td>Limitations: lack of pain scale &amp; anxiety tool for measurements, limited info on pts chars &amp; demo.</td>
</tr>
<tr>
<td>Determine IR rate after uncomplicated lac repair in IC pts using clean gloves vs sterile gloves. (Perelman et al., 2004)</td>
<td>Prospective RCT, multicentered. IV: clean gloves &amp; sterile gloves. DV: Wound IR.</td>
<td>Block randomization in blocks of 60 in both groups. Pt randomized in strata according to lac site. Approx 9,000 eligible pt, n = 1,100 approached, n = 816 included, consented &amp; randomized, n = 408 received SI &amp; n = 408 received EI. Age &gt; 1, M = 72.9%, F = 27.1%. Setting ED of 3 community hospitals in the greater Toronto, duration was not specified.</td>
<td>Wound infection defined based on assessing clinician’s impressions &amp; use of abx during post repair. Use of special randomization table in study package. Use of lac repair algorithm, initial &amp; f/u data sheet. Blinding to pts &amp; f/u physicians. f/u questionnaire assess: fever, erythema, edema, pus, clinical impressions, topical/oral abx, &amp; specialist referral.</td>
<td>IR in sterile gloves group 6.1% w/ 95% CI 3.8% to 8.4%. IR in clean gloves group 4.4% w/ 95% CI 2.4% to 6.4%. Relative risk of infection 1.37 w/ 95% CI 0.75 to 2.52 (p = .295)</td>
<td>No significant difference in wound IR on lac repaired between wearing clean gloves &amp; sterile gloves. Limitations: Partial blinding, lac repair by trainees, operator, possible contaminated open box by various staffs, Hawthorne effect on clean glove users, &amp; single f/u clinic for more standardization. +clean, non-sterile gloves can be safely used in lac repair w/ out increase IR +modest eco impact, convenient &amp; save time. +tx algorithm w/ table. +good tables (demo, wound chars, repair</td>
</tr>
<tr>
<td>Purpose, (Author(s), year)</td>
<td>Design and Key Variables</td>
<td>Sample and Setting</td>
<td>Measures, Operational Definitions of Variables</td>
<td>Results or Findings</td>
<td>Authors’ Conclusion; Study Limitations &amp; Notes</td>
</tr>
<tr>
<td>----------------------------</td>
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<tr>
<td>Compare effectiveness, complications, &amp; benefits of HAT performed by nurses vs doctors. (Ong et al., 2007)</td>
<td>Prospective RCT. IV: HAT by doctors &amp; nurses. DV: Wound infection, healing, bleeding &amp; complications.</td>
<td>Subjects randomly assigned to either doctors or nurses using sealed envelopes from table of random numbers. Randomized 164, doctors 88 w/ f/u 74; M = 49 (65.9%) F = 25 (34.1%); nurses n = 76 w/ f/u n = 60 M = 37 (61.8%) F = 23 (38.2%). Setting ED of Singapore General Hospital, Singapore, between 11/2002-02/2005.</td>
<td>Infection = presence of pus, discharge, erythema, edema, pain &amp; temp. Healing satisfactory w/ epithelial integrity &amp; no further tx required. Bleeding = persistent/recurrent bleeding after procedure w/ 5 minutes pressure. Complication = dehiscence, breakdown, rashes, angioedema or anaphylaxis. Intervention w/ minimal training 30-minutes HAT lecture &amp; demonstration to doctors &amp; nurses. Pain scale for children (no, mild, moderate, severe, unbearable). Standard wound preparation, clean, closure &amp; care instruction. Wound f/u reviewers blinded.</td>
<td>Primary outcomes wound infection, healing, complications w/ 95% CI did not cross ±5% threshold. Procedure duration doctors vs nurses: (9.0 ± 5.6 vs 12.8 ± 7.5 minutes, p = .001). Pain scores (p = .83).</td>
<td>HAT can be safely performed by trained nurses w/ equivalent outcomes as doctors. Limitations: Possible bias d/t subjective self-report procedure time. Scar formation/long term appearance can’t be assessed in 1 week review. Wound preparation not completely standardized &amp; varied between practitioners. +HAT technique step by step w/ picture. +concise article -Pain scale not well defined?</td>
</tr>
<tr>
<td>Determine use of AS vs NAS RCT.</td>
<td>Randomized into 2 groups (AS &amp; NAS).</td>
<td>Standardized data sheet &amp; care plan.</td>
<td>WES score at f/u between AS (63%) &amp;</td>
<td>Long term cosmetic outcomes in wounds</td>
<td></td>
</tr>
<tr>
<td>Purpose, (Author(s), year)</td>
<td>Design and Key Variables</td>
<td>Sample and Setting</td>
<td>Measures, Operational Definitions of Variables</td>
<td>Results or Findings</td>
<td>Authors’ Conclusion; Study Limitations &amp; Notes</td>
</tr>
<tr>
<td>---------------------------</td>
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</tr>
<tr>
<td>in ped lac affords positive long term cosmetic &amp; no increase in complications. (Karounis et al., 2004)</td>
<td>IV: AS &amp; NAS. DV: IR, DR &amp; surgical scar revision.</td>
<td>147 eligible, 95 randomized, AS 50, NAS n = 45, plastic surgeon f/u 63. Pt Age &lt; 18 years, lac &lt; 12 hours, M = 58 (61%), F = 37 (39%). Setting ED of Montreal Children’s Hospital, Canada, between January 1999 &amp; December 2001.</td>
<td>Validated WES (0-6) tool used at f/u. Validated VAS (0-100) tool used at plastic surgeon &amp; repeat WES. Infection = purulent discharge, excessive erythema, pain, fever.</td>
<td>NAS (49%) (relative risk = 0.73; 95% CI = 0.45 – 1.17. VAS score at 4 months AS = 79 (95% CI = 73 – 85) &amp; NAS = 66 (95% CI = 55 – 76). WES score at 4 months AS (36%) &amp; NAS (28%) (relative risk = 0.88; 95% CI = 0.62 – 1.26) DR AS vs NAS (2% vs 11%; p =.07). IR AS vs NAS (0 vs 2; p =.3).</td>
<td>repaired w/ AS seem to be as good as in wounds repaired w/ NAS. DR &amp; IR show no significant difference between AS &amp; NAS. Limitations: No use of standardized scale of cosmetic for comparison. Large number refusal from pts to use NAS &amp; f/u after presented w/ this study. +good use of WES &amp; VAS tools. -small SSZ f/u &amp; need cosmetic scale comparison.</td>
</tr>
</tbody>
</table>

AA = African American, abx = antibiotic, anesth = anesthesia, approx. = approximately, AS = absorbable sutures, chars = characteristics, CI = confidence interval, CV = confounding variables, demo = demographic, DM = diabetes mellitus, DR = dehiscence rate, DV = dependent variable, ED = Emergency Department, EI = experimental intervention, F = female, f/u = follow up, HAT = Hair Apposition Technique, h/o = history of, IC = immunocompetent, imp = important, IntraVen = intravenous, IV = independent variable, IR = infection rate, lac = laceration, LMMHC = Lincoln Medical & Mental Health Center, M = male, mil = million, mgt = management, mth = month, NAS = non-absorbable sutures, NHAMC = National Hospital Ambulatory Medical Care Survey, NY = New York, OR = odd ratio, ped = pediatric, pt = patient, pts = patients, RCT = Randomized Controlled Trial, rx = prescription, SI = standard intervention, temp = temperature, TSS = target sample size, tx = treatment, USA = United States of America, VAS = visual analog, vs = versus, WES = wound evaluation score scale, w/ = with, w/o = without.
Literature Review:

- Wound closure time
  Do you agree with levels and quality ratings of evidence assigned?
  Yes?  No?
  What is essential ________________________________

- Wound locations
  Do you agree with levels and quality ratings of evidence assigned?
  Yes?  No?
  What is essential ________________________________

- Wound characteristics
  Do you agree with levels and quality ratings of evidence assigned?
  Yes?  No?
  What is essential ________________________________

- Wound cleansing (solutions, pressure, debridement, no irrigation)
  Do you agree with levels and quality ratings of evidence assigned?
  Solutions.
  Yes?  No?
  What is essential ________________________________
  Pressure.
  Yes?  No?
  What is essential ________________________________
  Debridement.
  Yes?  No?
  What is essential ________________________________
  No irrigation.
  Yes?  No?
  What is essential ________________________________
• Role of antibiotic prophylaxis
  Do you agree with levels and quality ratings of evidence assigned?
  Yes?  No?
  What is essential _______________________________________________________

• CPGs effect on healthcare expenditure/costs
  Do you agree with evidence in the literature?
  Yes?  No?
  What is essential _______________________________________________________

• CPGs effect on patient health outcomes
  Do you agree with evidence in the literature?
  Yes?  No?
  What is essential _______________________________________________________

CPGs written clearly & easy to follow:
• Yes?  No?
• What area needs improvement? ___________________________________________

Feasibility:
• Yes?  No?
• What area needs improvement? ___________________________________________

Suggestions for Improvements:
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Prepared by Hengky Lim DNP, NP-C, MSN, BSN
APPENDIX C

CLINICAL PRACTICE GUIDELINES FOR LACERATION REPAIR IN URGENT CARE

These are the 2015 recommendations for the management of laceration repair in urgent care. The recommendations presented in this guideline are based on related literature reviews and expert opinions. This clinical guideline is not intended as a sole source of information or to replace clinical judgment in treating lacerations.

Laceration Closure Time
- The clinicians should approximate a laceration within the first 12 hours of injury (Level 3, Grade A).
- A laceration closure time of less than 6 hours is significantly associated with a lower infection rate (Level 3, Grade A).
- Wound age was not a significant indicator of infection risk in simple laceration repair; however, there were no studies about suture repair of lacerations older than 24 hours (Level 3, Grade A).

Wound Locations
- Wound infection is less likely to occur on the neck, face, and scalp (Level 3, Grade B).
- Wound infections are more likely to occur on extremities, especially lower extremities (thigh, lower leg, foot and toes) as compared to upper extremities (upper arm, forearm, hand and fingers) (Level 3, Grade B).

Wound Characteristics
- The clinician should consider the role of wound characteristics as a factor in infection rates. Lacerations more than 5 cm or longer that are deeper, wider, jagged and/or have noticeable debris may develop wound infection (Level 3, Grade B).

Wound Cleansing: Irrigation Solutions
- Wound infection rates are not affected by types of irrigation solutions, such as normal saline, tap water, and antiseptic solutions (povidone iodine, chlorhexidine, hydrogen peroxide) (Level 4, Grade A).
- Antiseptic solutions for wound irrigation may be harmful to healthy tissue and delay wound healing (Level 4, Grade A).

Wound Cleansing: Irrigation Pressure
- Optimal volume of irrigation fluid is between 50 and 100 mL per cm of wound length plus consideration of degree of contamination and environmental exposures (Level 4, Grade A).
- Application of a constant flow of solution with pressure of 8 to 12 psi on the wound surface is effective in reducing inflammation and infection (Level 4, Grade A).
• Extremely high pressure wound irrigation may cause tissue damage and increase infection risk (Level 3, Grade B).

Wound Cleansing: Debridement
• Ischemic or gangrenous wounds should be excised and approximated immediately if there is no intrinsic, extrinsic, or mechanical damage requiring surgical intervention or healing by secondary intention (Level 4, Grade B).

Wound Cleansing: Irrigation versus No Irrigation
• The clinician should properly clean the wound prior to closure to prevent wound infection (Level 4, Grade B).
• There is no difference in post laceration repair outcomes with or without irrigation on non-contaminated highly vascular area, such as neck, face and/or scalp (Level 4, Grade A).
• Children will have the same, if not better, outcomes post laceration repair even if their lacerations are less likely to be cleaned prior to closure (Level 4, Grade A).

Role of Antibacterial Prophylaxis
• Current evidence does not support the use of antibiotic prophylaxis in simple laceration repair of wounds less than 12 hours old with appropriate wound cleaning and closure (Level 1, Grade A).
• Clinical judgment in prescribing antibiotics prophylaxis should be based on a case by case basis considering individual circumstances. Wound characteristics, location and degree of contamination are important factors to consider when making a decision to put a patient on antibiotic prophylaxis (Level 3, Grade B).

Adapted from Johns Hopkins Nursing on evidence-based practice (JHNEBP) model and guidelines (2014), the levels of hierarchies of evidence varied into 5 levels.

- Level I is evidence obtained from randomized controlled trial (RCT) or meta-analysis of RCTs.
- Level II is evidence obtained from quasi-experimental study.
- Level III is evidence obtain from non-experimental study, qualitative study, or meta-synthesis.
- Level IV is non-research evidence appraisal obtain from systematic review and CPGs.
- Level V is non research evidence obtained from expert opinion, case studies and literature review.

The quality ratings of scientific evidence, summative review, and expert opinion are categorized into:

- A: High quality.
- B: Good quality.
- C: Low quality or major flaws.

Pertinent findings or evidence from each study or article were summarized in a table of evidence.

Prepared by Hengky Lim DNP, NP-C, MSN, BSN
APPENDIX D

SAMPLE DEMOGRAPHIC INFORMATION

Circle or answer appropriately the following questions:

Age:  
- 18-25  
- 26-35  
- 36-45  
- 46-55  
- 56-65

Gender:  
- Male  
- Female

Ethnicity:  
- American Indian  
- Black/African-American  
- Asian or Pacific Islander  
- Hispanic or Latino  
- White  
- Other(s): ____________

Employment:  
- Full time  
- Part time  
- Not employed  
- Retired

Medical Comorbidities:  
- Diabetes  
- Hypertension  
- Cancer  
- HIV  
- Other(s): ____________

Prepared by Hengky Lim DNP, NP-C, MSN, BSN
## APPENDIX E

### SAMPLE WOUND EVALUATION TOOL

Circle or answer appropriately the following questions:

<table>
<thead>
<tr>
<th>Visits:</th>
<th>Initial</th>
<th>Wound evaluation follow up</th>
<th>Suture removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Scalp</td>
<td>Face</td>
<td>Neck</td>
</tr>
<tr>
<td>Others:</td>
<td>_______</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape:</td>
<td>Linear</td>
<td>irregular</td>
<td>Flap</td>
</tr>
<tr>
<td>Other(s):</td>
<td>_______</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size:</td>
<td>Less than 5 cm</td>
<td>Greater than 5 cm</td>
<td></td>
</tr>
<tr>
<td>Depth:</td>
<td>Epidermis</td>
<td>Dermis</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>Skin Color:</td>
<td>Pink/Normal</td>
<td>Erythematous</td>
<td>White/Grey pallor</td>
</tr>
<tr>
<td>Exudate &amp; Type:</td>
<td>None/Dry wound</td>
<td>Scant</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>Bloody</td>
<td>Serosanguineous</td>
<td>Serous</td>
</tr>
<tr>
<td>Edema:</td>
<td>1+</td>
<td>2+</td>
<td>3+</td>
</tr>
<tr>
<td>Pain:</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
| Irrigation:                    | Normal Saline | Tap Water            | Sterile Water | Povidone iodine | Other(s): _______
|                                | Hydrogen peroxide | Other(s): _______|
| Antibiotic use:                | yes      | no                         | Cephalexin (Keflex) | Trimethoprim/sulfamethoxazole (Bactrim) | Clindamycin (Cleocin) | Other: _______

---

Prepared by Hengky Lim DNP, NP-C, MSN, BSN
APPENDIX F

APPROVAL TO USE JHNEBP MODEL AND TOOLS

Thank you for submitting the requested information. You now have permission to use the JHNEBP model and tools.

Click here to download the tools. Reminder: You may not modify the model or the tools. All reference to source forms should include “©The Johns Hopkins Hospital/The Johns Hopkins University.”

We offer an excellent online course about our model/tools. It is an engaging online experience, containing interactive elements, self-checks, instructional videos, and demonstrations of how to put EBP into use. The course follows the EBP process from beginning to end and provides guidance to the learner on how to proceed, using the tools that are part of the Johns Hopkins Nursing EBP model.

Take a sneak peek of the course.

Group rates for the course are available. Email ijhn@hmi.edu to inquire.

Click here for more information.

Go back to the form.
APPENDIX G

JHNEBP RESEARCH EVIDENCE APPRAISAL TOOL

JHNEBP Research Evidence Appraisal

Evidence Level:___

<table>
<thead>
<tr>
<th>ARTICLE TITLE:</th>
<th>NUMBER:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTHOR(S):</td>
<td>DATE:</td>
</tr>
<tr>
<td>JOURNAL:</td>
<td></td>
</tr>
<tr>
<td>SETTING:</td>
<td>SAMPLE (COMPOSITION/SIZE):</td>
</tr>
</tbody>
</table>

- Experimental  □  Meta-analysis  □  Quasi-experimental  □  Non-experimental  □  Qualitative  □  Meta-synthesis

Does this study apply to my patient population?  □ Yes  □ No

If the answer is No, STOP here (unless there are similar characteristics).

Strength of Study Design
- Was sample size adequate and appropriate?  □ Yes  □ No
- Were study participants randomized?  □ Yes  □ No
- Was there an intervention?  □ Yes  □ No
- Was there a control group?  □ Yes  □ No
- If there was more than one group, were groups equally treated, except for the intervention?  □ Yes  □ No
- Was there adequate description of the data collection methods  □ Yes  □ No

Study Results
- Were results clearly presented?  □ Yes  □ No
- Was an interpretation/analysis provided?  □ Yes  □ No

Study Conclusions
- Were conclusions based on clearly presented results?  □ Yes  □ No
- Were study limitations identified and discussed?  □ Yes  □ No

Pertinent Study Findings and Recommendations

Will the results help me in caring for my patients?  □ Yes  □ No

Evidence Rating (scales on back)

<table>
<thead>
<tr>
<th>Strength of Evidence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ High (A) □ Good (B) □ Low/major flaws (C)</td>
</tr>
</tbody>
</table>

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STRENGTH OF EVIDENCE
 LEVEL 1 (HIGHEST)

EXPERIMENTAL STUDY (RANDOMIZED CONTROLLED TRIAL OR RCT)
- Study participants (subjects) are randomly assigned to either a treatment (TX) or control (non-treatment) group.
- May be:
  - Blind: neither subject nor investigator knows which TX subject is receiving.
  - Double-blind: neither subject nor investigator knows which TX subject is receiving.
  - Non-blind: both subject and investigator know which TX subject is receiving; used when it is felt that the knowledge of treatment is unimportant.

META-ANALYSIS OF RCTs
- Quantitatively synthesizes and analyzes results of multiple primary studies addressing a similar research question.
- Statistically pools results from independent but combinable studies.
- Summary statistic (effect size) is expressed in terms of direction (positive, negative, or zero) and magnitude (high, medium, small).

LEVEL 2

QUASI-EXPERIMENTAL STUDY
- Always includes manipulation of an independent variable.
- Lacks either random assignment or control group.
- Findings must be considered in light of threats to validity (particularly selection).

LEVEL 3

NON-EXPERIMENTAL STUDY
- No manipulation of the independent variable.
- Can be descriptive, comparative, or relational.
- Often uses secondary data.
- Findings must be considered in light of threats to validity (particularly selection, lack of severity or co-morbidity adjustment).

QUALITATIVE STUDY
- Exploratory in nature, such as interviews, observations, or focus groups.
- Starting point for studies of questions for which little research currently exists.
- Sample sizes are usually small and study results are used to design stronger studies that are more objective and quantifiable.

META-SYNTHESIS
- Research technique that critically analyzes and synthesizes findings from qualitative research.
- Identifies key concepts and metaphors and determines their relationships to each other.
- Aim is not to produce a summary statistic, but rather to interpret and translate findings.

QUALITY RATING (SCIENTIFIC EVIDENCE)

A  High quality: consistent results, sufficient sample size, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific evidence.

B  Good quality: reasonably consistent results, sufficient sample size, some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence.

C  Low quality or major flaws: little evidence with inconsistent results, insufficient sample size, conclusions cannot be drawn.
### APPENDIX H

**JHNEBP Non-Research Evidence Appraisal Tool**

**JHNEBP Non-Research Evidence Appraisal**

<table>
<thead>
<tr>
<th>Evidence Level</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ARTICLE TITLE:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>AUTHOR(S):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>JOURNAL:</strong></td>
<td></td>
</tr>
<tr>
<td>□ Systematic Review</td>
<td>□ Clinical Practice Guidelines</td>
</tr>
</tbody>
</table>

**Does review/expert opinion address my practice question?**

<table>
<thead>
<tr>
<th>If the answer is No, STOP here (unless there are similar characteristics).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systematic Review</strong></td>
</tr>
<tr>
<td>• Is the question clear?</td>
</tr>
<tr>
<td>• Are search strategies specified, and reproducible?</td>
</tr>
<tr>
<td>• Are search strategies appropriate to include all pertinent studies?</td>
</tr>
<tr>
<td>• Are criteria for inclusion and exclusion of studies specified?</td>
</tr>
<tr>
<td>• Are details of included studies (design, methods, analysis) presented?</td>
</tr>
<tr>
<td>• Are methodological limitations disclosed?</td>
</tr>
<tr>
<td>• Are the variables in the studies reviewed similar, so that studies can be combined?</td>
</tr>
</tbody>
</table>

**Clinical Practice Guidelines**

| □ Were appropriate stakeholders involved in the development of this guideline? | □ Yes □ No |
| □ Are groups to which guidelines apply and do not apply clearly stated? | □ Yes □ No |
| □ Have potential biases been eliminated? | □ Yes □ No |
| □ Were guidelines valid (reproducible search, expert consensus, independent review, current, and level of supporting evidence identified for each recommendation)? | □ Yes □ No |
| □ Are recommendations clear? | □ Yes □ No |

**Organizational Experience**

| □ Was the aim of the project clearly stated? | □ Yes □ No |
| □ Is the setting similar to setting of interest? | □ Yes □ No |
| □ Was the method adequately described? | □ Yes □ No |
| □ Were measures identified? | □ Yes □ No |
| □ Were results adequately described? | □ Yes □ No |
| □ Was interpretation clear and appropriate? | □ Yes □ No |

**Individual expert opinion, case study, literature review**

| □ Was evidence based on the opinion of an individual? | □ Yes □ No |
| □ Is the individual and expert on the topic? | □ Yes □ No |
| □ Is author's opinion based on scientific evidence? | □ Yes □ No |
| □ Is author's opinion clearly stated? | □ Yes □ No |
| □ Are potential biases acknowledged? | □ Yes □ No |

**Pertinent Conclusions and Recommendations**

Were conclusions based on the evidence presented? □ Yes □ No
Will the results help me in caring for my patients? □ Yes □ No

**Quality Rating (scale on back):**

Basic quality rating of the study under review (check one):

- □ High (A)
- □ Good (B)
- □ Low/major flaws (C)
STRENGTH OF EVIDENCE

LEVEL 4
SYSTEMATIC REVIEW
- Research review that compiles and summarizes evidence from research studies related to a specific clinical question
- Employs comprehensive search strategies and rigorous appraisal methods
- Contains an evaluation of strengths and limitations of studies under review

CLINICAL PRACTICE GUIDELINES
- Research and experiential evidence review that systematically develops statements that are meant to guide decision-making for specific clinical circumstances
- Evidence is appraised and synthesized from three basic sources: scientific findings, clinician expertise, and patient preferences.

LEVEL 5
ORGANIZATIONAL
- Review of quality improvement studies and financial analysis reports
- Evidence is appraised and synthesized from two basic sources: internal reports and external published reports.

EXPERT OPINION, CASE STUDY, LITERATURE REVIEW
- Opinion of a nationally recognized expert based on non-research evidence (includes case studies, literature review, or personal experience).

QUALITY RATING (SUMMATIVE REVIEWS)

A High quality: well-defined, reproducible search strategies; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies, and definitive conclusions

B Good quality: reasonably thorough and appropriate search; reasonably consistent results, sufficient numbers of well-designed studies, evaluation of strengths and limitations of included studies, with fairly definitive results

C Low quality or major flaws: undefined, poorly defined, or limited search strategies; insufficient evidence with inconsistent results, conclusions cannot be drawn

QUALITY RATING (EXPERT OPINION)

A High quality: expertise is clearly evident.

B Good quality: expertise appears to be credible.

C Low quality or major flaws: expertise is not discernable or is dubious.