Journal of
FORENSIC NURSING
THE OFFICIAL JOURNAL OF THE INTERNATIONAL ASSOCIATION OF FORENSIC NURSES

ORIGINAL ARTICLE

Alternate light sources in sexual assault examinations: An evidence-based practice project

Kelli Eldredge, RN, MSN, CCRN, SANE-A[1], Emily Huggins, RN, BSN, MHA, CEN, SANE-A, SANE-P[2], and Linda C. Pugh, PhD, RNC, FAAN[3]

1 Clinical Nurse III/Clinical Educator, Trauma Surgical Intensive Care Unit, WellSpan Health, York Hospital, York, PA
2 Forensic Examiner Team Program Manager, Department of Emergency Medicine, WellSpan Health, York Hospital, York, PA
3 Professor and Director, Graduate Programs in Nursing, York College of Pennsylvania, York, PA

Keywords
Alternate light source; evidence-based practice; forensic nursing; Wood's lamp.

Correspondence
Kelli Eldredge RN, MSN, CCRN, SANE-A, Clinical Nurse III/Clinical Educator, Trauma Surgical Intensive Care Unit, Wellspan Health, York Hospital, 1001 South George Street York, Pennsylvania 17403;
E-mail: Keleld@comcast.net

Received: May 2011; accepted: October 2011

doi: 10.1111/j.1939-3938.2011.01128.x

Abstract

The ability of sexual assault nurse examiners to correctly identify and collect DNA evidence improves patient outcomes and prosecution rates. The purpose of this paper is to present findings from a collaborative evidence-based practice (EBP) project between forensic nurses and baccalaureate nursing students. The goal of the project was to determine best practice using an alternate light source (ALS) to identify trace DNA evidence in sexual assault forensic examinations. Using the Johns Hopkins Nursing Evidence-based Practice model, the team searched several databases to summarize the limited amount of evidence available regarding this topic. Recommendations from the EBP project include: elimination of the Wood's lamp in sexual assault examinations; use of an ALS that provides appropriate wavelengths to detect DNA; education of forensic nurses about the advantages and limitations of an ALS; and additional research related to use of an ALS. By participating in similar collaborative efforts, practicing forensic nurses have the opportunity to collaborate with local colleges and universities to make complex projects more manageable while fulfilling the International Association of Forensic Nurses vision for ethical practice.

Forensic nurses must address legal and medical needs of sexual assault victims to provide the best patient care. The ability of sexual assault nurse examiners (SANEs) to correctly identify and collect DNA evidence improves patient outcomes and prosecution rates. Research reveals that evidence collection by SANEs results in significant improvements in completeness of information gathered relevant to medical–legal issues, a significant association with filing of charges, and more successful prosecution of sexual assault as perceived by law enforcement and prosecutors (Crandall & Helitzer, 2003; Derhammer, Lucente, Reed, & Young, 2000; McGregor, Mont, & Myhr, 2002). Although patient history is the primary factor guiding evidence collection, alternate light sources (ALSs) can be used as an adjunct tool. In many practices, a Wood's lamp with wavelengths from 280 to 360 nanometers (nm) is used as the light source to identify potential DNA evidence. Literature has shown that wavelengths associated with a Wood's lamp are outside the range required to accurately identify semen stains (Nelson & Santucci, 2002; Santucci, Nelson, McQuillen, Duffy, & Linakis, 1999; Wawryk & Odell, 2005). Visible-range light energy ALSs with wavelengths between 400 and 600 nm are considered more sensitive and specific when identifying semen (Carter-Snell & Soltys, 2005; Marshall, Bennett, & Fraval, 2001; Nelson & Santucci, 2002). The purpose of this paper is to present findings from a collaborative evidence-based practice (EBP) project to determine best practice using ALSs to identify trace DNA evidence in sexual assault forensic examinations.

Discussion among members of a community hospital SANE team elicited concerns related to use of an ALS in sexual assault examinations. Although some team members used a Wood's lamp during examinations, others did not. To determine variations in practice, the SANE team manager posted a question to the International

Association of Forensic Nurses (IAFN) list-serve (IAFN, nd). The IAFN list serve, which is available to between 3000 and 3300 active IAFN members, allows forensic nurses to collaborate with colleagues regarding forensic practice issues (S. Robertson, personal communication, September 14, 2011). Participation on the list serve is optional. The question posted was: Are there any programs using a Wood's lamp and if so, do you have a policy for its use? (September 2, 2008). The following responses were received:

- We do use the Wood's lamp, but I am not convinced of its validity.
- I hardly ever see fluorescence and I know that there has to be semen present more than I see fluoresce.
- I put my Wood's lamp on the shelf about 5 years ago and have used my ALS with goggles for the last 5 year . . . . . I would rather depend on my experience and methodology than any light source of any wave length.
- We still use the Wood's lamp where I work and while we do find some fluorescence, I too rely on the history to guide where I might attempt to retrieve possible evidence.
- We quit using the Wood's lamp several years ago when we were able to use a grant to obtain an ALS. . . . We have had success with the ALS . . . . However, we do not just go by what we find, we go more on what the history tells us. The ALS many times simply helps us confirm what we have heard.

These responses prompted members of the SANE team to more closely examine use of an ALS in their program. Concurrently, an opportunity to collaborate with baccalaureate nursing students at a local college became available. Forensic nurses from the SANE team volunteered to participate in the EBP collaboration.

Collaboration

The collaborative EBP project pairs clinical nurses in a community hospital with baccalaureate nursing students in a junior level nursing research class. The purpose of this collaborative project is to expose students to real life clinical practice issues (White, Newhouse, Dearholt, Poe, & Pugh, 2008). The program is facilitated by Linda C. Pugh, college professor and director of EBP/nursing research at the hospital. All registered nurses at the hospital are notified about the collaboration by e-mail blast. Nurses who express an interest attend an EBP class before the beginning of the semester. The class includes a basic explanation of EBP, its impact on professional nursing, and introduction of the Johns Hopkins Nursing Evidence-based Practice (JHNEBP) model. The same information is presented to nursing students during a regular class session. The clinicians choose an EBP issue before the first meeting with the students. Nursing students are made aware of the practice issues and assigned to groups based on their clinical interests.

The groups meet four times throughout the semester. During the first session, the group discusses the practice issue and identifies the practice question. Members are asked to conduct literature searches related to the topic and bring selected articles to the next meeting. The second class session includes a discussion of the reference list and prioritizing of the most relevant literature. Group members are assigned articles to read and appraise and prepare an evidence summary before the next meeting. During the third session, practice recommendations are made on the basis of the strength and quality of the evidence. At the end of the semester, students develop a professional nursing poster describing their EBP project. A poster presentation is held during the final class session. Nursing professors attend, question the students about their projects, and judge the presentations based on various criteria such as clarity, organization, and accuracy.

The EBP group examining the ALS practice issue consisted of the manager of the SANE program, a SANE team member, and four nursing students. During the initial class session, the forensic nurses explained forensic nursing to the students and the role of an ALS in sexual assault exams. Students were shown a Wood's lamp to help them better understand ALSs. The ensuing section explains the EBP process and its application to identify best practice related to use of an ALS.

John Hopkins Nursing Evidence-Based Practice (JHNEBP) Model

EBP is a "problem-solving approach to clinical decision making within a health-care organization that integrates the best available scientific evidence with the best available experiential (patient and practitioner) evidence" (Newhouse, Dearholt, Poe, Pugh, & White, 2007, p. 3). The goal of EBP is to promote effective nursing interventions, efficient care, and improved outcomes for patients The JHNEBP model was utilized for this project (see Figure 1). The Practice question, Evidence, and Translation process, which guide project development, are presented in the following sections.

Practice question

The EBP practice question identifies and narrows search terms to provide evidence specific to the problem and question (Newhouse et al., 2007). The PICO process

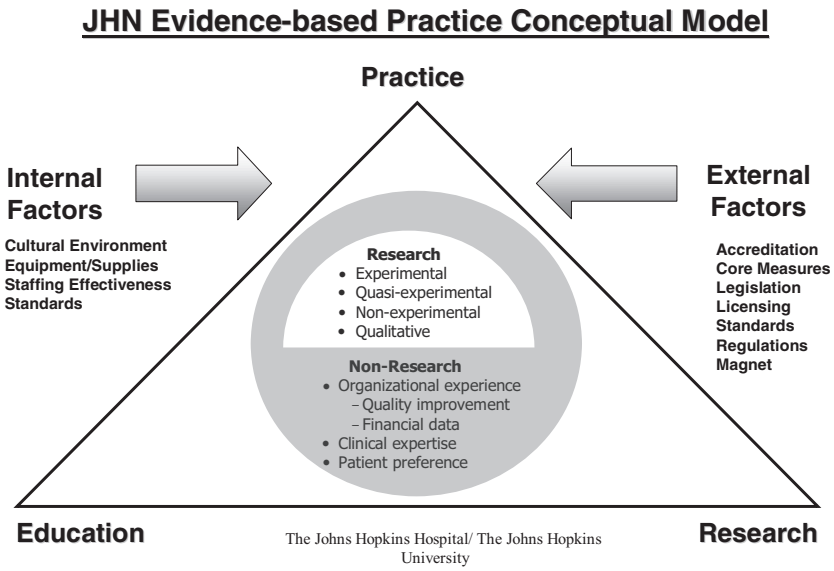

Figure 1. Johns Hopkins nursing evidence-based practice model (Newhouse, Dearholt, Poe, Pugh, & White, 2007).

described by Richardson, Wilson, Nishikawa, and Hayward (1995) is used in the JHNEBP model to develop a narrow, well-built clinical question which frames the problem clearly and assists in the evidence search by identifying core key words. The acronym PICO is represented by: **P**- Patient, population or problem (age, sex, patient setting); **I**- Intervention (treatment, medications, education, diagnosis); **C**- Comparison with other treatments (may not always be applicable); and, **O**- Outcome (anticipated). The PICO process and its application to determine best practice related to use of an ALS in sexual assault exams is as follows:

P: adult patient who has reported sexual assault
I: Wood's lamp
C: other alternate light source
O: positive identification of trace biological evidence.

The resulting practice questions were: Does the Wood's lamp or other ALS positively identify trace biological evidence containing DNA in patients reporting sexual assault? and; Which light source (Wood's lamp or other ALS) identifies trace biological evidence more accurately?

Evidence

Evidence, including both research and nonresearch sources, is at the core of the JHNEBP model. In this model, evidence is divided into levels according to assessed strength. Research is considered the strongest evidence with experimental studies and meta-analyses rated Level I, quasi-experimental studies rated Level II, and nonexperimental and qualitative studies and metasyntheses rated as Level III (Newhouse et al., 2007). The JHNEBP encourages use of nonresearch evidence as well. This evidence specifically informs nursing knowledge by addressing current practice related to individual patients, populations, and systems (Newhouse et al., 2007). Nonresearch evidence includes systematic reviews (level I–IV), clinical practice guidelines (Level IV), and expert opinion, case studies, literature reviews, quality improvement studies, and financial analysis reports (Level V). After the strength of evidence is evaluated, the quality is assessed as high, good, or low/major flaw.

PubMed, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), National Clearinghouse Guidelines, Google Scholar, and the National Criminal Justice Reference Service were searched for evidence regarding best practices to identify trace DNA. Keywords included Wood's lamp, ALS, forensic nursing, and trace DNA. Fourteen articles (from the United States, Australia, and Canada) were initially reviewed. Seven articles that included discussions of ALSs and their applicability to DNA evidence collection were chosen for further appraisal. Three of the articles were quasi-experimental studies and rated as level II evidence. Four of the articles were descriptive studies and rated as level III evidence. The quality of all evidence was assessed as "good" (see Table 1). Research evidence graded as "good" has the following characteristics: reasonably consistent results; sufficient sample, some control, with fairly definitive conclusions; and, reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence (Newhouse et al., 2007).

According to the evidence, semen samples did not fluoresce at wavelengths associated with the Wood's lamp.

Table 1 Summary of evidence

Findings	Reference	Strength/Design
Substances other than semen fluoresced using wavelengths less than 450 nanometers (nm); 450nm lights almost exclusively only fluoresced when stain was semen.	Carter-Snell, C & Soltys, 2005	Level II/ Quasi-experimental
On all surfaces, visibility of fluorescence was increased by reduced distance of light source from surface and increased concentration of semen on surface. Visibility of fluorescence not noticeably affected by angle at which light source was held in relation to surface. ALS may be useful as screening tool to direct examiner to areas of particular interest for swabbing.	Lincoln, McBride, Turbett, Garbin, & McDonald, 2006	Level II/Quasi-experimental
Visible fluorescence of dried semen through goggles and through camera on live skin was successful in large number of excitation and emission filter combinations of 415 nm and above.	Marshall, S., Bennett, A., & Fraval, 2001	Level II /Quasi-experimental
All physicians identified semen as fluorescing and 25% successfully differentiated semen from other product using ALS with wavelength 390–500 nm. Products most commonly mistaken for semen were hand cream, Castile soap, and bacitracin. After training session, 83% of physicians successfully differentiated semen from other products.	Nelson, D. & Santucci, 2002	Level III/Descriptive
None of the 41 physicians were able to differentiate semen from other products using a Wood's lamp (WL). Four most common products mistaken for semen using WL were A&D ointment, surgilube, barrier cream and bacitracin ointment. None of the 29 semen sample fluoresced under the ultraviolet light provide by 2 WL's.	Santucci, Nelson, McQuillen, Duffy, & Linakis, 1999	Level III/Descriptive
Most useful general condition for observing fluorescence of seminal or saliva stains on various materials using the Polilight was with wavelength set to 450 nm while wearing orange goggles. Polilight was found to be poor at distinguishing between different fluids and may also pick up residual laundry detergent. Polilight's function is as a screening aid: it should be used merely to locate stains which will then require further analysis.	Vandenberg & van Oorschot, 2006	Level III/Descriptive
In all cases low powered light sources were unable to show visible fluorescence in semen on skin. High powered lights showed faint fluorescence of semen on skin in 3 of 8 subjects. In all cases it was easier to determine presence of something on skin by reflection of plain white light rather than by fluorescence.	Wawryk & Odell, 2005	Level III/Descriptive

Santucci et al. (1999) report that none of 29 semen samples fluoresced when two different types of Wood's lamps were used. Wawryk and Odell (2005) reported that low powered light-emitting diode (LED) lights were unable to excite visible fluorescence in the semen. In addition, other substances were often incorrectly identified as semen when the Wood's lamp was utilized. Such substances included urine, saliva, powder, body gel, laundry detergent, hand cream, Castile soap, A&D ointment, surgilube, barrier cream, and bacitracin ointment (Carter-Snell & Soltys, 2005; Nelson & Santucci, 2002; Santucci et al., 1999; Vandenberg & van Oorschot, 2006).

Visible-range light energy ALSs with wavelengths of approximately 400–600 nm were found to be more effective in fluorescing semen particles. In one study, physicians were able to detect semen stains 100% of the time with higher wavelength ALS's (Nelson & Santucci, 2002). Carter-Snell and Soltys (2005) found that 450 nm lights almost exclusively only fluoresced when the stain was semen. A study conducted by Marshall et al. (2001) found

that visualization of dried semen stains through goggles and through the camera on live skin were successful in a large number of excitation emission filter combinations of 415 nm and above. Similar to the Wood's lamp, longer wavelength ALSs demonstrated a lack of specificity when identifying stains (Carter-Snell & Soltys, 2005; Nelson & Santucci, 2002; Santucci et al., 1999; Vandenberg & van Oorschot, 2006). In one study, education improved the ability of providers to accurately identify semen using a longer wavelength ALS (Nelson & Santucci, 2002). Using a Blumaxx BM500 with a wavelength of 450 nm, physicians could differentiate semen from other stains 83% of the time after the training session.

Wawryk and Odell (2005) found that while an ALS is useful for identification of stains on clothing, its use in detecting stains on skin is limited. Using ALSs with wavelengths between 370 and 500 nm, the authors report that it was easier to detect semen on the skin by the reflection of plain white light rather than by fluorescence. Lincoln, McBride, Turbett, Garbin, and MacDonald (2006) used an ALS (excitation filter 450 nm and barrier filter goggles) to detect semen on a range of inanimate surfaces and human skin. The authors found that, on both inanimate surfaces and human skin, visibility of fluorescence was increased by reduced distance of light source from the surface and increased concentration of semen on the surface. They suggest that an ALS may be useful as an adjunct screening tool in conjunction with the routine "blind" forensic samples taken as part of sexual assault forensic exams. Vandenburg and van Oorschot (2006) found that the Polilight (wavelength 415–650 nm) had a relatively high incidence of false positives when examining casework exhibits for seminal stains. The authors reported that the Polilight ALS should function as a screening aid only, used merely to locate stains, which will then require further analysis in a laboratory.

Several recommendations were made based on the evidence. The EBP team recommended that use of the Wood's lamp be eliminated from sexual assault exams. It was also suggested that forensic teams consider use of an ALS that provides appropriate wavelengths to detect DNA. If an ALS is purchased, forensic nurses should be educated about the advantages and limitations of an ALS and proper use to improve sensitivity and specificity when identifying stains. Last, more research must be conducted related to use of an ALS including: research on the sensitivity and specificity of various long wavelength lights on various skin types and at various time frames after application of stains; the role of time and normal "wear and tear" on stains because most victims come in at least 12 to 24 hours after assault; and, the development of a system to distinguish semen from other possible contaminates.

Translation

Translation is the phase in which recommendations are evaluated for application in the clinical setting and, if appropriate, an action plan is created (Newhouse et al., 2007). This is often the most difficult phase of the EBP process. The project team has been fortunate in that several of their recommendations have been translated into practice. The forensic team has eliminated use of the Wood's lamp in their exams. The SANE team manager has successfully applied for a grant to purchase an ALS. Several vendors were contacted in an effort to find an ALS that would best meet the team's needs in terms of affordability, ease of use, and educational and technical support. After a review of various products, a new ALS with a 470 nm wavelength has been purchased. The next steps are to develop an ALS practice policy and educate forensic team members. In the future, the team hopes to conduct research to compare data from the crime lab to determine if use of the new ALS improves confirmation of trace DNA.

Implications for practice

By participating in similar collaborative efforts, practicing forensic nurses have the opportunity to collaborate with local colleges and universities to make complex projects more manageable while fulfilling the IAFN vision for ethical practice. According to the IAFN Vision of Ethical Practice (2008), "Forensic nurses should seek to advance nursing and forensic science, understand the limits of their knowledge, and respect the truth." (IAFN, para 6). The vision further states, "Forensic nurses should ensure that their research and scientific contributions are thorough, accurate, and unbiased in design and presentation" and "forensic nurses should incorporate evidence-based knowledge in practice decisions" (IAFN, para 6). The EBP project presented in this article fulfills the IAFN vision in a number of ways. The impetus for this project was the recognition by forensic nurses of limits of knowledge related to use of an ALS in sexual assault exams. Rather than accepting inconsistencies in practice as the "norm," the nurses challenged themselves to expand their knowledge related to use of an ALS by participating in an EBP project. Next, the use of the JHNEBP model ensured a systematic and rigorous approach to guide clinical decision-making. Finally, the SANE team is in the process of implementing their EBP findings related to the ALS into clinical practice. If forensic nurses are given the opportunity to participate in similar collaborative efforts, they can utilize the process to determine best practice related to any identified forensic practice issue while fulfilling the IAFN expectations for ethical practice.

Collaborative EBP projects are an innovative strategy to benefit both nursing students and practicing forensic nurses. Students benefit by learning about forensic practice issues from experienced nurses who care for victims and perpetrators of violence. Forensic nurses, many of whom may be unfamiliar with EBP, are able to learn the process in a nonthreatening environment under the guidance of a professor or nurse researcher. As a result, both novice and expert nurses will be better equipped and more confident when implementing EBP into forensic practice.

Forensic nursing is a new and growing specialty. Collaborative projects allow experienced forensic nurses to share their passion for forensic nursing with students who are preparing to enter the nursing profession. One of the former nursing students related:

> At the beginning of the project I was a little apprehensive about the project and how much our research would actually help to change protocol and procedure at this hospital. But after we met and we had done some research, I truly enjoyed doing the project and learning about the subject as a whole . . . I actually think this project gave me a new interest in SANE nursing and that I will look into it when I step out into the real world.

Both nursing students and forensic nurses on the EBP team exhibited a sense of pride and accomplishment when they realized their work had affected real change.

Most importantly, EBP encourages forensic nurses to take accountability for their profession. Forensic nurses are the frontline caregivers for victims of violence. They are the most qualified professionals to identify forensic practice issues and advocate for change. These nurses should be the driving force behind the changes in clinical practice that result in improved nursing process, best nursing practice, and improved patient outcomes.

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