Alternate Light Assessment of Skin Trauma (AtLAST)

Guidelines for Clinical Application

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(AtLAST v.1.0)

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Cover image: Photo taken of Katherine Scafide by Rene Ayala, George Mason University.

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Introduction

The following document provides practice guidelines for using an alternate light source (ALS) to detect and document possible physical trauma during a clinical skin assessment. These guidelines offer recommended standards for forensic clinicians to apply the ALS technology during patient encounters and appropriately interpret observations based on available scientific evidence.

Development of these guidelines included a contextual assessment of patient care practices, organizational resources, and stakeholder input (i.e., forensic clinicians, law enforcement professionals, and prosecuting attorneys) at two forensic nursing departments.[1] Data collection included historical data from a forensic nursing department with ten years of clinical experience integrating ALS in medical forensic examinations of soft tissue skin injuries and a forensic nursing department at a separate organization integrating ALS as a new clinical practice. A focused grey literature search for existing standards and practice guidelines on ALS application in the clinical setting assisted in understanding current practices further. Finally, a systematic review and appraisal of peer-reviewed literature provided the scientific evidence base to support the practice recommendations in these guidelines (see Appendix A).

These guidelines address considerations related to the physical clinical environment, equipment, and patient conditions for using ALS in clinical practice to assess for possible soft-tissue skin trauma. The included step-by-step protocol for ALS application in the clinical setting is trauma-informed, patient-centered, and considerate of patient and user safety. These guidelines also include sections introducing the reader to documentation considerations (written and image documentation) of ALS technology use, informed testimony preparation, and education and training requirements.

Safety Considerations

- Reading and understanding this document is not sufficient to implement the use of an ALS skin assessment in forensic clinical practice.
- To prevent harm from unsafe use, all clinicians must receive appropriate education and training that is beyond the scope of this document. See *User Education and Training* section for minimum recommendations.

Background

Alternate Light

The energy from light, or electromagnetic radiation, is composed of waves with different wavelengths. The measurement of wavelengths is expressed in *nanometers* (*nm*). Shorter waves have more energy than longer waves.[2] Ultraviolet (UV) light has shorter wavelengths, and infrared light has longer wavelengths than visible light. Visible light includes wavelengths ranging from ~400nm, which appears violet, to 700nm, which appears red. White light (e.g., sunlight) is composed of emitted wavelengths across the entire visible light spectrum.

Alternate light refers to the light of a specific range of wavelengths or bandwidth, usually within the UV, visible, or infrared spectrums.[3] A device that emits alternate light, called an *alternate light source* (ALS), uses internal filters to isolate the emitted light into specific bandwidths. The ALS manufacturer should provide information on the device's wavelength range and the peak wavelength of light. For example, an ALS composed of visible light might emit only violet (400-450nm, peak 415nm) or blue light (450-490nm, peak 475nm). The *peak wavelength* represents the wavelength with the most light emitted by the device.

When focusing ALS light onto a non-mucosal skin surface, light may reflect or transmit to deeper structures, be absorbed by specific molecules, or result in a combination of reflection and absorption (Figure 1).[2] Certain substances on the skin's surface may absorb light, causing molecules to become excited, emitting light at a longer wavelength. The result is a perceived "glow" called *fluorescence*. Alternatively, *absorbed light* on or deeper into the skin surface that converts the energy to heat appears dark or black compared to surrounding tissue. Blood and its breakdown components (e.g., bilirubin) absorb light at certain wavelengths. To view fluoresced or absorbed light, the observer must view the skin through colored goggles or employ camera filters to block the reflected light of higher energy and shorter wavelengths. Such *longpass filters* for the camera come in various colors (e.g., yellow, orange, red), with recommendations for yellow and orange when using violet and blue lights, respectively.[3]

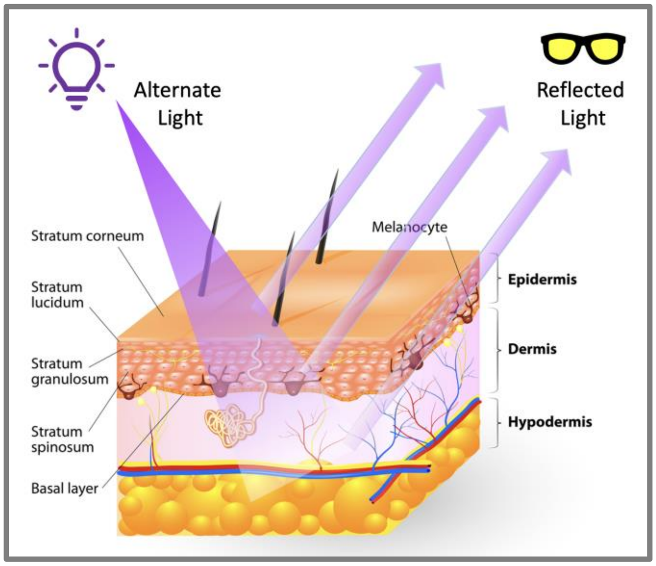

Figure 1. Interaction of alternate light with skin layers

Statement of Need

Bruising is the most common soft-tissue skin trauma identified among patients reporting violence, regardless of age.[4–7] The assessment of skin injuries during a medical forensic examination of living patients serves to direct clinical care and identify potential implications (medical or legal) pertinent to the assessment findings.[1,8] Many factors create barriers to observing bruises, including a patient's underlying skin pigmentation or the age of the injury.[9] Although researchers have suggested using ALS to detect and visualize bruises[10–14], national protocols lack specific guidance on ALS application, documentation, and interpretation during clinical skin assessments.[15] Practice guidelines are needed to prevent inappropriate or unsafe use of an ALS during injury assessments and ensure such use is ethically sound, evidence-based, and consistent with recommended practice standards.

Section Terms, Abbreviations, and Acronyms

absorbed light	Light on the skin or deeper into the skin surface that converts the energy to heat appears dark or black compared to the surrounding tissue. For example, blood and its breakdown components absorb light at certain wavelengths.
alternate light	Light of a specific range of wavelengths or bandwidth, usually within the UV, visible, or infrared spectrums.
alternate light source	A specific type of device that emits alternate light.
fluorescence	When certain substances on the skin's surface absorb light, molecules become excited and emit longer wavelength light. The term "glow" is often used to describe this phenomenon. For example, semen on the skin surface absorbs shorter wavelengths and emits longer wavelengths.
nanometers	A unit of measurement to measure length, in the context of ALS, refers to light wavelength.
nm	Abbreviation for nanometer.
peak wavelength	Predominant wavelength emitted by an ALS device. For example, a single-wavelength ALS device emits light at a peak wavelength plus a small range of wavelengths surrounding the peak wavelength.
longpass filter	Barrier optical filter that blocks light transmission below a certain wavelength range, allowing the viewer to perceive light with a longer wavelength. For example, a 455 longpass filter would allow light with a wavelength greater than 455nm to pass through the filter but block light lower than 455nm.

Equipment Considerations

ALS Unit

Various handheld, bedside-accessible ALS units are on the market (see Figure 2 for examples). Before purchasing, users should trial and compare ALS units from different manufacturers to determine the best fit for their clinical setting and practice. The following criteria are considerations for product trial and selection processes:

1. **Wavelength:** According to published scientific evidence, the ALS peak wavelength that best detects evidence of bruising across skin pigmentations among living patients is 400nm-450nm.
2. **Light Intensity/Brightness:** *Lumen* is a measurement of light intensity, with higher lumens indicating a brighter light emission. Higher lumens are preferred when conducting skin assessments in environments with ambient light and when examining patients with darker skin pigmentation.
3. **Uniformity of Lighting:** The ALS unit should emit consistent and uniform light distribution across the skin surface. If the distribution of light is not uniform (i.e., areas of darker and lighter illumination), is inconsistent (e.g., flickering), or has a bulb that is not working properly, *hot spots* may occur. Hot spots are areas of greater light intensity surrounded by areas of less light intensity.
4. **Bulb:** Users should consider the average life of the bulb(s) when making an ALS purchase due to the potentially high bulb replacement cost. LED bulbs last significantly longer in ALS units than xenon or incandescent bulbs.
5. **Portability:** The ALS unit should be easily portable in size and weight to handle appropriately during a patient examination. The unit's weight should include the ALS device with all batteries installed. The user must also consider ease of use during digital imaging, with and without a camera mount.
6. **Power Source:** Portable units typically have rechargeable batteries with battery life varying depending on the ALS unit and intensity of use.
7. **Cost:** Similar to photodocumentation equipment, ALS equipment has a range of price points. The most expensive unit is not necessary to meet the needs of the clinical forensic environment.
8. **Support:** Consider manufacturer support offered after purchase, such as warranty, repairs, troubleshooting, education, etc.

ALS Accessories

ALS users must wear either manufacturer-provided or manufacturer-recommended colored goggles when operating the ALS unit. In the case of an ALS skin assessment, recommended longpass filter wavelengths are yellow and orange goggles. Users should purchase goggles in quantities to protect the eyes of all individuals present during the ALS skin assessment, including the patient. Alternatively, people within view of the ALS who are not involved in the patient exam may use sunglasses or other glasses with UV protection with instruction and agreement not to look at the light emitted by the ALS unit.

Figure 2. Example single wavelength and multi-wavelength alternate light sources.

Additional recommended ALS accessories include battery charging equipment, a camera mount for small ALS units, a tripod for large or heavy ALS units, and non-fluorescing rulers to measure the size of the light absorption area and provide scale in digital images.

Digital Camera and Accessories

The digital camera equipment used by medical forensic clinicians and programs varies greatly. Some users may purchase equipment and accessories from consumer stores, whereas others may buy from healthcare suppliers or vendors marketing specifically to forensic clinicians and their organizations.

The lighting considerations listed under ALS equipment (e.g., intensity, spread, uniformity, hot spots) also apply to the camera equipment flash and the source of focused, maneuverable lighting. Pull-down, ceiling-mounted procedural lights may give too much light intensity during photodocumentation, resulting in images that are overly washed out, diffuse, or contain hot spots.

As technology advances, the items needed for efficient photodocumentation processes resulting in representative images will change. For example, a mirrorless camera with a mounted continuous light source may provide a lighter, smaller camera body option with a less intense uniform light source.

Below is a general list of items to consider for clinical forensic photodocumentation. Please note that the specific equipment needed can vary by practice setting (e.g., dedicated exam room, mobile response).

- Camera
- Macro lens
- Macro ring light
- Remote shutter switch/release and extension cables
- Camera stand such as a monopod, tripod, wall-mounted arm
- Ball head for camera stand
- Quick-release mount for ball head attachment (camera plate, ball head plate)
- Protective case for camera and accessories
- Camera battery and backup battery
- Flash batteries and backup batteries
- Camera battery charger
- Flash battery charger, if applicable
- Memory cards or means to immediately and securely upload images
- Memory card reader
- Color filters for camera lens
- Step-up ring for camera lens filters

Section Terms, Abbreviations, and Acronyms

lumens	Numerical measurement of light intensity.
hot spots	Occur when a light source creates areas of greater light intensity surrounded by areas of less light intensity.

Safety Considerations

- Using battery-operated ALS units reduces the potential for a trip hazard from electrical cords in a darkened examination room.
- Eye protection must be available for all individuals present during the ALS exam, including the patient, patient support person(s), advocate, and forensic clinicians in training. If support animals are allowed during the exam, eye protection for the support animal must also be considered.
- To prevent harm from unsafe use, the ALS equipment should only be handled by trained forensic clinicians and stored in a secure, limited access location.

Supporting Evidence: [3,10–14,16,17]

Clinical Guidelines

Setting

General

- The clinical setting for an ALS skin assessment should provide patient privacy.
- The exam environment should be free from tripping hazards. Electrical cords pose trip hazards in a darkened room.
- All equipment should be readily available in the exam room and easily accessible to the clinician and support staff when applicable.

Lighting

- Ambient exam room lighting should include overhead diffuse and focused sources of white light. Evidence suggests that cool or warm white light bulbs are sufficient during a skin assessment, with cool white light bulbs (fluorescent or LED) providing a more accurate color interpretation.
- Focused, maneuverable lighting (e.g., gooseneck lamp, medical headlamp) provides added light intensity during the skin assessment.
- Although total room darkness is typically unnecessary, there should be a means to darken the room (e.g., windows, lights) as is appropriate for the brightness of the ALS device used during the assessment and skin pigmentation.

Safety Considerations

- Examining the patient in a private setting avoids unnecessary exposure of patients, family, clinicians, staff, and other individuals to the alternate light.
- Eye protection must be available for all present during an ALS exam

Supporting Evidence: [2,3]

Patient Conditions

An ALS assessment should only occur after receiving patient consent for the medical forensic examination. To determine if a patient is a candidate for an ALS assessment based on capacity to consent, mental status (e.g., intoxication, exhaustion), medical status, skin conditions, and available history of trauma requires clinical judgment.

- Research evidence supports the application of an ALS to assess for indications of skin trauma among adult and adolescent patients with either a known history of physical trauma occurring within two weeks of examination or the presence of assessment findings indicating possible injury (e.g., tenderness, swelling), or a combination of both.
- Trauma to the mucous membranes (i.e., oral cavity, anogenital) or near the eyes is inappropriate for an ALS assessment.
- Certain medical conditions may prevent patients from tolerating prolonged positioning during the exam or limit access to the skin during the assessment (e.g., splints or medical devices).
- Patients with medical or skin conditions contributing to the formation of cutaneous lesions or tissue hypertrophy may not be appropriate for an ALS assessment if those lesions or tissue changes interfere with interpreting exam findings.
- Always consider patient stability and tolerance, setting and equipment adequacy, and the value added if completing the ALS examination.

Safety Considerations

- Clinical judgement and patient safety remain priority.
- Avoid using the ALS near the patient's eyes as the light may cause retinal damage.

Supporting Evidence: [10–12,16]

Skin Assessment

The following table (Table 1) recommends evidence-based steps for using ALS during a clinical physical examination of patients who meet the previously stated conditions. Specific details related to written and photodocumentation of skin assessments appear in the *Documentation* section. The protocol does not provide specific guidance on trace evidence collection; clinicians should obtain this information from the local forensic lab.

Forensic clinicians should identify and follow designated local and national protocols (e.g., *National Protocol for Sexual Assault Medical Forensic Examinations*[15]) as appropriate. Such protocols may provide direction related to obtaining a patient's history, conducting the physical assessment, collecting evidence, documenting exam observations, evidence collection kit information, and preserving the chain of custody.

As with all patient encounters, use trauma-informed practices. Clearly explain exam processes, adjust the amount of ambient light for patient comfort, and use clinical judgment to determine the appropriateness of an ALS assessment considering the patient's history, status, and comfort. Follow-up assessments are encouraged to evaluate injuries and associated absorption areas further when feasible.

Safety Considerations

- To avoid injury to the patient or user, only trained individuals should use ALS equipment during a patient examination.
- Always provide protective goggles/glasses to all individuals present during the exam and instruct them to avoid looking directly at the light emitted by the ALS unit to prevent possible eye injury.
- Avoid positioning the ALS near any skin surface, heat from the unit may cause discomfort.
- Alcohol wipes can irritate the skin; avoid cleansing the skin with alcohol wipes.
- Sanitize equipment to prevent disease transmission and contamination.

Supporting Evidence: [3,10–16,18,19]

Table 1. AtLAST Skin Assessment Protocol

1. PATIENT PREPARATION
a. Explain the ALS assessment to the patient and confirm the patient's understanding. b. Answer patient questions regarding the use and purpose of ALS. c. Place the patient in a comfortable position that allows access to the anatomical area of examination.
2. CONDUCT SKIN ASSESSMENT USING **WHITE LIGHT**
a. Conduct a head-to-toe skin assessment for signs of injury and trace evidence, using patient history to guide a further focused assessment of potential anatomical locations for trauma. b. Using established methods, collect potential trace evidence as soon as observed to prevent loss during the examination. c. Record the physical assessment observations through written and digital photographic documentation.
3. CONDUCT **ALS EXAMINATION** LOOKING FOR **FLUORESCENCE**
a. Apply protective eyewear to the patient and all observers and instruct all present during the assessment not to look directly at the light emitted by the ALS. b. Darken the room and ask the patient and anyone not assisting with the assessment to remain seated or standing in the same place to prevent accidental injury. c. Conduct an ALS skin assessment to identify fluorescence that may indicate the presence of possible trace evidence. i. Begin the ALS fluorescence exam using blue light (~450nm) with orange goggles. ii. Additional assessments may be considered using other wavelengths, such as violet light (~415nm), with yellow or orange goggles. d. Collect samples, as appropriate, of observed fluorescence using established methods. e. Record ALS examination and evidence collection through written documentation.
4. GENTLY CLEANSE THE SKIN
a. Use soap and water (e.g., bath wipes), alcohol wipes, or make-up remover wipes to cleanse the skin after collecting all possible trace evidence. b. Gently wipe the area; rubbing, scrubbing, or scratching the skin can affect ALS observations and interpretation.
5. CONDUCT **ALS EXAMINATION** FOCUSED ON **ABSORPTION**
a. Apply protective eyewear to the patient and all observers and instruct all present during the assessment not to look directly at the light emitted by the ALS. b. Darken the room and ask the patient and anyone not assisting with the assessment to remain seated or standing in the same place to prevent accidental injury. c. Conduct a focused ALS skin assessment on anatomical locations of trauma reported by the patient and where possible injuries were visible under white light examination. i. Begin the ALS absorption exam using violet or blue light with yellow goggles. ii. Consider additional assessments using orange goggles. d. Record ALS examination observations using written and digital photographic documentation with a colored camera filter consistent with the goggle color worn during the exam.
6. AFTER THE EXAMINATION
a. Review the ALS exam findings with the patient and answer their questions. b. Sanitize the equipment based on manufacturers' recommendations and organizational policy. c. Store ALS equipment in a safe, dry, secure location with limited access.

Documentation

Written

A documented skin assessment in the medical record should represent a true and accurate description of how the clinician conducted the exam, observations during the exam, and the patient's condition during the ALS skin assessment. The clinician responsible for the skin assessment should complete the written documentation as soon as feasible after the patient encounter. In some healthcare settings, the clinician responsible for the skin assessment may receive assistance documenting during the examination, such as from a scribe, second clinician, technician, or clinician in training. Clinicians who receive help from support staff during the patient encounter remain responsible for accurate documentation and should review the exam notes for accuracy and consistency with observations during the patient encounter.

In addition to a history of physical trauma, written documentation of injuries observed during the **white light examination** should include:

- Description of observed injury (e.g., type, size, shape, color, presence of induration or swelling)
- Location of injury on the body (e.g., body map, distance from nearby anatomical structures)
- Evidence of healing (e.g., wound margins, granulation tissue, crusting)
- Presence of pain, tenderness, or other sensation as described by the patient (e.g., numb, throbbing, burning)
- Discharge from wound (e.g., bleeding, serosanguinous weeping)
- Other descriptors applicable to the type of injury (e.g., active bleeding, evidence of infection, bridging tissue)

When documenting the appearance and location of debris or substances on the skin collected during the white light examination, avoid subjective statements identifying the item/substance (e.g., semen) unless local protocols require identification based on patient history (e.g., possible semen, saliva, emesis) or point of care presumptive testing.

Written documentation of the process and observed findings during the **ALS examination** should include the following:

- ALS equipment used, including settings (i.e., wavelength or color light)
- Color of goggles worn during the exam
- Skin cleanser used
- Presence of absorption or fluorescence or both
- Location of absorption/fluorescence on the body (e.g., using a body map or distance from nearby anatomical structures)
- Size and shape of absorption area

Deferring the ALS skin assessment or completing a limited ALS skin assessment should also be documented, including the rationale for a deferred or limited assessment (e.g., patient preference, patient comfort, equipment malfunction).

Digital Photodocumentation

Considerations for digital photodocumentation apply equally to images collected during the white light skin assessment, ALS skin assessment, and any other images obtained during the patient encounter. Whether an independent forensic clinician, independent clinical forensic program, or clinical forensic unit is part of a healthcare system, policies and procedures should exist for handling digital images obtained during a patient encounter. Considerations include, but are not limited to:

- When to collect images
- Who can collect images
- How images are collected
- Deferring image collection
- Transferring image data for temporary, long-term, and permanent storage
- Security of image data before transfer and after transfer to storage
- Access to stored image data
- Transferring image data to external entities

Testimony

Testimony is a typical responsibility of forensic clinicians where they appear as a fact witness, expert witness, or both during legal proceedings. Clinicians are held to a professional scope and standard of practice based on their education, license, and additional training. All forensic clinicians must practice within the limits of their licensure, know the duties and responsibilities within their scope and standards of practice, and be able to describe each to non-clinician professionals and laypersons.

Additional standards include practices related to clinical forensic interventions, such as collecting items from a patient's body that may hold evidentiary value (e.g., swabbed substances, collecting debris, collecting or receiving clothing). Testimony preparation includes all aspects of the clinician's education, licensure, certifications, ongoing education, additional training, and the clinical forensic interventions provided during a specific patient encounter.

Testimony considerations for an ALS skin assessment include, but are not limited to:

- Clinical decisions to complete or defer an ALS assessment when it is a typical intervention in practice.
- How the ALS equipment works and associated processes in the clinical setting.
- Strengths and weaknesses of research on the clinical application of ALS.
- The science supporting ALS use in clinical settings during a skin assessment.
- Clinical interpretation of observations or lack of observations.
- Confounding factors that can affect the presence or absence of clinical observations.
- Limitations of use and interpretation.

The depth of testimony and types of questions can vary depending on witness status - fact witness versus expert witness testimony. For example, an expert witness may receive questions about specific research findings and publications.

The following table (Table 2) lists potential questions about the ALS skin assessment that may arise during testimony. This list of questions is not exhaustive, and the suggested responses may not be appropriate in all situations.

Table 2. Potential Testimony Questions Related to ALS Skin Assessment

QUESTION	POTENTIAL RESPONSE
What education or training have you received for using ALS during a patient exam?	[Specify initial and continuing didactic, hands-on, experiential learning, and clinical training received.]
How do you use the alternate light source during a patient exam?	Our program follows an established research-based protocol. First, I conducted a head-to-toe physical exam and documented my observations under normal lighting. Then, I used the alternate light source to observe for signs of fluorescence on the patient's skin that may indicate the presence of physical evidence. For this step, I used a [specify color] light and [specify color] goggles. After collecting that material, I gently washed the skin using [specify product used]. Finally, I again used the alternate light source to observe for any light absorption in the areas where the patient reported trauma. I used a [specify color] light and [specify color] goggles to assess for evidence of bruising.
How does light absorption differ from fluorescence?	Absorbed light appears dark compared to the surrounding skin. Alternate light can also cause molecules of other types of physical evidence, such as semen and fibers, to become excited, causing them to appear very bright. This phenomenon is called fluorescence.
Tell us about the equipment [alternate light source] you use.	Our department uses [provide name]. It is a handheld device and works off a battery.
Why did you use an ALS during your examination of this patient?	The patient reported a history of physical trauma. Bruises can be challenging to see for a variety of reasons. After completing the head-to-toe physical exam, I used an alternate light source to see if I could detect additional signs of possible bruising. An alternate light source is a special light with a specific wavelength. The light is absorbed by different components of the blood in a bruise, causing it to appear dark compared to the surrounding skin. I wear colored goggles to see the areas of absorbed light.
You documented that you saw absorption during the exam. What does that mean?	The absorption I saw was consistent with the location of potential bruising based on the patient's report of experiencing trauma to that area. [If applicable: During my physical exam under exam room lighting, I also saw discoloration consistent with a bruise in the same location as the light absorption. The absorption area had faded at the follow-up exam and is consistent with a healing bruise.]

Supporting Evidence: [11,13,16,20]

User Education and Training

Any licensed healthcare provider who conducts medical forensic examinations (e.g., nurse, nurse practitioner, physician, physician assistant) in a clinical setting where ALS skin assessments are supported should receive proper training on its application.

Only forensic clinicians with appropriate education and training in using, documenting, and interpreting ALS findings should conduct skin assessments utilizing this technology. Such education and training are essential given the patient and user safety considerations reflected in this guide. Stakeholders, such as law enforcement, attorneys, and advocates, should be provided opportunities to receive education on ALS before its implementation into practice.

Initial user training should include a combination of didactic and experiential learning activities. Access to recorded didactic content and just-in-time learning modules allows for reviewing specific material as needed by an individual clinician. The following table (Table 3) lists key topics to include in the didactic portion of ALS skin assessment.

Table 3. Minimum Didactic ALS Training Content

FOUNDATIONAL CONCEPTS
A. Bruise physiology
B. Factors affecting bruise visibility and appearance
C. Basic physics of light
D. Light's behavior with skin and bruises
E. Factors affecting how light interacts with skin
F. Mechanics of an ALS
G. Types of ALS equipment and accessories
APPLICATION
H. Research evidence on ALS
I. Context for ALS use, including setting and patient conditions
J. Skin assessment skills (review)
K. Procedures for direct observation with ALS
L. Digital photodocumentation skills (review)
M. Procedures for digital photodocumentation with ALS
N. Documenting ALS findings
O. Interpretation of observations during ALS skin assessment
P. Testimony related to ALS findings

Additionally, users must receive education and demonstrate an understanding of these clinical practice guidelines and associated organizational policies/procedures directing ALS use. As with any equipment in the clinical setting, users should receive hands-on training and practice with the ALS and digital photodocumentation equipment and demonstrate competency before independent administration during a patient encounter.

Following the initial training, the user's organization should provide ongoing support to reinforce learning and address challenges with implementation. Ongoing access to continuing education in ALS should be provided annually or more frequently, depending on the number of patient examinations conducted.

Implications for Practice

The guidelines presented in this document are to assist forensic clinicians when incorporating an ALS during the skin assessment for injuries. These guidelines do not cover all patient scenarios. Clinical judgment is required to determine the suitability of an ALS skin assessment based on the best available evidence, examination context, patient preferences, and other factors.

Proper education and training are critical for the safe administration and appropriate interpretation of ALS skin assessment findings. Education about the clinical problem addressed by this practice change, the scientific basis of alternate light, and the content of these practice guidelines should be shared and discussed with stakeholders external to the patient and forensic nursing program (i.e., advocates, law enforcement, and prosecutors). Seeking input from stakeholders is recommended before implementing any significant practice change.

Organizational Support

A successful, sustainable, and measurable practice change requires organizational and leadership support. When integrating an ALS skin assessment into clinical forensic practice, organization support should include, but is not limited to:

- Investing in quality equipment
- Delivering access to initial and ongoing ALS training, including "just-in-time" learning options
- Modifying existing documentation (if necessary)
- Consistent, quality mentoring
- Establishing and maintaining relationships with stakeholders
- Providing additional resources identified by the clinicians.

Safety Considerations

Safety considerations throughout this document have emphasized the importance of protecting observers' eyes (i.e., clinician, patient, and all individuals present) when using ALS during skin assessments. Most ALS units with violet or blue light are a Risk Group 2 (Moderate Risk) at 20cm. UV light falls into Risk Group 3 (High Risk). According to international standards,[21] moderate risk light does not usually pose a danger to the eyes due to a person's natural response to look away from a bright light source or move away due to thermal discomfort. Various factors contribute to whether the potential hazard of ALS light becomes an actual hazard, such as distance from the eyes, exposure length, and light distribution by the light source. To avoid retinal damage, looking directly at the light should be limited to less than 0.25 seconds.[21] Because a patient or observer may be unable (or unwilling) to look away during an ALS skin assessment, all persons present should wear protective eyewear.

Limitations of Alternate Light

Outside of safety risks, additional challenges can occur if administering or interpreting the application of an ALS during a clinical skin assessment outside of what the evidence base supports. Forensic clinicians who implement an ALS during skin assessments must know the limitations of the technology and its related findings, both in general and for the specific patient. Such limitations may include:

- Whether positive or negative for absorption, ALS findings are not diagnostic for the presence or absence of injury.
- Interpretation of ALS findings does not occur in isolation; the context of interpretation includes patient history and clinical assessment findings.
- Observed light absorption similar to bruising may occur when using an ALS on other skin lesions, such as acne, pressure injuries, scars, hyperpigmentation (e.g., birthmarks, congenital dermal melanocytosis), nevi, and tattoos.[11,13,20,22]
- Topical products (i.e., cosmetics and sunscreen) can cause light absorption.[18,23]
- Medical conditions and medications that affect chromophores in the blood/skin tissue can affect absorption during an ALS skin assessment.
- Not all bruises will absorb light. The depth of light penetration from an ALS differs by wavelength. Bruises and other injuries can be present in the tissue beyond the penetration depth of the light wavelength.
- According to research, an ALS skin assessment for absorption has high sensitivity and low specificity. [11,14,16]

Before implementing an ALS skin assessment in practice, education must include the limits of the technology, limits related to the interpretation of findings, and how to document actions to mitigate false absorption findings and identify potentially confounding factors for absorption (e.g., medications, diagnosis, skin conditions).

Future Considerations

The clinical practice guidelines provided in this document are not static, and users should ensure they have the most current version available. Research on using alternate light in injury visualization continues to evolve in the US and internationally. This ongoing research is expected to affect the future use of alternate light among living and deceased patients, ensuring knowledge continues to advance. These guidelines are subject to ongoing review and updating as the results of such research begin to have a practical impact.

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Appendix A: ALS Evidence Table

Clinicians are responsible for maintaining knowledge of current literature regarding their practice. The following table provides a chronological list of published research literature investigating the use of visible spectrum (400-700nm) ALS for the clinical assessment of skin injuries. The list is current as of this document's publication date.

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
Scafide et al. (2022), US Secondary data analysis of prospective (21 times over 4 weeks), RCT with crossover design	• 157 adults with inflicted bruise to an upper arm • 2897 skin assessments • 73% female • 23% Black; 30% brown/dark skin pigmentation • Age M=24yrs	• Multiwavelength unit: HandScope® Xenon FLS HSX-5000 • Wavelengths: ○ UV (350nm) ○ Violet (415nm) ○ Blue (450nm) ○ Blue/green (475nm) ○ Green (495nm, 515nm, 535nm) • Goggles: ○ Yellow ○ Orange ○ Red	• ALS 415nm or 450nm with yellow goggles had more frequent detection of bruising than white light across all skin pigmentation groups. • 415 nm and 450 nm viewed through yellow goggles had the greatest detection probability across all skin pigmentation categories (415nm: probability estimate=0.90-0.99; 450nm: estimate=0.85-0.99). • Orange goggles were less effective on dark pigmentation (probability estimate 415nm=0.70, 450nm=0.79) than white light (estimate=0.81).	• Outcome assessor not blinded • Bruise location restricted to arms may limit generalizability

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
Scafide, Sheridan, et al. (2020), US Prospective (21 times over 4 weeks), RCT with crossover design	• 157 adults with inflicted bruise to upper arm and forearm • 73% female • 23% Black; 34% brown/dark skin pigment • Age M=24yrs	• Multiwavelength unit: HandScope® Xenon FLS HSX-5000 • Wavelengths: ○ UV (350nm) ○ Violet (415nm) ○ Blue (450nm) ○ Blue/green (475nm) ○ Green (495nm, 515nm, & 535nm) • Goggles: ○ Yellow ○ Orange ○ Red	• ALS more frequently detected bruising than white light; most frequent was 415nm or 450nm with yellow goggles. • More bruises visible under ALS (n=103, 81.8%) than white light (n=64, 50.8%) after 4 weeks • ALS using 415nm & 450 nm with yellow goggles had greater odds of detecting bruising than white light while controlling for injury age and other factors (415 nm yellow: OR=5.34, 95% CI: 4.35-6.56; 450 nm yellow: OR=4.08, 95% CI: 3.36-4.96). • Orange filter was effective but only on superficial bruises (415 nm: OR=1.42, 95% CI: 1.20-1.68; 450 nm: OR=1.77, 95% CI: 1.50-2.10).	• Outcome assessor not blinded • Forearm induction method may not be effective • Bruise location restricted to arms may limit generalizability
Scafide, Sharma et al. (2020), US Prospective (9-12 times over 3	• 8 adults with inflicted bruises to a forearm	• Multiwavelength unit: HandScope® Xenon FLS HSX-5000 • Wavelengths:	• Detected bruising in 78% of assessments; of those, 98% detected by ALS, and 24% detected by white light	• Pilot study • Bruise induction method may not be effective

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
days), quasi-experimental crossover design	• 59 skin assessments • n=3 females • n=5 dark skin tone • Age M=28yrs	○ UV (350nm) ○ Violet (415nm) ○ Blue (450nm) ○ Blue/green (475nm) ○ Green (495nm, 515nm, & 535nm) • Goggles: ○ Yellow ○ Orange ○ Red	• Shorter wavelengths (UV, 415nm, or 450 nm) had a greater likelihood of detection than higher ALS wavelengths over time ($p=0.002$) • Goggle color not associated with detection ($p=0.453$)	• Light source order not randomized – potential carry-over bias • No evaluation of reliability between observers • Outcome assessor not blinded • Insufficient power to detect differences in detection by colored goggles • Small sample limits generalizability
Nijs et al. (2019) Prospective (0.25, 1, 2, 7, and 14 days), quasi-experimental crossover design	• 73 adults with photographs of inflicted bruises on forearms • 170 assessments • 50.7% females • 100% Caucasian	• Single wavelength unit: Projectina, SL-450 • Wavelength: ○ Violet: 415 nm • Camera Filter ○ Yellow	• Visibility measured 1-10 scale • Fewer bruises detected using ALS than white light ($p<0.02$). • Mean visibility was higher using an ALS than white light on Days 1 & 2 ($p < 0.01$; $p < 0.05$, respectively). However, the difference was small (Day 1=0.6 and Day 2=0.4).	• Outcome assessor not blinded • Subjective visibility scale • Statistics used (i.e., logistic regression) are not appropriate for repeated measures

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
	• Age M=37 years		• No significant difference in bruise visibility at other time points (0.25, 7, and 14 days)	• All participants are Caucasian, limiting generalizability
Mimasaka et al. (2018), Japan Prospective (daily for 7 days, then weekly until resolution), quasi-experimental crossover design	• 15 healthy children with existing accidental bruises • Unknown gender • Unknown skin tone • Age M=11 years	• Single wavelength units: Blue ring Illuma-Light™ and Crime-lite® 2 • Wavelengths: ○ Blue ring light (450-500 nm) ○ UV (350-380 nm) ○ Blue (420-470 nm) ○ Violet (400-430 nm) • Goggles/filter: ○ Yellow	• Mean time bruise visible: violet light=2.1 months (mo), blue light=1.5 mo, UV=1.1 mo, blue ring=7 days, and white light=6 days • Bruises were visible under violet light for a longer duration than other light sources ($p < 0.001$)	• Unknown whether observers were blinded or the reliability of observers • Participant's skin tone is unknown • Small sample limits generalizability
Lombardi et al. (2015), US Prospective (1, 7, & 14 days), single-blind, RCT design	• 59 adults with 118 inflicted latent bruises on forearms • 56 case arms, 62 control arms	• Multiwavelength unit: Mini-Crimescope 400® • Wavelengths: ○ UV (300nm) ○ Violet (415nm) ○ Blue (455 nm)	• ALS had consistently higher sensitivity* (60.7 – 76.8%) than white light (32.1 – 69.6%). • White light had consistently higher specificity* (71.0 – 86.9%) than ALS (51.6 – 59.7%).	• ALS wavelength order not randomized: potential carry-over bias

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
	• 5.1% Black • M age=35yrs	○ CSS ○ Green (515 nm, 535 nm, 555 nm) • Goggles: ○ Yellow ○ Orange ○ Red	• Wavelength (goggles) with the highest sensitivity/specificity: ○ Day 1 – UV, 415nm (yellow/orange), 455nm (yellow/orange), CSS (orange) ○ Day 7 – UV, 415nm (yellow/orange/red), 455nm (yellow, orange, red), CSS (orange/red), 515/535/555 (red). ○ Day 14 – 415nm (yellow/orange/red), 455nm (orange/red), CSS/515/535 (red).	• Bruise induction method may not be effective • Incidental trauma to arms between repeated (blinded) assessments may create false positives • Possible underestimating sensitivity due to over precise (0.5cm) benchmark distance of observation to the trauma site • Few participants with dark skin tone – limiting generalizability • Incorrect terminology used to describe positive ALS findings (i.e., fluorescence)

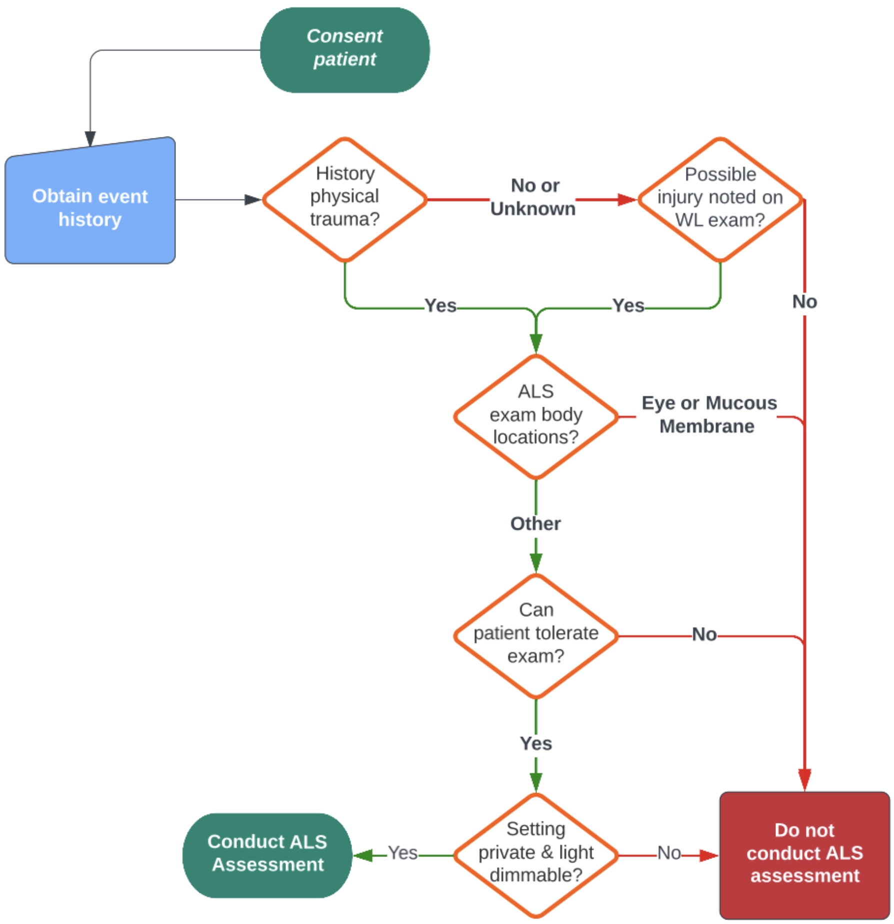
Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
Holbrook & Jackson (2013), US Retrospective, descriptive design	• 172 patients reporting strangulation during DV or SA or both • 99% female • 69% Black • Unknown age	• Multiwavelength unit: SPEX CrimeScope® • Wavelengths (clinicians' choice): ○ UV ○ Violet (415nm) ○ Blue (450nm) ○ Blue-green (475nm or 495nm ○ Green (515nm, 535nm) ○ CSS (<520nm) • Goggles (clinicians' choice): ○ Yellow ○ Orange ○ Red	• 93% (n=160) of cases not visible to the naked eye • Of these, 98% (n=157) had positive ALS findings • Blue ALS light was reported by clinicians as being most frequently used to visualize bruising (56.4%, n=97) • Orange goggles were reported most frequently by clinicians as being used to visualize bruising (70.3%, n=121)	• Retrospective design cannot establish causation • Limited or no information on skin assessment protocol and data collection • Only descriptive statistics – limited generalizability beyond the sample
Limmen et al. (2013), Netherlands	• 53 patients • 63 existing injuries • 50% female	• Single wavelength units: Crime-lites® • Wavelengths:	• 43% of injuries showed improved visibility with ALS, including hematomas/bruises (n=11), erythema (n=7), tenderness with	• Goggles/filters used are unknown • Participant's skin tone is unknown

Author (Year), Country & Study Design	Participants/ Observations	ALS Equipment (wavelength/filter)	Major Findings	Study Limitations
Cross-sectional, quasi-experimental crossover, descriptive design	• Unknown skin tone • Age M=29 yrs. • Injury age M=2.6 days	○ Violet (400-420 nm) ○ Blue (430-470 nm) ○ Blue-green (460-510 nm) ○ Green (500-550 nm) • Filters/goggles: unspecified	no visible injury (n=4), abrasion (n=4), and swelling (n=1) • Most observations with improved visibility were with violet or blue light (respectively, 32% and 35%) • Blue/green & green had the most observations with worse visibility (respectively, 19% and 41%)	• Single observer – outcome assessor not blinded • Light source order not randomized: carry-over bias • Subjective visibility scale • Only descriptive statistics – limited generalizability beyond the sample

Acronyms: ALS=alternate light source, CSS=crime scene search, DV=domestic violence, M=mean, SA=sexual assault, UV=ultraviolet, SD=Standard deviation
*Sensitivity: probability of detecting a bruise when there is a bruise; Specificity: probability of not detecting a bruise when there is no bruise

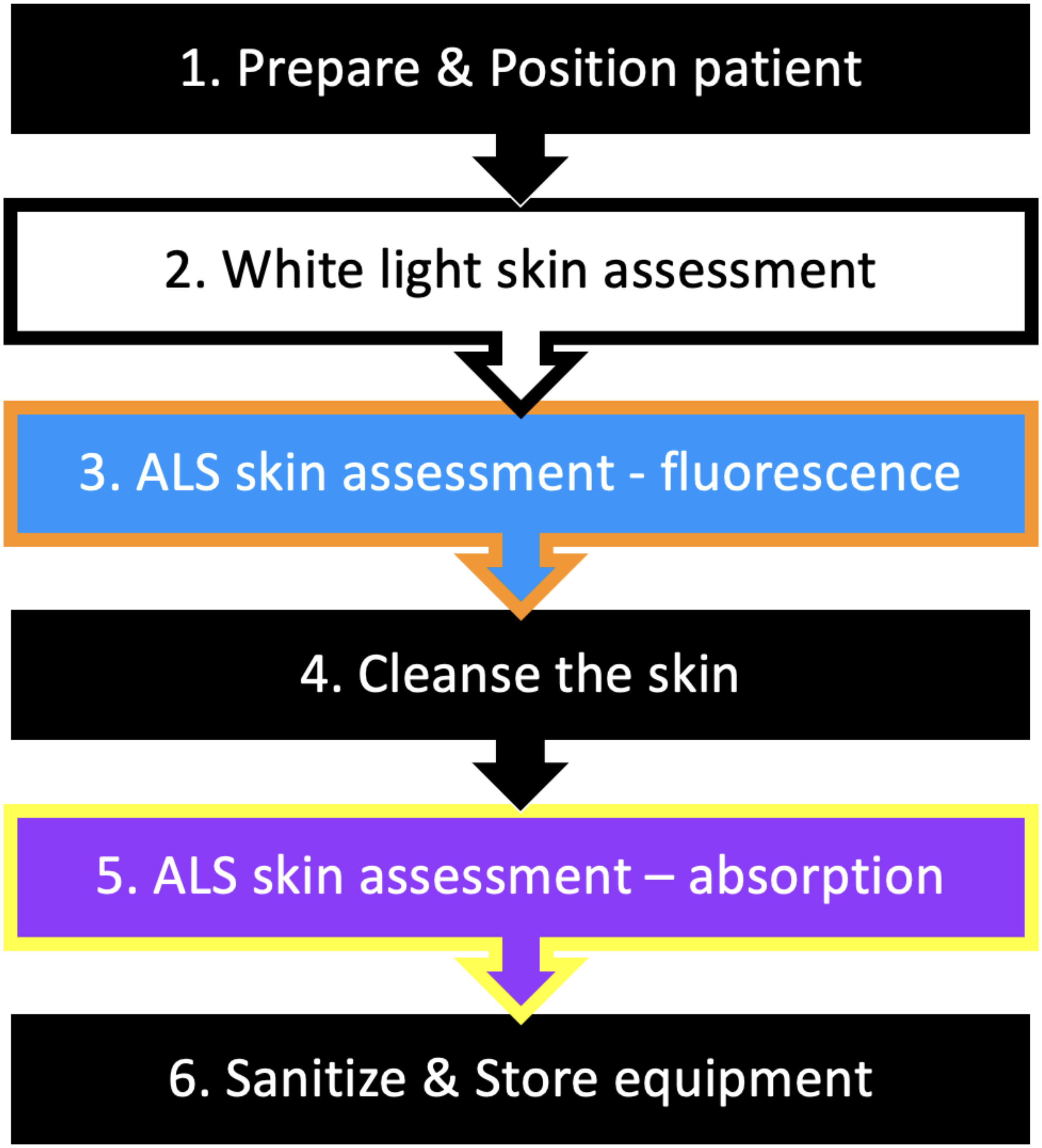
Appendix B: Decision-making Algorithm

The following algorithm provides simplified steps for determining whether using an ALS to assist with injury assessment is appropriate for a patient. Clinical judgment is required to determine when deviations from the algorithm are ethical, safe, and in the patient's best interest.



WL = White light

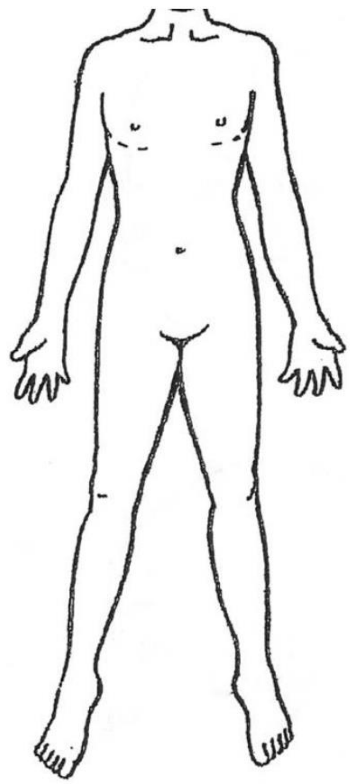
Appendix C: AtLAST Protocol Checklist Placard



Appendix D: Example Written Documentation

The following example of ALS documentation is an excerpt from a forensic medical examination record provided in this appendix with permission.

LEGEND: Types of Findings	
AB	Abrasion
ALS-A	Alternate Light-Absorption
ALS-F	Alternate Light-Fluorescence
AV	Avulsion
BI	Bite (per patient history)
BR	Bruise
BU	Burn
DE	Debris
DF	Deformity
EC	Ecchymosis
ER	Erythema
FB	Foreign Body
IN	Induration
IW	Incised Wound
LA	Laceration
OBF	Other Body Fluids/ Secretions
OI	Other Injury
PE	Petechiae/ Microhemorrhage
PI	Pattern Injury
SI	Suction Injury (per patient history)
ST	Skin tears
SW	Swelling
TE	Tenderness



Locator #	Type	Description

RECORD EXAM METHODS

	No	Yes		No	Yes
Speculum	☐	☐	Toluidine Blue Dye	☐	☐
Foley Techniques	☐	☐	Radiological Studies	☐	☐
Cotton Swab/Q-Tip	☐	☐	Anoscope	☐	☐
Alternate Light Source	☐	☐			

If yes, ☐ Full ☐ Limited (explain)____________________________

Color of glasses: ☐ Yellow ☐ Orange Light color: Blue

Color of filter: ☐ Yellow ☐ Orange

If no, state reason: ☐ Patient declined ☐ Not indicated per patient history ☐ Equipment unavailable

☐ Other (explain)____________________________

The authors of the AtLAST Clinical Practice Guidelines welcome feedback from the community of practice and stakeholders.

Please submit questions, recommendations, and comments using the following link or QR Code:

Community of Practice Feedback