Improving Bruise Detection in Patients with Dark Skin Tone

A forensic nurse partners with engineers to address health care equity.

This is the fifth article in a series on nurse innovators, which focuses whenever possible on nurse–engineer partnerships and outlines working, replicable models of collaboration between the two disciplines. In this installment, we profile Katherine N. Scafide, a forensic nurse and researcher, who has partnered with engineers over many years to improve bruise detection in patients with dark skin tone.

THE NURSE: KATHERINE N. SCAFIDE

Katherine N. Scafide graduated from Georgetown University in Washington, DC, with a BSN in 2000. Five years later, she completed her master's degree as a forensic clinical nurse specialist. She has worked as a forensic investigator and forensic nurse examiner, and continues to provide forensic consultation as an expert witness. It was through her clinical work that Scafide sought to address disparities in trauma care between patients with lighter and darker skin tones. Her desire to address this issue has fueled a long and nonconventional program of nursing research and innovation. Today, she is associate professor at George Mason University in Fairfax, Virginia, where she continues to be involved in an active research program to tackle this challenge.

THE PROBLEM: BRUISE DETECTION IN PATIENTS OF COLOR

As a forensic nurse examiner working primarily with victims of sexual assault, Scafide saw firsthand the difficulty in identifying bruises in patients with diverse skin tones. Because pigment is closer to the surface of the skin than a bruise, in patients with darker skin tones, bruise detection with the naked eye can be difficult or impossible. Scafide recalls a woman she cared for who had experienced sexual assault and reported having been bitten on her back. Unfortunately, during her assessment, Scafide was unable to see any marks, even after adjusting the lights and pulling out a flashlight. She realized that patients whose injuries cannot be seen or documented could face challenges being believed, may be more hesitant to ask for help, and could suffer inequities in their legal outcomes. As Scafide searched for clinical recommendations, she found that there was very little guidance or research on bruise identification in patients of color.

LEARNING MORE AND TEAMING UP

To tackle the problem of bruise detection across varying skin tones, Scafide had to first improve her understanding of skin anatomy, the properties of light, and current light technologies. To do this, she had to look beyond the nursing literature and collaborate with others outside of the nursing field. She recalls, "It was a lot of self-teaching, reading, and networking." While getting her PhD at Johns Hopkins University in Baltimore, Maryland, Scafide reached out to various academic departments to find collaborators and even enrolled in a gross anatomy class in the university's medical school to learn more about skin physiology.

It was during this time that Scafide first began to work with engineers. In order to study bruises, she decided to create them in subjects using paintballs. She teamed up with the engineering department at Johns Hopkins to use slow-motion video capture to investigate a paintball's force of impact and its equivalence to a violent injury. This research led to her dissertation, which described the relationship between changes in bruise color over time and skin tone, sex, and subcutaneous fat.[1]

Since that first collaboration, Scafide has consistently relied on the expertise of engineers and other disciplines. Engineers have been critical to helping her understand and apply different technologies. For example, Scafide has amassed the largest known body of digital bruise images in the world. By partnering with a health informaticist and an engineer who is an expert in deep machine learning, she intends to use this dataset to learn how to determine the age of bruises and to make these data available to others. As there is currently no valid approach to estimating the age of a bruise, her work is a powerful tool for forensic nurses, law enforcement, and health care clinicians.

Scafide says her interdisciplinary partnerships are rewarding, but she emphasizes the value of her nursing background to these partnerships. "I'm learning every day from them, but they don't have the clinical expertise. I'm essential to giving them the clinical understanding," she says. Her knowledge of anatomy, physiology, and the different physical conditions that impact bruise

formation has been vital to her work. This expertise helps build teamwork and mutual respect. "We have a wonderfully rich interdisciplinary partnership because we all value what each of us is contributing." Scafide notes that this spirit of interdisciplinary collaboration is a part of the forensic community, where nurses, engineers, DNA experts, toolmark experts, entomologists, and other disciplines often learn and work together.

INNOVATIVE SOLUTIONS

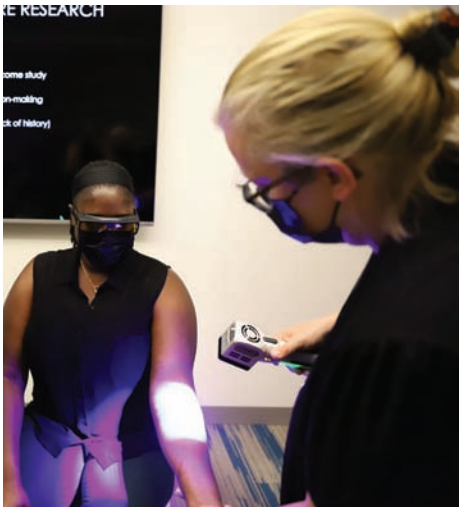
In her early work, Scafide was able to identify the best light wavelengths to use to visualize bruises across diverse patients using an alternate light source, or a light source that emits a specific bandwidth or color of light. For example, Scafide found that violet and blue light used with yellow goggles can detect bruises on darker skin up to five times easier than the traditional white light used in examination rooms. This technology was originally developed for forensic crime scene investigations to identify hard-to-see evidence. Scafide has since conducted focus groups with nurses to understand patients' experience with alternative light source forensic examinations and has found that patients really appreciate and value this technology. Patients feel truly validated when their injuries are seen and documented.

This research has dramatically improved the understanding of bruise detection across varying skin tones. Scafide sees her work as important to promote equity in care and to protect vulnerable populations, such as children or patients with cognitive challenges who may have difficulty communicating an injury.

Scafide's research has also helped reduce financial burdens on forensic nursing. By identifying the light wavelengths that are most effective, forensic nurses can use a device that emits a single wavelength to examine patients, rather than purchasing multiple devices or larger, more expensive equipment. She recalls that the older equipment can cost up to $10,000, but a high-quality, single-wavelength device may cost only around $3,000.

Future goals. Scafide is currently using her expertise to develop clinical practice guidelines for forensic nurses on the use of alternate light sources to detect bruising.[2] She has also created and tested a scale to enable nurses to rate the visibility of bruises.[3] In the future, she hopes to explore the improvement of available alternative light tools to make them lighter and more easily portable. She also sees potential applications for alternative light technology to improve pressure injury identification.

There is growing recognition of the importance of Scafide's work. She has received several grants from the National Institute of Justice to support her research. Her innovative ideas have been featured on the local and national news, and she has even garnered the support of actor Angelina Jolie, who is a vocal activist for victims of domestic abuse. While advocating for Congress to reauthorize the Violence Against Women Act in 2022, Jolie used Scafide's research to ask for more funding for technology that detects bruising and injuries across skin tones. The forensic community, law enforcement, and prosecutors are especially eager for Scafide's research to continue to improve bruise detection capabilities.



Katherine N. Scafide demonstrates how an alternate light source can be used to help detect evidence of bruising on a volunteer with dark skin tone. Photo courtesy of Katherine N. Scafide.

WORDS OF WISDOM

When asked for advice, Scafide notes the importance of "persistence, thinking outside the box, and looking to other disciplines, because not all the answers are in nursing." She has never been hesitant to reach out to others. When she wanted to perform a study using a $20,000 spectrometer, she called up the company that made the device and asked to borrow their equipment. When she had data that she couldn't find time to analyze, she turned to the bioengineering department at her university for help. When she wanted to pursue deep machine learning, she assembled her own team of experts. Scafide encourages others not to shy away from technology or from topics that may fall outside of a traditional nursing education. As she says, "Nursing research cannot operate in a silo." ▼

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