Increased Clinical Effectiveness in Pediatric Vascular Access with VeinViewer® by Christie Medical Holdings, Inc.

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Clinical studies have shown that between 25-50% of pediatric patients require multiple attempts to achieve peripheral intravascular access.[1-5] There are many reasons for this including smaller size of the veins and inability to adequately visualize and palpate them.[6] There are several imaging technologies health care professionals use to help improve their success rates, including transilluminators, ultrasound, and near-infrared imaging devices. In this paper, near-infrared imaging devices and their clinical successes will be specifically reviewed.

Transillumination has been successful by focusing light through the tissue, but it has largely been limited to infants and small children as it tends not to penetrate through thicker tissues or be anatomically useful beyond the hand or wrist area.[7] Ultrasound can provide excellent resolution of vessels and tissues using high frequency sounds waves delivered through a transducer held on the skin and the image being observed on a screen, but it requires the user to hold a transducer with one hand, perform the vascular puncture with the other hand, and possess the skill to think three dimensionally as one is looking at a two-dimensional image while attempting to place the needle in the center of the vessel.[8]

Near-infrared projection devices appear very practical in vascular access. One such device called VeinViewer® was created by Christie Medical Holdings, Inc.[9] This technology displays subcutaneous veins on the surface of the skin allowing the clinician to perform the vascular access with both hands, does not require three-dimensional extrapolation, and does not expose either the patient or the clinician to ionizing radiation.[9]

VeinViewer works simply by illuminating the area of interest with near-infrared (NIR) light, and because it is known that NIR light is absorbed by blood, an image of where the veins are and are not located can be displayed on the surface of the skin. First, the skin is flooded with safe NIR light (figure 1). The light not absorbed by the blood reflects back to the NIR detector (figure 2). The VeinViewer projector then projects the pattern of where the NIR light was and was not absorbed, with an image digitally enhanced for clarity (figure 3).

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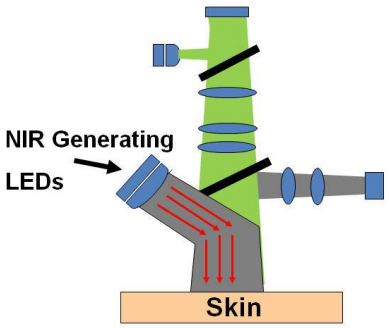

Figure 1

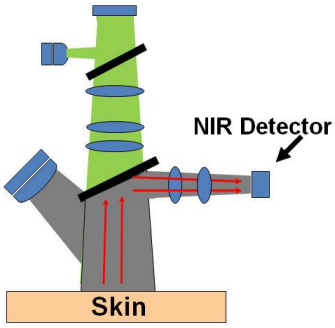

Figure 2

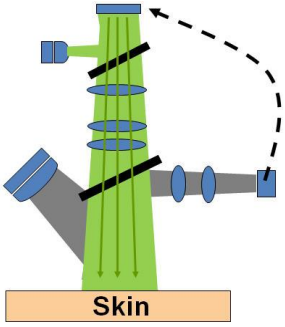

Figure 3

Clinical Studies

A number of peer reviewed articles about VeinViewer have been published showing both parent and clinician acceptance, and more importantly, statistically significant effectiveness.

In 2010, Hess published a prospective, non-randomized cohort study demonstrating that when using VeinViewer® a pediatric surgical unit's venipuncture first attempt success rate increased by a statistically significant 31% (49.3% to 80.2%, $p < 0.001$).[10] The mean number of attempts per patient decreased from 1.97 to 1.29 (table 1).

The percentage of procedures completed in 15 minutes or more increased from 52.8% to 86.7% (table 2). Results were statistically significant for all outcome variables between the two groups and also when re-analyzed in subgroups controlling for age.

Over a 9 month period, Strehle conducted a study regarding the usefulness of VeinViewer in the perception of both the user and the parent.[11] His findings from 50 surveys completed by a variety of health care professionals who used VeinViewer demonstrated that 72% of the doctors and nurses found it useful, no matter their level of experience or seniority. Visibility of the veins was noted as being "improved" 76% of the time and as the "same as with natural vision" 24% of the time. Parents were 100% accepting of the technology.

Limitations of the devices were noted by Hess and Strehle as the unit being both large and difficult to use in a confined space and or as an expensive piece of capital equipment. It is of note that both sites used the previous VeinViewer GS Model.

Table 1: Wolfson Children's Venipuncture Success Rates

Group (N)	First time success rate	Mean # of Attempts per Patient
Control (150)	49%	1.97
VeinViewer (91)	80%	1.29
Significance	X2(1) = 22.711 p < 0.001	t(227.8) = 5.198 p < 0.001

Table 2: Wolfson Children's Procedure Times and Subject Ages

Group (N)	Procedure Time 15 minutes or More	Mean Age (Years)
Control (150)	52.8%	5.7
VeinViewer (91)	86.7%	9.0
Significance	X2(1) = 28. 107 p < 0.001	t(191.1) = -4.056 p < 0.001

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Christie has released multiple generations of VeinViewer. Models currently available are substantially smaller in size and price point.

Strehle concluded that VeinViewer could assist healthcare workers in training with the localization of peripheral veins and is likely to increase the first puncture success rate, "…therefore reducing the amount of pain inflicted on acutely or chronically ill."[11]. And, Hess demonstrated what Strehle thought possible, the use of VeinViewer can increase the first puncture success rate in pediatric patients.

The financial benefits of decreased number of sticks for both venipunctures and intravenous access remains to be more thoroughly studied, but as estimated by Hess, a hospital experiencing at 30% first-stick success rate increase could save $720 per 100 IVs, or $86,400 annually if placing 1000 IVs a month.[10]

VeinViewer, as with all medical technology, is intended as a tool to help the clinician maximize their success and efficiencies in the daily procedures for both themselves, and most importantly, their patients. Christie is driven to providing innovative healthcare products and technologies that enhance patient care and outcomes while reducing costs and improving efficiency for healthcare organizations.

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