

Community Pharmacy Foundation Grant

Quantitative Test of Lower Extremity Circulation

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Introduction:

Greenhaw Pharmacy is an independently owned pharmacy located in Hillsboro, Kansas. Attached to the local Family Practice Clinic, the pharmacy has a total operating space of about 900 square feet. The staff includes 3.5 pharmacists, 2.5 technicians, one cashier, one office manager, one registered nurse, and a part-time delivery driver. Greenhaw Pharmacy staffs four registered pharmacists and two nationally certified technicians.

The residents of Marion County in rural Kansas depend upon Greenhaw Pharmacy to fulfill a variety of needs. Marion County has a population of just fewer than 13,000 and depends heavily on agriculture for its economic health. More specifically, Hillsboro has a population of about 3,000 people. To aid in growth and to keep competitive pricing, Greenhaw Pharmacy has increased prescription volume in part by reaching out to residents outside the city limits of Hillsboro. Product selection, charge accounts, mail and delivery services, and exceptional service are keys that make shopping with Greenhaw Pharmacy more convenient.

Greenhaw Pharmacy is open Monday through Friday 8:30am to 5:30pm and on Saturday 8:30am to noon. Twenty-four hour emergency call is also available. In addition to walk-in customers, the pharmacy services two nursing homes, three assisted living facilities, and does patient compliance packing on over 40 patients. The pharmacy focuses solely on health related items. Products include a variety of over-the-counter products, walkers, canes, crutches, and several other DME products available in the pharmacy or next day through the wholesaler. Greenhaw Pharmacy has recently become an Accredited DME provider.

In addition to the main pharmacy, Greenhaw Pharmacy Inc. also has office space in the Hillsboro Family Practice Clinic where a nurse is available. This space allows Greenhaw Pharmacy to be much more than a prescription shop. Within this area the pharmacists and registered nurse (Jeanne Rziha) perform a variety of functions including; compression stocking measurements, flu shots, diabetic screenings, diabetic counseling, diabetic shoe fittings, hemoglobin A1C, body fat analysis, dietary consults, blood pressure screening, osteoporosis screening, cholesterol checks, arterial elasticity testing, heart risk assessment (Framingham), facial skin analysis, and skin care consults.

With the seed money provided by the Community Pharmacy Foundation Grant, Greenhaw Pharmacy purchases and implemented a Photoplethysmography machine. The Elecat D-PPG/Quantitative Plethysmography is used to measure venous functions. It has the ability to detect both DVT and more superficial blood flow problems such as venous insufficiency, venous refill and venous reflux. Manufacturer supplied studies show the Quantitative Plethysmography to be 96% accurate compared to invasive procedures at detecting DVT and venous insufficiencies. The Elecat D-PPG is small and portable. Results are available within about 60 seconds per leg, and an automatic calibration feature enables adaptation to different skin pigmentations. Once the test is completed,

results obtained are stored and printed out on command. The printed reports include the D-PPG waveform along with additional hemodynamic parameters.

Patients with venous insufficiency probably do not care about venous refill time or pumping output. What they should care about are the effects venous insufficiency will have on their lives. Untreated venous insufficiency is a progressive disease and is attributed to swelling, skin changes, and tissue breakdown. Specific patient symptoms include burning, swelling, throbbing, cramping, aching, hyperpigmentation of the leg, heaviness, and leg fatigue. The symptoms are related to backflow of blood due to leaking venous vessels. This backflow results in pooling of blood and the circulation being compromised.

Graduated compression stockings provide symptomatic relieve by decreasing the backflow of venous blood. Sufficient compression is needed to minimize the backflow; too much compression can act like a tourniquet and make the leg circulation worse. Although it is difficult to determine the extent of backflow and how much compression is needed, an analytic approach to choosing the compression level would greatly aid in the compression selection process.

Objective:

The first objective was to assess the effects of various medical conditions on venous pump power. The medical conditions identified as high risk for lower leg circulation problems included: generalized leg pain, Restless Leg Syndrome, edema in ankles, Pre-Operative (Knee Replacement), Diabetes, generalized knot under knee, possible blood clot, and pregnancy.

The second objective was to identify venous refill insufficiencies and provide a quantitative aid in identifying need for support stockings. Although many factors are considered, the compression level is still somewhat an arbitrary number. The quantitative results produced by the Elecat D-PPG provide a more reliable and consistent approach to determining compression level. The Elecat D-PPG can also screen for earlier detection of venous disease, allowing for earlier diagnosis and treatment than what is currently available.

Methods:

The Elecat D-PGG Photoplethysmography machine uses LRR (light reflection rheography) to detect and report available hemodynamic parameters. The most important parameters are T_o (venous refill time) and V_o (Venous pumping output). Venous pumping output is determined by the movement of patient calf muscle contractions. As peripheral venous pressure decreases with calf muscle action, arterial inflow refills the leg. In legs with venous insufficiency, the refill time will be faster since venous blood is escaping form the normal flow and refluxing back to the congested leg. Measuring the refill time provides quantitative data, showing the overall circulation of the leg. The measurable quantitative parameters are as follows:

T_o = Venous Refill Time	
Greater than 25 seconds	Healthy vein
Between 24 and 20 seconds	Slight Disturbance

Between 19 and 10 seconds	Medium Disturbance
Less than 10 seconds	Severe disturbance
V_o = Venous Pumping Output	
Greater than or equal to 3%	Normal
Less than 3%	Disturbed

Test patients were selected randomly to examine lower extremity circulation. Test participants were identified as higher risk for leg circulation problems with one of the following medical conditions: generalized leg pain, Restless Leg Syndrome, edema in ankles, Pre-Operative (Knee Replacement), Diabetes, generalized knot under knee, possible blood clot, and pregnancy.

Results:

Quantitative Photoplethysmograph

Criteria for test	Age	Venous Refilling Time	Venous Pump Power	Symptoms
Legs ache	46	Rt. Leg = >48 Lt. Leg = >48	3.3% 2.7%	some edema some edema
Restless Leg Syndrome	52	Rt. Leg = 29 Lt. Leg = 19	7.5% 8.1%	leg pains, slight edema
Edema in ankles	61	Rt. Leg = >48 Lt. Leg = >48	4.1% 8.3%	edema in foot and ankles
Pre-Operative (Knee Replacement)	63	Rt. Leg = >48	8.5%	slight edema
Diabetic	71	Rt. Leg = 23 Lt. Leg = 45	4.0% 4.3%	edematous, reddened
Knot Under Knee (right)	53	Rt. Leg = 23 Lt. Leg =	2.5%	pain in knot
Possible Blood Clot	56	Rt. Leg = 7 Lt. Leg = 18	1.6% 4.4%	swollen leg, discolored some edema
Pregnant (8th month)	27	Rt. Leg = >42 Lt. Leg = 25	6.1% 5.7%	some edema some edema

LEGEND

Venous Refilling Time	
Normal:	>25 Seconds (healthy veins)
Insufficiency Level I:	24-20 seconds (slight discharge disorder)
Insufficiency Level II:	19-10 seconds (moderate discharge disorder)
Insufficiency Level III:	under 10 seconds (severe discharge disorder)
Venous Pumping Power	
Normal:	equal or above 3%
Pathological:	below 3%

Conclusion:

As one would expect, a variety of medical conditions can effect lower extremity circulation. This study showed the value of a Photoplethysmography machine in providing a quantitative way to look at circulation disorders. Instead of traditional more subjective tests, the Photoplethysmography machine provides a specific number showing Venous Refill Time and Venous Pump Power. These numbers can aid in diagnosis circulatory disorders by giving concrete data to compare to known, healthy extremity data. The test results can also be helpful in monitoring a specific patient by examining extremities over time.

Use of the Photoplethysmography machine could also serve as an early diagnostic tool. High risk medical conditions or patient's that present with early signs of circulation disorders could be examined and evaluated before additional signs or symptoms present. Done at a Community Pharmacy, this screening could become a valuable niche business. The Photoplethysmography machine could become a revenue source in both a charge for the test and resulting compression stocking sales.

During this study, a few limitations and challenges were identified. First, limited information is available in the operation and evaluation of test of the Photoplethysmography machine. This proved to be a major delay in the start-up and completion of our study. The Photoplethysmography machine came with very limited operating instructions. The sales representative that we purchased the test equipment from was also the sole person responsible for providing information. Communication was limited due to time zone differences and staffing hours available. Once training was complete, the Photoplethysmography machine proved to be a useful tool with reasonable ease of operation. The evaluation of results was also a challenge mainly due to the fact this technology is fairly new and in limited use.

A second limitation proved to be finding participants for the study. Greenhaw Pharmacy strives to be a vital member of there customers health. This positions us to have a good knowledge of individual's medical conditions and what role we can play in optimizing treatment. Even with this knowledge, patients that fit the test criteria were hard to identify. This resulted in a major limitation for this study of a very small sample base. To remain consistent throughout the test groups, the sample size was limited to 1 patient within each medical condition. This resulted in comparison between medical

conditions virtually impossible. What the data does do however, is show the value the Photoplethysmograph can provide in screening for lower leg circulation problems.

In conclusion, the Photoplethysmography machine could be a valuable part of a pharmacies screening and treatment programs. Taking some of the guess work out of compression hose selection will improve patient outcomes with proper fitting hose. In addition, the potential for early detection and treatment will be a valuable component of the Elecat D-PPG. Earlier detection will allow treatment to begin before the patient presents with the more severe symptoms of venous backflow.

Thank you for your support of this study. The support provided by The Community of Pharmacy Foundation for the ongoing interests in the practice of pharmacy is very much appreciated.

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