

# Clinical Application Using Heart Rate Variability

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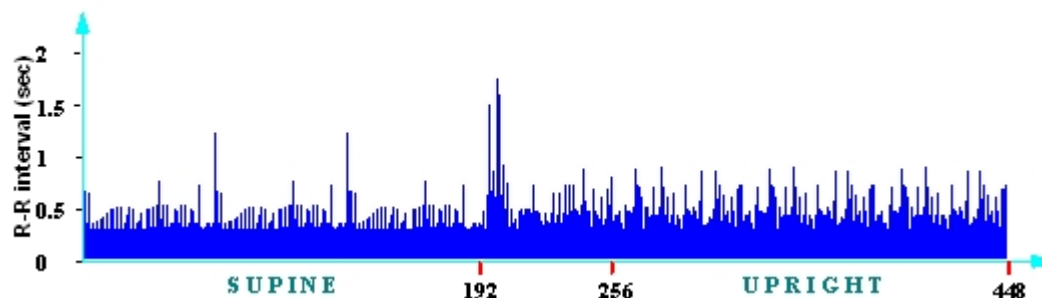
This article is designed as a continuation of the [Adaptability](#) article that appeared in the **February 2019** issue of “**The Scope**” newsletter. (You can read that article on [gonstead.com](#) by clicking on the “Members” tab and choosing “Newsletter Archives”.) The Adaptability article introduced HRV as a method of more fully measuring ANS physiology . In this article, HRV is shown as an actionable information source in clinical and personal practice.

## HRV What do I do with it?

I have been using HRV in both my personal and professional life for several years. I have found it to be a useful tool in my practice during the initial physical assessment of a new or returning patient, as well as for periodic re-evaluations. It can be performed in about five minutes with the unit that I use: NerveExpress by Intelliwave, Inc. It performs an Orthotest as well as Valsalva and Deep Breathing test, which produce several different views of the function and relative balance of the components of the autonomic nervous system (ANS). My goal is to use this technology to determine which areas of the ANS are dysfunctional, either over or under functioning, and to assess what interventions can assist the body in returning to a state of autonomic balance. Myself and others also hope that this technology can be used to objectively validate the greater effects of the Specific Gonstead Adjustment.

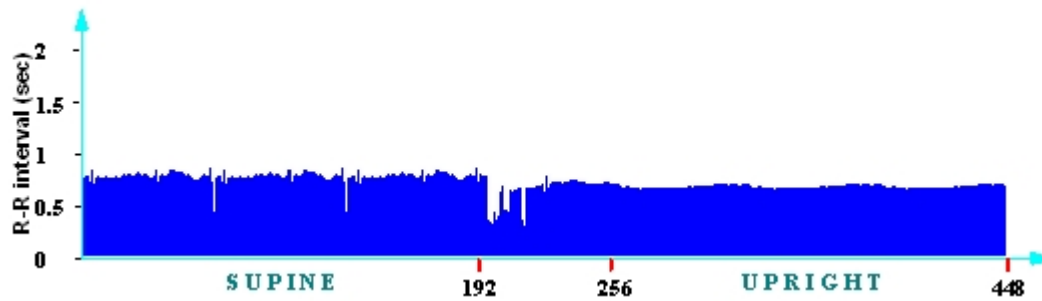
HRV can be a helpful tool, and it can also be very frustrating at times. Some patients respond well, and we see good improvements in ANS function, and others barely change at all. HRV is very susceptible to confounding variables and noise. Recently, I took a reading on a patient which showed very strange measurements. (figure 1)

Figure 1



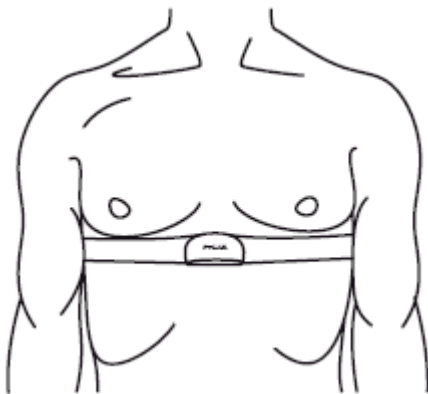
So, I changed the position of the chest belt, tightened it and re-wetted the electrodes. The test results were completely different after re-running it. (figure 2)

Figure 2



You can see the difference between the first and second heart rate pattern. The first is filled with ectopic beats and noise, while the second is much more uniform. The better of the two scans would still need manual cleaning to remove the small amount of remaining noise for research grade work. This machine does not have that option, so I review the data and determine how much noise is too much. The second scan is good for clinical use. The first scan is garbage, but it serves a useful purpose in that it shows what effect a 1.5-inch difference in position, 2 inches of slack in the belt taken up, and re-wetting the belt can make. (figure 3)

Figure 3



This patient is a large woman with abundant abdominal fat requiring that I position the belt without losing contact. The adipose tissue itself acts as an insulator and makes the reading more difficult to pick up, so these all have to be dealt with. Nevertheless, usable data can be obtained if you are diligent.

Another factor to keep in mind is that the Polar belt can become “polluted” over time by body care products, body oils and other compounds, which raise the resistance of the conductive plastic composition of the electrode. Over time, this will make the belt less and less sensitive and eventually the plastic will get brittle and break. Some will become unusable before they break. It is best to clean the electrodes regularly with soap or detergent (without moisturizers) and water. You can test the belt by checking its resistance with a multimeter if you suspect it may be a source of errors. The two electrodes can be brought into contact to complete a circuit and then the multimeter can test the points that the transmitter will plug into. The resistance across the circuit composed of the conductive plastic should be

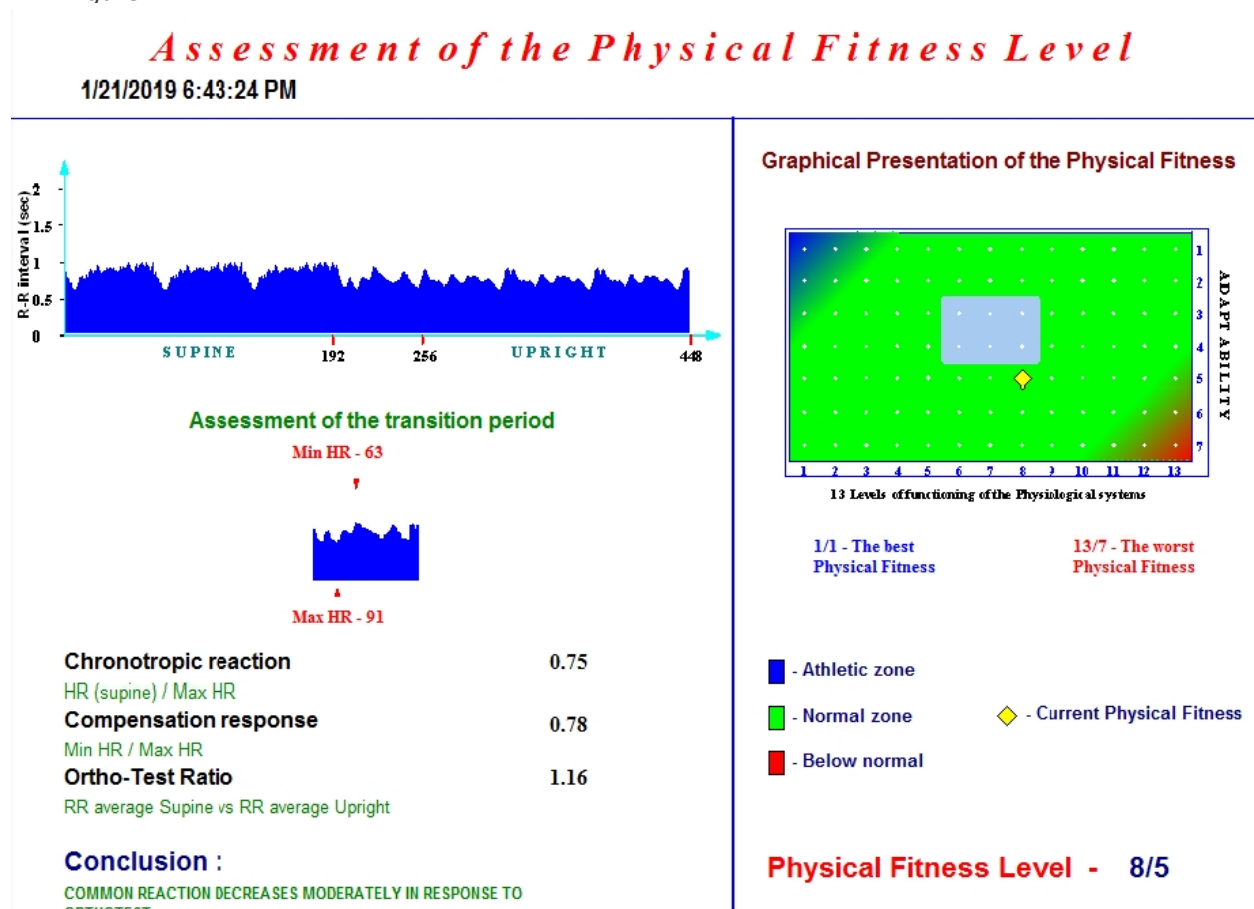
500-10,000 ohms, some will increase the resistance to up to 15-20,000 ohms or more and at this point they should be replaced. There is a fellow from Finland who hosts at YouTube channel: Tom Tech who can give you more information on this process: <https://www.youtube.com/watch?v=QXJ0spt9A1E>

I have worn out two different belts by wearing them 23.5 hours a day for weeks on end. And, I have learned from much trial and error that good data can usually be taken in less than three minutes thus avoiding the introduction of ectopic beats and noise which can contaminate the data. Noise will generally introduce an increase in variability of the signal, which will end up giving you SDNN and other HRV values that are higher than those without noise. In research, data that is not manually cleaned up to remove this noise results in HRV values that are unnaturally high. Dr. Gary Berntson advised us to take this fact into account whenever we read any HRV literature. Review the methods to see how the data was cleaned and whether a proprietary algorithm was used. This is one of the drawbacks of the units that I use. They both use proprietary algorithms. Yet, I feel that useful data can be obtained by taking care in performing the readings and discarding those with obvious noise—of which you will become more discerning with practice.

### How to use HRV

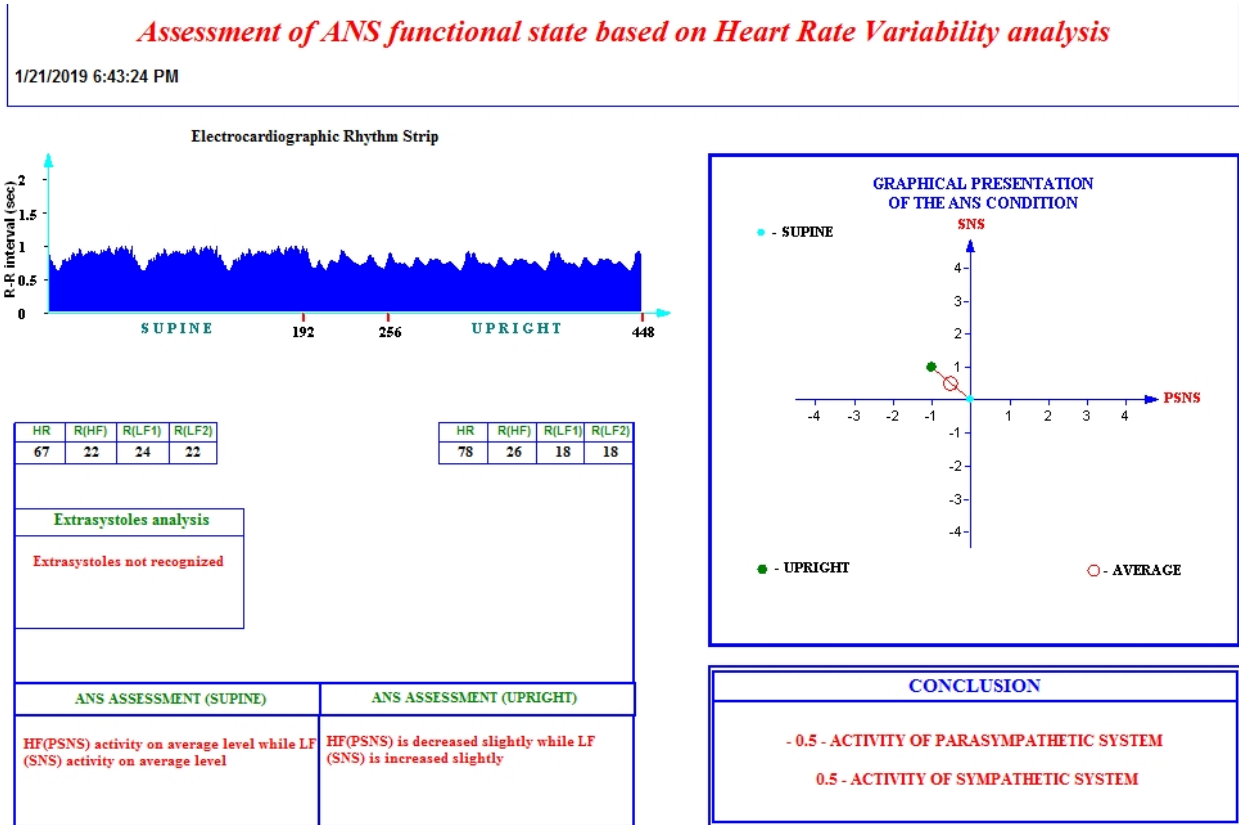
I use HRV several different ways. In the office I use it as a physical evaluation tool to assess the ANS functional state of my patients when they first come in for care and then on re-exams. Over time, I look for any trends or changes in ANS function that indicate improvement in Parasympathetic (PSNS) or Sympathetic (SNS) functional capacity, or any lack of change in ANS function. The Nerve Express unit has a Fitness Score that indicates a target zone for healthy individuals (figure 4)

Figure 4



as well as a graphical presentation of the ANS condition on an X-Y coordinate system, with the SNS function being displayed on the Y axis and the PSNS on the X axis. (figure 5)

Figure 5



This device has greatly increased in price since I purchased it ten years ago but is more useable than other devices. It can allow a good amount of data to be gathered in six to eight minutes and so is useful for clinical evaluations. <http://nerveexpress.com/>

I have also been using the Elite HRV App on my Samsung phone for my personal use. (figure 6) It has taken more than two years of constant working and tinkering with the App to learn how to get the most information. My conclusion: The most usable information is acquired by performing a consistent 2.5-minute 'Morning Readiness' daily snapshot. The routine is setup so that there are as few confounding variables as possible. Typically, I will do the scan after using the bathroom and before eating or drinking anything. My 2.5-minute reading is taken lying down and after a short rest period to slow the heart rate (usually a minute or less) while maintaining a normal breathing pattern and avoiding movement.

See next page for Figure 6

Figure 6



With a consistent data set of 140 days in a row at present, I can begin to determine which of many variables have an effect on my ANS. So far, the biggest variables have been sleep and alcohol use. I suspect there is an inflammatory effect from alcohol that negatively effects my nervous system. Also, one of the best methods I have found to improve my HRV morning readiness score is to get more sleep. I have been a night owl most of my life but am getting to bed earlier since seeing how much of a positive effect sleep has on my ANS function.

Other things that I have found to be supportive in increasing HRV, at least in the short term, is the practice of cold showers. I can see an increase of 15-20 points in a low morning HRV score by simply ending my shower with a minute of soaking cold water. I have also been experimenting with beginning the shower with cold switching to warm and then finishing with cold again. I suspect the body may habituate to any stimuli over time, so it may be good to mix it up and not do the same thing every time. I am still collecting data on this practice and will report when I know more.

I suspect there is an element of Trigeminal Nerve stimulation and the diving reflex neural pathways that are similar to the calming effects that can be obtained by splashing cold water on your face, or submerging your face in a basin of cool water. The following links dive deeper (pun intended) into this area of research. There appears to be 2 very different responses by the ANS to cold water applied to the face vs cold water applied to the body but not the face and head.

<https://www.physiology.org/doi/full/10.1152/physiol.00020.2013>

<https://www.physiology.org/doi/full/10.1152/advan.00045.2002>  
[utm\\_source=TrendMD&utm\\_medium=cpc&utm\\_campaign=Advances in Physiology Education Trend MD\\_0](https://www.physiology.org/doi/full/10.1152/advan.00045.2002?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Advances_in_Physiology_Education_TrendMD_0)

As a side note, there are striking similarities and overlap seen in the prior article on the diving reflex with the work of Dr. Steven Porges and Poly Vagal Theory.

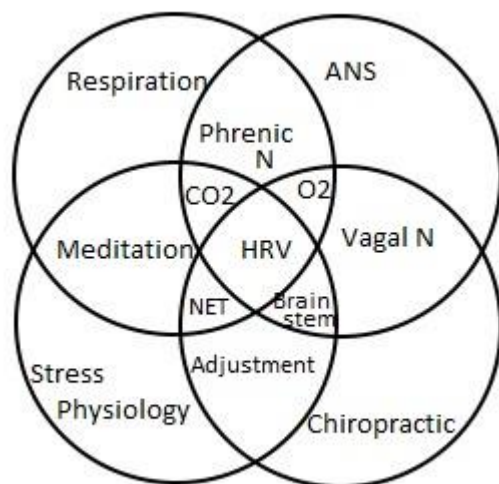
My suspicion is one of the benefits of the cold shower may be the control that one must exert over the vagal and phrenic nerves in order to control the reflex to shout and hyperventilate. The act of controlling one's breathing must play a role in this neural pathway change, and much like meditation, I suspect there is a toning effect on the phrenic and vagal pathways as well as on the sympathetic spinal motor nerves as pertain to breathing control as well. There is some promising research regarding ANS functional improvement and Inspiratory Muscle Strength Training IMST that shows a clinically relevant relationship between five minutes a day (thirty breaths) of IMST exercise a day for six weeks lowering systolic blood pressure by twelve points.

<https://www.sciencedaily.com/releases/2019/04/190408161643.htm>

<https://www.healthnutnews.com/quick-breathing-technique-lowers-blood-pressure-in-minutes/>

It is fascinating to see the connection between the act of influencing breathing through conscious control of physiology via the nervous system and the effect it has on the ANS and multiple other body systems. The whole field of research on Mindfulness Meditation is dependent on this link which greatly overlaps with the neural circuits and feedback loops that HRV is measuring. (figure 7)

Figure 7



To what extent is an adjustment in the thoracic spine influencing not only the disc and spine and nerves, but also the spinal sympathetic chain, the respiratory reflex, the diaphragm, the lungs and heart and the entire respiratory process? If a person cannot breathe, they will be in a highly SNS dominant physiology, so if they can breathe more freely post adjustment, does this allow an increase in PSNS function to be expressed? Is this a possible means by which adjusting in the “Sympathetic System” has a “Parasympathetic” effect?

#### Other tools:

The Oura Ring is another device for gathering HRV data but I don't have direct experience with it at this time. <https://ouraring.com/>

I know other practitioners who use the Oura Ring and report that they are very helpful in evaluating their sleep quality. It also records HRV values through the day and night. My friends have switched from using the Elite HRV to this platform and have found it to be better for their bio monitoring. One friend found that his sleep and HRV scores went up when he switched from a Ketogenic diet to re-incorporating some complex carbohydrates to his diet prior to bed. His body responded better, and his sleep improved after making this change. HRV data was able to provide quick feedback allowing him to see how this simple change effected his physiology.

There is a great quote from David Deutsch in the book *"The Beginning of Infinity"* where he says that we as a civilization do not need better and smarter people in positions of power and influence, but simply better feedback systems. This way, when we are in error, we can quickly make changes and then get feedback, and then make more changes and so on . . . I feel that HRV is one of those tools for providing feedback.

The developers of the Elite HRV App state that HRV is the best noninvasive test for determining your overall health and wellness status. This is a bold statement, but they may indeed be correct. I have not yet found a better and easier test that gives me the amount of information that this tool provides. The present problem is sorting through the sheer amount of information for the most useable/actionable parts.

How a specific adjustment affects HRV is still an open question. You can look at it over a time frame of minutes, hours or days. The longer the time period, the more other variables will begin to intrude on the effect that we hope to link to the adjustment intervention. We have yet to come up with experimental methodologies to allow us (with measurable uncertainty or certainty) to measure what affect a specific adjustment has on ANS physiology at a given time interval. Right now, I am using the HRV tools I have to do a quick and dirty reconnaissance of the ANS territory with the goal to do deeper more localized study of any anomalies or notable findings with the higher resolution that is available with research grade equipment. I think that right now the best use of my resources is to get a greater sense of the "lay of the land" so to speak. I hope to gather more reading in order to learn more, which will allow me and others to come back in the near future to study more deeply what is found of interest.

This is a time of making connections between many seemingly different fields of clinical and research science. The more you look, the more interconnected things become. I encourage each of you to look into HRV and the vast sea of research and publications that have already been done. And ask yourself how we can make valuable discoveries by using this tool in our own practice of Gonstead chiropractic.

#### **Future ideas:**

Adjustment of specific subluxation(s) and its observed effect on HRV, in different time intervals. The methodology for determining the subluxation and performing the adjustment will need to be standardized and controlled, and this is an area that certainly needs to be worked out.

HRV reducers: Air Pollution, Alcohol, Stress, Lack of Sleep, Subluxation, Injury, SNS activation, Respiratory Distress,

Means of modifying HRV via lifestyle: Diet, Exercise, Sleep, Social Contact, Stress reduction, Adjustments, Breathing work, IMST, DeFlame nutrition, Cold Showers, Omega 3 oils, Meditation, Shinrin Yoku, Carbohydrate intake modification or restriction, Ketogenic Diet.

HRV is a means of measuring the Vagal component of the ANS, there is more to the ANS for us to discuss, and other reflex arcs that can be evaluated apart from that which HRV measures:

- Pupillometry: CNs II Optic, III Oculomotor
- Pulse Wave Velocity: Cardiac Vagal ANS loop
- Rectal/Vaginal sensors for Biofeedback: Sacral ANS loop
- Special Visceral Efferents: Facial Sensation: CN V Trigeminal, Facial Expression: CN VII Facial N. Pharyngeal Arches: CN IX Glossopharyngeal N, X Vagal N. SCM and Trapezius Muscles: CN XI Spinal Accessory N.
- General Visceral Efferents: (To smooth muscle, cardiac muscle and glands) CN III Oculomotor N, CN VII Facial N, CN IX Glossopharyngeal N, CN X Vagal N,
- Gastric Motility: CN X Vagal N
- Special Visceral Efferents and Social Engagement: PVT of Steven Porges and Rosenberg's work
- Adverse Childhood Experiences (ACE's) study
- Uses of HRV: Athletic training, HIIT training and avoiding overtraining. Food Sensitivity testing, Interpersonal dynamics, drug uses screening, deception detection. Mental status testing/screening for high responsibility position: Air traffic controller, pilot, nuclear reactor manager. Psychophysiologic research, Marketing research, Military screening tool
- Means of altering HRV as observed by other HRV users in clinical practice
- Stress and HRV
- The link between Cranial Nerves: IX, X, XI, The nuclei of origin are the same for all 3 (Nucleus Ambiguus) and Nuclei of Efferent are the same as well (Solitary Nucleus)
- HRV and Senescence paper
- Palo Alto Homeostatic Capacity Prize

### **Addendum:**

There is some question as to which method of recording R-R intervals for HRV analysis is the best. And there is also the very big difference in the resources required to use the different methods in both time and monetary costs. The gold standard is the multiple lead ECG (3 to 6 leads) that has the sensors physically glued to the skin with a gel electrolyte coated electrode. This gives the readings with the least noise but are the most expensive and take the most time to get the data. And on top of that it will still



have to be manually cleaned. Examples are the Nerve Express ECG unit or the Mind Ware units.

<https://www.mindwaretech.com/>

The second level down regarding quality of reading is the Holter style chest monitor such as Polar makes, and which is used by the basic level Nerve Express unit or Elite HRV App. This has more noise, is hard to (impossible to) manually clean the data, but which is much easier to use in terms of convenience and time. They are less expensive as well. This is the method I use now clinically and personally.

The third level down is the photoplethysmography sensor that is applied to an extremity, i.e., finger cuff, wrist, watch or ring type, and uses a beam of IR light to take the R-R intervals. There is an increased likelihood of errors due to the distance from the heart and the fact that other variables can intrude on the physiology that you want to most directly measure, the CNS function. The more layers between what you desire to measure and the data you take, the more likely errors will accumulate.

Now that I have stated all of this, there is debate about whether the Holter belt, wrist and finger photoplethysmography sensors are really that inferior to the gold standard ECG data.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4751190/>

This paper analyses the differences in the end result of HRV data obtained by three different methods. It concludes that the end results are only marginally different between the three methods. As far as clinically vs potentially, some research-based data gathering may be largely functionally equivalent.

There is a chapter on remote monitoring in the *Handbook of Psychophysiology*, which asserts that the very act of taking a blood pressure changes the blood pressure in ways that are not able to be compensated for fully. There is a goal in the field of psychophysiology to develop ways to assess ANS function without touching a person potentially from a distance, or even from video recordings. This would allow more accurate measurements to be made of the ANS and how the body reacts free of the variables introduced by the tools used to make the measurements themselves. Motion Microscopy aka Eulerian Video Magnification (EVM) <https://www.extremetech.com/extreme/149623-mit-releases-open-source-software-that-reveals-invisible-motion-and-detail-in-video> is one of these promising technologies that we may be using in the future. This video shows its potential:

<https://www.youtube.com/watch?v=kztqmhX-dpY>

The field continues to change as the technology develops. Stay tuned for more changes. In the meantime, let's use the technology that is available now to see the effect that our work has on both our patients and ourselves. Start working with this technology and upgrade when time and money allow. Start playing with it in your own practices and in your own life and see what you can discover.