Biofeedback
Volume 47, Issue 1, pp. 12–21
DOI: 10.5298/1081-5937-47.1.04

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Research Article

Care for Biofeedback and Neurofeedback Instrumentation

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Keywords: biofeedback, neurofeedback, equipment maintenance, hygiene, infection risk mitigation

Hagedorn (2014) has highlighted the infection risks in biofeedback and neurofeedback practice and identified broad strategies for mitigating infection risk. In the age of Clostridum difficile, Methicillin-resistant Staphylococcus aureus, and human immunodeficiency virus, infection risk cannot be ignored in any health discipline that attaches sensors to patients' skin in most treatments. The present article discusses specific guidelines for care and hygiene of biofeedback and neurofeedback instruments, encoders, cables, and sensors. Attention to practice standards can greatly reduce the risk to practitioner and client alike.

Introduction

In a previous *Biofeedback* article, Hagedorn (2014) introduced the problem of infection and contagion in clinical biofeedback practice and suggested broad guidelines for mitigating infection risk in biofeedback and neurofeedback practice. The present article was developed by a team of practitioners and a biomedical engineer to provide more specific detail on care, cleaning, and aseptic techniques in biofeedback and neurofeedback.

Care for General Biofeedback Instrumentation

Although the care and hygiene of instrumentation for general biofeedback and neurofeedback overlap, there are differences. We will begin with a discussion of the care for instrumentation for general biofeedback (or "peripheral biofeedback") and turn to neurofeedback later in the article. When using biofeedback equipment in clinical practice, there are many pieces of equipment to manipulate and some of those components get in contact with various liquids or sticky pastes as well as in close contact with clients' skin. In order to ensure safe use of equipment, it is critical to be aware of potential risks to the equipment, to the practitioner, and to clients. We recommend establishing simple "rules of engagement" (or repetitive routines) to optimize the levels of cleanliness and hygiene in clinical practice.

Acquiring biofeedback and neurofeedback equipment represents a significant investment in clinical practice. Reading the user manual will generally inform the practitioner on the essential ways of caring for the equipment, but cleanliness and hygiene rules may vary depending on the practitioner's profession and specialty areas.

Care for Instrumentation

Manufacturers expend considerable effort in ensuring that delicate electronics are not exposed and at risk of being damaged by touch or minor fluid spills, but establishing a few basic care practices will minimize risk further.

Sensors and Encoder Boxes

- Keep the encoder device as far away from the client space as the cables will allow, to minimize the chances of getting abrasive or conductive paste on it. Abrasive or conductive pastes and gels will not only make the device and cables sticky and unappealing, they can also damage the electronics if they get on input/output sockets or inside the battery compartment. This rule also applies to the computer and USB connectors. With fiber optic and Bluetooth connections between encoder and computer, no paste or gel should reach the computer, and no client contact should reach the computer or its inputs/outputs.
- When using conductive pastes or gels, wash the stuff off sensors, cables, and devices as soon as possible after use because it is much easier to wash off when it is fresh. Dried-up paste may require a more forceful intervention, which can scratch delicate metal surfaces. The guideline is to *wipe, don't scrub*.
- Because conductive pastes are salt-based, they are corrosive to metallic surfaces. Leaving paste on electrodes and cables for too long can damage the generally thin

conductive surfaces of electrodes and tiny metallic pins inside the sensor and device connectors. Checking reusable electrodes for discolored surfaces and flaking of the conductive surface (metal plating or AgAgCl film) is a good habit to develop.
- When using cleaning products, don't spray or splash devices. Instead, wipe with a cloth, moistened with some cleaning fluid. (Specific cleaning products will be listed later.)

Cables and Electrode Leads

- Rinse your electrode leads with lukewarm water and hang them to dry as soon after use as possible to remove the paste.
- Don't soak cables or electrodes in cleaning products. After rinsing, wipe them with a cloth moistened with the cleaning product, let sit for a couple of minutes, and rinse once more to remove excess cleaning product from the surfaces that will be in contact with skin to prevent skin irritation.
- Having moist cleaning cloths on hand is useful, but don't have water containers on your desk. Spills happen fast and are devastating to electronic equipment.

Cleanliness

Basic cleanliness practices can be generalized to the entire clinical practice and involve things like washing hands between clients and after using conductive or abrasive paste. Using disposable electrodes is always better than reusing electrodes from client to client. Disposable electrodes are widely used now for surface electromyography, electrocardiogram, and electrodermal biofeedback. The thermistor utilized for temperature biofeedback, the photoplethysmograph utilized for blood volume pulse biofeedback (BVP), and the respirometer for respiratory biofeedback will be discussed separately, because no disposable electrodes are currently available for these modalities.

If you are going to reuse electrodes, it is better to reuse them with the same client, never with other clients. Wiping the hands with a moist towelette or a squirt of hand cleaner after touching clients and before touching equipment is also a good habit.

- While alcohol-based wipes are OK for cleaning the hands and equipment after manipulating conductive or abrasive paste, we recommend washing the hands with antibacterial soap between clients.
- Throw paper tissues and cotton swabs in the trash basket instead of putting them on the desk or tabletop, where they risk touching equipment.

Hygiene

Basic hygienic practices involve special attention when manipulating your equipment, using proper cleaning products, and understanding how viruses and bacteria are usually passed around.

- Think like a crime scene investigative agent. When you're working with a client, it is easy to touch the client, equipment, and workspace surfaces without awareness. If the client has a skin condition or even a cold, any object the practitioner touches in the environment can become a health hazard for the practitioner and for other clients. Restrict touching to a minimum and keep the things you touch in the same area, so they can be cleaned between clients.
- Wiping equipment that doesn't come in contact with clients using alcohol-based cleaner is acceptable, but it is essential to use a more powerful disinfectant cleaner for any sensor surface, reusable electrode, and electrode lead that makes contact with the client's skin.
- We recommend wiping sensor cases, attachment straps, cables, and electrode leads with a cloth moistened with the cleaning product. Let the product act for a minute or two, then wipe with a wet cloth to remove excess cleaning product. Electrode leads and straps, if they aren't attached to electronics, can be rinsed in lukewarm water and hung to dry. This avoids any skin irritation caused by the cleaning product. Don't soak electrodes and leads in the cleaning product. Soaking can damage electrodes and wires.
- There is a significant cost to disposable electrodes; nevertheless, we strongly recommend using disposable electrodes with each client, especially in busy practices. Reusing disposable electrodes, even for the same client, is not recommended because mistakes happen. A practitioner may inadvertently end up using one client's electrodes on another client. In addition, disposable electrodes are not made to last and the conductive surface wears off easily, which leads to bad signal quality.

Care for Nonelectrode Sensors

A number of physiological sensors, such as the temperature (thermistor), blood volume pulse (photoplethysmograph), and respiration (strain gauge), do not require disposable electrodes or use other means of separation between the client and the sensor. Because those sensors need to be placed directly on the client skin, basic cleanliness and hygienic precautions have to be taken when using these sensors. Finally, some sensors use reusable electrodes, which need to be cleaned between clients.

Temperature

Peripheral temperature biofeedback is often done using a thermistor-based sensor. The sensor uses a temperature-sensitive electronic component that needs to be placed directly on the fleshy part of a finger, in direct contact with the skin. Generally, the thermistor is directly soldered to the sensor cable and held in place with shrink tubing. Some effort is made to prevent fluids from being able to seep inside the plastic protection, but soaking the sensor in cleaning liquid could still damage the sensor. Instead, it is preferable to use a cloth, dampened with a bit of cleaning product, to wipe the thermistor and part of the sensor cable after each session. Allow a minute or two for the product to act and wipe the sensor again, with a clean wet cloth, to remove excess cleaning product.

Photoplethysmograph

The BVP sensor is a small box that needs to be held fairly tightly against the client's skin to work properly. The sensor shines infrared light of a specific frequency into the skin and measures variations in light absorption with each heartbeat. Generally, the sensor is built from two components: An infrared emitter (LED) shines infrared light through the client's finger, and an infrared sensor (photoelectric device) picks up the light that is reflected or transmitted by the finger's tissues to generate the pulse signal. These are generally set behind one or two small plastic windows on the surface of the sensor. The same cleaning method for the thermistor is recommended for the BVP sensor, but special care should be taken with the small windows, which can be slightly recessed inside the sensor case and a good place for dirt or cleaning substance residue to accumulate over time, to keep them clean and transparent. Any dirt on the window can dampen the amount of light that is passing through and weaken the BVP signal. The best way to prevent this is to use a cotton swab, slightly wet with alcohol, to clean the window. (Note: Some sensors place both components behind the same window, but other BVP sensors, such as those placed on the tip of a finger or an earlobe, shine the light through the tissues. These sensors have two windows, one on each side.)

Respiration

Most respiration sensors use some sort of strap contraption that needs to be fastened around the client's chest or abdomen. For the most part, respiration sensors can be used over the client's clothing, so they are not really in direct contact with the skin. The respiration sensor is usually built of two parts: the sensor box itself, which houses a stretch-sensitive electronic component (strain gauge), and the strap(s), which are attached to the sensor and wrapped around the client. The same cleaning method as recommended for the thermistor is recommended for the sensor box. If the straps can be unfastened from the sensor box, they can be cleaned by soaking using gentle laundry soap, rinsed thoroughly, and hung to dry. If they cannot be unfastened from the sensor box, then hold the sensor box in one hand while rinsing the straps as described above without getting the box wet. Do not soak the sensor box.

Reusable Components

Some manufactures provide reusable electrodes with their equipment. Skin conductance sensors often come with leads with snap adapters onto which you can attach removable electrodes. These electrodes tend to be a bit sturdier than disposable ones, so they can be used for multiple clients, but special cleanliness and hygienic care should be taken when using them.

Some reusable electrodes come sewn in the middle of a short Velcro strap that can easily be attached to a client's finger. Because reusable electrodes are going to be used on multiple clients, it is important to take a bit more care when using them. Soaking electrodes is not recommended because that can damage their conductive surface. Use a cloth, dampened with a bit of cleaning product, to wipe the electrode (gently, no scrubbing) and the Velcro strap. Allow a couple of minutes for the cleaning product to act and rinse the electrode under cold water, drying them immediately with a clean paper towel.

It is important to realize that the conductive surface (silver chloride) of all electrodes eventually wears off, so it is essential for clinicians to replace old electrodes with new ones every few months. A brief inspection of the conductive surface can reveal patches where the darker conductive stuff is scratched or peeled off. When the conductive surface wears out, the electrode's conductivity decreases and the signal quality declines.

Special Case: Vaginal or Rectal Sensors

In the biofeedback treatment of urinary or fecal incontinence and other pelvic floor disorders, the practitioner must without exception provide clients with their own vaginal or rectal sensors. This is a necessary and expected component of the client's expense. The practitioner is responsible to teach all new clients how to keep their sensors clean. Vaginal or rectal sensors should be cleaned before the first use and immediately after every use. The recommended method involves washing and lathering hands with soap in flowing lukewarm water, and then liberally applying the lather to the sensor, washing it carefully. The sensors can be rinsed but care should be taken to keep water off the sensor connector. Dry the sensor with a clean cloth or paper towel and allow it to completely air dry before storing it in its original box or in a plastic bag.

Further Considerations

As a general rule, biofeedback equipment prefers gentle disinfection to aggressive sterilization methods. Never subject biofeedback equipment to extreme temperatures or abrasive detergents and never boil or autoclave it. Recommended disinfectant cleaning products include Cidex®, Protex™, Sekusept® PLUS, and alcohol (70% isopropyl or 70% ethanol).

If a practitioner has a busy practice and equipment is intensively used every day, consider purchasing multiple sets of electrode leads and reusable electrodes, so that you can use one set while the others are being cleaned. Also, because intensively used equipment can break, make sure to have spare sensor cables and attachment straps to avoid downtime.

Keep in mind that sensors and electrodes that get in direct contact with clients can become potential biohazards. Handle and dispose of them in accordance with accepted medical practice and applicable local, state, and federal laws and regulations.

Equipment Care in Neurofeedback

The last decade has seen a notable amount of clinical (e.g., medical electroencephalography [EEG]), industry (e.g., neuromarketing), and consumer (e.g., attention and relaxation peak performance) market use in electrophysiology signal detection and feedback. Increasingly smaller and more portable electrophysiology recording devices are marketed to both medical and nonmedical markets for electrophysiology signal analysis and biofeedback applications. EEG necessitates contact between a person's scalp and some conductive electrode in order to obtain a sufficient electrode–electrolyte interface for electrical recording (Baek, Lee, Lim, & Park, 2013).

Electrodes designed to make contact with the person's skin have historically used highly conductive metal materials, but more recently these are giving way to new conductive materials that can be molded into many shapes and sizes. As a result of this electrode expansion and growing medical and nonmedical applications, it is prudent to summarily address this electrode technology emergence in the context of proper aseptic technique to mitigate transmission of disease and infection (e.g., human immunodeficiency virus, Methicillin-resistant Staphylococcus aureus; Ferree, Luu, Russell, & Tucker, 2001). This segment will highlight several classes of electrophysiology conductive electrodes and address the implicit need for hygienic use in the growing marketplace.

Several electrode materials and configurations (or "form factors") currently in clinical and consumer use are depicted in Table 1. There are many more examples, but these represent a good cross-section of the commonly seen material options and sensor configurations available. Not depicted are the electrodes that share the same material but make contact with other than scalp locations such as the ear lobes for grounding or reference purposes. In some instances, the disposable pre-gelled adhesive patches adhere to the skin and facilitate ground and/or reference contact points. While the adhesive patch is for single use, and thereby disposable, the snap "hub" that the patch connects to will most often also come into direct contact with the person's skin and therefore requires proper surface cleaning.

While the use of electrodes to deliver current to the skin surface is beyond the intended scope of this paper, it is nevertheless important to understand that the anode and cathode electrodes used for this neuromodulation purpose also come into contact with the person's skin. Therefore, cross-contamination potential exists if the device and associated electrode sponges or other configurations used are not handled with similar aseptic technique. For a more detailed discussion of this growing use of electrophysiology electrodes, which can both record EEG and deliver forms of electrical current, see the LOTES-2017 device standard (Bikson et al., 2018).

EEG recordings require conductive electrode contact with the scalp, through hair, and with configurations and conductive material selections that mitigate artifacts and aid or maintain ample conductivity. To this end, electrode materials are expanding from the more common metals (e.g., gold, silver, tin, silver coated with silver chloride, stainless steel) to novel bioactive materials like plylactic acid or polylactide. In addition, common configurations (e.g., flat surfaced, cup surfaced) are giving way to flexible bristle, foam pellets, dense sponge pillars, inflexible pins/posts, and other designs used with (wet) or without (dry) the addition of viscous or liquid electrolytic media (i.e.,

Table 1. Types of electrodes used to record electroencephalograms

Image	Conductive Material	Configuration
	Tin or Ag/AgCl with conductive hypoallergenic saline-based gel or paste	Silicone cup-surface design to hold conductive gel in a defined space. The sensor is held in place by molded plastic sewn or heat-molded into a cloth cap. Conductive gel is injected into a small port with a blunted needle.
	Foam impregnated with saline (0.9% NaCl) solution to facilitate conduction between metal contacts within the plastic hub and saline contact with the scalp.	The foam plug makes contact with the scalp on one end and the other end is held within a plastic hub sewn or otherwise attached to a cloth form-fitting cap covering the skull.
	Silver with conductive gel or paste applied to the sensor surface that is in turn in contact with the scalp.	Flat surface metal connected to conductive wire.

gel, paste, saline solution). Disposable three-dimensional printed or molded plastics mixed with carbon-based conductive compounds (i.e., graphene) are quickly becoming popular for consumer and clinical EEG applications due to lower costs, disposability, and good conduction (Xu et al., 2017).

The electrodes themselves and the headset or cap apparatus that holds the electrodes are subject to the all-important skill of aseptic technique (Hagedorn, 2014). The EEG skull-shaped caps, hair/head nets, head bands, plastic wands, etc. that position the EEG electrodes against the scalp remain a source of cross-contamination and infection

Table 1. Continued

Image	Conductive Material	Configuration
	Gold conductive gel or paste applied to the sensor surface that is in turn in contact with the scalp.	Cup surface metal connected to conductive wire.
	Gold rounded tip pins that are conductive by making contact with naturally occurring moisture from the skin without the addition of gel or other conductive solution.	Pins apply point of contact pressure to the skin. Some models allow the pin to retract within a same metal sheath against an inner spring. Multiple pins within each single electrode disperse points of pressure over skin surface area.
	Porous ceramic pillars with sintered Ag/AgCl and saline (0.9% NaCl) solution.	Ceramic pillars held in place with molded plastic are connected to another plastic hub sewn to a cloth head strap.

risk. The commonly used flexible and porous cloth material that retains moisture from the head of the person wearing it is also in need of proper cleaning. Medical applications may hold to a higher standard of infection risk reduction procedures, but these same principles should apply to consumer use of the same EEG electrode technologies and products. Just because the intended use is for consumers, the principles of aseptic technique remain. Designs that restrict cleaning solution use should be used by a single person and not shared by others.

Keeping with a prior convention of discussing electrophysiology sensor cleaning against the Spaulding classification (Rutala, Weber, & Healthcare Infection Control Practices Advisory Committee, 2008), new electrode and

Table 1. Continued		
Image	Conductive Material	Configuration
	Ag/AgCl conductive ink applied over a plastic molded flexible bristle that makes contact with naturally occurring moisture from the skin.	Molded flexible plastic prongs coated with conductive material. Each sensor tip snaps to a conductive hub with conductive wire to the amplifier.
	Sintered (heated below melting point) Ag/AgCl sensor used with conductive gel for contact between the sensory material and the skin (scalp).	Flat surface conductive ring connected to the amplifier by a conductive wire. Each sensor locks in place to a plastic hub attached to a cloth form-fitting cap placed on the head.
	Carbon-based electrolytic compound used with or without conductive paste.	Semiflexible bristles are held within a mounted sensor hub to a form-fitted plastic band enclosed with cloth material.

electrode holder designs can perhaps be reviewed collectively. It appears that the very configuration of new electrodes may implicate different infection risk and thereby different cleaning criteria. Table 2 shows the Spaulding classification categories expanded with columns addressing electrode use type and the collective design of the electrode material, configuration, and mechanism to hold the electrode to the scalp.

By way of review, there are three infection risk classifications (critical, semicritical, noncritical) and each should be considered part of responsible risk mitigation. It's incumbent on the professional who oversees the use of EEG

Table 2. Spaulding classification with electrophysiology instrument and electrode (sensor) correlations

Spaulding Classification	Comes in Contact With	Type Recommended	Electrophysiology Recording Modality	Conductive Sensor and Sensor Holder Material
Critical	Tissue; vascular space	Sterilization	EMG pelvic floor perineometer; open wound sensor placement; scalp open wound or unintended open wound from electrode tip puncture	Small diameter needle or rounded needle-shaped electrode prongs that may puncture layers of skin
Semicritical	Mucous membrane; nonintact skin from over abrasion causing blood exposure	High level disinfection	Reusable EEG cap with multiple sensor array; individually placed EEG sensor	Graphite flexible or nonflexible bristles; ceramic pillars; metal pillars; needle-shaped prongs that are larger diameter to avoid skin punctures
Noncritical	Intact skin; nonmucous membranes	Intermediate or low-level disinfection	Disposable pre-gelled ECG patches; disposable EEG electrodes; finger placed thermistor; EEG/ECG sensor harness or hub to hold electrodes in place	Snap-lead hub that receives a disposable pre-gelled adhesive patch; cap or scalp-placed harness with receiving hubs for disposable snap-in or lock-in electrodes

Note. EMG = electromyography; EEG = electroencephalogram; ECG = electrocardiography.

recording to also remain attentive to potential mistakes in the cleaning of the equipment and to be aware of the guidelines for disinfection and sterilization in healthcare facilities published by the Association for the Advancement of Medical Instrumentation (Weber & Rutala, 2013). The "critical" classification is tied to sterilization methods that kill or remove all microorganisms (i.e., bacteria). Steam application by autoclave and other high heat (325°–375° F) is perhaps the more common method of removing microorganisms but there are also lower temperature applications (e.g., vaporized hydrogen peroxide) that may not damage the electrodes.

Special Risks

Some of the microorganisms that are very hard to destroy or remove are prions that would be found in patients with Creutzfeldt-Jakob disease or spores such as *Clostridium difficile* (frequently referred to as *C-diff*). It is recommended that aseptic technique be used in these cases. Reapplying the same electrode used earlier with a C-diff patient is extremely hazardous and should be avoided.

The semicritical classification implies the use of very strong disinfection methods that substantially kill almost all microorganisms. Disinfectants include germicides—chemicals such as ortho-phthaladehyde, hypochlorite, glutaraldehyde, and peracetic acid. Finally, the noncritical classification implies lower levels of disinfection that kill many fungi, bacteria, and viruses. Disinfectants that would be used for this category could be the same as those for semicritical, but may also include high concentration isopropyl alcohol, improved hydrogen peroxide, bleach, phenolic, or iodophor.

New EEG electrodes may not always include instructions about preuse skin preparation or skin abrasion; however, it is not uncommon for the configuration to have contact points against the skin and by purposeful or accidental movement these small points of pressure have an abrasive effect. There are some bristle designs that are rather uncomfortable on the scalp due to the small pointed tip of the electrode bristle, but still flexible enough that they don't typically puncture a skin layer. Other configurations that use a wider point of contact against the skin are not rounded but are cylindrical with edges that when moved back and forth on the scalp will abrade or scratch the skin. As a result, these configurations in current use may be considered a semicritical risk where preuse disinfection should be applied (e.g., 2% glutaraldehyde).

The majority of electrodes used for biofeedback or routine EEG recording best fall into the semicritical classification where high-level disinfection is indicated. In more rare cases, there are some electrode designs that use conductive metal (e.g., gold) posts that have a diameter that is small enough to be considered a large needle. Some are stiff and cover a small skin surface area and are rather prone to puncture skin, particularly with the elderly. Others use metal prongs or posts that retract into a same metal hollow sleeve such that an internal spring reduces the tension or pressure against the skin. Still, with a smaller-than-appropriate flexible cap that holds these electrodes in place, they can still puncture the skin. In these cases where the electrode posts are of small diameter and where the skin is more prone to puncture, it is prudent to raise the classification level to that of critical and use presterilized electrodes.

The materials and design features that permit electrode placement over the scalp vary a great deal. A common design is the elastic cloth cap that has plastic hubs permanently attached using the 10/20 international system of electrode placement. This cap type often permits conductive gel to be applied to each individual electrode through a hole or port using a blunt-tip needle. The misuse of this needle increases the infection risk by overly abrading or puncturing skin. In general, the proper use of this cap design type with conductive gel introduced to the electrode and skin falls within the semicritical Spaulding classification. Similarly, head- or skull-shaped netting material and elastic bands or straps that hold electrodes in standardized locations on the scalp also meet the semicritical category for aseptic use.

With some cloth or neoprene cap designs there are electrode receptacles wired to the cap that allow snap-in or twist-in electrodes. These electrodes may be disposable or may be designed for postuse sterilization or disinfection. In either case, the wired receptacle for that contact electrode will no doubt make contact with the person's head or neck and should therefore be cleaned under noncritical disinfection criteria (e.g., germicide impregnated cloth wipe, Freshnit®, or Virusolve®).

The growing number of new EEG headset designs for consumer markets use plastic hands, wands, or arms to both hold electrodes at one end and make contact with the head for stability purposes on the other end. Some may have only one EEG scalp location and others make contact with forehead and neck skin locations with little to no hair. These designs combine the need for the contact electrode to be sterilized or disinfected (critical or semicritical) with the headset or electrode-holding mechanism to be disinfected using lighter methods (noncritical). Some designs lack surfaces that are amenable to even these noncritical disinfection methods due to having cloth coverings that cannot be removed or submersed in solution. In these cases, the device should be single-use only so as to avoid cross-contamination. Other designs that do permit the surface material to be wiped down with biocide-impregnated towelettes would fall within the noncritical Spaulding classification and could be used for more than one person.

The modern use of medical EEG has a rich diagnostic and treatment efficacy history (Fotuhi et al., 2016; Ratti, Waninger, Berka, Ruffini, & Verma, 2017). Medical office- and hospital-based EEG applications are now more than ever being joined by a variety of nonmedical purposes. Consumer applications for self-help or peak performance or consumer preference determinations are among the more recent uses of EEG recordings and feedback (Vecchiato et al., 2011). In all cases there are headset and electrode designs that make contact with skin and hair and each require proper cleaning to reduce infection risk. The integrated use of the Spaulding classification can help guide EEG device users to reduce infection risk no matter what device or electrode type they happen to use. Device manufacturers might also benefit from the classification by using materials and form factors that improve end users' ability to disinfect or even sterilize the electrodes and the mechanism that holds the electrodes.

Infection Risk Is Not Always in the Instrumentation

This article has focused on the serious risk that illness can be transmitted by means of a practitioner touching the client, applying a sensor to the client's skin, and incidental contact of the patient's skin with cables, leads, quantitative EEG caps and similar means, spreading an infection from one client to another. The risk is real and human beings today are suffering increasing numbers of illnesses that are resistant to treatment. Practitioners must be on guard.

Fortunately, contagion of infection through instrumentation is not a frequent incident in clinical biofeedback and neurofeedback. Other risks to be considered include the sick patient who coughs and sneezes and spreads illness in the lobby and consulting room.

Responsible Decisions on When to Refuse Biofeedback Training

A common threat of infection for biofeedback and neurofeedback practitioners is from bacteria and viruses that are transmitted through the air or by contact with the eyes, nose, and mouth, such as flu. Most experts believe that flu viruses are primarily spread from infected people when droplets (from coughing, sneezing, or talking) land in the mouths or noses of people who are nearby, and/or are inhaled into the lungs. This flu delivery system can happen at a distance of 6 feet. People can also get flu by touching a surface or an object that has flu virus on it, and then touching their own nose or mouth, but this form of transmission is thought to happen less often (www.cdc.gov/flu/about/disease/spread.htm). The most obvious form of prevention is to stay away from sick people. If your patient has cold or flu, reschedule the appointment. If you have cold or flu, stay home.

The second most basic and effective technique for lowering risk of these airborne infections is frequent hand washing and/or the use of antibacterial hand gel. For proper hand washing, one must scrub with an antibacterial soap for at least 20 seconds (about as much time as it takes to sing the happy birthday song). A third infection prevention technique is to disinfect areas where patients and clinicians have contact (chairs, desks, biofeedback sensors, and leads, etc.). For instance, germicide-impregnated cloth wipes can be used to wipe down surface areas or equipment. However, when assessing the risk of spreading infection, if a sick person has not been in the room, coughing, sneezing, and touching things, it is less likely that infection is present.

A similar situation arises with the patient who presents with open sores, skin rashes, and other visible skin conditions. Placing a sensor or a thermistor on the skin in contact with a visible skin condition is hazardous to the next person touched by the same thermistor, sensor, or lead. The biofeedback session should be delayed until the skin condition is diagnosed, treated, and healed.

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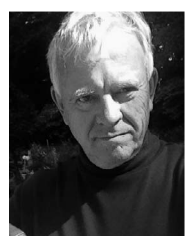

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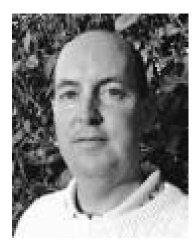

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