

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Previous Date: May 21, 2004

Reviewed Date: Sept 4, 2008

Polysomnogram (PSG) Wiring Procedure

Page 1 of 12

Purpose:

To provide procedure and guidelines for wiring subjects for sleep studies. And to outline the placement of physiological monitoring equipment on subjects involve in research PSG sleep studies conducted on the Clinical Research Unit (CRU)

Equipment:

1 Tube Nu-Prep	2 Respiratory effort belts
1 Tube elefix paste	1 Roll 1 inch adhesive tape
6 4x4 non-sterile gauze pads	1 Pulse oximeter & finger probe
12 2x2 non-sterile gauze pads	1 Nonin finger probe wrap
3 Cotton-tipped applicators	4 Cup electrodes (Optionally pre-attached to head box)
12 Alcohol swabs	7 Ambu neurology electrodes
4 ECG patches	2 Snap ECG wires
3 Posey wraps	2 Snap leg wires (4 for SIT protocol)
1 Thermistor nasal probe & extension wire	1 Bottle PreTac
1 Nasal cannula	1 Measuring tape
9 1x2 pre-cut adhesive tape stripes (Attached to edge of tray)	
1 China marker	

Definitions:

Polysomnography (PSG) the collective process of monitoring and recording physiologic data during sleep using polysomnograph, a machine that converts electrical signals in the body to a graphical representation.

Electrode metal cup attached to a colored wire that registers voltage changes from the skin surface and conducts these electrophysiological signals from the body to PSG monitoring equipment

Nu-Prep™: a compound used to remove body oils and debride the skin.

Elefix™: a paste used to hold cup electrodes on the skin.

SIT protocol: a research study of restless leg syndrome (RLS).

Pre-tac™: a commercial liquid used to make the skin sticky.

Embla™: The vendor's product name of the hardware used in CRU sleep studies.

Head box. All the wires from the subject are connected to a common piece of hardware called a jackbox or head box.

M1, M2, F3, F4, C3, C4, O1, O2, GND (Ground): Locations on the cranium used for electroencephalography. (See Figure 1)

Cannula: Similar to a cannula that delivers oxygen to a subject through the nose; a cannula used in sleep studies measures air pressure.

Thermistor: A device placed in the subject's nose that measures minute changes in the temperature of the air breathed by the subject. The thermistor also has an extension that is placed in front of the subject's mouth to measure mouth-breathing.

Posey™ wrap: a cloth-like Velcro™ strip used to wrap into a neat bundle the wires and tubes connecting the subject to the head box.

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 2 of 12

Procedure:

Subject Information

1. Enter demographics and custom information into the computer before starting the study.

Preparing the subject

2. Introduce yourself. Let subject know what to expect and explain in testing procedure address any questions or concerns they might have.
3. Wash hands and take a previously prepared tray with needed equipment.
4. Explain to the subject the purpose of each attachment and the procedure for mid-study bathroom breaks.
5. Instruct the subject to turn off any cell phones or pagers. Inform the subject of the purpose of the video monitor.
6. Ask the subject to wash his/her face (to remove makeup, oils and dirt).
7. Have the subject remove eyeglasses, earrings and necklaces as these may interfere with the electrodes.
8. Position a chair so you have enough room to walk around, and have the subject sit in it.
Note: The subject may watch television or read during the procedure.
9. Squeeze a generous amount of Nu-Prep onto two stacked 4x4 pads.

Electrocardiogram (ECG) Preparation

10. The first ECG electrode site is located just under the right clavicle and the second over the lower left thorax.
11. Prepare and apply leads to the ECG sites by:
Note: If the subject's chest is hairy, it may be necessary to first shave the sites.
 - a. First lightly rub the site with an applicator dipped in Nu-Prep.
 - b. Next remove the Nu-Prep with 4x4 gauze.
 - c. Then lightly rub the area with an alcohol swab.
Note: Alcohol is used to remove Nu-Prep residue and any remaining body oils and perspiration.
 - d. Next put a few drops of PreTac on 2x2 gauze and rub the site with the gauze.
 - e. Attach an ECG snap wire to an ECG patch and apply to the site.
 - f. Repeat for the second site.

Leg Attachments (See Figure Two)

12. Prepare and apply leads to the legs using the same procedure as for the ECG.
Note: If the subject's legs are hairy it may be necessary to shave the sites.
13. The sites are located on the anterior tibialis muscle.
14. Two leads are used on each leg, 3cm apart.
15. Ask the subject to run the leg leads up inside their clothing and out the collar of the top.
Note: For modesty you may leave the room.

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 3 of 12

Belt Application

16. Ask the subject to stand to apply the thorax and abdomen belts.

Note: The belts should be oriented so that the manufacturer's trade mark is right-side up. The belt wires should go over the shoulder closest to the Embla tableside equipment. Ensure the belts go between the subject's back and all the wires.

Connections to the head box

17. Ask the patient to sit and plug the ECG, belt and leg wires into the head box.

- a. The right ECG wire is plugged into the ECG – (negative) port of the head box
- b. The left wire is plugged into the ECG + (positive) port.

Note: For standard PSG protocols plug the left and right leg wires into the appropriate connection.

Chin (EMG) Application

18. Prep the area for the subject's chin leads. The areas are located 1cm out and 1 cm. down from the corners of the mouth.

19. First, lightly rub the area with an applicator dipped in Nu-Prep.

20. Next remove the Nu-Prep with a 4x4 gauze.

21. Then lightly rub the area with an alcohol swab.

22. Scoop a small amount of Elefix paste into the cup of an ECG lead and affix the cup to the site.

Note: A little paste should extrude from the hole in the cup.

23. If the subject has a beard or stubble, use the same procedure used for EEG steps 11 a-f.

24. Secure the cup to the site with a strip of adhesive tape.

Eyes (LOC ROC) Wire Application

25. Attach leads to the eyes as in steps 11 a-f. The eye locations are: left eye – 1 cm. out and 1 cm down from the outer left canthus; 1 cm. out and 1 cm. up from the ® outer canthus.

26. Attach the ground lead to the center of the subject's forehead using steps 11 a-f.

EEG Application (See Figure One)

27. Using the procedure in step 11 a-f, prep the sites behind the subject's ears.

Note: The sites are located on the mastoid protuberance behind the ear.

Note: A1 is located behind the *left ear* and A2 behind the *right*.

28. Attach the ear electrodes using cup wires and Elefix.

29. Apply a drop of Elefix to a 2x2 gauze and press over the electrode.

Note: Ensure that the cup hasn't moved from its original location and continue pressing the electrode for a few seconds.

30. Locate the sites for F3, F4, C3, C4, O1 and O2 using the 10/20 measuring system and apply electrodes.

- a. Mark your (4) landmarks:

1. Nasion

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 4 of 12

2. Inion
 3. Right - pre-auricular
 4. Left - pre-auricular
- b. Measure nasion to inion = _____ cms
1. Mark 10% up from nasion for FPZ
 2. Mark 50% up from nasion for CZ
- Note: Turn tape around and mark 10% up from inion for OZ.
- c. Measure pre-auricular to pre-auricular = _____ cms
- d. Do one side of head at a time:
1. Mark 10% up for T4
 2. Mark 30% up for C4
 3. Mark 10% up for T3
 4. Mark 30% up for C3
- e. Measure circumference from 10% line. (FPX, OZ, T3 and T4) = _____ cms
1. From FPZ mark 5% for FP1 and 5% right for FP2
 2. Back to inion OZ mark 5% left for O1 and 5% right for O2
 3. From FP1 to C3 mark 50% of distance for F3
 4. From FP2 C4 mark 50% for the distance for F4

NASAL Application of Cannula and Thermistor

31. Attach the thermistor to the extension cable then apply it to the subject.
32. Slightly bend the two prongs so they won't touch the inside of the nose.
33. Insert the thermistor inside the subject's nose and stabilize it by running the wires over the subject's ears.
Note: The wires should be over the 2x2 gauze holding the M1/M2 electrodes.
34. Slide the adjustable collar up to fit snugly under the subject's jaw.
35. Plug the wires into the head box.
36. Place the cannula prongs inside the subject's nose and put the tubes over the subject's ears.
37. Slide the adjustable collar up to fit snugly under the subject's jaw
38. Connect the cannula tube to the head box.
39. Using 3 Posey wraps, gather all the wires and tube into a pigtail behind the subject's head.
40. Wrap the Posey's lightly, not tight, so the wires can move.
41. Allow the subject to use the bathroom if he/she desires.
42. Have the subject sit on the side of the bed.
43. Plug the cable into the head box ensuring that the labels marked "TOP" on the cable and the head box match. Even numbers on right side and odd numbers on left side of head box.

Oximeter Attachment

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004

Reviewed Date: Sep. 2008

Page 5 of 12

44. Plug the oximeter into the head box and ensure a red light is visible on the end of the probe.
45. Attach the oximeter finger probe to a finger of the hand (See Figure Three)
46. Perform Embla impedance checks and repair any problems.
47. For problems:
 - a. First apply pressure to the site to ensure good contact.
 - b. Then if problems persist, re-prep the site and re-apply the wire.
 - c. Lastly, use a new wire.

Note: The most likely candidates for problems are the ground wire and A1 and A2.
48. Have the subject lie down, clip the nurse call box to the bed, place the head box on the bed, and if necessary, tape the head box to the sheet.
49. Perform the Embla biocals and make any necessary adjustments.

Computer Setup

1. Setting up computer before you start the study.
2. Go to Sleep computer and pull up Somnologica. Click on Patient Information: Insert the patient's information. Before you click the OK button, go to the top where tabs are and click on customs and insert patient information there also. When done, click the OK button. Follow the steps to complete all data entry.

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

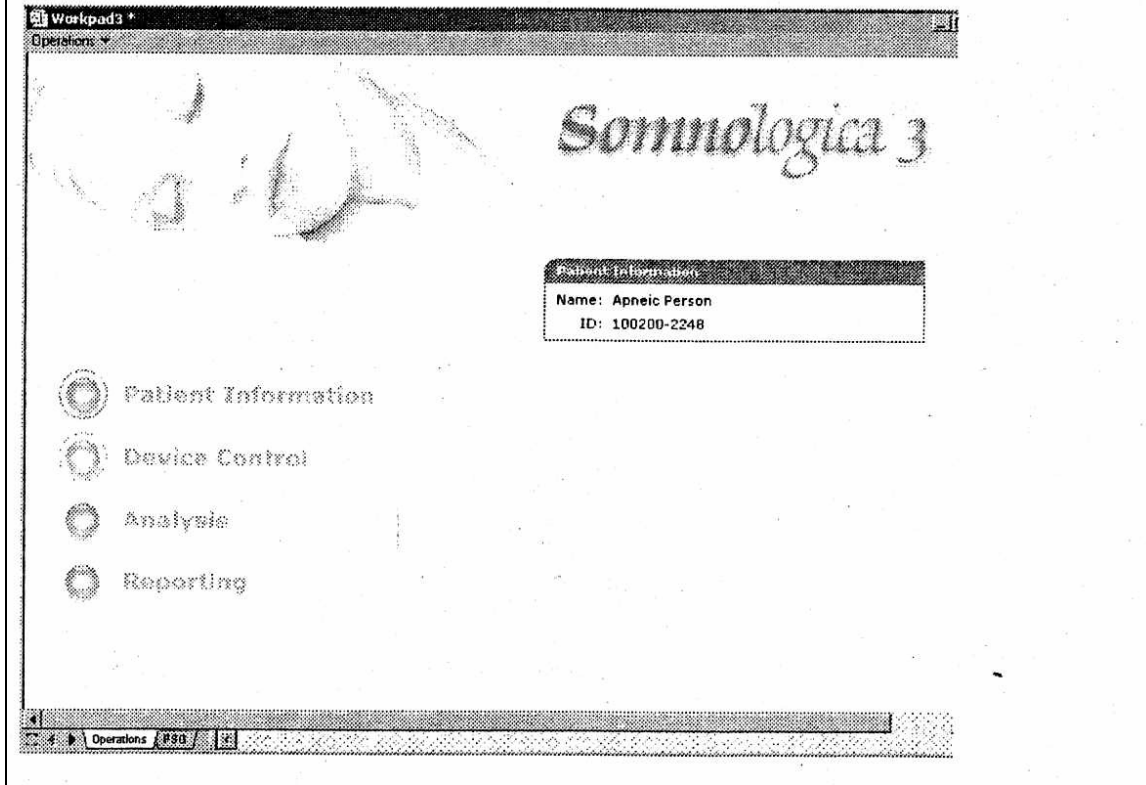
Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004

Reviewed Date: Sep. 2008

Page 6 of 12

The buttons change colors and are bluish when active and gray when inactive.



Finishing:

1. The patient will be asked to perform the specific behavior to be calibrate, such as eyes, EMG, respiration, legs. As the behavior is performed the mark event buttons is pressed to mark the event into the recording. When bio calibrations are complete, (lights out).

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

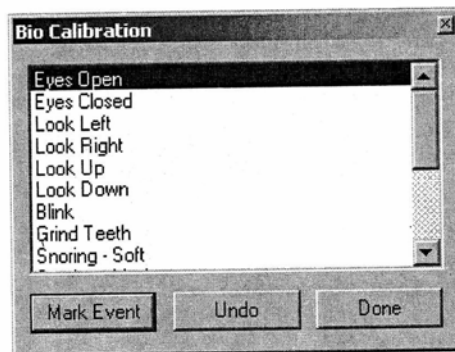
Page 7 of 12

Bio Calibration

The Biological Calibration tool is a tool used in an online recording to mark specific patient behavior into the recording e.g. eye movement. These markings may be of use later, when the recording is analyzed. Bio calibration can be used in connection with an ambulatory recording and is then performed during patient hook-up as a separate online recording.

Performing the Bio Calibration

The bio calibration is accessed through the **Tools ▶ Bio Calibration** menu.



Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

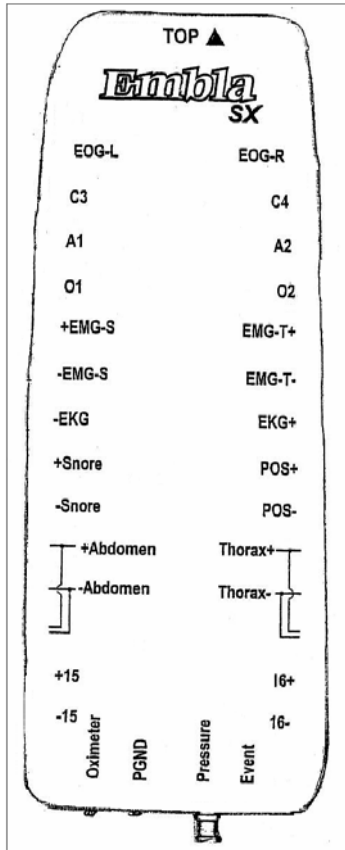
Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 8 of 12

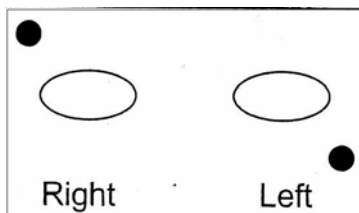
A-10 Unit:



N7000 Unit:



Eyes (LOC and ROC) Placement:



Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 9 of 12

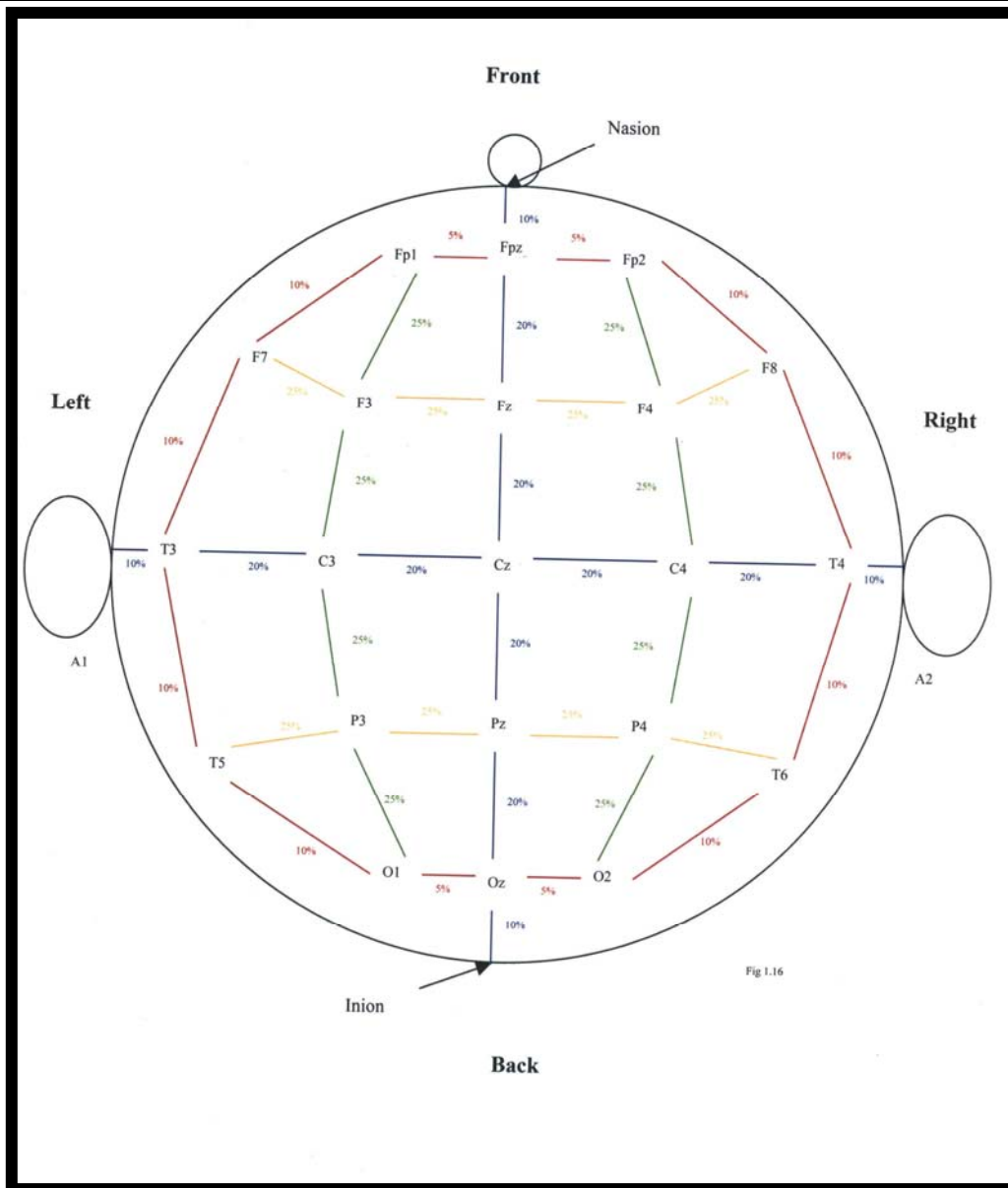


Figure One. Locations of EEG Sites

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

Page 10 of 12

To find the muscle, have the subject place their feet flat on the floor.

Then have the subject extend and flex the foot. You will be able to feel the muscle move.

Place the electrode patches here.

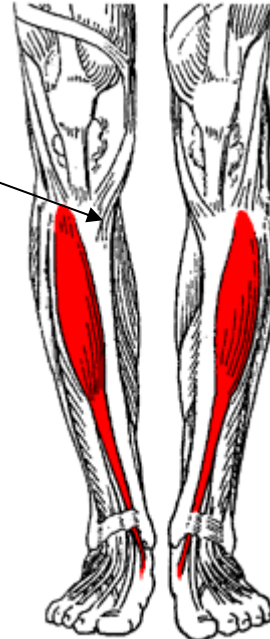


Figure Two Locations of the Anterior Tibialis muscles

Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

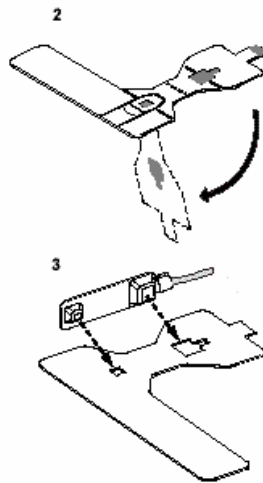
Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004
Reviewed Date: Sep. 2008

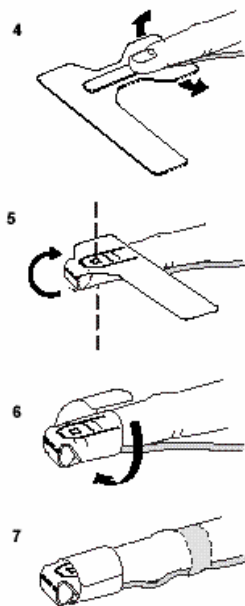
Page 11 of 12

Figure 3. Applying the Oximeter Probe



To apply the Adult FlexiWrap to the NONIN Model 8000J Adult Flex Sensor:

1. Grasp the blue tab on the Adult FlexiWrap (Figure 2). Peel the paper backing away just far enough to apply the FlexiWrap to the sensor.
2. The Adult FlexiWrap has cutouts which conform to the shape of the NONIN Model 8000J Adult Flex Sensor (Figure 3). Carefully line up the sensor with the cutouts on the adhesive side of the FlexiWrap, then press the FlexiWrap firmly against the sensor.
3. Remove and discard the paper backing.



To attach the FlexiWrap/Sensor assembly to a finger or toe:

1. Carefully position the finger or toe on the adhesive side of the FlexiWrap/Sensor assembly, as shown in Figure 4. Make sure that the dashed line printed on the FlexiWrap is at the tip of the finger or toe. (This positioning helps line up the light emitter and the light detector.)
2. Wrap the side flaps of the FlexiWrap around the sides of the finger or toe as indicated by the arrows in Figure 4.
3. Carefully fold the flap of the FlexiWrap/Sensor assembly over the finger or toe as shown in Figure 5. Make sure that the light emitter and the light detector are vertically aligned (as illustrated by the dotted axis line in Figure 5).
4. Wrap the side flap of the FlexiWrap around the side of the finger or toe. Wrap the long flap of the FlexiWrap around the finger or toe as illustrated in Figure 6.
5. For the best results secure the sensor cable independently from the sensor with medical tape, preferably around the base of the finger (Figure 7). Make sure that the tape securing the cable does not restrict the blood flow.

Note: If the sensor is not adjusted properly, light may bypass the tissue and result in SpO₂ inaccuracies.

Proper sensor placement is critical for good performance.

References:

1. Atlas of Polysomnography by Nic Butkov, 1996 Synapse Media, Inc.
2. Johns Hopkins Bayview Center Sleep Disorder Center Policy and Procedure Manual
3. A Review of the International Ten-Twenty System of Electrode Placement by Harner & Sannit, Grass Instrument Co., 1974
4. Directions for Use, Adult FlexiWrap, Nonin Medical, Inc., Plymouth, MN.
5. Embla (2007). Retrieved from Embla.com.
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Johns Hopkins Bayview Medical Center

CLINICAL RESEARCH UNIT

Policy 144

Polysomnogram (PSG) Wiring Procedure

Previous Date: May 21, 2004

Reviewed Date: Sep. 2008

Page 12 of 12

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