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# Ambu Disposable Cup Electrode

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**ABSTRACT:** The Ambu Neuroline cup electrode is a silver/silver chloride-based sensor designed for single patient use. The electrode was developed to reduce the risk of cross infection associated to the reuse of EEG cup electrodes and to improve the clinical workflow by eliminating the need of cleaning and sterilisation of the electrodes.

Cross infection is a problem that affects the healthcare community worldwide, which can be reduced by using disposable medical devices. However, there is still a discussion regarding the costs associated to the use of disposable medical devices and also the quality of disposable as compared with reusable products.

The present document presents a review of the cross infection literature associated to reusable surface electrodes. The data illustrates the potential of electrodes and electrode pastes to transmit contamination from patient to patient.

This is followed by a summary of the article published by Finnegan [5], in which the author explains the procedure followed at the Department of Clinical Neurophysiology, Walton Centre for Neurology and Neurosurgery NHS Trust, Liverpool, to introduce the Ambu Neuroline disposable cup electrodes. The study shows a 100% reduction in the infection rate of grid and telemetry patients at the department after 18 months of use of disposable cups.

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## Cross infection risk:

Healthcare associated infection is defined as an infection that occurred in a patient in the healthcare setting in whom the infection was not present, or incubating, at the time of admission [1]. The World Health Organization reported in 2002 that the problem of nosocomial-acquired infection affects 1.4 million people worldwide. Annually, in the United Kingdom approximately 5,000 patients die, and 15,000 more are substantially affected by healthcare-acquired infection [1]. For the British National Health Service, the cost of nosocomial infections is approximately £1 billion per year. In 2000, 380,000 bed days were lost due to delayed discharges and ward closures due to healthcare-acquired infections [2].

Reusable ECG electrodes have the potential of transmitting infection from patient to patient. Since the EEG signal is of very low amplitude, during patient preparation and to reduce the skin impedance a dull needle is used to inject conductive gel underneath the cup while abrading the skin. Often, small skin lesions are produced in the area underneath the electrodes.

The decontamination of the electrodes shall be carried out very effectively to ensure that skin defribs are removed from the electrodes. Otherwise, electrodes can lead to cross-infection by Multi Resistant Staphylococcus Aureas (MRSA) and Varicella Zoster (Chicken Pox virus) and others. Decontamination protocols usually include chemicals, which are considered hazardous to the health and are not ideal within the clinical environment.

In 1999 AMBU A/S performed two clinical investigations at the University Hospital Kreiskrankenhaus – Lörrach, Germany [5]. The aim was to investigate the potential of vacuum ECG system electrodes to carry microorganisms from patient to patient.

In one of the studies, patients underwent conventional resting ECG procedures using vacuum ECG systems. Ninety-five electrodes were sampled and tested for presence of microorganisms. The vacuum electrodes were cleaned before the first patient/session of the day as recommended by the manufacturer of the electrodes. Microbiological samples were taken before the first patient, after the first patient, after the fifth patient, and after the last (tenth) patient of the day. The samples were incubated in blood agar plates and dermatophyte plates.

The microbiological results showed that before the first patient/session there was already an average of 30 Staphylococcus Epidermidis (SE) coloni forming units, evidencing the poor efficiency of the cleaning procedures. After the 1st and 2nd patients there were more than 400 SE colonies and 40 micrococcus (MC) colonies in the samples. After the 5th and 10th patients the amounts of both, SE and MC colonies was higher than 400. Moreover, results of the coloni forming units on dermatophyte plates showed that while fewer fungi were found, some of the types were pathogenic (Candida albicans and Trichophyton).

Three hundred patients were incorporated to the second investigation. The patients underwent conventional resting ECG measurements and were assigned to either the vacuum-system-group (150 patients) or the AMBU SU-disposable-electrode-group (150 patients). Microbiological samples of both electrodes were taken before the first session/patient of the day for each group. The vacuum system electrodes were sampled as explained before (after patient 1, 5 and 10 every day). Moreover, the disposable SU electrodes were sampled after each patient.

The microbiological results of the vacuum system showed that there was already an average of 2 coloni forming units of *Bacillus Subtilis* before the first patient/session, evidencing again the poor efficiency of the cleaning procedures. After the first patient there was an average of 14 coagulase negative staphylococci (CNS, staph. epidermis) colonies, an average of 12 CNS was found after the 5th patient, and finally, an average of 26 CNS was found after the last patient/session of the day (patient number 10). In this study, no colonies were found in the dermatophyte agar plates, indicating no fungi or pathogenic bacteria.

While these studies were performed for ECG electrodes, the data illustrates the potential of electrodes and electrode pastes to transmit contamination. In fact, the EEG electrodes may present even a higher risk as compared to ECG electrode, since the preparation is more aggressive. It is very often that small lesions are produced in the area underneath the electrodes.

**The cost of using disposable electrodes:**

In 2007, Finnegan [5] published a study presenting the experience of introducing disposable EEG electrodes at the Department of Clinical Neurophysiology, Walton centre for Neurology and Neurosurgery NHS Trust, Liverpool, UK. The article proposes the steps for a business case analysis to evaluate the pros and cons of reusable vs. disposable electrodes.

Some of the most important aspects the author discusses are to have a clear description of the purpose of the request for changing to disposable products, a clear overview of the Neurophysiology service, analysis of the risks of not incorporating disposable electrodes: including information from the infection control team, clinical incidents logged whereby the infection status of the patient was not confirmed until after the test, etc. It is also important to analyse alternative devices where not only the cost is analysed but also workflow impact, performance of the devices etc.

Moreover, the authors performed an evaluation of the technical quality of the Ambu disposable electrodes. The authors concluded that the electrode performance was comparable to reusable devices. The author

succeeded to introduce disposable EEG electrodes at the hospital. Most importantly, site surveillance performed 18 months after the change to disposable electrodes showed a reduction in the infection rate of grid and telemetry patients of 100% (Infection rate decreased from 18 in the year before the introduction of the disposable electrode to 0 the year after the introduction of disposable electrodes).

**Performance of the Ambu disposable EEG cups:**

The objective of the study [6] was to investigate the electric, mechanical and handling features of the Ambu disposable cup electrode in terms of signal quality and handling of the electrode. The study was an international, multicenter (3 sites) investigation. A total of 113 patients undergoing electroencephalography (EEG) and polysomnography (PSG) examinations were recruited (54% males and 46% females; mean age 45.2 years). The evaluation of the different parameters was performed between the Ambu disposable cup and the disposable cup electrode used at the site.

The results showed that the mean time used for application of the Ambu disposable cup was 16.03 min, which was comparable to the competitor device; and the application was rated as easy or fairly easy in 91.8% of all cases.

Regarding signal quality, the Ambu cup electrode was rated as "Better" than or "As good" as the comparative electrode in 99% of the examinations. In 92% of the examinations, handling of the Ambu cup electrode was rated as "Better" or "As good" as the comparative electrode.

**CONCLUSION**

Nosocomial-acquired infection affects patients worldwide.

Reusable ECG electrodes have the potential of transmitting infection from patient to patient. The cleaning and decontamination process is time demanding and shall be carried out very effectively to ensure that skin defribs are removed from the electrodes.

The use of disposable EEG cups is sometimes considered expensive as compared to reusable EEG. However, when all costs are considered, the results can be different. The study of Finnegan presents a business case that could be used to argue for the advantages of using disposable EEG electrodes. The author successfully incorporated disposable EEG cup electrodes at the Department of Clinical Neurophysiology, Walton centre for Neurology and Neurosurgery NHS Trust, Liverpool, UK. More interestingly, an 18 months follow up showed a reduction in the infection rate of grid and telemetry patients of 100%.

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