Skin Disinfection and Acupuncture

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Summary
The need for skin disinfection before insertion of an acupuncture needle is controversial and there is no specific research on this topic. However research and observations on the effect of, and the need for, skin disinfection before injections forms a good analogy of acupuncture. Whilst microorganisms present on the surface of the skin are accessible to disinfection, those located under the surface in ducts, glands and follicles are out of reach and can be inoculated into the sterile tissues below by needle insertion. Fortunately, the bacteria resident on the skin have a low potential to cause infection if host immunity is not severely impaired or compromised by the long-term presence of foreign material, such as a surgical stitch. Disinfection of clean skin before injection is not generally considered necessary and observations of lack of infection following injections without prior skin disinfection support this; however, contamination by micro-organisms not normally resident on skin can pose a higher risk of infection. If skin is visibly soiled, it should be washed and if needle insertion is near an infected or contaminated site, it should be disinfected with alcohol.

Practitioner hand hygiene between patients is important, even if gloves are worn. Hands should be washed with soap or detergent and water, or an alcohol handrub can be used if hands are physically clean.

Keywords
Acupuncture, skin disinfection, handwashing.

Introduction
The Microbiology of Skin
Skin is an inhospitable environment; it is dry, salty, acidic and there are few readily-available nutrients. The most fertile area of the skin is the outermost layer, but this surface is constantly being sloughed off and replaced by lower layers. An assortment of glands, follicles and ducts that go deep into the skin are also home to many microbes. As with many other microbial niches, competition between colonising species is severe and established species will exclude most potential newcomers.

Total bacterial counts on the skin’s surface range from around 10 to 1,000,000 per square centimetre, but typically around 1,000. These bacteria are mostly present within microscopic colonies, typically composed of a few hundred bacteria, but which can contain up to 10,000 bacterial cells. However, if the bacteria found in the ducts, glands and follicles below the skin’s surface are taken into account by using a biopsy sampling method, the numbers recovered are around ten-fold higher than by sampling just the surface; so most of the skin’s microbial inhabitants are hidden from all but the most invasive of sampling methods. Passing a needle through the skin is thus one of the most searching methods of ‘sampling’ its microbial population.

Microbes on the skin can be divided into two groups: those that live and replicate on the skin, known as the skin’s ‘resident microflora’, and those that are not long-term residents but whose presence results from recent contamination, termed ‘transient microflora’. 
The Resident Microbial Population

The skin’s resident microbial population is, not unsurprisingly, one that has very little potential to cause infection (‘pathogenicity’). The most pathogenic organism found on the skin is *Staphylococcus aureus*, one of the main causes of wound infection, but when colonisation does exist, it is usually confined to the nose and perineum. More widespread colonisation with *Staph. aureus* can be found with skin conditions such as psoriasis and eczema. Normal skin is populated with coagulase-negative staphylococci (i.e. staphylococcal species other than *Staph. aureus*) and micrococci, a variety of coryneforms including propionibacteria and brevibacteria and a few gram-negative bacteria - acinetobacter and moraxella. These rarely cause infection, but can do so in situations where people’s immunity has been compromised in some way, for example following surgery, burns, or insertion of indwelling foreign material such as surgical stitches.

The Transient Microbial Population

These skin contaminants will be located superficially on the skin unless they have been ground-in, such as bacterial spores following earth contamination during gardening or sport. When transient skin contaminants are superficially located, they are very readily lost by transfer on contact or washing. As they are acquired by touch, they are most commonly found on the hands. They can consist of anything at all; whatever was present on the last surface to be touched.

Skin Disinfection

Many different products are available under the general title of ‘skin disinfectant’. (They are also referred to as antiseptics, meaning disinfectants compatible with living tissues). All skin disinfectants however are not the same and will be formulated to achieve one of three main functions:

Hygienic hand disinfection

This is where transient contamination is removed from the hands. This type of hand decontamination, where the main function is to remove contamination acquired from previous patients, is highly appropriate to acupuncture practitioners. Contamination of a practitioner’s hands with very small volumes of blood and serum can occur easily and is capable of transmitting infection. The most infectious of the blood borne viruses is hepatitis B which can be transmitted in 10 picolitres of serum (1 picolitre is 0.000 000 001 of a millilitre). The transfer of these minute volumes of serum from a patient’s skin to a practitioner’s hands and then to a subsequent patient’s skin at an insertion point can occur quite easily. Scrupulous hand hygiene is needed to prevent the spread of such infectious agents. Gloves frequently develop holes during use and liquid contamination can actively travel through such holes by capillary action, so the wearing of gloves does not negate the need for hygienic hand disinfection. (Gloves must be changed between patients). Hygienic hand disinfection can be accomplished either by washing with soap or detergent and water, or use of an alcohol-based handrub is suitable. If hands are visibly soiled, they should be washed with soap or detergent and water; alcohol does not reliably penetrate organic, particularly proteinaceous, matter. Whatever the treatment, it has to be compatible with frequent use without damaging the skin.

Surgical hand disinfection

This is where transient contamination is removed, resident microflora are removed as far as possible and their re-growth inhibited for the duration of surgery. This is not relevant to acupuncture and is intended to suppress hand contamination that could be transferred into a surgical wound if glove puncture occurred during deeply-invasive surgery. This is traditionally accomplished by use of aqueous surgical scrubs which will remove transient and many resident microbes by detergent action and leave a microbicidal residue on the skin to discourage resident regrowth for some hours.

Patient preoperative skin disinfection

This is where transient contamination is removed,
residual microflora are removed as far as possible and their re-growth inhibited for the duration of the surgical dressing application. This is not relevant to acupuncture. It is accomplished by use of alcohol with an additional microbicide, repeatedly applied with friction for 3-4 minutes; the alcohol produces a high level of microbial kill, then evaporates, leaving a substantial residue of the microbicide (usually chlorhexidine) on the skin to discourage resident overgrowth for days in the ‘greenhouse’ environment (high moisture plus nutrients from the wound) under the dressing.

Skin Preparation before Acupuncture
None of the skin disinfection applications listed above are appropriate for pre-acupuncture patient skin preparation. The nearest analogous application is that of patient pre-injection skin disinfection, normally comprising a wipe with an alcohol-containing swab. The need for this category of skin disinfection and its effectiveness have both been questioned. The evidence, such as it is, that exists on these matters is outlined below.

The Aim of Pre-acupuncture Skin Preparation
The aim of pre-acupuncture skin preparation must be similar to that of pre-injection skin preparation, which itself is not as well established as the procedures given above. The reason generally given is to sterilise the skin and thus reduce the possibility of an infection resulting from the skin being pierced by a needle. Both the effect of skin preparation and the probability of an infection following skin penetration by a sterile needle are controversial.

The Microbicidal Effect of Skin Preparation
The agent normally used for pre-injection skin preparation is alcohol, either as isopropanol or ethanol (usually as industrial methylated spirit) at a dilution of 70%; undiluted alcohol is a poor microbicide. Alcohol is the most appropriate agent for this function: it acts rapidly and has activity against all of the skin’s resident microflora as well as most of the transient contaminants likely to be present. However it does have limitations. The volatility of alcohol is both an advantage and a disadvantage; it evaporates quickly making it convenient to use, yet even a rapid disinfectant has little chance to act to its full potential in the ten to twenty seconds between application and evaporation. A five-second application of 70\% isopropanol gives reductions of 82 to 91\% upon sampling the surface of the skin.\textsuperscript{4}

Many of the skin’s microbial population are located under the surface, as was referred to earlier. This hidden microbial population will also be out of reach of any disinfectant used. The inability to truly sterilize skin was demonstrated in the same research in which cadaver skin was sampled by biopsy. None of the samples showed complete absence of bacterial growth after prolonged disinfection, and some types of skin, such as scalp and forehead, retained at least half their original bacterial colony-forming units.\textsuperscript{2} Passing a needle, solid or hollow, through skin has much in common with biopsy sampling methods; the needle will come into contact with bacteria deep in the skin, out of reach of both disinfection and normal sampling methods, and move some of them further down the needle’s path. Thus any claims that have shown living skin to be ‘sterilised’ must be regarded merely as failure to find microbes surviving the disinfection process under the skin’s surface. However, in a survey of those giving injections in a UK hospital, over 50\% gave ‘sterilisation’ as the reason they prepared skin prior to injection.\textsuperscript{5}

Infection Following Sterile Needle Penetration
The possibilities of cross-infection, i.e. infection transmitted from other patients (due to failure of decontamination, or recontamination) or the practitioner (due to recontamination) are distinct and will not be considered in this section.

Even if disinfection does not truly sterilise the skin, does the microbial reduction it produces significantly reduce the possibility of an infection after skin piercing? Is there a significant risk of infection following skin penetration by a sterile needle?

The most likely bacterial species to cause infection following sterile needle penetration is...
Staph. aureus, an occasional inhabitant or contaminant of skin (see the section on the skin’s resident microbial population above). In an unusual set of experiments in the 1950s (it is highly unlikely they could be repeated ethically today), volunteers were injected with cultures of abscess-derived Staph. aureus. Only injection of high numbers, around 7,500,000 organisms, produced infection at the inoculation site.

Looking at these results in the context of acupuncture and in the unlikely event that there were significant numbers of Staph. aureus on the skin, the following calculation can be derived. Assuming an acupuncture needle of 0.29 mm (which would have a cross-sectional area of 0.066 mm² and skin with a maximum bacterial population of around 1,000,000 cm⁻², or 10,000 mm⁻²; if the needle produced inoculation of skin equivalent to its whole cross-section (a generous assumption), on average 660 bacterial cells would be pushed into the skin by an acupuncture needle. Even if the acupuncture needle hit a large microcolony and pushed it all into the skin (another generous assumption), this would be a maximum of around 10,000 organisms. This calculation shows infection from an acupuncture needle passing through normal skin of an individual without compromised immunity to be a very remote possibility.

The factor found to enhance infectivity was to introduce the staphylococci on a suture which was then left in the skin, in which case around 100 organisms could produce an infection. However, when around 2,400 Staph. aureus were deposited in the skin by drawing a contaminated suture through the skin but not leaving it in place, no infection resulted. It was concluded that it was the long-term presence of a foreign body that compromised host defences, rather than it acting as a vehicle for the inoculum. This seems to justify patient preoperative skin disinfection but not pre-acupuncture or pre-injection skin preparation.

Observations in Practice
The origins of skin prepping before injection, the nearest analogy for pre-acupuncture skin preparation, are unclear but it seems safe to assume that it was thought to be general good practice. There is no record that it was prompted by observation of post-injection infections. The first record of this ritual being questioned is in 1962 by the Ministry of Health in its Memorandum on Vaccination Against Smallpox by noting’, after advising that alcohol could be used on the vaccination site, “Many doctors use nothing at all if the arm is reasonably clean and there is no evidence to condemn this practice”.

This was followed by a university Medical Officer, TC Dann, who abandoned skin preparation before injections unless the skin was obviously dirty. Over the course of six years, his department gave over 5,000 injections to students, all types of university staff (not just academic staff) and their families (age range 4 months to 66 years). No resulting infections were observed. A letter in response to this publication supported lack of observed infection following thirty years of injections without prior skin preparation both in the UK and in a Himalayan population “which had never washed since birth”. However in both of these studies, no details of structured follow-up observations to observe complications are given. There has been a small trial of alcohol swab (93 patients) versus no pre-treatment (103 patients) before venesection, with follow-up observations at 1, 3 and 5 days. Although two patients developed an abscess at the venesection site (both of these were in the alcohol swab group and both were on long-term steroid therapy), there was no statistically-significant difference between the two groups.

There is some authoritative recommendation on the matter of skin preparation. The Martindale pharmacopoeia, published by the Royal Pharmaceutical Society, on the topic of disinfection of injection sites, states:

The need to disinfect the skin before injection is controversial. Routine skin preparation of the injection site has been reported to be both ineffective and unnecessary.

The Public Health Laboratory Service, in its publication Chemical Disinfection in Hospitals, states:
The necessity to disinfect the site with 70% ethanol or 60 - 70% isopropanol prior to injection is controversial. There is evidence that giving an injection without prior cleaning is not associated with increased infection risk in young, healthy individuals and it is not recommended for routine insulin injections in diabetic patients because of potential damage to the skin. Some hospitals have given up the use of alcohol before giving injections and no adverse effects have been reported. It is still used (usually with chlorhexidine) before cannulation procedures, intra-articular injections and taking blood cultures. However, disinfection of the injection site continues to be used in most hospitals, particularly for injections into the thigh, and in elderly or immunocompromised patients, or close to infected or colonized lesions. The area should be wiped thoroughly and allowed to dry before giving the injection. This will remove or kill most transient organisms.

Although changes in skin preparation policy are rarely made public, there are exceptions. In 1985 Nottingham City Hospital reported that:

Skin preparation before intramuscular and subcutaneous injections has been discontinued without any adverse effects.¹³

Other hospitals have introduced similar changes, but without such announcements. One such reported that it can be difficult to interrupt a well-established ritual; eight years after a policy decision to cease routine pre-injection skin swabbing, 78% of staff surveyed at a UK hospital continued the practice. The main reason given by those continuing was ‘sterilisation’ (52%).³

Reference list