Alcohol gels – more harm than good?

Alcohol hand sanitisers are currently recommended for use by many healthcare organisations across the world, including the World Health Organization (WHO). However, a group of authors* claims a multi-centre "real time" study of Colony Forming Unit (CFU) counts on human skin show that this advice may actually be detrimental. **Dr Andrew Kemp JP PhD**, principal scientific officer at Q Technologies group, University of Lincoln, shares his findings.

Until recently the effects of alcohol gels on skin bacterial counts over extended time periods have been overlooked. After an extensive literature search revealed no published studies on the effects of alcohol gel on skin for any periods of time over 10 minutes, an initial pilot study showed an unexpected result leading to a study on a much larger sample group. The results of this study show that alcohol gel reduces bacterial counts initially, however, after one hour it causes a significant increase in skin bacterial counts when compared to washing with soap and water only.

The potential increases in institutional bioburden caused by this effect should be understood by clinical staff, who should then review their own practice to determine if the use of alcohol gels is safe.

The authors propose that current recommendations are reviewed and possibly changed to avoid potential harm to both patients and staff. Any changes to current recommendations may also have significant financial implications to healthcare providers.

Figure 1: Comparison test over 1 hour. Handwashing only v alcohol gel.

Hand hygiene in hospitals

Since the days of Semmelweis circa 1847, the healthcare community has known about the value and importance of hand hygiene in respect to Hospital Acquired Infections (HAI's) and more specifically cross infection.[1] From that time an ever growing body of evidence has confirmed its importance as a preventative step in almost every aspect of infection control in a healthcare setting, from the operating theatres to the community and infectious disease containment.[2]

Hand washing with soap and clean water is recommended by the WHO[3,4,5] the US Centre for Disease Control (CDC) as well as the other CDC's around th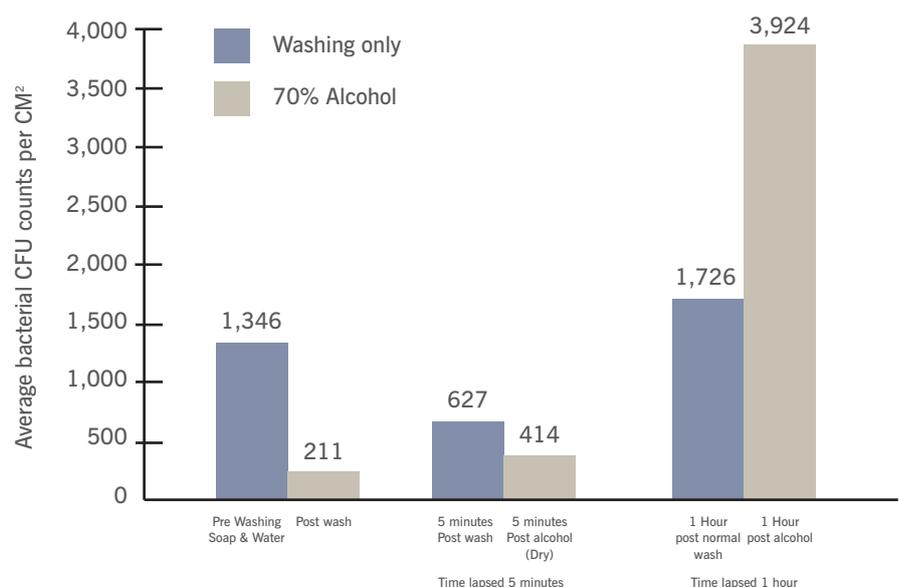e world. In fact the US CDC's recommendations on the use of antibacterial soaps provoked further investigations, some of the resultant studies demonstrated an increase in effectiveness when using these soaps.[6,7,8] Methodology of hand washing, including method of drying have also been studied with varying results.[9,10,11]

Based on these studies, recommendations and their easy availability, alcohol gels have appeared in many environments outside healthcare, including schools, food manufacturing plants, restaurants and farms. Available in retail outlets as well, they have become the norm in many people's pockets and bags for day to day use.

Sanitisers in healthcare

In more recent times the introduction of alcohol hand sanitisers into the healthcare environment has had a major impact on working procedures, protocols, audits, and staff sickness due to skin problems.[19, 20, 23] Their large scale introduction was as a result of significant, public and political pressure on hospitals and other healthcare institutions to reduce the ever increasing incidence of antibiotic-resistant cross-infections, most notably Methicillin Resistant Staphylococcus Aureus. In the UK, the NHS has even had financial penalties imposed on hospitals for not achieving targets set by governments. Studies done outside the healthcare setting have shown that the introduction of alcohol sanitisers did appear to reduce staff sickness from colds and gastro intestinal illnesses.[12]

Although there have been a significant number of studies looking at the effectiveness

of alcohol gels versus soap and clean water in healthcare,[13] the authors could find no peer review publications that looked at the effect of alcohol gel versus soap and water where no other interventions had taken place and with time periods in excess of 10 minutes.[13, 14, 15, 16, 17] Current guidance from the WHO and the US CDC simply states that a 60% minimum concentration of alcohol must be used.[21, 22] In fact the WHO guidance actually goes on to state that no further intervention is required when alcohol gels are used.[18]

During the course of the authors' investigations into the long term efficacy of surface disinfectants, it was decided to look at the efficacy of skin disinfectants over time to see if there was any difference in efficacy between surface and skin decontamination using the same active chemicals at the same concentrations. Surface disinfectants that had an equivalent product available for skin sanitation were tested.

Study results

Figure 1 is a pilot study using 20 administration staff showing the effect of alcohol gel vs handwashing over one hour. Figure 2 shows the results of a study of two groups of administration staff, working in similar office conditions. CFU counts were taken from the palm of the hands of 200 administration staff (400 samples in total). Staff were asked to participate and were split into two groups of 100. All staff were asked to go to the toilet before washing their hands under supervision to ensure that no further hand sanitation would be required for at least one hour (the length of time the sampling would take).

Standard sterile swab samples were taken before and after washing their hands and drying on clean dry paper towels. Unlike the pilot study, the pre wash groups were

Figure 3: Profile 1 live bacteria test kit

separated to ensure there was no significant difference in pre wash counts as well as post wash counts. A 1cm square was marked in the palm of both hands and the average CFU count calculated pre and post washing. 100 individuals were then treated with alcohol gel, 100 had no other intervention. All participants were then asked not to sanitise their hands again and to go back to work for one hour before re testing. After one hour the same area of the palm of their hands was retested using the same methods and an average CFU count for both groups calculated.

All bacterial counts were undertaken and results obtained on the day of testing using the "real time" rapid highly sensitive metabolic assay known as Profile 1 (New Horizons Diagnostic corps). The Profile 1 test system has been adapted for healthcare research use from its original use as a biological warfare early warning system.[24, 25, 26, 27]

Profile 1 live bacteria test kit

The pilot study (Figure 1) and the larger study (Figure 2) both showed a similar pattern of results. At five minutes post application the alcohol gel had reduced CFU

counts by an average of 47% more than by hand washing alone. Paradoxically though, after one hour the hand wash only group CFU counts had returned to approximately the same levels that had been recorded pre washing. After one hour alcohol gel treated hands showed an average increase in CFU counts almost 2.5 times that of the hand wash only group. No anomalous results were recorded from any of the samples with a 5% north – south shift from the mean counts.

A separate study, this time using surgical skin preparations, shows further evidence of this increase in CFU counts over time when alcohol is used on skin. The graph in Figure 4 shows the results of the study into the effects of three different skin prep solutions all of which contain alcohol, on normal abdominal skin prior to surgical incision. Each of the skin prep solutions were tested on 100 test sites using the same test methods as in the hand wash study. It clearly shows that the effect of alcohol on its own as a liquid is similar to that of the alcohol in gel solution. At five minutes post application alcohol has reduced CFU counts by 49%. However, at one hour CFU counts have increased to 19% above the pre-treatment counts.

This study also demonstrates that this is not an effect experienced when combined with another antimicrobial chemical solution containing alcohol as both the other solutions tested also contain alcohol. It is worthy of note that the negative effect of alcohol on skin bacterial counts appears to peak and then begins to reduce over longer time periods.

Conclusion

Data collected from these studies, although controversial, is both illuminating and compelling. The study clearly shows that alcohol used as a skin antimicrobial on its own could potentially do more harm than good by causing a significant rise in skin bacterial counts for more than an hour after use. It is clear from the skin prep study that if used, 70% alcohol needs to be combined with another safe skin antimicrobial chemical (in this case 2% chlorhexidine gluconate) in order to continue to deliver reduced CFU counts over time. It also demonstrates that 70% alcohol as a liquid has a similar but not as marked an effect as 70% alcohol as a ▶
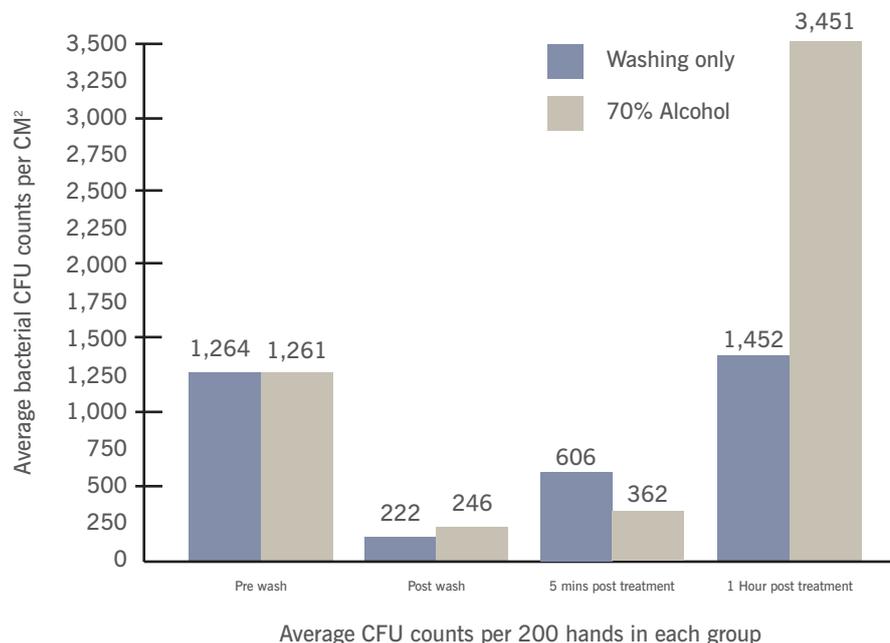
Figure 2: Comparison test over 1 hour. Handwashing only v alcohol gel.

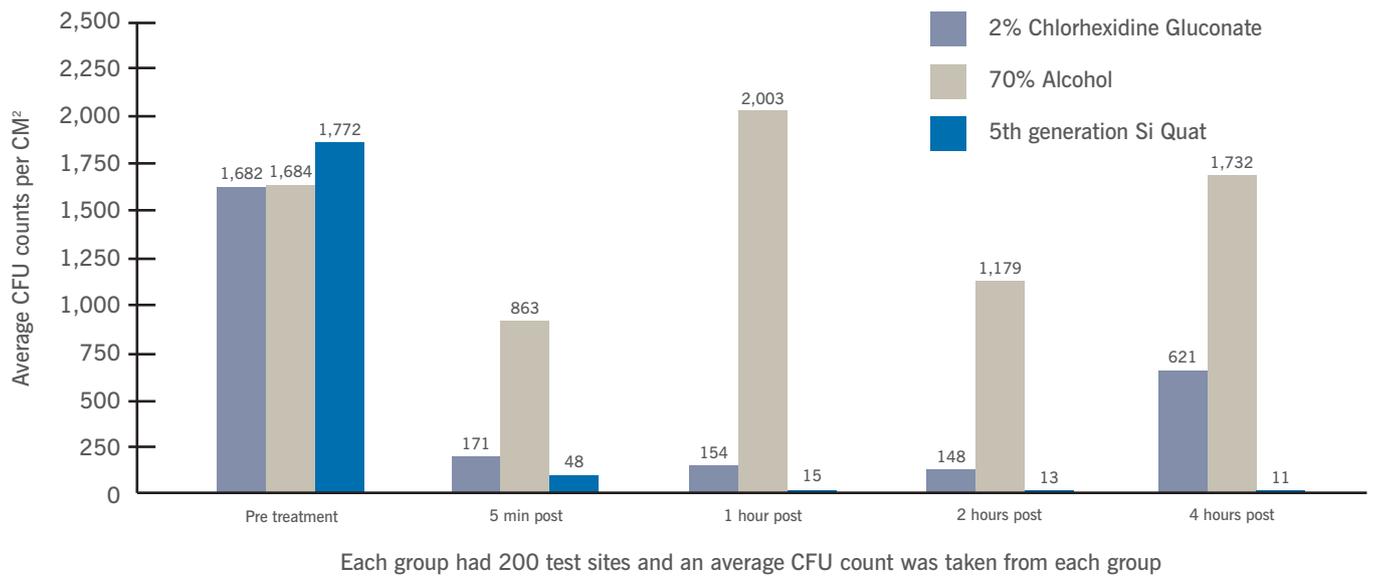Average CFU counts per 200 hands in each group

Figure 4: Comparison of 3 types of surgical skin prep solution

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hand gel and therefore, should also be combined with another antimicrobial chemical to be effective over time.

Discussion and recommendations

Despite the fact that alcohol hand gels are ubiquitous throughout healthcare and the food industry, among others, their effective use is not understood. The dangers of this are evident, especially within healthcare, and may result in increased hospital acquired infections.

The current methods of education and hand hygiene audit in hospitals need to be revisited and questioned for their effectiveness. The potential for change in the behaviour of staff who know they are being observed is well known. Goodheart's law28, which is sometimes confused with Heisenberg's uncertainty principle, but is in fact a social analogue of Heisenberg's uncertainty principle, states "Measuring the system usually disturbs it." This idea has been repeated and described many times, in many forms, and for many industries and academic institutions.[28, 29, 30, 31] It is sometimes referred to as the Hawthorne effect[32] which describes a type of reactivity in which individuals modify or improve an aspect of their behaviour in response to awareness of being observed. Each variation of the theme, has a common core of understanding: "If people know they are being observed they change their behaviour." We therefore have to question the validity of any audit of hand sanitation where staff are aware that they are being observed. It is therefore reasonable to assume that the WHO 5 moments in hand

sanitation[21] are not always practiced by all staff. The myth that not following the WHO guidance would not cause any increase in environmental bioburden can, because of this research, now be dispelled.

The results of these studies raise the questions: "What is occurring to cause this unexpected outcome?" and, based on these results, "Should the WHO make changes to the recommendations on the use of alcohol gels in our hospitals?" There are many aspects of risk associated with high CFU counts in a healthcare workers' work environment, and each clinician's work place and risk is different. It is therefore the view of the authors that clinicians should be involved in the decisions related to hand hygiene practice in their own area of practice, with guidance and support given from infection control teams.

The authors recommend that the following questions are asked by healthcare workers and infection control teams:
1. If alcohol gel is to be used, can it be used every 10 – 15 mins, or can hands be washed within 15 mins of using an alcohol gel to avoid substantial increases in CFU counts?
2. Is this cost effective in their own clinical areas?
3. Should a skin sanitiser be required in their area of practice, what alternatives are available that do not have the same effect as alcohol gel?

Question 3 is appropriate because there is a significant body of evidence over many years showing high levels of bacterial contamination

on Information Technology (IT) tools in regular use in clinical areas. These IT tools include mobile phones, tablets, computer screens, and key boards. The data in these studies clearly shows that healthcare workers will put themselves and patients at risk if there is no effective measure to ensure they do not contaminate their hands when using these devices in clinical settings. The recent introduction in the UK of electronic records, X-ray and laboratory reporting systems are a simple example of how these devices are now needed in almost every clinical area of practice. Yet changes in hand sanitation practice have not adapted to this. The reasons why there is such a significant increase in skin bacteria counts should be investigated further so that we can understand why this occurs.

The effect of differences in background levels of surface contamination (bio burden) in clinical areas on hand bacterial levels needs to be understood to determine if skin sanitation alone is sufficient. It is probable that both surface and skin sanitation methods should be taken into account when assessing risks in clinical areas. The importance of studying the effects on environmental bio burden of long term sanitation on the skin and on surfaces, will become more important as new methods of long term disinfection and sanitation are made available.   CSJ

References
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