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Editorial

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Current Trends section – Quaternary ammonium chloride (QAC) compounds are the most common active ingredient found in disinfectants used in healthcare environments. This is largely because products formulated with QACs are readily available and versatile. In addition, the products typically offer broad-spectrum efficacy and do not have the unpleasant odor of oxidizing-based products, such as Sodium Hypochlorite (Bleach) and Hydrogen Peroxide.

In Profile Scientist – Heinrich Hermann Robert Koch was a German physician and microbiologist. As the discoverer of the specific causative agents of deadly infectious diseases including tuberculosis, cholera, and anthrax, he is regarded as one of the main founders of modern bacteriology.

Bug of the month – *Burkholderia mallei* is a **Gram-negative, bipolar, aerobic bacterium,** a human and animal pathogen of genus Burkholderia causing glanders; the Latin name of this disease (malleus) gave its name to the species causing it.

Did You Know? – There is a rumor that your stomach acid is so strong that it can dissolve a razor blade. But it is true that the hydrochloric acid in your stomach is some strong stuff. While your blood has a pH of around 7.4, your stomach acid has a pH of 1 to 2. That means it is a strong acid indeed, although it is our "gastric juice" is a mixture of different secretions, not just acid. But surely, if your stomach acid could dissolve the metal of a razor blade, it would dissolve itself? Surely not! It turns out, according to at least one study, that stomach acid can do a pretty good number on a razor blade.

Best Practices – Surgical site infection is divided into two main groups, incisional and organ–space. The aim of skin disinfection is to remove and rapidly kill skin flora at the site of a planned surgical incision. The antiseptics that are currently available do not eliminate all microorganisms, and coagulase-negative staphylococci can be isolated even after three applications of agents such as iodine-alcohol to the skin.

"There is nothing in the world so irresistibly contagious as laughter and good humor." so ease your mind with some light humour in our **Relax Mood** section.

Looking forward for your feedback & suggestions.

Microbiology of milk and milk products (II)

Milk is a very good culture medium for many different kind of microorganism, as it is high is moisture, near neutral pH and rich in nutrients. Microorganism causes changes in primary characteristics and properties of milk and milk products. Premature spoilage and varying product quality due to microbial contamination constitute major problems in dairy industry. Spoilage-associated bacteria may enter the product either as part of the raw milk microbiota or as recontaminants in the dairy plant.

Sources Microbial Contamination of Milk

Interior of udder

Raw milk as it leaves the udder of healthy cows normally contain very low numbers of microorganisms and generally will contain less than 1000 colony-forming units of total bacteria per ml (cfu/ml). In healthy cows, bacterial colonization within the teat cistern, teat canal, and on healthy teat skin does not significantly contribute total numbers of bacterial neither in bulk milk, nor to the potential increase in bacterial numbers during refrigerated storage.

While the healthy udder should contribute very little to the total bacteria count of bulk milk, a cow with mastitis has the potential to shed large numbers of microorganisms into her milk. The influence of mastitis on the total bacteria count of bulk milk depends on type of bacteria, the stage of infection and the percent of the herd infected. Majority of mastitis cases are produced by relatively small group of bacteria *Staphylococcus aureus*, *Streptococcus uberis*, Mycoplasma spp. and *Escherichia coli*.

Exterior of udder

Unclean udder and teats of animal contribute to total bacterial counts of milk. Microbes naturally associated with skin of animals as well as from the environment where cow is housed and milked are predominant in milk. Udder and teat become soiled with dung, mud, bedding material such as saw dust, straw etc. (coliforms and *Bacillus* spp.)

Coat of cow

Coat serves as vehicle to contribute bacteria directly to milk. Hairs around udder, flanks and tail contribute to higher bacterial count in milk. Coat may carry bacteria from stagnant water pools, especially ropiness causing milk microbes.

Animal shed and surroundings:

Milk produced on farms with poor hygiene practices may undergo significant spoilage and has shorter shelf-life. Microbes associated with bedding materials include coliforms, staphylococci, streptococci and other Gram-negative bacteria.

Milking staff

Hand contacts or dislodging of dust and dirt particles by milker may add microbes to milk. Risk of contamination from milker are higher, when cows are hand milked in comparison to machine milked. Milker with infected wounds on hands contributes pathogenic Streptococcus spp. and micrococci. Microbial pathogens causing typhoid, dysentery, septic sore throat, diphtheria, cholera etc. contaminate the milk.

Milking equipment

Improperly cleaned milking and cooling equipment's are main sources of milk contamination. Tanker and collecting pipes are sources of contamination, if not adequately cleaned. Unclean or improperly cleaned milk cans and lids if they are still moist, results in multiplication of thermophilic bacteria (*Bacillus cereus*). Improperly sterilized milking machines contain thermoduric micrococci, Microbacterium spp.

Water supplies

Water can be a predominant source of microbial contamination. Uncleaned storage tanks, untreated water supplies from natural sources (bore wells, tanks and rivers) may be contaminated with faecal microbes (coliforms). Saprophytic bacteria (*Pseudomonas*) may also be present in water and contaminate the milk.

Spoilage of Milk

Any undesirable change or deterioration in the quality of milk is called Spoilage of milk. These changes can be like an unpleasant appearance, colour, odour, taste etc. There are two factors involved in the spoilage of milk, namely Intrinsic and Extrinsic factors.

Intrinsic factors: These are innate to the food composition. It includes many factors like moisture content, pH, nutrient content, antimicrobial constituents of food.

Extrinsic factors: These are innate to environmental factors. It includes temperature, relative humidity, oxygen availability and microbial interaction.

Raw milk and pasteurized milk contain many types of microorganisms, they are refrigerated, yet they have limited shelf life. During refrigerated storage (at dairy farms and processing plants) before pasteurization, only psychrotrophs can grow in refrigerated milk storage such as *Pseudomonas, Flavobacterium, Alcaligenes, Listeria monocytogenes, Yersinia enterocolitica*, some coliforms, and *Bacillus* spp.
Those that spoil milk after heating are the thermoduric

microorganisms surviving pasteurization such as *Micrococcus*, some *Enterococcus, Streptococcus*, some *Lactobacillus*, and spores of *Bacillus* and *Clostridium*.

Milk contains bacteria that can be classified into three types
- Biochemical Type
- Temperature Characteristic Type
- Pathogenic Type.

Biochemical Type:
This group consists of those microorganisms occurring in milk which bring about biochemical changes in it.
- Acid forming microbes.
- Gas forming microbes.
- Ropy milk forming microbes,
- Proteolytic microbes,
- Lipolytic microbes.

Acid Forming Microbes:
These are bacteria which bring about natural fermentation of milk. The most common type is the lactic acid fermentation which takes place during souring of milk under natural conditions.
Milk of good sanitary quality when kept under conditions that allow growth of *Streptococcus* spp. (e.g., S. cremoris) and *Lactobacillus* species (e.g., *L. casei, L. plantarum, L. brevis*, and *L. fementum*) develops sour flavour.
Streptococcus spp. ferment lactose quickly but do not produce as high a concentration of lactic acid-as members of the genus *Lactobacillus*. *Micrococcus* species, e.g., *M. luteus, M. variens* and *M. freudenreichii* produce small amount of acid from lactose fermentation and sour the milk.
Escherichia coli and *Enterobacter aerogenes* also ferment lactose to a mixture of end products like acids, gases and some neutral compounds. These are considered undesirable as they produce CO2, H2 and unpleasant flavour. *Microbacterium lacticum* is also reported in milk and ferments lactose to lactic acid and other end products.

Gas Forming Microorganisms:
There are certain coliform bacteria like *Clostridium butyricum* which ferment lactose to acids accompanied with accumulation of gases, the gas being usually a mixture of CO2 and H2.
Clostridium butyricum produces large amount of CO2 whereas coliform bacteria produce H2 in addition. Certain yeasts, e.g., *Torula cremoris, Candida pseudotropicalis*, and *Torulopsis sphacrica* are reported in milk They, too, ferment lactose and produce CO2.

Ropy milk Forming Bacteria:

The conversion of liquid milk to viscous material by the action of microbes is called 'ropy fermentation'. These microorganisms synthesize a viscous polysaccharide material that forms a slime layer or capsule around their cells. *Alcaligenes viscolactis, Enterobacter aerogenes Streptococcus cremoris,* and some species of Micrococcus are responsible for ropy fermentation. Ropy milk is not deleterious to health but is usually objectionable due to its appearance and is frequently used as the culture medium.

Proteolytic Bacteria:
These microorganisms hydrolyse milk protein and increase the pH. Proteolysis may be preceded by coagulation of the casein by the enzyme rennin elaborated by bacteria resulting in the formation of soluble form of casein. Proteolysis degrades the casein to peptides which may be further degraded to amino acids which are responsible for alkaline reaction and bitter taste of milk. *Bacillus subtilis, B. cereus var. mycoides, Pseudomonas putrefaciens, P. viscosa, Streptococcus, liquefaciens,* and *Proteus* spp. are the proteolytic bacteria present in the milk.

Lipolytic Microorganisms:
Some of the microorganisms produce enzyme (lipases) which split milk fat to glycerol and fatty acids. Some of these fatty acids have a sharp flavour which causes imparting rancid flavour and-odour to milk. Lipolytic microorganisms present in the milk are the bacteria *Pseudomonas fluorescens, Achromobacter lipolyticum;* yeasts, e.g., *Candida lipolytica*; and moulds, e.g., *Pencillium* spp. and *Geotrichum candidum*.

Temperature Characteristic Types:
On the basis of temperature for growth and heat resistance, the bacteria encountered in milk are of the following four types:
- Psychrophilic.
- Mesophilic.
- Thermoduric
- Thermophilic.

Psychrophilic Bacteria:
Psychrophilic bacteria (cryophilic) grow low temperatures, usually below 10°C. Pasteurized milk stored in refrigerator may be satisfactorily preserved for a week or even longer. But eventually, microbial deterioration manifested by 'off' flavour or odour will become evident because of the accumulation of metabolic products of psychrophilic bacteria eg. *Pseudomonas, Flavobacterium, Alcaligenes*, and some coliform bacteria.

Mesophilic Bacteria:
Mesophilic bacteria grow best between 10°C and 45°C, usually at 25-40°C. Lactic streptococci and some coliform bacteria are the examples. These are mainly the 'acid producing types. In addition to acid, they may produce gas that results in 'off' flavours in milk. *Streptococcus lactis var. maltigenes* produce a malty or caramel taint. *Pseudomonas icthyosmi*a, however, imparts a fishy flavour.

Thermoduric Bacteria:
Thermoduric bacteria survive pasteurization in considerable numbers but do not grow at pasteurization temperatures. Since they are not killed by pasteurization, they may contaminate the containers. As a result of the faulty cleaning of the containers, the subsequent batches of milk processed through the same containers will become heavily contaminated. *Microbacterium lacticum, Micrococcus luteus. Streptococcus thermophilus,* and

Bacillus subtilis exemplify this category.

Thermophilic Bacteria:
Thermophilic bacteria develop best at 55-65°C with minimum and maximum of 40°C and 80°C respectively eg. *Bacillus stearothermophilus*.

Pathogenic Types:
Some pathogenic forms of microorganisms are found in milk, which can cause serious illness. Diseases can be transmitted either through raw milk, cow and others. eg Tuberculosis is caused by *Mycobacterium tuberculosis* in both cow and man. *Bacillus anthracis* causes anthrax in both cow and man. *Streptococcus pyogenes* causes scarlet fever in man.

Source	Diseases		Causal organism
	Cow	Man	
Cow	Tuberculosis	Tuberculosis	*Mycobacterium tuberculosis*
	Mastitis	Sore throat	*Micrococcus piogenes*
	Brucellosis	Undulant fever	*Brucella abortus*
	Anthrax	Anthrax	*Bacillus anthracis*
Other	—	Typhoid	*Salmonella typhi*
		Diphtheria	*Corynebacterium diphtheriae*
		Scarlet fever	*Streptococcus pyogenes*
		Q. fever	*Coxiella brunetti*
		Cholera	*Vibrio coma*
		Enteric fever	*Salmonella paratyphi, S. typhimurium*

Diseases transmitted through milk either from infected cows or other sources

Media used in dairy industry

- Brilliant Green Bile Broth 2%
- Brilliant Green, Phenol Red, Lactose Monohydrate, Sucrose Agar (Agar Medium L) BP
- Brilliant Green, Phenol Red, Lactose Monohydrate, Sucrose Agar (Agar Medium L) EP
- Deoxycholate Lactose Agar
- Elliker Broth
- Fluid Lactose Medium
- Fluid Lactose Medium
- Fluid Lactose Medium USP
- Lactose Broth
- Lactose Broth BIS
- Lactose Monohydrate Broth(Broth Medium D) EP
- Lactose Monohydrate Broth(Broth Medium D) BP
- Lactose Tryptose Broth(Lauryl Sulphate Broth)
- MacConkey Agar Plate (Harmonized)
- Nusept™-C
- Nutrient Agar with 1% Peptone
- Nutrient Agar with Skim Milk
- Nutrient Broth with 1% Peptone
- Plate Count Agar (Gamma-Irradiated)
- Plate Count Agar (Standard Method Agar)
- Plate Count Agar(Standard Methods Agar) BIS
- Potato Dextrose Agar
- Potato Dextrose Broth
- Skim Milk Agar
- Tetrathionate Broth Base, Hajna
- Tryptone Glucose Beef Extract Agar(TGB Agar)
- Tryptone Glucose Yeast Extract Agar
- Violet Red Bile Glucose Agar Plate(Harmonized)
- Xylose Lysine Deoxycholate Agar Plate(Harmonized)

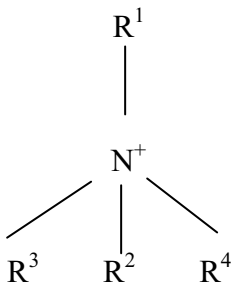
The Quat Advantage: Quaternary Ammonium Chloride and Its Advanatages in Healthcare Facilities

BACKGROUND

Quaternary ammonium chloride (QAC) compounds are the most common active ingredient found in disinfectants used in healthcare environments. This is largely because products formulated with QACs are readily available and versatile. In addition, the products typically offer broad-spectrum efficacy and do not have the unpleasant odor of oxidizing-based products, such as Sodium Hypochlorite (Bleach) and Hydrogen Peroxide.

The basic chemical structure of QACs consist of a nitrogen atom with some combination of four other organic chains or rings as shown in Figure 1.

Figure 1. Quaternary Ammonium cation



The QAC market has substantially evolved since its inception more than 100 years ago and has significantly matured providing disinfectant solutions that today provide improved benefits compared to historical QAC disinfectants. Due to the limitless number of possible combinations, there are many different versions of QACs on the market already and new ones are constantly being developed. The most current QACs on the market are seventh generation providing enhancements in efficacy with less toxicity. Table 1 outlines the evolution of QACs.

This communication is intended to identify the many benefits of QAC's and provide insight into the future of QAC's for use as active microbial agents in surface disinfection products.

Table 1. Outline of the various generations of QAC's

FIRST GENERATION: Benzalkonium chlorides (example: Benzalkonium chloride). First generation QACs have the lowest relative biocidal activity and are commonly used as preservatives.
SECOND GENERATION: Substituted benzalkonium chlorides (example: alkyl dimethyl benzyl ammonium chloride). The substitution of the aromatic ring hydrogen with chlorine, methyl and ethyl groups resulted in this second generation QAC with high biocidal activity.
THIRD GENERATION: "Dual QACs" (example: contain an equal mixture of alkyl dimethyl benzyl ammonium chloride + alkyl dimethyl ethylbenzyl ammonium chloride). This mixture of two specific QACs resulted in a dual QAC offering increased biocidal activity, stronger detergency, and increased safety to the user (relative lower toxicity).
FOURTH GENERATION: "Twin or Dual Chain QACs" – contain dialkylmethyl amines (example: didecyl dimethyl ammonium chloride or dioctyl dimethyl ammonium chloride). Fourth generation QACs are superior in germicidal performance, lower foaming, and have an increased tolerance to protein loads and hard water.
FIFTH GENERATION: Mixtures of fourth generation QACs with second-generation QACs (example: didecyl dimethyl ammonium chloride + alkyl dimethyl benzyl ammonium chloride). Fifth generation QACs have outstanding germicidal performance, are active under more hostile conditions and are safer to use.
SIXTH GENERATION: Polymeric Quaternary Ammonium Chlorides.
SEVENTH GENERATION: Bis-Quaternary Ammonium Chlorides with Polymeric Quaternary Ammonium Chlorides.

QAC ACTIVITY

QACs are good cleaning agents and are widely used as disinfectants for noncritical environmental surfaces in healthcare settings. QACs have the broadest spectrum of any microbial agent, having shown efficacy against Bacteria, Viruses, Protozoa, Fungus, and Algae commonly found in healthcare environments. The broad spectrum efficacy claims obtained from the QAC along with the ability to couple with alcohol allows for a broad spectrum disinfectant with a fast contact time (less than or equal to 3 minutes) and excellent compatibility. The bactericidal action of the QACs have also been attributed to the inactivation of energy-producing enzymes, denaturation of essential cell proteins, and disruption of the cell membrane.

Generalized statements that QACs overall are not effective against target organisms has led to a misrepresentation of the efficacious ability of QACs to mitigate specific target organisms, specifically Norovirus. QAC-based formulations are tested using the Environmental Protection Agency (EPA) standardized testing protocols for claims against a specific organism. These tests must be conducted with the specific organism to ensure efficacy. In numerous studies published, the authors neglected to determine if the product had been registered for that specific organism or application, and most of the QACs had been tested alone versus in conjunction with many of its synergistic partners. In fact, QACs alone have the ability to mitigate 37 of the top 50 organisms as well as persistent organisms, such as Acinetobacter spp (3 days to 5 months), Chlamydia psittaci (15 days), Shigella spp (2 days to 5 months), MRSA (7 days to 7 months), Adenovirus (7 days to 3 months) and Candida Albicans (1-120 days).

COMPATIBILITY

One of the advantages of Quaternary ammonium disinfectants is that they do not damage clothing and carpets the way that oxidizing chemistries do. They are also non-corrosive to metal pipes and other surfaces. QAC formulated disinfectant products predominantly sold into the healthcare surface disinfectant industry are diluted for easy use, and therefore possess a much lower risk of damaging surfaces versus concentrated QAC forms.

As a results of the formulation properties, QAC-based as well as alcohol/QAC-based disinfectant products provide exceptional material compatibility as shown in table 3. These alcohol/QAC-based formulations are safe for repeated use on hard, non-porous surfaces. With repeated use, these formulations do not streak or build up on the surface.

A study conducted by Lonza in 2002, provided data from a material compatibility test demonstrating the advantage of using QAC-based disinfectants versus Hydrogen Peroxide-based formulation on rolled steel. This value proposition of enhanced material compatibility provided by a QAC-based formulation is seen on most metal, plastic, and fabric material compositions, and these findings have been correlated to over 70% of the medical device manufacturers in the healthcare industry.

Table 2 : Outlines the advantage of QACs versus various other types of disinfectants

	QUATERNARY AMMONIUM CHLORIDES	BLEACH	HYDROGEN PEROXIDE	CHLORINE DIOXIDE	PERACETIC ACID
Effective pH	1.13	9.13	1.5	1.14	1.5
Cleaning	Good	Poor	Poor	Poor	Poor
Staining	No	No	Yes	Yes	Yes
Odor	Low	High	Moderate	High	High
Skin Irritation	Low	High	Medium	High	High
Storage Stability	Excellent	Poor	Poor	Poor	Poor
Disinfectant (ppm)	450-850	200-5000	500-1000	5-10	<50
Sanitization (ppm)	150-400	50-200	50-100	<5	5-10

Table 3: Material Compatibility testing conducted by 3rd party comparing Hydrogen Peroxide (3%) with QAC.

	304 SS	ACETAL	BUNA	EPR, EPDM	FLUORO CARBON	FLUOROELASTOMER (FKM)	TPE	NITRILE	NYLON
H202	-	D	B	B	A	A	D	-	D
QAC	A Polychloroprene	- Polypropylene	A PTFE	- PVDF	A Santoprene	A UHMWPE	-	A	-
H202	D	A	A	A	A	A			
QAC	A	-	A	-	-	-			

STABILITY

Not all disinfectant chemistries possess the same stability. The stability property of some chemistries can lead to exothermic decomposition caused by the interaction with other chemicals. In most cases, this can lead to the formation of gases and other bi-products, categorizing these types of chemistries as Reactive Oxygen Species (ROS). This is influenced by a variety of effects ranging from temperature, pH, and the presence of other reactive components. The inability to stabilize these disinfectant formulations properly can lead to challenges in finished product packaging as well as once applied to surfaces. In most instances, oxidative chemistries currently in the surface disinfectant market require two part activation, short product shelf life, and, in some cases, require an additional cleaning step or pre-cleaning.

QAC-based chemistries provide superior stability properties versus any other disinfectant chemistry with having a shelf-life greater than three (3) years. This value proposition of a greater than three (3) year shelf life provided by QACs is not available in any aqueous oxidizing disinfectant formulation. In addition, the active QAC component has been tested to be stable and continue to be efficacious at elevated temperatures at both basic and acidic pH ranges.

QAC MISCONCEPTIONS

A misconception is that QACs lose effectiveness when mixed with organic matter, such as blood and/or in the presence of hard water. In fact, advances in the area of formulation science allow for surfactants and modifiers to be introduced into the formulation as inerts to provide for improved effectiveness and cleaning performance for blood, urine, and other soil types found on surfaces.

Another important misconception is that continuous use of QAC-based chemistries results in the development of antimicrobial resistance, but recent publications have proved this to be untrue. These recent reviews provide evidence and basic theory based on the mode of attack that QACs utilize that it is highly unlikely it would lead to treatment failure. In addition, a study conducted by Meyers C. in 2010, provided data that rotating different QAC

formulations in healthcare reduce the risk or the probabilities that environmental treatment would improve. Research regarding resistance to biocides, specifically QAC-based formulations, has not provided evidence to substantiate this resistance theory. In most instance, the root cause associated with these false positives stem from incorrect handling of product, sample preparation, and human error.

CONCLUSION

QACs have been extensively studied for their efficacy, safety and toxicity, and environmental effects, and continue to serve as the primary form of surface disinfection in the healthcare environment. QAC-based formulations continue to evolve and provide broad spectrum efficacy, short contact times, extensive shelf life and stability profile, low odor, safety, and a wide effective pH range. The misconceptions regarding QAC-based chemistries in the public have proven to be false and lack the evidence-based data to substantiate the claims. Lastly, QAC-based surface disinfectant formulations provide the advantage of a highly compatible formulation that is non-corrosive on metal surfaces and with the majority of medical grade plastic types having strong material compatibility. The four main pillars to a strong and effective surface disinfectant product, efficacy, contact time, safety and toxicity and compatibility, are what continues to enhance the popularity of QAC-based chemistries and serve as the top infection prevention solution for surface treatment in the healthcare environment.

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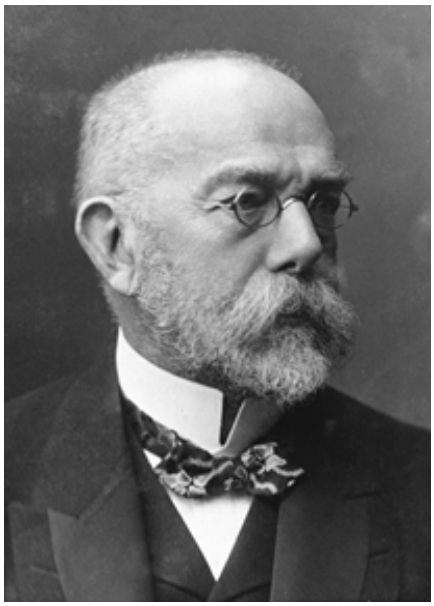
Robert Koch



Robert Koch was born on December 11, 1843, at Clausthal in the Upper Harz Mountains. The son of a mining engineer, he astounded his parents at the age of five by telling them that he had, with the aid of the newspapers, taught himself to read, a feat which foreshadowed the intelligence and methodical persistence which were to be so characteristic of him in later life. He attended the local high school («Gymnasium») and there showed an interest in biology and, like his father, a strong urge to travel.

In 1862 Koch went to the University of Göttingen to study medicine. Here the Professor of Anatomy was Jacob Henle and Koch was, no doubt, influenced by Henle's view, published in 1840, that infectious diseases were caused by living, parasitic organisms. After taking his M.D. degree in 1866, Koch went to Berlin for six months of chemical study and there came under the influence of Virchow. In 1867 he settled, after a period as Assistant in the General Hospital at Hamburg, in general practice, first at Langenhagen and soon after, in 1869, at Rackwitz, in the Province of Posen. Here he passed his District Medical Officer's Examination. In 1870 he volunteered for service in the Franco-Prussian war and from 1872 to 1880 he was District Medical Officer for Wollstein. It was here that he carried out the epoch-making researches which placed him at one step in the front rank of scientific workers.

Anthrax was, at that time, prevalent among the farm animals in the Wollstein district and Koch, although he had no scientific equipment and was cut off entirely from libraries and contact with other scientific workers, embarked, in spite of the demands made on him by his busy practice, on a study of this disease. His laboratory was the 4-roomed flat that was his home, and his equipment, apart from the microscope given to him by his wife, he provided for himself. Earlier the anthrax bacillus had been discovered by Pollender, Rayer and Davaine, and Koch set himself to prove scientifically that this bacillus is, in fact, the cause of the disease. He inoculated mice, by means of home-made slivers of wood, with anthrax bacilli taken from the spleens of farm animals that had died of anthrax, and found that these mice were all killed by the bacilli, whereas mice inoculated at the same time with blood from the spleens of healthy animals did not suffer from the disease. This confirmed the work of others who had shown that the disease can be transmitted by means of the blood of animals suffering from anthrax.

But this did not satisfy Koch. He also wanted to know whether anthrax bacilli that had never been in contact with any kind of animal could cause the disease. To solve this problem he obtained pure cultures of the bacilli by growing them on the aqueous humour of the ox's eye. By studying, drawing and photographing these cultures, Koch recorded the multiplication of the bacilli and noted that, when conditions are unfavourable to them, they produce inside themselves rounded spores which can resist adverse conditions, especially lack of oxygen and that, when suitable conditions of life are restored, the spores give rise to bacilli again. Koch grew the bacilli for several generations in these pure cultures and showed that, although they had had no contact with any kind of animal, they could still cause anthrax.

The results of this painstaking work were demonstrated by Koch to Ferdinand Cohn, Professor of Botany at the University of Breslau, who called a meeting of his colleagues to witness this demonstration, among whom was Professor Cohnheim, Professor of Pathological Anatomy. Both Cohn and Cohnheim were deeply impressed by Koch's work and when Cohn, in 1876, published Koch's work in the botanical journal of which he was the editor, Koch immediately became famous. He continued, nevertheless, to work at Wollstein for a further four years and during this period he improved his methods of fixing, staining and photographing bacteria and did further important work on the study of diseases caused by bacterial infections of wounds, publishing his results in 1878. In this work he provided, as he had done with anthrax, a practical and scientific basis for the control of these infections.

Koch was still, however, without adequate quarters or conditions for his work and it was not until 1880, when he was appointed a member of the «Reichs-Gesundheitsamt» (Imperial Health Bureau) in Berlin, that he was provided, first with a narrow, inadequate room, and later with a better laboratory, in which he could work with Loeffler, Gaffky and others, as his assistants. Here Koch continued to refine the bacteriological methods he had used in Wollstein. He invented new methods – «Reinkulturen» – of cultivating pure cultures of bacteria on solid media such as potato, and on agar kept in the special kind of flat dish invented by his colleague Petri, which is still in common use. He also developed new methods of staining bacteria which made them more easily visible and helped to identify them. The result of all this work was the introduction of methods by which pathogenic bacteria could be simply and easily obtained in pure culture, free from other organisms and by which they could be detected and identified. Koch also laid down the conditions, known as Koch's postulates, which must be satisfied before it can be accepted that particular bacteria cause particular diseases.

Some two years after his arrival in Berlin Koch discovered the tubercle bacillus and also a method of growing it in pure culture. In 1882 he published his classical work on this bacillus. He was still busy with work on tuberculosis when he was sent, in 1883, to Egypt as Leader of the German Cholera Commission, to investigate an outbreak of cholera in that country. Here he discovered the vibrio that causes cholera and brought back pure cultures of it to Germany. He also studied cholera in India.

On the basis of his knowledge of the biology and mode of distribution of the cholera vibrio, Koch formulated rules for the control of epidemics of cholera which were approved by the Great Powers in Dresden in 1893 and formed the basis of the methods of control which are still used today. His work on cholera, for which a Prize of 100,000 German Marks was awarded to him, also had an important influence on plans for the conservation of water supplies.

In 1885 Koch was appointed Professor of Hygiene in the University of Berlin and Director of the newly established Institute of Hygiene in the University there. In 1890 he was appointed Surgeon General (Generalarzt) Class I and Freeman of the City of Berlin. In 1891 he became an Honorary Professor of the Medical Faculty of Berlin and Director of the new Institute for Infectious Diseases, where he was fortunate to have among his colleagues, such men as Ehrlich, von Behring and Kitasato, who themselves made great discoveries.

During this period Koch returned to his work on tuberculosis. He sought to arrest the disease by means of a preparation, which he called tuberculin, made from cultures of tubercle bacilli. He made two preparations of this kind called the old and the new tuberculin respectively, and his first communication on the old tuberculin aroused considerable controversy. Unfortunately, the healing power that Koch claimed for this preparation was greatly exaggerated and, because hopes raised by it were not fulfilled, opinion went against it and against Koch. The new tuberculin was announced by Koch in 1896 and the curative value of this also was disappointing; but it led, nevertheless, to the discovery of substances of diagnostic value. While this work on tuberculin was going on, his colleagues at the Institute for Infectious Diseases, von Behring, Ehrlich and Kitasato, carried out and published their epoch-making work on the immunology of diphtheria.

In 1896 Koch went to South Africa to study the origin of rinderpest and although he did not identify the cause of this disease, he succeeded in limiting the outbreak of it by injection into healthy farm-stock of bile taken from the gall bladders of infected animals. Then followed work in India and Africa on malaria, blackwater fever, surra of cattle and horses and plague, and the publication of his observations on these diseases in 1898. Soon after his return to Germany he was sent to Italy and the tropics where he confirmed the work of Sir Ronald Ross in malaria and did useful work on the aetiology of the different forms of malaria and their control with quinine.

It was during these later years of his life that Koch came to the conclusion that the bacilli that caused human and bovine tuberculosis are not identical and his statement of this view at the International Medical Congress on Tuberculosis in London in 1901 caused much controversy and opposition; but it is now known that Koch's view was the right one. His work on typhus led to the idea, then a new one, that this disease is transmitted much more often from man to man than from drinking water and this led to new control measures.

In December, 1904, Koch was sent to German East Africa to study East Coast fever of cattle and he made important observations, not only on this disease, but also on pathogenic species of *Babesia* and *Trypanosoma* and on tickborne spirochaetosis, continuing his work on these organisms when he returned home.

Koch was the recipient of many prizes and medals, honorary doctorates of the Universities of Heidelberg and Bologna, honorary citizenships of Berlin, Wollstein and his native Clausthal, and honorary memberships of learned societies and academies in Berlin, Vienna, Posen, Perugia, Naples and New York. He was awarded the German Order of the Crown, the Grand Cross of the German Order of the Red Eagle (the first time this high distinction was awarded a medical man), and Orders from Russia and Turkey. Long after his death, he was posthumously honoured by memorials and in other ways in several countries.

In 1905 he was awarded the Nobel Prize for Physiology or Medicine. In 1906, he returned to Central Africa to work on the control of human trypanosomiasis, and there he reported that atoxyl is as effective against this disease as quinine is against malaria. Thereafter Koch continued his experimental work on bacteriology and serology.

In 1866 Koch married Emmy Fraats. She bore him his only child, Gertrud (b. 1865), who became the wife of Dr. E. Pfuhl. In 1893 Koch married Hedwig Freiberg.

Dr. Koch died on May 27, 1910, in Baden-Baden.

Jokes

Corporate joke
Manager told a joke.
Everyone in the team laughed except 1guy

Manager-Didn't you understand my Joke

guy-I resigned yesterday

Always give 100% at work.

12% Monday, 23% Tuesday, 40% Wednesday, 20% Thursday and 5% Friday.

Boss: "Do you believe that there is life after death?"

Employee: "No, that can't be proved.

Boss: "Well, there is now! Yesterday after you left work saying that you had to go to your grandma's funeral, she called the office looking for you!"

I always tell new hires: Don't think of me as your boss;

think of me as your friend who can fire you. Simple!

I had a job interview today. The interviewer told me I'd start on $3,000 a month, and then after three months, I'd get $3,500 a month

I told them I'd start in three months.

Burkholderia mallei

Etiologic Agent

Burkholderia mallei, a gram-negative bacillus.

Sequelae

Systemic invasion can occur with resulting chronic abscessation.

Diagnosis

The disease is diagnosed in the laboratory by isolating *Burkholderia mallei* from blood, sputum, urine, or skin lesions. Serologic assays are not available.

Trends

Glanders continues to be extremely rare in humans. In 2000, one case occurred in a research laboratory worker in the U.S. after accidental exposure.

While no national or state surveillance exists, the case-fatality rate can be up to 50% with traditional antibiotic treatment. However, susceptibility data suggest newer antibiotics should be more efficacious. The latest estimates show the mortality rate for localized disease can be as low as 20% with appropriate treatment, and the overall mortality rate is 40%.

Glanders is an infectious disease that is caused by the bacterium *Burkholderia mallei*. While people can get the disease, glanders is primarily a disease affecting horses. It also affects donkeys and mules and can be naturally contracted by other mammals such as goats, dogs, and cats.

Transmission

The bacteria that cause glanders are transmitted to humans through contact with tissues or body fluids of infected animals. The bacteria enter the body through cuts or abrasions in the skin and through mucosal surfaces such as the eyes and nose.

It may also be inhaled via infected aerosols or dust contaminated by infected animals. Sporadic cases have been documented in veterinarians, horse caretakers, and laboratorians.

Cases of human-to-human transmission have not been reported in the U.S.

Signs and Symptoms

Symptoms of glanders commonly include:

- Fever with chills and sweating
- Muscle aches
- Chest pain
- Muscle tightness
- Headache
- Nasal discharge
- Light sensitivity (sometimes with excessive tearing of the eyes)

The particular symptoms experienced, however, will vary depending on the type of infection. The four types of infections, along with the symptoms associated with each, are listed below.

Localized Infection

If there is a cut or scratch in the skin, a localized infection with ulceration may develop within 1 to 5 days at the site where the bacteria entered the body. Swollen lymph nodes may also be apparent.

Infections involving the mucous membranes in the eyes, nose, and respiratory tract will cause increased mucus production from the affected sites. Dissemination to other locations in the body may occur 1-4 weeks after infection.

Pulmonary Infection

Glanders often manifests itself as pulmonary infection. In pulmonary infections, pneumonia, pulmonary abscesses, and pleural effusion can occur. Chest X-rays will show localized infection in the lobes of the lungs.

Bloodstream Infection

Without treatment, glanders bloodstream infections are usually fatal within 7 to 10 days.

Chronic Infection

The chronic form of glanders involves multiple abscesses within the muscles and skin of the arms and legs or in the lungs, spleen, and/or liver.

Treatment

Since human cases of glanders are rare, there is limited information about antibiotic treatment in humans. Sulfadiazine has been found to be effective in experimental animals and in humans.

In addition, the bacterium that causes glanders is usually susceptible to:

- Tetracyclines
- Ciprofloxacin
- Streptomycin
- Novobiocin
- Gentamicin
- Imipenem
- Ceftazidime
- Sulfonamides

Prevention

Presently, there is no vaccine available for glanders.

In countries where glanders is endemic in animals, prevention of the disease in humans involves identification and elimination of the infection in the animal population.

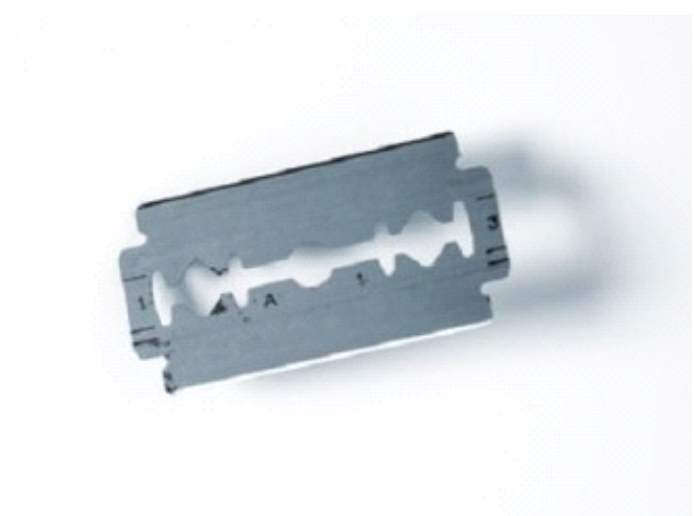
Within the health care setting, transmission can be prevented by using standard and airborne precautions.

Your Stomach Acid Can Dissolve a Razor Blade: True or False?

Although this site is about food, I think that the subject of eating pieces of metal, and certainly the risky practice of swallowing razor blades, are fair game. There is a rumor that your stomach acid is so strong that it can dissolve a razor blade. I'd hate to be the guy to test that assumption, but it is true that the hydrochloric acid in your stomach is some strong stuff. While your blood has a pH of around 7.4, your stomach acid has a pH of 1 to 2. That means it is a strong acid indeed, although it is our "gastric juice" is a mixture of different secretions, not just acid. But surely, if your stomach acid could dissolve the metal of a razor blade, it would dissolve itself? Surely not! It turns out, according to at least one study, that stomach acid can do a pretty good number on a razor blade.

Of course, it there was a razor blade in your stomach, it would do a lot of damage. So, researchers did not have someone ingest a razor blade to test this. Instead they studied metal corrosion by stomach acid in vitro, meaning "outside the body in a simulated environment." According to the study by Paul K. Li, et al. corrosion of razor blades occurs fairly rapidly in the normal stomach. 1 Now, I think that this is a stretch, because a stomach with a razor blade in it probably wouldn't be a normal stomach for long, and the esophagus wouldn't be very happy, either. Nevertheless, according to the research, double-edged blades become fragile and easily-breakable within 24 hours, having only 63% of their original mass. You should note, however, that the stomach acid had no effect on pennies within this time-frame, nor did it cause disc batteries to spring a leak within the same amount of time.

t would be a stretch to say that stomach acid would have a large effect on a big chunk of steal within 24 hours, and of course, things do not sit in your stomach for that long. Razor blades are already very thin and flexible pieces of metal, so to corrode them enough to be brittle is perhaps not as much a feat as it seems. We do not know how long it would take to completely dissolve one.



Regardless, stomach acid, it appears, can begin to dissolve a razor blade in a reasonable time period, perhaps underscoring just how awesome our digestive system is. But if the acid is so strong, how can your stomach hold it without the acid eating right through? If you eat a steak, it will be nothing more than a liquid slurry of mushy nastiness in no time. And your stomach is, essentially, meat, right? At least, it is made of proteins. Well, the truth is that your stomach acid would happily digest your stomach if given a chance. And, when things don't go right, we get things like ulcers, which are open sores or raw areas in the stomach. When this happens, it is because a large enough amount of acid has come into contact with the stomach wall on a regular enough basis.
Normally, however, the stomach has a protective lining. This lining consists of a layer of mucosal protein (just think mucus) that is covered with molecules of sugar, held together tightly through the magic of chemical bonds. The sugars are really good at resisting the acid. You have a bunch of specialized epithelial cells that produce this mucous stuff.

It's not perfect protection, and some stomach acid gets through now and again. Now, there is a lot of blood flow in the stomach wall, so that helps to neutralize and wash away some of the acid, but it still does damage and it destroys some of the cells of the stomach. In fact, a whole lot of your stomach cells get destroyed, all the time. Thankfully, they are such busy little buggers when it comes to reproducing themselves. They do NOT take days off, at least normally. When cells are damaged, newly generated cells move up to take their place. In fact, the entire stomach lining is replaced about every three days.

When things go wrong and the mucus lining is damaged, and more acid than normal gets through, damage can occur faster than cells can be renewed, and thus a sore, or even a hole, can form. This is called an ulcer. People used to think that ulcers were caused by a bad diet. Spicy foods or fatty foods were often blamed, as well as cigarette smoking, alcohol consumption, and just a predisposition for producing excess stomach acid. While there is not a lot of evidence that food habits or stress cause ulcers, some of these other factors may be at work. Mostly, though, these earlier beliefs about the causes of ulcers were a matter of correlation. It is true that the pain and discomfort of ulcers can get worse when we eat spicy foods, drink alcohol, or during periods of stress.

The theory now is that the most common cause of an ulcer is a bacterial infection! It usually happens when the stomach becomes infected with a bacteria called *Heliobacter pylori* (H. pylon). Most of us already have these bacteria in our digestive tract. These bugs can secrete an enzyme around them that protects them from the stomach acid, and then they can invade the mucosal layer, taking up residence there and weakening the stomach lining, allowing too much acid to leak through, resulting in an ulcer. That is why one of the standard treatments for ulcers, today, is an antibiotic.

Minimize Risk Of Surgical Site Infection (part 1)

Surgical site infection is divided into two main groups, incisional and organ–space. Incisional infections are further subdivided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue such as fascia and muscle layers). Organ–space surgical site infection involves any part of the anatomy other than the incision that is opened or manipulated during an operation (Figure 1). The criteria for the different sites of infection are given below.

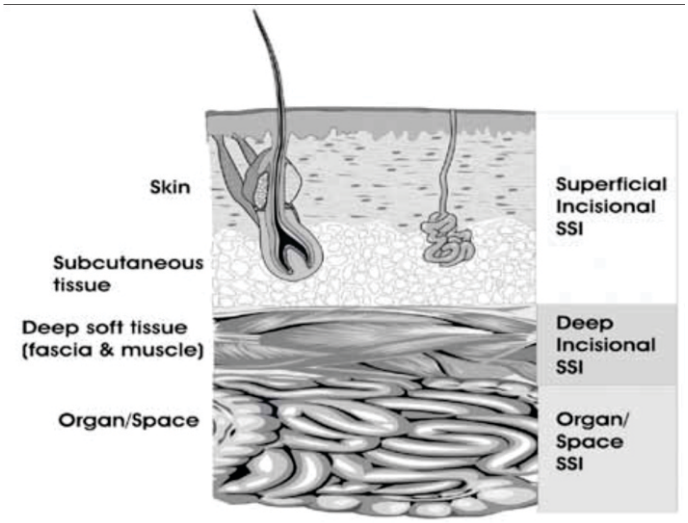


Figure 1 - Cross-section of abdomen depicting classification of surgical site infection according to the Centres for Disease Control and Prevention (United States)

The aim of skin disinfection is to remove and rapidly kill skin flora at the site of a planned surgical incision. The antiseptics that are currently available do not eliminate all microorganisms, and coagulase-negative staphylococci can be isolated even after three applications of agents such as iodine-alcohol to the skin.

The United States Food and Drug Administration defines a skin disinfectant as a "fast acting, broad-spectrum and persistent antiseptic-containing preparation that significantly reduces the number of microorganisms on intact skin." There is no clear-cut level of bacterial skin load that should be removed or killed before surgery, and 80% of bacteria in surgical site infections originate from the skin of the patient. Therefore, the Food and Drug Administration and authorities in Europe and elsewhere have set standards that a disinfectant for presurgical skin preparation must meet before it can be legally marketed. The Food and Drug Administration requires testing at both 10 minutes and 6 hours: disinfectants should reduce colony-forming units (CFU) by more than 2 log10 at dry sites (e.g. abdominal skin) and by 3 log10 at moist sites (e.g. groin).

Most guidelines recommend a scrub-paint technique for applying a disinfectant. One study indicated, however, that spraying might be sufficient. The number of bacteria expected at a surgical site ultimately determines the number of disinfectant applications. As a general rule, three applications are sufficient; however, in areas with high densities of bacteria, this might not be sufficient to kill all vegetative bacteria.

Before a patient's skin is prepared for a surgical procedure, it should be cleansed of gross contamination (e.g. dirt, soil or any other debris). Although preoperative showering has not been shown to reduce the incidence of surgical site infection, it might decrease bacterial counts and ensure that the skin is clean. The antiseptics used to prepare the skin should be applied with sterile supplies and gloves or by a no-touch technique, moving from the incision area to the periphery. The person preparing the skin should use pressure, because friction increases the antibacterial effect of an antiseptic. For example, alcohol applied without friction reduces bacterial counts by 1.0–1.2 log10 CFU compared with 1.9–3.0 log10 CFU when friction is used. Alcoholic sprays have little antimicrobial effect and produce potentially explosive vapours.

Alcoholic compounds: For centuries, alcohols have been used for their antimicrobial properties. Ethanol and isopropanol act within seconds, are minimally toxic to the skin, do not stain and are not allergenic. They evaporate readily, which is advantageous for most disinfection and antisepsis procedures. The uptake of alcohol by intact skin and the lungs after topical application is negligible. Alcohols have better wetting properties than water due to their lower surface tensions, which, with their cleansing and degreasing actions, make them effective skin antiseptics. Alcoholic formulations used to prepare the skin before invasive procedures should be filtered to ensure that they are free of spores; otherwise, 0.5% hydrogen peroxide should be added.

Alcohols have some disadvantages. If alcoholic antiseptics are used repeatedly, they may dry and irritate the skin. In addition, they are flammable (the flash-point should be considered) and cannot penetrate protein-rich materials. The exact mechanism by which alcohols destroy microorganisms is not fully understood. The most plausible explanation for their antimicrobial action is that they coagulate (denature) proteins, such as enzymatic proteins, thus impairing specific cellular functions. Ethanol and isopropanol at appropriate concentrations have broad spectra of antimicrobial activity that include vegetative bacteria, fungi and viruses. Their antimicrobial efficacies are enhanced in the presence of water, with optimal alcohol concentrations being 60–90% by volume.

Alcohols such as 70–80% ethanol kill vegetative bacteria such as S. aureus, Streptococcus pyrogenes, Enterobacteriaceae and Ps. aeruginosa within 10–90 seconds in suspension tests. Isopropanol is slightly more bactericidal than ethanol and is highly effective against vancomycin-resistant enterococci. It also has excellent activity against fungi such as Candida spp., Cryptococcus neoformans, Blastomyces dermatitidis, Coccidioides immitis, Histoplasma capsulatum, Aspergillus niger and dermatophytes and mycobacteria, including

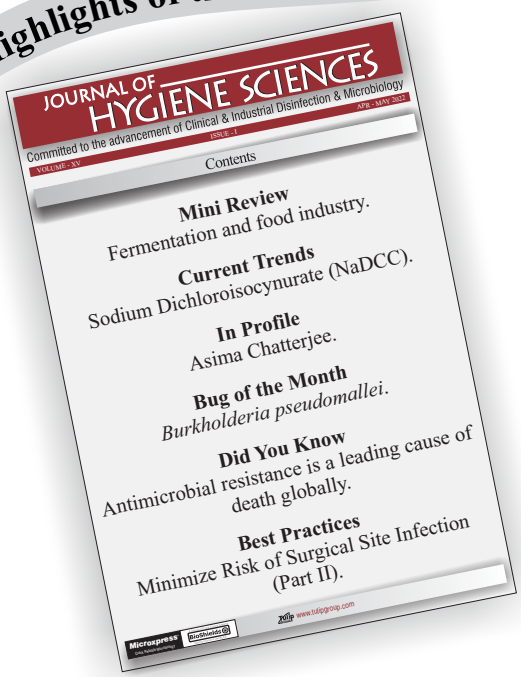
Mycobacterium tuberculosis. Alcohols generally do not, however, destroy bacterial spores, and fatal infections due to Clostridium species have occurred when alcohol was used to sterilize surgical instruments.

Both ethanol and isopropanol inactivate most viruses with a lipid envelope (e.g. influenza virus, herpes simplex virus and adenovirus). Several investigators found that isopropanol had less virucidal activity against naked, nonenveloped viruses. In experiments by Klein and DeForest, 2-propanol, even at 95%, did not inactivate nonenveloped poliovirus type 1 or coxsackievirus type B within 10 min, whereas 70% ethanol inactivated these enteroviruses. Neither 70% ethanol nor 45% 2-propanol killed hepatitis A virus when their activities were assessed on stainless-steel discs contaminated with faecally suspended virus. Of the 20 disinfectants tested, only three reduced the titre of hepatitis A virus by more than 99.9% in 1 min (2% glutaraldehyde, sodium hypochlorite with > 5000 ppm free chlorine, and a quaternary ammonium formulation containing 23% HCl). Bond et al. and Kobayashi et al. showed that 2-propanol (70% for 10 minutes) or ethanol (80% for 2 minutes) rendered human plasma contaminated with hepatitis B virus at high titre non-infectious for susceptible chimpanzees. Both 15% ethanol and 35% isopropanol readily inactivated human immunodeficiency virus (HIV), and 70% ethanol rapidly inactivated high titres of HIV in suspension, independent of the protein load. The rate of inactivation decreased when the virus was dried onto a glass surface and high levels of protein were present. In a suspension test, 40% propanol reduced the rotavirus titre by at least 4 log10 in 1 min, and both 70% propanol and 70% ethanol reduced the release of rotavirus from contaminated fingertips by 2.7 log10 units, whereas the mean reductions obtained with liquid soap and an aqueous solution of chlorhexidine gluconate were 0.9 and 0.7 log10 units, respectively. Alcohol is thus the most widely used skin disinfectant. Alcohols used for skin disinfection before invasive procedures should be free of spores; although the risk of infection is minimal, the low additional cost for a spore-free product is justified. One study indicated that isopropanol in a commercial hand rub could be absorbed dermally, transgressing the religious beliefs of some health-care workers, although the results have been put into question by a recent trial. WHO resolved the issue in their most recent guidelines on hand hygiene by carefully analysing the available information and concluding that use of alcoholic compounds for patient care does not transgress religious beliefs. Alcoholic compounds are not suitable for use during surgery at or in close proximity to mucous membranes or the eyes.

References:

www.who.int/patientsafety/en/
www.who.int/patientsafety/safesurgery/en

Highlights of the coming issue



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