
# Keeping Children Safe

# Objectives

- To consider the various factors in choosing the right disinfectants
  - Know the standard guidelines of cleaning and sanitising in schools and childcare centres
  - Know the common types of disinfectants used in sanitising
  - Determine if the disinfectant is safe and non-toxic to children
  - Consider the ease of handling, applying and storage of the disinfectant

- To determine if GK-Germkiller® products are suitable for use in childcare centres
  - What are the active ingredients used in GK-Germkiller® products
  - Are GK-Germkiller® products safe for children, upon incidental contact with food/mouth
  - Are GK-Germkiller® products effective in preventing the spread of diseases
  - Availability of supporting test reports
  - Customers' references

- To know the certifications provided by international agencies, US EPA, FDA, HACCP

- To differentiate the science of the disinfectants from marketing gimmicks

# Outline

- Guidelines of disinfectants used in Schools & Childcare Centres
  - Know the difference: Cleaning, Sanitising & Disinfecting
- Characteristics of common disinfectants used
  - Comparing pros & cons of selected disinfectants
- Choosing Quats as the active ingredient in GK-GermKiller®
  - What are Quats and what they do?
  - Where are Quats-based disinfectants being used ?
  - Why use Quats?
- Overview of GK-Germkiller® products
- Additional Information
  - What is HACCP
  - What is food-grade disinfectant
- Online references

# Guidelines of Disinfectants in Childcare

**Based on USA EPA Chemical Safety Regulation[1],** the following substances are disallowed or discouraged to be used in presence of children:

- Lead
- *Polychlorinated Biphenyls (PCBs)*
- *Pesticides*
- *Long-Chain Perfluorinated Chemicals (PFCs)*
- *Chlorpyrifos*
- *Formaldehyde*

***Based on Singapore Ministry of Health Infection control guidelines[2]*** *for schools and childcare centres, the recommended cleaning and disinfecting steps include good hygiene practices like:*

- *hand washing with mild liquid soap*
- *hand sanitising with alcohol-based hand rubs*
- *disinfecting common areas, communal toys with 1:10 diluted household bleach or wipe with alcohol-impregnated wipes.*

# Cleaning, Sanitising or Disinfecting[3]

- **Cleaning removes germs**, dirt, and impurities from surfaces or objects. Cleaning works by using soap (or detergent) and water to physically remove germs from surfaces. This process does not necessarily kill germs, but by removing them, it lowers their numbers and the risk of spreading infection.

- **Sanitising lowers the number of germs** on surfaces or objects to a safe level, as judged by public health standards or requirements. This process **works by either cleaning or disinfecting** surfaces or objects to lower the risk of spreading infection.

- **Disinfecting kills germs** on surfaces or objects. Disinfecting works by using chemicals to kill germs on surfaces or objects. This process does not necessarily clean dirty surfaces or remove germs, but by killing germs on a surface after cleaning, it can further lower the risk of spreading infection.

**Do you know?**
Cleaning with detergent alone is not enough to prevent spread of diseases

# Cleaning, Sanitising or Disinfecting[4]


**It is thus important to choose the RIGHT disinfectant for the job!**

**Efficiency in Preventing Spread of Diseases**

| Cleaning | Sanitising | Disinfecting |
|---|---|---|
| To remove visible debris, dirt and dust | To reduce occurrence and growth of bacteria, viruses and fungi | To "kill" or destroy all microscopic organisms found |
| Improve appearance of indoor conditions but not reducing the risk of cross-contamination | Reduce the risk of cross-contamination but may not eliminate all bacteria or stronger virus strains | Highly effective in preventing cross-contamination. |

VANCE CHEMICALS

# Which is the Right Disinfectant?

| Common Types of Disinfectants[5] | Common trade names[5][6][7] |
|---|---|
| Alcohols | Ethanol, isopropanol - more often used as antiseptics |
| Aldehydes | Formaldehyde, glutaraldehyde – used as a high-level disinfectant with controlled use |
| Oxidizing agents | Chlorine, Sodium hypochlorite(bleach), Iodine-based, Hydrogen peroxide – often used as a high-level disinfectant with controlled use |
| Phenolics | Chloroxylenol (dettol) – used as semi-critical level disinfectant but not recommended for infant nurseries.[6] |
| Quaternary ammonium compounds (Quats) | benzalkonium chloride – used as non-critical level disinfectant |
| Silver | Nano technology / Silver ions – yet to used as a common hospital-grade disinfectant |

**choose the safest & most effective option for both caretakers & children!**

VANCE CHEMICALS

# Comparing Disinfectants [8]

To be discussed more in next slide

## Characteristics of Selected Disinfectants

For More Information, see the 'Disinfection 101' document at www.cfsph.iastate.edu

| Disinfectant Category | Alcohols | Aldehydes | Biguanides | Halogens: Hypochlorites | Halogens: Iodine Compounds | Oxidizing Agents | Phenols | Quaternary Ammonium Compounds (QACs) |
|---|---|---|---|---|---|---|---|---|
| Sample Trade Names | Ethyl alcohol<br>Isopropyl alcohol | Formaldehyde<br>Glutaraldehyde | Chlorhexidine<br>Nolvasan®<br>Virosan® | Bleach | Betadyne®<br>Providone® | Hydrogen peroxide<br>Peracetic acid<br>Virkon S®<br>Oxy-Sept 333® | One-Stroke Environ™<br>Pheno-Tek II®<br>Tek-Trol® | Roccal®<br>DiQuat®<br>D-256® |
| Mechanism of Action | •Precipitates proteins<br>•Denatures lipids | •Denatures proteins<br>•Alkylates nucleic acids | •Alters membrane permeability | •Denatures proteins | •Denatures proteins | •Denature proteins and lipids | • Denatures proteins<br>• Alters cell wall permeability | • Denatures proteins<br>• Binds phospholipids of cell membrane |
| Advantages | •Fast acting<br>•Leaves no residue | •Broad spectrum | •Broad spectrum | •Broad spectrum<br>•Short contact time<br>•Inexpensive | •Stable in storage<br>•Relatively safe | •Broad spectrum | • Good efficacy with organic material<br>• Non-corrosive<br>• Stable in storage | • Stable in storage<br>• Non-irritating to skin<br>• Effective at high temperatures and high pH (9-10) |
| Disadvantages | •Rapid evaporation<br>•Flammable | •Carcinogenic<br>•Mucous membranes and tissue irritation<br>•Only use in well ventilated areas | •Only functions in limited pH range (5–7)<br>•Toxic to fish (environmental concern) | •Inactivated by sunlight<br>•Requires frequent application<br>•Corrodes metals<br>•Mucous membrane and tissue irritation | •Inactivated by QACs<br>•Requires frequent application<br>•Corrosive<br>•Stains clothes and treated surfaces | •Damaging to some metals | • Can cause skin and eye irritation | |
| Precautions | Flammable | Carcinogenic | | Never mix with acids; toxic chlorine gas will be released | | | May be toxic to animals, especially cats and pigs | |
| Vegetative Bacteria | Effective | Effective | Effective | Effective | Effective | Effective | Effective | YES—Gram Positive<br>Limited—Gram Negative |
| Mycobacteria | Effective | Effective | Variable | Effective | Limited | Effective | Variable | Variable |
| Enveloped Viruses | Effective | Effective | Limited | Effective | Effective | Effective | Effective | Variable |
| Non-enveloped Viruses | Variable | Effective | Limited | Effective | Limited | Effective | Variable | Not Effective |
| Spores | Not Effective | Effective | Not Effective | Variable | Limited | Variable | Not Effective | Not Effective |
| Fungi | Effective | Effective | Limited | Effective | Effective | Variable | Variable | Variable |
| Efficacy with Organic Matter | Reduced | Reduced | ? | Rapidly reduced | Rapidly reduced | Variable | Effective | Inactivated |
| Efficacy with Hard Water | ? | Reduced | ? | Effective | ? | ? | Effective | Inactivated |
| Efficacy with Soap/ Detergents | ? | Reduced | Inactivated | Inactivated | Effective | ? | Effective | Inactivated |

? Information not found

*Disclaimer: The use of trade names does not in any way signify endorsement of a particular product. For additional product names, please consult the most recent Compendium of Veterinary Products.*

References: Linton AH, Hugo WB, Russel AD. Disinfection in Veterinary and Farm Practice. 1987. Blackwell Scientific Publications; Oxford, England; Quinn PJ, Markey BK. Disinfection and Disease Prevention in Veterinary Medicine, In: Block SS, ed., Disinfection, Sterilization and Preservation. 5th edition. 2001. Lippincott, Williams and Wilkins: Philadelphia.



the Center for Food Security & Public Health
Iowa State University
www.cfsph.iastate.edu

# Comparing common disinfectants

| Types of Disinfectants[5] | Advantages[5][9][11] | Disadvantages[10][12][13] |
|---|---|---|
| Oxidising agents, eg bleach | - display bactericidal, fungicidal, tuberculocidal, virucidal and sporicidal properties<br>- low cost, easily available<br>- widely used in hospitals, food preparation[11], households | - can burn skin & eyes<br>- respiratory irritant<br>- corrosive to most materials<br>- can bleach |
| Phenol-based | - effective bactericides, fungicides, tuberculocides and virucides, but are ineffective against spore-forming bacteria<br>- widely used in hospitals, households | - can burn skin & eyes<br>- respiratory irritant<br>- corrosive to some rubber & plastics<br>- can leave residue |
| Quaternary ammonium compounds (quats) | - display bactericidal, fungicidal and virucidal properties; however, they only display mycobacteriostatic and sporostatic activity<br>- widely used in hospitals, food preparation[11] | -effectiveness dropped in presence of soap, anionic cleaner or hard water<br>- may cause skin and eye irritation |
| Silver-based , Ag | -display antimicrobial properties, but compounds suitable for disinfection are usually unstable and have a limited shelf-life [5]<br>- suggest to be non-toxic, non-corrosive but there exists 'large data gaps related to effects of nano-Ag on ecological and human health.[9] | -Silver kills bacteria in the same concentrate range where it harms human cells[12]<br>- research data are not as established as the other disinfectants[13] |

# Comparing common disinfectants

| Types of Disinfectants[5] | GHS Pictograms based on SDS[15] | Disadvantages[10][12][13] |
|---|---|---|
| Oxidising agents, eg bleach |  | - can burn skin & eyes<br>- respiratory irritant<br>- corrosive to most materials<br>- can bleach |
| Phenol-based |  | - can burn skin & eyes<br>- respiratory irritant<br>- corrosive to some rubber & plastics<br>- can leave residue |
| Quaternary ammonium compounds (quats) |  | -effectiveness dropped in presence of soap, anionic cleaner or hard water<br>- may cause skin and eye irritation |
| Silver-based , Ag |  | -Silver kills bacteria in the same concentrate range where it harms human cells[12]<br>- research data are not as established as the other disinfectants[13] |

Though Safety Data Sheet (SDS) is mandatory by law, there is no regulatory law to ensure the same set of information is represented on the finished product. Hence, it is important to know how to interpret the information accurately. [14]

# Choosing Quats in GK-GermKiller®

## What are Quats and what they do?[16][17]

"Quats" is the nickname used for quaternary ammonium compounds. Their disinfectant properties have been recognized for nearly 100 years. These products range from disinfectants, sanitizers, and cleaners to wood preservatives, fabric softeners and personal care products.

As a group, quats are highly-effective compounds for controlling a broad spectrum of microorganisms, including bacteria, molds, yeasts, fungi, and some viruses. They are:

- used in **formulations for cleaning, sanitizing and disinfecting** hard, non-porous surfaces such as floors, walls, toilets and fixtures found in hospitals, schools, offices, and homes.
- **used in food-service environments** for disinfecting and sanitizing surfaces found in commercial kitchens and food processing plants. On the farm, they can be used on agricultural tools, vehicles, shoes, and milking equipment.
- used to **disinfect water-related equipment** in industrial processes, such as re-circulating cooling water systems and waste water systems. They are used, as well, in commercial swimming pools, spas, hot tubs, decorative ponds and fountains.
- used **in wood preservation** and as algaecide for use in farm ponds, landscape water features, and other aquatic environments where algae control is needed.

**For more info, refer to**

http://www.quats.org/wp-content/uploads/2012/03/Sheet-2-FINAL-Did-You-Know_-Facts-About-Quats.pdf

# Choosing Quats in GK-GermKiller®

**Where are Quats-based disinfectants used?**[18]

- **At home**: On non-porous surfaces such as floors, counter tops, appliances, walls, toilet areas and fixtures.

- **In healthcare settings**: On hard non-porous surfaces in hospitals and other healthcare facilities, including nursing homes and medical research laboratories.

- **For commercial applications**: Registered for use in food handling/food storage establishments for use on the premises and on equipment, in flower shops, and for industrial premises and equipment. Other commercial sites include funeral homes, athletic facilities, hotels, barber and beauty shops, convenience and grocery stores, offices, laundromats, correctional facilities, emergency vehicles and transportation terminals.

- **In schools**: On non-porous high touch areas in schools and daycare centers, libraries, gymnasiums, locker rooms and other areas where children and others convene. Disinfection in schools after routine cleaning helps control outbreaks of communicable diseases.

# Choosing Quats in GK-GermKiller®

**Where are Quats-based disinfectants used?**[18]

- **On the farm**: Used in hatcheries, swine/poultry/turkey farms, dressing plants, farrowing barns, mushroom operations, citrus farms, and animal housing facilities.
- **As wood preservatives**: Help to remove and prevent mold and fungi that can cause wood deterioration over time.
- **For industrial processes and wastewater**: Added to recirculating water systems, cooling water, disposal water and oil field operations water to control the growth of microorganisms.
- **In recreational and landscaping water environments**: Used on surfaces around swimming pools, hot tubs, and in ponds and fountains to disinfect and control algae.

# Choosing Quats in GK-GermKiller®

**Where are Quats-based disinfectants used?[18]**


Household Cleaners
http://thebiologyofleah.hubpages.com/hub/The-Science-Behind-Household-Cleaners

Contact lens cleaning solutions
https://pubs.acs.org/cen/whatstuff/86/8646wts.html


Food Service Sanitiser
http://www.coast-products.com/products/fss.html

Hair care products
http://mommagotstyle.com/2014/01/21/winter-skin-solutions-shut-out-the-dry/



Hospital Disinfectant
http://solutionsdesignedforhealthcare.com/solutions/products/disinfectants/virex%C2%AE-tb-rtu

# Choosing Quats in GK-GermKiller®

**Why use Quats?**[19]

- Quats are one of the key types of **disinfectants ingredients used worldwide** to help reduce the number of microorganisms on surface.

- Quats are excellent antimicrobial agents. By themselves, they are **odourless, non-staining and non-corrosive** to metals when used according to directions. They effectively kill bacteria, viruses, molds and fungi on solid surfaces and in water. Commercial formulations are often used to kill germs that can cause disease in hospitals, restaurants, schools, and on the farm.

- The anti-microbial properties of quats have **been recognised for nearly a century**.

- Quats **have a long history of safety and have been evaluated by the FDA**

- Quat-based disinfectants are “one-step” products. They clean, disinfect and even protect at the same time.

- More than 30 different quat compounds have **been registered under U.S. EPA for use** in formulating cleaning, sanitising and disinfecting products

# Choosing Quats in GK-GermKiller®

**Why use Quats?**[19]

- More than 30 different quat compounds have **been registered under U.S. EPA for use** in formulating cleaning, sanitising and disinfecting products
- Quat compounds are stable in liquid form, so they do not give off harmful/hazardous vapors
- Quats-based disinfectants must be applied so that the surface is thoroughly wet and allowed to air dry after 10mins. Most formulation are **"non-rinse" products**.
- **At low 0.2% concentration, QUATS can be applied as non-rinse sanitisers to food contact surfaces**[20]
- Quats are being used everywhere, including personal care products such as shampoo, cosmetics, contact lens cleaner, hand sanitisers, nasal sprays.
- To use Quats in contact lens cleaning solutions which are **used for highly sensitive application (human eyes)** shows its sterility!

# GK-Germkiller® Disinfectants

**Proudly Manufactured by Vance Chemicals in Singapore,**

**GK-Germkiller®** carries a premium range of water-based disinfectants with a broad spectrum bactericidal and virucidal properties, with specific products formulated safe for daily use in the presence of children;

- GK Air™ – To be used as a Air Disinfectant, Deodorizer and Freshener
- GK Surface™ – To be used as Surface Disinfectant for all surfaces, including fabrics.
- GK Concentrate™ – To be diluted and used for soaking of toys and laundry
- GK Hand Sanitizer™ - To be used as alcohol-free sanitizer for germ-free hands.

More info on Quats can be found in Slide #7

**GK-Germkiller®** uses blends of quaternary ammonium compounds (QUATS) as its main active ingredient. QUATS are highly effective, quick-acting germicidal agents that are non-toxic to humans or animals.

**GK-Germkiller®** products do not contain any known hazardous substances and can be used daily as a safe cleaner and protector for both environmental and personal use, even in the presence of children.

Copies of test reports and product safety data sheet (SDS) are attached separately.

# GK-Germkiller® Disinfectants

**QUATS that we use in our GK-GermKiller®;**

- Are a proprietary blend of Quats produced exclusively by Lonza, one of the leading global life science and pharmaceutical companies.
- Lonza has the broadest portfolio in the industry that offers biocides for various applications globally.
- Most of Lonza Quats formulations have been registered under USA EPA* as microbial products against most common emerging pathogen[21]
- Lonza sites are routinely inspected by the FDA@ and other national health agencies to enable their products to be used by their customers in the United States, Europe, Japan, and many other regulated markets. [22]

**GK-Germkiller®** meets the requirements of *US EPA* Chemical Safety Regulation* in regards to Children's Health and does not contain any of the restricted substances that may pose risks to children's health.

*The United States Environmental Protection Agency (US EPA) is an agency of U.S. federal government which was created for the purpose of protecting human health and the environment. Official website is http://www.epa.gov/

@ The Food and Drug Administration (FDA) is an agency within the U.S. Department of Health and Human Services, responsible for protecting public health through regulation of food safety, tobacco, medical prescriptions & more. www.fda.gov

# GK-Germkiller® Disinfectants

**GK-Germkiller®** products are <u>fully certified and tested to be 99.9999% effective</u> against a broad spectrum of microorganisms such as gram–positive and gram–negative bacteria.

**Our flagship product, GK Surface™** has been demonstrated effective against MRSA hospital superbug, and viruses such as H1N1 Influenza A flu virus, human coronavirus (stimulant of SARS & MERS) and coxsackie virus (that causes HFMD).

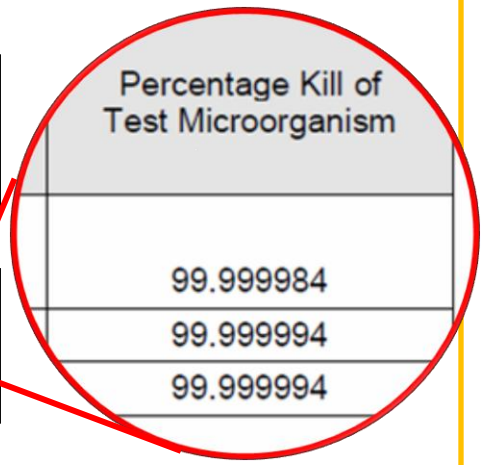

**RESULTS**

Product Name : GK Surface
Test Microorganism : *Staphylococcus aureus* (ATCC 6538)

| Dilution / Contact Time | Initial Count of Test Microorganism per ml of Test Mixture | | Count of Surviving Test Microorganism per ml | | Log Reduction | Percentage Kill of Test Microorganism |
|---|---|---|---|---|---|---|
| | CFU per ml | $Log_{10}$ | CFU per ml | $Log_{10}$ | | |
| **Neat** | | | | | | |
| 1 minute | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999984 |
| 5 minutes | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999984 |
| 30 minutes | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999984 |

Test Microorganism : *Pseudomonas aeruginosa* (ATCC 15442)

| Dilution / Contact Time | Initial Count of Test Microorganism per ml of Test Mixture | | Count of Surviving Test Microorganism per ml | | Log Reduction | Percentage Kill of Test Microorganism |
|---|---|---|---|---|---|---|
| | CFU per ml | $Log_{10}$ | CFU per ml | $Log_{10}$ | | |
| **Neat** | | | | | | |
| 1 minute | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999984 |
| 5 minutes | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999994 |
| 30 minutes | 64 000 000 | 7.81 | Less than 10 | Less than 1 | More than 6.81 | 99.999994 |




**GK Surface™** is effective against:

- ✓ 99.9999% harmful bacteria
- ✓ MRSA
- ✓ HFMD
- ✓ H1N1
- ✓ Mers-coV

# GK-Germkiller® Disinfectants

**For products that may come in contact with skin,**

**GK Surface Wipes™** and **GK Hand Sanitiser™** are registered with Health Sciences Authority (HSA) under the Health Products Act.[23]


HSA Health Sciences Authority

**HSA registered**

- **GK Surface Wipes™**
- **GK Hand Sanitiser™**

***GK-GermKiller® Range of Premium Water-based Disinfectants*** has been widely used in childcare sector, hospitality sector, including hotels, service apartments, medical care centres and leading airlines in Singapore.

To know the unique features of each *GK-GermKiller®* product, pls see next slide or log onto www.gk-germkiller.com

VANCE CHEMICALS


GK® Surface 85ml, 500ml

## GK Surface™

- High Kill rate of 99.9999% bacteria
- Also effective against
  - ✓H1N1
  - ✓HFMD
  - ✓Mers-coV
  - ✓ Mould & Mildew

## GK Air™

- High Kill rate of 99.9999% bacteria
- Freshens air
- Eliminate bad odour


GK® Air 300ml

GERM KILLER DISINFECTANT

## GK Hand Sanitiser™

- Kills 99.9999% bacteria
- Alcohol-Free


GK® Hand Sanitizer (WB), 250ml

## GK Concentrate™

- Kills 99.99999% bacteria
- High concentration
- dilution rate of 1:80


GK® Concentrate 2L

# What is HACCP?

"HACCP International is a leading food science organisation specialising in the HACCP food safety methodology and its application within food and related industries. HACCP International operates a world-renowned product certification scheme - certification of food safe equipment, materials and services - confirming a product's suitability for use within food businesses that operate to the world's highest standards. With regional offices in major international food market centres, HACCP International is well positioned to meet the requirements of industry." [24]

- It represents a system of food safety to ensure food is not contaminated

HACCP has been increasingly applied to industries other than food, such as cosmetics and pharmaceuticals. This method, which in effect seeks to plan out unsafe practices based on science, differs from traditional "produce and sort" quality control methods that do nothing to prevent hazards from occurring and must identify them at the end of the process. HACCP is focused only on the health safety issues of a product and not the quality of the product [25]

- Point here is that having HACCP does not mean "food-safe" .. it just means that hazards were prevented that would have rendered "food" unsafe.

- In non-food applications, it does not mean that the product is inherently safe. Poison produced under HACCP conditions, is STILL POISON.

# Food-grade disinfectants?

## Disinfectants cannot be food-grade because they are not food.

**National Sanitation Foundation (NSF) International** is the only independent, third-party organization that offers product registration for nonfood compounds such as lubricants, cleaners and water treatment chemicals used in food and beverage processing.

The NSF Nonfood Compounds Registration Program is a continuation of the USDA product approval and listing program, which is based on meeting regulatory requirements including FDA 21 CFR for appropriate use, ingredient and labelling review

Link below shows the list of non-food products meeting the regulatory requirements set by FDA21 CFR http://info.nsf.org/usda/Listings.asp

- Taking an example of a bleach-based disinfectant, which is approved for use on food-contact surfaces. http://info.nsf.org/usda/letters/134105.pdf

- Having a FDA-compliance certificate does not mean that the product is food-grade, it suggests that when the product is being used appropriately, it will not render the food as 'unsafe'. The certificate does not imply the product is safe for human consumption. Fundamentally, the basic property of bleach as corrosive material is still a fact!

# Online references


[1] Environmental Protection Agency, 2014. Regulations.[Online]
Available at: <http://www2.epa.gov/children/regulations#5 >, last visited on 10.07.2015.

[2] Ministry of Health,2012. Infection Control Guidelines for Schools and Child Care Centres.[Online] Available at :
<https://www.moh.gov.sg/content/dam/moh_web/Publications/Guidelines/Infectious%20Diseases%20guidelines/2009/IC%20Guidelines%20for%20Schools%20and%20Child%20Care%20Centres.pdf>, last visited on 10.07.2015.

[3] Centers for Disease Control and Prevention. How To Clean and Disinfect Schools To Help Slow the Spread of Flu. [Online].
Available at: <http://www.cdc.gov/flu/school/cleaning.htm>, last visited on 10.07.2015.

[4] Contracting Profits, 2012. The difference between cleaning, sanitizing and disinfecting. [Online] Available at :
<http://www.cleanlink.com/cp/article/The-Difference-Between-Cleaning-Sanitizing-and-Disinfecting--14213>, last visited on 10.07.2015.

[5] Wikipedia, n.d. Disinfectant, [Online] Available at: < https://en.wikipedia.org/wiki/Disinfectant >, last visited on 10.07.2015

[6] William Rutala, et.al, 2008. Guideline for disinfection and sterilization in healthcare facilities, 2008. [Online] Available at: <
http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf> , last visited on 10.07.2015

[7] Hospital management.net, 2012. Top ten disinfectant to control HAIs [Online], Available at :
<http://www.hospitalmanagement.net/features/featureppc-disinfectants-hai-globaldata/>, last visited on 10.07.2015

[8] CFSPH, 2008. Characteristics of Selected Disinfectants. [Online] Available at :
<http://www.cfsph.iastate.edu/Disinfection/Assets/CharacteristicsSelectedDisinfectants.pdf >, last visited on 10.07.2015.

# Online references


[9] Nanotechnology Industries Association, 2012. US EPA releases case study for nanoscale silver. [Online] Available at : < http://www.nanotechia.org/news/news-articles/us-epa-releases-case-study-nanoscale-silver > , last visited on 07.10.2015

[10] New York State Department of Health, n.d. Hospital Disinfectants for General Disinfection of environmental surfaces. [Online] Available at : <https://www.health.ny.gov/professionals/protocols_and_guidelines/antibiotic_resistance/docs/hospital_disinfectants_for_general_disinfection_of_environmental_surfaces.pdf > , last visited on 10.07.2015

[11] Allan Pfuntner, 2011. Sanitizers and Disinfectants: The chemicals of prevention. [Online] Available at:<http://www.foodsafetymagazine.com/magazine-archive1/augustseptember-2011/sanitizers-and-disinfectants-the-chemicals-of-prevention/ > , last visited on 10.07.2015

[12] Christina Greulich, et. Al. 2012. The toxic effect of silver ions and silver nanoparticles towards bacteria and human cells occur in the same concentration range. RSC Advances, pp6981-6987, [Online] Available at :< http://www.researchgate.net/publication/255764216_The_toxic_effect_of_silver_ions_and_silver_nanoparticles_towards_bacteria_and_human_cells_occurs_in_the_same_concentration_range > , last visited on 10.07.2015

[13] Julie Deardorff, 2014. Some antibacterials come with worrisome silver lining. 'Nanosilver' particles applied to variety of products kill microbes, but unintended health, environmental consequences unknown. [Online] Available at :< http://articles.chicagotribune.com/2014-02-16/health/ct-nanosilver-met-20140216_1_consumer-products-other-antibiotic-drugs-germs >, last visited on 10.07.2015

[14] Personal Care. Information based on scientific fact.[Online] Available at: < http://personalcaretruth.com/2011/04/a-closer-look-at-msds/ >, last visited on 10.07.2015.

# Online references


[15] Wikipedia, n.d. Safety Data Sheet, [Online] Available at: <https://en.wikipedia.org/wiki/Safety_data_sheet >, last visited on 10.07.2015.

[16] Quats Website, What are Quats, [Online], Available at: <http://www.quats.org/home-page/what-are-quats/> last visited on 10.07.2015

[17] Quats Website, What Quats do, [Online], Available at: <http://www.quats.org/home-page/what-quats-do//> last visited on 10.07.2015

[18] Quats Website, Where are Quat-based disinfectants used, [Online], Available at: < http://www.quats.org/home-page/where-quat-based-disinfectants-are-used/ > last visited on 10.07.2015

[19] Quats Website, Why use Quats, [Online], Available at: < http://www.quats.org/home-page/why-use-quats/> last visited on 10.07.2015

[20] Food Safety Magazine, Sanitizers and Disinfectants, [Online], Available at: < http://www.foodsafetymagazine.com/magazine-archive1/augustseptember-2011/sanitizers-and-disinfectants-the-chemicals-of-prevention/ , last visited on 10.07.2015

[21] US EPA, Selected EPA Disinfectants, [Online], Available at: < http://www.epa.gov/oppad001/chemregindex.htm>, last visited on 10.07.2015

[15] Health Science Authority, 2014. Overview of Cosmetics Control Unit. [Online] Available at:< http://www.hsa.gov.sg/content/hsa/en/Health_Products_Regulation/Cosmetic_Products/Overview.html>, last visited on 10.07.2015

# Online references


[22] Lonza, Regulatory Support. [Online] Available at: http://www.lonza.com/custom-manufacturing/capabilities-overview/regulatory-support.aspx, last visited on 10.07.2015

[23] Health Science Authority, 2014. Overview of Cosmetics Control Unit. [Online] Available at:< http://www.hsa.gov.sg/content/hsa/en/Health_Products_Regulation/Cosmetic_Products/Overview.html>, last visited on 10.07.2015

[24]US Food and Health Administration, Hazard Analysis & Critical Control Points (HACCP) [Online]. Available to: <http://www.fda.gov/Food/GuidanceRegulation/HACCP/, last visited on 10.07.2015

[25]US Food and Health Administration, Hazard Analysis & Critical Control Points (HACCP) [Online]. Available to: <https://en.wikipedia.org/wiki/Hazard_analysis_and_critical_control_points>, last visited on 10.07.2015