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## Review Literature on Evaluation of Hand Sanitizer and Handwash: Due to Regular use Related Skin Problems and Other Complications and Prevention

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### ABSTRACT:

Hygiene is the primary requirement for healthy lifestyle and Hand hygiene is one of them. Hand hygiene preventive step for reduce the transmission of virus, bacteria or any infectious agents to the body. In current situation People are commonly using hand sanitizer and hand wash as a regular basis. During this pandemic and to prevent COVID 19, people are regularly use hand sanitizer and hand wash as a safety precaution, which are very use full and need during protect yourself to COVID 19 virus. There are many Corona warriors like Doctor, Nurses, Pharmacist, Workers who have the regularly use hand sanitizer and hand wash to protect themselves. But overuse of alcohol-based hand sanitizer and hand wash which causes very serious Problem to Human health as a regular basis. This review focuses on the critical or dangerous problems occurring to regular use of alcohol-based hand sanitizer, from this it also covering the cure and prevention steps for skin problems, hand hygiene products selection criteria according to skin, maximum percentage of excipients in the hand hygiene products.

**KEY WORDS:** Hand hygiene, Hand sanitizer, Hand wash, Skin effects, Skin disorders, Skin dermatitis Preventive steps

## INTRODUCTION

Hand hygiene is one among the first methods want to reduce the faecal-oral transmission of infectious agents. However, conflicting hand hygiene recommendations for various settings are causing confusion among the overall general public on what's the simplest the best practice to follow or what products should be used for daily hand washing and hand hygiene. The body parts of healthy humans and animals are hosts to a spread of microbes referred to as resident microbes. The goal is to reduce the number of bad microbes to a level low enough for the body to reasonably fight them off with its existing immune

system. But through contact with other objects, the body also picks up other microbes referred to as transient microbes.

### Introduction to Hand Sanitizer

Most of the effective hand sanitizer products are alcohol-based formulations containing 62%–95% of alcohol because it will denature the proteins of microbes and therefore the ability to inactivate viruses. Hand laundry is one among the foremost vital important management points in a food premise or institute in preventing the unfold of microorganism and viruses, that ultimately cause food borne sickness. Hand cleansing is an act of cleaning

hand with sanitizers to ensure proper hand hygiene. Hand sanitizer may be a liquid, gel, or foam generally want to decrease infectious agents on the hands.

The alcohol-based hand sanitizer to kills 99.99% microorganisms including the most resistant form. The alcohol-free hand sanitizer viz. povidone-iodine, benzalkonium chloride or triclosan have persistent antimicrobial activity for a prolonged period and to be effective in killing microorganism. Alcohol-based versions typically contain some combination of isopropyl alcohol, ethanol (ethyl alcohol), or n - propanol, with versions containing 60% to 95% alcohol the most effective. Hand sanitizers are useful to get rid of bacteria and some microbes quickly and they are very handy as well. A hand sanitizer can be used to clean them as it is more effective against microorganisms as compared to regular soap. Even the World Health Organization (WHO's) guidelines on hand hygiene cite that an alcohol-based hand sanitizer is more effective to prevent the transmission of bacteria as compared to a plain soap and water.<sup>[6]</sup>

### Introduction to Hand Wash

In the cleaning process, soaps or detergents help reduce surface tension. They make water mix better with dirt and soil on surfaces and skin. Many soap-based cleanings products are formulated with other ingredients to deliver cleaning functions as well as other specific desired properties. Depending on the other ingredients, they may also moisturize the skin and/or kill or inhibit bacteria that can cause odour or disease. Plain soap is used primarily in the mechanical removal of transient microorganisms whereas antimicrobial products are used for the mechanical removal and killing or inhibition of both resident and transient microbes. Triclosan is the most commonly used chemical ingredient in antimicrobial soaps. CDC recommends hand washing with soap and water whenever possible as it remarkably reduces the amount of all types of microbes and dirt on the skin surface. Both the soaps and alcohol-based sanitizers work by dissolving the lipid membranes of microbes, thereby inactivating them.<sup>[6]</sup>

### Introduction to COVID 19

One of these dangerous pathogens is "severe acute respiratory syndrome corona virus" or SARS-CoV-2, more commonly known for causing corona virus disease 2019 or COVID-19, which has been declared a global pandemic by the World Health Organization in early 2020.

The most noticeable clinical features of COVID-19 are fever, which is not common in some people, cough, sore

throat, myalgia, fatigue, headache and difficulty in breathing. These symptoms are usually mild. By the end of the week infection begins gradually and the disease can grow up to or progress to pneumonia, becomes seriously ill and rapidly develops respiratory failure and death. The other complications included are acute lung injury, acute kidney injury, ARDS AND shock. COVID -19 (Corona virus disease -2019), the novel and new disease spread s through recent corona virus (SARS -CoV -2) from Wuhan, China. No medication or vaccine is available to cope with this novel corona virus and infection rate is increasing drastically across the globe. Adaptation of effective hand hygiene is vital, where one of the best advice by WHO is to wash or sanitize your hands frequently with soap or >60% alcoholic hand sanitizer, respectively. WHO suggested two alcohols-based formulations for hands hygiene in healthcare to sensitize the hands and to reduce the spread and infectivity of coronavirus (WHO, 2020)?<sup>[2,6]</sup>

### Introduction to Skin

Skin is the largest part in the body and covers the entire body surface. It is made up of three layers, the epidermis, dermis, and the hypodermis, all three of which vary significantly in their anatomy and function.<sup>[1,7,19]</sup>

### COMPOSITION OF HAND SANITIZER AND HAND WASH:

Hand sanitizer works by killing cells not human cells. It kills microbial cells. It's based on the use of 70 % isopropyl alcohol, which is rubbing alcohol. That is the concentration of rubbing alcohol that is most effective in killing germs it's even more effective than 100 %. Because it has a little bit of water in it, it improves penetration. For a virus, sanitizers work by disrupting the virus's outer coat. The choices of components for the WHO-recommended hand rub formulations. It contains Ethanol 96%, Isopropyl Alcohol 99%, Hydrogen Peroxide 3%, Glycerol 98% and water.

Hand wash contains Hydrogen peroxide, Alcohol, Chlorhexidine gluconate, Chloroxylenol, Iodine/Iodophors, Quaternary ammonium compounds, Glycerol, Benzalkonium chloride, Cetylpyridinium Chloride, Essential oils, Fragrance and colorant, Xanthum gum, polyacrylic acid and polyethylene glycol. This components are used to denatures protein and lipid membrane of microorganisms, Inactivates contaminating spores in the bulk solutions or excipients, Inhibits the growth of microorganisms on living tissues. It acts as an antibacterial, antiviral, antimicrobial and antiseptic properties.<sup>[7]</sup>

## MECHANISM OF ACTION OF HAND HYGIENE PRODUCTS THROUGH MICRO-ORGANISM

The CoV s belongs to the same genus Beta coronavirus, sharing similar morphology in the form of enveloped, positive single-stranded RNA viruses. These viruses can be deactivated by certain lipid solvents such as ethanol, ether (75%), chlorine-containing disinfectants, and chloroform, except chlorhexidine. Ethyl alcohol, at concentrations of 60%–80%, is a potent virucidal agent inactivating all the lipophilic viruses (e.g., influenza, herpes and vaccinia virus) and many hydrophilic viruses (e.g., adenovirus, enterovirus). The 2015 WHO Model List of Essential recommended ethanol at 80% (v/v) and isopropyl alcohol at 75% (v/v) under the category 'Disinfectant: Alcohol-based hand rub'. Ethanol (60%–85%) appears to be the most effective against viruses compared to isopropanol (60%–80%) and n- propanol (60%–80%). The study conducted with WHO-recommended alcohol-based formulations demonstrated a strong virucidal effect against emerging pathogens, including ZIKV, EBOV, SARS-CoV, and MERS-CoV. Another study conducted in Germany found that the ethanol in the concentration of 42.6% (w/w) was able to destroy SARS coronavirus and MERS coronavirus within 30 s. [5,7,9,11,23]

## RELATED SKIN EFFECTS/DISEASE TOOVERUSE OF HAND SANITIZER AND HAND WASH

### Skin effects due to overuse of Hand sanitizers and Hand wash

Frequent Hibernization of hands may generate various changes in skin texture, ranging from the development of cutaneous xerosis (dryness of the skin) up to irritant contact dermatitis (ICD) or, rarely, even allergic contact dermatitis (ACD). Many hand sanitizers come with a fragrance that you cannot resist. Some fragrances contain phthalates (endocrine disrupters) which can imitate your hormones and affect your genital growth.

The most commonly reported skin reactions with the use of ABHS are irritant contact dermatitis (ICD) and allergic contact dermatitis (ACD). The symptoms of ICD can range from mild to debilitating with manifestations like dryness, pruritus, erythema and bleeding, if severe. As for ACD, the symptoms can either be mild and localized or severe and generalized, with most severe forms of ACD being manifested as respiratory distress or other anaphylactic symptoms. Sometimes, it may be difficult to distinguish between ICD and ACD due to the overlap and similarities of symposiasts also has a drying effect on hands which can further cause the skin to crack or peel. [6,7,23,26]

### Body effects due to overuse of Hand Sanitizer and Hand wash

Adverse effects to overuse of Hand sanitizer which causing Irritation, Headache, vomiting, depression, mental illness and dryness of skin. The adverse effects caused by sanitizer or handwashing soaps can be easily prevented by identifying the trigger and countered with appropriate measures.



Figure 1 Skin rashes due to sanitizer and hand wash

When frequent hand cleansing is expected, for instance, among healthcare workers, it is preferable to select products that have a good balance between effectiveness, safety and compatibility with all skin types. [6,7,24,26]



Figure 2 Side effects like Vomiting Due to Regular Use

### Ethanol toxicity

Ingestion or dermal contact with ethanol-based hand sanitizer is associated to minimal systematic toxicity. Acute alcohol toxicity may occur via oral consumption of any household product such as alcohol-based hand sanitizers (ABHS), mouthwash, and cosmetics etc. that contain alcohol. The clinical symptoms express themselves at a particular blood alcohol concentration. Lethal dose of ethanol is >400ml/dl while in an unhabituated individual exposure of 400 ml (80% ethanol-based solution) may be lethal. Absorption occurs s mainly in proximal Intestinal track, followed by stomach (70%) and duodenum (25%) while small percentage remains in small intestine.

A CNS depressant, metabolized into acetone which may result into prolonged CNS depression, decrease respiratory drive and hypotension. Isopropyl alcohol also irritates mucosal lining in gastrointestinal tract and contributes to gastritis, associated to cause ketosis, hypoglycaemia, respiratory depression, and increase in the serum creatinine. Higher dose may cause myocardial depression while its prolonged use contributes to rhabdomyolysis, myoglobinuria, and acute renal failure. Death has been linked with ingestion of causes portal vein embolism, gastrointestinal issues, mild mucosal irritation and vomiting. [6,7]

### Hydrogen Peroxide Toxicity

It has been recognized that ingestion of low concentration of hydrogen peroxide (3% solution) is not acute hazardous for human health and is responsible for minor health problems. In few cases it Due to presence of abundant tissue catalase and  $H_2O_2$  access to vascular system, gas emboli may occur easily in multiple organs. A study reported 670 cases of 3%  $H_2O_2$  exposure, revealed that 77% were ingestion cases and about half of 77% were children under age of 6 years. All these exposure s cases did not exhibited gas emboli and revealed only mild symptoms such as nausea and vomiting. Only a child, who ingested 2 -4 oz of 3%  $H_2O_2$  was affected by gastric ulcer and duodenal erosion, whereas mucosal injury was also indicated in that child through endoscopy. Dermal contact with 3% hydrogen peroxide leads towards mild irritation of skin and mucous membrane. Hydrogen peroxide causes s toxicity by gas formation and local tissue injury, where it interacts with tissue catalase and decomposes into oxygen and water. Amount of released oxygen is associated with concentration of hydrogen peroxide. Dermal absorption of isopropanol can cause irritation of skin and ice, prolonged and frequent exposure results in skin rash, itching, redness and dryness. [6,7,12,26]

### Risk Factor for Children

Most of hand sanitizers are available in brightly hued bottles and have appealing smell like candy or any food flavours which is very tempting to young children. If a child licks a small amount of sanitizer to taste, is probably not going to become sick but ingesting any more than a taste could be at risk of alcohol poisoning. Young children have declined liver glycogen stores, which increase their susceptibility to develop hypoglycaemia and numerous pharmacokinetic factors which make them more prone to alcohol poisoning. Recent reports have recognized serious concerns, including apnoea, acidosis, and coma in young

children who ingested alcohol -based (alcohol) hand sanitizer. [6,7,19]

### Increased Risk of Other Viral Diseases

Medical experts have started to warn that excessive use of alcohol-based hand sanitizer as a preventive measure against coronavirus indirectly increase the risk of infection through skin disorders. Too much use of sanitizer against new pneumonia causing virus is responsible for skin damage and reduce its ability to work as a barrier against other harmful viruses.



Figure 3 Various Skin Effects in Children

Excessive use of alcohol-based sanitizer increased permeability of skin and deprives oil and water from skin and leads to skin roughness and irritation. Dry and damaged skin is hotbed for many diseases causing bacteria with increase d risk of virus entry into skin. Research reports have been indicated that overuse of sanitizers in some cases may increase risk of viral outbreaks. Previously published report revealed that the extensive use of alcohol-based hand sanitizer results the increased risk. [6,7,25,26]



Figure 4 Fungal infection due to viral

### Allergic contact dermatitis

Allergic contact dermatitis often occurs at the contact site that is exposed to certain disinfectants. Rashes may present as an eczematous erythema with clear demarcation limited to the disinfectant-exposed area, accompanied with swelling, pruritus and tabbing pain. In severe cases, the lesions may develop into papules, blisters

or even erosion, potentially followed by secondary infections.<sup>[6,7,17,19]</sup>

### Irritant contact Dermatitis

Repeated cleansing and use of disinfectants to the skin may damage the lipid layer on skin surface and undermine the skin barrier, which can lead to irritant contact dermatitis. Skin manifestations may include erythema, papules, blisters and chapped skin, often with itch.<sup>[7,15]</sup>



Figure 5 Allergic Contact dermatitis

### Secondary superficial fungal infection

Prolonged use of protective equipment can create a sweaty, moist and warm environment in the skin folds, which may cause superficial fungal infection such as tinea corporis, tinea cruris, and Tinea manual and tinea pedis. Tinea manual/tinea Pedis may present as either skin maceration followed by erosion at the webs of fingers or toes (interdigital type), or vesicles followed by skin peelings (vesicular type), Recommended treatment: (i) Similar measures are recommended as mentioned in section Skin maceration to keep the skin dry. (ii) To treat the fungal infection, apply topical antifungals such as bifonazole cream and ketoconazole ointment. (iii) If skin lesions are widespread or resistant to topical treatment, systemic antifungal drugs such as itraconazole or terbinafine can be used as appropriate.<sup>[6,7,17,19]</sup>

### Acne

For medical personnel caring for patients with COVID-19, their mental stress, overwhelmingly heavy workload and sleep deprivation may cause acnes or deteriorate their existing acnes. Prolonged occlusion and local pressure on the skin caused by masks may lead to occlusion of the pilosebaceous ducts, which may also contribute to the development of acnes. Recommended treatment: The general principles for controlling acnes are recommended, including: (i) wash the face twice daily with warm water. (ii) Choose appropriate facial cleansers, and do not use soap

with strong alkalinity. (iii) Select light cosmetics or avoid cosmetics altogether. (iv) For severe conditions, systemic treatment with minocycline or isotretinoin can be added as appropriate.<sup>[6,7]</sup>

## CURE PROCEDURE AND PREVENTION ON SKIN DERMATITIS

### Factors to consider when selecting hand hygiene Products

There are 3 primary steps for reduce hand hygiene-related Allergic contact dermatitis among health care personnel: Choice of less irritating hand hygiene things; instruction regarding proper beauty care management, and procedure to use of moisturizing skin care products.

1. Selecting fewer irritating products
2. Pilot testing
3. Selection of chemical used in Hand sanitizer

Because health care personnel must cleanse their hands frequently, it is important for health care facilities to provide products that are both efficacious and as safe as possible to the skin.

2. Pilot testing

Pilot testing to assess acceptability is strongly recommended before final selection of hand hygiene products. Characteristics that can affect staff acceptance of a hand hygiene product Include dermal tolerance and skin reactions to the product and its fragrance, consistency, and color. Structured self-administered questionnaires may be useful tools to assess acceptability of hand hygiene products. Such tools should, however, be adapted to the local setting because of differences in socio cultural backgrounds, weather and environmental conditions, and clinical practices among users. Skin reactions to hand hygiene products may be heightened by low relative humidity. Therefore, dry weather, for replacement of an old product, the new product should be at least as good as the previous one.

3. Selection of chemical used in Hand sanitizer

This array of symptoms like dryness, irritation, itching is referred to as irritant contact dermatitis. The other type of skin reaction, allergic contact dermatitis, is rare and represents an allergy to some ingredient in a hand hygiene product. Symptoms of allergic contact dermatitis can also range from mild and localized to severe and generalized. In its most serious form, allergic contact dermatitis may be

associated with respiratory distress and other symptoms of anaphylaxis.

Factors to be taken into consideration during user acceptability testing include the following:

- 1) Dermal tolerance and skin reactions.
- 2) Some preferences of personnel and patients such as Odor, Shade, Appearance, and Utility.
- 3) Practical considerations such as availability, dispenser convenience and functioning, and ability to prevent contamination.
- 4) Cost issues. [12,16,17,22]

#### Prevention Steps during adverse effects on Skin

- 1) Use of moisturizing skin care products  
Several controlled trials have shown that regular use of such products can help prevent and treat irritant contact dermatitis caused by hand hygiene products.
- 2) As the WHO recommends, hands should be washed thoroughly (including fingernails, interdigital web spaces, wrists) for at least 20 seconds, using lukewarm water and soap, particularly after being in public areas, before meals, after coughing or sneezing, after using the toilet, and whenever the hands are dirty.
- 3) After washing, we advise rinsing the hands by using gentle movements, without causing a physical irritation to the skin.
- 4) Applying moisturizing skin care products after hand cleansing is the essential step in keeping the skin hydrated and preventing further abnormal skin reactions.
- 5) Use cream, skin protective every day to apply to skin to become moist.
- 6) Thick greasy creams and ointments (e.g., petroleum jelly) provide higher protection against xerosis than lotions.
- 7) For people with highly sensitive skin, which easily develop disturbing forms of dermatitis, short courses of topical corticosteroids may be used to reduce the signs and symptoms of inflammation. [7,25]

#### Maximum Percentage of excipients in Hand Sanitizers and Hand wash

Most alcohol-based hand antiseptics contain isopropanol, ethanol, n-propanol, or a combination of these products. The microorganism's cells are then lysed, and their cellular

metabolism is disrupted. Alcohol solutions containing 60% to 95% alcohol is most effective. The highest antimicrobial efficacy can be achieved with ethanol (60% to 85%), isopropanol (60% to 80%), and n-propanol (60% to 80%). [12,24]

#### CONCLUSION

Frequent hand hygiene during patient care, health care professionals have a higher prevalence of skin irritation than seen in the general population. Damaged, irritated skin is undesirable, not only because it causes discomfort and even lost workdays for the professional but also because hands with damaged skin may in fact increase the risk of transmission of infections to patients. Procedure to reduce the feasible damaging effects of hand hygiene include selecting comfort products, using skin emollient, and adjust certain hand hygiene practices such as unnecessary washing. Dermal tolerance and aesthetic preferences of users as well as practical considerations, such as convenience, storage, and costs. Appropriate pilot testing, product selection and user education will contribute to healthier hands of care providers and improved adherence to expected hand hygiene practices.

#### REFERENCES

1. Ahuja Mphasis R. Efficiency of Liquid Hand Wash on Microbial flora of Hands, International Journal of Recent Scientific Research, 2017;8(12):22199-22201.
2. Gunter K., Harald L. Prevention of Irritant Contact Dermatitis among Health care Workers by Using Evidence based Hand Hygiene Practices: A Review, Industrial Health ,2007;45: 645- 652.
3. Sachdeva Giannotti R., Shahab M., Bradavidin L. Cutaneous manifestation of COVID 19, Report of Three Cases and a review of Literature, Journal of Dermatological Science,2019; 98(2): 75-81.
4. Long H., Zhao H., Chen A., Yao Z., Cheng B., Lu Q. Protecting Medical Staff from skin injury/ Disease caused by personal protective equipment during epidemic period of COVID 19: Experience from China, Journal of the European Academy of Dermatology and Venereology, 2020;34(5): 919–921.
5. Golan A., Choi D., Granary A. Hand sanitizer: A Review of Ingredients, mechanism of action, Modes of Delivery and Efficacy Against Corona virus, American Journal of Infection Control (2020);48: 1062–1067.

6. Mahmood A., Esan M. COVID 19 and frequent use of Hand Sanitizers; Human health and environmental hazards by exposure pathways ,2020;742:123 -126.
7. Jia Jing J., Pei T., Bose R. Hand sanitizers: A Review on Formulation Aspects, Adverse Effects and Regulations, International Journal of Environmental Research and Public Health,2020; 3326(17):1-17.
8. Song D., Peacock H. Evaluating the Effectiveness of alcohol-based hand sanitizers Compared to alcohol free hand Peacock Environmental Public Health Journal,2016;17(2): 227-229.
9. Indre D., Kumar P. Isopropyl alcohol (70%) based hand sanitizer induced contact dermatitis: a case report and COVID 19, Indian Journal Case Reports, 2020; 6(7): 404-406.
10. Aiello A., Coulbourne R. Effect of Hand Hygiene on Infectious Disease Risk in the Community, American Journal of Public Health,2008;98(8):1165-1168.
11. An J., Enum K. Assessment of the dermal and ocular irritation potential of alcohol hand sanitizers containing aloe vera with in vitro and in vivo methods, Molecular and cellular toxicology,2010 ;6(4):397-404.
12. Boyce J., Kelleher S., Vallance N. Skin Irritation and Dryness associated with two Hand hygiene Regimens: Soap and water hand washing verses hand antiseptic with Alcoholic Hand Gel, Infection Control & Hospital Epidemiology,2000;21(7): 442 -448.
13. Usman Z., Adam M. Sanitizer and cleaning for COVID 19, Principles, Guidelines and prospective, a Text book of the sars-cov-2: guidelines and protocol development, Mahi publication,2020:60-72.
14. Beau C., Mihai M. Frequent Hand Washing for COVID-19 Prevention Can Cause Hand Dermatitis: Management Tips, 2020 ;12(4): 332-335.
15. Morogoro P., Bader A. Obsessive-compulsive disorder in dermatology, Journal der Morogoro Gesellschaft ,2015; 13: 991-999.
16. Kumar D., Kaushal S. Evaluation of the antibacterial activity of commonly used alcohol-based hand sanitizers on common pathogenic bacteria., International Journal of Applied Research,2015; 5(3):562-564.
17. Tiwari S., Rai N., Khushi C. Hand Sanitizer: Effectiveness & Characterization', International Journal of Engineering Research & Technology ,2020;9(04):841-843.
18. Devi S., Singh K. Is Covid-19 Sibling of SARS AND MERS? A Review on: Novel COVID-19- 19, International Journal of Pharmaceutical Education and Research, 2020;54(3):491-495.
19. Rabie T., Curtis V. Handwashing and risk of respiratory infections: a quantitative systematic review, Journal of Tropical Medicine and International Health ,2006;11(3):258– 267.
20. G. Kampia, H. Löffler Dermatological aspects of a successful introduction and continuation of alcohol-based hand rubs for hygienic hand disinfection, Journal of Hospital Infection ,2003;55: 1–7.
21. E. Kowiatek Review Hand hygiene and skin health, Journal of Hospital Infection ,2003;55:239–245.
22. Larson, E., Girard R. Skin reactions related to hand hygiene and selection of hand hygiene products, American Journal of Infection Control,2006; 34(10):627-35.
23. Margaret A., Wassef C. Preventing adverse cutaneous reactions from amplified hygiene practices during the COVID-19 pandemic: how dermatologists can help through anticipatory guidance, Archives of Dermatological Research, 2020;17(9): 667-679.
24. Rai H., Knighton H., Trina F. Comparison of ethanol hand sanitizer versus moist towelette packets for mealtime patient hand hygiene, American Journal of Infect Control,2017;45(9): 1033-1034.
25. WHO COVID 19 Guidelines, 2020., December 2019. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>
26. WHO COVID 19 Emergency Guidelines ,2020, December 2019. <https://www.who.int/news-room/feature-stories/detail/a-guide-to-who-s-guidance>

