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Role of Hand Sanitizers in Infection Control Practices

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ABSTRACT:

Hand sanitizers are available in the form of liquid, gel or foam used to decrease infectious agents on the hands. This way of sanitation which doesn't require water or any other material. This is the best way of killing organisms and they are portable.They are made of alcohol and hence they evaporate once they are placed on hands. Commercially prepared sanitizers have aloe vera gel which is an important ingredient in prevention of skin dryness.The hand sanitizers have a great impact in the reduction of student absenteeism from illness by 20%.It kills germs bacteria,virus, and interrupt the transmission of flu like diseases. This method of hand sanitation is the best way of killing microorganisms on a larger scale. It's said that sanitizers kill 99% of microorganisms. But sanitizers are good bactericidal agents rather than antimicrobial agents. The new developments in the sanitizers include the addition of aloevera gel. This prevents the hands from dryness. The aim of the research is to study the recent developments on hand sanitizers.

Keywords: Hand sanitizers, dryness,bactericidal, potential,Alcohol.

INTRODUCTION:

Hand sanitizers can be defined as a liquid,gel,or foam used to remove infectious agents on the hands(Jing *et al.*, 2020). Alcohol based versions are preferable as they are most effective in killing microorganisms than soap and water. Hand sanitizers are convenient, portable and easy to use(Brewer and Streel, 2020). Commercially prepared sanitizers have aloe vera gel which is an important ingredient in prevention of skin dryness.The hand sanitizers have a great impact in the reduction of student absenteeism from illness by 20%(Jairoun, Al-Hemyari and Shahwan, 2020).It kills germs bacteria,virus, and interrupt the transmission of flu like diseases. Alcohol based hand sanitizers fight and kill about 99.9% of the germs(Harsha and Brundha, 2017). They have the ability to retain their effect for upto 6 hours. They are less irritating to the skin than soap and water(Ravichandran and Brundha, 2016).

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Hand sanitizers were first introduced in the year 1966 in medical settings. This product became popularizers in the early 1990s. Hernandez was the first person who developed portable hand sanitizers(*Website*, no date a). They can be used in situations where there is no access to soap and water. Recognising the commercial potential, this idea went as an interventional hotline leading to a patent registering. This product reached its maximum popularity in 2004(Prashaanthi and Brundha, 2018). The hand sanitizers production boosted during SARS and COVID-19.

The hand sanitizers when compared to soaps, have its own advantages. A hand sanitizer is the best way of killing organisms and they are portable. They are easy to use and don't require any substance to wipe or wash(Opatz, Senn-Bilfinger and Richert, 2020). Conversely soaps are the best way to remove the dirt as well as microbes from the hand. They use water to wash off. Hence they don't give an intense sanitizer smell. There is always a contradiction between these two. Hand sanitizers can be used only when there is no access to soap and water, but doctors prefer using soap and water whenever they can. Soap and water not only removes disease causing pathogens, they remove the dirt present in the hands too. This helps us to have clean and dirt free hands. There are some substances like water, other forms of alcohol which acts as a retarder for the on set of action of hand sanitizers, but there are no retarders for soap. The calcium hydroxide acts as a catalyst here. The retarding substance is compensated and overpowered by the calcium hydroxide leading to the quick onset of action. But when there is no access to soap and water, sanitizers are the best way of hand sanitation. The aim of the research is to study the working, uses and limitations of sanitizers.

Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Ariga*et al.*, 2018; Basha, Ganapathy and Venugopalan, 2018; Hannah *et al.*, 2018; Hussainy*et al.*, 2018; Jeevanandan and Govindaraju, 2018; Kannan and Venugopalan, 2018; Kumar and Antony, 2018; Manohar and Sharma, 2018; Menon *et al.*, 2018; Nandakumar and Nasim, 2018; Nandhini, Babu and Mohanraj, 2018; Ravinthar and Jayalakshmi, 2018; Seppan*et al.*, 2018; Teja, Ramesh and Priya, 2018; Duraisamy*et al.*, 2019; Gheena and Ezhilarasan, 2019; Hema Shree *et al.*, 2019; Rajakeerthi and Ms, 2019; Rajendran *et al.*, 2019; Sekar*et al.*, 2019; Sharma *et al.*, 2019; Siddique *et al.*, 2019; Janani, Palanivelu and Sandhya, 2020; Johnson *et al.*, 2020; Jose, Ajitha and Subbaiyan, 2020).

MATERIALS AND METHODS:

A systematic review was conducted to examine the effectiveness of sanitizers and its recent advancements. PUBMED,CINAHL, EMBASE and SCOPUS were searched for randomised and non randomised controlled trials.The comprehensive search strategy included all english articles with hand hygiene or handwashing-related terms. These hand hygiene practices included the initiation of multimodal hand hygiene initiatives, the introduction of alcohol sanitizers, the implementation or changes of the infection control practices or infection control policies, and other organizational interventions.

DISCUSSION:

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Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; VijayashreePriyadharsini, SmilineGirija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramaduraiet *al.*, 2019; Sridharan *et al.*, 2019; VijayashreePriyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

Alcohol hand sanitizer is more efficient:
Alcohol based hand rubs or gels containing 60-95% alcohol has the greatest efficiency. The antimicrobial activity of alcohol solutions has the ability to denature proteins. Ethanol is an antimicrobial agent and they were first recommended for the treatment of hands in 1888. The combination of alcohol gives the synergistic effect. The comparison between the hand sanitizers are ranked by wilcoxon test. The foam type of alcohol based hand sanitizers are significantly superior. (Brundha, 2015)
Research is being carried on randomisation generation, blinding and allocation effects. Hand hygiene is very important in protecting against diseases from livestock barns(Voller, Schlarbaum and Hylwa, 2020). Since there are limited hand washing facilities there, it's good to have hand sanitizer.microorganism reduction, skin irritation are comparatively good when compared to commercially available soap. The use of alcohol gel hand sanitizer has a decreased infection rate and they are an effective tool in case of infection. They are tremendously effective in preventing the spread of seasonal flu, H1N1, URI and other viral and bacterial based diseases.(Brundha, no date)

PATHOGEN	DISEASE CAUSED
H1N1	influenza
Coronavirus	COVID-19
E.coli	Cholecystitis, bacteremia and cholangitis
S.aureus	Pimples, cellulitis, pneumonia and meningitis
Salmonella	typhoid
cryptosporidium	cryptosporidiosis
Norovirus	gastroenteritis
Polyoma virus	Affects immunocompromised people
Polio virus	polio
Calicivirus	Respiratory infection
Hepatitis A virus	HAV
Clostridium difficile	Fever, diarrhea and abdominal pain

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Fungal diseases	Fungal spores

Table 1: disease and causative agents that can be prevented on using hand sanitizers

Impact of hand sanitizers on microorganisms:

Hand sanitizers reduce the level of microorganisms by killing them chemically, giving a disinfected environment(Ayaz, 2020). The magnitude of the effect is proportional to the function of hand sanitizer and its usage, hands are the primary mode of transmission of microbes and infection(Reilly, 2017). Alcohol based sanitizers have a greater impact on killing fungal spores, they are antifungal agents. Researchers determine that the viral effect of H1N1 virus is extremely less on usage of hand sanitizers. The sanitizers of 60% alcohol stops the spread of COVID-19(*Website*, no date b). The hand sanitizer with 70% ethyl alcohol and triclosan is most effective in inhibiting the growth of organisms like E.coli and S Aureus(Brundha, Pathmashri and Sundari, 2019). The herbal form of the hand sanitizers which has a less or no alcohol proportion has a inhibitory effect of salmonella(Pfeiffer, 2011). People now use instant hand sanitizers while washing with water giving extra protection. Here is the list of parasites and microorganisms which can be killed using hand sanitizers. And the diseases they cause are also mentioned (table 1).

Ingredient analysis:

Moisturizing hand sanitizer has water,alcohol and a high internal phase emulsion. The high internal phase emulsion comprises an emulsifier of 0.1% to 10%(‘FDA requests safety data on hand sanitizers’, 2016). They attack and destroy the envelope protein of the pathogen. The presence of water is a crucial factor that destroys or inhibits the growth of pathogenic microorganisms. Water acts as a catalyst in denaturing the proteins(*Website*, no date c, *Website*, no date d). 70% IPA solutions penetrate the cell wall and cause the death of microorganisms. Citrus flavoured hand sanitizers give freshness. The IPA is an endothermic substance hence brings chillness. The Rodent preserved in 70% Isopropyl alcohol wasn't found to have aerobic bacterial decontamination on laparotomy surgeries(Knopf, 2020). Aloe vera has an inhibitory effect on pathogenic bacteria, the composition containing inorganic ingredients- peroxides, oxygen; Ozone, water phase - 0.5% to about 12% of hydrogen peroxide(Vogel, 2011).

Sanitizers on other aspects:

A branded hand sanitizer restores moisture. Several studies conclude that the risk of spreading gastrointestinal,respiratory infections are decreased on the usage of hand sanitizers. After applying hand sanitizer ,avoid vigorous rubbing (*Website*, no date e).Alcohol based handrubs doesn't have any skin softness.Aloevera is added to some hand sanitizers which prevent hand dryness(&na; and &NA;, 2010). Ethanol which has a wide spread use in the field of mouthwash for oral cleaning,medications, cosmetic products ,hydro-alcoholic disinfectants and antiseptics.Hand sanitizers are used as deodorants in some cases because they have the property to kill the bacteria which causes odor(Weaver, 2005).

Illness related absenteeism in elementary school:

Absenteeism due to communicable illness is a major problem encountered in the elementary school children(Green, no date). There was a huge illness related absenteeism in elementary school. Although hand washing is an infection control measure, school environment compliance to the routine,alternative hand hygiene techniques include the usage of hand sanitizers, there is a

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significant reduction in absenteeism in elementary school(*Website*, no date f). SARS brought the usage of hand sanitizers to the spotlight.Not only schools, illness related absenteeism in all kinds of institutions can be reduced by motivating students to use hand sanitizers and other ways of hand sanitation. This will bring a significant reduction in the absenteeism in all kinds of institutions. Hand hygiene programs are the most important infection control measure in the school environment. Potentially large public health, economic implications are to be conducted on awareness of hand sanitation.

Evolution of hand sanitizers:

Hand sanitizers were first introduced in 1966. The product was popularised in the early 1990s. They are more convenient compared to hand washing with soap and water in the situations in health care settings(Balaji, Brundha and Path, 2016). They are generally more effective in hand antiseptics. A German company sterellum, brought the world's first remarkable alcohol based disinfectant in the year 1985. Hand sanitizers contain at least 60% of persistent antiseptic(Shenoy and Brundha, 2016). Alcohol rubs kill many different kinds of bacteria which are even antibiotic resistant. Eg: TB bacteria. In 1988, hand gel Purell, a 70% ethyl alcohol primary ingredient hand gel was introduced. That was the first hand sanitizer to have alcohol as primary ingredients. Several researches were conducted and found that the Alcohol hand sanitizers are the best way of hand sanitation which kills almost all kinds of bacteria and viruses. The Isopropyl Alcohol (IPA) was first used in hand sanitizers in 2004. Further increase of IPA in hand sanitizers gradually increases from 2006.

Recent advances:

Manufacturers no longer use 28 active ingredients including triclosan and benzethonium chloride as they are banned in US(Ahmed *et al.*, 2020). Millions of consumers switched to herbal hand sanitizers. The 99.8% IPA based hand sanitizers was recently introduced. Hydrogen peroxide of 3% which is a mild antiseptic, prevents infection in minor cuts, scrapes and burns. Glycerol 98% also serves as humectant. Aloe vera gel helps in moisturizing skin. Vitamin E oil is also used in the manufacture of hand sanitizers(Kalaiselvi and Brundha, 2016). Hydrogen peroxide is a powerful disinfectant which can kill all kinds of bacteria and some kind of viruses like SARS and COVID-19. They are added to give a longer effect on hand sanitizers and they act as a catalyst for the onset of action.

Working of hand sanitizers:

Hand sanitizers work by removing the outer layer of oil. Washing with warm water and soap is the gold standard method of hand hygiene. Washing with warm water and soap clears the harbour of microbes(Charbonneau, 2015). The IPA in the hand sanitizers destroys the cell wall of the microbe. The rubbing of hands gives friction, which dissipates the alcohol along with the killed pathogens.

A drop of sanitizer is applied in hand, they are evenly spreaded out all over the hand. The heat generated by spreading the hand sanitizer leads to evaporation of the alcohol along with the dead disease causing pathogens. Even then the person is requested to stay away from fire, cause the alcohol in the hand sanitizer is highly inflammable. The hand sanitizers are the short acting substances where their effect no longer acts more than an hour.

Herbal hand sanitizers:

The herbal hand sanitizers are the type of hand sanitizers prepared from the leaves extracts of *Ocimumcanctum*Linn.(Tulsi) and *Eucalyptus globulus* (Nilgiri). Mostly these plants play a major role in Ayurvedic medicine. *Ocimumcanctum*Linn.(Tulsi) have antipyretic, antiseptic and disinfectant properties. They cleanse off the disease causing pathogens. The advantage of herbal hand sanitizers are they are non-inflammable, kill almost all the pathogens, natural freshness, no effect on digestion if they are unknowingly consumed. The most important disadvantage, they are less efficient than alcoholic hand sanitizers. The onset of action is very slow when compared to alcohol hand sanitizer.

CONCLUSION:

We all know that the frequent hand washing is important to prevent the spread of infection. The infectious agent can be direct or indirect and it's not always convenient to wash. And some products marketed to the public as antimicrobial gel are not as muchefficient . A hand sanitizer with more than 60% of alcohol is always preferable.They can be used in circumstances like there is no access to soap and water. The hand sanitizer with IPA as primary ingredient has a rapid action. They play a major role in the reduction of microbes.

REFERENCES:

1. Ahmed, K. *et al.* (2020) ‘Analysis of anti-microbial and anti-biofilm activity of hand washes and sanitizers against S. aureus and P. aeruginosa’, *Journal of the Pakistan Medical Association*, 70(1), pp. 100–104.
2. Ariga, P. *et al.* (2018) ‘Determination of correlation of width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A systematic review’, *World journal of dentistry*, 9(1), pp. 68–75.
3. Ayaz, F. (2020) ‘In-vitro antibacterial activity of commercially available hand sanitizers’, *Pure and Applied Biology*. doi: 10.19045/bspab.2020.90112.
4. Balaji, S., Brundha, M. P. and Path, D. N. B. (2016) ‘Awareness of About Breast Cancer among Dental Surgeons’, *Research journal of pharmaceutical, biological and chemical sciences*, 8(8), p. 797.
5. Basha, F. Y. S., Ganapathy, D. and Venugopalan, S. (2018) ‘Oral hygiene status among pregnant women’, *Journal of advanced pharmaceutical technology & research*, 11(7), p. 3099.
6. Brewer, C. and Streel, E. (2020) ‘Is Alcohol in Hand Sanitizers Absorbed Through the Skin or Lungs? Implications for Disulfiram Treatment’, *Alcohol and alcoholism* . doi: 10.1093/alcalc/agaa045.
7. Brundha, M. P. (2015) ‘A Comparative Study-The Role of Skin and Nerve Biopsy in Hansen’s Disease’, *Research journal of pharmaceutical, biological and chemical sciences*. Available at: https://www.researchgate.net/profile/Brundha_Mp/publication/283561218_A_comparative_study-_the_role_of_skin_and_nerve_biopsy_in_hansen’s_disease/links/5892ba5d458515aeac946451/A-comparative-study-the-role-of-skin-and-nerve-biopsy-in-hansens-disease.pdf.
8. Brundha, M. P. (no date) ‘Awareness of Stye’.
9. Brundha, M. P., Pathmashri, V. P. and Sundari, S. (2019) ‘Quantitative Changes of Red

Blood cells in Cancer Patients under Palliative Radiotherapy-A Retrospective Study', *Research Journal of Pharmacy and Technology*, p. 687. doi: 10.5958/0974-360x.2019.00122.7.

10. Chandrasekar, R. *et al.* (2020) 'Development and validation of a formula for objective assessment of cervical vertebral bone age', *Progress in orthodontics*, 21(1), p. 38.
11. Charbonneau, D. (2015) 'Hand Cleansers and Sanitizers', *Cosmetic Dermatology*, pp. 110–123. doi: 10.1002/9781118655566.ch12.
12. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295.
13. Ezhilarasan, D., Apoorva, V. S. and Ashok Vardhan, N. (2019) 'Syzygiumcumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121.
14. 'FDA requests safety data on hand sanitizers' (2016) *C&EN Global Enterprise*, pp. 17–17. doi: 10.1021/cen-09427-govcon003.
15. Gheena, S. and Ezhilarasan, D. (2019) 'Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells', *Human & experimental toxicology*, 38(6), pp. 694–702.
16. Green, O. (no date) *Homemade Hand Sanitizer Recipes: Easy DIY Hand Sanitizers*.
17. Hannah, R. *et al.* (2018) 'Awareness about the use, ethics and scope of dental photography among undergraduate dental students dentist behind the lens', *Journal of advanced pharmaceutical technology & research*, 11(3), p. 1012.
18. Harsha, L. and Brundha, M. P. (2017) 'Prevalence of dental developmental anomalies among men and women and its psychological effect in a given population', *Research journal of pharmaceutical, biological and chemical sciences*, 9(6), p. 869.
19. Hema Shree, K. *et al.* (2019) 'Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis', *Pathology oncology research: POR*, 25(2), pp. 447–453.
20. Hussainy, S. N. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of conservative dentistry: JCD*, 21(5), pp. 510–515.
21. Jairoun, A. A., Al-Hemyari, S. S. and Shahwan, M. (2020) 'The pandemic of COVID-19 and its implications for the purity and authenticity of alcohol-based hand sanitizers: The health risks associated with falsified sanitizers and recommendations for regulatory and public health bodies', *Research in social & administrative pharmacy: RSAP*. doi: 10.1016/j.sapharm.2020.04.014.
22. Janani, K., Palanivelu, A. and Sandhya, R. (2020) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study', *Brazilian dental science*, 23(1). doi: 10.14295/bds.2020.v23i1.1805.
23. Jeevanandan, G. and Govindaraju, L. (2018) 'Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial', *European archives of paediatric dentistry:*

official journal of the European Academy of Paediatric Dentistry, 19(4), pp. 273–278.
24. Jing, J. L. J. *et al.* (2020) 'Hand Sanitizers: A Review on Formulation Aspects, Adverse Effects, and Regulations', *International journal of environmental research and public health*, 17(9). doi: 10.3390/ijerph17093326.
25. Johnson, J. *et al.* (2020) 'Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH', *Hypertension research: official journal of the Japanese Society of Hypertension*, 43(4), pp. 360–362.
26. Jose, J., Ajitha and Subbaiyan, H. (2020) 'Different treatment modalities followed by dental practitioners for Ellis class 2 fracture – A questionnaire-based survey', *The open dentistry journal*, 14(1), pp. 59–65.
27. Kalaiselvi, R. and Brundha, M. P. (2016) 'Prevalence of hysterectomy in South Indian population', *Research Journal of Pharmacy and Technology*, p. 1941. doi: 10.5958/0974-360x.2016.00398.x.
28. Kannan, A. and Venugopalan, S. (2018) 'A systematic review on the effect of use of impregnated retraction cords on gingiva', *Journal of advanced pharmaceutical technology & research*, 11(5), p. 2121.
29. Knopf, A. (2020) 'Mallinckrodt donates hand sanitizers to all OTPs', *Alcoholism & Drug Abuse Weekly*, pp. 4–4. doi: 10.1002/adaw.32744.
30. Kumar, D. and Antony, S. D. P. (2018) 'Calcified canal and negotiation-A review', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3727.
31. Manohar, M. P. and Sharma, S. (2018) 'A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 29(6), pp. 716–720.
32. Mathew, M. G. *et al.* (2020) 'Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial', *Clinical oral investigations*, pp. 1–6.
33. Menon, S. *et al.* (2018) 'Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism', *Colloids and surfaces. B, Biointerfaces*, 170, pp. 280–292.
34. &na; and &NA; (2010) 'Pediatric Ingestions of Hand Sanitizers: Debunking the Myth', *Pediatric Emergency Care*, p. 235. doi: 10.1097/01.pec.0000369381.89147.74.
35. Nandakumar, M. and Nasim, I. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of conservative dentistry: JCD*, 21(5), pp. 516–520.
36. Nandhini, J. S. T., Babu, K. Y. and Mohanraj, K. G. (2018) 'Size, shape, prominence and localization of gerdy's tubercle in dry human tibial bones', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3604.
37. Opatz, T., Senn-Bilfinger, J. and Richert, C. (2020) 'Thoughts on What Chemists Can Contribute to Fighting SARS-CoV-2 - A Short Note on Hand Sanitizers, Drug Candidates and Outreach', *AngewandteChemie*, 59(24), pp. 9236–9240.
38. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*. Available at: https://europepmc.org/article/med/29624863.

39. Pfeiffer, A. (2011) 'Manufacturers of Hand Sanitizers Falsely Claim MRSA Prevention', *Skin & Allergy News*, p. 6. doi: 10.1016/s0037-6337(11)70311-4.
40. Prashaanthi, N. and Brundha, M. P. (2018) 'A Comparative Study between Popplet Notes and Conventional Notes for Learning Pathology', *Research Journal of Pharmacy and Technology*, p. 175. doi: 10.5958/0974-360x.2018.00032.x.
41. Rajakeerthi and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *CumhuriyetÜniversitesiDişHekimliğiFakültesidergisi*, 22(2), pp. 249–256.
42. E-Murshid, M., Haque, M.The global gag rule: The death trap for comprehensive sexual and reproductive healthcare and way to overcome the us gag rule(2020) Journal of Population Therapeutics and Clinical Pharmacology, 27 (2), pp. e87-e99.
43. Ramadurai, N. et al. (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', Clinical oral investigations, 23(9), pp. 3543–3550.
44. Ramesh, A. et al. (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', Journal of periodontology, 89(10), pp. 1241–1248.
45. Ravichandran, H. and Brundha, M. P. (2016) 'Awareness about personal protective equipments in hospital workers (sweepers and cleaners)', *International Journal of Pharmaceutical Sciences Review and Research*, 40(1), pp. 28–29.
46. Ravinthar, K. and Jayalakshmi (2018) 'Recent advancements in laminates and veneers in dentistry',*Journal of advanced pharmaceutical technology & research*, 11(2), p. 785.
47. Reilly, L. (2017) 'Just Pediatrics: Keeping Our Children Safe: From Opioids to Hand Sanitizers', *Journal of Radiology Nursing*, p. 133. doi: 10.1016/j.jradnu.2017.04.002.
48. R, H. *et al.* (2020) 'CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene', *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, pp. 306–312. doi: 10.1016/j.oooo.2020.06.021.
49. Samuel, S. R. (2021) 'Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life?', *International journal of paediatric dentistry / the British Paedodontic Society [and] the International Association of Dentistry for Children*, 31(2), pp. 285–286.
50. Sekar, D. *et al.* (2019) 'Methylation-dependent circulating microRNA 510 in preeclampsia patients', *Hypertension research: official journal of the Japanese Society of Hypertension*, 42(10), pp. 1647–1648.
51. Seppan, P. *et al.* (2018) 'Therapeutic potential of Mucuna pruriens (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats', *The aging male: the official journal of the International Society for the Study of the Aging Male*, pp. 1–14.
52. Sharma, P. *et al.* (2019) 'Emerging trends in the novel drug delivery approaches for the treatment of lung cancer', *Chemico-biological interactions*, 309, p. 108720.
53. Shenoy, P. B. and Brundha, M. P. (2016) 'Awareness of polycystic ovarian disease among females of age group 18-30 years', *Research journal of pharmaceutical, biological and chemical sciences*, 8(8), p. 813.
54. Siddique, R. *et al.* (2019) 'Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47.

55. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306.
56. Teja, K. V., Ramesh, S. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of conservative dentistry: JCD*, 21(6), pp. 592–596.
57. VijayashreePriyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448.
58. VijayashreePriyadharsini, J., SmilineGirija, A. S. and Paramasivam, A. (2018) 'In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species', *Archives of oral biology*, 94, pp. 93–98.
59. Vogel, L. (2011) 'Hand sanitizers may increase norovirus risk', *Canadian Medical Association Journal*, pp. E799–E800. doi: 10.1503/cmaj.109-3922.
60. Voller, L. M., Schlarbaum, J. P. and Hylwa, S. A. (2020) 'Allergenic Ingredients in Health Care Hand Sanitizers in the United States', *Dermatitis: contact, atopic, occupational, drug: official journal of the American Contact Dermatitis Society, North American Contact Dermatitis Group*. doi: 10.1097/DER.0000000000000567.
61. Weaver, J. M. (2005) 'The Increasing Use of Alcohol-Based Hand Sanitizers', *Anesthesia Progress*, pp. 85–85. doi: 10.2344/0003-3006(2005)52[85:tiuoah]2.0.co;2.
62. *Website* (no date a). Available at: Brundha, M. P., & Nallaswamy, D. (2019). Hide and seek in pathology- A research on game-based histopathology learning. International Journal of Research in Pharmaceutical Sciences, 10(2), 1410– 1414. https://doi.org/10.26452/ijrps.v10i2. 606 (Accessed: 10 June 2020).
63. *Website* (no date b). Available at: Timothy, C. N., Samyuktha, P. S., & Brundha, M. P. (2019, August 1). Dental pulp stem cells in regenerative medicine – A literature review. Research Journal of Pharmacy and Technology. Research Journal of Pharmacy and Technology. https://doi.org/10.5958/0974-360X. 2019.00698.X (Accessed: 4 June 2020).
64. *Website* (no date c). Available at: Kumar, A., & Brundha, M. P. (2016). Awareness about nocturia - A questionnaire survey. Research Journal of Pharmacy and Technology, 9(10), 1707– 1709. https://doi.org/10.5958/0974-360X. 2016.00344.9 (Accessed: 4 June 2020).
65. *Website* (no date d). Available at: Hannah, R., Ramani, P., Brundha, M. P., Sherlin, H. J., Ranjith, G., Ramasubramanian, A., … Archana, S. (2019). Liquid paraffin as a rehydrant for air dried buccal smear. Research Journal of Pharmacy and Technology, 12(3), 1197–1200. https://doi.org/10.5958/0974- 360X.2019.00199.9 (Accessed: 4 June 2020).
66. *Website* (no date e). Available at: Shreya, S., & Brundha, M. P. (2017). Alteration of haemoglobin value in relation to age, sex and dental diseases- a retrospective correlation study. Research Journal of Pharmacy and Technology, 10 (5), 1363–1366. https://doi.org/10. 5958/0974-360X.2017.00241.4 (Accessed: 4 June 2020).
67. *Website* (no date f). Available at: Preethikaa, S., & Brundha, M. P. (2018). Awareness of diabetes mellitus among general population. Research Journal of Pharmacy and Technology, 11(5), 1825– 1829. https://doi.org/10.5958/0974-360X. 2018.00339.6 (Accessed: 4 June 2020).