

## **Dental Waste Management For Environmental Sustainability – Review Of Literature In Systematic Manner**

**By**

**Somalee Mahapatra**

<sup>1</sup>PhD Scholar, Faculty of Management Science, IBCS, Tutor, Department of Prosthodontics & Crowns & Bridges, IDS, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

**Manoranjan Dash**

<sup>2</sup>Professor, Faculty of Management Science, IBCS, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

**Priyanka Debta**

<sup>3</sup>Professor, Department of Oral Pathology and Microbiology, Institute of Dental Science and Hospitals, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

**Saswati Siddharatha**

<sup>4</sup>Reader, Department of Oral Pathology and Microbiology, Hi-Tech Dental College & Hospitals, Bhubaneswar, Odisha, India

**Subhashis Mohanty**

<sup>5</sup>Histopathology Consultant, Histopathology Department, Sum Ultimate Medicare, Bhubaneswar, Odisha, India

**\*Corresponding Author: Dr. Somalee Mahapatra**

\*PhD Scholar, Faculty of Management Science, IBCS, Tutor, Institute of Dental Sciences, Siksha O Anusandhan (Deemed to be University), Bhubaneswar.,

Email: [msomalee@gmail.com](mailto:msomalee@gmail.com)

### **Abstract**

The biomedical waste are the waste arising during the process of diagnosis, therapy and immunization of the human beings or animals. A subpart of the biomedical waste comprises of the dental wastes. These dental healthcare generates a number of biomedical wastes, including the materials such as scrap amalgam, photochemical waste (developer and fixer), lead foil from traditional X-ray packets, blood-soaked materials, human tissue, and disinfectants, which are challenging to the environment. So, handling this waste generated from the dental procedure and from the dental office is called dental waste management. Although the dentist are dedicated holistically for the welfare of their patient's and to the community but they lack behind in maintaining environmental sustainability. The Environmental sustainability is capacity to improve the quality of human life while living within the carrying capacity of the earth's supporting ecosystems. This review explores how a sustainable environment can be achieved by managing different dental waste in the clinical setting.

Many studies reviewed pointed out that four key hindrance's are - individual, educational, institutional, infrastructural and to endorse this initiatives for environmental sustainability in clinical dental setting by dental professionals. The dental professionals who embrace environmental sustainability should take steps against the factors which restrict

against the environmental effect for their dental practices which hold up the health of the population in the communities that they are serving and the welfare of the posterity.

**Keywords:** Dental professionals, biomedical waste, environmental sustainability, practices, dental waste management.

## Introduction

The Biomedical waste was confined only to the medical field but by the increased dental problems, the number of dental clinics and hospitals have also elevated leading to roaring practice by the dental professionals with that generating large amounts of dental waste. This increased dental waste is causing disturbance in the environmental sustainability. The environmental sustainability is the liability or the responsibility to protect the ecosystems and preserve the resources that are natural to support the wellbeing and health now & in future. And this responsibility is accountability by the dental professionals as they are generating the dental waste which is disturbing the environmental sustainability. But by proper management of the dental waste an unique environmental sustainability can be acquired and maintained presently and for the future.

### *The Effects of Dental Practice on the Environment:*

The dental professionals are not considering about the effects of the dental waste on the environmental sustainability.<sup>(1-5)</sup>The dental practice comprises of intensive resource factory with demanding largely on energy, fuel, water, supplies & more for the day to day activities done clinically.<sup>(1-4)(6-13)</sup>As per some studies in United Kingdom the dental professional's from their dentistry field resulted about 3 percent or about 675 Kilotonnes for National Health Service's accounting to carbon emission total footprint which was recorded in the year 2014 to 2015.<sup>(1,14)</sup>The dental practitioner is an occupation which promotes all the practices that are ethical as non maleficence and beneficence that are extended to human's environment inhabit, accumulating the promotion of health of the population and the prevention of diseases.<sup>(5,15)</sup>The adoption of the Environmental sustainability by the dental professionals in their dental setting will not only benefit and protect this environment but along with this will help in improving the outcomes of the client by initiating in saving the economics for long period both the practices(public/private) that deflect the labour, time along with the physical resources in regards to the deliverables of the client's which improves.<sup>(2-4),(11,12)</sup>

The Authorities of the Indian Dental Association (IDA) board is for the protection of all the public individual's those acquiring dental healthcare out from the licenced dental practitioners. However very less attention is given towards effect for the dental healthcare upon the ecosystem. Away out of the prevention from the infection and to maintain the protocol to control the microbial averting or cross contamination by amalgam and from the landfills the sharps being separated, there lies a poverty in the guidelines, infrastructure, incentives and education to assist the dental professionals who are interested in the Environmental Sustainability initiatives.<sup>(2-4),(6-13),16,17</sup>Studies on this environmental sustainability practices among the dental professionals in this dentistry field is pause and those tending to concentrate towards the dentists and the students studying dentistry. The research studies published are none belonging to Odisha although scanty research may be available elsewhere in India. So this review will put forward the practices or initiatives by which dental waste can be managed to achieve Environmental Sustainability which constitutes of 3R's that is reuse, reduce and recycle. Our objective of this review is to acknowledge the point of

view or attitude and the present practices followed by the staff in the dental clinical setting accepting the reduce reuse & recycle intervention for the management of the resources.

## **Material And Methods**

**Methodology:** A systematic review of relevant cross-sectional studies was conducted regarding BMW management in India in dental teaching institutions in India. Six studies were finally included in the present review after conducting both electronic and manual search like Pubmed, Scopus etc. and after making necessary exclusions. Potential biases were addressed and relevant data was extracted by the concerned investigators.

The search engines and the academic databases applied to sort out the qualitative, mixed or quantitative study methods of Environmental Sustainability in the dental settings of the dental professionals comprising of Google scholar, Pubmed and Scopus. The confined search was limited to open access that are peer-reviewed articles in the languages of English published between 2011 to 2021. The Keywords for search comprised of dental professionals, biomedical waste, environmental sustainability, attitudes, knowledge, practices, reduce, recycle, reuse, dental waste management. The total number of articles especially to this were 6 articles which were selected for reviewing finally including of mixed methods (a survey comprising of both that is descriptive and research approach).

## **Results**

The number of articles identified through the search engine from Scopus and Pubmed were 20. The additional number of articles from other sources were 10. So the total number of articles were 30 from which articles which were excluded as they had only abstract were 9. The articles screened after elaborate evaluation were 21. Then the articles were excluded as they were not related to the specific dental waste management were 15. Then the final full text articles included for this review for dental waste management for environmental sustainability were 6 in numbers as demonstrated in figure 1.

An outlook about the attitudes and the practices presently followed by the dental professionals & adopting the Environmental Sustainability initiatives in the dental practices by the mode of open-ended interviews, action and survey approaches for the research. These studies identified the attitudes and the practices carried out by the dental professionals presently and to formulate the initiatives by which the environmental sustainability can be achieved. A keen knowledge was acquired about the dental waste which could be managed by reuse, reduce and recycle.

## **Discussion**

The dental professional's always practices ethical paradigms, competencies and principles that guide the dentists to care about their clients, populations and the communities by taking into account the risk from environmental factors that will compromise the health and quality of life.<sup>(5,15,18,19)</sup> Ethical principles as that of nonmaleficence and beneficence, the determinants of social health & Human Walsh's Conceptual Needs Model 1998<sup>(5)</sup> and Yura relate health of the human directly towards issues for the environment.<sup>(5,15,18,19)</sup> The client's consideration is the main prospect but even the environment helps the dental professionals to get involved in activities crowning prevention of disease, promotion of health, justice socially, therefore incorporating no harm doing and only good.<sup>(5,15)</sup> There are evidence

showing environmental pollution and interaction by the climate which leads to harming the current and future health of the generations.<sup>(20-23),(14,24,25),(2-4)</sup> The dentists perform the clinical protocols and the operations within the dental practices but the assistant & the accessory staffs are involved in the management of the dental waste generated. The dental profession involves the well being of the client so constituting preventive type of care hence the interest of the dentist should encourage & adopt with other staffs the initiatives for environmental sustainability. To understand the reason for barriers & facilitate the practices of environmental sustainability is acquired from the dental professionals insight.<sup>(6)</sup> The efforts for environmental sustainability should be followed to maintain the conditions – dynamic, globally. This pandemic situation of Covid-19 have illustrated that diseases of infectious type can spread rampantly.<sup>(26-28)</sup> By this Covid-19 scenario, prevention from infection at high level should be streamlined and protocols to control such conditions have elevated the demand to use personal protective equipment, single use disposables, barriers, adherent astringents for sterilization and disinfection methods along with the use of single dose materials.<sup>(28-33)</sup> Due to this pandemic distancing physically is required and the important services should be only ordered around the globe by which the environmental sustainability has been halted enclating enforcement, protests, monitoring and summits.<sup>(34-36)</sup> More research will help in understanding the attitudes and practices to follow for maintaining environmental sustainability. Hence by gathering information from all the members of the dental office team by adopting the initiatives for environmental sustainability maintenance.

#### ***Operators for the change:***

***Reuse.*** Equipments and devices could be reused if appropriately cleaned and disinfected. A study done with dental burs before proves the fact that the burs which are reusable have a better impact on the environment than the disposable burs.<sup>(37)</sup> There is tax incentives in few countries for donation of old equipments. (38) There are also schemes for reconditioning of equipments to be used in circulation by RHL (Robinson Healthcare Ltd.) and HEG (Healthcare Environmental Group).<sup>(14)</sup>

Reuse by the means of: Reuse of plastics and instruments in the healthcare unit is normally associated with lot of challenges owing to the nature & construction of polymers also as we live in a society prone to increased levels of litigation.<sup>(39)</sup>

#### ***Reduce the generation of Waste:***

Out of the 3 Rs the easy method to achieve reducing waste in oral health care is to reduce the demand for products and materials. This could be possible by encouraging and promoting better prevention methods along with maintenance plans with the patients cooperation.<sup>(44)</sup> The foremost ways by which the dental healthcare can do reduction of waste by less purchase; along with paper procurement inside the aforementioned series.<sup>(45)</sup> The already mentioned should incorporate proper levels of stock management to ward off the expiration as of the unutilized consumables.<sup>(46)</sup> The rotation of stock is another important way to make sure that the commodities are given preference for utilization with - use by date rather than the newer stocks.<sup>(46)</sup>

***Recycle.*** Recycling has its own benefits also in the domestic level. It reduces the need of raw materials, encourages individuals for responsibility on waste management. Recycling is either low cost or doesn't cost anything, but it generates income and prevents the expenditure of domestic waste disposed.<sup>(43,47)</sup>

Healthcare management uses SUPs (Single use plastics) for mechanical and chemical recycling. Many practices are encouraged for recycling which includes educating staff,

separation of waste and increasing awareness among people.<sup>(48)</sup> It's a requirement to separate plastic and paper before recycling. Separation of sterile wrapping effectively could save as much as 5 kg of waste in a week.<sup>(38,49-51)</sup> Other than plastic and paper old instruments, materials and nonfunctioning equipment also are recycled.<sup>(38,40-42,52,53)</sup> Recycling zirconia used for dental prosthesis also has a substantial advantage.<sup>(54)</sup>

As per the six articles searched for this paper, in the review article by Martin N. Sheppard M. illustrates that the drivers-opportunities-recommendations are the utmost practices in dental healthcare to attain environmental sustainability. The attitudes and behavior could be changed positively as there is absence of professional and public awareness which is the biggest drivers to get involved. For the future strategy, education through awareness is the main gate way at every level. The elevated opportunities for recycling and waste reduction should be the main objective for environmental sustainability along with policymakers and legislation engagement. By Duane B, Borglin L have enumerated that the burden on this environment could be reduced which should be considered by the team of endodontics. They should consider if anything else could be used instead of is opropyl alcohol, use of disposable instrument and use of electricity. More research to be done for medicaments which should be ecofriendly and the investigate for the other types of gold to be used rather than the present (cytotoxic gold) standards. For the improved environmental effect on the root canal treatment by the endodontics very less invasive methods could be formulated to regenerate the defective pulpal tissue or initiate the repair of this pulp. According to Mazur M, Ndokaj A, described by adopting the fourR's prospects that is reuse, recycle, reuse, rethink along with this moving forward by the use of dental materials, for the oral healthcare that is environment friendly. As stated by Leon MLd, the dental health practitioners following the environmental sustainability(ES) inventiveness will help in the well-being of each individual's health and well-being of the society and the ecosystem. By these initiatives of ES it will help in enhancing the patient's outcome by long period of savings in their practices that canbe divided to magnify the patient's healthcare along with the environmental benefit's. In accordance with Grose J, Richardson J, for the management of resources for embracing the procedures of reuse, recycle and reduce-the behavior and the attitudes of the staffs is needed in the dental healthcare. At last as reported by Boricha Z, Girotra C, the dental healthcare is developing as greendentistry, by the reduction in dental waste, minimizing the consumption of energy and water, decreasing the rate of pollution and the resources to conserve. Knowing all these demands which are consistent and the climate issues keep changing along with the environmental sustainable practices having expectations, it's essential to recognize the awareness and knowledge of the students in the dental field regarding the (green dentistry).

#### ***Recommendation for Nanotechnology:***

The concept of reuse, reduce and recycle constitutes a good number of operators by which the procedure of dental biomedical waste can be managed for environmental sustainability. So a new proforma of achieving Environmental sustainability is by application of nanotechnology to reduce the generation of Dental biomedical wastes. In dentistry the harmful effects of nano technology in healthcare can be reduced by imparting knowledge. So nano plastics should be thoroughly studied. This paper clarifies the knowledge gap as well as the need of nanotechnology in dentistry. More research on this aspect is a requisite in future.

## Conclusion

The dental field works by demanding on resources without which it cannot operate the clinical practices. So for the success of environmental sustainability initiatives in this field it has to depend on multidimensional, collaborative, high technology approach to diminish the emissions of greenhouse gas & pollution. Furthermore to go ahead time to time education and follow of policies, protocols and change in the infrastructure will help in the achievement of environmental sustainability initiatives.

## Acknowledgement

I am thankful to Institute of Business and Computer Sciences Dean (Anup Samantaray) and Institute of Dental Sciences College & Hospitals Dean (Dr. Neeta Mohanty). I am, Dr. Somalee Mahapatra, Phd Scholar of Hospital Management. This survey is part of my Phd thesis.

## References

1. Mystica Lopez de Leon, Barriers to environmentally sustainable initiations in oral health care clinical settings. *Can J Dent Hyg.* 2020;54(3);156-160.
2. Hastings B, Yee S. Enviro Dental Practice: The future is in your hands. *Can J Dent Hyg.* 2017;51(2):90–93.
3. Mulimani P. Green dentistry: the art and science of sustainable practice. *Br Dent J.* 2017;222(1):954–61.
4. Khanna SS, Dhaimade PA. Green dentistry: a systematic review of ecological dental practices. *Environ Dev Sustain.* 2019;21:2599–2618.
5. Darby ML, Walsh MM. *Dental hygiene theory and practice.* 4th ed. St. Louis: Missouri; 2015.
6. Al-Qarni MA, Shakeela NV, Alamri MA, Alshaikh YA. Awareness of eco-friendly dentistry among dental faculty and students of King Khalid University, Saudi Arabia. *J Clin Diagn Res.* 2016;10(10):75–78.
7. Al Shatrat SM, Schuman D, Darby ML, Jeng HA. Jordanian dentists' knowledge and implementation of eco-friendly dental office strategies. *Int Dent J.* 2013;63:161–68.
8. Ranjan R, Pathan R, Singh DK, Jalaluddin Md, Kore SA, Kore AR. Awareness about biomedical waste management and knowledge of effective recycling of dental materials among dental students. *J Int Soc Prev Community Dent.* 2016;6(5):474–79.
9. Burns L, Grose J, Mukonoweshuro R, Richardson J, Mills I, Nasser M, et al. Developing sustainability in a dental practice through an action research approach. *Br Dent J.* 2018;225(5):409–412.
10. Grose J, Richardson J, Mills I, Moles D, Nasser M. Exploring attitudes and knowledge of climate change and sustainability in a dental practice: A feasibility study into resource management. *Br Dent J.* 2016;220(4):187–91.
11. Chopra A, Raju K. Green dentistry: Practices and perceived barriers among dental practitioners of Chandigarh, Panchkula, and Mohali (Trinity), India. *J Indian Assoc Public Health Dent.* 2017;15(1):53–56.
12. Goddard MC, Pavlik S, Kamodia S, Schmenk M, Meyer R, Yates E. "Greening the dental clinic." *Pursuit of sustainability at the University of Michigan School of Dentistry.* Ann Arbor (MI): University of Michigan, Dow Sustainability Fellows Program; 2016. 55p.
13. Agrasuta V. *The adoption of green dentistry among dentists in Thailand.* Manchester (England): The University of Manchester, Manchester Business School; 2013. 58p.

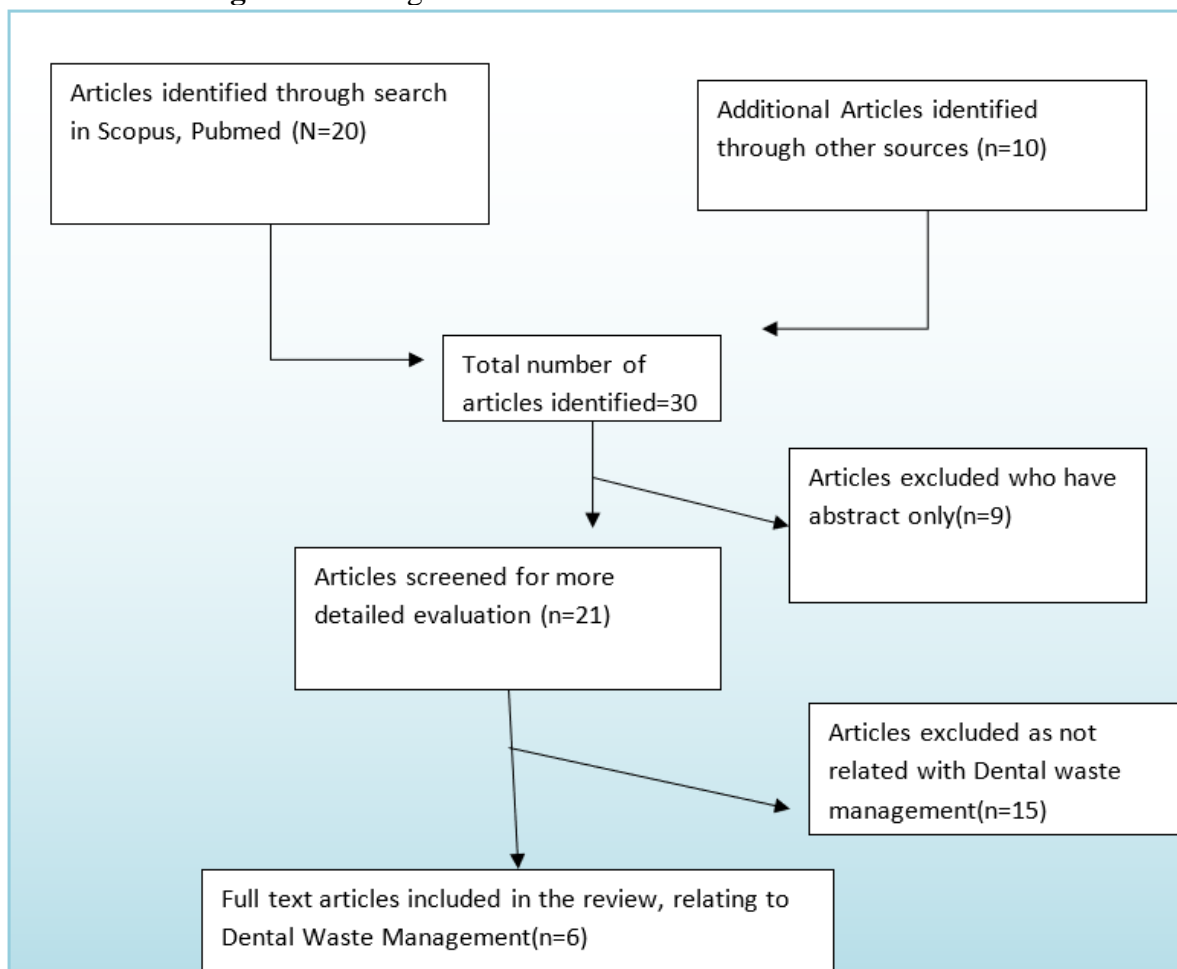
14. Duane B, Harford S, Ramasubbu D, Stancliffe R, Padeski-Clewer E, Lomax R, et al. Environmentally sustainable dentistry: A brief introduction to sustainable concepts within the dental practice. *ABr Dent J.* 2019;226(4):292–95.
15. Canadian Dental Hygienists Association. *Dental hygienists' code of ethics.* Ottawa: CDHA; 2012.
16. The College of Dental Hygienists of British Columbia. CDHBC Infection Prevention and Control Guidelines [Internet]. 2012 July [cited 2019 September].
17. College of Dental Surgeons of British Columbia. Infection Prevention and Control Guidelines [Internet]. 2012 July [cited 2019 September].
18. Raphael D. *Social determinants of health: Canadian perspectives.* 2nd ed. Toronto: Canadian Scholars' Press; 2009.
19. Mikkonen J, Raphael D. *Social determinants of health: The Canadian facts.* Toronto: York University School of Health Policy and Management; 2010.
20. Office of Sustainability, University of Alberta. *What issustainability?* Edmonton: University of Alberta; nd. [cited 2019 October].
21. United Nations. Global Issues: Climate Change [Internet]. c2019 [cited 2019 September].
22. United Nations Climate Change Secretariat. *Climate action and support trends 2019.* Bonn (Germany): UNCCS; 2019.
23. World Health Organization. Health-Care Waste [Internet]. 2018 February 8 [cited 2019 February 21]. Geneva, Switzerland: WHO; 2018.
24. Government of Canada. Participation in International Environmental Agreements and Instruments [Internet]. Date
25. unknown [cited 2019 September].
26. Government of Canada. Acts and Regulations: Environment and Climate Change Canada [Internet]. 2019 April 2 [cited 2019 September].
27. Public Health Agency of Canada. Coronavirus Disease (COVID-19): Prevention and Risks [Internet]. 2020 May 12 [cited 2020 May].
28. Public Health Agency of Canada. Risk-Informed Decision-Making for Mass Gatherings During COVID-19 Pandemic [Internet]. 2020 April 3 [cited 2020 May].
29. Public Health Agency of Canada. Coronavirus Disease (COVID-19): For Health Professionals [Internet]. 2020 May 13 [cited 2020 May].
30. Office of the Provincial Health Officer. *Workplace COVID-19 safety plans.* Victoria: British Columbia Ministry of Health; 2020 May 14.
31. College of Dental Hygienists of British Columbia; College of Dental Technicians of BC; College of Denturists of British Columbia; College of Dental Surgeons of British Columbia. Transitioning Oral Healthcare to Phase 2 of the COVID-19 Response Plan [Internet]. 2020 May 15.
32. Shared Health Manitoba. Shared Health Manitoba Memo: COVID-9 – Guidance for Resumption of Services [Internet]. 2020 May 5.
33. College of Registered Dental Hygienists of Alberta. *COVID-19 return to work guidelines for dental hygienists.* Edmonton: CRDHA; 2020 May 4.
34. Saskatchewan Dental Hygienists' Association. *COVID-19 pandemic IPC interim protocol.* Saskatoon: SDHA; 2020 May 4.
35. Office of the Provincial Health Officer. *Notice to owners, occupiers and operators of places at which large numbers of people gather.* Victoria (BC): British Columbia Ministry of Health; 2020 May 16.
36. Wilkinson D, Chavez LT. How Covid-19 Could Impact the Climate Crisis. New York: Human Rights Watch. 2020 April 16.
37. Alam H. Wet'suwet'en release draft deal reached with federal, B.C. governments amid Indigenous blockades. *National Post,* 2020 May 12.

38. S.R. Unger, A.E. Landis, Comparative life cycle assessment of reused versus disposable dental burs, *Int. J. Life Cycle Assess.* 19 (2014) 1623–1631.
39. S. Arora, S. Mittal, V. Dogra, Eco-friendly dentistry: need of future. an overview, *J. Dent. Allied Sci.* 6 (2017) 22.
40. N. Martin, S. Mulligan, P. Fuzesi, T. Webb, H. Baird, S. Spain, T. Neal, A. Garforth, A. Tedstone, P. Hatton, Waste plastics in clinical environments: a multidisciplinary challenge, in: *Creat. circ. econ. approaches to elimin. plast. waste. UK Res. innov. UK circ. plast. netw.*, 2020: pp. 86–91.
41. S.S. Khanna, P.A. Dhaimade, Green dentistry: a systematic review of ecological dental practices, *Environ. Dev. Sustain.* 21 (2019) 2599–2618.
42. H. Rahman, R. Chandra, S. Tripathi, S. Singh, Green dentistry-clean dentistry, *Indian J. Restor. Dent.* 3 (2014) 56–61.
- A. Kakkar, V.P. Aggarwal, S. Singh, Go green: a new prospective in dentistry, *MOJ Curr. Res. Rev.* 1 (2017) 7–10.
43. NHS Estates, Total Waste Management : Best Practice Advice on Local Waste Management for the NHS in England, The Stationery Office, London, 2004.
44. B. Bowden, A. Iomhair, M. Wilson, Evaluating the environmental impact of the welsh national childhood oral health improvement program, designed to smile, *Commun. Dent. Heal* 38 (2021) 15–20.
45. Duane B, Ramasubbu D, Harford S et al. Sustainability and procurement within the dental practice. *Br Dent J* 2019;
46. Royal College of Physicians. Less waste, more health: A health professional's guide to reducing waste. 2018.
47. B. Duane, D. Ramasubbu, S. Harford, I. Steinbach, J. Swan, K. Croasdale, R. Stancliffe, Environmental sustainability and waste within the dental practice, *Br. Dent. J.* 226 (2019) 611–618.
48. Creative Circular Economy: Approaches to Eliminate Plastic Waste, in: *UK Circ. Plast. Netw.*, UK Research & Innovation and Plastics Research and Innovation Fund (PRIF).
49. S. Harford, B. Duane, Sustainable dentistry: how-to guide for dental practice sustainable dentistry how to guide for dental practices sustainable dentistry: how to guide for dental practices, *Cent. Sustain. Healthc.* (2018).
50. Australian Dental Association, Policy Statement 6.21 – Dentistry and Sustainability, Policy (August 21, 2020), 2020.
51. G.M. Chadha, G. Shenoy Panchmal, R.P. Shenoy, S. Siddique, P. Jodalli, Establishing an eco-friendly dental practice: a review, *IJSS Case Rep. Rev.* (2015).
52. B. Avinash, B.S. Avinash, B.M. Shivalinga, S. Jyothikiran, M.N. Padmini, Going green with eco-friendly dentistry, *J. Contemp. Dent. Pract.* 14 (2013) 766–769.
53. P. Eram, S. Shabina, M. Rizwana, N. Rana, Eco dentistry: a new wave of the future dental practice, *Ann. Dent. Spec.* 5 (2017) 14–17.
54. C.Y. Su, J.C. Wang, D.S. Chen, C.C. Chuang, C.K. Lin, Additive manufacturing of dental prosthesis using pristine and recycled zirconia solvent-based slurry stereolithography, *Ceram. Int.* 46 (2020).



**FIGURES:**

**Fig. 1.** Flow diagram of identification of studies for inclusion:



**Summary:**

The medical healthcare facilities help is the procedures of diagnosis, treating and immunization for the human beings. As the medical healthcare, the dental sector is a subset and with the increased urbanization the requirements for dental treatment has increased leading to elevated numbers of dental hospitals and clinics. These dental and medical sector in the course of action of treating their patients discard a huge amount of waste which are disposed to the environment creating pollutions leading to the disturbances to the ecosystem which inturn creates problems for the well-being of the society. So this review of literature in a systematic manner will help in creating the awareness and knowledge among the dental health care practitioners to practice the technique of reuse, recycle and reduce the dental waste materials by which environmental sustainability can be achieved.