**RISK OF MERCURY IN DENTAL AMALGAM**

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**Introduction**

 Historically, the alternative use of mercury in dental amalgam as a health restorative in treatment of dental cavities remains to be debated by the scientific world due to the proper documented environmental and health risks of mercury. Thus, the substitution of product to replace mercury in health organizations specifically in dental amalgam and health and environmental and safety risks of commercially available alternatives have begun to receive public scrutiny more so from the public health stakeholders. Some of the alternatives include composite resins, compomers, glass ionomer cements and gold alloys. For an individual to be in a position to develop and strategically adopt a scientific approach to health, a comparative health and environmental risks and the general benefits of dental amalgam and its substitutes must be critically evaluated using both qualitative and quantitative approaches. The evaluation should take factors that are related to the resource of infrastructure, they must have access to this kind of infrastructure and the viability of the economy of the substitutes for the public into account in order for an individual to be able to successfully design and implement a strategy for the health sector while at the same time protect the environment.

 This paper gives quantitative and qualitative needs of evaluating occupational exposures and evaluation of the environmental exposures as well. It also give the cancer and the non-cancer risks of dental mercury and its substitutes for adults as well as children using the alternative four-step human health risk comprehensive approach originally given a hand by the National Academy of Sciences in the year 1983. It was then later used extensively by the federal agencies of the United States that was solely responsible for environmental and public health protection (USEPA 1995, 2000) (Hylander & Goodsite, 2006). This paper is based on the primary literature; it majorly includes hazard identification, exposure assessment, and environmental assessment and risk steps. This paper majorly focuses on the documented scientific evidence for the exposures to and the potential health effects that are associated with resin based substitutes in a comprehensive way.

 The use of mercury in most health organization remains to be a question that continues to be debated. It has long been debated by the scientific world due to the adverse environmental and health risk mercury possess. There still remains a considerable controversy regarding the health implications and benefits of utilizing mercury that contains amalgam. There are neither epidemiologic scholars nor consensus complements that have strongly come up with evidence that really shows that the use of mercury in dental filling causes harm to the individuals that adopt the treatment. At the very same time, mercury contribution in dental amalgam use to the environment has burdened the society and it has largely contributed to neurotoxic damage in children. The usage of alternative material in dental amalgam to replace mercury is growing and to some areas mercury has been virtually replaced. Specifically, Norway, Denmark and Sweden have done away with the use of dental amalgam except for some few special cases.

 This paper largely depends on the availability of various public available scientific evaluations that are undertaken by different policy and regulatory agencies and works that are published in scientific literature, a limited approach is also used for dental amalgam risk evaluation, and the paper also presents epidemiological evidence. A proper scientific evidence is also presented while evidence analysis is done with due consideration of strengths and certainties present in the available data (Lloyd et al, 1996). The main aim of this paper is to give information to public policymakers in line with safety of products usage in the restoration of the teeth in order to give protection to oral and public health to all humans, including all sub populations while at the same time provides protection to the environment.

 Dental amalgam scientifically contains a mixture of alloy elements and mercury that has been used by dentists in different forms for treatment of affected cavities and the restoration of teeth for more than 140 years around the entire globe (Lloyd et al, 1996). When dental amalgam was first applied in dentistry, gold was also applied in some cases of dental restoration (Maqbool et al, 2014). However, many individuals did not apply gold because it was relatively expensive than dental amalgam hence prohibited its widespread. At that time, there were no alternatives that were to be applied as alternatives for dental amalgam. As a result, the widespread use of dental amalgam has been seen all over the world and it is presently used in large cavities due to its superiority in its mechanical properties, low costs and durability. A number of alternatives that are in form of ceramics and gold alloys have been developed in past decades and their widespread usage has continued due to the superiority of its properties and the health implications that are related to the usage of dental amalgam. Due to the documented health effects of mercury and its elements, the connection between exposure to mercury that is released from amalgam and formation of disease in individuals with amalgam fillings has and still is scientifically being discussed in regulatory and academic community in the 21st century (Plous, 1993).

 Many government institutions have investigated the health implication brought about by mercury that is contained within amalgam and the main role of mercury in cause of disease with a systematic distribution and accumulation in the human body. Various scholars have recently conducted epidemiological research in order to know whether mercury in amalgam has a role in any incidence of the disease (Maqbool et al, 2014). Till now there has been no consensus that has been forthcoming. As scholars have attempted to provide cosmetic safer and pleasing substitutes to amalgam, there have been a number of chemical formulations that have been developed in the past four decades and successfully introduced in the business world with an exemption of not going through human exposure assessment. Dental scholars are frequently exposed to elements from resin restorative materials during routine process. Research studies have shown that exposures frequently occur through dermal absorption and inhalation. Peer reviewed studies of estrogenicity; acute toxicity and sensitized potential of the alternative materials were drafted from the literature.

**Hazard Identification**

 It is very important for an individual to know both the risks and benefits of dental amalgam and its alternatives; this involves incorporating the state-of-art data so that the dental society and clients are informed and policies can be developed in protection of oral and public health as well as giving protection to the environment (Saxe et al, 1999). In this kind of evaluation, it is entirely necessary for an individual to evaluate the chemical, physical, environment, transport channels an human compounds of all the available constituents, while at the same time examines the potential routes of exposures in every possible route of exposure in each step of restoration of the teeth from preparation of material to relevant techniques that are applied in promotion of adhesion to the surface of the teeth. An entire different health evaluation risk for each individual receptor of concern is performed including both adults and children and above all pregnant women. It critically takes into consideration different phase of usage that majorly includes placement of filling, degradation and wear in clinical usage. Specific risk data needs to be augmented by the environmental exposure and emission information while at the same time give attention to the sustainability of the environment and product life cycle for amalgam and its substitutes. The environmental certainty and transport property information shows that an element of resin based alternative material is complex in the way it responds to the environment and while others are biodegradable, some are persistent.

 Amalgam is usually formed when mercury is only mixed with any metal. Mercury is one of the metals that is only liquid at room temperature hence the reason for many individuals to adopt it in the mixture and solidification of other metals. When a dentist usually selects any type of dental amalgam, it then only involves a selection of metal with which mercury basically gets mixed (Schwartz, 2004). Although the composition of mercury differs among manufactures, the old alloy used in dental amalgam is usually a mixture of zinc, silver, copper and some case mercury. From the scientific studies, it is clearly seen that the mass of dental amalgam is mercury which is usually mobile in the environment; this is well documented in the health implications discharge of mercury (Schwartz, 2004). Mercury is regulated worldwide due to its human and eco-toxicity implications.

 According to USEPA, the maximum contaminant level that is recommended for inorganic mercury in drinking water is 2 μg/L (Spencer, 2000). There are a number of literature bodies that clearly demonstrate how waste from amalgam from dental institutions is the main source of mercury pollution in the environment. Various scholars have evaluated the concentrations of mercury and other metals in waste of some dental facilities and the influence of wastewater treatment in the United States (Spencer, 2000). Different samples collected during the study showed a much higher values than the standards that are given locally. The scholars preferred the classification of wastewater discharge from dental facilities as hazardous waste material and give a recommendation that the wastes should be well attended to during treatment before it is allowed to the environment (Stringer & spencer, 2001). In the United States, the use of mercury in dental amalgam sold in the year 2001 was roughly about 30.8 tons; it decreased to a near figure of 26.6 tons in 2004 and later 16.6 tons in 2007 (Stringer & Spencer, 2001). The awareness campaign of mercury fillings has been hypothesized over the years in driving future decline in the usage of mercury. Dental Amalgam has over the years remained to be largest category of the usage of mercury in products that are incorporated in the IMERC years of report (Maqbool et al, 2014).

**Hazard Assessment**

 Scientific researchers have given a report that solid amalgam waste are typically disposed on a daily basis, while the rate of amalgam use over resin is one-third in restorative procedure in dental facilities. Resin composite usage has had a significant rise within the last 20 years, however, no data has been found to have that kind of solid wastes emissions that carry residues of resin restorative materials in non-regulated waste (Swain et al, 2007). This has made the waste to be classified as municipal waste by the regulatory world. Such municipal waste is usually disposed in a landfill. The contamination of the environment with restorative materials is feasible when there is a release during transportation of dental leakage that leads to the contaminant to the population. However, there is no concrete concern for the contaminated environmental media with resin based substitutes due to their small quantities that are disposed. However, various scholars need to thoroughly research how to verify different assumptions in particular areas like landfills which basically receives large quantity of dental waste that needs to basically be based with actual environmental measurements (Walters & Walters, 2002).

 Dental amalgam is among the largest single source of metallic exposure for all members of the general public who have amalgam fillings. Mercury is basically released from amalgam fillings in shape of elemental mercury. When an individual inhales mercury vapor and absorps it through the GI tract, they usually get exposed to mercury that is released from dental mercury (Hylander & Goodsite, 2006). On the other hand, mercury is long recognized as a toxic metal because of its effects on humans following chronic high-level occupational exposures. A summary of toxicity values (RFD/RFC/CSF) for the elements of dental amalgam alternatives show that inhalation Hazard quotient (HQ) significantly varied from its original value. The estimates are significantly low and it should be noted that risk for mixtures have not been critically assessed. The main target organs for mercury are the kidney, the central nervous system and the thyroid glands. Several agencies in the globe have reviewed the primary literature seeking the connection between dental amalgam and health implications to direct environmental and public health procedural decisions. The Swedish government assigned Math Berlin a task to summarize and critically evaluate research findings that are closely connected to mercury from amalgam; this was published from the year 1997 to 2002 in order to supplement risk analysis that was done by the Swedish government (Maqbool et al, 2014).

**Exposure assessment**

 A research that was carried out in the United States by the Life Sciences Research office scientifically analyzed the health implications for dental amalgam, which was done in the year 2004 (Lloyd et al, 1996). It examined the peer reviewed, the scientific and medical literature related to dental amalgam and the health of a human being. The analysis concluded that there is no enough evidence to exhibit the correlation that occurs between the exposure of dental amalgam and kidney, the cognitive dysfunction that mainly includes the Alzheimer’s disease and sclerosis (Schwartz, 2004). There were also several other symptoms that were attributed by others to dental amalgam that have not been shown due to mercury release and absorption. Dental amalgam is also in a position to produce the hypersensitivity reactions in some individuals. For the few individuals affected, the complete removal of dental amalgam restoration with some materials is suggested to give a promotion to the resolution of the allergic symptomatology.

 Despite of this existence, the CDC gives a summation that there is very little evidence to support the connection of casual connection between mercury fillings and human health implications in the population (Spencer, 2000). It is noted by scientific scholars that data is still lacking because of the existence of a limited information that is connected to long term health outcomes that are very vulnerable to human’s subpopulations (Spencer, 2000). Recent research by scholars have tried to investigate the evidence for Alzheimer’s disease as connected to inorganic mercury, its examined effects are also closely associated with other forms of mercury that includes dental amalgam (Maqbool, 2014). A large number of references were peer reviewed and several studies were peer fulfilled in the inclusion criteria. The scholars have also noted that almost all studies on health implications in persons that have amalgams have been negative and methodologically flawed (Swain et al, 2007). The above summation has given the negative literature with respect to the health implications and the scientific controversy as to why there are inherent problems in the studies that give space for concern about the unidentified health implications. Due to the high levels of toxicology and the amount of mercury that gets released to the environment, the World Health Organization has tried to combat the situation by trying to pass information to all stakeholders involved, the message is always clear to everyone, it is the mandate of the WHO to seek every stakeholder to reduce or eliminate any possible use of mercury in dental amalgam due to its potentiality risks to the general human population.

**Risk management**

 Risk management begins with the detailed process of risk assessment; it evaluates the clinical, environmental and the occupational risks that are cause by the use of mercury in dental amalgam. It basically adopts the four step human health risk assessment approach that has long been used by the United States federal agencies. Based on the primary literature, the four step process includes; hazard identification, hazard assessment, exposure assessment and risk elimination. In following the due process, one will be in a process of being in control of any risk associated with mercury in dental amalgam.

 It is now recognized all over the world that dental amalgam is a significant main source of human exposure to inorganic mercury, While are concerned about the significantly low levels neurologic implications of mercury, inhalation of mercury gives the body an elevation of both organic and elemental as it is evidenced by its detection in various tissues of the human beings. Unlike the dental amalgam, the environmental release of compounds found in resin is significantly expected in some special circumstance. There is evidence that shows how resin based alternatives materials should be, limited to all patients and above all the dental care providers (Walters & Walters, 2002).

 Based on the critical review and the practical experience of scholars in the dentistry field that have seen the complete clear out of dental amalgams, it is very much possible to have alternatives used for mercury in dental amalgam. The relevant government stakeholders and international organizations should make available resources so as to reduce the cost of transition in areas that are economically crunched. There should be a thorough research that should aim to improve exposure and toxicity information that pertains to mixtures and constituents of the alternatives.

 In summation, based on all the evaluated scientific literature that pertains to the environmental emissions, the exposures of dental amalgam, human exposures the health implications and the resin based alternatives for restoration of teeth, scholars have proposed to the WHO that there is need for every nation to carry the burden of mercury in dental amalgam. There is indeed high risk in the use of mercury in dental amalgam, therefore alterative resin based materials is best suited in the dentistry departments.

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