ORIGINAL ARTICLE

NANOTECHNOLOGY APPLICATION IN DENTISTRY: A SURVEY AT DOW UNIVERSITY OF HEALTH SCIENCES

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ABSTRACT

Nanotechnology concerns a field of applied science which deals with the control of matter on the molecular level in scales smaller than 1µm. The aim of this cross-sectional observational study was to evaluate awareness on nanotechnology application in dentistry at Dow University of Health Sciences (DUHS). A questionnaire with 18 close-ended questions and one open ended question was devised and distributed. Total of 100 questionnaires were distributed and 88 proper replies were selected. Out of these 88 participants, 65% were under graduates, 25% were Graduates and 10% were Post Graduates. Almost half of the participants were having some awareness on Nano technology and remaining were not confident. Mostly believed in the application of Nano technology in dentistry, however, they were not using Nano technology in practice. Only fewer people gave correct answer regarding Nano particle size and very few had knowledge on Nano implants or Nano composites. Very few participants undergone any studies related to Nano dentistry and mostly were not aware of the progress being made in Nano dentistry. However, most of the participants recommended that inclusion of Nano dentistry as a subject needs consideration. Therefore, this survey reveals that there is lack of awareness on Nanotechnology application in dentistry. This study is just one step in that direction to emphasize on the need of realizing importance of nanotechnology in dentistry. It is anticipated that the future dentist will see nanotechnology as an inalienable part of practice and efforts will enable to cope well in advance at all levels.

Key Words: *Nanotechnology, Nano particles, Nano Implants, Biomarkers, Dentistry, Atomic Force Microscopy (AFM) and Optical interferometry.*

INTRODUCTION

The concept of nanotechnology was introduced in 1959 by Richard P Feynman, a Nobel winning physicist, with the fundamental idea of employing machines to make even smaller machine tools until we reach the nano, or atomic, level.[1] The nanotechnology is that specific science which deals with manipulating matter measured in the billionths of meters or nanometers, roughly the size of 2 or 3 atoms.[2] Nanotechnology concerns a field of applied science and technology which deals with the control of matter on the molecular level in scales smaller than 1µm, normally 1-100nm, and the construction of devices in that size range.[3]

There are two approaches by which nanotechnology creates structures: Top down, or bottom up. 'Top down' entails minimising the size of a current structure down to a nanoscale level. 'Bottom up' on the other hand involves manipulating individual atoms and molecules into nanostructures more like traditional biology and chemistry.[4] There are varieties of new dental products available, ranging from implants to oral hygiene products that rely on nanoscale properties. The application of Atomic Force Microscopy (AFM) and Optical interferometry on the spectrum of dentistry matters, including characterization of dental enamel, oral bacteria, biofilms and the role of surface proteins in biomechanical and nanomechanical of bacterial adhesions, will be seen at play here. Nanodentistry developments such as saliva exosomes based diagnostics, designing biocompatible, antimicrobial dental implants are bringing a cutting edge revolution to this field.[5]

Although the field of Nanodentistry is still nascent and many issues need to resolution, the new era of nanotechnology in dentistry could change a lay man's view of dentist. It promotes minimally invasive dentistry, creating a more dentist friendly atmosphere. However, patient awareness and education is vital to keep them abreast with the developments in the field and the options available in the treatment.

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What nanodentistry will do is to make the maintenance of effective oral health possible by using nanomaterials, biotechnology and ultimately dental nanorobotics.[6] The research into Nanotechnology is currently in the early stages. It is yet to be understood since many materials begin to act very differently on these nanoscales, often changing their properties in unusual manners.[7] Today, dentistry is at the edge of a major revolution due mainly to nanotechnology. Nanotechnology is still in the very initial stages of research only becoming possible in the last century and is yet to be fully understood since many materials begin to act very differently on these nanoscales, often changing their properties in an unusual manner.[8]

The tools of modern science have surprised, tantalized and over whelmed our imagination. They have improved the oral health of and quality of life for legions of people and communities.[9] Nanomaterials and nanoparticles are likely to be the foundations of innovative nanodental devices to be used for drug discovery and delivery, discovery of biomarkers, and molecular diagnostics.[10] New treatment opportunities may include dentition renaturalization, permanent hypersensitivity cure, complete orthodontic realignments during a single office visit, covalently bonded diamondized enamel and continuous oral health maintenance through the use of mechanical dentifrobots.[11]

One hardly comes across the concepts on nanotechnology or nano-dentistry in the curriculum being followed at different dental education level. A need was felt to carry out a research survey in order to measure knowledge, attitude and practical application of nanotechnology in the field of dentistry. The rationale of this survey research was to evaluate Knowledge, Attitude and Practice of Nanotechnology in Dentistry among Under Graduates and Post Graduate Students at DUHS.

METHODOLOGY

This study was a questionnaire based cross-sectional study. A structured close ended questionnaire was designed to assess basic understanding of the under graduate, graduate, post graduates available in Dow University of Health Sciences. SPSS 16 Version was used for statistical Analysis. Descriptive statistics was used to report frequency and percentage. A total of 100 participants were distributed with the self administered closed ended questionnaire. The questionnaire was designed to obtain information about the basic knowledge, attitude and awareness on nano technology being used worldwide for better dental treatment. All participants who filled the questionnaire were informed about the survey. This questionnaire was designed to pan out into three basic categories without defining it to anyone taking the survey. Inclusion criteria included Performa be made available to only those people who readily accepted to fill it and these broadly distributed in three categories. Exclusion criteria considered were rejection of Incomplete Performa's, any scribbling or over writing and Performa's filled with discussions were not entertained. Moreover First and second year BDS students were also excluded. A total of 88 participants actively participated out of the total 100 candidates & only their responses were included in the study. In this survey, Knowledge, Attitude and Practice towards nanotechnology in dentistry was focused starting from basic knowledge to some latest advancements related questions were included.

RESULTS

A total of hundred participants were approached but only 88 participants responded with a complete questionnaire. Out of the 88 questionnaire, sixty five percent were answered by under graduate's students. Twenty five percent were graduates and ten percent were post graduates. Based on the frequencies obtained, following was deduced in reply to the questionnaire summarized below:

TABLE 1: KNOWLEDGE AND AWARENESS ABOUT NANOTECHNOLOGY

	Frequency		
Variables	**(Yes %)**	**(No %)**	**(Maybe %)**
Do you know what nanotechnology is?	50 (56.8%)	26 (29.5%)	12 (13.6%)
Do you have any idea about the size of nanoparticle?	58 (66.7%)	15 (16.7%)	15 (16.7%)
What is the size of nanoparticle?	37 (41.5%)	24 (26.8%)	28 (31.7%)
Do you think nano materials are hazardous?	13 (14.3%)	52 (59.5%)	23 (26.2%)
Nano materials used in dentistry are beneficial?	54 (61.9%)	13 (14.3%)	21(23.8%)
Nano materials used in dentistry are antimicrobial?	25 (28.6%)	36 (40.5%)	27 (31.0%)
Are nano materials more durable?	38 (42.9%)	23 (26.2%)	27 (31.0%)
Are nano materials lightweight?	49 (56.1%)	9 (9.8%)	30 (34.1%)
Are you familiar with the term nanorobots?	6 (7.3%)	82 (92.7%)	0/(0%)

TABLE 2: UTILIZATION OF NANOMATERIALS IN CLINICAL PRACTICES

Variables	Frequency (Yes %)	(No %)	(Maybe %)
Do you agree that there is any possibility of its practical application?	71(81.0%)	4(4.8%)	13(14.3%)
Have you utilized nano materials in your clinical practice?	15(17.5%)	70(80.0%)	3(2.5%)
Have you placed any dental nano implants in your patients?	0(0%)	84(95.0%)	4(5.0%)
Do you use nano composite?	26(29.3%)	56(63.4%)	6(7.3%)
Is your patient satisfied with the use of nano materials?	29(32.5%)	26(30%)	33(37.5%)

TABLE 3: ATTITUDE TOWARDS ITS APPLICATION

Variables	Frequency (Yes %)	(No %)	(Maybe %)
Have you studied nano materials in dental course?	4 (4.9%)	82 (92.7%)	2 (2.4%)
Have you attended any lecture on nanotechnology?	19 (22.0%)	67 (75.6%)	2 (2.4%)
Are you aware of developments in dentistry world over?	28 (31.4%)	58 (65.9%)	0 (0%)
Do you consider inclusion of nanodentistry as a subject?	77 (87.8%)	9 (9.8%)	2 (2.4%)
Any recommendation	0 (0%)	0 (0%)	0 (0%)

DISCUSSION

Given that nanotechnology is one of the most popular emerging sciences, it has a very promising future. A lot of research is taking place around the globe in this area and a number of studies being undertaken. It was concluded in a study by Abiodun-Solanke et al.[12] that Nanotechnology is foreseen to change health care in a fundamental way. It forms the basis of novel methods for disease diagnosis and prevention. It will be useful in therapeutic selection tailored to the patients profile and will come in handy in drug delivery and gene therapy. However, very little knowledge and understanding exists in this connection amongst the dental professionals reviewed in this study. Since the concept of nanotechnology was introduced in 1959 by Richard P Feynman, however, the history of nanotechnology is dotted with a certain amount of skepticism. Sneha S. Mantri et al believes firmly that this is a brand new form of scientific evolution that did not develop until the late 1980s or early 1990s.[13] Overall, survey respondents were unfamiliar with nanotechnology and viewed it as personally unimportant. According Kathleen M. Rose paper, it was concluded that overall survey respondents were unfamiliar with nanotechnology and viewed it as personally unimportant.[14] According to their survey, respondents' attitudes toward nanotechnology were relatively ambiguous, with similar views of both risks and benefits. Despite the ambiguity, participants generally supported regulations and more supported the use of nanotechnology than did not. Lastly, although participants felt they were not informed about nanotechnology, they expressed an interest in learning more".

Mehdi Rahimpour et al highlighted that Iranian people like the residents of the above mentioned countries are anxious about nanotechnology products and expressed that using them needs being regulated by the governments so that people can rely on these products.[15] The study revealed that in other countries, similar studies also show that there is the anxiety about selling nanotechnology products freely. For example, 63% of American residents agree that until more is known about the risk of nanotechnology, the government should control its use, while this percentage among Canadians is 73%.

As per Cook AJ et al mentioned that in New Zealand, though more than 48% of respondents admit the use of nanotechnology, around 40% of people are anxious about its use.[16] As per Mallanagouda Patil etal explains that Nanodentistry will make possible the maintenance of near perfect oral health by employing nanomaterials, including tissue engineering, and ultimately, dental nanorobots.[17] Khoosla R states that new potential treatment opportunities in dentistry may include local anaesthesia, dentition renaturalization, and permanent hypersensitivity cure, complete orthodontic realignments during a single dental appointment, covalently bonded diamondised enamel, and continuous oral health maintenance using mechanical dentirobots, to destroy bacteria in the mouth that cause dental caries or even repair spots on the teeth where decay has set in, by use of computer to direct these tiny workers in their tasks.[18] Raybachuk AV et al is convinced that nanodentistry can help in creating artificial bone and teeths.[19] R Nutalapati etal concluded that nanodentistry will open a wide range of opportunities for the benefits

of both the dentist and the patient.[20]

The participants in this survey revealed that they were having some awareness of the nano technology as a science; however, they were not much confident about its application in dentistry. The skeptism towards nano dentistry future are not totally incorrect since the worldwide research and development also going through the phases of deep scrutiny which only helps in strengthening the cause for more research and study at all levels. People are not confident over the anti microbial properties of nano dentistry materials, their inherent strengths, and their inherent lightness. For example, nano implants are being advanced with the help of nano technology, however, only 5% participants replied that they may be using nano implants. The participants were not aware of the Nanorobot development or advancements in Nano implants/Nano composites. As an encouraging sign, almost all participants agreed upon the need of nano technology to be introduced as a subject in dentistry studies.

CONCLUSION

This study reveals that there is lack of awareness on Nanotechnology application in dentistry amongst the dentists at Dow University of Health Sciences. Nevertheless, despite lack of awareness on nanotechnology application in dentistry amongst dental fraternity at DUHS, there is a great amount of enthusiasm in learning nano technology and its application in dentistry since majority of the participants recommended its inclusion as part of the dental studies. Therefore, this study is just one step in that direction to emphasize on the need of realizing importance of knowledge, attitude and practice towards use of nanotechnology in dentistry. It is anticipated that the future dentist will see nanotechnology as an inalienable part of practice and efforts will enable to cope well in advance at all levels.

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1 Sarah Ali:	Concept of research, questionnaire design, data collection, write up of manuscript, data analysis, compilation and submission.
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3 Sofia Ali:	Assistance in data collection.
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