



## **Awareness about Nanotechnology among Upcoming Clinicians in Vidarbha, Maharashtra**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The making of new things at an incredibly small “nano” scale (100,000 times smaller than the human hair) is called nanotechnology and it is one of the most exciting and fast-moving technology in today’s world. Scientists and engineers have been working hard to make the maximum utilization of this knowledge towards applications like cure for certain diseases, to create certain renewable sources of energy and to bring human race safety into next millennium, thus nanomedicine being one of the most important evolution of nanotechnology.

In this research, we have done a cross sectional observation, knowledge, perception and attitude study among 56 residents of various clinical departments of Datta Meghe Medical College. According to our survey, it was evident that only 48.21% of the residents were aware of the science of nanotechnology. Television was the source for most of them to know about it. Approximately 35.71% knew the size of nanoparticles which is really low. Of all the residence who knew about nanotechnology, most of the (42.86%) them knew about its application in healthcare whereas comparatively less (28.57%) were aware of its applications in areas besides healthcare. As expected very few (14.29%) had practically used this advanced science in health care. And hardly

any knew about limitations or long-term side effects of nanotechnology in health care but most of them supported it.

With our limited analysis and discussion, we could conclude that awareness and knowledge about nanotechnology among residents who are our upcoming clinicians, was deficient in more than half of them and inadequate among those who had. Universities need to add this subject in their curriculums and have an interdisciplinary approach towards this recent advance so that all the medical students and upcoming clinicians have awareness and adequate knowledge regarding nanotechnology & nanomedicine which is going to be the future of medicine having significant impact on our health, comfort and lifestyle.

**Keywords:** *Nanotechnology; nanoparticles; nanomedicine; Alzheimers; atherosclerosis; diabetes; tissue engineering.*

## 1. INTRODUCTION

The term nanotechnology refers to ability to measure, manipulate and organize matter at atomic level. There are one billion nanometer (nm) in 1 m (just to compare we can say the width of one human hair is 80,000nm wide) [1]. If we are able to use this ability to create structures from the idea of one atom at a time, we can produce mechanisms with capacity far superior than current mechanisms or devices [2]. Studies have shown that the electrical, mechanical, optical, thermal and magnetic properties of these nanoparticles are very different than its bulk material [3].

Scientists and engineers have been working hard to make the maximum utilization of this knowledge towards applications like cure for certain diseases, to create certain renewable sources of energy and to bring human race safety into next millennium [4]. As the world moves ahead there are many people who believe that we have to move ahead in the digital era and not the atomic era and the same group of people think that they can manage to move ahead with minimum understanding and application of nanoparticles [5].

The knowledge of risks of nanoparticles and how it would regulate the society's development with its application is a matter of concern [6]. Specifically many incremental and desperate targets to produce what is now competent and functional nanotechnology industry that is focused to grow to produce millions of dollars, in coming decades. Have been attempted without proper guidance without keeping in consideration human and animal life cycles, environmental health risks and social impacts of this technology [7].

We all are aware of how unique and useful nanotechnology and its application as

nanomedicine are. The European Science Foundation (ESF) defined nanomedicine as "the science and technology of diagnosing, treating, preventing disease and traumatic injury, of relieving pain, of preserving and improving human health, using molecular tools and molecular knowledge of the human body" The use of nanotechnology has become common in the treatment of cancer, Alzheimer's, atherosclerosis, diabetes, tissue engineering, treatment of infectious disease and many more [8]. But we also need to assess and identify the risk imposed by nanotechnology before it comes into medical and non-medical market. The biggest challenge for this technology is lack of understanding among students. The matter of concern is not the scientific basis of this subject, but the doctor's knowledge and doubts in projected applications of nanotechnology. [9,10]

Besides the people who are into scientific forums, the knowledge about nanotechnology among general medical fraternity is quite low. Unless we are aware of complete information about nanotechnology, it is not possible to judge and opine regarding the application of nanotechnology in favour of best interest of humans. As we see medical applications are the most innovative, interesting but at the same time most controversial applications of all, for instance efficient drug delivery systems, diagnosis and treatment of diseases etc. Its other applications include those in military like advanced weapons, newer energy resources, in electronics like smaller and smarter electrical devices. These hi-tech applications have the power to drastically affect our future in terms of health, comfort and environment, thus being a hotspot of concern from the scientific universities.[11,12]

## 2. MATERIALS AND METHODS

This study was conducted in Datta Meghe Medical College & Shalinitai Meghe hospital and

research centre, where 56 residents from the department of Medicine, Psychiatry, Dermatology, General Surgery, Orthopaedics, Ophthalmology, ENT, Paediatrics and obstetrics & Gynaecology were assessed. All of them were given a questionnaire on knowledge and concepts of nanotechnology and answers were assessed. This type of questionnaire was distributed for the first time among the residents

of Datta Meghe Medical college, it included 8 questions to understand their conceptual and scientific knowledge.

### 3. RESULTS

We collected our data and analysed the data as a balanced figure in a percentage of application. We transformed all our data using basic statistical analysis package.

#### Questionnaire on Awareness of Nanotechnology in healthcare

Name:

Age:

Sex:

Specialty:

1: Do you know what is nanotechnology?

Ans: Yes /no

2. From where did you know about nanotechnology?

Ans: Teachers, television, newspaper, Journal/books, social media, friends and others?

3. What is the size of nanoparticles?

Ans: 10<sup>-2</sup>, 10<sup>-6</sup>, 10<sup>-9</sup>, 10<sup>-12</sup> meters

4. Do you know about the applications of nanotechnology in health care?

Ans: Yes/no

5. Do you know the applications of nanotechnology elsewhere besides health care ?

Ans: Yes/no

6. Have you used nanotechnology in health care?

Ans: Yes/no

7. Are you aware of the limitations/long term side effects of nanotechnology in health care?

Ans: Yes/no

8. Do you support nanotechnology?

Ans .Yes/no

**Table 1. Responses as per questionnaire**

Question (science concept)	Possible responses	Percentage of who provided responses (n = 56)
Do you know what nanotechnology is	Yes	48.21% (n=27)
	No	51.79% (n=29)
Where did you hear about nanotechnology	JOURNAL/BOOKS	7.14% (n=4)
	SOCIAL MEDIA	10.71% (n=6)
	TEACHERS	5.36% (n=3)
	TELEVISION	21.43% (n=12)
	NOT APPLICABLE	55.36% (n=31)
The size of the nanoparticle is	10 <sup>-9</sup>	35.71% (n=20)
	10 <sup>-12</sup>	5.36% (n=3)
	10 <sup>-6</sup>	8.93% (n=5)
	NOT APPLICABLE	50% (n=28)

Do you know about the applications of nanotechnology in health care	Yes	42.86% (n=24)
	No	57.14% (n=32)
Do you know the applications of nanotechnology elsewhere besides health care?	Yes	28.57% (n=16)
	No	71.43% (n=40)
Have you used nanotechnology in health care?	Yes	14.29% (n=8)
	No	85.71% (n=48)
Are you aware of the limitations/long term side effects of nanotechnology in health care?	Yes	8.93% (n=5)
	No	91.07% (n=51)
Do you support nanotechnology?	Yes	48.21% (n=27)
	No	51.79% (n=29)

According to our survey, it was evident that only 48.21% of the residents were aware of the science of nanotechnology. Television was the source for most of them to know about it. Approximately 35.71% knew the size of nanoparticles which is really low. Of all the residence who knew about nanotechnology, most of the (42.86%) them knew about its application in healthcare whereas comparatively less (28.57%) were aware of its applications in areas besides healthcare. As expected very few (14.29%) had practically used this advanced science in health care. And hardly any but not surprisingly knew about limitations or long term side effects of nanotechnology in healthcare. It was good to know that everyone who knew about nanotechnology appreciated it and supported it.

#### 4. DISCUSSION

The subject of nanotechnology is increasing diverting attention of most of the universities due its varied applications in medical science, artificial intelligence, sources of energy and military area. In medical science its uses and advantages being varied from diagnostic to therapeutic importance. Since nanotechnology's introduction in medicine, many concepts and methods of treatment have changed. As per our study in which we assessed 56 residents working in various departments of Shalinitai Meghe hospital and research centre ,we analysed that of all the residents, only 48.21% of the residents were aware of the science of nanotechnology. Television was the source for most of them to know about it. Approximately 35.71% knew the size of nanoparticles which is really low. Of all the residence who knew about nanotechnology, most of the (42.86%) them knew about its application in healthcare whereas comparatively less (28.57%) were aware of its applications in areas besides healthcare. As expected very few (14.29%) had practically used this advanced science in health care. And hardly

any but not surprisingly knew about limitations or long term side effects of nanotechnology in healthcare.

This proves that grossly only half of our upcoming clinicians are aware of nanotechnology and less than that of them have gone into the science, applications and disadvantages of it. Most of them whatever knowledge they have, was received from social media rather than journals or universities. Less number of people knew about the size of nanoparticles conveying that not many residence payed attention to the science that elements are building blocks of any matter, and interests should be shown by science students in atoms and its sizes. Many of them did not that it is a universal science and had varied applications besides medical fields. Considering the small number pf people who had practically used nanotechnology in their practices, the significantly low number of upcoming clinicians knowing about the risks or disadvantages can be very well explained. But we were definitely glad to know that those who were aware of nanotechnology supported it.

In end, the complicated nanoparticles in medical science referred to on this take, gives us a subtle insight in the upcoming responses, yielding greater perception into scholar gaining knowledge of approximately nonmedical topics. Leveraging this work, future research should optimize the contributions of quantitative analyses of student overall performance of college students 'written responses in therapeutic software based on nanomedicine. Subsequently, destiny research studies can make a contribution to the sector via supplying greater details. Approximately technology mastering and the supports vital to help students increase a deep knowledge approximately essential technology subjects that affect society with new era and therapeutic utility.

## CONCLUSION

Nanotechnology is increasing used term in medicine, surgery and biology, while developers are developing new ways and modern techniques to use nanoparticles to their advantages. The problem with using this technology in medical applications is that some people are not even sure of what they should expect from nanotechnology or what it can do, but the fact is that it has great impact on these areas. As we analysed the knowledge and perception and attitude of our residents towards nanotechnology, especially nanomedicine, it was not surprising but annoying to find that less than half of our residents, who are upcoming clinicians were aware about the science of nanotechnology, its impact on medicine & future and its risk.

Predictions state that nanomedicine can revolutionise healthcare system by enabling more personalised, predictive, preventive, regenerative and even more remote (tele) medicine. Around 800 nanomedicine products are available in the global market and even more in phase I,II and III trail all over.

Indian government has made strategic rule in nanomedicine based formulations in October 2019. Only few prominent universities like IITs, IISc Bangalore, INST Mohali, IISERs, CSIR laboratories and few prominent hospitals are actively involved in nanomedicine research and trying to commercialise their achievements. We do not have dedicated institutes for nanotechnology due to practical limitations and lack of awareness. We need interdisciplinary courses, strong interaction between academicians, technicians & clinicians, state of art infrastructure, strict ethic rules and regulations for approval of health care related products.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

Ethical clearance taken from institutional ethics committee & preserved by author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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