

NANOROBOTICS: A BOOMING TREND IN PHARMACEUTICAL INDUSTRY

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ABSTRACT

Health care enterprise is greater centred on enhancing the quality of medical treatments through growing minimally invasive strategies for diagnosis and along with the assist of recent advances in the discipline of nanotechnology. Nanotechnology through nanorobotics gives full-size blessings over the traditional techniques for diagnosis and treatment, exactly due to the expertise received from converging domains like molecular biology, chemistry, and physics at the nanometer scale. Nanorobots are charming nanodevices for the implementation of superior biomedical instrumentation. Reliable applications for nanorobotics in medication encompass early diagnosis and centred drug transport for cancer, arteriosclerosis, tissue engineering, dental surgery, pharmacokinetics tracking of drug

transport, cell help in inflammatory responses, and lots of others. This review article describes a few principles about the design, mechanism, and type of nanorobots, especially focusing on the medical applications of these promising nanodevices.

KEYWORDS: Nanorobots, Nanotechnology, Nanomedicine, Biohybride nanorobots and DNA nanorobots.

HISTORY

The first observations and length measurements of nanoparticles had been made at some point of the primary decade of the twentieth century with the aid of using Zsigmondy, 1914.^[1] In 29 December 1959 talk "There's Plenty of Room on the Bottom," the overdue Nobel physicist Richard P. Feynman proposed using gadget equipment to make smaller gadget equipment, those for use in flip to make nonetheless smaller gadget equipment and so

forth all of the manner right all the way down to the atomic level. Later in his anciantal lecture in 1959, Feynman taken into consideration the opportunity, in reference to organic cells, that we will manufacture an item that maneuvers at that level.^[2] Eric Drexler, in 1986 posted a technical paper suggesting that it is probably viable to construct, from organic parts, nanodevices that would investigate the cells of a living man or women and keep on upkeep inside them. Dr. Eric Drexler has posted the book Engines of Creation: The Coming Era of the nanotechnology. He expected the nanorobots as self replicating. The first book on the nanotechnology.^[3]

INTRODUCTON

Nanorobotics is rising as a demanding field dealing with miniscule things at molecular level, and it's specially used for medical applications. Nanorobotics are created for brand spanking new mechanism and human shielding device. They have a nanoscale dimension of 1-100nm. The section where in the ever-lowering length of operation is the improvement of nanotechnology, where researchers are able to work on the scale of nanometers. Nanotechnology is a aggregate of chemistry, physics, science, and biology, that has added collectively the desired want to develop novel technologies.^[4,5]

Nanorobts has successfully changed the strength supply into kinetic power. Three groups of powered nanorobots are specially described. Biohybrid systems combine artificial nanostructures with motile microorganisms as the engine of the nanorobots. Chemically powered nanorobots use uneven catalytic engines to selectively convert chemical fuels into locomotion. Physically powered nanorobots convert external energy inputs (e.g., magnetic, ultrasound, or light fields) into translational motion based on engine geometry and material. Atomic force microscope is an tool which can be taken into consideration as nanorobotics tool designs. Nanorobotics has excellent applications in the field of science and technology.^[6,7] Nano robots could carry and deliver drugs into defected cells. These nanorobots could be capable of restore tissues, clean blood vessels and airways, rework our physiological capabilities and even probably counter act the growing older process. Nano robots promise from removing sickness to reversing the aging process. They will offer customized treatments with stepped forward efficacy and decrease aspect consequences that are not available today.^[8]

Ideal characteristics of nanorobots

- They lie within the side length variety of 0.5 to 3 microns with 1-100 nm parts; else they could block capillary flow.
- Nanorobots save itself from being attacked via way of means of the immune gadget via way of means of having a passive, diamond exterior.
- It has the functionality to speak with the health practitioner via way of means of encoding messages to acoustic alerts at provider wave frequencies of 1-100 MHz.
- It can produce more than one copies of it to update tired units, a method referred to as self-replication.^[9]

TYPES OF NANOROBOTS

Pharmacyte: The pharmacyte is a nanorobot of 1-2 μm in size. Depending on venture requirements, the payload saved in onboard tanks of nanorobotics device may be discharged into the proximate extracellular fluid or brought without delay into the cytosol using a transmembrane injector mechanism.

Respirocyte: It is an Artificial Oxygen Carrier nanorobot. The strength is furnished with the aid of using endogenous serum glucose. This synthetic cell is capable of deliver 236 instances extra oxygen to the tissues per unit volume than RBCs.

Microbivores: It is an oblate spheroidal tool for nanomedical programs with 3.4 μm in diameter alongside its major axis and 2.0 μm in diameter alongside its minor axis. The nanorobot can eat as much as 200 pW. This strength is used to digest trapped microbes.

Clottocytes: This is a form of nanorobot, with a completely unique organic capability: They usually supply materials that assist to sell coagulation.

Chromalloyte: The Chromalloyte might update complete chromosomes in person cells for this reason reversing the outcome of genetic disorder and different collected harm to our genes, stopping aging.^[10]

COMPONENT

The substructures in a nanorobot encompass.

Payload: This is a void phase that holds a small dose of drugs or medicine. It can transverse withinside the blood and launch the drug to the site of infection or injury.

Micro Camera: The nanorobot may also encompass a miniature camera, and it could be found while navigating through the frame manually.

Electrodes: The electrode set up on the nanorobot should shape the battery through the usage of electrolytes in the blood. These sticking out electrodes can kill the most cancer cells through producing an electric powered modern-day and heating the cells up to death.

Lasers: These lasers can burn the dangerous fabric like arterial plaque, blood clots, or cancer cells.

Ultrasonic Signal Generators: These turbines are used while the nanorobots are used to goal and damage kidney stones.^[6,11]

Swimming Tail: By propulsion, nanorobots get into the frame. The motor is used for motion and manipulator palms or mechanical legs for mobility. They manipulate layout is the software program advanced for simulating nanorobots in an surroundings with fluids that's ruled via way of means of Brownian motion. The nanorobots have chemical sensors to stumble on the goal molecules. The 3 principle forms of swarm intelligence strategies designed are ant colony optimization (ACO), artificial bee colony (ABC), and particle swarm optimization (PSO). Structurally it has consisted of molecular sorting rotor, propellers, fins, and nanosensors.^[11]

MECHANISM OF ACTION

As included manipulate mechanisms at microscopic environments vary from traditional manipulate strategies, methods the usage of event-primarily based totally feed ahead control are sought to correctly increase new scientific technologies. The use of the micro gadgets in scientific treatments & surgical treatment is the truth which has introduced the numerous upgrades in the medical procedures in the current years. For the intracranial & coronary heart surgical treatment the catheterization has been used successfully as the critical methodology. Now the appearance of the bimolecular science & new production strategies is assisting us to increase a miniaturization of the gadgets from the micro to the nano electronics. The biomedical sensors are being operated by a latest technology which forms a basis for the designing bimolecular actuators.^[12] The powering of nanorobots is predicted to be achieved through the metabolism of: Local glucose, Oxygen, Externally furnished acoustic energy. Communication with the tool may be acquired through acoustic signaling navigational

network established withinside the body. When the project of the nanorobots is completed, they can be retrieved through letting them to effuse themselves through the same old human excretory channels.^[13] Nanorobots might use precise motility mechanisms to move slowly or swim through human tissues with

1. Navigational recession
2. Cytopenetration
3. Use any of multitudes of techniques to monitor, interrupt, or regulate nerve impulse site visitors in individual nerve cells.

MANUFACTURING OF NANOROBOTS

The capacity to fabricate nanorobots can also additionally end result from present day tendencies and new methodologies in fabrication, computation, transducers and manipulation. Complementary metal oxide semiconductor (CMOS) very huge scale integration structures layout the use of deep ultraviolet lithography offer excessive precision and a business manner for production early nanodevices and nanoelectronics systems.^[13]

A] Chemical sensor:- Chemical nanosensors may be embedded withinside the nanorobot to screen E-cadherin gradients. Thus, nanorobots programmed for this type of challenge could make an in depth screening of the affected person entire body, it makes use of electromagnetic waves to command and discovered the contemporary reputation of nanorobots inside the patient.^[14]

B] Power supply:- The use of CMOS for energetic telemetry and strength deliver is the simplest and stable manner to make certain strength so long as essential to preserve the nanorobot in operation. The equal approach is likewise suitable for different function like digital bit encoded record switch from interior a human body. Thus, nanocircuits with resonant electric powered houses can function as a chip imparting electromagnetic strength providing 1.7 mA at 3.3 V for electricity, permitting the operation of many obligations with few or no considerable losses in the course transmission

C] Data transmission:- The software of gadgets and sensors implanted in the human body to transmit facts approximately the fitness of sufferers can offer top notch blessing in non-stop scientific monitoring. Most recently, the usage of RFID for in vivo statistics amassing and transmission became efficaciously examined for electroencephalograms (EEG). For verbal exchange in liquid workspaces, relying on the application, acoustic, light, RF and chemical

signals can be taken into consideration as feasible selections for communication and data transmission.^[15]

SIMULATION

The use of micro devices in surgical procedure and scientific remedy is a fact which introduced many enhancements for scientific tactics withinside the previous few years. For example, the catheterization has been used as an crucial method for lots cardiology approaches in the equal manner because the improvement of micro technology. Nano robotic consists of external sensors to tell it of collisions and to discover while it has encountered a chemical signal or abrupt modification of temperature for centered areas so as to simulate diverse ranges of inflammation, it turned into used for one of a kind wall temperatures in the atherosclerotic plaque area and the temperature distribution in the stenosed coronary artery was calculated. Significant temperature gradients have been discovered withinside the recirculation zone, following the stenosis. The Trans cardiac awareness gradient of a few soluble adhesion molecules has been these days discovered to be correlative with the development of coronary atherosclerosis. Therefore, their awareness in the blood vessel is likewise monitored, the use of a uniform distribution launch from the plaque. The Nano robots swim in a near-wall area trying to find the atherosclerotic lesion. The atherosclerotic lesion turned into decreased because of Nano robot's activation. Nano robot need to carry out a pre- described mission in a selected goal area, the cause should be activated while the Nano robot is as near as feasible to the goal. The Nano robot movement takes the benefit of the blood go with the drift pace profile in such areas, which indicates considerably decrease velocities. Thus, the fast activation should bring about decrease demand of energy. The investigated stenosis artery fashions offer crucial data beneficial to Nano robot production design in phrases of sensors and actuators. The Nano robot's activation aim is to lower the artery occlusion.^[16]

APPLICATION OF NANOROBOTS IN MEDICAL FIELD

Nano robots are predicted to allow new remedies for sufferers affected by unique diseases, and could bring about wonderful boost withinside the records of medicine. Nanotechnology has furnished the opportunity of handing over drugs to precise cells the usage of nanoparticles. Examples of life-threatening situation that might be screened for consist of brain aneurysms, cancers and not using modern-day screening protocols such as lung cancer, and risky atherosclerotic lesions.

1] Nanorobots in dentistry

Nanorobotic in dentifrices is used to introduced both through mouthwash or toothpaste, can cover all subgingival surfaces, thereby metabolizing trapped natural count into innocent and odourless vapors. Properly configured dentifrobots can pick out and ruin pathogenic microorganism that exist in the plaque and elsewhere. These invisibly small dentifrobots are in basic terms mechanical devices that adequately deactivate themselves while swallowed. To maintain of oral hygiene mouthwash complete of clever nanorobots may want to pick out and ruin pathogenic bacteria at the same time as permitting the innocent vegetation of the mouth to flourish in a healthful ecosystem. Further, the devices could pick out debris of food, plaque, or tartar and raise them from the teeth to be rinsed away. They save your enamel decay and offer a non stop barrier to halitosis. To put together and repair hollow space. Multiple nanorobots painting at the enamel in teeth in unison, invisible to the bare eye, can be used for hollow space practice and restoration of teeth. Nanarobots used to induce anesthesia, is a colloidal suspension containing millions of energetic analgesic micron length dental nanorobots might be mounted at the patient`s gingiva. After contacting the floor of the crown or mucosa, the ambulating nanorobots attain dentin through migrating into the gingival sulcus and byskip painlessly through the lamina propria. Upon achieving the dentin, input the dentinal tubules and continue towards the pulp below nanocomputer control. Thus, the migration of nanorobots from the enamel floor to the pulp happens in 100 sec. Once established withinside the pulp, they setup manage over nerve impulse, analgesic nanorobots commanded through the dentist close down all sensitivity in any unique tooth requiring remedy.^[17]Nanorobots assist in accomplishing the therapeutic effects of the drug. Drugs are loaded with nanoparticles with a view enhance the properties of the drug such as sustained release and powerful low dosage. It may be beneficial in nearby drug delivery systems for treating periodontitis.^[18]Use of nanorobots in approaches inclusive of root canal fillings or in the treatment of contamination is likewise plausible. Nanorobots can be enveloped in particularly unique proteins to bind the focused pathogens for the treatment of contamination. For a system inclusive of a root canal, using a minute digital camera can offer visualization of the root, reducing any guesswork. Nanorobots can probably growth the fulfillment charge of root canal approaches.^[19]

2] HEMATOLOGY

Uses ranging to emergency transfusions of non-blood oxygen sporting compounds to restoring number one hemostasis, there's a big selection of programs below take a look at for

nanorobotics in hematology. One of those devices presently below layout is a nanorobot dubbed a respirocyte. This robotic is prepared to have 3 features because it travels via the bloodstream. First, amassing oxygen because it passes via the respiratory system for distribution at some stage in the bloodstream. Second, amassing carbon dioxide from tissues for launch into the lungs. And finally, metabolizing circulating glucose to energy its personal features. The respirocyte is designed to hold 236 instances extra oxygen consistent with unit of quantity as compared to red blood cells. Development and use of this era ought to offer an powerful and decrease danger opportunity to blood transfusions. Hemostasis is an advanced method related to numerous steps with some of promoters and inhibitors balancing thrombosis and fibrinolysis. When hemostasis works appropriately, it could be very powerful in halting bleeding and selling vessel repair. While there's an impairment of our physiologic hemostatic mechanisms, which include with thrombocytopenia. Patients present process platelet transfusions danger contamination with pathogens and the capability of triggering an immune response. The proposed nanorobot for this characteristic has been termed an synthetic mechanical platelet, or “clottocyte. Finally, some other capability use of nanorobots on this area is as phagocytic agents. These nanorobots were termed “Microbivores.” These robots could be designed to have a large range of customizable binding sites on their outside surface, for antigens or pathogens for some thing from HIV to E.Coli. Microbivores are theorized to be as lots as eighty instances extra powerful than our physiologic phagocytic capabilities, and will have the capability to clean septicemia inside hours of administration.

3] TREATING ARTERIOSCLEROSIS

Arteriosclerosis refers to a situation wherein plaque builds alongside the walls of arteries. Nanorobots could conceivably deal with the situation via way of means of reducing away the plaque, which could then input the bloodstream. Nanorobots might also additionally deal with situations like arteriosclerosis by bodily chipping away the plaque alongside artery walls. Breaking up blood clots and Helping the body clot: Blood clots can purpose headaches starting from muscle demise to a stroke. Nanorobots ought to journey to a clot and damage it up. The robotic need to additionally be small sufficient in order that it do. One specific form of nano-robotic is the clottocyte, or synthetic platelet. The clottocyte incorporates a small mesh internet that dissolves right into a sticky membrane upon touch with blood plasma.^[20]

4] GENE THERAPY

By evaluating the molecular systems of each DNA & proteins determined in the cell to the regarded or the preferred reference systems the medically nano robots can effortlessly deal with the genetic illnesses. The floating interior a nucleus of the human cellular, an assembler constructed restore vessel plays a number of genetic maintenance. The stretching the extraordinary coil of the DNA among its lower pair of the robotic arms, the nano device lightly pulls a unwound strand via the outlet in its prow for the analysis. Meanwhile the top arms detach the regulatory proteins from the chain & area them withinside the consumption port. The molecular systems of each the DNA & proteins are in comparison to the facts that is saved in a database of the bigger nano laptop that is placed out of doors the nucleus & is attached to a cellular-restore deliver via way of means of the communications link. The Irregularities found in both shape are then corrected & the proteins reattached to the chain of DNA which re-coils into its authentic shape with the diameter of the only 50 nanometers a restore vessel could be smaller than the maximum of the viruses & micro organism but it's miles able to the therapies & cure well. The ailment could be attacked at a molecular level & such maladies because the viral infections, arteriosclerosis & most cancers may be wiped out. Most of the human illnesses contain the molecular malfunction at a cell level & cellular characteristic is managed in large part via way of means of the gene expression & its ensuing protein synthesis. One of the not unusual place exercise of the genetic remedy which has loved handiest restricted achievement is to complement the prevailing genetic cloth via way of means of placing the brand new genetic cloth right into a cellular nucleus typically the use of the viral bacteriophage bacterial gadget cellular plasmid/phospholipid microbubble cationic liposome, the dendrimeric, chemical, the nanoparticulate or the alternative suitable switch vectors to breach the cellular membrane.^[21]

5] Nanorobots In Diagnosis and Treatment of Diabetes

The glucose that's carried through the blood movement is essential to keep a human metabolism running healthfully & it's accurate stage is the important thing problem in the diagnosis & treatment of the diabetes. The protein hSGLT3 has the essential have an impact on in retaining the right GI[Gastrointestinal] cholinergic nerve & skeletal muscle feature sports regulating the extracellular glucose awareness that's intrinsically associated with the glucose molecules. The hSGLT3 molecule can serve to outline the glucose ranges for the diabetes patients. A simulated nanorobot prototype version has embedded CMOS [Complementary Metal Oxide Semiconductor] nanobioelectronics. The nanorobot makes use

of the embedded chemosensor for the glucose monitoring, that includes the modulation of the hSGLT3 protein glucosensor activity. The nanorobot can consequently correctly decide through its on board chemical sensor, if a affected person desires to inject the insulin or to take any similarly motion which include any medicine that's clinically prescribed. The photograph of a NCD simulator workspace indicates a interior view of the venule blood vessel with the grid texture, RBCs [red blood cells] & nanorobots. They waft with the RBCs through a bloodstream detecting the extent of glucose. The nanorobots try and preserve the extent of glucose ranging round a hundred thirty mg/dl because the goal for the BGLs [Blood Glucose Levels], at the everyday glucose concentration.^[21]

6] Nanorobots In Surgery

Surgical Nano robots may be introduced into the body through the vascular system or at the ends of catheters into numerous vessels and alternative cavities within the body a surgical nanorobot, programmed or guided by an individual's surgeon, may act as a semi-autonomous on-the-spot surgeon within the body. Such a tool may perform numerous functions like checking out pathology so designation and correcting lesions by Nano manipulation, coordinated by associate degree on-board computer whereas maintaining contact with the management surgeon via coded ultrasound signals.^[22] Neurosurgery is unambiguously suited to profit from several of the innovations engineering science has got to provide. These advantages include improved detection of pathology, minimally invasive intracranial watching, and pharmaceutical delivery, amongst several others. One of the simplest approaches to save from morbidity and mortality within the field of operation is that the treatment of cerebral aneurysms before rupture. Rupture of a cerebral aneurysm yields a high fatality rate. Nanorobotics will gift a possible choice for screening for a brand new cardiovascular disease, or nearer watching of associate degree known cardiovascular disease. Cacalcanti et al have planned a style for associate degree intravascular nanorobot with the functionality to come across aneurysm formation by detecting magnified levels of nitric oxide synthase protein among the affected blood vessel. These nanorobots is given the functionality to wirelessly communicate information concerning pertinent vascular changes to worry suppliers, probably decreasing screening prices of imaging and frequent follow up visits. Significantly, developing the platform needed for this device will alter horizontal enlargement of the thought for several alternative uses, like neoplasm detection or anemia changes.^[23]

A] Bypass Surgery

People with coronary artery sickness are unit treated by doing heart bypass surgery. This is often achieved to extend the flow of blood to the heart muscles. More than one artery is bypassed throughout the operation, however this methodology isn't empty aspect effects. Instead, a nanorobot may be used to operate. The nanorobot is containing 2 regions that is outer region and an inner region is connected with an electrical motor for its circulation. In conjunction with the electrical motor an artery thermometer, a micro chip, a camera, and a revolving needle is incorporated into it. The micro chip will manage the whole operation. Radioactive material is infused into the outer region to trace the movements of the nanorobot. This can be switched anytime employing a magnetic switch. The caused nanorobot can reduce out the plaque and grind them into micro particles. After the action is over it's removed by leading the nanorobot to anchor to a blood vessel that's simply accessible from outside.

B] Delicate Surgeries

Immense hazard is concerned within the delicate surgeries of eyes, and that they need a gentle hand and powerful constitution. Microsurgery of the eye, in addition to surgical procedure of the retina and surrounding membranes, may be accomplished the use of nanorobots. Also, rather than injecting directly into the eye, nanorobots may be injected elsewhere within the body, which are going to be guided to the eye to deliver medication, if necessary. Another example of delicate surgery is craniate surgery. It's risky because of the high fatality rate of either the baby or the mother. It will attain a 100% success rate as nanorobots will offer higher access to the desired space causing minimum trauma.^[23]

7] Nanorobots In Kidney Disease

Nanorobots can be used to interrupt the kidney stones through ultrasonic shocks. Kidney stones cause immoderate ache and large stone shaped does not pass out in the urine. Nanorobot works to interrupt the stones in small pieces, which can pass out through urine.

8] Nanorobots In Gout

Gout is a situation wherein the kidneys lose the capacity to eliminate waste from the breakdown of fats from the bloodstream. Nanorobots offer remedy from the sign and symptoms by breaking up the crystalline structures at the joints, although they aren't capable of opposite the situation permanently.^[24]

9] Nanorobots In Tissue Reconstruction

Nanoparticles with Nano-robots can be designed in one of this manner that it resembles the bone shape. An ultrasound is accomplished on present bone structures, after which bone like nanoparticles are created the use of the consequences of the ultrasound. When they come at the fractured bone, they collect to shape a structure that will become part of the bone. So, such programs will useful in case of bone fractures, arthritic conditions *etc.*

10] Application of Nanorobots In Cancer Treatment

Nanotechnology has already proven and awful lot of promise in enhancing the control of most cancers. Increasing the sensitivity of most cancers imaging equipment 50, overcoming drug resistance, and progressed treatment of metastasis are few examples of nanoparticle technology's growing role.^[25]

Nanorobots with chemical biosensor (nanosensor) are used for detecting the tumors cells in the early degree of most cancer improvement. This Nano sensor will experience the presence of malignant cells in the body. Nanorobots with embedded chemical biosensors may be used to carry out the detection of tumor cells in the early stages of improvement in the affected person's body. Integrated nanosensors may be applied for this sort of undertaking with a purpose to discover the depth of E cadherin signals. Therefore, a hardware structure primarily based totally on nano bioelectronics is defined for the application of nanorobots for cancer therapy. The scientists have genetically changed salmonella bacteria which can be interested in tumors through chemical compounds secreted by cancer cells. The bacteria carry microscopic robots, about 3 micrometers in size that robotically launch pills full of capsules while the bacteria reach the tumor. By handing over drugs immediately to the tumor, the nanorobot, which the team named bacteriobot, attacks the tumor while leaving healthy cells alone, sparing the patient from the side effects of chemotherapy.^[26]

This nanorobot has been build using engineered DNA strands which have been made to fold right into a preferred tertiary structure. Upon binding the desired target, the conformation of the DNA nanorobot undergoes a structural reconfiguration and shifts from a closed to an open state, freeing the saved therapy. The concept of an independent nanorobot circulating through the bloodstream with the capacity to selectively launch treatment only in the essential areas. This may be executed through a nanorobot constructed of artificial factors, in contrast to the biological elements of a DNA nanorobot.^[27]

1] Applications of DNA Nanorobot in Treatment of Cancer

DNA nanorobot may be used as a focused drug transport system to enhance medical treatments. There are many chemotherapy drugs which can be designed to kill fast-dividing cells. But the real reality is fast-dividing cells now no longer include cancer cells however encompass stomach lining, hair follicles, blood cells, etc. As chemotherapy drugs attack all of these fast-dividing cells, they normally result in numerous adverse effects like nausea and vomiting, hair loss, low blood cell counts, etc. So, this is the primary limitation of chemotherapy drugs. It can be overcome by

- By stimulation of dying receptors causing apoptosis.
- Destruction of cancer cells by focused transport of anti-cancer drugs.
- By direct harm to the cancerous cells.^[28]

2] Delivery of Therapeutic and Imaging Agents for Cancer Therapy

Medical nanorobotics holds outstanding ability to supply drugs with a better degree of precision and velocity while in comparison to passive diffusion methods. In tumor therapy, the released drug may be externally triggered, permitting the nanorobotic platform to distribute a excessive quantity of the therapeutic agent in a localized vicinity of the tumor.

The implementation of nanorobots can enhance upon this technique by eliminating the need for the patient to be admitted a day prior to the technique and eliminating the chance of prostatitis related with the injection. Nanorobots might be administered intravascularly at some point of the procedure with the purpose to detect tumorous tissue margins and metastatic areas. The nanorobots then conglomerate at sites where tumor tissue is present, and send an electromagnetic localizing sign to the operating doctor for mapping.^[29]

11] Miscellaneous Applications of Nanorobots

The therapy for skin diseases, a cream containing nano-robots can be used. It should get rid of the proper quantities of dead skin and pores, get rid of extra oils, upload lacking oils, practise the proper quantities of herbal moisturizing compounds, and even acquire the elusive purpose of ‘deep pore cleaning ‘with the aid of using surely achieving down into pores and cleaning them out. The cream may be a clever material with smooth-on, peel-off convenience.

Nanomedicine

Potential applications for nanorobotics in medicine encompass early analysis and focused drug delivery for most cancer biomedical instrumentation, surgery, pharmacokinetics, tracking of diabetes, and health care in such plans, future medical nanotechnology is predicted to hire Nano robots injected into the affected person to carry out treatment on a cellular level. Such Nano robots supposed to be used in medicine must be non-replicating as replication could needlessly increase tool complexity, lessen reliability and interfere with the medical mission. Instead, clinical Nano robots are posited to be manufactured in hypothetical, cautiously managed. Nano factories wherein Nano scale machines could be solidly incorporated right into a meant desktopscale machine that could construct macroscopic product.

Disadvantage

- 1] Since those debris are very small, issue can surely rise up from the inhalation of those minute debris, similar to the issues a someone receives from breathing in minute asbestos debris.
- 2] Presently, nanotechnology may be very expensive and growing it may cost you a lot of money. It is likewise quite tough to manufacture, which might be why merchandise made with nanotechnology are more costly.
- 3] If the nanorobots are misused with the aid of using terrorists, it may also be used as bio-weapons and might end up a risk to the society.

CONCLUSION

This technology may sound like a fiction now, however Nanorobotics has robust capacity to revolutionize healthcare, to deal with sickness in future. It opens up new approaches for vast, considerable research work. Nanotechnology will alternate health care and human lifestyle extra profoundly than different developments. Consequently they will alternate the form of the industry, broadening the product improvement and advertising interactions among Pharma, Biotech, Diagnostic and Healthcare industries. Future healthcare will employ sensitive new diagnostics for an advanced personal risk assessment. Highest effect may be anticipated if the ones fundamental illness are addressed first, which impose the highest burden at getting older population: cardiovascular diseases, cancer, musculoskeletal conditions, neurodegenerative and psychiatric diseases, diabetes, and viral infections. Nanomedicine holds the promise to cause an in advance diagnosis, better therapy and

advanced complete with up care, making the fitness care greater powerful and affordable. Nanomedicine will even permit a greater personalised treatment for plenty diseases, exploiting the in-intensity knowledge of diseases on a molecular level.

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