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EDITORIAL

Nanoscale: a new era for health sector

Editor:
William Waissmann

"It was most suggestive, said Holmes. It has long been an axiom of mine that the little things are infinitely the most important."

Arthur Conan Doyle[1]

Two decades ago, Meirelles wrote a doctoral dissertation in which he analyzed the miniaturization of devices, evolution of human productive processes, and its association with the reduced need for socially necessary work[2]. Devices that are smaller, lighter, and easier to transport and that have more ingenious and particular characteristics have enabled gradual distancing from the sources of raw materials. Miniaturization has followed and partly induced the development of transformations in production, namely through changes in labor and social functional aspects. Device miniaturization has had an important role in increasing productivity of human labor throughout the centuries.

Materials have formed the base of these changes. The chronological system that divides European prehistory into ages on the basis of materials (stone, bronze, and iron) has enabled the understanding of the gradual development of new devices and the importance of materials in shaping the change of humans from hunters and gatherers to farmers and urban dwellers[3].

If it is possible to understand the role of silicon purification in the explosive and revolutionary era of information, **that we still live, we are in the beginning of a new era of domain**, with a potential power of social transformation but with qualitative differences over the previous eras.

At present, more than the type of materials, the size is capital per se. Nanoscale materials, approximately 1 to 100 nanometers, are more reactive and can exhibit many different characteristics of the large-scale versions of the same materials. This discovery of the "intimacy" of materials enables the development of devices, objects, and fabrics. The knowledge of its components, either by installing parts or shedding larger parts until the scale that allows the desired characteristic is obtained, has quickly attracted the interest of businessmen, scientists, politicians, agencies and other governmental institutions, non-governmental organizations, and consumers. Individuals who want a larger and faster development of nanotechnology products share this interest with those who advocate total halt of their production until their potential effects on health and the environment are best known.

These effects should be comprehensively analyzed. Their positive and negative effects should be examined, which involves knowing what they are. A great deal is already known on the subject; however, more knowledge is still required. Nanomaterials can interact with the inner environment of living organisms, depending on the characteristics inherent to the scale of the material itself. Many cellular components are nanoscale, thereby interacting more easily with nanomaterials; these structures include cellular and nuclear pores, proteins such as actin, tubulin (microtubules), hemoglobin, antibodies, various small proteins, membranes of cell and the Golgi complex (each one), tRNA, ribosomes, and plasmodesma[4]. If the scale enables the entry of nanomaterials in the body and cells and interaction with cellular components and molecules, substances can reach targets that are often unreachable without damaging the structures. Various applications have been developed, including contrasts using special nanomaterials; functionalized nanocapsules enabling targeted delivery of drugs; increased specificity and sensitivity of DNA, RNA, and proteins detection and other disease markers using nanosensors present in diagnostic, treatment, and follow-up tools (some for the simultaneous diagnosis of multiple conditions); and production of more specific vaccines. Although there is much to discover, the processes of materials and derived equipment production are undergoing a revolution which integrates, based on the complexes formed between nanomaterials and compounds or detected sites, the same production logic that is to be used in the various stages of illness; this is leading to the catapult of teradiagnosis[5], union of therapy, and diagnosis in the same productive and interdisciplinary sense.

However, the same arguments apply when we think of adverse consequences on health and the environment. Easier interactions can potentially have a distinct effect. By binding molecules and cellular components and by stopping or speeding reactions, they induce undesired toxic effects. Further knowledge on these effects is required. It has been established that nanoparticles enter the brain through the olfactory nerve, without even entering the bloodstream, and they can cause fibrillar and amyloid damage, damage DNA, alter chromosomes, interfere with chromosome movement, accumulate in the body, produce granulomas, induce inflammatory states and cytotoxicity through the production of oxygen reactive species, interfere with the immune and reproductive systems, promote hypercoagulability, and reduce vasodilatation. Most studies were *in vitro* experimental studies; with epidemiological approaches in its beginnings. It´s understood the effects depend on the characteristics of the nanomaterials, such as size, area, stability, chemical reactivity, and particle solubility[6]. The same effects of nanomaterials are a potential threat to the environment, although they are also effectively used to manage contaminated areas.

Increasing areas within the health sector are of interest. If benefits can came from nanomaterials, it shall involve more effective actions in prevention and toxicology, and encompass diverse fields of public health. Exposed workers would be the most at risk, which requires protection and follow-up measures to be analyzed. Consumers of nanoscale products, particularly general consumption products such as foods and medications, should be assured with regard to the quality of the products and information provided on the products, including the potential use of agrotoxic substances and other nanoscale agrochemical substances.

In any case, the development of nanomaterials should not disregard social, environmental, health, and safety effects as well as the potential ethical and legal implications of their use, which involves fostering the study of these topics[7]. There is urgent need for production control systems, standards, standardization procedures, and the vision that they have to be feasible in small- and medium-sized production plants, which are essential for the large-scale production of nanomaterials, which is expected to prevail in the 21st century[8]. Moreover, democratization of decisions and organized participation of the population in policy decisions that affect the general public are imperative.

These issues are all related to the milestones necessary for the regulation of nanotechnologies and nanomaterials and are essential for the health surveillance know-how in this emerging field.

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