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Nanomedicine: what's in a definition?

Welcome to the second issue of the International Journal of Nanomedicine (IJN)! Nanomedicine research is certainly international, as we try to emphasize in each and every issue of IJN. Over the next several issues, this editorial section will take a closer look at various aspects of international nanomedicine research. What a better place to start than its definition.

Although defining a term such as nanomedicine may sound simple, by comparing several main funding agencies from around the world, one quickly realizes that a uniform international definition of nanomedicine does not currently exist. This is typical of a new field, but can be problematic to those trying to understand the field, make significant contributions to it, and especially in how the public views nanomedicine. Clearly an established international gathering of nanomedicine experts would help establish an "internationally acceptable" definition and subsequent criteria for nanomedicine research.

For example, recently, the European Science Foundation (ESF 2004) took an extensive examination of the field of nanomedicine. The particular definition for nanomedicine that the Medical Standing Committee of the ESF compiled is "the science and technology of diagnosing, treating, and preventing disease and traumatic injury, of relieving pain, and of preserving and improving human health, using molecular tools and molecular knowledge of the human body" (ESF 2004). Further, they defined five main disciplines of nanomedicine: analytical tools; nanoimaging; nanomaterials and nanodevices; novel therapeutics and drug delivery systems; and clinical, regulatory, and toxicological issues. Compare and contrast these concepts with those presented on the United States' National Institutes of Health Roadmap for Medical Research in Nanomedicine (NIH 2006), in which nanomedicine is defined as "an offshoot of nanotechnology, [which] refers to highly specific medical interventions at the molecular scale for curing disease or repairing damaged tissues, such as bone, muscle, or nerve". Both reports emphasize that nanomedicine emerged from nanotechnology which is generally defined by the creation and use of materials at the level of molecules and atoms (sometimes specifically less than 100 nm, other times this dimension is more diffuse and confusing). The European report put it into simple terms where "the focus [of nanomedicine] is always on nanointeractions within a framework of a larger device or biologically with a sub-cellular (or cellular) system" (ESF 2004). This focus on elucidating nanoscale events may be one manner in which nanomedicine research separates itself from other medical research fields. But does it?

Specifically speaking, similarities in the numerous definitions of nanomedicine from around the world center on *molecular* events and this is where people (including scientists and clinicians) get somewhat confused. For example, many researchers in the medical fields (such as biology, anatomy, pathology) often state when presented with definitions of nanomedicine: "I have been examining *molecular* interactions for decades inside and outside cells (such as cell membrane calcium fluxes, mRNA, protein synthesis) and now my research is called *nanomedicine.*"

In comparison, similar statements were made by chemists and physicists (among others) over a decade ago when nanotechnology was first emphasized in various funding agencies. That is, statements such as "I have been studying atomic interactions for

decades, but why is my research now called *nanotechnology*?" were often asked.

What separated nanotechnology from the study of fundamental atomic and molecular interactions that a traditional research field may accomplish (clearly, research that is still needed) was an emphasis on *new* properties of materials gained when controlling structures at the atomic and molecular level. It was this emphasis on the control of structures at the nanometer level leading to *significantly changed properties* that allowed (and still allows) nanotechnology to be separated from other traditional science fields.

But what about the subset of nanotechnology, *nanomedicine*? How does nanomedicine separate itself from other traditional medical research fields? Is it really different from research that scientists conducted a decade or more ago? And, a possibly more important question, does it matter to the future of nanomedicine if it does not separate itself from these other traditional medical research fields? All questions worth asking for this maturing field.

IJN takes a firm stance in this respect and emphasizes nanomedicine research in which *significantly changed medical events* are elucidated only by concentrating on nanoscale events. In this respect, our attempt to separate nanomedicine from other traditional medical research fields is a focus on significantly changed medically related events that result by concentrating solely on the nanoscale. I ask you to join me in this, our second issue, to discover medical advances made in this exciting nanomedicine research field!

References

[ESF] European Science Foundation. 2004. Nanomedicine – An ESF–European Medical Research Councils (EMRC) Forward Look Report. Strasbourg cedex, France ESF.

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