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A SPECIAL ISSUE

A Special Issue on
Nanomedicine in Latin America

This special issue of *Journal of Biomaterials and Tissue Engineering* includes articles from Latin American researchers that work in an emerging discipline at the interface of biomaterials science, nanotechnology and therapeutics called Nanomedicine and that comprises the use of different mono, bi and three-dimensional nano-objects (e.g., nanoplates, nanoparticles, nanotubes, etc.) to address different medical problems. A peculiarity of Nanomedicine is its pivotal role in the articulation of different complementary research disciplines such as pharmaceutical technology (aimed to develop drug dosage forms) and bioengineering (aimed to engineer medical devices without pharmacological, immunological or metabolic activity). In the first case, drug-loaded *ad-hoc* designed nano-objects enable to control pharmacokinetics and intracellular traffic of drugs without modifying their chemical structure. Silver and zinc oxide nanoparticles are examples of nano-objects displaying physical or redox activity and used as antimicrobials in advanced medical devices. In the second case, nano-objects can be used to modify the function of the cellular machinery by delivering genetic material; for instance switching to new metabolic pathways is a competence of cell engineering. Besides, biocompatible and potentially extremely bioactive nano-objects can be used to build artificial extracellular matrices. By tailoring cell-matrix interactions at the molecular level, a fine control of signal transduction pathways can be triggered to modify cell spreading, migration, proliferation and differentiation. This fine control improves the development of *in vitro* and *in vivo* tissue and it is the competence of biomaterials, tissue engineering and bioartificial organs areas. Undoubtedly, the use of nano-objects to execute controlled functions in the health field is blurring frontiers among disciplines that were well defined until very recent times.

In this very dynamic scenario, the social and economic impact of Nanomedicine has to be undertaken by a scientific community that envisages and fully understands the profound consequences of its intervention in living beings. Unfortunately, a misinterpretation of the scope encompassed by Nanomedicine made at first glance in Latin America gave access almost exclusively to chemistry and physics experts. This vision restricted the involvement of biomedical researchers in the nanotechnology arena and, as a result of this phenomenon, most of the Latin American countries and particularly Argentina, delayed the local development of the nanomedicine education programs and scientific platforms.

The foundation of any emerging applied research field demands the strategic investment of extensive governmental funds and the consequent generation of a critical mass of young, motivated and highly-qualified scientists that will later develop powerful and versatile technological platforms and educate a next generation of scientists. Hence, to push the field forward, in 2010, we founded the Argentine Society for Nanomedicines (NANOMED-ar). One of the urgent issues to be addressed in Latin America is the absence of a public health agenda focused on Nanomedicine; priority research lines and disease-oriented research projects have not been identified yet. In Argentina, the critical mass of nanomedical scientists remains relatively small and most of the activities are concentrated by a few highly qualified research groups in public institutions distributed across the country. These research groups own solid expertise, know-how and nanotechnology platforms in areas such as (i) synthesis, modification and characterization of polymeric and non-polymeric carriers; (ii) design and development of drug delivery implants; (iii) encapsulation, release and targeting of drugs, genes and vaccines and (iv) development of standard and innovative pharmaceutical formulations and *in vitro* and preclinical studies, among others. However, in the absence of a general consensus and long-term development plans, efforts fade away in a number of research lines that are in the best of the cases self-sustained, but that owing to complex economic, political and social contexts are not likely to be translated into products.

A serious debate remains to be opened. In the framework of neglected diseases, the development of innovative medicines represents a less profitable niche for the pharmaceutical industry and a fine equilibrium between innovation and affordability needs to be achieved. In other words, in these specific cases, nanotechnologies need to be more scalable and cost-viable. An approach to make these technologies more cost-viable is to develop robust and versatile platforms that can be implemented in different drug families displaying similar physicochemical and pharmacokinetic drawbacks. Challenges related to scale-up, toxicity, stability and regulatory issues, as well as environmental impact and management of waste products derived from the production of nano-objects will not be solved

in the absence of new academic knowledge and an intimate industry-academia interaction. Improved and deeper knowledge could guide—at least partially—industrial stakeholders to start their own way with fewer risks. In this sense, our vision fits very well that of the European initiatives (see the documents "Nanomedicine. A European Science Foundation—European Medical Research Councils (EMRC) Forward Look report, 2005," and the "European Technology Platform, Strategic Research Agenda for Nanomedicine, 2006).

Summarizing, Argentina and other countries in the region undergo a transition and expansion period characterized by the availability of a small number of highly-qualified research groups that are very eager to take Nanomedicine from an explorative to a more applied level. This goal can be achieved mainly by improving the interaction with industry. Conversely, global pharmaceutical companies are increasingly interested in extending the utility of their expired patents and enrich their intellectual portfolio. In this context, the current circumstances represent a unique and advantageous milieu for future fruitful academia-industry collaborations in our countries. Cooperative research between Brazil and Argentina was absent in the last years. This situation began to change and it is expected that the intervention of initiatives such as Nanomed-ar and other scientific and professional forums will contribute to improve the interaction and exchange. The next challenge will be to make this incipient interaction extensive to other countries of our region for the common benefit of our patients.

Guest Editors

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Gustavo A. Abraham obtained his Ph.D. in Materials Science from the School of Engineering, National University of Mar del Plata, Argentina, and is working at the Research Institute for Materials Science and Technology (INTEMA) as independent researcher for the National Research Council (CONICET). He is Associate Professor of Chemistry and Biomaterials at the School of Engineering of the National University of Mar del Plata, Argentina. His research interests include polymeric biomaterials, scaffolding, tissue engineering, and biomimetic nanomaterials. He has authored more than 45 peer-reviewed research papers, 13 book chapters, and over 110 conference proceedings. His research supports are from the Argentinean National Agency of Scientific and Technological Promotion, the National Research Council, the Ibero-American Programme For Science, Technology And Development (CYTED), and the National University of Mar del Plata. He is an active member of the European Society for Biomaterials, Latin American Society for Biomaterials, Artificial Organs and Tissue Engineering, Argentinean Nanomedicine Association, and Argentinean Materials Association. He serves on the editorial board of the Journal of Biomaterials and Tissue Engineering as Regional Editor for South America. Dr. Abraham has been recognized with the Bernardo Houssay Award from the Ministry of Science, Technology and Productive Innovation of Argentina, in 2012.

Eder L. Romero is Biochemist from University of La Plata, Argentina and received a Ph.D. in Exact Sciences (1996). Following a post-doctoral research in Groningen University, The Netherlands (1997–1998), she returned to Argentina being currently an Independent Researcher at the National Council of Scientific and Technological Research (CONICET) (2010) and Associate Professor of Chemistry (tenure position 2008), at the Department of Science and Technology, National University of Quilmes, Buenos Aires, Argentina. From 2007 she is leading the Nanomedicine Research Program (NRP). The NRP is aimed to develop and follow the intracellular traffic of nanomedicines to be applied for topical/mucosal routes against infectious and inflammatory diseases and also in developing vaccination strategies employing biodegradable nano vesicles, to be applied by parenteral/topical/mucosal routes.

Alejandro Sosnik is Adjunct Professor (tenure) of Pharmaceutical Technology (Faculty of Pharmacy and Biochemistry, University of Buenos Aires) and Investigator of the National Science Research Council (CONICET). He received a Pharmacy degree of the University of Buenos Aires (1994) and a and Ph.D. in Applied Chemistry (Biomaterials Science) at the Casali Institute of Applied Chemistry (The Hebrew University of Jerusalem, Israel, 2003), under the supervision of Prof. Daniel Cohn. Between 2003 and 2006, Dr. Sosnik spent a postdoctoral stay in the laboratory of Prof. Michael Sefton (Institute of Chemical Engineering and Applied Chemistry, University of Toronto, Canada). Upon his return to Argentina in 2006, he founded "The Group of Biomaterials and Nanotechnology for Improved Medicines" (BIONIMED), a research group that works at the interface of biomaterials science, nanotechnology and pharmaceutical sciences. His main research interests are focused on the exploration of novel micro/nanotechnologies for the encapsulation, delivery and targeting of drugs involved in the pharmacotherapy of poverty-related diseases. He is a founding member of the Argentine Society for Nanomedicines (NANOMED-ar), where he serves as Secretary. He is also visiting professor and scientist at the National University of Colombia (Colombia), the University of Santiago de Compostela (Spain) and the Coucil for Scientific and Industrial Research (South Africa). He currently coordinates the "Iberoamerican Network of New Materials for the Design of Advanced Drug Delivery Systems in Diseases of High Socioeconomic Impact" (RIMADEL) of the CYTED Program.