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EDITORIAL

Cancer: Nanoscience and Nanotechnology Approaches

May is National Cancer Research Month. This is an excellent time to reflect on the current state of cancer research and to highlight future research opportunities. Advances in screening and diagnostic technologies and new therapeutic agents have led to a decrease in overall cancer death rates of 25% from 1991−2014 in the United States,[1] but patient survival is far from 100%. Until there are cures for cancers, researchers will continue to investigate this set of diseases, from pathophysiology perspectives to engineering new technologies that can improve cancer detection and treatment.

Nanotechnology will play critical roles in the fight against cancer. Nanotechnology provides: (a) new tools to elucidate tumor biology, (b) *in vitro* or *in vivo* diagnostic tools for identifying and classifying cancer cells, (c) carriers that enhance the delivery of cancer agents, and (d) therapeutic agents that can treat cancer. Many of these developments have been highlighted in *ACS Nano*. In the past few years, we have published articles that describe the engineering of nanomaterials for diagnosing and treating cancer (*e.g.*, upconverting nanocapsules and a combined photothermal and immunotherapy nanoparticle system),[2,3] targeting strategies to carry drugs to tumor sites,[4−6] and sensors to detect and to differentiate different types of cancer.[7−9] We have also focused on fundamental studies that define the principles of designing cancer nanomedicines. Some of these studies include the interactions of nanoparticles with serum protein,[10−13] cellular proteome,[14−16] and cancer delivery relevant cells.[17−19] These studies provide foundations for the design of nanoparticles for targeting cancer cells in the body.

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We have also invited contributions from experts that have laid out the major challenges in the design of nanotechnology for cancer applications. Recently, we assembled a team of 86 scientists and engineers from 17 countries for a comprehensive, forward-looking review of biomedical applications of nanotechnology.[20] Simberg and co-workers held a workshop that described the major barriers to the translation of cancer nanomedicines.[21] *ACS Nano* does not shy away from publishing controversial comments or papers that may be in conflict with current views. Dr. Kinam Park published an enlightened Perspective of the current state of using nanoparticles for cancer delivery applications.[22] *ACS Nano*'s objective is to present the best science and engineering *ideas* and advances in cancer nanomedicine, aiming to accelerate developments beyond the academic stage to the clinic.

For nanotechnology to have significant impact in the fight against cancer, there is a need to ensure that there is a path to translation. *ACS Nano* has encouraged the nanotechnology community to set its sights and to focus on clinical aspects, as many cancer nanomedicine concepts have been presented in the last 10 years. As a move in that direction, we have published a Perspective that aimed at educating readers on the differential metrics used to assess an *in vitro* diagnostic technology by clinicians *versus* engineers/physical scientists.[23] We also publish studies with clinical data: Haick and co-workers examined a breath test that included analysis of over 1400 patient samples,[7] and Chan and co-workers demonstrated the clinical validation of quantum dot barcode technologies.[24] We have encouraged researchers to submit more clinically relevant data.[25] The clinical data help the entire research community to assess the "translational" potential of the idea and ultimately can help guide the direction of cancer nanomedicine development.

Upon reflection, we have advanced far from many of the first concepts of cancer nanomedicine presented in the early part of this century. One of the most pervasive concepts though, the image of a nanorobot entering the body, targeting the tumor, and fixing it, remains foremost in the minds of many in the public. While these images provide inspiration for the field, we imagine greater effect and advances by leveraging the matching scales of nanoscience and biology and exploiting biological and biohybrid systems.

Announcement. We are pleased to announce that the 2017 *ACS Nano* Lectureship Award is now open for nominations (http://bit.ly/ACSNano17Award). These awards honor the contributions of three individuals—one each from the Americas, Europe/the Middle East/Africa, and Asia/Pacific—who have made major impacts on the field of nanoscience and nanotechnology. All nominations are due June 9.

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Notes

Views expressed in this editorial are those of the authors and not necessarily the views of the ACS.

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