J Canc Educ (2012) 27:1–2
DOI 10.1007/s13187-012-0338-z

"I don't think we're in Kansas anymore, Toto"

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Published online: 1 February 2012

I recently had a startling revelation that I wanted to share. I was asked by a great colleague, who is teaching physician assistant students near my medical school, to give an introductory lecture on the biology of cancer. I have always had a great affinity for the jobs that a PA can do in oncology since my best-ever colleague and oncology teammate was a PA. I could completely rely on him to "know what he knew and what he didn't" and to seek help for the latter. I also have been indelibly impressed with the insights that people like David Holcomb and Robert McLaughlin have taught me about the tremendous role that PAs can play in cancer care [1]. I jumped at the chance to give this lecture, but felt a little rusty.

To prepare, I went to our library and borrowed the most recent (fourth) edition of Raymond Ruddon's *Cancer Biology* [2]. I had always used Ruddon's text as my mainstay in my medical school oncology course because it was so readable and accessible; even for someone like me, who was so many years away from learning about DNA or facing "new" things like signal transduction, epigenetic mechanisms, apoptosis, and many other ideas that weren't even around when I first learned my medieval version of cancer biology years ago in medical school. I picked up Ruddon's book and was mesmerized. As a matter of fact, I took it on a mini-vacation and was so deeply engrossed reading it by the pool at the hotel that other guests would regard me with a little pity, concerned that I wasn't enjoying my "relaxation" time. They'd say to me with worried looks on their faces, "What are you reading?" I'd smile back at them and tell them that I was really excited about the topic and mesmerized by the book. I was having my eyes opened to the unfolding mysteries of cancer and in fact, coming around to a deep appreciation of how this amazing world was passing me by, even as I focused on my work at the sharp edge of patient care. I felt pretty adept at "state of the art" care too, but all of a sudden, I realized the future had to be so different ("We're not in Kansas anymore!"), and that our cancer education–as well as the materials that would support us in catching up–had a long way to go. I realized that as a practitioner, I was invested in choosing the right "chemo" or other treatment for my patients. I was keeping in touch with the treatment literature, always looking for the next, right thing (mostly an alphabet soup of chemo regimens), but in doing that, I was missing the world of oncogenes, growth factors, reasons for invasion, the possible Achilles' heels of metastases, and other interesting topics that were around the periphery and making some inroads into my cancer-treatment world. But I was in no way up to speed on these things.

I see all kinds of possibilities as we learn the molecular intricacies of both cancer cells and the host in which they reside, and I fear we are not teaching these things. For instance, at my institution (Dartmouth), some of my colleagues are the leading critics of cancer screening, noting that harms are greater than we advertise and benefits are less. But, in reading Ruddon, I felt that the arguments about screening shouldn't be "either-or" ones, but "both-and" ones. I believe our approaches should invest heavily in determining the molecular profiles of those prostate cancers, breast cancers, colon cancers, etc. that are going to behave aggressively and kill the patient. These are the ones we must find and attack early. Likewise we must disseminate information on those patients whose tumors will not be behaving aggressively and limit toxic, unhelpful therapy for them. For instance, see the data by Wang, et al. on using gene profiles to decide on adjuvant therapy for women with node negative breast cancer

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[3]. I see a vision of the future in which knowing oncogene profiles, growth factor effects, immune system vulnerabilities, apoptosis modulators, metastases and invasion profiles, and other aspects of cancer cells will be way more important than histology, grade, tissue of origin, and other factors we see as so important today. There will be opportunities for true prevention and intervention earlier in the road to carcinogenesis that we can only dream about today. And the application of robotics, nanotechnology, and other new tools will transform our approaches even further.

At the recent (Nov. 2011) Association of American Medical Colleges annual meeting, Chuck Friedman, PhD, a professor at the School of Information and Public Health at the University of Michigan and a friend and great visionary whose words I always take to heart, gave the Research in Medical Education invited address [4]. Here is his abstract:

"Nowadays, a $200 smart phone provides access to biomedical information–for students and clinicians–anywhere, anytime. Medical education and practice are increasingly immersed in and supported by a 'knowledge cloud.' These and other revolutionary developments in information technology bring renewed prominence to at least three competency areas for physicians: knowing what you do (and don't) know, efficiently retrieving and integrating information from the 'knowledge cloud,' and evaluating and weighing evidence for complex decisions. The imperative to endow future physicians with these competencies creates new challenges for educators and raises important questions for researchers [4]."

Dr. Friedman said that the practitioner of the year 2020 would be presented with more than 100 bits of information to integrate into a decision about the patient in front of him/her. The human mind can handle about 7 +/− 2 bits of information at a time, so that practitioner would need help....would need to utilize that "knowlege cloud" to apply effective care. To do so, and like my PA colleague above, the practitioner would have to know what he/she knew and didn't know, a state that Friedman described as "calibrated." How do we educate these "calibrated" physicians…and nurses and dentists and PAs and on and on…for this future not so far distant from us?

My message for cancer educators is that we have to teach this stuff. This journal would welcome more articles about teaching cancer biology. We need to think about how we not only prepare to have clinicians know what they know and what they don't, but to utilize the cloud to bring applicable information down to the patients in front of them. Plus, we need to build that knowledge in the cloud in an accessible way. I have several suggestions. Everyone reading this should get a copy of Ruddon's text! (And open yourselves to the wonder of the rapidly accumulating insights.) I also think the NCI (and PDQ folks, especially) should make cancer biology an integral part of PDQ, i.e., have a section for each tumor type detailing the new insights in lung cancer biology or new targets for prevention. I suggest that we build that as part of the cloud–a "go to" place for students to learn about the future. We should be beginning to prepare our students to assess a patient with cancer who has a particular pharmocogenetic profile and whose tumor has the molecular profile best targeted by these agents. In the meantime, there are some timeless and universal things we need to teach better, like smoking prevention, dealing with the obesity epidemic, promoting exercise and healthy eating, safe sex practices, and protection from environmental toxins, from too much sun, and from infectious diseases that are associated with cancer (e.g., use vaccines appropriately).

I'm so glad I was asked to talk to PA students. It opened my eyes to a new world.

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