ISMRM Strategic Planning 2017-2018: Connecting MR in a Changing World

By many measures, our International Society for Magnetic Resonance in Medicine is at the pinnacle of its success. We have a robust and engaged international membership, a rich tradition of connecting clinicians with the developers of new imaging techniques and technologies, a vibrant annual meeting, and a committed and effective central office.

At the same time, we exist in a rapidly changing world, which will increasingly pose pressing challenges and opportunities for our field. It is clear, for example, that the business model for clinical MR is in the midst of a sea-change. This change is being precipitated not only by declining reimbursements in the short term (and corresponding extreme pressures for imaging efficiency, which are reshaping imaging enterprises around the world), but also by a longer-term shift towards value-based medicine. The recent ISMRM Value Initiative -- which aims to prove and improve the practical value of MR -- is motivated in part by some of these changes.

The advent of new disruptive technologies like Artificial Intelligence also casts new light on the MR value proposition. Opinions vary dramatically on how, and to what extent, the current generation of AI will impact our field: whether it will be a flash in the pan -- the latest trend to ride the hype curve; or will upend the discipline of Radiology, replacing humans with machines; or will simply make human radiologists happier and more effective, interacting seamlessly with machine copilots, perhaps at the expense of some workforce reduction. Regardless, modern AI represents a powerful toolset, whose development is proceeding at a mind-boggling pace. Witness the burgeoning of AI-related presentations and sessions between last year's and this year's ISMRM annual meeting.

In either case, however, despite attempts to emphasize value and to incorporate developments like AI into our meetings, our Society has yet to grapple in any coherent way with the potential for true economic and technological disruption, which could stem the flow of corporate and clinical funding that supports both our Society and the broader research engine of our field.

Meanwhile, the science and technology of imaging is in a state of remarkable creative flux. In the past several years, our own field of magnetic resonance has seen a rapid imaging renaissance, with new approaches to image acquisition and reconstruction promising to overturn longstanding paradigms of imaging workflow and utilization. As our reimbursements get smaller, our data get bigger, encompassing ever more dimensions and ever larger numbers of quantitative parameters. Inspection of the programs of recent ISMRM Annual Meetings show that 4D is the new 3D, and, increasingly, 5D, 6D, and 7D are the new 4D. The need to digest and integrate these burgeoning datasets represents another opportunity for machine learning, which again we are only beginning to leverage proactively. Changes in modes of acquisition, reconstruction, and interpretation, moreover, increasingly promise to challenge longstanding assumptions about scanner design. Once again, despite interesting work on unconventional designs in scattered laboratories or startup companies around the world, our field has largely been reticent to confront and embrace such changes. At the same time, some of the fastest-moving engines of innovation in our modern world -- the Big Tech companies -- clearly have imaging in their sights. If we do not figure out how to engage with them early, we may miss our chance.

Similar transformations are currently underway in other imaging disciplines, including not only traditionally close cousins to MR, like PET and CT, but also more distant relatives, such as optical microscopy. Microscope technology has been advancing rapidly in recent years, and microscopists' datasets have also become increasingly high-dimensional, covering ever larger volumes at ever higher spatial and temporal resolution. At the same time, optical methods have become increasingly central to biology, as evidenced by the recent Nobel Prize for single-molecule super-resolution microscopy, and for green fluorescent protein before that. The vigorous adoption of optogenetic approaches, and the high profile of optical imaging methods in high-impact-factor publications such as *Nature* and *Science*, are further evidence of this trend.

The example of optics and photonics highlights another challenge for our field of MR – a challenge of connectivity. While we pride ourselves, legitimately, on connecting clinicians with imaging scientists, our scope may be narrower in some respects than we sometimes suppose. Our historic base of dedicated clinical members – those we refer to as our 'clinicians' – is made up largely of radiologists. In many ways, this is as it should be, since radiologists have been the principal users and traditional drivers of MR technology. However, the many other varieties of clinician who refer patients to radiologists – the oncologists, the neurologists, the orthopedists, and other specialists who drive utilization patterns for imaging, and who serve as custodians of many of the driving problems in clinical medicine – seldom attend our annual meetings. Likewise, what we call 'basic scientists' – our imaging physicists, method developers, and hardware engineers – are sometimes seen by basic scientists in other fields as something akin to technicians, turning the knobs of machines designed to illuminate gross anatomy. Our best scientists struggle to have articles published in *Nature* and *Science*, despite the fact that the practical impact of what we do may often be much greater than that of many methods published routinely in these journals. Even fMRI and diffusion imaging of the brain, which have captured the public imagination together with pride of place in high-impact journals, risk being viewed in neuroscientific circles as comparatively coarse instruments.

Such biases may not be entirely in our control, but it behooves us to address them nonetheless. While our Society is strong on internal communications and interactions, outreach to scientific disciplines beyond our usual bedfellows can be limited. This has not always been the case. Indeed, in the early days of MRI, identification as the Society for Magnetic Resonance *In Medicine* used to be a badge of open-mindedness and inclusiveness. After all, who would have thought, in those early days, that the physicists' and chemists' tool of MR would be so revolutionary for medicine? In the present day, however, this same identification risks putting us in a niche. Modern medicine is changing, and there are new, broader problems to be solved in biology, in physics, in information science. We have an historic opportunity both to benefit from and to influence radical developments in these areas. But, in order to do so, we will need to connect more broadly.

It could be said that we run the risk of any mature field -- the risk of becoming comfortable with talking mostly to ourselves. Our journals, like our society, have abiding value; but, despite the bests efforts of our excellent editors, they are not likely to break into the upper echelons of impact factor, unless the tables of contents themselves shift to areas of broader scientific interest. Our Annual Meeting has proudly embraced preclinical as well as clinical investigations, but the prevalence of presentations on animal imaging has declined steadily in recent years. This is not to say that our scope is inherently limited -- it is just that we haven't fully impressed on other scientists the breadth of the questions MR can answer. Sometimes, in fact, findings broadly accepted in the MR field are even at odds with what other disciplines know to be true. To cite one prominent example, it has been noted that axonal diameters reported routinely in numerous diffusion MRI studies differ by an order of magnitude from what histologists have documented in tissue. This is an issue not just of accuracy, but also of credibility. Our macroscopically-oriented imaging scientists risk being looked at askance by other scientists accustomed to operating at the cellular scale – scientists who, at least in many modern schools of medicine, are increasingly setting the standards for academic promotion.

Despite this starkly framed challenge of connectivity, one could argue that there has never been a better opportunity for broad connection than there is at the moment. Shared trends in image acquisition, reconstruction, and analysis could actually serve as the basis for productive conversation and collaboration between traditionally separated imaging modalities. If some of the uncertainties surrounding MR-derived tissue microstructure can be resolved, we may even be able to bridge traditional gulfs separating distinct spatial scales, and to answer questions of direct interest to other scientists studying ensembles of interacting cells. In the Century of Biology, enabled by the tools of Information Technology, on could easily imagine a Google Earth for biomedical imaging, in which the macroscopic and

the microscopic are stitched together for seamless zooming, depending upon the needs and interests of the user.

In short, while our Society has focused quite appropriately in recent years on forging broader geographic connections, perhaps the greatest opportunities for connection going forward lie in the scientific landscape itself. And, if we do not connect, we risk losing relevance rapidly. As a Society, it should be said, we must stay true to who we are: our history and heritage, our technological mission and our clinical impact. We must take care not be distracted by mere buzzwords in an increasingly fast-paced world. At same time, we need to find new ways to grow, to shape our future rather than just to be shaped by it. MR is a field which has repeatedly reinvented itself. And it is high time for another reinvention.

The goal of our ISMRM strategic planning effort for 2017-2018, therefore, is to address the twofold challenges of *disruption* and *connection:* disruption both in technology and in clinical practice, and connection both among diverse clinical specialties and among diverse scientific disciplines. Together, we will assess what can we do as a Society to promote connectivity and prepare for disruption in our rapidly changing world.

Goals for the Strategic Planning Process

- Enumerate key threats and opportunities for our field and our Society
- Identify tools that may be used to address these threats and opportunities
- In particular, identify means to
    - *Manage disruptive forces* currently roiling our field from outside (artificial intelligence, changing healthcare landscape and MR value proposition, etc.)
    - *Marshall disruptive innovation* to propel our field forward in new ways (question previous assumptions about MR technology and applications, leverage AI, create new value, etc.)
    - *Connect with the fields around us* (to expand the impact of our innovations)
    - *Tell our story* (to make the ongoing and evolving value of MR clear to the public, to diverse scientific disciplines, to diverse clinical specialties, and within our own community)
- Set priorities for future directions (our Strategic Plan), with concrete objectives that reflect the imperatives of our changing world
- Devise specific tactics and initiatives that may help to advance our objectives
- Align our governance and use of resources with our new strategic priorities
- Discuss how these priorities might affect the configuration and operation of our journals, our annual meetings and workshops, our committees, our study groups, and our modes of discourse in general.
- Explore means of broadening and sustaining the conversation beyond this year's particular planning process, engaging our membership at large in brainstorming, disruptive innovation and connective endeavors.