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EDITORIAL

# The cultural divide: exploring communication barriers between scientists and clinicians

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## Summary

Despite remarkable advances in basic biomedical science that have led to improved patient care, there is a wide and persistent gap in the abilities of researchers and clinicians to understand and appreciate each other. In this Editorial, the authors, a scientist and a clinician, discuss the rift between practitioners of laboratory research and clinical medicine. Using their first-hand experience and numerous interviews throughout the United States, they explore the causes of this 'cultural divide'. Members of both professions use advanced problem-solving skills and typically embark on their career paths with a deeply felt sense of purpose. Nonetheless, differences in classroom education, professional training environments, reward mechanisms and sources of drive contribute to obstacles that inhibit communication, mutual respect and productive collaboration. More than a sociological curiosity, the cultural divide is a significant barrier to the bench-to-bedside goals of translational medicine. Understanding its roots is the first step towards bridging the gap.


## Factors that promote and perpetuate the cultural divide

A cancer biologist working at a hospital-based research institute conducts laboratory experiments on brain neoplasms and participates in clinical case conferences. Describing her effort to maintain good relationships with both clinicians (oncologists and neurosurgeons) and her fellow basic scientists, she said, "I have one foot in each camp, with the Grand Canyon in between." Why is there such a gap between the worlds of laboratory basic science† research and clinical medicine? Scientists and clinicians both endure a decade or more of specialized education and apprenticeship-like training to hone intellectual and technical skills. In both worlds, flashes of insight and awe-inspiring moments punctuate work that is otherwise routine and repetitive. For each, there is a risk that reliance on high-tech equipment will replace thoughtful consideration in diagnosis or experimental design. In many industrialized nations, both groups struggle to maintain financial security, whether for research funding or payments for clinical services, in the ongoing battles over budget priorities. They both face increasing paperwork and regulatory compliance burdens. With so much to share, why do they feel like aliens in each other's camps? And why do they so often express harsh, antagonistic opinions about each other (Box 1)? In this Editorial, we discuss the factors at the root of this 'cultural divide' by drawing on our own experience and interviews with numerous biomedical scientists and clinicians throughout the United States.

First, basic scientists and clinicians **don't speak the same language**. Years of specialized training lead to two dialects, each loaded with arcane terminology, acronyms and tribal jargon that bind members of one group together but are unintelligible to outsiders (Greene, 2011). As a result, neither group can comprehend the other's published literature; each group may even have trouble following the other's conversations. This communication rift is established during formal schooling and heightened as medical and PhD students enter the clinical and laboratory realms, respectively. The well-reasoned underlying principle is that PhD students need to understand how (and how well) scientific investigations have revealed the facts, whereas medical students need to integrate basic and clinical science facts in the service of patient care. An unintended but predictable consequence of these different approaches is that clinicians are less likely to appreciate the research behind advances in medical diagnostics and therapeutics, making them vulnerable to exaggerated claims made by drug and device companies (Avorn, 2011). When clinicians in training work in research labs for the first time, as may be required by their residency or fellowship program, they are suddenly lost, discovering that the skill set that they have worked so hard to develop is irrelevant in a laboratory setting. A clinician-scientist who is the Research Director of a surgical specialty department at a famous Boston-area hospital said that it was "like dropping someone...into the jungle with a knife and matches, and asking them to make dinner". Conversely, scientists are less likely to recognize the potential translational applications of their research to problems in clinical medicine, causing lost opportunities for therapeutic advances. Moreover, scientists miss out on understanding the clinical aspects of disease, the ramifications of human-imposed disease classification and the nature of 'differential diagnosis', the analytical process through which an individual patient is evaluated – often in a step-wise process over time – to determine the most likely diagnosis to explain his or her particular constellation of symptoms and signs.

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An even larger communication gap separates scientists and clinicians from the public. The dialects of both scientists and clinicians are incomprehensible and inscrutable to the general population, but the problem is a bigger challenge for scientists. Miscommunication between clinicians and patients has significant

†Although we acknowledge that clinical research can be 'basic' in nature, for the purposes of this article we use 'basic science' in the more commonly understood and narrower context of laboratory research.

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## Box 1. Scientists and clinicians talk about the cultural divide

• "During basic science courses in medical school there was no time for thinking about 'why?'" - **MD/PhD student, pharmacology**
• "Graduate students *need* to know 'why?' at a level that medical students simply don't." - **PhD, neuroscience, NIH administration**
• "PhDs think MDs have an easy life, making easy money. They don't understand the enormous responsibility and time commitment required for patient care, or how little money one makes seeing patients in an academic setting. MDs think PhDs have an easy life, that they can sit around all day thinking. Without first-hand lab experience, they don't know how hard it is to make experiments work. Both think the grass is greener on the other side...They have to walk in each other's moccasins." - **MD, oncology, university-based cancer center**
• "Residents and attendings not initiated into the art of doing science...couldn't care less about what and how research is done...They do not see the connection between basic research and [clinical practice]...The clinical environment is not at all conducive to the kind of deeper thinking that is required to approach basic research questions." - **MD/PhD neurology resident, academic medical center**
• "A lot of physicians think they know everything about everything...99% of the published research in my field has problems in study design and statistical analysis." - **VMD/MD/MS (statistics), oncology, university-based cancer center**
• "Basic scientists don't understand clinical research – it's not like a bunch of rats... Physicians don't have a clue about how to evaluate claims by drug reps." - **MD, neurology, NIH administration**
• "MDs think that they have an innate ability to do research...that research is something that you do on weekends for several hours." - **PhD, cancer biology, university-based cancer center**
• "…most researchers aren't aware of the many disease-related areas they could be working on that are fascinating from the basic science perspective." - **PhD, genetics, NIH administration**
• "Too few clinicians are qualified to run clinical trials...Many of the trials proposed are poorly designed..'Relevance' sections [from PhDs] often reveal their ignorance of human disease." - **PhD, neuroscience, private disease-based foundation**
• "... all of our [lab] work is, of course, in mice and cell culture. While many of us can characterize the pathology of [mutant] mice, we – embarrassingly – have a very vague idea of what happens in the human condition." - **PhD student, physiology/molecular genetics**
• "MDs don't grasp the oversight aspect of doing research, such as peer review of papers and grants. They're used to making independent patient management decisions." - **MD, infectious disease/cell biology, academic medical center**
• "Scientists are not articulate when communicating with the lay public or with clinicians." - **PhD, neurogenetics, hospital-based research institute**
• "Teaching Biochemistry to first-year medical students was a painful experience...It was very frustrating to be teaching something I loved to students who just wanted to know what they should memorize...The spoon-feeding philosophy [of the medical school] drove me crazy." - **PhD, genetics, university**
• "There's a mystique to lab science techniques...Physicians can collaborate [with basic scientists] if they have the right mindset – if they are not looking for someone to do their work for them...There remains a huge gulf." - **MD, surgery, PhD candidate in molecular biology, university**
• "I was a pariah. No one wanted to invest the time to train me at the bench." - **MD, oncology, university (during his sabbatical to learn molecular biology)**
• "I have reservations about PhDs. It's easy to get a PhD degree if you sit around the lab long enough." - **MD, neurology, academic medical center**
• "The basic science establishment feels threatened by disease...We are in an era of negativism. PhDs think that MDs are money grubbers and lousy scientists...But, can a PhD be a first-class citizen in a clinical department?" - **MD, internal medicine and physiology, university**
• "PhDs don't appreciate the difficulty of doing good clinical research." - **PhD, neurochemistry, hospital-based research institute**
• "In the past, medical and graduate students used to be more similar to each other. Now, 'straight' medical students focus on practical, hands-on activities and have *no* respect for research...It's the PhDs who have the stronger vocational commitment." - **MD, neurology and neuroscience, academic medical center**
• "It's the basic scientists who are reluctant to move quickly from cell culture models to clinical trials." - **MD, neurology, NIH administration**
• "The public has been...led to believe that NIH and basic research are there to help them...The scientists know...that, for the most part, this is not why they are in the lab....this gets PhDs squirming in their seats at [patient] presentations because the patients are being sooo open and honest and the scientists are not...In the end, I am not convinced that one should bring MDs and PhDs together...Could one argue...that science and medicine are helped by some 'isolation'?" - **PhD, neuroscience, private research institute**
• "PhDs have no clue about what things are important to people – but maybe they shouldn't [be influenced by that]!" - **MD/PhD, neurology and neuroscience, university**
• "One of the...common complaints…among basic scientists has to do with their bad experiences working with clinicians...Most of this probably derives from simple misunderstandings." - **PhD, physiology, university**
• "[I'm in the group] of people who are kind of oblivious to the issue. Am I alone?...You should not pander to prejudice, or accept bad attitudes as an inevitable status quo...People are inclined to project hate onto other groups...Jealousy...does tend to be the strong arrow that points to where insecurity lies...Maybe the people who really hate the MDs are externalizing some sort of anxiety about their own place in the world." - **PhD, genetics, university**

consequences (Michaels et al., 2007). Competition for patients, fear of litigation and common sense should motivate clinicians to speak in plain, jargon-free terms to patients and their families. By contrast, most scientists never have to speak directly to the public, and only recently have federal funding agencies in the United States required lay-language summaries or educational outreach as part of grant applications. Notably, most scientists have a personal physician, whereas few physicians outside academic medical centers have a personal or professional relationship with a scientist. In addition, popular culture, especially television, presents many fictionalized accounts of clinical medicine, admittedly over-simplified and distorted, but nonetheless containing some truth. The general public is fascinated by the mystery-solving aspects of medical diagnosis. For example, the *New York Times*' popular *Magazine* column 'Think Like a Doctor' has real-life diagnostic puzzles that are explored like murder mysteries. By contrast, the rare depictions of scientists in popular culture are so caricatured as to perpetuate stereotypes without shedding light on the nature of scientific inquiry. What about documentaries describing basic science and scientists? Although these have increased dramatically with the expansion of specialty television channels, they usually focus on discoveries that have become success stories. They might convey how an idea evolved through data collection and hypothesis refinement, but these productions do not capture the day-to-day reality of being a research scientist. Thus, the cultural divide, whose origins are understandable – but not insurmountable – consequences of distinct career paths, is further aggravated by a public-understanding deficit in which science is viewed as inaccessible – a complex, mysterious craft carried out by eccentric people, often investigating obscure topics.

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Second, scientists and clinicians **lack a common value system, even regarding knowledge and ignorance**. Their seemingly shared foundation of life-science knowledge, detailing genes, cells, tissues and organs, belies very different views and rewards within their professions and in society. Medical students are not encouraged to be skeptical. One MD/PhD clinician and academic administrator put it more bluntly, "Medical school is cognitively impairing." Clinicians believe that medical textbooks are filled with facts; indeed, these books perpetuate a myth of medical certainty whenever they ignore past misconceptions that led to less-than-optimal treatments (Monmaney, 1993). Scientists realize that the content of today's textbooks will not only be expanded in the next edition, but might be greatly altered by new discoveries that challenge longstanding dogma. Scientists in training are rewarded for asking important questions, whereas clinicians in training are rewarded for knowing answers. Furthermore, the questions they care about are fundamentally different and posed from different angles. Scientists ask "why?" and "how?" at increasingly mechanistic levels, whereas physicians need practical answers to "how?" and "what?" – "how is this condition recognized and what should I do to treat it?". To a clinician, asking "why?" distracts from the sense of mastery that comes from accumulating information and applying it in a clinical setting. Scientists strive to fill knowledge gaps, whereas clinicians face the reality that, in the words of a clinician-scientist, "clinical decisions are often based on imperfect data".

Doctoral and postdoctoral research trainees are expected to generate new knowledge, and are rewarded for independent thinking and creativity. The path to a position as an academic scientist is riskier and, at every step, less certain than the path to a medical degree and board certification. In comparing his two educational experiences, an MD/PhD researcher said, "Graduate school is a much lonelier enterprise." For many scientists, the disease relevance of a project is a convenience – or a nuisance – when writing research proposals to request funding. By contrast, medical students and residents are rewarded for using their knowledge of disease to expedite and coordinate patient care, often involving consultation with several medical or surgical specialists. For many of these clinicians, research is only of interest once it has been translated into FDA-approved medicines or devices that they can prescribe.

After their specialty training is complete, scientists and clinicians are rewarded in distinctly different ways, both tangible and intangible. The monetary gain that drives some clinicians is more obvious than the power and influence that lure scientists into top-level academic positions. In the United States, the social status and incomes of clinicians are considerably higher than those of researchers, which fuels resentment and jealousy among scientists. Parents in the United States relate more easily to the image of "my daughter, the doctor" than "my daughter, the scientist". The high social status of clinicians – despite the fact that some of them are less than competent, less than honest or simply not very personable – speaks volumes about our society. We want to have heroes, especially when we entrust them with our lives. But how can the general public come to appreciate scientists, let alone revere them, when there is no easy way to learn about the specialized work that they do, the challenges they face or why their work is important? Not only is our culture deficient in factual science literacy, but it also lacks a basic understanding of scientific method and practice.

A third component of the cultural divide comes from the **different sources of passion and emotional intensity** that motivate and challenge scientists or clinicians as they choose and develop careers. As a computer science professor said to his physician, "The difference is that you deal with life and death, and I don't." (G.R.P., personal anecdote). This dichotomy in the experience of medical and PhD students continues throughout their careers. Both clinicians and scientists have "Ah-hah!" moments when data, whether clinical or experimental, suddenly make sense. The emotional highs are easy for outsiders to understand: the patient survived a dangerous surgery; a ground-breaking experiment confirmed a novel hypothesis. The big difference comes when the passions that drive the career choice are challenged by negative outcomes. Altruism does not prepare clinicians for the feeling of helplessness when a patient who might have been saved does not pull through, or when the limitations of modern medicine mean that nothing more can be offered (Treadway and Chaterjee, 2011). Conversely, the distress that a scientist experiences when experiments fail to verify or illuminate a mechanistic hypothesis, on opening a journal to find one's own experiments reported by a competing lab ('getting scooped') or of just missing a funding payline for a grant application, have no counterpart in clinical medicine. When faced with such psychological stressors, people are more likely to turn to their own colleagues for support rather than to try explaining to others why it is so difficult to bear. Thus,

it is difficult to empathize with the demands and disappointments of the other group. We do not understand each other's tragedies.

## Why does the cultural divide matter?

First and foremost, the cultural divide matters because the contributing factors – communication barriers, mutual ignorance, and the resulting lack of respect between scientists and clinicians (Box 1) – hinder the translation of scientific discoveries into medical advances. The cultural divide may even hinder scientific progress. All medical advances in diagnostics and therapeutics emerge from basic science research – mainly in life science areas, but also in physical science and engineering. Conversely, human diseases provide fascinating windows into biological functions of specific molecules, the ability of biological systems to compensate for missing or toxic molecules, and the spiral of pathogenic mechanisms that lead to cell, tissue and organ malfunction. The wider the cultural divide, the less likely it is that useful connections between the worlds of science and medicine will be made. Such connections are not automatic; they require individuals to have insight and the resources to pursue that insight. Ironically, there are now many scientists who think that they know about disease, because they study molecules that have been associated with a disease or because they use an animal model of a disease (which may, in fact, be a very poor model). The reductionist, mechanistic research approach that led, for example, to valuable targeted therapies in oncology, has had the unintended consequence of balkanizing the life sciences and creating a cadre of molecular biologists who know little about the biological context of the molecules they investigate. One such scientist recently asked, "What's the difference between the biological basis of disease and the molecular basis of disease?", as if a set of rogue molecules could *be* the disease. These scientists have little knowledge about how a disease is recognized or distinguished from other similar diseases, and, for most diseases, they have never met a patient. The era of modern molecular medicine has partly masked the cultural divide and created the illusion, among both scientists and clinicians, that 'translation' is right around the corner. In fact, translation requires thinking and communication across the divide.

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Second, the cultural divide means that pivotal decisions related to translation – ranging from selecting which medical conditions will be targeted to deciding which drugs or devices will be pursued for FDA approval – are being made primarily as business decisions. That is, if scientists do not embrace human medicine as a worthy and valuable part of life science, and clinicians do not have an understanding of the research behind new therapies and diagnostics, then decision making is largely in the hands of the pharmaceutical industry and device manufacturers – and, importantly, not in the hands of their scientists, but rather of their business executives. This is neither surprising nor inappropriate for companies that are responsible to their shareholders. However, in place of transparency there is an aggressive public-relations campaign mounted by PhARMA (Pharmaceutical Research and Manufacturers of America[‡]) to convince the public, as well as the medical community, of the industry's commitment to new and better medicines to improve patient outcomes. There is no mention of their dependency on the enormous foundation of taxpayer-funded basic-science research data, and the NIH has failed to correct the impression that PhARMA companies deserve all the credit. One might say that the private sector has filled the vacuum created by the cultural divide, and thrived there with relatively little direct input from either the scientific or clinical communities.

Because the cultural divide creates roadblocks to translating basic research into clinical applications, we feel compelled to provoke discussion that will lead to narrowing and bridging it. Addressing the issues discussed above will require improving communication between basic scientists, clinicians and the public; the reintegration of basic science education for medical and PhD students; creating more forums for interdisciplinary discussions; and more active engagement of research institutions in technology transfer and industry partnerships. In closing, we offer below a few specific suggestions for individuals:

(1) In the words of Aretha Franklin (http://www.last.fm/music/Aretha+Franklin/_/Respect), '**R-E-S-P-E-C-T**' what you don't understand. Don't generalize from difficult interactions with individual members of the other group.

(2) **Be curious; ask questions**. Ask to visit a scientist's laboratory or a clinician's office. Attend Grand Rounds or case conferences. Tell a scientist about the unmet medical needs of your patients. If you are interested in a particular disease, join a local support organization and meet the patients and their families. If you are interested in the research related to your clinical practice, join the national research organization and attend their annual conference.

(3) **Curriculum reform**. Put the biology back into molecular biology. This might work best through teaching teams (e.g. pairing a physiologist with a molecular biologist in the classroom). Put research methods and analysis at the core of medical education; teach medical students where the 'facts' come from.

(4) **Get involved**. Contact the Director of NIH (Francis.Collins@nih.gov) and ask him to do more to educate the public about the benefits of taxpayer-funded research. Participate in outreach activities that explain science to the public.


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[‡]'Research' was added to the name in 1994. This organization is also pressing the European Commission to rescind the ban on direct-to-consumer marketing.