Making Cardiovascular Discoveries Work for Everyone

John M. Westfall, George A. Mensah

That’s one small step for (a) man, one giant leap for mankind

—Neil Armstrong; July 20, 1969

How could walking on the moon help mankind? The purpose of the 1960s NASA moonshot was to put a man on the moon. To what end? What might a stroll on the moon actually mean for America and humanity? If the Moonshot was about leaving a few footprints on the moon, it would have only fulfilled half the mission. But it was about more. The 1960s arguably saw one of the most dramatic accelerations in the pace of scientific discovery in the past 100 years. The outcome was so much more than footprints on the moon. The scientific discoveries necessary to put that human on the moon were translated out into the nation in hundreds of ways. Yes, the primary aim was space exploration, a human lunar landing and safe return to earth. However, the translation of those discoveries improved nearly every American life in ways we could not imagine in 1960.

We are on the cusp of another giant leap for humanity as we face the unparalleled discoveries in cardiovascular disease prevention, treatment, and management. The pace of discovery has accelerated, providing another opportunity for broad translation that can impact every American. From new drugs and newer devices to genetic risk and precision treatments to social determinants of health and local prevention strategies, the pipeline of discoveries has reached gravitational escape velocity. The scientific momentum energizing discovery science in heart disease and health could carry us to the moon, perhaps even Mars. But it would not carry us above the clouds without translation into the clinic, community, and culture. And that translation now requires engaging the practices (T3 translation) and the community (T4 translation) to make the discoveries meaningful and feasible in every household.

Translational research is a long and winding road. Many discoveries are just discoveries, interesting tidbits of science, appropriate for a journal article, but hardly impactful on the practice of medicine or living one’s daily life. However, some discoveries may be of great consequence, perhaps a crucial link between genetic makeup and disease expression, or a cellular process susceptible to new types of medications and treatments, a novel chemical compound that targets a diseased cell and leaves a healthy cell untouched, a program to mitigate the negative consequences of poor social drivers of health. These discoveries need to be translated into clinical practice and then into clinical practice, and then into the broader cultural understanding of a disease, its origins, and its management.12 This final step of translation, now known as T4 translation is crucial to making discoveries part of routine everyday life.

Slow Pace of Translation

The discovery of germs as a disease vector in the 1860s was initially unacceptable to the scientific medical community.3,4 Slowly, germ theory was translated into human clinical research; antiseptics and then antibiotics were discovered; and gradually, infections, antibiotics, and sophisticated treatment regimens entered clinical practice. And little by little, germ theory translated into everyday patient and community understanding. It was 100 years after that initial discovery that widespread T4 translation of hand hygiene occurred and made hand washing and use of hand disinfectants the routine standard of care in healthcare facilities and households.5 Now, some would say that we may have translated too far and that germs are not all bad and antibiotics may be over used. The point we are making is that the translation of scientific discovery into clinical practice and common community understanding can take much too long.

Balas and Boren6 estimated that it takes an average of 17 years for just a small portion of new evidence-based findings to reach clinical practice. It takes even longer to reach beyond the confines of the clinical practice setting to impact population health.7 In contrast, the 1960s NASA moonshot got serious about discovery and translation. New discoveries had to be translated into practical use immediately to get a man on the moon; and by committing to this end goal, NASA scientists and the broader scientific and education community were

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able to translate many of these discoveries into everyday life in America. T4 translation of NASA discoveries occurred rapidly during that very decade and continued throughout the end of the 20th century.

However, we are at risk of another hundred years of dirty hands and cardiovascular deaths. The National Institutes of Health has lofty goals to discover the genetic cause for heart disease, the cure for hypertension, the protein that heals, and the public health message that changes behavior. And these discoveries will be most successful if attention and resource is given to the full spectrum of translational science: from bench to bedside to practice to population (Figure). It is very likely that discoveries will get to people with serious heart disease. But that next step in translation, T4, moving discoveries into the population, will take our diligent attention. And it is beyond our ability to predict what these discoveries and their translation into the population may lead to. Who would have thought that we could eliminate chlorine from our water purification processes? From heart surgery and nitinol implants to longer golf shots, better sunglasses, and home blood pressure cuffs, the 1960s Moonshot discoveries underwent rapid T4 translation resulting in better living. T4 translation can do that again if we persistently translate the upcoming research from discovery science into life-changing and life-saving treatments and population knowledge and programs in the coming decade. But what is T4 translation and how should we do it?

**T4 Translation: What It Is, and How to Do It**

T4 translation is the last mile on the long journey from fundamental discovery to population health impact. It is the final translational step that makes discoveries part of routine everyday life. The T4 translation step goes beyond the publication of clinical practice guidelines and recommendations to address how guidelines might be applied in everyday clinical settings and communities far beyond the academic medical center. T4 translation explores solutions to questions of relevance, acceptability, affordability, adaptability, sustainability, and feasibility of delivering with high fidelity what has been demonstrated to be efficacious and effective in earlier translational steps. Just like germ theory finally translated into a broad community-based understanding of infection, disease, treatment, and hygiene, T4 translation can change our cultural constructs and ideas about science and cardiovascular health. The focus of T4 translation is maximizing the return on investments made in fundamental discovery science and early translational steps by ensuring that proven interventions can have the widest reach and can be adopted or adapted, implemented, and sustained long term. The recent discovery and partial translation of monoclonal antibody treatments for resistant hypercholesterolemia provides an example of the disconnect between discovery and usefulness at the practice and patient level because of high cost and marginal value. Likewise, the lack of local relevance in the national Million Hearts campaign has led to generally disappointing outcomes. Successful T4 translation can lead to locally relevant messages and materials, increased use of proven therapies, and better health outcomes. The mission of turning fundamental discovery science into health impact is likely to be most successful by embracing the full spectrum of translational steps inclusive of T4.

T4 translation begins and ends with active community engagement; community members, patients, and practice-based research networks engaged in participatory research that seek answers to how proven-effective evidence-based interventions can be adopted or adapted with high fidelity in a sustainable environment.
way to maximize population health impact. Several conceptual and theoretical frameworks and models are available to guide T4 translation. T4 translation can inform the full spectrum of scientific discovery by impacting research and funding priorities, providing crucial feedback to feasibility and acceptability of early discoveries, and developing messages and materials that change knowledge and behavior. By engaging patients, providers, and community members throughout the full research roadmap, new discoveries are more likely to be relevant and meaningful and will be more readily translated to bedside and beyond. The complete manual on T4 translation is beyond the scope of this commentary. But there are thousands of patients, community members, practices, public health agencies, and community organizations ready to collaborate to get new discoveries into their neighborhoods. And get the health problems they face every day into the hands of academic researchers.

In the 1960s, we all felt part of the NASA Moonshot. We drank Tang and ate freeze-dried ice cream. And we all watched as Neil Armstrong took those first steps on the moon. And each day we enjoyed more and more translated benefits from the NASA Moonshot. We can do that again if we attend to T4 translation. Imagine a goal to eliminate systolic blood pressure over 140 mmHg. Such a cardiovascular moonshot would require basic scientists, clinical researchers, primary care and cardiology practices, patients and communities to come together; discoveries in genetics, proteomics, chemistry and physiology, health services research, and public health translated into relevant, innovative medications, clinical care, public health programs, and health policy. We have seen this T4 Moonshot successfully deployed to walk on the moon and improve the lives of every American. Now, more than ever, we need those same strategic partnerships and active engagement of patients and practices to achieve the health for which we strive.

Disclosures

None.

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