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## HOWARD TAYLOR LECTURE

# Great moments in global health, and why we are in one now☆☆



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We've seen a host of great moments in global health history, but we've never seen one quite like this one. We're living in a moment of unprecedented achievements. Building on these achievements, we have the chance, together, to be part of the greatest global health triumph in human history.

On September 25, 2015, leaders from around the world—193 countries—gathered at the United Nations and declared their commitment to an ambitious new set of 17 Sustainable Development Goals that build on the achievements of the Millennium Development Goals (Supplementary Material S1).

In opening the UN Sustainability Summit, Secretary General Ban Ki-moon said, “The new agenda is a promise by leaders to all people everywhere” [1]. These 17 ambitious goals adopted by global leaders included eliminating extreme poverty by 2030. Now that might sound too ambitious, until we recognize that the Millennium Development Goal to reduce extreme poverty by half was achieved 5 years ahead of schedule in 2010. We can do it.

The following day, the Secretary General launched another ambitious effort—a new Global Strategy with goals that include eliminating preventable deaths of women, children, and adolescents everywhere by 2030. I was in the room for that launch as the Secretary General, heads of state, Melinda Gates, and others pledged their support. The room was filled with the energy of purpose and commitment, and I can tell you that, in my entire life, I've never had greater hope for the women, children, and families we serve around the world. Today we have the chance to be part of the greatest global health triumph in human history. This multinational governmental and private sector commitment suggests that the tide has turned against the poignant observation made by Dr. Mahmoud Fathalla at the 2000 International Federation of Gynecology and Obstetrics (FIGO) meeting when he said, “Women are not dying of diseases we can't treat....They are dying because societies have yet to make the decision that their lives are worth saving” [2].

We've seen numerous important moments in the history of global health that have prepared us for this one, but I want to highlight just three. We can call the first of these, “the Ignaz Semmelweis moment.”

### The Ignaz Semmelweis moment

Dr. Semmelweis was a Hungarian obstetrician who practiced in the mid-19th Century at the Vienna General Hospital's First Obstetrical Clinic. We all know this story.

Dr. Semmelweis observed in 1847 that the First Obstetrical Clinic, which was the teaching service for medical students, had a higher rate of puerperal fever than the Second Clinic, which was staffed solely by midwives—a rate much higher than that even for women who delivered in the streets. When he concluded that he and his students were transmitting what he called “cadaverous particles” (this was before the germ theory), he instituted a policy of hand washing with calcium hypochlorite between autopsies and patient examinations. Despite the fact that the mortality rate in the First Clinic quickly declined by 90%—to a level comparable with the rate of the Second Clinic, Dr. Semmelweis's recommendations for hand washing were roundly rejected by his colleagues.

The Semmelweis moment continued when Louis Pasteur, often called the father of microbiology, built on the observations of Semmelweis and others in developing the germ theory and its application to medicine, including reducing deaths from puerperal fever. The moment continued when Sir Joseph Lister, a British surgeon, applied Pasteur's work in pioneering antiseptic surgery, which profoundly reduced postoperative infections and dramatically improved the safety of surgery overall.

Now, let's fast-forward more than 100 years to the moment we're in now, in which we're working not only to reduce hospital infections but also to improve patient safety more broadly. It's taken over a century, but the Semmelweis moment has brought us to a global movement for patient safety and quality improvement, one that has drawn on lessons learned from quality improvement in the auto industry and the airline industry. The scientific discipline that supports these efforts is increasingly referred to as *improvement science*—and improvement science is the first of three new streams of scientific disciplines we'll consider that will be mission-critical for the global health triumph we're working toward.

### The John Snow moment

The second stream of scientific support comes from evidence-based practice and implementation science. It's what we can call “the John Snow moment,” and it has been key in getting us there.

John Snow was an English physician who, at about the time of Semmelweis, made key contributions to our understanding of disease transmission when he mapped the occurrence of cases during a cholera epidemic in London and determined that they clustered along the

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public water pump on Broad Street. He used statistical methods to strengthen the link between the water source and the cases identified. His finding that the disease was waterborne was compelling enough that the local council removed the handle from the pump, ending the outbreak.

John Snow is now widely considered as the father of epidemiology because of the innovative methods he used for this landmark work. The field of epidemiology has had enormous impact, often being called “the basic science of public health.” Epidemiology has transformed medicine as well. Archie Cochrane urged us to base our clinical practices on the best evidence from epidemiologic studies saying, “It is surely a great criticism of our profession that we have not organised a critical summary, by specialty or subspecialty, adapted periodically, of all relevant randomised controlled trials” [3]. The work of Professor Cochrane led to the development of the Cochrane Database of Systematic Reviews, the establishment of the UK Cochrane Centre in Oxford, and the international Cochrane Collaboration, all of which have made important contributions to our collective efforts to assure that practice in our field is evidence-based.

To identify the imperative of evaluating interventions before widespread use, we need look no further than the over 10 000 premature infants blinded in the 1950s by excessive administration of oxygen—a well-intended but harmful intervention. William A. Silverman, a prominent neonatologist at the time, used the tragic lesson learned from retrolental fibroplasia to champion clinical trials before widespread use of medical interventions, which was a key moment in the history of evidence-based medicine. Indeed, Silverman has been called the pioneer of evidence-based medicine.

The first issue of the journal *Evidence-Based Medicine* was published in 1995. Two decades later, all of our top-tier journals consider themselves to be evidence-based publications and would not begin to even consider themselves as being otherwise. Today, the expectation that both medical and public health practice should be evidence-based is a mission-critical contribution toward assuring that the interventions we recommend in this global moment are driven by our best available science.

The story of the John Snow moment continues with the work of Professor Dean Fixsen and colleagues who reviewed the literature on implementation research in 2005 and made a compelling case that we need not only effective interventions but also effective strategies for implementing them [4].

Based on their synthesis of the evidence, Fixsen et al. proposed a formula for achieving successful outcomes that has profound implications for global health and is at the heart of the new field of implementation science: effective interventions  $\times$  effective implementation  $\times$  enabling contexts = socially significant outcomes [4]. There are three synergistic components at work here, and we need all three: 1) effective interventions, 2) effective implementation of these interventions, and 3) an enabling context to support this implementation. We'll look at all three as key to achieving our global health goals and objectives. Let's take, for example, an evidence-based life-saving intervention that's 100% effective. If it cannot be implemented, that is, implementation = 0, then we wind up with no improvement in outcomes. Likewise, if we have a highly effective intervention that has been successfully implemented in one context, let's say a strong health system, but cannot be successfully implemented in a weak health system, we again have no improvement in outcome in that alternate setting. This understanding is clearly pivotal for success in achieving our new global health goals and objectives.

So, the John Snow moment brought us epidemiology, then evidence-based clinical and public health practice, and we're now in the early days of this new important discipline of implementation science.

### The Edward Jenner moment

That brings us to our third and last moment, “the Edward Jenner moment,” which, like the other two, have, after prolonged gestations, brought us to a third stream key to our global health triumph.

Edward Jenner is often called the father of immunology because he pioneered the first vaccine—the smallpox vaccine. In 1796 he inoculated James Phipps, the son of his gardener, with cowpox. After later inoculating and evaluating others, he concluded that those he vaccinated were immune to smallpox.

Smallpox killed an estimated 300–500 million people in the 20th Century alone, representing about one-third of those infected. Happily for the course of American history, Abraham Lincoln, who was in the incubation period of smallpox when he delivered the Gettysburg address, was one of the survivors.

An improved vaccine and the development of the bivalve needle, which improved administration of the vaccine, provided *effective interventions* that were key to the eradication of smallpox. Fixsen's formula for achieving a successful outcome requires *effective implementation* as well. Bill Foege, a public health giant who helped lead the smallpox eradication program, said in his book *House on Fire* [5] that much of the success of the campaign was due to innovations in the delivery of the vaccine. In other words, it was not only imperative that we had a highly effective vaccine but also a highly effective program for delivering it. It took political will and priority along with interdisciplinary teams, governmental and nongovernmental agencies, and scientists and implementers—all working hand in hand.

Born, in part, from concerns regarding a shortage of vaccine supplies, Dr. Foege and his team recommended use of a new surveillance and containment strategy as an alternative to the mass vaccination strategy used in other vaccination programs, and used initially in the smallpox program. Dr. Foege tells a story in his book about a key moment in the deployment of this innovative approach, when a young physician convinced a skeptical minister of health in India to try it, saying that if a house were on fire in a village, they would put water on the house that was burning where it would do the most good (the surveillance and containment strategy) rather than putting water on other houses in anticipation that the fire might spread (the mass vaccination strategy). That moment proved to be pivotal to the continued use of the surveillance and containment strategy and the ultimate success of the eradication program.

So it was innovations not only in technologies—highly effective vaccines and bivalve needles—but also in delivery that made it possible for WHO to declare that smallpox had been eradicated in 1980, 3 years after the last two cases were identified. This greatest global health triumph in history is celebrated today with a statue on the front lawn of WHO's headquarters in Geneva, Switzerland. One of the most important lessons learned is that all global health triumphs will occur in the context of health systems. These systems, which, ideally, become *enabling contexts*, complete Fixsen et al.'s equation and must be sufficient to support successful implementation.

This Edward Jenner moment leads us to the last of our three streams—systems science and the imperative of health system strengthening. Six WHO building blocks are essential for all functioning health systems: leadership and governance, health information, service delivery, the health workforce, financing, and medical products. Now we can take all three streams and weave them together. Improvement and implementation science deal primarily with leadership and governance, service delivery, and the health workforce. Systems science deals with the functioning and the interaction of the whole system—all six building blocks. These three streams—evidence-based practice and implementation science, improvement science, and systems science and health systems strengthening—will be key to achieving the potential of this golden moment for women's, children's, and adolescents' health.

### Political will, science and technology, and partnerships

Many of us are old enough to remember the day that President John F. Kennedy delivered his speech at Rice University declaring that we would put a man on the moon. That vision, 53 years ago, was hard to even imagine. Most of us who remember that speech recall him saying

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