

## Not the Last Word: Ponseti Broke the Iron Triangle

Joseph Bernstein MD

If you are reading this column on a smartphone or tablet, you are holding in your hand more computer power than NASA used to put a man on the moon. In the four dozen years since Neil Armstrong took his famous steps, computer chips have gotten a billion times faster, and the price of a transistor fell from more than USD 8 to less than a penny.

The trend of improved computer efficiency follows what is known as

Moore's Law. Gordon Moore [14], the founder of Intel, observed that every 18 months or so, engineers double the number of processors that can be etched on a computer chip.

Over the years, health care has also gotten markedly better, but certainly not any cheaper. In 1969, Americans spent USD 65 billion on health care; in 2016, Americans spent USD 3.3 trillion [4]. Even accounting for inflation, that's a 758% increase.

The link between better health care and higher spending has been designated "The Iron Triangle of Health Economics" by William Kissick, a physician on President Lyndon Johnson's team that drafted the original Medicare law. In his book, *Medicine's Dilemmas* [12], Kissick claimed that health care systems can increase access, improve quality, and contain costs— but not simultaneously. These three aims are rigidly linked, such that any one might be attained, but only by compromising on the other two.

Of course, neither Moore's Law nor Kissick's Triangle describes an inviolate rule of nature. For one thing, the doubling of computer chip density cannot go on forever. Inevitably, the girth of an electron, small as it is, makes it impossible to stuff another transistor within the confines of a single

chip. Similarly, the Iron Triangle has already shown some cracks, too.

One example is the work of Ignacio Ponseti treating clubfoot [15]. As many readers know, Ponseti described an elegant method of serial manipulation of an infant's foot to reshape the deformity and produce near-normal alignment. The Ponseti method not only provided superior outcomes compared to open surgical procedures, it allowed treatment to be offered in remote areas and at lower cost.

Ponseti's method is simple, but the Iron Triangle can be broken with cutting edge technology, too. For example, the alpha-defensin [9] assay for periprosthetic infection is a likely triangle-breaker, and it is based on extremely sophisticated science. Its inventor, Carl Deirmengian, correctly surmised that synovial fluid white cells express different genes depending on their stimulus. From this insight, he built a test with "the best diagnostic performance" [19]. Still, the assay might break the Iron Triangle not because of its power, but because it, like the Ponseti method, promotes new modes of care. Currently, postoperative arthroplasty care must be offered by an arthroplasty expert. The alpha-defensin assay—a binary test that can be interpreted by the non-maven—will help topple that traditional model. Simplifying the work-up for possible postoperative infection might allow more patients to travel to regional centers of excellence for surgery

---

*A note from the Editor-in-Chief: We are pleased to present to readers of Clinical Orthopaedics and Related Research® the next Not the Last Word. The goal of this section is to explore timely and controversial issues that affect how orthopaedic surgery is taught, learned, and practiced. We welcome reader feedback on all of our columns and articles; please send your comments to [eic@clinorthop.org](mailto:eic@clinorthop.org).*

The author certifies that neither he, nor any members of his immediate family, have any commercial associations (such as consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research®* editors and board members are on file with the publication and can be viewed on request.

The opinions expressed are those of the writers, and do not reflect the opinion or policy of *Clinical Orthopaedics and Related Research®* or The Association of Bone and Joint Surgeons®.

Joseph Bernstein MD (✉), University of Pennsylvania, 424 Stemmler Hall, Philadelphia, PA 19104, USA, Email: [orthodoc@uphs.upenn.edu](mailto:orthodoc@uphs.upenn.edu)

---

J. Bernstein, Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA, USA

## Not the Last Word

and get their followup back home. With that, we reap the increases in quality, access, and cost savings that only regionalized care can provide.

Ponseti's method and the alpha-defensin assay both contain a key element of what Christiansen [10] calls "disruptive innovation." Indeed, they don't merely tweak prior paradigms, they upend the status quo. Disruptive innovation is needed to break the Iron Triangle. We don't have enough of it.

The shortage of disruptive innovation has many causes. Yes, geniuses like Ponseti and Deirmengian are always in short supply, and in health care, failure with a new treatment invites a lawsuit. The main impediment to disruptive innovation in medicine, however, is bureaucratic: The need for governmental approval and third-party payer acceptance.

Getting governmental approval can be tough. The law demands that drug companies, for example, demonstrate that their products are "safe and effective" [1]—a prodigious undertaking. Even with governmental approval, disruptive innovation can be blocked by third-party payer resistance. To get around that, I endorse programs that encourage people to spend their own money on health care, such as medical spending accounts [2]. This will not only liberate the funds to pay for disruptive innovation, it will inject greater vigilance into the process: When people spend their own money, they care more about costs.

Disrupting the third-party payer system is of course a radical move. Then again, the Apollo moon shot was the product of fundamental change as well. Before 1957, the federal government barely invested in scientific education. Thereafter, with the successful Soviet launch of the Sputnik satellite, Congress was spurred to pass the National Defense Education Act, dedicating

billions of dollars to university science departments. This funding not only supported the efforts of the space program but, as President Barack Obama acknowledged in his 2011 State of the Union Address [20], "unleashed a wave of innovation" in myriad fields.

We now need a wave of innovation in health care. Overspending on health care is probably a greater threat to the United States than Sputnik ever was. We need to break the Iron Triangle, and we must disrupt things that stand in the way of that goal.

**Stuart L. Weinstein MD**  
**Ignacio V. Ponseti Chair and**  
**Professor of Orthopaedic Surgery**  
**University of Iowa Hospitals and**  
**Clinics**

I was stimulated by Dr. Bernstein's essay on breaking the "Iron Triangle" and will use it as a platform to address some of the issues he raised, and express a somewhat-related but tangential opinion. Having worked with Ignacio Ponseti for 36 years, I would beg to differ that the impediment to the adoption of his disruptive innovation method of treatment for clubfoot had anything to do with government bureaucracy or third-party players. In fact, the failure to adopt this less costly, more effective treatment has more to do with failure of the orthopaedic community to adopt a method first described in 1963 [18] with excellent short-, mid- and long-term results [8, 13]. It was only because of the emergence of the Internet and concerned parents of affected children seeking a more-effective way of treating their children that turned the tide.

While disruptive innovations will appear from time to time, it is unfortunate that not only in orthopaedics, but in medicine in general, the time it takes for translational research to be adopted into practice is staggeringly long. Again, this is not due to government bureaucracy,

but rather the passive way scientific information is transmitted [3, 16]. In America, we have a costly and unsustainable health care system where care is often fragmented and quality variable, both of which erode access to care. I am, however, optimistic that we as physicians can collectively, within our individual delivery systems and our professional organizations, work to help define what "quality" musculoskeletal care is and lower costs, which in turn should broaden access. From 2002 to 2015 all physician groups fought to eliminate the flawed Sustained Growth Rate formula under which physicians were paid under Medicare and which often set the standard for third party payers. In 2014 and 2015, the MACRA legislation (The Medicare Access and CHIP Reauthorization Act of 2015) [5] was passed with broad bipartisan support. For the first time in recent memory, members of Congress asked for physician professional society input and incorporated much of that input into the legislation, with the goal of having the physician community help determine the parameters of value and quality. And while the system is still undergoing refinement [6], this legislation put the ball squarely in the physician community's court to come up with the determinants of quality and value by the development of clinical practice guidelines, appropriate use criteria, performance measures, and registries [11].

While many physicians feel that these measures represent further intrusions into their practices, it is clear that either we as physicians must lead these efforts, or we and our patients will suffer from decisions made by a government that likely will base its decisions on cost rather than quality. I am excited that an increasing number of our young orthopaedic graduates are pursuing advanced degrees to ensure that our orthopaedic community leads in the health care

## Not the Last Word

delivery reform that I believe will break the “Iron Triangle.”

**Thomas Parker Vail MD**

**James L. Young Professor and Chair**

**University of California, San Francisco**

Dr. Bernstein argues that “we need a new wave of innovation in health care,” and cites several examples of technology advancements. Most intriguing, yet paradoxical, is the observation that the “low-tech” Ponseti method may be among the most impactful contributions in recent orthopaedic history. While acknowledging the irony of the Ponseti breakthrough, one must agree that the pace of general technology advancement in the last 2 decades (witness the computer chip) has been nothing short of staggering.

In orthopaedic surgery, technology advancements derived from powerful computing, digital imaging, and electronic health records (EHR) have provided substantial benefits. However, technology has also created unanticipated consequences. For example, EHR systems promise enlightened communication and improved access to information at the point care, yet are associated with increased burden of documentation without fully delivering on their original promise. The consequence is that physicians experience burnout at higher rates related in part to the burden of EHR technology [17].

We currently sit at the intersection of pressing clinical and economic necessities, advancements in relevant fields of science, and emerging technology breakthroughs [21]. Digital technology and regenerative science lead the list of promising fields that could deliver some of the needed breakthroughs if applied specifically to solving musculoskeletal health challenges. For example, we are beginning

to witness the potential power of cell-based therapy, genome science, and artificial intelligence to substantially catapult forward our diagnostic and therapeutic capabilities. Accelerated translation of key technology from other fields will require a highly focused strategy that develops those unique ideas that sit at that intersection of need, science, and technology. That intersection is where disruption occurs. If that connection with other fields can be achieved, then musculoskeletal health is poised for a renaissance.

Disruptive innovation creates a new market or value network, potentially displacing existing business models and products [7]. In the medical context, disruption must deconstruct the constrained relationship between access, quality, and cost [12]. The best possible innovation scenario is simple and low-cost technology with broad impact, while the least desirable scenario is technology with high cost and low impact. Technology that disrupts, or solves a pressing clinical need is far more important than new technology that does not lead to positive societal impact. In orthopaedics, we clearly have a large component of the former, but we may also have too much of the latter.

### References

- Bernstein A, Bernstein J. An information prescription for drug regulation. *Buff L Rev*. 2006;54:569–6158.
- Bernstein J. Not the last word: JoeCare: Free health insurance coverage for all. *Clin Orthop Relat Res*. 2017;475:1537–1543.
- Brownson RC, Kreuter MW, Arington BA, True WR. Translating scientific discoveries into public health action: How can schools of public health move us forward? *Public Health Rep*. 2006;121:97–103.
- Centers for Medicare & Medicaid Services. Historical. Available at: <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html>. Accessed April 3, 2018.
- Center for Medicare & Medicaid Services. The Medicare Access and Chip Reauthorization Act of 2015: Path to value. Available at: <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/MACRA-MIPS-and-APMs/MACRA-LAN-PPT.pdf>. Accessed April 25, 2018.
- Center for Medicare & Medicaid Services. What’s MACRA? Available at: <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/MACRA-MIPS-and-APMs/MACRA-MIPS-and-APMs.html>. Accessed April 25, 2018.
- Christensen CM. *The Innovator’s Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, MA: Harvard Business School Press; 1997.
- Cooper DM and Dietz FR. Treatment of idiopathic clubfoot. A thirty-year follow-up note. *J Bone Joint Surg Am*. 1995;77:1477–1489.
- Deirmengian C, Kardos K, Kilmartin P, Cameron A, Schiller K, Parvizi J. Diagnosing periprosthetic joint infection: Has the era of the biomarker arrived? *Clin Orthop Relat Res*. 2014;472:3254–3262.
- Hwang J, Christensen CM. Disruptive innovation in health care delivery: a framework for business-model innovation. *Health Aff (Millwood)*. 2008;27:1329–1335.
- Jevsevar DS, Karl JW, Bhandari M, Bozic KJ, Piasio MA, Weinstein SL. Evidence, quality, costs, and reimbursement: Connecting the dots. *AAOS Instr Course Lect*. 2016;65:567–575.
- Kissick WL. *Medicine’s Dilemmas: Infinite Needs Versus Finite Resources*. New Haven, CT: Yale University Press; 1994.
- Laaveg SJ, Ponseti IV. Long-term results of treatment of congenital club foot. *J Bone Joint Surg Am*. 1980;62:23–31.
- Moore GE. Cramming more components onto integrated circuits. *Proceedings of the IEEE*. 1998;86:82–85.
- Morcuende JA, Dolan LA, Dietz FR, Ponseti IV. Radical reduction in the rate of extensive corrective surgery for clubfoot using the Ponseti method. *Pediatrics*. 2004;113:376–380.
- Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: Understanding time lags in translational

**Not the Last Word**

- research. *Journal of the Royal Society of Medicine*. 2011;104:510–520.
17. Noseworthy J, Madara J, Cosgrove D, Edgeworth M, Ellison E, Krevans S, Rothman P, Sowers K, Strongwater S, Torchiana D, Harrison D. Physician burnout is a public health crisis: A message to our fellow health care CEOs. Available at: <http://healthaffairs.org/blog/2017/03/28>. Accessed April 30, 2018.
  18. Ponseti IV, Smoley EN. Congenital club foot: The results of treatment. *J Bone Joint Surg Am*. 1963;45:261–344.
  19. Saleh A, Ramanathan D, Siqueira MBP, Klika AK, Barsoum WK, Rueda CAH. The Diagnostic Utility of Synovial Fluid Markers in Periprosthetic Joint Infection: A Systematic Review and Meta-analysis. *J Am Acad Orthop Surg*. 2017; 25:763–772.
  20. The White House. Remarks by the President in the state of the union address. Available at: <https://obamawhitehouse.archives.gov/the-press-office/2011/01/25/remarks-president-state-union-address>. Accessed April 3, 2018.
  21. Vail TP. A musculoskeletal moonshot: Accelerating orthopaedic innovation. *J Bone Joint Surg Am*. 2018;100: 627–628.