8TH ANNUAL MEETING 2023

JUNE 17, 2023 HOTEL DEL CORONADO, SAN DIEGO

Codman Shoulder Society

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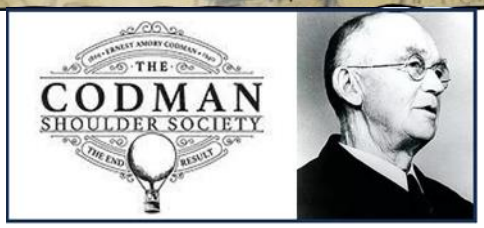


Innovators, Entrepreneurs, Behaviors, and Culture
Value-Based Healthcare
Leadership & Career Development

Codman Shoulder Society Meeting 2023 Group Photo

Front row: Matthew Provencher, Jon Ticker, Joaquin Sanchez-Sotelo, Bassem ELHassan, David Jevsevar, Alan Friedman (J3P Healthcare Solutions), Lanny Johnson, James Esch, Jon "JP" Warner, Ron Adner, Christian Gerber, Benjamin Byers (DePuy Synthes), Porter Jones, John Macy, Tim Lanier (Stryker)

Back row: Sarah Shubert, Ryan Cole, Ryan Whalen, Megan Plain, Phob Ganokroj, Abdulaziz Ahmed, Cory Stewart, Chuck Smark, Greg Alberton, Eric Wagner, Mustafa Rashid, Daniel Hatch, Peter Vezeridis, Eric Bowen (Zimmer-Biomet), John Costoros, Brett Sanders, Sarah Koljaka, Rod Allen (Smith & Nephew), Matthew Galati, Kyong Min, Orsa Britton (Zimmer-Biomet), Jason Burns (MyHealthTrack)

In blue: former & current fellows, others working in Boston Shoulder Institute

Not pictured: David Nichols, Matthew Putnam, John Sperling, Emilie Cheung

2023 CSS Meeting Agenda

4:00-4:25PM	Cocktail Reception
4:25-4:35PM	Group Photo
4:35-4:40PM	Introduction to the Meeting & Speakers (J.P. Warner)

PART I: Innovators, Entrepreneurs, Behaviors and Culture

4:40-4:50PM	**Dr. Jon "J.P." Warner**: Welcome — Innovation & Entrepreneurship: What Is It? Who Does It? Which Structures and Cultures Allow or Prevent It?
4:50-5:10PM	**Prof. Christian Gerber**: What Drives Scientific Creativity and Innovation?
5:10-5:30PM	**Dr. Lanny Johnson**: Innovation & Entrepreneurship: Scaling Your Idea Outside the Box
5:30-6:00PM	**Prof. Ron Adner**: Innovating the Healthcare Ecosystem: The Case of IPT
6:00-6:40PM	***Panel Discussion***: C. Gerber, L. Johnson, R. Adner, John Macy M.D., Derek Haas (via Zoom) **Moderators**: JP Warner & Porter Jones, M.D., M.B.A.

Part II: The Avant-Garde Health/CSS VBHC Research Group Update

6:40-7:10PM	***Working Dinner & Presentation***: Porter Jones, M.D., M.B.A. & Derek Haas, M.B.A. (via Zoom)

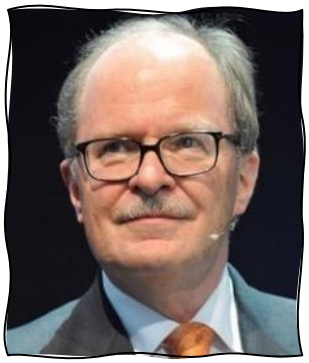
Part III: Leadership & Career Development

7:10-7:20PM	**Dr. Jon "J.P." Warner**: Introduction: Leadership and Career Development
7:20-7:40PM	**Mr. Alan Friedman**: Using a Data-Based Approach to Innovation, Collaboration and Outcomes
7:40-8:10PM	***Panel Discussion***: David Jevsevar, M.D., M.B.A. (*CEO, OrthoVirginia*) Tim Lanier (*VP & GM Stryker Upper Extremity*), Benjamin A. Byers, PhD, (*Global Marketing Director, Soft Tissue Solutions, DePuy Synthes, Johnson & Johnson*)

SPEAKERS BIOS

Jon "J.P." Warner, M.D. is the Co-Chief of the **Mass General Shoulder Service**, Vice Chair for Quality & Safety for MGH Orthopedics, and Professor of Orthopedics at Harvard Medical School. He is the founder of The Codman Shoulder Society, a network of experts dedicated to improving outcomes for patients through research and clinical collaboration. He is also the founder of the Boston Shoulder Institute, a patient portal for shoulder orthopedics education and outcomes data analysis and transparency.

In addition, he founded the New England Shoulder and Elbow Society, a not-for-profit educational program which fosters collaboration among all shoulder and elbow surgeons in the New England region. He is also President-elect of the San Diego Shoulder Institute, the leading international course for shoulder education and oldest program of its kind. Dr. Warner's postgraduate education included fellowships in Shoulder and Sports Medicine both in the United States and Europe. He is a 2019 alumnus of the Executive Program (alternative eMBA program) at Harvard Business School.



Christian Gerber, M.D., F.R.C.S. is Emeritus Chair of Orthopedics at the **Balgrist Klinik, University of Zurich** and Founder and Director of the RESORTHO Foundation, Balgrist Campus Research Center. He is also the Founder of the Dominik Meyer Award for Discovery, Innovation, and Disruption in Orthopedics. He is arguably the most influential surgeon of his generation, personifying the ideal of the surgeon-scientist. His work has been honored with numerous

awards, including his Kappa Delta OREF Clinical Research Award (First Non-American Awardee) for his body of work on Rotator Cuff Tear Treatment: Bench to Bedside. He is one of the few researchers to win the esteemed Neer Award of the American Shoulder and Elbow Society (ASES) four times. He is also the recipient of the Didier Patte Award of the European Society for Shoulder and Elbow, the Silver Medal of Merit of the state of Zurich (for extraordinary achievements in science), the Arthur Steindler Award of the Orthopaedic Research Society, and many more. He has published 475 original research papers and has an H-index of 109 with 43,300 citations (Google Scholar). He has been an invited lecturer for societies and meetings all over the world.

His research has resulted in paradigm shifts for shoulder care, including the first description of isolated subscapularis tendon tears, the development and application of latissimus dorsi transfer for irreparable rotator cuff tears, the patho-anatomy and etiology of rotator cuff tears and the optimization of surgical repair strength, the durability of the Latarjet procedure for shoulder instability, the etiology and solution for refractory posterior shoulder instability, the classification of proximal humerus fractures and the natural history of avascular necrosis, techniques for shoulder arthroplasty, and many more. He has also developed many products including shoulder arthroplasty implants and instruments for shoulder surgery.

Most importantly, he has inspired and educated an entire future generation of surgeon-scientists who will carry on with his unique combination of curiosity and scientific discipline in order to improve the lives of orthopedic patients.

Over the course of his career in private practice, ***Lanny Johnson, M.D.***'s focus has been the improvement of patient care. He is certainly one of the most successful innovator entrepreneurs in orthopedic surgery. As such, he was one of the pioneers of arthroscopic surgery with the invention of motorized instrumentation. He was perhaps the first to offer a primitive method to stabilize the shoulder and to demonstrate the arthroscopic technique for the elbow, wrist, hip, ankle, and even the temporal mandibular joint. Dr. Johnson's patient-focused interests coupled with curiosity and vision resulted in over 80 U.S. patents related to orthopedic surgery (e.g., bio-absorbable implants).

His interests expanded to developing an Electronic Medical Record (EMR) in 1980 to create a more efficient practice. The data provided by the EMR granted him comprehensive insight into

the outcomes and value of his practice. This led to a novel means of controlling one's practice by offering a package care product to insurers with a fixed fee less than present profile, including a financial warranty that was published in Arthroscopy. This was likely the first ever surgeon-designed bundle for arthroscopic surgery.

Over the course of his career, Dr. Johnson was visited by many notable surgeons whom he greatly influenced. This includes Freddie Fu, James Andrews, and many others.

Since concluding his clinical practice in 1996, Dr. Johnson has morphed to a basic scientist exploring the potential of a phytochemical, protocatechuic acid (PCA). This benzoic acid is found throughout nature, common to the human diet, and manufactured in small amounts by the bacteria in the human large bowel. The F.D.A. has determined that PCA is generally recognized as safe (G.R.A.S.), now with more than 20 patents on the potential clinical applications — a broad-spectrum antibiotic, biofilm destroyer, and antiviral for SARS CoV2 and other encoated viruses. Even more surprising is the anabolic nature of PCA. It has been shown to turn on the gene for IGF-1 in human and animal synovium and has the potential to be a DMOAD. In addition, there is basic science evidence that PCA causes human osteoblasts and mesenchymal stem cells to produce bone, i.e., fracture healing and treatment for osteoporosis.

In between his medical and scientific pursuits, he had a 10-year stent as a certified instructor on the PGA tour.

Ron Adner, Ph.D. is the Nathaniel D'1906 and Martha E. Leverone Memorial Professor of Business Administration and Professor of Strategy and Entrepreneurship at the **Tuck School of Business at Dartmouth College**. Prior to joining Tuck, he was the Akzo-Nobel Fellow of Strategic Management at INSEAD, where he served on the faculty for ten years.

Dr. Adner's award-winning research introduces a new perspective on value creation and competition when industry boundaries break down in the wake of ecosystem disruption. His two books, The Wide Lens: What Successful Innovators See that Others Miss (2012) and Winning the Right Game: How to Disrupt, Defend, and Deliver in a Changing World (October 2021) have been heralded as landmark contributions to the strategy literature. Clayton Christensen (*Innovator's Dilemma*) described his work as "path-breaking" and Jim

Collins (*Good to Great*) has called him “one of our most important strategic thinkers for the 21st century.”

Dr. Adner is an elected Fellow of the Strategic Management Society. He has held editorial and board positions in the leading peer-reviewed academic journals of his field, including the *Academy of Management Review, Management Science, the Strategic Management Journal*, and *Strategy Science*. His managerial articles have been published in outlets including *Harvard Business Review, The Atlantic, Fast Company, Forbes, Wired, The Financial Times,* and *The Wall Street Journal*.

Dr. Adner’s work is a rare convergence of rigorous academic research, profound managerial insights, and practical, powerful frameworks. Applied, tested, and validated in some of the world’s leading companies, his approach to seeing the strategic bigger picture has been transformative in driving effective innovation in both the corporate and social sectors.

Dr. Adner is founder of the Strategy Insight Group, whose mission is to help clients eliminate strategic blind spots and build robust go-to-market strategies in complex ecosystems, both internal and external. He is a keynote speaker, consultant, and advisor to companies around the world. His engagements have transformed strategy at Fortune 500 firms as well as at entrepreneurial startups. He is an accomplished teacher and a seven-time winner of the annual student-voted Award for Teaching Excellence at both Tuck and INSEAD (2000, 2002, 2003, 2004, 2005, 2011, 2019).

Dr. Adner holds a Ph.D. and an M.A. from the Wharton School at the University of Pennsylvania, as well as master’s and bachelor’s degrees in mechanical engineering from the Cooper Union for the Advancement of Science and Art.

John C. Macy M.D., M.H.C.D.S. is Chairman, Dept. of Surgery & and Chief of Mansfield Orthopedics at **Copley Hospital**, Morrisville, VT. Dr. Macy specializes in treating disorders and injuries of the shoulder, including arthritis, instability, rotator cuff tears, and shoulder replacement surgery. He recently received his Master’s in Health Care Delivery Science at the Amos Tuck School of Business/TDI, Dartmouth College in Hanover, NH. More recently, he

completed the Physician Executive Leadership Institute sponsored by the Vermont Medical Society Education and Research Foundation. He is a founding member and Co-Medical Director of Innovative Peri-Operative Technology (IPT, LLC) a health-tech start-up company focusing on real-time visibility and information for peri-operative asset management, waste reduction, and patient safety. He is a design surgeon for Shoulder Innovations, a comprehensive shoulder replacement system focusing on InSet™ technology that allows for improved bone fixation with minimally invasive, bone-sparring novel techniques. He also serves on many local and regional committees, including the Medical Executive Committee at Copley and the General Advisory Committee for the Green Mountain Care Board.

Dr. Macy has been a member of the American Shoulder & Elbow Society for 15 years, is a founding member of the New England Shoulder & Elbow Society (20 years), member of the Codman Shoulder Society and the immediate past president of the Vermont Orthopedic Society. He is also a Fellow of the American Association of Orthopedic Surgery and Arthroscopy Association of North America. A graduate of the University of Medicine & Dentistry of New Jersey, Dr. Macy performed his internship and residency at the University of Vermont – Fletcher Allen Health Care and completed the Transcontinental Shoulder Fellowship at Massachusetts General Hospital and Balgrist Klinic in Zurich, Switzerland. He has written several peer-reviewed scientific articles, reviewed articles for several journals since 2009, given many local, national and international presentations, and is involved with ongoing research focusing on patient-reported outcomes following shoulder surgery. He currently serves as a U.S. Ski Team physician, traveling internationally with the USSA Teams and works locally with the National Ski Patrol at Jay Peak, VT and as a volunteer physician at 3 Peaks Medical Clinic, Sugar Bush, VT. Dr. Macy is also the Medical Director for VLCT and VSBIT, dedicated to improving the quality of care of employees with work-related injuries. When not in the clinic or operating room, he enjoys the great outdoors, most notably mountain biking and back-country skiing. Dr. Macy and his family live in Shelburne, VT.

Porter Jones, M.D., M.B.A. currently serves as the VP of Clinical Transformation at **Avant-garde Health**, where he works with hospitals and surgery centers to implement value-based improvements. Dr. Jones is a seasoned healthcare professional with vast experience in hospital administration and the medical device industry. He spent four years at the Albert Einstein

Hospital in Sao Paulo, Brazil, where he managed the oncology department as well as the medical practice division. In this role, he also oversaw the quality, outcomes, health economics and the medical record departments. Porter is a graduate of The University of Utah School of Medicine and has a business degree from Harvard Business School.

Derek Haas, M.B.A. is the Founder and CEO of **Avant-garde Health**, a venture-backed company whose mission is to help physicians and hospitals understand and improve care quality and cost across the care continuum. He has written 9 Harvard Business Review articles and been quoted by the Wall Street Journal in a front-page article. Previously, he worked on the staff of the President's Council of Economic Advisers, for Bain & Co, at Harvard Business School, and launched a small business health insurance program in partnership with the Chambers of Commerce in Massachusetts. Avant-garde Health builds on his work as the Project Director and Fellow for Value-Based Health Care Delivery at the Harvard Business School, where he works with health care providers to help them better measure and manage their costs. Derek also teaches HBS executive education courses related to value management in health care. Derek holds an M.B.A. and a B.A. in Economics from Harvard University, where he was elected to Phi Beta Kappa.

Alan Friedman, M.A. is the founder and CEO of **J3P Healthcare Solutions**. He is a trusted advisor and coach to senior healthcare leaders. His thought leadership has influenced organizations throughout the United States, Italy, France, the United Kingdom, Argentina,

Mexico, Guatemala, Australia, and Canada. Since founding J3P Healthcare Solutions, he has led J3P's extensive research efforts, in collaboration with nationally and internationally ranked academic programs, resulting in numerous publications in high-impact, peer-reviewed journals. He is known as a dynamic and engaging presenter and educator, adept at engaging clinical students, residents, physicians, nurses, and healthcare leaders. His role as executive coach to clinicians and leaders provides the foundation for J3P's unique approach to individualized development on behalf of healthcare organizations.

David S. Jevsevar, M.D., M.B.A. is CEO of **OrthoVirginia**, having joined the organization in 2022. He was previously Chair of the Department of Orthopaedics at the Geisel School of Medicine at Dartmouth and Vice President of the Orthopaedic Service Line for Dartmouth-Hitchcock Health. Dr. Jevsevar has had a long involvement with value-based care including evidence-based medicine, clinical program and care pathway development, quality and performance improvement, and clinical/patient–reported outcomes. He is active within the American Academy of Orthopaedic Surgeons (AAOS), serving as Chair of the Council on Research and Quality and ex-officio member of the AAOS Board of Directors. He is also currently Chair of the American Association of Hip and Knee Surgeons Evidence-based Practice Committee and was previously Vice-President of the New Hampshire Orthopaedic Society. Dr. Jevsevar's clinical practice is focused on hip and knee arthroplasty.

Tim Lanier, B.S. was appointed VP & GM, Upper Extremities at **Stryker** in July 2016. He has recently been promoted to President of Extremities and Trauma for Stryker. He has over 35

years of medical device and commercial operations experience. His career has taken him through the vascular, oncology, ophthalmology, and orthopaedic arenas. Mr. Lanier has earned a reputation for building world-class teams and organizations. He is laser-focused on one thing, “setting the strategic plan for how we lead in and transform the Upper Extremity market, primarily in the shoulder marketplace.” Mr. Lanier’s passion for winning is equally reflected in the passion he has for the people he leads.

Benjamin A. Byers, Ph.D. is the Senior Director of Sports Medicine at **DePuy Synthes** where he leads its global soft tissue solutions business. With over 17 years of medical device experience spanning both marketing and research & development, Dr. Byers’ orthopaedic device career has included experiences in sports medicine, spine, trauma, biologics, and health system marketing. Taking a page from the playbook of his most impactful managers and mentors over a career at Johnson & Johnson, he places a centralized focus on building and cultivating diverse teams that deliver complementary skills and perspectives to enable efficient adaptation to the ever-evolving medical device marketplace.

All speaker videos are posted to **Vumedi** and **YouTube**. If you are a physician, health professional, or hold an allied health position in business, you may join Vumedi for free and access this program through Vumedi links.
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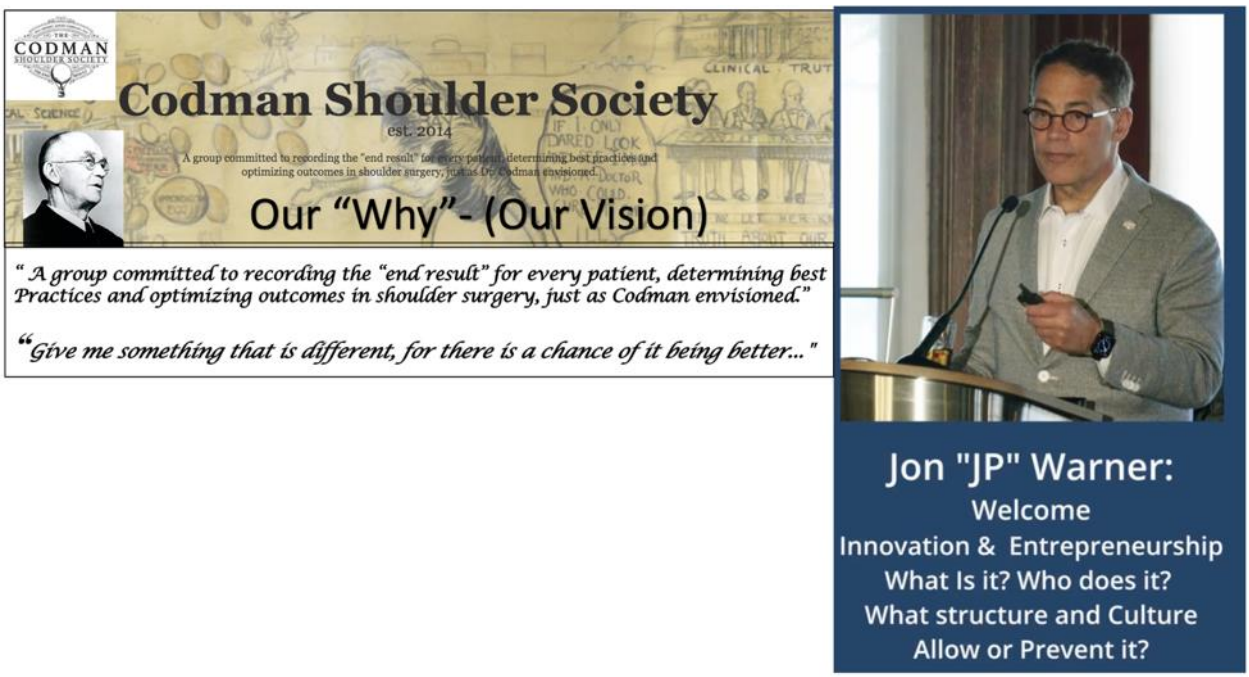


Video Link to Dr. Warner's Introduction of the 8th Annual Codman Shoulder Society Meeting:
Welcome - Innovation & Entrepreneurship: What is it? Who does it? What Structures and Cultures Allow or Prevent it? (contributor: Jon J.P. Warner)
VuMedi | YouTube

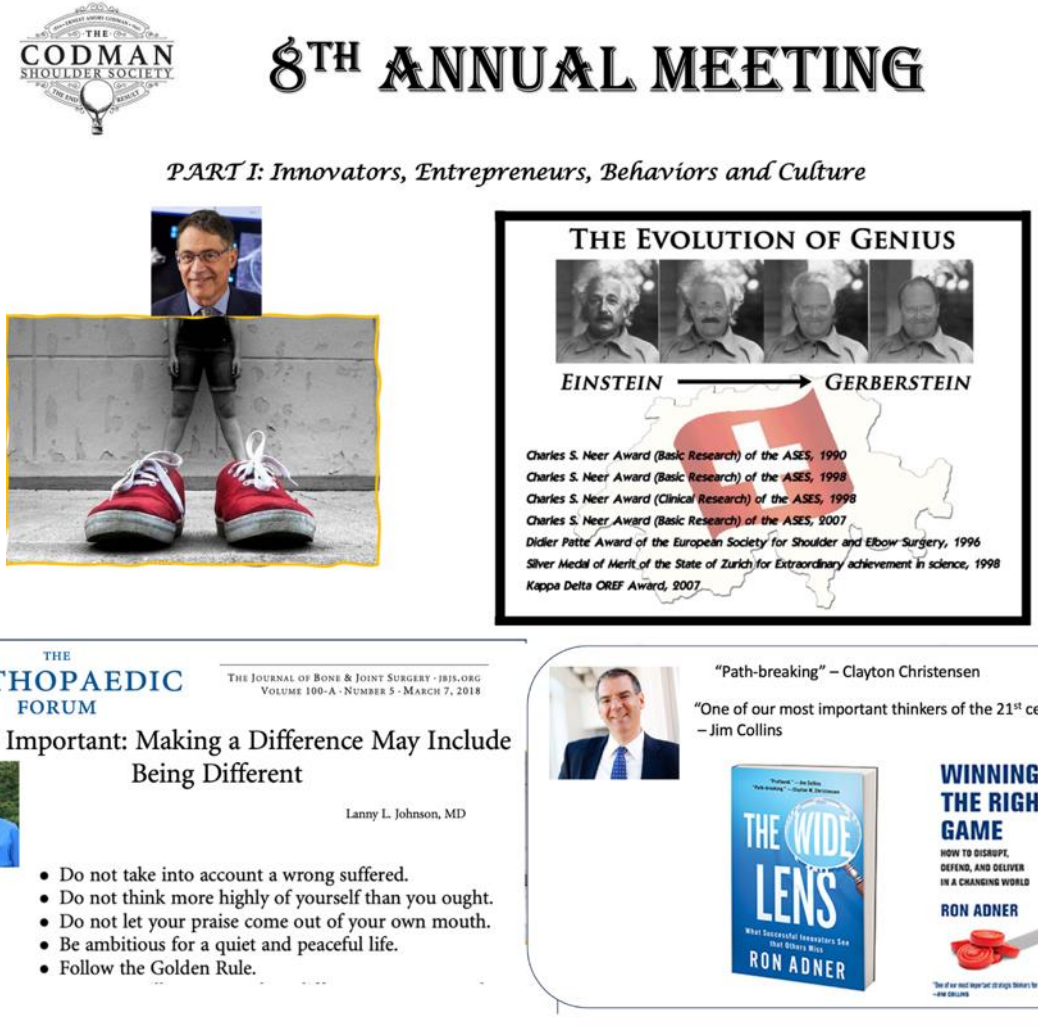
Summary: Dr. Warner's Welcome and Introduction:

The history of the Codman Shoulder Society Meeting (CSS):

- This is our 8th Annual meeting.

- Thank you to Dr. Jim Esch, Founder & CEO of the San Diego Shoulder Institute, and to Leslie Lebitski, COO of SDSI, for their ongoing support of the CSS. Congratulations on the 40th anniversary of the SDSI, the oldest and most revered shoulder meeting in the world.
- Thank you to our industry partners for their ongoing commitment in support of the SDSI every year.
- Our "Why" (our vision) is based on EA Codman's commitment to measurement of outcomes in order to improve care for our patients, and his aspiration for better care through innovation.
- The CSS is intended to be an opportunity for orthopedic business to connect with surgeons on matters relevant to advancing patient care.
- While we started out as an alumni meeting for the Boston Shoulder Institute Fellowship at Harvard, our mission and vision has changed as we are now an expert network of surgeons and industry representatives.
- Past topics have included:
    - Innovation – what it is and how we do it and why we do it? (Drs. Snyder, Burkhart, and Esch)
    - How can we use evidence-based approaches to improve the care we deliver? (Dr. Mohit Bandari)
    - How can we improve shoulder arthroplasty? (Dr. Robert Cofield)
    - How do we get better and why do we innovate? (Drs. Christian Gerber and Gilles Walch)
    - How do we measure outcomes and quality in healthcare? (Prof. Robert Kaplan)
    - Digital healthcare in the post-pandemic world (many industry representatives & start-up company founders)
- This year's program is in 3 parts.
    - ***Innovation & Entrepreneurism***
    - ***Value-Based Healthcare Collaboration between CSS & Avant-Garde Health***
    - ***Leadership & Career Development***

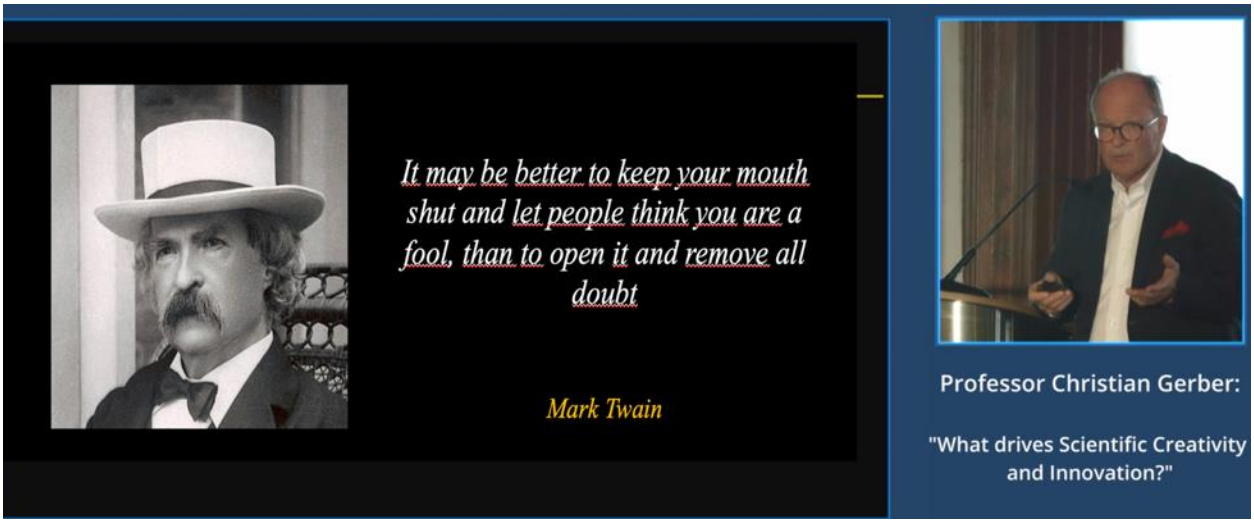
PART I: Innovators, Entrepreneurs, Behaviors and Culture



Summary: Dr. Warner's Introduction to Part I

- "Culture Eats Strategy for Breakfast" (Peter Drucker), so innovation and entrepreneurism can only flourish in environments where these endeavors are valued.
- Prof. Christian Gerber is perhaps the most influential and accomplished innovator in shoulder care of his generation. He will present on what he believes drives scientific creativity and innovation.
- Dr. Lanny Johnson discusses your own personal principles and the role they play in your success as an entrepreneur: "Making a difference by being different."
- Professor Ron Adner will talk about the strategic approach to innovation in the context of the innovation ecosystem required for an endeavor to scale and be successful. He will also present the start-up he and John Macy are working on which is intended to disrupt orthopedic inventory management in hospitals.
- Clayton Christensen and colleagues have defined the 5 critical behaviors of the most successful innovators (The Innovator's DNA):

    - Questioning to "Puncture the Status Quo"
    - Observing "with Intensity Beyond the Ordinary"
    - Networking to Create Diverse Connections.
    - Experimenting which is Central to Innovation.
    - Associational Thinking by Linking Ideas not Directly Related.
- Most innovations in shoulder surgery over the past half-century have come from outside of mainstream academia.
- The technology lifecycle requires that for a novel idea to succeed, it must serve the needs of the broader market by not creating major changes in processes and offering less expensive and higher value alternatives to the current status quo (***Crossing the Chasm*** by Geoffrey Moore)
- Finally larger organizations (such as AMCs) tend to hire leaders with better management skills and generally, innovation from these organizations are largely incremental.
- Smaller organizations often hire leaders who have disruptive skills and can thus create an environment for more radical (innovative) alternatives.
- "There is nothing more powerful and an idea whose time has come" (Victor Hugo)



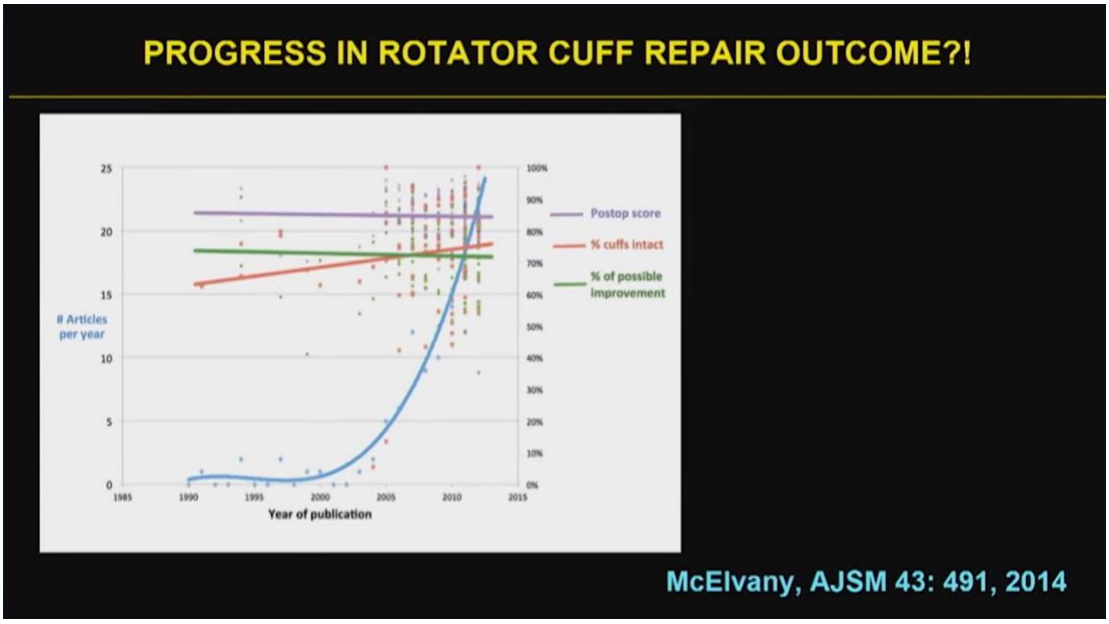
Video link to Prof. Christian Gerber's Talk:

What Drives Scientific Creativity and Innovation? (contributor: Christian Gerber)
VuMedi | YouTube

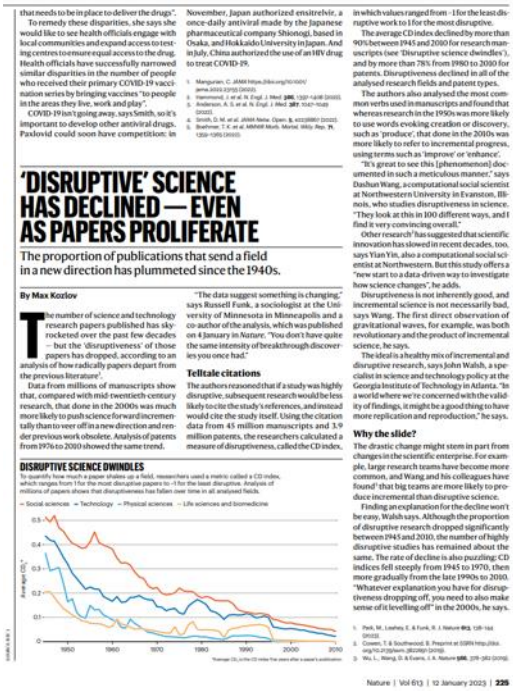
Summary of Prof. Christian Gerber's presentation:

- "Whatever I will be saying is completely unscientific."
- "What drives scientific creativity and innovation?"

- Medical knowledge has been expanding exponentially. Whereas the doubling time was an estimated 5 years back in 1950, it accelerated to 7 years in 1980, 3.5 years in 2010, and a projected 73 days by 2020, according to a 2011 study in Transactions of the American Clinical and Climatological Association:
    - "50% of this knowledge is new & 50% is disproving old knowledge."
    - "We "knew" that all rotator cuff tears are caused by subacromial impingement."
    - "We knew that the earth was a flat disc."
- "Our goal is to create knowledge that is beneficial for our patients."
- "The fact that we know something does NOT mean it is true." (Dominik Meyer, M.D.)
- "I do not believe in transmission of knowledge, as 50% of what I know is probably not true. I do believe in the transmission of enthusiasm and curiosity."
- "You can only light the fire of enthusiasm in someone else if it is first burning in you."
- "Brilliant people are not eager to learn. They are eager to understand." (R. Ganz)
- "Price is what you pay, value is what you get." (Warren Buffett)
- Since 1990, there have been over 4000 studies on rotator cuff repair outcome, and yet there has been no real improvement in our surgical results:



    - "Orthopedic research has been ineffective and increased irrelevant knowledge has not led to patient benefit."
    - "Research is neither centered on understanding nor patient benefit."
    - "Most of what is presented is "me too" research."



that needs to be in place to deliver the drugs".

To remedy these disparities, she says she would like to see health officials engage with local communities and expand access to testing centres to ensure equal access to the drug. Health officials have successfully narrowed similar disparities in the number of people who received their primary COVID-19 vaccination series by bringing vaccines "to people in the areas they live, work and play".

COVID-19 isn't going away, says Smith, so it's important to develop other antiviral drugs. Paxlovid could soon have competition: in November, Japan authorized ensitrelvir, a once-daily antiviral made by the Japanese pharmaceutical company Shionogi, based in Osaka, and Hokkaido University in Japan. And in July, China authorized the use of an HIV drug to treat COVID-19.

1. Mangurian, C. JAMA https://doi.org/10.1001/jama.2022.23703 (2022).
2. Hammond, J. et al. N. Engl. J. Med. 386, 1397–1408 (2022).
3. Anderson, A. S. et al. N. Engl. J. Med. 387, 1047–1049 (2022).
4. Smith, D. M. et al. JAMA Netw. Open 5, e2228807 (2022).
5. Boehmer, T. K. et al. MMWR Morb. Mortal. Wkly. Rep. 71, 1259–1265 (2022).

'DISRUPTIVE' SCIENCE HAS DECLINED — EVEN AS PAPERS PROLIFERATE

The proportion of publications that send a field in a new direction has plummeted since the 1940s.

By Max Kozlov

The number of science and technology research papers published has skyrocketed over the past few decades — but the 'disruptiveness' of those papers has dropped, according to an analysis of how radically papers depart from the previous literature[1].

Data from millions of manuscripts show that, compared with mid-twentieth-century research, that done in the 2000s was much more likely to push science forward incrementally than to veer off in a new direction and render previous work obsolete. Analysis of patents from 1976 to 2010 showed the same trend.

"The data suggest something is changing," says Russell Funk, a sociologist at the University of Minnesota in Minneapolis and a co-author of the analysis, which was published on 4 January in *Nature*. "You don't have quite the same intensity of breakthrough discoveries you once had."

Telltale citations

The authors reasoned that if a study was highly disruptive, subsequent research would be less likely to cite the study's references, and instead would cite the study itself. Using the citation data from 45 million manuscripts and 3.9 million patents, the researchers calculated a measure of disruptiveness, called the CD index, in which values ranged from –1 for the least disruptive work to 1 for the most disruptive.

The average CD index declined by more than 90% between 1945 and 2010 for research manuscripts (see 'Disruptive science dwindles'), and by more than 78% from 1980 to 2010 for patents. Disruptiveness declined in all of the analysed research fields and patent types.

The authors also analysed the most common verbs used in manuscripts and found that whereas research in the 1950s was more likely to use words evoking creation or discovery, such as 'produce', that done in the 2010s was more likely to refer to incremental progress, using terms such as 'improve' or 'enhance'.

"It's great to see this [phenomenon] documented in such a meticulous manner," says Dashun Wang, a computational social scientist at Northwestern University in Evanston, Illinois, who studies disruptiveness in science. "They look at this in 100 different ways, and I find it very convincing overall."

Other research[2] has suggested that scientific innovation has slowed in recent decades, too, says Yian Yin, also a computational social scientist at Northwestern. But this study offers a "new start to a data-driven way to investigate how science changes", he adds.

Disruptiveness is not inherently good, and incremental science is not necessarily bad, says Wang. The first direct observation of gravitational waves, for example, was both revolutionary and the product of incremental science, he says.

The ideal is a healthy mix of incremental and disruptive research, says John Walsh, a specialist in science and technology policy at the Georgia Institute of Technology in Atlanta. "In a world where we're concerned with the validity of findings, it might be a good thing to have more replication and reproduction," he says.

Why the slide?

The drastic change might stem in part from changes in the scientific enterprise. For example, large research teams have become more common, and Wang and his colleagues have found[3] that big teams are more likely to produce incremental than disruptive science.

Finding an explanation for the decline won't be easy, Walsh says. Although the proportion of disruptive research dropped significantly between 1945 and 2010, the number of highly disruptive studies has remained about the same. The rate of decline is also puzzling: CD indices fell steeply from 1945 to 1970, then more gradually from the late 1990s to 2010. "Whatever explanation you have for disruptiveness dropping off, you need to also make sense of it levelling off" in the 2000s, he says.

1. Park, M., Leahey, E. & Funk, R. J. *Nature* **613**, 138–144 (2023).
2. Cowen, T. & Southwood, B. Preprint at SSRN https://doi.org/10.2139/ssrn.3832269 (2019).
3. Wu, L., Wang, D. & Evans, J. A. *Nature* **566**, 378–382 (2019).

DISRUPTIVE SCIENCE DWINDLES

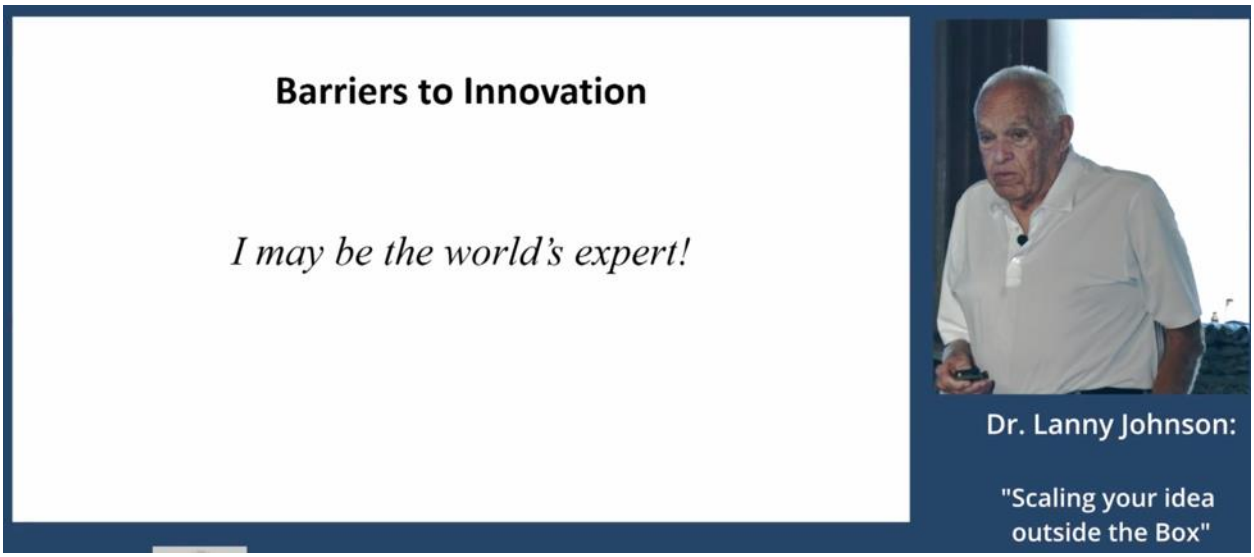
To quantify how much a paper shakes up a field, researchers used a metric called a CD index, which ranges from 1 for the most disruptive papers to –1 for the least disruptive. Analysis of millions of papers shows that disruptiveness has fallen over time in all analysed fields.

– Social sciences – Technology – Physical sciences – Life sciences and biomedicine

*Average CD, in the CD index five years after a paper's publication.

Nature. 613:225,2023

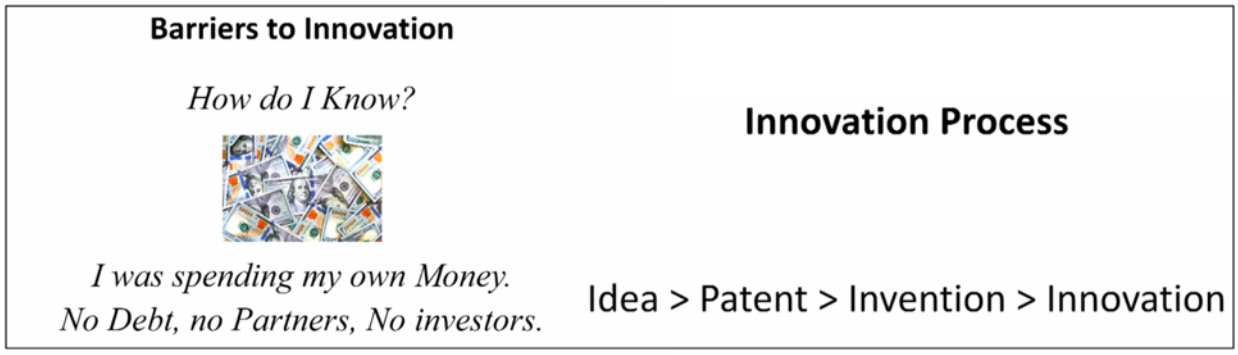
- "It is a miracle that curiosity can survive formal education." (Albert Einstein)
- "Experts extrapolate the past, they do not create the future." (Elon Musk)
- "The experts are the ones who review our papers and decide whether or not an innovation deserves publication."
- "Surgeons may be wrong, but they are never in doubt." (Judah Folkman)
- "Culture is the key issue if we want to progress."
- "We are unable to live in doubt and make up the best history we can and live as if this story were true." (Daniel Kahneman, 2002 Nobel Laureate)
- "The mind is like a parachute; it only works when it is open." (Frank Zappa)
- "Research is to see what everybody sees, and to think what nobody has thought before." (A. Szent Gyorgyi)
- "New ideas usually arrive in one brain. A team approach in trying to innovate is deadly; however, a team approach in validating a new idea is indispensable."
- "The great obstacle to discovery is not ignorance but the illusion of knowledge." (D.J. Boorstin)
- "If your experiment needs statistics, you should have done a better experiment." (Lord Ernest Rutherford)



Video link to Dr. Lanny Johnson's Talk:

Innovation and Entrepreneurship: Scaling Your Idea Outside the Box (contributor: Lanny Johnson)

VuMedi | YouTube



Summary of Dr. Lanny Johnson's Presentation:

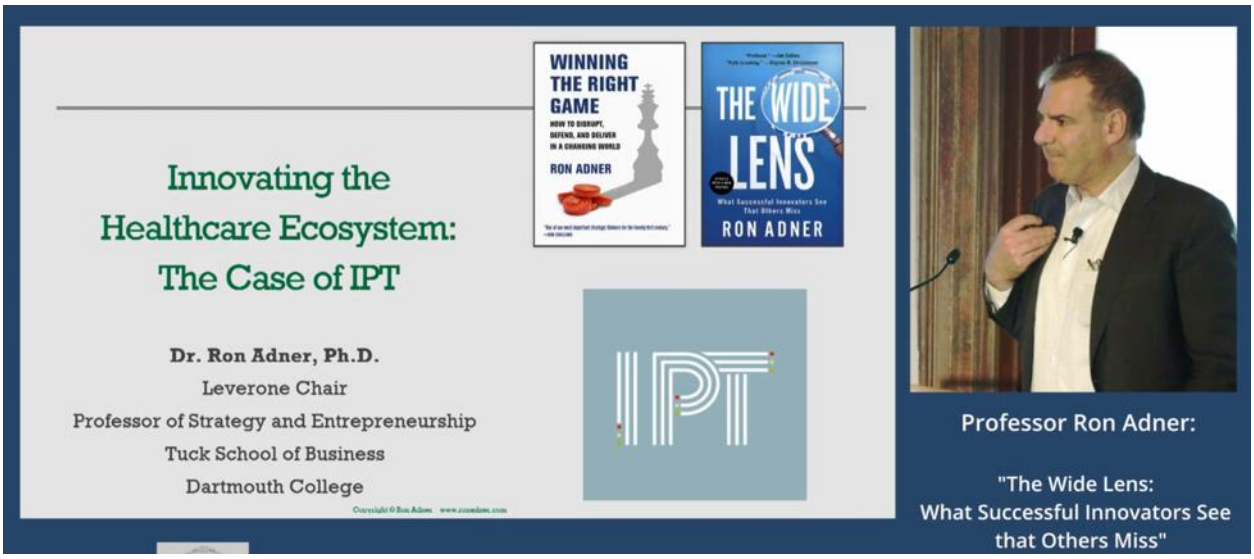
- "I might be the world's expert on barriers to innovation."
- The Innovation Process: Idea > Patent > Invention > Innovation
- An idea leads to a functional prototype, leads to better idea….
- The Route to Innovation:
    - Establishing: Google Literature search
    - No prior art: Google Patent search
    - No prior patent: Review commercial literature
    - Create specific patent claims.
    - Engage a patent attorney: patentable risk; ROI.

    - Review prior art: 3-5 years' time; 41% granted; 1% commercial success…must engage a patent attorney to submit patent.
- The Discovery Process: Idea > Invention > Innovation
    - Invention must be confirmed by issuance of a patent, but not yet an innovation.
    - Innovation translates to disruption due to bringing new value proposition to the market.
    - Need a business partner: Management; Manufacturing; Marketing; Sales; Distribution; Legal Protection.
- Barriers to Innovation:
    - Failure to observe
    - Observed but not felt to be worthy
    - "A series of one is better than a series of none"
    - "Stay curious all the time; the innovation is there waiting"
    - Over the past 10 years most innovation is spine; everything else is a 510k pathway
    - Practice Environment:
        - The individual – risk averse
        - The university – more interested in practice and $$ than innovation
        - "RIGID IRB"
    - Cost Benefit vs. ROI:
        - Your time: literature search and patent search
        - Prototype development costs
        - Attorney costs
        - Drawings and art
        - Patent office actions/responses: $10,000 to $50,000
        - 2017 tax law change: must sell entire entity to one party to get capital gains
    - Government communication is very poor.
    - FDA Regulation Barriers
    - EPA Barriers to innovation
    - IRB
    - Large Corporations – risk averse; not invented here (NIH)
    - Personal finance: Ford went bankrupt 3x and Edison 2x
- Success Factors:
    - Networking (like the Codman Shoulder Society)
    - Podium access
    - Publications
- Commercialization:
    - On your own
    - Collaborate with a strategic
    - Sell to a strategic
- TWO OPPORTUNITIES FOR THE CODMAN SHOULDER SOCIETY
    - Advanced research projects
    - Artificial intelligence

- Move from labor to management

Recognize the value of data!

- **A Business Plan for CSS:**
  - Member investor option
  - Data owned by investors.
  - No patent
- No regulation for member use
- Software not for sale
- Establish Al for diagnosis
- Establish surgical indications
- Measure outcomes
- Form self insurance
  - Sell associate membership
  - User right

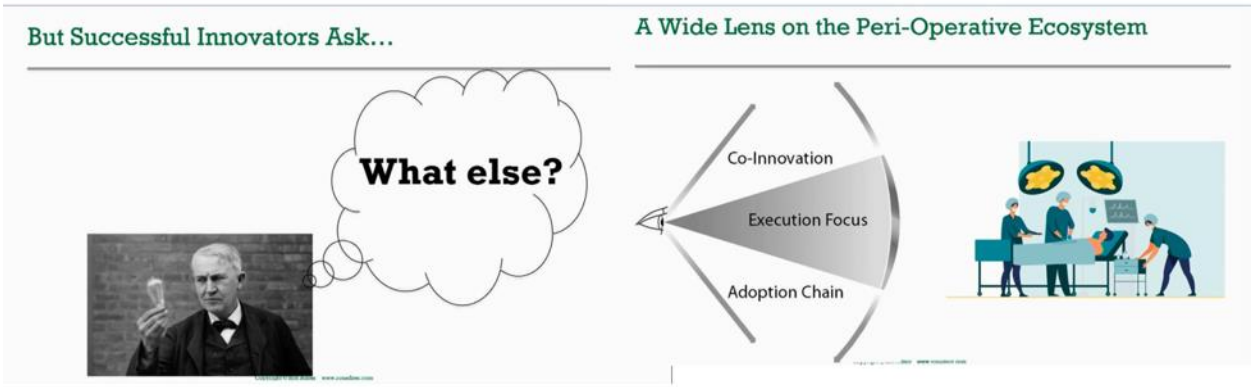


Video link to Prof. Ron Adner's Presentation:

The Wide Lens: What Successful Innovators See that Others Miss (contributor: Ron Adner)

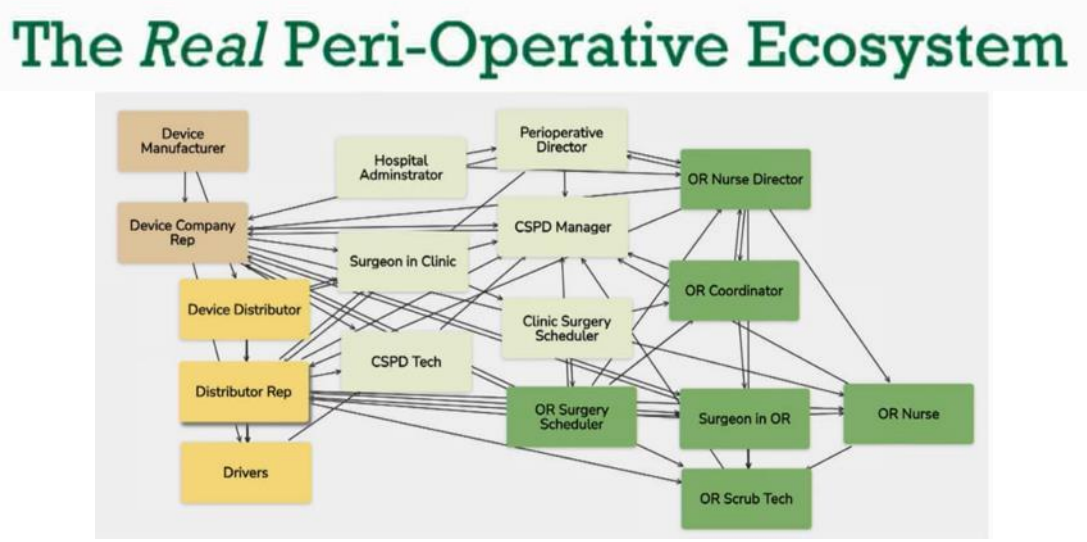
VuMedi | YouTube

Summary of Prof. Ron Adner's Presentation:



- The light bulb was invented 60 years before Edison was credited with its invention. So it was a failure for 60 years until he made it a success by asking "What else?" He saw all the things required for it to scale as a successful innovation: The need to generate and transfer electricity. This was a "wider lens view."
- Most innovations fail because of a "narrow lens view." This is simply making something better.
- Much of orthopedic innovation is a narrow lens view; taking something and simply making it better (I would call this derivative innovation)

- Other things must happen to make a core innovation give greater value: co-innovation (what else must be innovative to make your innovation have more value?) & adoption chain (critical stakeholders who affect the innovation scaling)
- Consider the example of the perioperative space: the stuff which happens around the operation. Equipment and implant preparation is done in CSPD by very low-level trained individuals.
- IPT: Innovation in an Ecosystem Strategy
- Where do all the trays of instruments for a surgery come from? Where do they go?
- PROBLEM: instrument and equipment management – it costs $90/tray to process instruments; many trays are unopened and this wastes resources to prepare these trays. Most recording of inventory trays is on paper = chaos & waste; trays vary in cost from $30,000-$200,000….Cost to Capital.
- Inefficient inventory management is the key problem.



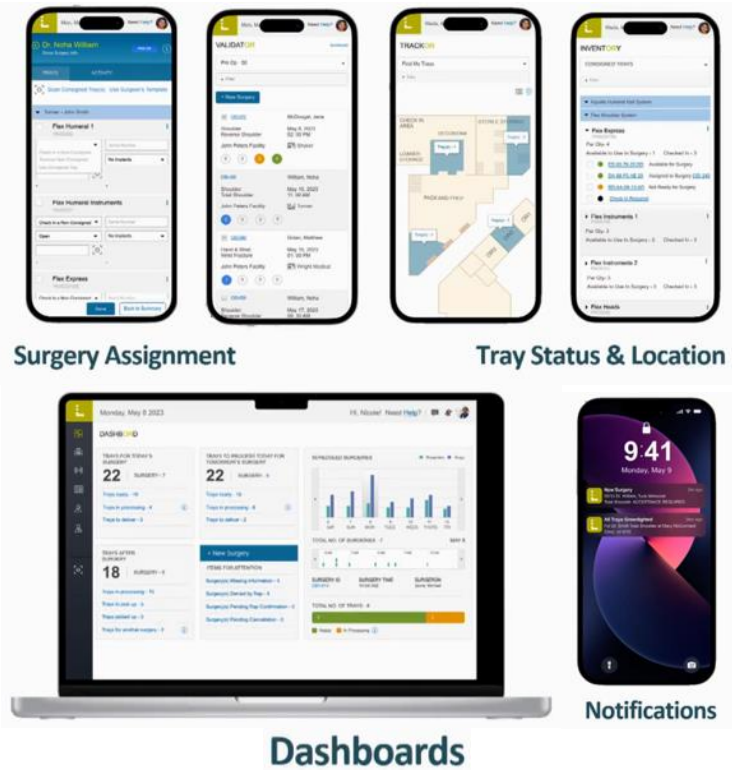
- Company Reps for companies are stressed with management of inventory needs for surgery due to this complex chaotic interdependent ecosystem in which the surgeon requires sterile instruments and trays which hold them.
- CSPD is further affected by insufficient budget to manage inventory.

Business School 101:
Invisible Problem x Complex interactions x No Budget
= Find an Easier Opportunity

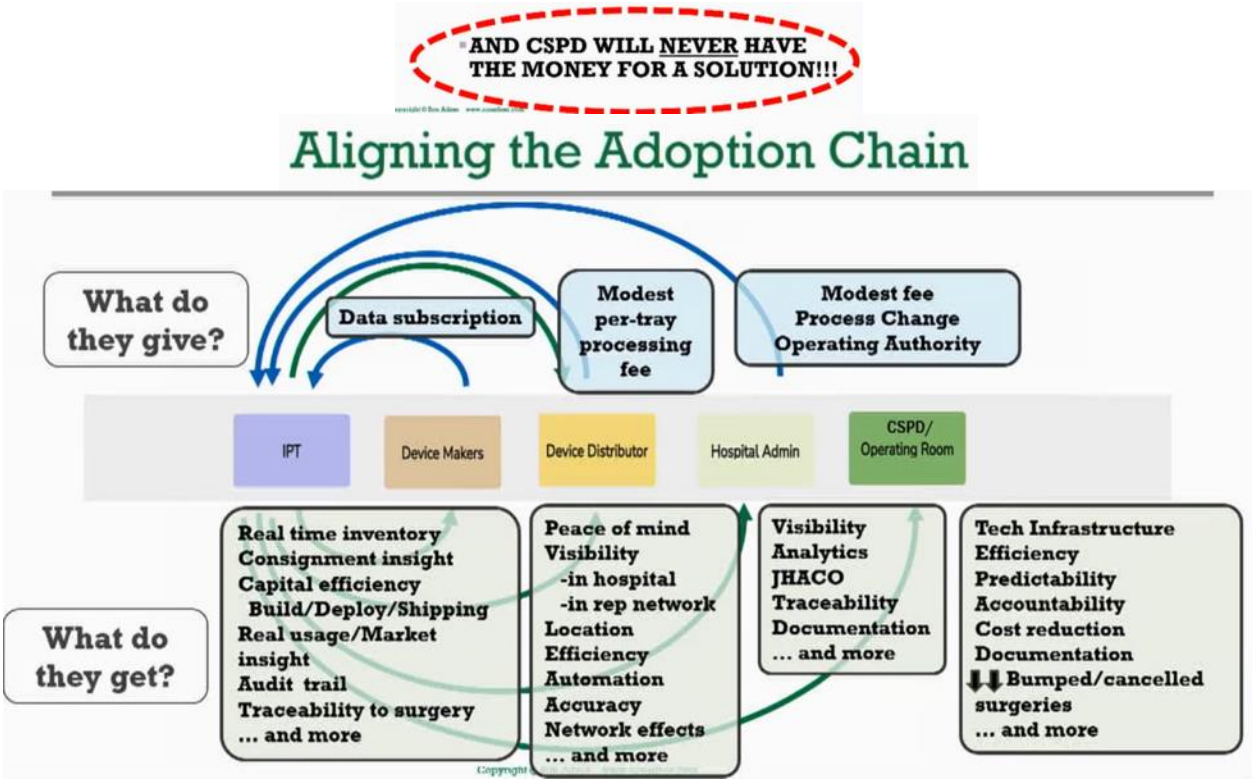
IPT

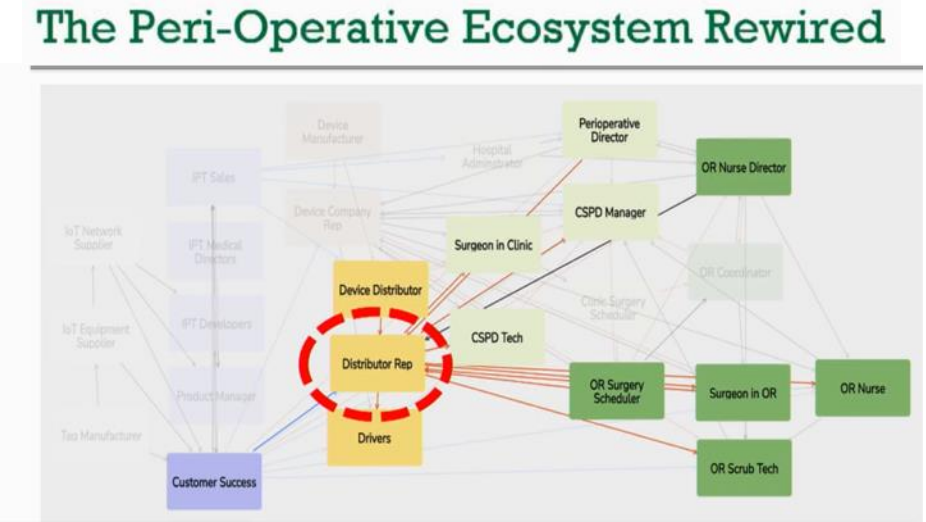
Ecosystem Strategy for the Peri-Operative Space

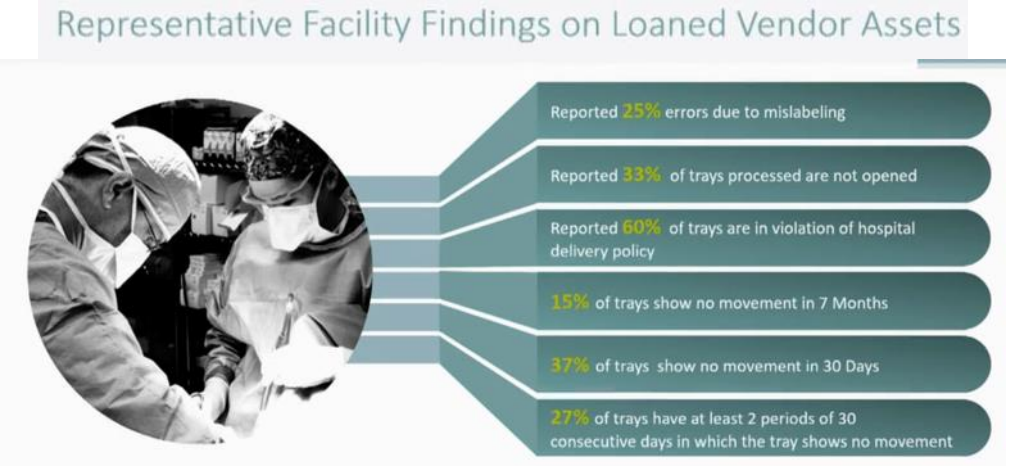
- The fundamental problem of the perioperative space:
  - Mission critical
  - High complexity
  - Physical chaos
  - Real-time last-minute interactions
- IPT is a co-innovation to solve the above problem. Tags on trays and beacons to locate them in the hospital = where is the inventory needed for surgery? Has it been autoclaved or not? Real-time tracking of each tray.



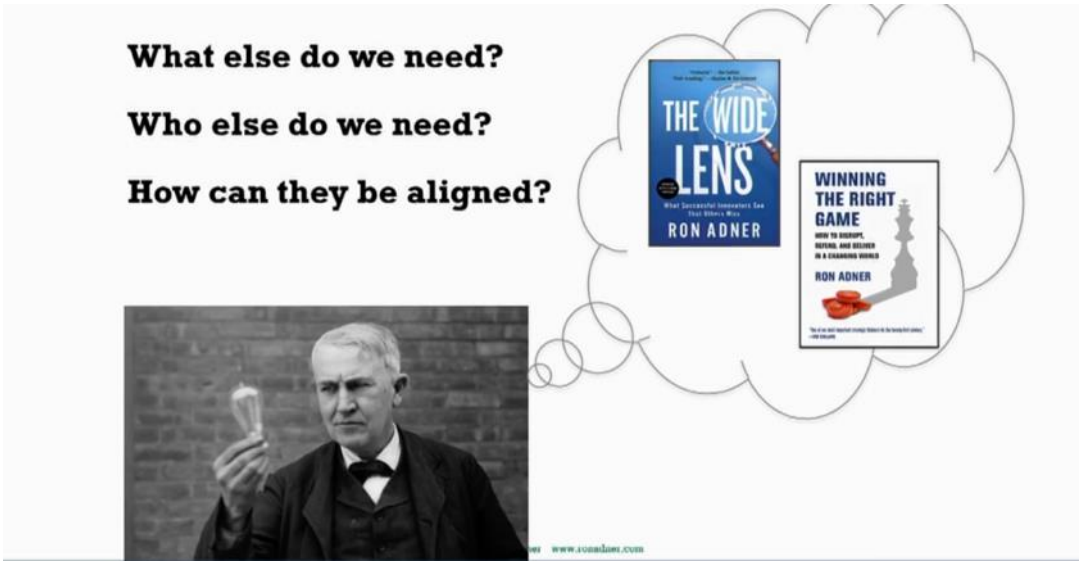
- Reducing cost of capital!





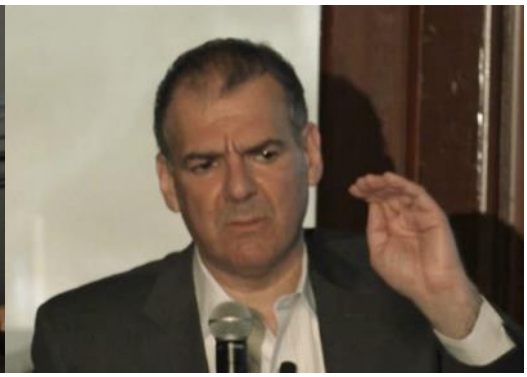


- Tray Level Data = We know exactly which tray
- This is only possible with a facility-based vendor neutral solution.



Video link to Part I: Panel Discussion:

Part I Panel Discussion (contributors: Christian Gerber, Lanny Johnson, Ron Adner, John Macy, Derek Haas, Jon J.P Warner, Porter Jones)
VuMedi | YouTube



Question (David Jevsevar): For the physicians on the panel, what of your innovations are you most proud of?

Answer (Lanny Johnson): *Motorized instruments developed for arthroscopic surgery.*

Answer (Christian Gerber): *"I don't really know." If I can say those innovations that have most benefited patients, then Latissimus Dorsi Transfer, Bone grafting for locked posterior dislocations.*

Answer (JP Warner): *Gerber is modest as his concepts have changed how we help our patients: Concept of 3rd generation arthroplasty (anatomical reconstruction), Kappa Delta Award for Bench to Bedside approach to Rotator cuff repair.*

Answer (Industry): *Gerber also created the concept of a stem convertible from Anatomical to Reverse implant.*

Question (Oke Anakwenze): For Ron Adner – How are you going to test a minimal viable product (MVP)? In a specific size hospital, academic or private? And what will the customer acquisition costs be?

Answer (Ron Adner): *In an ecosystem where you are dealing with partners, it is a challenge to implement and iterate a service along the lines of an MVP. These multiple partners will not be willing to change their processes under these circumstances. The approach which IPT has taken in this ecosystem innovation is to commit to "the bet which has been made and played." The second question about go-to-market can be answered as we are in 5 facilities at this point. Hospitals seem very excited, at this point, to sign up. Now we have to pick the best hospitals to start with and bring the manufacturers on board.*

Answer (John Macy): *This concept was first tested in my small community hospital with 3 ORs. Now we're in beta phase testing in several additional institutions which are small- to medium-size institutions. "The problem is fundraising to scale up to size to get to the next level."*

Comment (Christian Gerber): In Switzerland, we do not have that experience in our hospitals. Walter Cronkite (famous news anchor) said, "the American healthcare system is neither healthy, nor caring, nor a system." The "industry" has made major errors in providing trays. "The fact that you need seven trays for a total knee replacement is a declaration of the failure of the engineers." The real solution is for industry to solve the problem of too many trays to do an operation.

Answer (Ron Adner): *The CSPD issues are really the same in Europe as they are in the USA. Even though it is the right thing for industry to reinvent itself (less trays), it is really hard to get them to do this. Even if you came up with a two-tray solution, or even a one-tray solution, the problem of management of that tray will still exist. Furthermore, the data provided by the IPT ecosystem will help industry see if reduction of inventory or tracking of trays is the better solution.*

Question (Christian Gerber): Will single use (disposable instruments) become more prevalent to avoid inventory tracking?

Comment (JP Warner): *There are companies that have a green proposition, and they are doing just the opposite. They provide reusable instruments for anchors in sports medicine.*

Comment (Matt Putnam, DePuy, J&J): *Our company has both supply chain issues and green initiatives. Our biggest need today is related to MDR (medical device regulation). The IPT solution is very interesting. I think this might be a new way for us to gather outcomes. "When you're delivering these trays to a doctor, you're also delivering them to a patient." We need to gather data about the instruments, or we won't even be able to let surgeons use the prosthesis. MDR is saying we need data on the instruments as well as the implants. This could be a possibility for us to get that data.*

Question (JP Warner): To Ron Adner and John Macy: Who is paying for this? Do you anticipate barriers in hospital adoption? Large AMCs tend to be resistors to change and innovation, while smaller hospitals tend to be more open to innovation. How will this affect your strategy to scale this?

Answer (Ron Adner): *I'll invite Dave Nichols, our Co-Founder and CEO to answer this question. The short answer is "everyone is paying something."*

Answer (Dave Nichols): *We are actually having more conversations with the larger health systems in the country. They are having a significant problem, so the value is very real to them. This is a "chain of custody problem" for all the trays. We started with the smaller community hospitals during COVID when access into hospitals was very difficult. We are now moving to the larger facilities which have a bigger problem than the smaller ones.*

PART II: The Avant-Garde Health/CSS VBHC Research Group Update

Video Link to Part II presentation:

The Avant-garde Health/CSS VBHC Research Group Update (contributors: Porter Jones, Derek Haas)

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Surgeon and Institution Participation

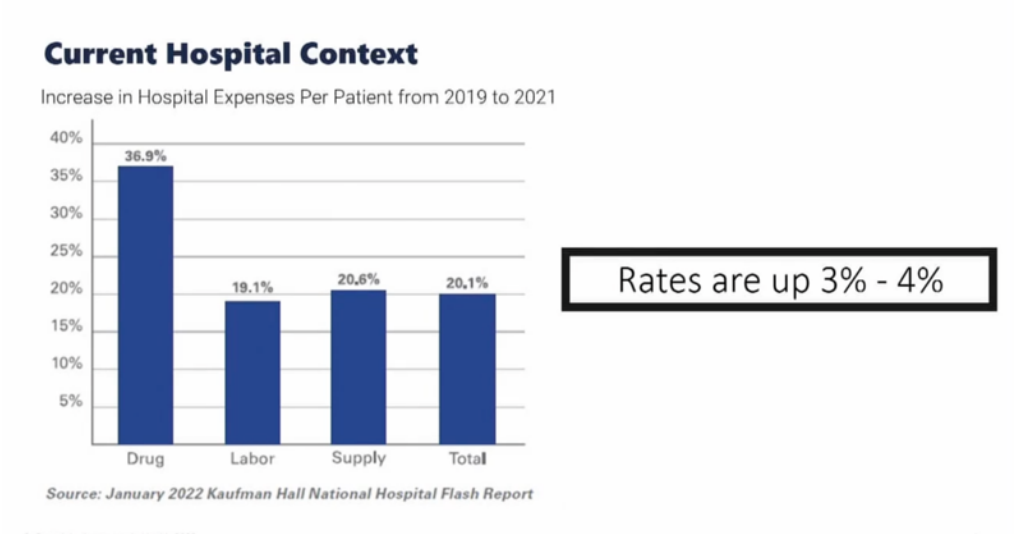
Catherine Fedorka	Cooper University
Eric Wagner	Emory University
Michael Gottschalk	Emory University
John Costorous	Institute for Joint Restoration
Matthew Best	Johns Hopkins Hospital
Uma Srikumaran	Johns Hopkins Hospital
Jon "JP" Warner	Massachusetts General Hospital
Evan O'Donnell	Massachusetts General Hospital

Jacob Kirsch	BILH / Tufts
Jason Simon	Newton-Wellesley Hospital
Jarrett Woodmass	Pan Am Clinic
April Armstrong	Penn State Milton S. Hershey Medical Center
Gary Updegrove	Penn State Milton S. Hershey Medical Center
Adam Khan	Rothman Institute
Joseph Abboud	Rothman Institute

- 15 surgeons from 10 institutions
- Started in August 2021
- Monthly hour-long meetings

Our Vision for the Value-Based Care Shoulder Research Group

Publish high impact articles that advance our understanding of the cost, quality, and value of shoulder care, as well as disparities in treatment, and apply these insights to improve care



Summary of Avant-garde Health's Presentation and Discussion:

Derek Haas: ***We are a mission-driven organization –*** *our goals are to provide necessary information for physicians, hospitals and surgicenters to provide insights needed to*

1. *offer the highest quality care.*
2. *know where there are opportunities for innovation and efficiency.*

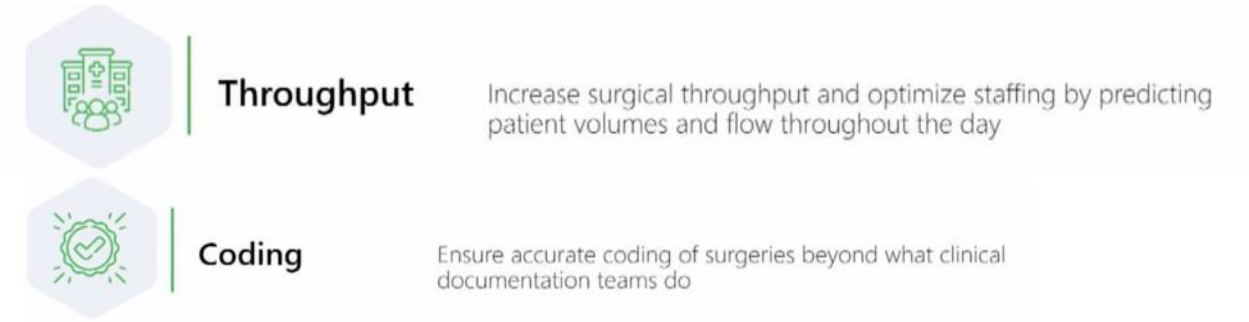
- *Two years ago, we started a collaboration with the Codman Shoulder Society in order to bring together leading shoulder surgeons at different institutions with the goal of forming a community around different insights into value-based healthcare for shoulder problems.*

Porter Jones: ***This is an overview on what we are and what we've been able to accomplish over the past few years.***

- ***Why is this important?***
  - *Post-pandemic hospital systems have lost billions of dollars in their operation.*
  - *Drug prices are up, as are labor and supply costs while reimbursement rates to these institutions are only rising about 3-4%*

    - *1 in 5 physicians and 2 in 5 nurses plan to leave their positions within 2 years.*
    - *It costs $1 million to replace an M.D. who leaves the profession.*
    - *Physician burnout costs about $4.6 billion.*
- ***Our vision for this collaboration:*** *publish high impact articles that advance our understanding of cost, quality, and value of shoulder care, as well as disparities in treatment, and apply these insights to improve care.*
- *We meet monthly and data-analysts at AVGH help with the analysis so we can publish high quality studies.*
- ***3 recently published articles:***
    - Higher Surgeon Volume is Associated with Lower Rate of Subsequent Revision Procedures Following Total Shoulder Arthroplasty: A National Analysis with 2-Year Longitudinal Follow-up
    - Impact of the COVID-19 Pandemic on Shoulder Arthroplasty: Surgical Trends and Post-Operative Care Pathway Analysis
    - The Impact of the COVID-19 Pandemic on Racial Disparities in Patients Undergoing Total Shoulder Arthroplasty in the United States
- ***3 articles submitted for review recently:***
    - Five Year Patient Mortality Following Shoulder Arthroplasty
    - Trends and Outcomes of Outpatient Total Shoulder Arthroplasty After Its Removal from CMS's Inpatient Only List
    - Trends in the Adoption of Outpatient Joint Arthroplasties and Patient Risk During 2019-2022
- ***Manuscripts currently in progress:***
    - Trends and Costs of Shoulder Revisions
    - A Risk Scoring System to Assign Patients to Outpatient Shoulder Surgery
    - Trends and Outcomes of Outpatient Total Shoulder Arthroplasty
    - Supply Cost Variation Across Regions, Hospitals and Surgeons
    - TDABC for Rotator Cuff Repair
    - When Outpatient Orthopedic Surgery is Safe
    - TDABC for Total Shoulder Arthroplasty
    - TDABC for Proximal Humerus fractures
    - 5-year Mortality Rates in Fracture Vs. Non-Fracture TSAs

- ***The big picture:***

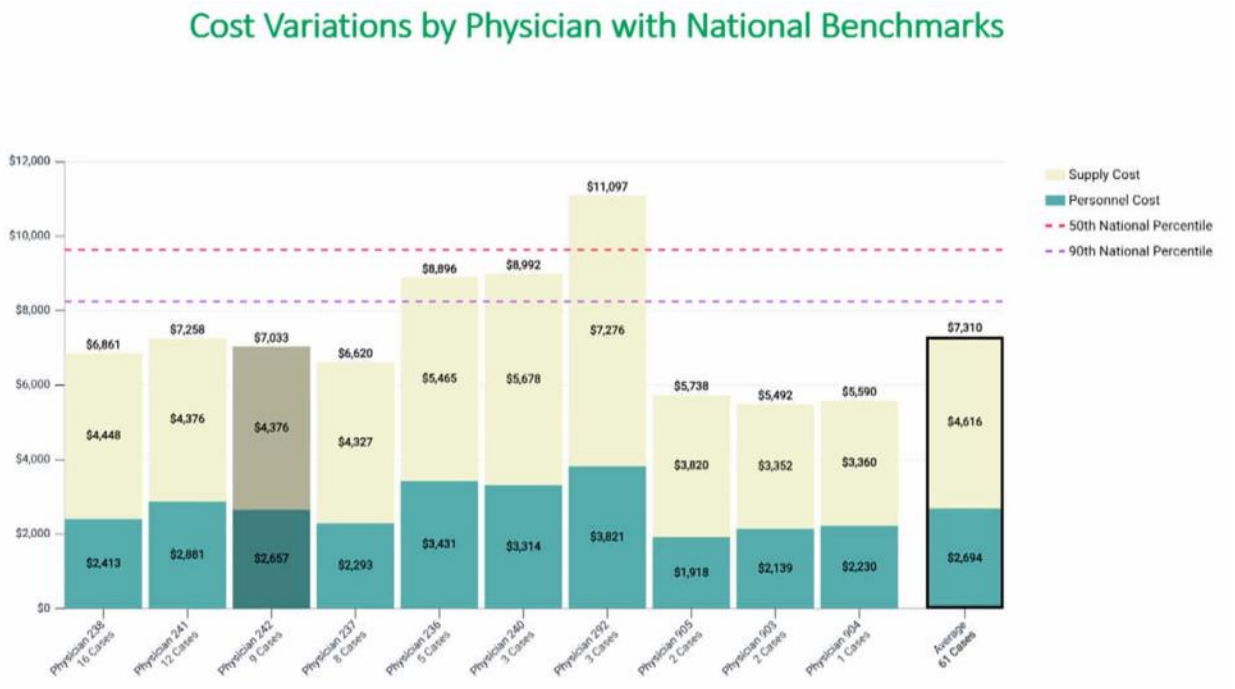


- ***How do you compare?***

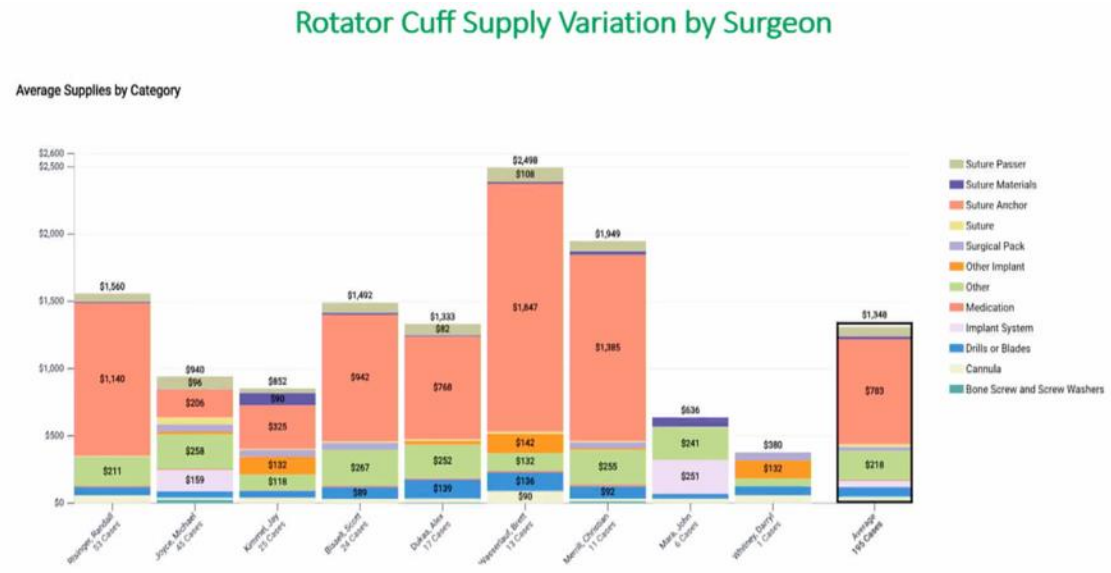
- ***Financial reporting on a per-physician basis:***

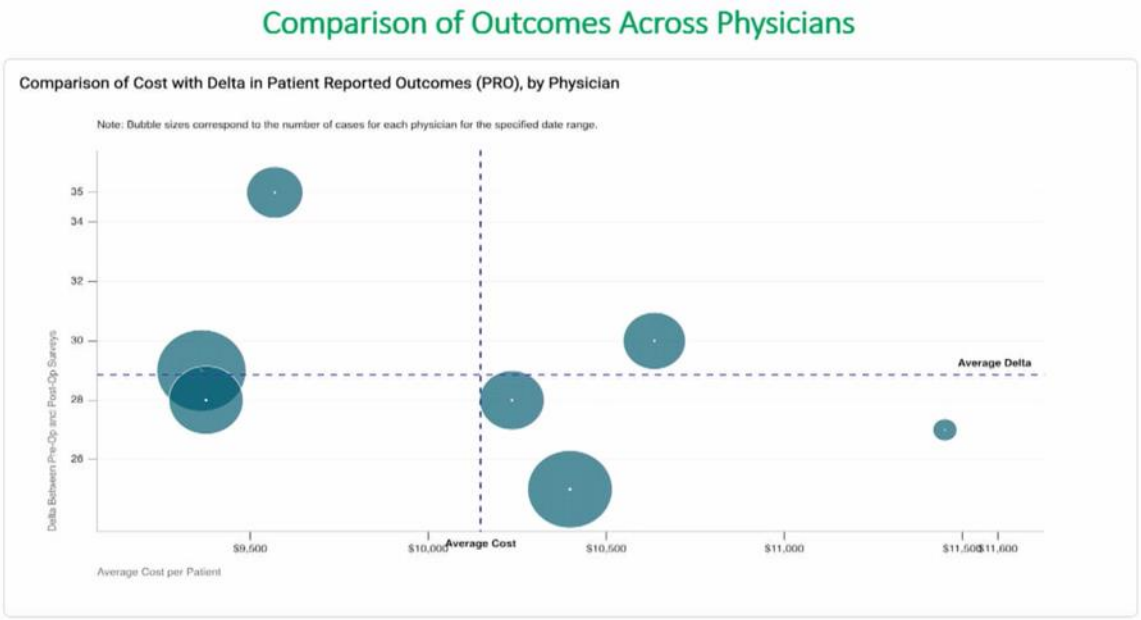
Direct contribution margin because these are the items that physicians can actually control.

- ***Cost variation by a physician for a particular procedure:***



- Measurement may change behavior?
- **JP Warner:** What is the motivation to change surgeon behavior and how can the hospital incentivize physicians to do so?





Discussion and Comments:

Comment (JP Warner): *Prof. Robert Kaplan at HBS said "If you can't measure it, you can't manage it, and if you can't manage it, you can't improve it." Measurement is not a common practice in our specialty of orthopedics, though there has been a recent movement to improve on this. Also, hospitals differ in their accounting methodology; for example, some facilities use cost averaging rather than TDABC. And finally, to what degree are hospitals willing to align with physicians in a partnership to reduce costs?*

Answer (Derek Haas): *I agree with JP that we need to look at cost and outcomes, but we can also look at the care processes. Our experience has been that the types of things you do to improve quality also improve costs of care. We now also know that the higher the volume of care (by a provider) the better the value of that care due to many factors including lower complication rates and greater efficiency.*

As for alignment between physicians and hospital systems, the typical approach in healthcare systems is to take a top-down approach of the administration mandating changes and thus force these on physicians. We believe initiatives are much more successful when they happen collaboratively. This alignment is easiest if the physician has an ownership interest or a financial incentive.

JP alluded to lack of measurement culture. There are no standards on how costs are measured. At AVGH we apply a standard of cost accounting called TDABC so we can compare across organizations.

Question (Mustafa Rashid): *How much of what AVGH does is manual and how much is automated? Can we allow physicians to care for patients while data is collected in the background?*

Answer (Porter Jones): *Our approach at AVGH is to have all data collection essentially automated. We gather data from different areas with the help of IT in the facility.*

Question (John Macy): *Are you using average cost capacity for all surgeons or TDABC per surgeon per dept.?*

Answer (Porter Jones): *Yes, that is the cleanest approach as we don't want to expose salary information. And this will change between hospital systems. But when we are doing benchmarking, we will normalize these costs so they are controlled over different regions of the country.*

Question (Christian Gerber): *Are you only looking at costs incurred by a hospital? In our healthcare system for example, the cost for trauma is about 15% in the hospital and the rest is disability pensions, time lost from work. So, 2 questions: first was asked already and second is, when looking at outcome do you look at the state of health of an individual to begin with and correlate that with the money spent on care?*

Answer (Porter Jones): *We are only measuring the cost of perioperative care, not indirect costs such as lost work. For the second question, we do look at the delta for preop vs postop recovery not raw scores.*

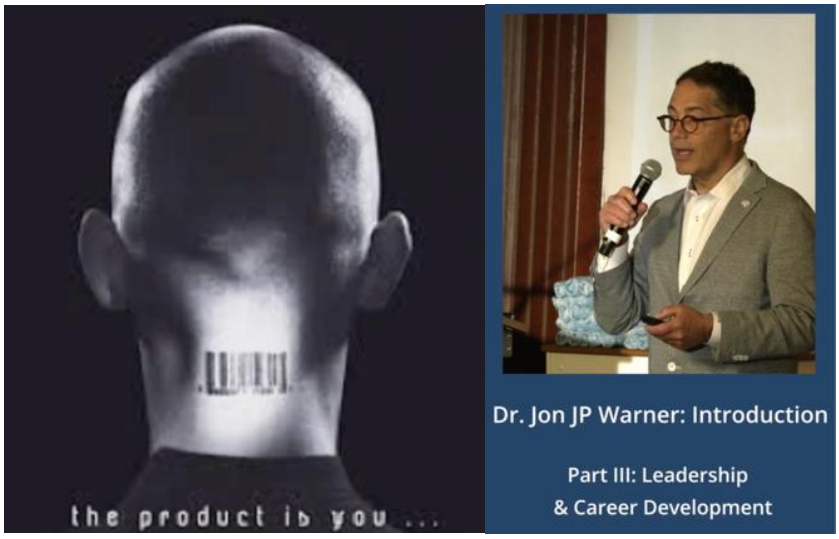
Question (Ron Adner): *Are you able to look at experience and its effect on time it takes to do a surgery?*

Answer (Porter Jones): *We can risk stratify and we can go on a case-by-case basis. And we must identify when surgeons slow down to teach new fellows. There is a learning curve experience.*
Answer (JP Warner): *I think we can answer this with the study we just published with a large data-set of 150,000 shoulder replacements, on the effect of volume of surgery performed by surgeons on reoperation rates. There was a direct correlation between volume with a 4x risk of re-operation in low volume surgeons. The problem is how do we control for learning curves ethically caring for our patients?*

Part III: Leadership & Career Development

Video Link to Part III Introduction:

Introduction – Leadership and Career Development (contributor: Jon J.P. Warner)
VuMedi | YouTube



- Success is not a straight line and failure is actually necessary for success to happen.
- Your roadmap should include mentors who help you and you should formulate a strategy for your profession and personal life; you should update this as you realize a change or pivot is necessary for you.

- You need role models!

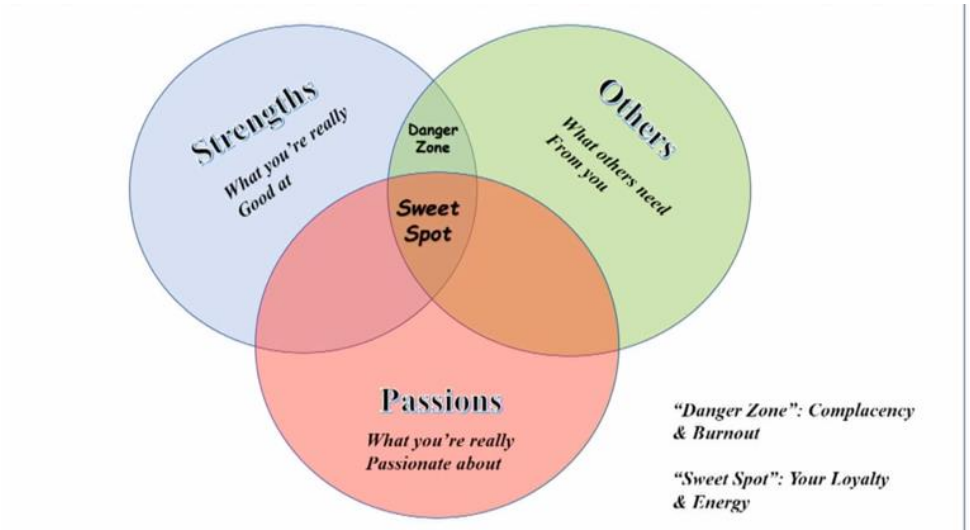
- What context do you want for your career?
  - Group Practice
  - Rural vs. Urban
  - Academic vs Pvt. Practice
  - Institute
  - Industry Relations
  - Private Equity


Relevant Factors = Context
Group practice
Concord Orthopaedics
Excel
Rural vs Urban
Institute
The Steadman Clinic
Steadman Philippon Research Institute
Academic
Mass General Brigham
Specialist
HSS Hospital for Special Surgery
Rothman Orthopaedics
Generalist
Large Healthcare System
Kaiser Permanente
BaylorScott&White Health
Industry Relationships
stryker
Zimmer Biomet
DePuy Synthes
smith&nephew
Arthrex
Private Equity
HOPCo
Physician Growth Partners
partnercare
Mayo Clinic
Economic forces
Technology
Regulatory
THE WORLD IN 2030

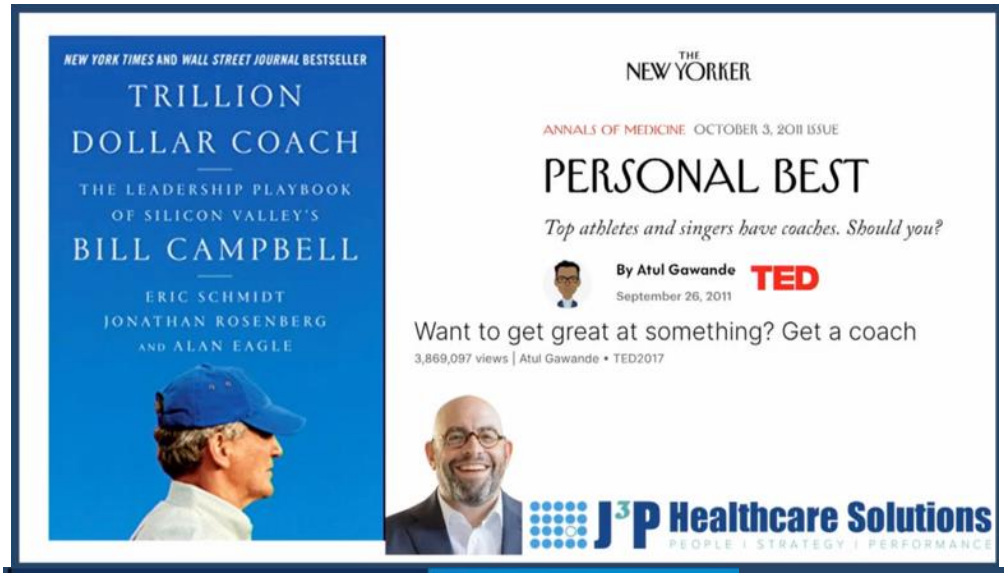

Harvard Business Review
Personal Ethics
How Will You Measure Your Life?
Don't reserve your best business thinking for your career. by Clayton M. Christensen
Clayton Christensen
TED Talks
THE CODMAN SHOULDER SOCIETY
VuMedi
"Warner's Corner"

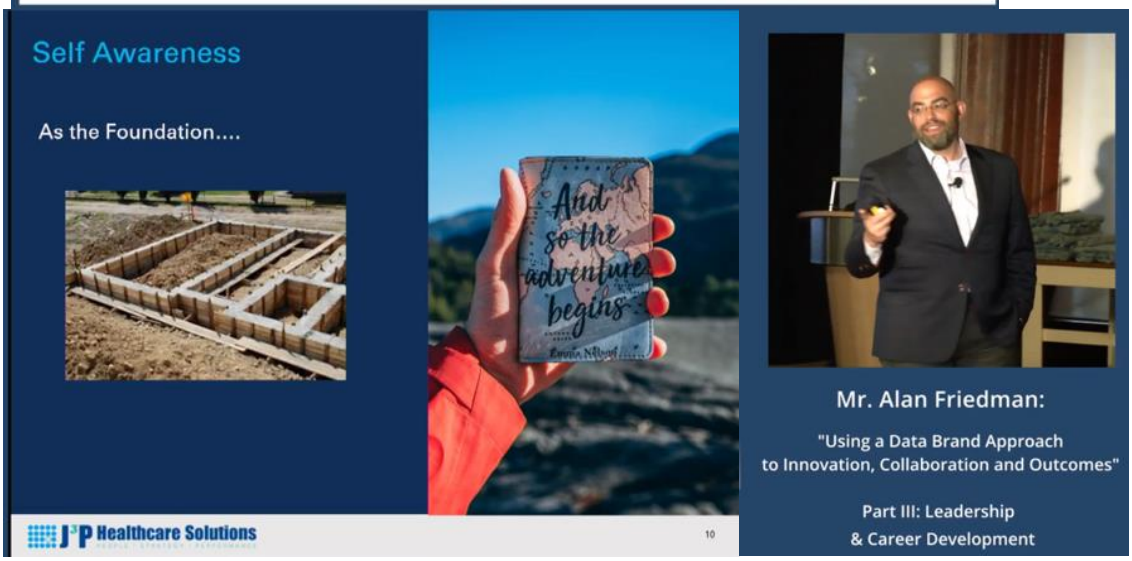

How Will You Measure Your Life? Clay Christensen at TEDxBoston
Companies & People fail because they
Do not align their strategy in life & Business
With what they really want...happiness &
Business success...This is the short-term view
Vs the long-term view of strategy
The way we invest our time energy and talents causes us to
Implement a strategy that we wouldn't really want to pursue if
Happiness is out goal
Family, children, takes a longer time to realize the ROI
If we have free time, we will allocate
It to the activities that give us the
Most immediate evidence of achievement: Our careers
Can you predict what will happen
In your life?


The essence of strategy
is choosing what not to do
Michael Porter,Ph.D
HARVARD
BUSINESS SCHOOL
AZ QUOTES


Strengths
What you're really
Good at
Danger
Zone
Others
What others need
From you
Sweet
Spot
Passions
What you're really
Passionate about
"Danger Zone": Complacency
& Burnout
"Sweet Spot": Your Loyalty
& Energy


What is a Network?
Building a network isn't about the number of people you meet, but the number you introduce others to. It is the power of compounding interest.





Video Link to Mr. Alan Friedman's Talk:

Using a Data-Based Approach to Innovation, Collaboration, and Outcomes (contributor: Alan Friedman)

VuMedi | YouTube

Summary of Mr. Friedman's presentation:

- Introducing Alan Friedman, Founder and CEO of J3P Healthcare Solutions
- "I spend my day working as an Executive Coach and an Organizational Psychologist"

- "Insanity is doing the same thing over and over again and expecting different results." (Albert Einstein)
- "Flaws in self-awareness cause otherwise skilled and talented individuals to make mistakes, underperform or spectacularly derail."
- "Self-awareness is the foundation which impacts all outcomes (clinical, business, personal)"
- "How do you show up" as a team member? What is your "best self?"

Identity vs. Reputation

We don't care what people say about themselves

We study what **other people say** about you when you are NOT there

Self-Awareness

- You can't change your personality
- But you CAN change how you think AND how you behave!

The "Iceberg"

What you can see:

- Words
- Tonality
- Body Language
- Gestures

What you do **(Results)**
and
How you do it **(Behaviors)**

Behavior=Thought Process f(Personality, Environment, Motivation)

What is below the surface:

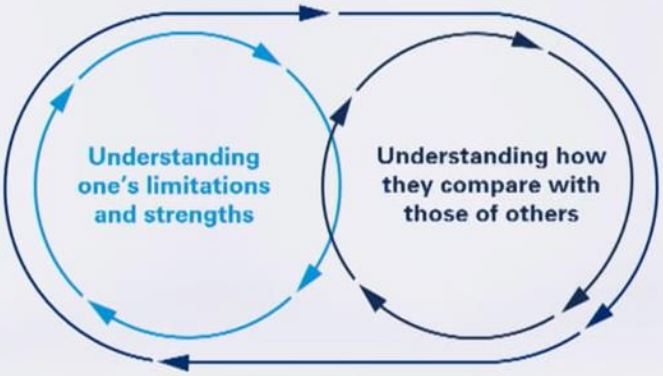
- Beliefs
- Values
- Biases
- Prejudices
- Experiences
- Fears
- Dreams
- Feelings

J³P Healthcare Solutions
PEOPLE | STRATEGY | PERFORMANCE

Role of Self-Awareness

The degree to which one **understands their performance capacity** in any competitive environment.

It has two components:

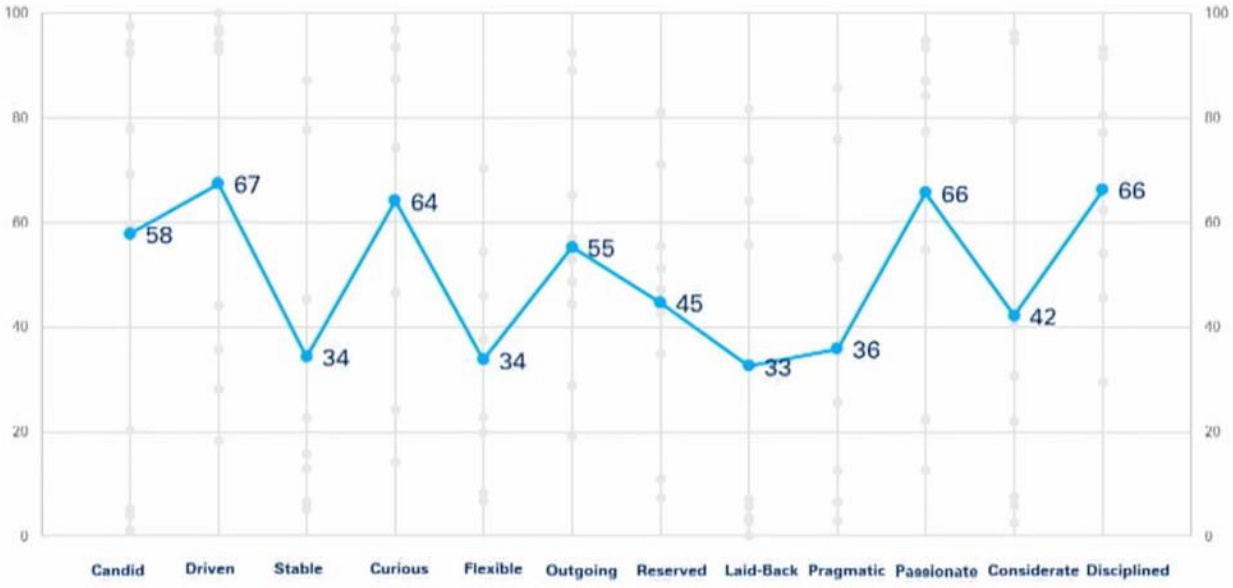


What do YOU need to understand to be effective?

Core Behaviors for Effective Relationships


Humility
Curiosity
Empathy

Codman(N=9)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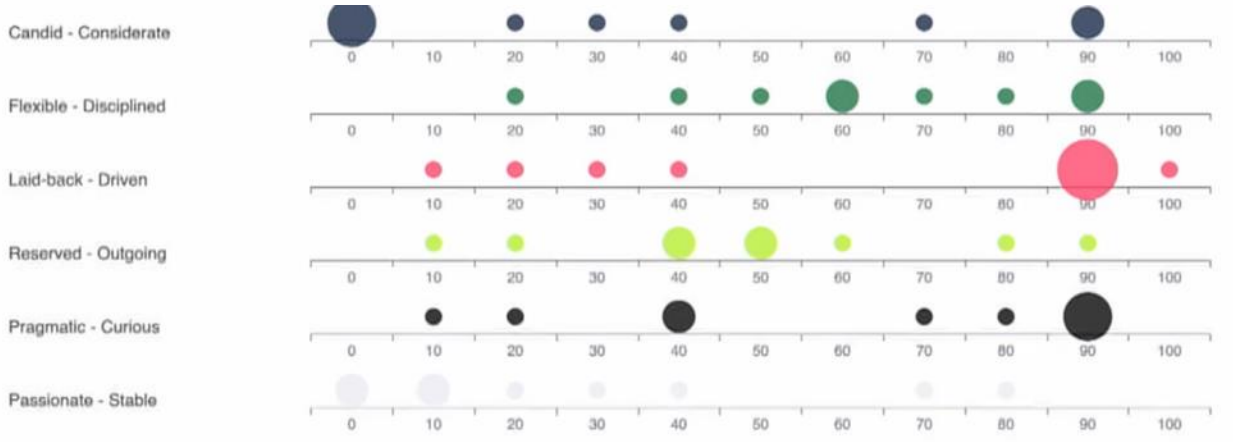
Flexible
Outgoing
Reserved
Laid-Back
Pragmatic
Passionate
Considerate
Disciplined


Candid - Considerate
Flexible - Disciplined
Laid-back - Driven
Reserved - Outgoing
Pragmatic - Curious
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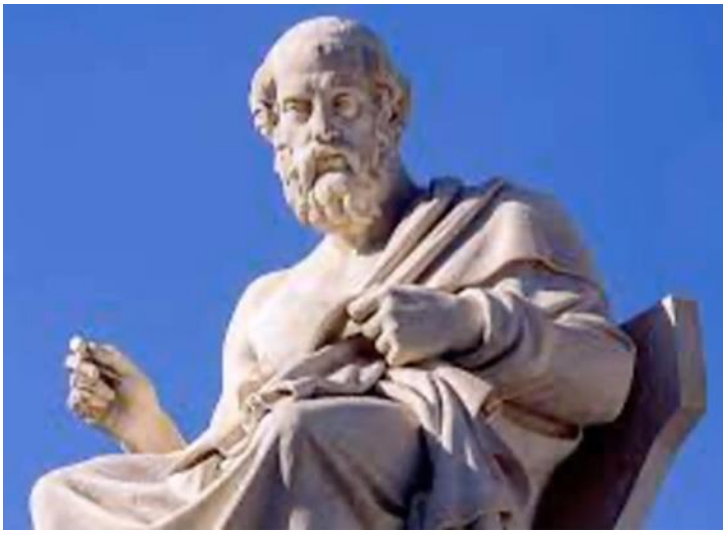


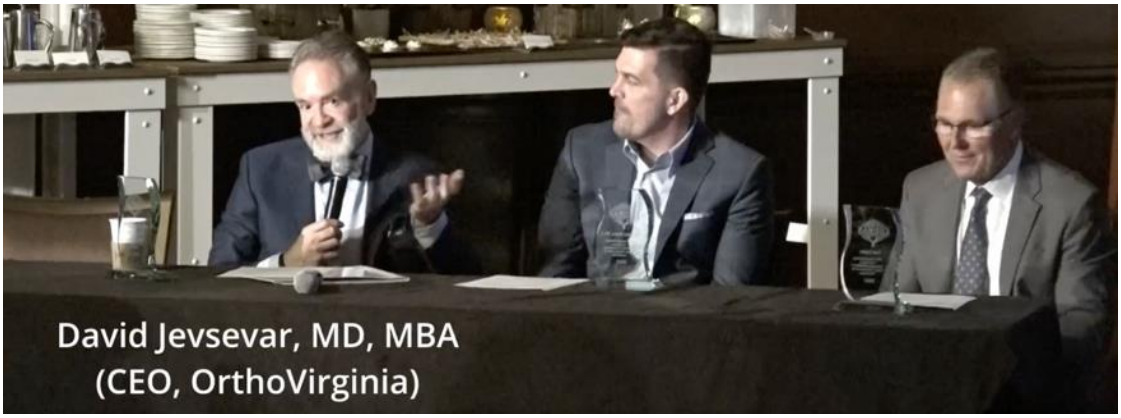
"The ideal leader is someone who commits himself and is trained for a life of service and devotion to fellow citizens."
...Plato

Email:
afriedman@j3phealthcaresolutions.com

Video Link to Leadership and Career Development Panel Discussion:

Part III Panel Discussion (contributors: David Jevsevar, Tim Lanier, Benjamin Myers)

VuMedi | YouTube



Summary of panel discussion:

Question (Alan Friedman): *What is the importance of clinical people and relationship with industry?*

Answer (David Jevsevar): *I left academic medicine because I could not innovate for the value in healthcare delivery. I can only accomplish this in a large practice group where I have control. Our relationship with vendors in the past has always been translational. That is not the relationship I want with our vendors and collaborators. As orthopedic surgeons, we have ceded value to everyone but ourselves. To bring this value back to ourselves, we need collaboration with others who work in our space.*

Answer (Benjamin Byers): *I like Dr. Gerber's comment that the generation of an idea is usually one person but the maturation and development of that idea becomes much more powerful when a team is behind it. One person may come with an idea which we then build a team around, which allows it to become a product which creates value for patients. Also, it's not just about product, we can also bring value by how we make these things available to our customers.*

Answer (Tim Lanier): *Obviously when we think about innovation, we need these partnerships and relationships. This is not only about product development but also education and training. But there is one other element. This is engaging our surgeon partners in helping us guide our strategy. This results in debate and disagreement, but it helps us with our alignment for our strategy. This is a quality process that is essential for our innovation of new products and services. The most difficult thing for us (industry) is to put all these instruments and implants in the hands of surgeons. It is incredibly expensive to capitalize an orthopedic business.*

Question (Alan Friedman): *How do you manage compliance in your relationships with clinicians?*

Answer (Tim Lanier): *Compliance has become more important over the last 15 or 20 years. It is especially the case for public companies which must spend a lot of time managing relationships. Everything we do is with integrity in mind. There is immense oversight by the Department of Justice (DOJ), by the FDA, all kinds of governing bodies. It is not uncommon for one of these government bodies to show up at your door unannounced ready to audit your business practices. We train all of our employees on a code of conduct which includes guidelines for our interaction with health professionals, so we remain compliant. We all participate in Advamed, a trade association designed to advance medical technology while ensuring compliance to the rules of engagement while representing the patient's*

needs as the top priority. It is essential to remain compliant as failure to do so can lead to expensive settlements with the DOJ and derail our innovation initiatives with our surgeons and our R & D groups."

Answer (Benjamin Byers): *The regulatory side is another layer of compliance we should add to this discussion. As global companies we face different regulations, requirements, and levels of evidence in different countries. For example, what Europe is doing with the CE Mark places a significant burden on us due to the very high level of evidence in the USA experience, before we can launch technology in Europe. Every single clinical application must have evidence as there is no longer a general application for products and services. This creates a large cost burden for industry to comply with requirements for on-label use. This challenges us to remain innovative in creating a portfolio to serve the needs of all our surgeons. This takes financial resources away from the pipeline of new innovations since we have to fund all our compliance requirements.*

Answer (David Jevsevar): *From the surgeon practice point of view, we have insurance for compliance issues, but if there is a criminal component to a given behavior, there is no insurance for this. The big companies are not a concern. It is the smaller companies that may not have such robust compliance practices. With over 60 surgeons to manage, it is difficult to keep track of all of them and we are very serious about compliance in our institution.*

Question (Alan Friedman): *How do we manage a culture of innovation in the context of compliance?*

Answer (Benjamin Byers): *This process is a grind. The 80/20 rule is that in order to get products to market we go through 80% of our effort for documentation of evidence and compliance vs 20% of our effort to innovate new products to bring to the market. Also, innovation comes from everywhere, not just from the R&D engineers. We are constantly trying to stimulate a culture that includes innovation in marketing, sales and other services that bring our products to market.*

Answer (Tim Lanier): *Tornier (as a component of Stryker) has a legacy culture of innovation. This was created by the Tornier family along with Gilles Walch and Pascal Boileau. This formula of industry and surgeons innovating products and validating them with published evidence of effectiveness was the key to scaling products to the marketplace. This was all based on a strategy to meet the unmet needs of shoulder arthroplasty. This has also led to other companies following suit.*

We have tried to have a strategic advisory board of clinicians that help us figure out what it is we should be doing. We never take for granted that we understand what is best. The culture we have is a collaborative relationship between our surgeon designers, R&D, and other parts of our company. We have many design surgeons and we take their input as an essential part of our process for innovation. We create an environment that allows surgeons to debate and discuss innovative ideas.

Answer (David Jevsevar): *I would add that obviously innovation of products is sexy and lucrative, but I hope in the future we can focus on innovating value by measuring outcomes and getting back to Codman's original tenants.*

Question/Comment (Matt Putnam): *Every product has a design, failure mode effects analysis file. Each file is sometimes a thousand Excel lines long. And then there is a grading sheet that demonstrates we've made failure as low as possible with what we design. If we have a significant risk, we keep working the product to reduce such a risk. These companies work very hard to achieve reliable products that are safe for use. Having industry here is a very important initiative. So, thank you. I appreciate being here.*

Question/Comment (Christian Gerber): *The perception for a certain small minority of surgeons is that the big companies wait until a small company has made a very good idea and then they buy it at as low a price as possible. And R&D creation of new products by big companies seems to be rather rare. It is not true that surgeons feel that the big companies are extremely risk averse? Is that inflammatory enough?*

Answer (Benjamin Byers): *There are 3 levers for innovation that we look to at J&J. The first is business development including licensing new products and services that address a key unmet need. It may take us years to develop these ideas. So, we have a mindset to look externally for new ideas and products. Internal innovation is often much more difficult to develop. We try to find strategic acquisitions that make sense and help us balance risk.*

Answer (Tim Lanier): *Big companies and small companies need each other. It is hard for us (big companies) to be both fast and agile in development of new technology because of the regulations process. The small companies may have a great idea, but they cannot scale due to limitations of financial resources. Small companies innovate and big companies buy them and all benefit.*

Comment (JP Warner): *We left out of this equation all the responsibilities the large companies have to shareholders, patients, and society. It isn't just about companies and surgeons. I think we can now see there can be more of an empathy and understanding on the part of physicians about what industry has to deal with, relative to what we want to accomplish.*

So that wraps it up for us. Thank you to all of our esteemed speakers and panelists and to all of our participants.