Demonstrating the Value of Interventional Radiology

Mohammad-Kasim Fassia, MD, MS[1] Resmi Charalel, MD, MPH[1] Adam D. Talenfeld, MD, MS, FSIR[1]

[1] Division of Interventional Radiology, Department of Radiology, Weill Cornell Medical College, New York, New York

Semin Intervent Radiol 2023;40:403–406

Address for correspondence Adam D. Talenfeld, MD, MS, FSIR, Division of Interventional Radiology, Department of Radiology, New York Presbyterian Hospital/Weill Cornell Medical Center, 525 E. 68th Street, Payson 501, New York, NY 10065 (e-mail: adt9010@med.cornell.edu).

Abstract

While national healthcare expenditures per capita in the United States exceed those in all other Organisation for Economic Co-operation and Development (OECD) countries, measures of health outcomes in the United States lag behind those in peer nations. This combination of high healthcare spending and relatively poor health has led to attempts to identify high- and low-value healthcare services and to develop mechanisms to reimburse health care providers based on the value of the care delivered. This article investigates the meaning of value in healthcare and identifies specific services delivered by interventional radiologists that have accrued evidence that they meet criteria for high-value services. Recognizing the shift in reimbursement to high-value care, it is imperative that interventional radiology (IR) develop the evidence needed to articulate to all relevant stakeholders how IR contributes value to the system.

Keywords

- value-based payment
- interventional radiology
- health outcomes
- healthcare safety
- healthcare costs
- healthcare quality
- patient experience

Over the past 40 years, healthcare spending in the United States has steadily outpaced every other sector. In 1980, health care accounted for 9% of the U.S.'s gross domestic product (GDP). By 2019, that number doubled to 18%.[1] Despite spending the highest per capita, median life expectancy in 2019 in the United States was only 30th out of 38 Organization for Economic Cooperation and Development (OECD) countries.[2] To combat growing costs and stagnant outcomes, four laws passed by Congress over the past 14 years have mandated and facilitated a paradigm change from fee-for-service to value-based healthcare payment including the American Recovery and Reinvestment Act (2009), the Affordable Care Act (2010), the Medicare Access and CHIP Reauthorization act (MACRA, 2015), and the Inflation Reduction Act (2022). Under the new legislation, clinicians and hospital systems are increasingly reimbursed based on the value, rather than the amount, of care provided.

While claiming to offer the best value has long been a fundamental advertising technique, value in healthcare was formally defined in 2010 as quality health outcome per dollar spent.[3] The American Medical Association subsequently expanded the equation to define value as the ratio of four variables: outcomes, safety, and service divided by the cost to the healthcare system (►**Fig. 1**).[4]

Value = Outcomes × Safety × Service/Cost

Based on this equation, valuable treatment options increase quality and quantity of years lived, have fewer complications, and provide a better patient experience, while also having lower costs. Most interventional radiologists would likely agree these are attributes of the care our specialty provides; and the proof, many argue, is in the spread of interventional radiology (IR) procedures throughout the medical world. "Bread-and-butter" IR procedures like image-guided percutaneous drainage, needle biopsy, and central venous access have become mainstays of diagnosis and treatment, replacing their surgical predecessors.[5] However, current reimbursement trends do not reflect this. Over the past 8 years, reimbursement for IR procedures has decreased (6.9%) despite an increased demand for image-guided procedures.[6] The shift to a payment-for-value paradigm now requires that the value of IR care be made explicit.

Issue Theme Nonclinical Drivers in IR; Guest Editors, Laura K. Findeiss, MD, MHA, FSIR and Charles E. Ray, Jr., MD, PhD, FSIR

Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

DOI https://doi.org/10.1055/s-0043-1774407.
ISSN 0739-9529.

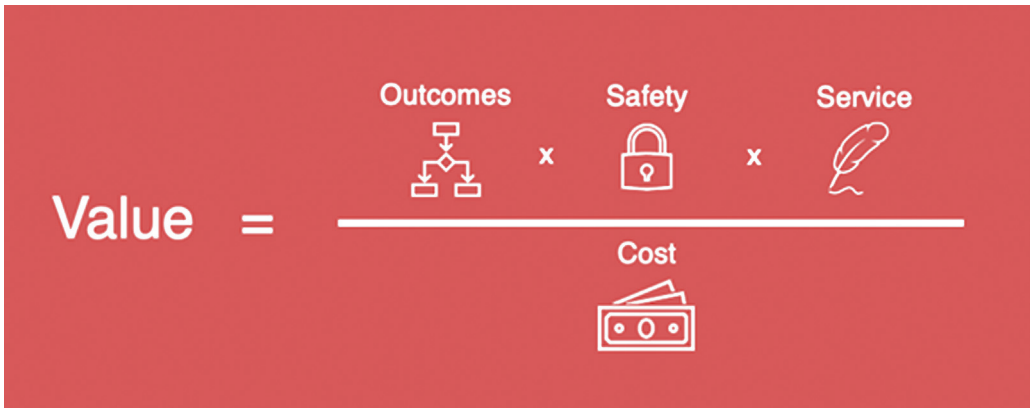

Fig. 1 The Healthcare Value Equation developed by Porter et al describes the value of care provided as the ratio of outcomes, safety, and service to the total cost of the care provided.

The Centers for Medicare and Medicaid Services (CMS) is the largest healthcare payer in the United States. Tasked by Congress with implementing this value legislation, CMS has worked closely with epidemiologists, economists, and professional societies to develop metrics that objectively assess the value of various treatments. Many of the metrics were designed to broadly incorporate principles from the National Academy of Medicine's STEEP goals such as safety, efficiency, and equity.[4] Some system-wide metrics familiar to many clinicians include rates of hospital-acquired infections, post-procedure complications, and acute inpatient readmission rates. Additional performance metrics have been designed in conjunction with different medical societies according to their specific management algorithms. CMS and the Society for Interventional Radiology (SIR) codeveloped metrics for appropriate assessment of retrievable inferior vena cava filters for removal, clinical outcomes post-endovascular stroke treatment, door-to-puncture time for endovascular stroke treatment, documentation of angiographic endpoints and interrogation of ovarian arteries during uterine artery embolization, and outcomes after varicose vein treatment with saphenous vein ablation.[7] But these measures are the "tip of the iceberg" in assessing the value of IR to patients across the spectrum of health and disease. Interventional radiologists and our allies must develop an evidence base that proves quantitatively how IR care is high-value care. The value equation serves as guidepost for further developing our value literature. The following brief survey of existing literature aims to highlight the ways future research can demonstrate the value of IR using transparent, clearly defined endpoints that are meaningful to patients.

Quality Outcomes

According to the American Medical Association, high-value care reduces mortality and morbidity. One of the best examples of IR adding quality years of life is the development of transarterial therapies for hepatocellular carcinoma (HCC) management. Prior to transarterial chemoembolization (TACE), patients with unresectable HCC, lacking effective treatment options, were offered only best supportive care. Starting in 1996, Llovet et al conducted a randomized controlled trial comparing TACE to conservative management. Prior studies had shown no clinically significant benefit of TACE; however, the authors believed lack of accounting for performance status (PS) had confounded outcomes in those studies. Excluding patients with poor PS, their landmark study clearly demonstrated TACE to confer a significant overall survival benefit compared with conservative management for patients with multinodular HCC.[8] Recently, Gabr et al reported a multicenter 45-patient series of hepatic explants after yttrium-90 segmental transarterial radioembolization (TARE) for solitary HCCs less than 8 cm.[9] Finding complete necrosis in all patients receiving over 400 Gy, the study led to incorporation of Y90 TARE into the Barcelona Clinic for Liver Cancer's current HCC treatment guidelines.[10]

Within and beyond the world of oncology, transarterial therapies throughout the body have been shown to improve outcomes in diverse patient populations. A systematic review and meta-analysis by Liu et al in 2018 found that uterine artery embolization for postpartum hemorrhage reduced blood loss and length-of-stay compared to hysterectomy.[11] A randomized, controlled trial published in 2023 demonstrated nearly twice the improvement in lower urinary tract symptoms (LUTS) after prostate artery embolization (PAE) versus dual-agent medical therapy for benign prostate hyperplasia.[12]

Safety

Prostate artery embolization also exemplifies of a safe treatment. A systematic review and meta-analysis by Knight et al compared PAE to transurethral resection of the prostate (TURP) for the treatment of LUTS secondary to benign prostatic hyperplasia. The meta-analysis included six studies with 598 patients. The final results showed PAE and TURP led to equivalent changes in the International Prostate Symptom Score (IPSS), but PAE had significantly fewer complications.[13]

Postprocedural complications are one of the big targets for the CMS' quality improvement initiatives. Many interventional radiologic procedures offer equivalent therapeutic outcomes with less risk compared to surgical counterparts. Another example is percutaneous thermal ablation for localized renal cell carcinomas. Using population data, Talenfeld

et al in 2018 found similar 5-year cancer-specific survival with percutaneous ablation versus surgery, one-fifth as many serious adverse events compared to partial or radical nephrectomy and nearly half the rate of new-onset chronic renal insufficiency versus radical nephrectomy.[14] In a population study of treatments for early HCC, Charalel et al demonstrated fewer complications, including fewer ICU days and readmissions, and lower costs with percutaneous ablation compared to surgery.[15]

Researchers interested in advancing the interventional radiology field must continue to prove its value with investigations revealing the safety of image-guided endovascular, endoluminal, and percutaneous procedures in patient-centered, head-to-head comparisons with surgical and medical therapies.

Service

The last variable in the numerator of the healthcare value equation is service. The Agency for Healthcare Research and Quality (AHRQ) administers the Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey of patient experiences.[16] Questions can include ratings on facility cleanliness, physician communication, and details on privacy. In this case, more favorable patient experiences correspond to higher value of care provided. Medicare uses these surveys in conjunction with clinical and administrative data to penalize low-performing and reward high-performing healthcare providers, such as via the value-based purchasing (pay for performance) initiatives. The CAHPS program distinguishes experience from satisfaction, experience being based on factors more likely to influence health outcomes, like patients' clear understanding of their plan of care, and the ease and completeness of care coordination.

Interventional radiologists directly interact with their patients; therefore, multiple opportunities exist to prove value through patient experience. On an individual level, IRs can improve patient experience by reducing wait times, openly communicating with patients, and empowering patients to make decisions about their care with shared decision-making techniques.[17] On a larger scale, IR can leverage its inherently interdisciplinary position in health systems to improve patient experience by facilitating care coordination and playing a more proactive role in care transitions.

Cost

Cost is the only variable in the denominator of the healthcare value equation. In the context of the value equation, expensive treatments decrease the value of care, whereas inexpensive treatments result in more valuable care. Often using time-dependent activity-based costing (TDABC), detailed costs can be described from the hospital perspective, as done by LaRoy et al, who compared institutional data from patients receiving medicine infusion ports in IR suites versus operating rooms.[18] These authors found similar rates of complications between the two groups, but costs from placements in IR suites were nearly half of those from insertions in operating rooms.

Often less detailed, but much more readily generalizable costs can be described from the societal payer perspective, with Medicare, Medicaid, or private insurance claims data often providing the most straightforward means of economic analysis and largest sample sizes. Trivedi et al used the Medicare limited data set to compare 5-year societal costs for dialysis access maintenance in Medicare beneficiaries, finding similar rates of dialysis shunt patency, with a cost from maintenance by interventional radiologists of less than half compared to access maintenance by surgeons, $71,000 versus $179,000.[19]

Cost-effectiveness and cost-utility studies can sometimes yield information specific to a variety of particular clinical scenarios. Though often methodologically complex, for example, employing Markov and Monte Carlo probabilistic decision tree modeling, these studies can produce outcomes in terms of directly applicable to health policy, such as quality-adjusted life-years and incremental cost-effectiveness ratios. Pron et al, performing a systematic review of cost-effectiveness studies of vertebral augmentation for osteoporotic fractures, found vertebroplasty and kyphoplasty to be cost-effective in multiple settings, being associated with earlier health gains and shorter hospital stays.[20]

Demonstrating Quality Care Requires Quality Research

A specialty centered in disruptive technology, the field of IR has a track record of developing novel microinvasive techniques leveraging the latest advances in materials science and image guidance. These first-in-human studies are, by necessity, usually case series. Such early transitional, bench-to-bedside exploratory studies are essential in breaking new ground but are rarely sufficient to change practice guidelines, referral patterns, and payment policies. As reimbursement for health services becomes increasingly value-based, more and more robust health services research is required to prove in the most concrete and relevant terms possible: the quality, safety, service, and cost benefits of IR care. While many of the most impactful IR studies have been randomized controlled trials and systematic reviews (►**Fig. 2**), well-designed pragmatic trials and population health studies can provide complementary real-world data, often with greater generalizability. Where large real-world data specific to IR care do not yet exist, those data must be gathered by the Society of Interventional Radiology's VIRTEX registry.[21] Those interested in proving IR's worth must partner within

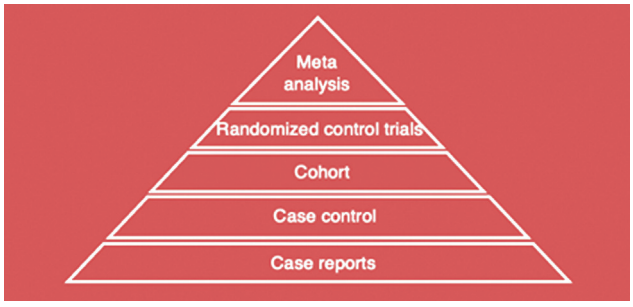

Fig. 2 Hierarchy of scientific evidence. (Adapted from Evidence-Based Practice: Levels of Evidence. Evidence Based Pyramid, John Moritz Library, Nebraska Methodist College.)

and across professional societies, such as with the SIR and Neiman Health Policy Research Institute,[22] collaborating whenever possible with health economists and health policy experts. Studies must be quantitative, disease-specific, and comparative, and they must focus on concrete, transparent, patient-centered endpoints. IR professional societies, like SIR and the Cardiovascular and Interventional Radiological Society of Europe (CIRSE), should double and redouble their support of investigators seeking foundation and federal funding for pivotal IR studies. And IR researchers should seek to incorporate as many of the variables of the value equation into their investigations as possible, illustrating in the clearest terms that IR care is valuable to patients, healthcare systems, and society as a whole.

Disclosures
M.-K.F., R.C., and . A.D.T. report no financial conflicts.

References

1 U.S. Health Expenditure as GDP Share 1960-2021. Accessed July 9, 2023 at: https://www.statista.com/statistics/184968/us-health-expenditure-as-percent-of-gdp-since-1960/
2 OECD Health Status. Accessed July 14, 2023 at: https://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_STAT
3 Porter ME. What is value in health care? N Engl J Med 2010;363(26):2477–2481
4 What Are the Components of Value-Based Care? Health Care Delivery Models | AMA Health Systems Science | AMA Ed Hub; November 14, 2019. Accessed August 25, 2023 at: edhub.ama-assn.org/health-systems-science/interactive/18028223
5 Charalel RA, McGinty G, Brant-Zawadzki M, et al. Interventional radiology delivers high-value health care and is an Imaging 3.0 vanguard. J Am Coll Radiol 2015;12(05):501–506
6 Schartz D, Young E. Medicare reimbursement trends for interventional radiology procedures: 2012 to 2020. J Vasc Interv Radiol 2021;32(03):447–452
7 Explore Measures and Activities - QPP. Accessed August 25, 2023 at: qpp.cms.gov/mips/explore-measures
8 Llovet JM, Real MI, Montaña X, et al; Barcelona Liver Cancer Group. Arterial embolisation or chemoembolisation versus symptomatic treatment in patients with unresectable hepatocellular carcinoma: a randomised controlled trial. Lancet 2002;359(9319):1734–1739
9 Gabr A, Riaz A, Johnson GE, et al. Correlation of Y90-absorbed radiation dose to pathological necrosis in hepatocellular carcinoma: confirmatory multicenter analysis in 45 explants. Eur J Nucl Med Mol Imaging 2021;48(02):580–583
10 Reig M, Forner A, Rimola J, et al. BCLC strategy for prognosis prediction and treatment recommendation: the 2022 update. Hepatol 2022;76:68193
11 Liu Z, Wang Y, Yan J, et al. Uterine artery embolization versus hysterectomy in the treatment of refractory postpartum hemorrhage: a systematic review and meta-analysis. J Matern Fetal Neonatal Med 2020;33(04):693–705
12 Sapoval M, Thiounn N, Descazeaud A, et al; PARTEM Study Group. Prostatic artery embolisation versus medical treatment in patients with benign prostatic hyperplasia (PARTEM): a randomised, multicentre, open-label, phase 3, superiority trial. Lancet Reg Health Eur 2023;31:100672
13 Knight GM, Talwar A, Salem R, Mouli S. Systematic review and meta-analysis comparing prostatic artery embolization to gold-standard transurethral resection of the prostate for benign prostatic hyperplasia. Cardiovasc Intervent Radiol 2021;44(02):183–193
14 Talenfeld AD, Gennarelli RL, Elkin EB, et al. Percutaneous ablation vs. partial and radical nephrectomy for T1a renal cancer: a population-based analysis. Ann Intern Med 2018;169(02):69–77
15 Charalel RA, Mushlin AI, Zheng X, et al. Beyond survival: complications and care delivery outcomes following early liver cancer treatment in a nationally representative cohort. J Vasc Interv Radiol 2023:S1051-0443(23)00519-5
16 Consumer Assessment of Healthcare Providers & Systems (CAHPS). Accessed July 14, 2023 at: https://www.cms.gov/research-statistics-data-and-systems/research/cahps
17 Delgado J, Huang AJ. Improving the patient experience during musculoskeletal interventional procedures. Skeletal Radiol 2023;52(05):889–895
18 LaRoy JR, White SB, Jayakrishnan T, et al. Cost and morbidity analysis of chest port insertion: interventional radiology suite versus operating room. J Am Coll Radiol 2015;12(06):563–571
19 Trivedi PS, Jensen AM, Brown MA, et al. Cost analysis of dialysis access maintenance interventions across physician specialties in US Medicare beneficiaries. Radiology 2020;297(02):474–481
20 Pron G, Hwang M, Smith R, Cheung A, Murphy K. Cost-effectiveness studies of vertebral augmentation for osteoporotic vertebral fractures: a systematic review. Spine J 2022;22(08):1356–1371
21 SIR Data Registry. Accessed July 14, 2023 at: https://www.sirweb.org/practice-resources/quality-improvement2/data-registry/
22 HPI. Accessed July 14, 2023 at: https://www.neimanhpi.org/about/