Clinical Performance and Value Vignettes (CPVs) Decrease Clinical Care Variation, Improve Patient Outcomes, and Decrease Costs

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Introduction

Estimates from the US suggest that more than 30% of health care is inappropriate or wasteful: up to a third of all deaths occur annually as a result of medical errors, and only 55% of needed health services are delivered.[1,2] This has important economic implications: an estimate from 2016 stated that nearly $1 trillion (of an estimated $4 trillion total spend) is wasted annually on therapies that do not improve patients' health.[3,4] These numbers are alarming given that decades prior, the US Institute of Medicine (IOM) called for standardization of clinical practice via the development and application of clinical practice guidelines.[5] Adherence to guidelines, when written according to IOM criteria, i.e., they include a systematic review of the evidence, explicit consideration of values and preferences, and address issues related to conflicts of interest, could prevent as many as a third of the leading causes of death, and reduce health-care spending by a third.[5,6] *This being the case, why can't physicians consistently practice according to the best accepted evidence? Or better still, how can we increase awareness*

and the adoption of evidence into their practice? More to the point, what can be done about this?

Barriers to physician adherence to clinical practice guidelines include lack of familiarity with or awareness of the guidelines, non-agreement with the recommendations, absence of self-efficacy, perceived outcome expectancy, the ability to overcome the inertia of previous practice, and external hurdles.[7-9] Most notable, however, is that knowledge of guideline contents does not guarantee adherence and newly acquired knowledge does not lead to behavior change.[10,11]

Employing newer approaches to learning and encouraging changes in physician practice offer some hope. Active learning, timely and anonymous feedback, group engagement, serial measurement, and peer comparison that engages learners increases self-awareness and critical thinking.[12] Use of active engagement methods in continuing medical education (CME), for example, reinforce content and promote changes in physician practice with improvement in patient outcomes.[13] One approach that leads to significant changes in clinical practice is the use of timely feedback on case-based decisions using validated case simulations.[14-16] Another avenue employs the motivational aspects of gaming, real-time scoring, digital feedback, leaderboards, and serial competition to advance medical education.[17-20] At QURE Healthcare, we have shown that Clinical Performance and Value vignettes (CPVs) overcome the barriers to reducing practice variation and the failure to engage physicians to change their practice. Here we describe the 10-year experience of using QURE's validated Clinical Performance and Value (CPV®) case simulations and feedback to engage clinicians and standardize evidence-based practice, reduce variability in patient care, and decrease healthcare costs.

Clinical Performance and Value Vignettes

CPVs are online simulated patients (to be referred to as "CPV patient" in text) in which providers proceed through the domains of a simulated clinical encounter. The use of CPVs to improve quality of care has been previously validated.[21,22] Simulations are interactive and open ended in order to accurately measure clinical practice. The use of our online engagement tool provides a contemporary relevant learning experience based on adult learning theory, or andragogy.[23] In andragogy, learners take responsibility for their own education and have an active role in directing what they need. Their motivation and the focus of the learning is on application of knowledge and the development of skills needed at the time.[24]

CPV patients are seen and cared for online. Each CPV takes 20-30 minutes to complete and guides the clinician through a typical patient encounter: taking a history, conducting the physical examination, ordering the diagnostic workup, making a diagnosis, and developing a treatment plan. At each step, the participant responds to open-ended questions about the care they would deliver. Cases have clear evidence-based scoring criteria and responses are compared against the criteria.

We use a typical serial engagement of 2 years and 6 rounds of CPV patient simulations per participant. Individual feedback includes an overall CPV quality score and specific scores for each domain of care, as well as personalized recommendations for improvement. Scores range from 0% to 100%, with higher scores reflecting greater alignment with best practice recommendations. Links to clinical guidelines and the medical literature are included. To provide additional feedback, participants' scores are benchmarked against their colleagues' scores and shared in aggregate (**Figure 1**). Finally, providers attend group feedback sessions to discuss variations in care provided for the same patient. This full cycle of measurement and feedback method, as shown in **Figure 2**, has been used in a variety of care settings and multi-country comparisons to measure variation, improve quality and outcomes, evaluate policies, and lower costs by standardizing practice.[25,26]

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Clinicians' scores across CPV rounds are tracked including 1) the overall vignette score, corresponding to the percentage of items correctly addressed by the participants according to the guideline-based scoring criteria, and 2) domain scores: history, physical, workup, diagnosis, and treatment. A two-sample variance test comparing equality of standard deviations is used to determine whether use of CPVs decrease the variation in domain and overall scores between rounds.

Participants are also asked to complete a survey at the end of the CPV cycle to provide feedback on their experience. The survey is comprised of statements which are scored on a 5-point Likert-type scale, with 1 indicating "poor' and 5 indicating "outstanding". Clinicians are also invited to make open-ended comments. The answers are collated and summarized for QURE review and process improvement.

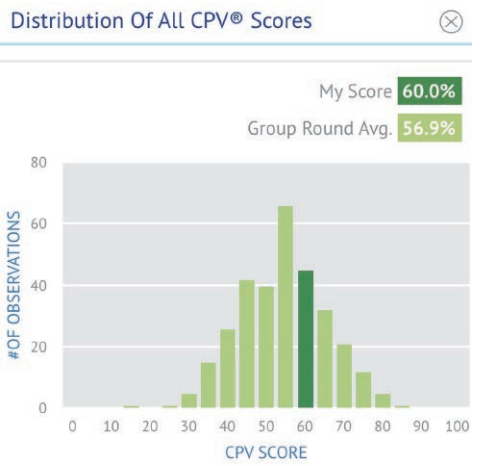

Figure 1: Example of participant score readout.

Level of Engagement with the QURE Approach

QURE clients are leaders in health systems with a desire to deliver consistent evidence-based care, improve patient outcomes, and reduce costs across their networks. These health systems partner with QURE Healthcare to implement a physician engagement and care standardization collaboration by participating in the CPV vignettes. To date, over 20,000 providers have cared for simulated patients in over two dozen national and international health systems across multiple specialties including cardiology, oncology, hospital medicine, and primary care. In our experience of over 10 years, a successful project includes several key elements. Three elements in particular are worth noting: first, a strong and engaged leadership team to identify areas of clinical concern is needed to cultivate physician engagement. Second, a source of high quality case vignettes, based on available evidence, guidelines, and local context, is paramount in supporting the adult learner. Third, providing both individualized and group-level feedback, noting areas of clinical concern or variation, drives improvement.

The QURE Experience: Reducing Variation and Raising Quality

Here, we highlight our experience with four major health systems[15,16,27,28] across the US:

1) Ochsner Health System (OHS), Louisiana's largest non-profit academic healthcare system,
2) Advocate Health Care (AHC), which annually diagnoses and treats more than 10,000 patients with cancer,

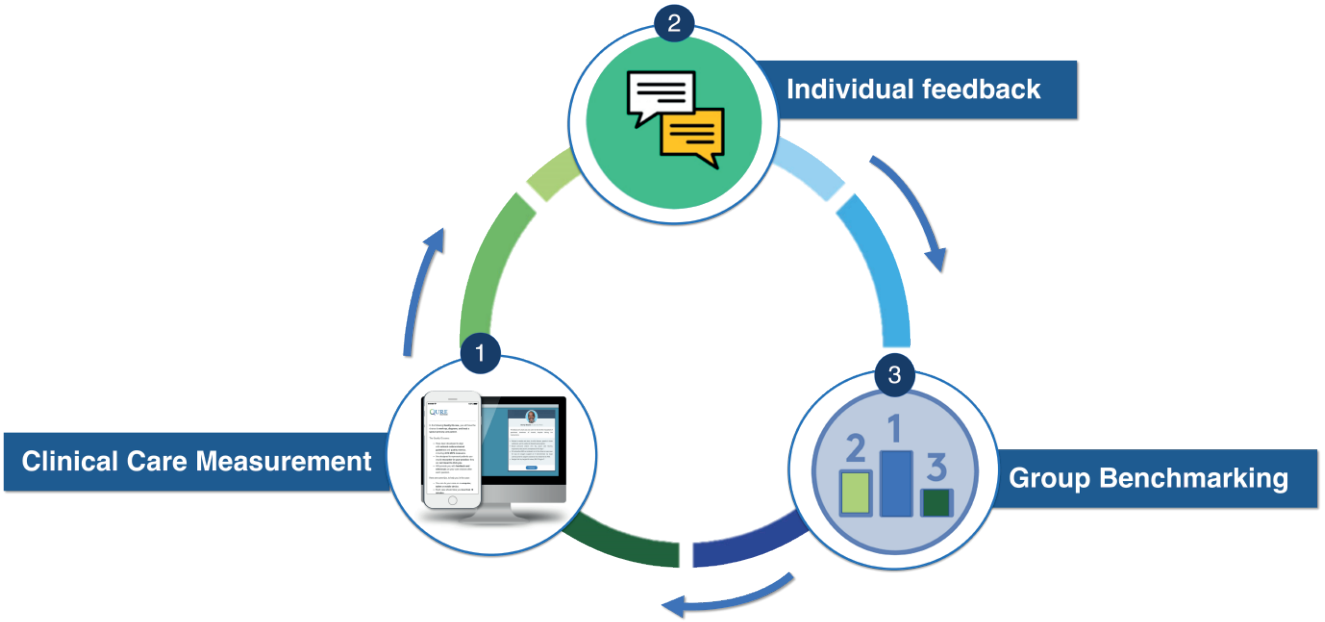

Figure 2: Measurement and feedback cycle.

3) Advent-Health, a faith-based health system with hospitals across nine states, and
4) ProHealth Physicians, the largest physician group in Connecticut.

At baseline measurement, overall quality scores across the board ranged from 56% to 65%. Individual domain scores for history, physical examination, diagnostic workup, diagnosis, and treatment plan ranged from a low of 21% (workup) to a high of 89% (physical examination). The highest level of variability in clinical care was typically in the diagnosis domain and the lowest level of variation was demonstrated in history taking. Variation in the diagnostic workup in each system was predominantly due to the ordering of unnecessary tests, an average of two tests per case.

As shown in the **Table** and **Figure 3**, mean end-of-cycle CPV scores showed a statistically significant and consistent improvement over time. Overall quality of care scores increased between 5% and 16%, with improvements in all five domains of care: history-taking, physical examination, diagnostic workup, diagnostic accuracy, and treatment plans.[15,16,27,28] Examples of specific improvements in the individual domains of care are outlined next.

Improved Diagnostic Workup and Accuracy

Among hospitalists treating simulated patients with pneumonia/sepsis or heart failure, *primary diagnosis improved from 73% to 81%* (p=0.093).[27] There was also a *15% decrease in low-value diagnostic work up items such as urinary antigen testing (p = .001) and sputum cultures*, which declined 26% (p = .004) Significant improvements in diagnostic workup were documented in simulated oncology patients with a *decrease in orders for imaging studies* from 32% at baseline to 21% at study end (p = .024).[16] In the same group, identification and documentation of the correct *primary cancer diagnosis increased by 6 percentage points, from 91% to 97%* (p=.001). Amongst cardiologists, the *diagnoses of valvular heart disease (VHD) increased by 29%* (p<0.001) *and heart failure (HF) by 36%* (p<0.001).[27] Primary care physicians ordered an average of 2 unnecessary tests per CPV case at baseline and fewer than 1 unnecessary test per CPV case at study end (p<0.001).[15] They also demonstrated an improvement in primary diagnosis from 63% to 80% (p<0.001).

Enhanced Evidence-based Treatment

In patients hospitalized with pneumonia/sepsis, absolute adherence to all four elements of the 3-hour sepsis bundle improved by 12% (p = .034) and adherence to preferred antibiotics increased by 37% (p = .047).[28] Maximizing HF medication treatment improved from 58% to 72% (p=0.038)

Table: Real world outcomes.

Study Group	Specialty	Baseline Score	End-of-study Score	Real-World Outcomes
Advent-Health[28]	Hospitalist	61.9%+10.5%	66.7%+13.4%	Reduction in LOS and inpatient costs: 11.5% reduction in O/E LOS and 15.5% reduction in cost = over 1.5 years in overall LOS savings and $2.4M in overall cost savings.
Advocate[16]	Oncology	64.9%+11.4%	72.6%+11.2%	Decrease in metastatic workup for early-stage breast cancer: 9.1% reduction in PET/CT; 16.7% reduction in CT of the chest/abdomen/pelvis; 27.3% reduction in brain MRIs and bone scans.
Ochsner[27]	Cardiology	56.0%+10.5%	70.1%+9.5%	Reduction in readmissions, in-hospital mortality, and total direct cost: 25.7% reduction in readmissions; 15.8% reduction in in-hospital mortality; and 6.0% reduction in total cost.
ProHealth[15]	Primary Care	58.0%+11.9%	73.6%+9.7%	Improved ACO measured outcomes: +9% increase in ACEI/ARB orders for DM/CAD patients; +10% increase in beta blocker orders for LVSD; +45% increase in breast cancer screening; +20% in LDL testing for DM patients.

LOS – length of stay; O/E – observed/expected; PET – positron emission tomography; CT – computed tomography; MRI – magnetic resonance imaging; ACO – accountable care organization; ACEI – angiotensin converting enzyme inhibitor; ARB – angiotensin receptor blocker; DM – diabetes mellitus; CAD – coronary artery disease; LVSD – left ventricular systolic dysfunction; LDL – low density lipoprotein.

and VTE prophylaxis in HF improved from 17% to 51% (p< .001).[28] In simulated cancer patients, use of evidence-based chemotherapy regimens improved by 10% (p = .009).[16] Among cardiologists, treatment scores increased dramatically as well, by 14% for VHD (p=0.002) and 12% (p=0.001) for coronary artery disease (CAD); appropriate medication orders for statins and aspirin increased by 10% each (p=0.325 and p=0.278).[27] Primary care physicians' treatment scores improved from 52% at baseline to 67% (p<0.001). This included increased appropriate use of angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs), provision of pneumococcal vaccinations, and use of aspirin in patients with ischemic valvular disease.[15]

Improvements in non-pharmacologic management of CPV patients were also demonstrated.

Discharge planning in sepsis improved from 42% to 67% (p<0.001), referrals for end-of-life and palliative care in CPV patients with cancer increased from 40% to 62% (p<0.001), cardiac rehabilitation referrals increased by 39% (p=0.001), and primary care physicians reduced the referral of patients with HF to cardiology from 70% to 9% (p < 0.001).[15,16,28]

Real World Outcomes Improve Using the QURE Approach

The value of the QURE approach is demonstrated in the translation of improvement in the simulated patients' care to improvement in real-world patient outcomes. For example, in the CPVs, cardiologists ordered coronary angiography unnecessarily 20% at baseline and 9% at cycle end. Patient-level data at the health system indicated coronary angiography use decreased from 13% before CPV participation to 10% after (p<0.001).[27] Similarly, the number of unnecessary test orders for the workup of early-stage metastatic breast cancer decreased from 1.6 to 1.2 (p<0.001).[16] In the primary care arena, appropriate use of ACEIs or ARBs for patients with coronary artery disease and diabetes increased by 5% in the CPV cases and 9% in the patient-level quality measures.[15] At the hospital level, improvements in CPV performance led to decreases in length of stay, readmissions, and in-hospital mortality.[27,28] Real world outcomes are summarized in the **Table**. While we don't have long-term follow-up data for these health systems, there is reason to believe these improvements will be sustained. Five years after a quality improvement program using CPVs to enhance the quality of hospital care yielded significant improvements, intervention sites continued to have significantly higher quality compared with the control sites.[29]

CPVs Result in Cost Reductions

CPVs result in decreased clinical variation and improved patient care, yielding savings in significant cost reductions. Hospitalists caring for patients with sepsis or heart failure reduced the annual number of inpatient lengths of stay by 570 days, accounting for $1.6 million cost savings at one year.[28] Over the two-year project, $2.4 million total savings were attributable to participation in CPVs. In the workup of cancer, spending on unwarranted tests fell by $313 per patient, from $1,106 to $793 (p<0.001).[16] For patients admitted to the hospital for cardiac causes, the total per patient direct costs decreased $493, $305, and $55 in SVT, HF, and CAD, respectively (p<0.05 for SVT and HF).[27] Readmission rates fell by 8% for HF and 7% for SVT (both p<0.001) and nonsignificantly for CAD (from 14% to 11%, p=0.112). The cost avoidance/revenue generation opportunity amounted to annual savings of $4.34 million, with no significant changes to in-hospital mortality rates (p>0.05). Finally, among primary care physicians participating in an accountable care organization, reductions calculated for spending on unneeded tests and specialist referrals exceeded $4.8 million.[15]

"Over 90% of participants completed all assigned CPV cases. Survey results indicated CPV vignettes were relevant to clinicians' practice and the overall quality of the material was very good."

Positive Participant Feedback

Over 90% of participants completed all assigned CPV cases. Survey results indicated CPV vignettes were relevant to clinicians' practice and the overall quality of the material was very good. Importantly, over 80% of clinicians reported they plan to do something different in their practices based on participation. Comments included: "Realistic scenarios help me practice evidence-based decision making" and "The virtual clinical case vignettes were smooth to navigate through."

Discussion

Standardization of clinical practice within a system improves patient outcomes and lowers costs. Despite this observation, payers and providers face considerable challenges to engage physicians in accessing and using data in real time to evaluate and improve physician performance. Simulations and modeling are being used to overcome these obstacles.[30-32] At QURE, we regularly see significant baseline variation in the care of simulated patients. We consistently found across 4 diverse health care systems that serial feedback and benchmarking

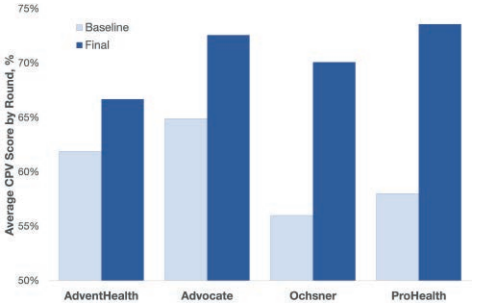

Figure 3: CPV score improvements.

improved care and corelated with improved performance in patient-level quality measures including reductions in unnecessary testing and more guideline-based treatment decisions. Importantly, changes in CPV-measured practice translated into lower costs, shorter length of stay, reduction in readmission rate, and lower in-hospital mortality. Collaboration between large health systems and QURE Healthcare benefits not only the providers and payers, but also individual patients.

Future Directions

We have developed and implemented a novel gamified web-based patient-simulation platform that uses high scores and leaderboards for clinicians to compete against their peers. This platform, called Quality IQ, focuses on primary care providers (PCPs) and leverages the sequential engagement of case-based learning in CPVs with immediate personalized evidence-based feedback.[20] This approach can be used across all participants in the continuum of care. We are currently engaged with several large systems where the whole care team, including providers, care management, practice management, and clinical support staff are participating in QualityIQ cases.

Another potential use for QURE CPVs is to determine the clinical utility of novel diagnostic tools. Patient simulations that elicit real-world clinical practice patterns from active providers offer a novel, inexpensive way to reveal whether a diagnostic test provides utility in a more cost-effective way than randomized controlled trials (RCTs) enrolling live patients. For pioneering diagnostic companies, an RCT approach using validated CPV simulated patients as a practice measurement tool is an innovative way of assessing clinical utility before spending time and resources on implementing a trial.

Finally, at a policy level, we believe this, and similar approaches, point to the real possibility of having a national measure for the standard of care to increase both performance and financial

accountability. Alignment of fee-for-service payments with patient outcomes, i.e., pay for quality performance, would incentivize both payers and providers to invest in continual practice improvement and standardize patient care according to the best available evidence. QURE's CPVs offer an engaging and practice-changing tool that can pave the way to realize this goal. JoPM

Summary Points

- Variation and non-adherence to the evidence base in the clinical care of patients is an enormous problem that results in ineffective and inefficient care, unnecessary deaths, and outrageous healthcare costs.
- Clinicians themselves do not have the ability to reduce variation or increase evidence-based practice on a systemwide basis, so forward-thinking leaders must find a solution that works.
- Clinical Performance and Value (CPV) vignettes decrease variation in clinical care, increase adherence to the evidence base, and improve patient outcomes.
- CPVs dramatically decrease unnecessary testing, length of stay, readmissions, and in-hospital mortality in as little as 9 months resulting in an enormous and rapid return on investment.

John Peabody, MD, PhD

President

Dr. Peabody is an international health care leader in measurement, health policy, health systems, and quality of clinical care. He has contributed to more than 200 peer-reviewed publications and several books on quality, measurement, economics, and healthcare systems. An actively funded National Institutes of Health (NIH) researcher, John works with clinical leaders, academic medical centers and multidisciplinary teams to help healthcare organizations better align their clinical staff. For almost two decades, he has examined how health systems affect, and potentially improve, care quality and patient outcomes. His leadership in this arena has led to his placement on Institute of Medicine and NIH committees and World Health Organization task forces. He has also testified before Congress on these issues. John developed the globally adopted standard for measuring clinical practice variation, known now simply as CPV Vignettes, the pillar stone of QURE Healthcare.

David Paculdo, MPH

Director of Analytics and Research

As Director of Analytics and Research at QURE Healthcare, David is responsible for planning and executing data analyses related to QURE's core business, as well as guiding and overseeing the overall analytics and statistical modeling projects of the analytics team. David received his Master of Public Health from Dartmouth College in 2003, with an emphasis in quality improvement and biostatistics, and a Bachelor of Science in Electrical Engineering from the University of California, Irvine. David has over ten years of experience related to healthcare analysis and outcomes, and he has been a contributing author to over a dozen peer-reviewed articles. Prior to this, he worked in semiconductor technology at IBM, where he fulfilled several technical and information technology roles for US and international clients to enable the success of multiple projects.

Trever Burgon, PhD

Vice President

Dr. Burgon is a nationally recognized leader in healthcare strategy and has worked extensively with senior health system leaders across the country on projects ranging from demand forecasting and value-based payment structures to clinical technology assessment and cancer center development. In addition, Trever speaks frequently at national conferences on issues of quality and value in healthcare. Before joining QURE, Trever served as Vice President at Sg2 (now a division of MedAssets), a health care analytics and intelligence company. At Sg2, Trever led the firm's Center for Clinical Technology as well as the Oncology Strategy team. Trever holds a PhD from Stanford University in Microbiology and Immunology and received his BS from Brigham Young University.

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