Moving From Discovery to System-Wide Change: The Role of Research in a Learning Health Care System: Experience from Three Decades of Health Systems Research in the Veterans Health Administration*

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Keywords

Abstract

The Veterans Health Administration is unique, functioning as an integrated health care system that provides care to more than six million veterans annually and as a home to an established scientific enterprise that conducts more than $1 billion of research each year. The presence of research, spanning the continuum from basic health services to translational research, has helped the Department of Veterans Affairs (VA) realize the potential of a learning health care system and has contributed to significant improvements in clinical quality over the past two decades. It has also illustrated distinct pathways by which research influences clinical care and policy and has provided lessons on challenges in translating research into practice on a national scale. These lessons are increasingly relevant to other health care systems, as the issues confronting the VA—the need to provide timely access, coordination of care, and consistent high quality across a diverse system—mirror those of the larger US health care system.

INTRODUCTION

The Department of Veterans Affairs (VA) and its research agenda are at a crossroads. As an integrated health care system with research spanning basic science to implementation, the VA has been in a unique position to translate research findings to clinical practice in order to improve the health care and health of veterans. As one of its core missions (along with clinical care and education), the VA's research program enables investigators embedded in the VA care system to conduct scientific studies on health issues uniquely affecting veterans, while benefitting from partnerships with academic centers and clinical programs. Recent reports based on published data suggest that on most (but not all) measures, the quality of VA care continues to be comparable to or better than that in the private sector (70, 73, 82, 90, 91). At the same time, these reports note wide variation in practice across VA medical centers, which signals more systemic issues that affect organization and management within the VA. These issues exploded into the headlines in 2014 when a newspaper story based on a VA whistleblower attributed the deaths of 40 veterans to long waiting times at the Phoenix VA hospital. Subsequent reports by the VA Office of the Inspector General (OIG) (99, 100), though unable to confirm that delayed care caused specific deaths, concluded that these delays in care impacted overall quality (99). Moreover, the OIG concluded that the practice of manipulating scheduling data to conceal how long veterans were waiting was "a nationwide systemic problem" (p. iv). In the wake of this scandal, Congress passed the Veterans Access, Choice and Accountability Act of 2014 (also commonly known as the Choice Act). The legislation established a Commission on Care that has recently made several recommendations to reform the VA (16). Many of the recommendations align with priorities previously outlined by David J. Shulkin, then Under Secretary for Health (USH), which include improving access to care, improving employee engagement, spreading best practices, developing a high-performing network of community providers, and restoring trust in the VA (98).

As the VA continues to address these challenges, research will need to help the VA fulfill the vision of a learning health care system as outlined by the Institute of Medicine (IOM) (43). Meeting this goal will require aligning the science with clinical priority goals, conducting more rapid and efficient studies, and leveraging existing data to deploy and evaluate innovations and best practices. In this overview, we review the ways that VA research has contributed to improvements in care and health outcomes, reflect on ongoing challenges in getting new evidence taken up quickly in a diverse health system, and offer some suggestions about different roles for research in a learning health care system.

BACKGROUND AND HISTORY OF VA RESEARCH

The history of the Veterans health care system traces back to the US Civil War, when in 1866, President Abraham Lincoln established the first Federal Veteran facility. Today, the words from Lincoln's second inaugural address are enshrined as the motto of the VA: "to care for him who shall have borne the battle and for his widow, and his orphan."

Since then, services for veterans have undergone numerous cycles of growth, reorganization, and reforms coinciding with surges of veterans returning from war. In 1930, Congress combined veteran-related programs under a single Veterans Administration founded by President Hoover (36). The US Medical Council responsible for advising the VA recommended "the establishment of a Section on Investigation and Research in the Medical Service" and that "staffs shall be encouraged to engage in research work in so far as their duties will permit" (36, p. 18). With the expansion of VA programs after World War II, President Harry S. Truman established the VA Department of Medicine and Surgery. This department oversaw the addition of 70 new hospitals, the creation of academic partnerships and training programs with medical schools, and the growth of VA medical

research. Over the next decade, the VA research budget grew from $500,000 to $4 million, and the number of VA publications grew from fewer than 50 to almost 900 per year. During the 1960s and 1970s, further growth of VA research was driven largely by biomedical and clinical research, exemplified by the Cooperative Studies Program (CSP), which was home to groundbreaking trials in the treatment of hypertension (77), tuberculosis (45), and schizophrenia (84).

Today, the Office of Research and Development (ORD) funds research through four programs of research and development: Biomedical and Laboratory, Clinical Sciences (including CSP), Rehabilitation, and Health Services (HSRD). In 2016, the $633 million budget supported more than 2,000 investigators at 83 VA medical centers, who were responsible for conducting more than 1,000 active projects. With additional funds from other federal research agencies and private funders, and from the medical care appropriation to support clinicians' salaries and administrative costs, the funds dedicated to research for veterans total more than $2 billion annually.

THE ORGANIZATION AND IMPACT OF VA RESEARCH

From the outset, research has been seen as an important component of high-quality care for veterans and has attracted trainees and cemented relationships with leading academic partners. Because the VA research program is an intramural program—only individuals with at least 60% commitment to the VA can lead VA projects—research is an important tool for attracting senior clinicians to the VA health care system. Because more than 60% of principal investigators are also VA clinicians, including physicians, psychologists, pharmacists, and nurses, researchers are intimately connected to the needs of veterans and the delivery system that serves them. The breadth of research, including implementation research, gives the VA the capability to address the full range of translation: T1 (basic science to clinical application), T2 (clinical innovation to patient care), and T3 (clinical evidence to consistent practice) (20) (see **Table 1**).

VA research has evolved with the changing needs of veterans from different conflicts. Research on human immunodeficiency virus (HIV) and hepatitis C grew as high infection rates were recognized among Vietnam veterans (22, 69); more recently, investments in traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD) have accelerated dramatically to address these prevalent problems among veterans from the wars in Iraq and Afghanistan (15).

Changes in the VA delivery system have also shaped VA research. As the VA underwent major system-wide reforms in the late 1990s, transitioning from a hospital-based treatment system to a population-based health care system, research on primary care and delivery issues expanded (60, 61). Clinician researchers were an integral part of these reforms, aiding in implementation of new primary care services, developing data to track progress, and documenting the impact of the reforms on quality of care (61, 65). This research was accelerated by the availability of population-based data on clinical care and clinical outcomes made possible by national implementation of the electronic health record (EHR).

VA leaders during this period recognized the large gap between research evidence and practice in the VA, as failings in the US health care system in general were described in the IOM's *Crossing the Quality Chasm* report (42). Along with promoting evidence-based guidelines and tools delivered through the EHR, the VA established a new program on research translation, the Quality Enhancement Research Initiative (QUERI) (19, 24), to assist in implementing evidence-based practices in high-priority areas, such as mental health and spinal cord injury (86). Since 1998, QUERI has funded more than 360 studies that have informed implementation of best practices in VA clinical care, including development of a national registry to monitor outcomes for all cardiac catheterization procedures (12, 66), rapid testing for HIV in VA clinics (1), national deployment of integrated primary care–mental health services (85), and computerized dashboards

Office of Research and Development (ORD): the program within the VA that supports research to improve veterans' lives

Post-traumatic stress disorder (PTSD): a mental health condition that affects some people, notably the veteran population, who have experienced a trauma or life-threatening event

Electronic health record (EHR): an electronic version of a patient's medical record, which can be used to guide individual care while also facilitating population management and quality improvement

Quality Enhancement Research Initiative (QUERI): Veterans Health Administration program with the purpose of improving the health and care of veterans by implementing effective clinical practices into routine care

Table 1 Progression of research and translation steps

Research stage	Types of studies	Examples
Basic biomedical T1 translation	■ Cellular and physiologic mechanisms of disease ■ Imaging ■ Biomarkers ■ Genomics	■ Neuroimaging studies detect brain differences in PTSD ■ Ongoing studies of genomic markers and biomarkers
Epidemiologic	■ Developing clinical measures ■ Developing data infrastructure ■ Prevalence and incidence ■ Risk factors ■ Long-term outcomes	■ Higher prevalence of physical symptoms in patients with PTSD ■ High (13%) prevalence of PTSD in women veterans ■ Military sexual trauma as a cause of PTSD ■ TBI strong predictor of PTSD
Clinical T2 translation	■ Phase 1, 2, and 3 trials ■ Drug and device trials ■ Provider and patient interventions ■ Comparative effectiveness research using large observational data sets	■ Cognitive processing therapy and prolonged exposure therapy effective for symptoms of PTSD ■ Prazosin reduces sleep disturbances in PTSD ■ Atypical antipsychotic respiridone not effective for PTSD ■ Mantram meditation reduces PTSD symptoms
Implementation and effectiveness T3 translation	■ Multicenter effectiveness trials ■ Implementation ■ Hybrid studies ■ System reengineering ■ eHealth	■ Clinical video telehealth is as effective for delivering PTSD treatment as in-person care ■ PTSD smartphone app launched
Delivery system and population health	■ Performance measures ■ Costs, budget impact, cost-effectiveness ■ Studies of variation in care	■ Structured diagnostic and disability rating process more reliable for assessing disability in PTSD

Abbreviations: PTSD, post-traumatic stress disorder; TBI, traumatic brain injury.

to monitor and improve opioid prescribing practices (89). Additional research focused attention on how system factors, such as health information technology, redesign of clinical processes, and appropriate performance measures, could promote uptake of evidence. Many of these initiatives helped inform the IOM's learning health care system framework (43).

MODELS FOR RESEARCH INFLUENCE ON PRACTICE

The past two decades at the VA have illustrated several distinct patterns by which research findings diffuse into VA practice. **Figure 1** displays a framework derived in part from the evidence-generating medicine cycle (23). In one pathway, definitive findings from well-designed clinical trials shape practice through their incorporation into guidelines, quality measures, or other system-wide implementation efforts. In a second pathway, when the evidence base is insufficient to address current needs, researchers and clinical program leaders collaborate to establish the evidence, through common research priorities and data collection strategies, and use research to inform progressive iterations of new clinical programs. Finally, a national health care system offers the possibility of a third pathway when policy changes and clinical innovations driven by the health care system serve to generate evidence via natural experiments that can be used to test specific strategies.
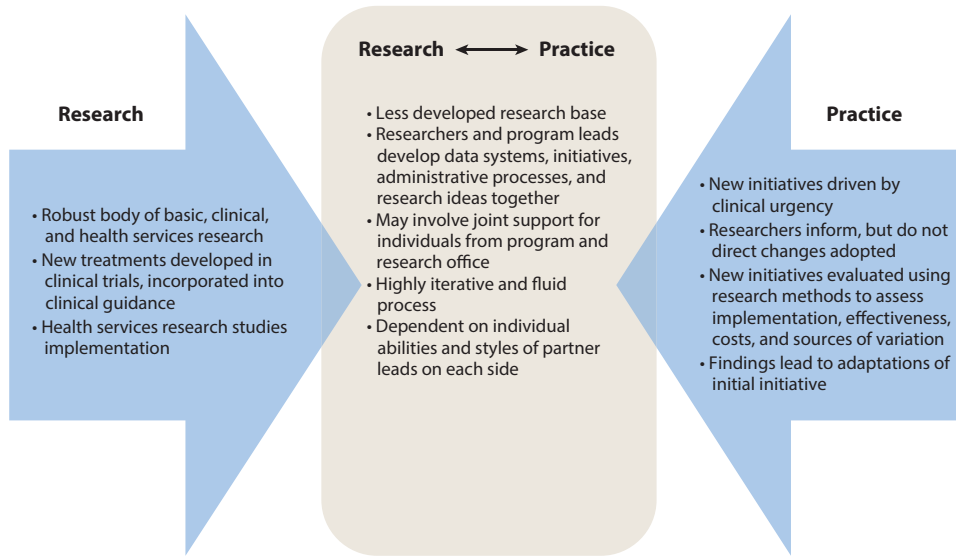
Figure 1

Bidirectional relationship between research and practice. This figure defines three pathways that describe the relationship between research and practice: how well-designed clinical research shapes practice, how researchers and practitioners collaborate when the evidence base is insufficient to address current needs, and when policy changes and clinical innovations driven by practice generate evidence.

Research Driving Practice: Mental Health Care

Perhaps no area better demonstrates the model of research evidence driving practice and improved care than mental health care, specifically the treatment of major depression, serious mental illness, and PTSD. The VA has had a major focus on mental health research for several decades, owing to the nature of these conditions and their higher prevalence among those seeking VA care. The VA also supports centers devoted specifically to advancing research, education, and clinical care for mental health conditions, including 15 Congressionally established mental illness–focused centers (95).

Research on PTSD (**Table 1**) showcases the importance of focusing on the numerous steps required to translate effective treatments into improved outcomes. Effectiveness of PTSD treatment is eroded by a number of factors. Many veterans with PTSD escape detection while in care, resist seeking or cannot access specialty care treatments, drop out of treatment prematurely, or are receiving care that is not delivered with high fidelity. Although VA research helped to establish the effectiveness of two psychological treatments for PTSD—cognitive processing therapy and prolonged exposure therapy (49)—uptake of these treatments has lagged for various reasons, including distance from trained mental health providers, number of sessions required, or stigma or resistance to therapy. These barriers to uptake led to a range of VA-funded studies to establish that (*a*) therapy can be delivered effectively through telehealth or collaborative care (28, 29, 30, 31, 102); (*b*) expert facilitation can help institute effective mental health treatments; and (*c*) alternative treatments, such as meditation, which may be more acceptable to some patients, can also reduce symptoms (10).

Findings from mental health research on depression have also been effectively adopted in VA routine practice. In 2007, the VA established the Primary Care–Mental Health Integration (PC-MHI) program to advance the use of evidence-based integrated care for depression, PTSD,

Primary Care–Mental Health Integration (PC-MHI): mental and behavioral health services that combine evidence-based care management and co-located collaborative care, provided to Veterans through patient aligned care teams within primary care

and substance use in VA primary care settings (9, 59, 78), in response to evidence suggesting that most patients with mental health symptoms present first to primary care. PC-MHI is based on findings from groundbreaking research showing that integrated collaborative care when delivered via a care manager can improve physical and mental health outcomes (81, 85, 97). VA mental health care was further bolstered by implementation of routine screening for PTSD, depression, and hazardous alcohol use using standardized measures that had been validated in VA studies (11, 76). The impact of applied research on mental health clinical care improvements in the VA has been documented in studies demonstrating that the overall quality of VA mental health care substantially outperforms care in the private sector (73, 104). O'Hanlon and colleagues (73) found greater access to on-site mental health services within the VA and better mental health–related patient outcomes after two years, compared with general Medicare patients. A study examining quality on the basis of 7 mental-health process measures found that the VA outperformed private-sector care by 30–100% (104).

Developing Research and Clinical Practice in Parallel: Homelessness and Women Veterans Health

Veteran homelessness. Clinical leaders do not always have the benefit of well-developed research knowledge when they are compelled to act. In 2009, President Obama set a goal of ending homelessness among veterans, who comprised 12% of all homeless Americans. While VA researchers had been involved in work on homelessness prior to the new initiative, the push to end homelessness invigorated a more concerted research effort. In 2012, VA investigators assessed the VA's transition to the Housing First approach of placing veterans in permanent, supportive housing through the use of rental vouchers. Qualitative researchers found that VA medical centers effective in advancing Housing First were able to engage and organize change with community partners (54). Other studies examined how the patient-centered medical home model could be adapted to address the specific needs of homeless veterans, incorporating new services and assessments to link veterans to community outreach (74, 75).

To improve efforts to prevent homelessness, investigators leveraged the VA's EHR to build predictive models to identify at-risk veterans by applying natural-language processing to clinical text notes to extract specific concepts (e.g., job loss or economic stress) not available from standard EHR data. An unexpected finding from this work was that being discharged at "less than honorable" status from the military was a major risk factor for homelessness, which has led to recommendations to revise eligibility standards for some VA services (16). In addition, VA researchers developed and tested a facilitation program that coached providers on leadership and strategic thinking to support implementation of an outreach program (Re-Engage) for veterans at risk of homelessness (18, 34, 56, 58). The program significantly increased the uptake of Re-Engage within six months at little cost (58). As a result, Re-Engage is now in the VA national performance monitoring system (96). VA research investment has contributed to the successful concerted efforts of VA programs against homelessness: Veteran homelessness has fallen by 36% from 2010 to 2015 (71).

Women veterans health. The military mobilization required for the Iraq and Afghanistan conflicts drew a new cohort of women into the US Armed Services and into VA care beginning in the early 2000s. As the VA hurriedly added new clinical services for women, the research service worked to mobilize a new cohort of women's health researchers (105, 106). The VA Office on Women's Health Services (WHS) funded a national survey to document the specific needs of women veterans (16, 104, 105), which informed a research agenda developed jointly by ORD and

Women's Health Services (WHS): Veterans Health Administration program dedicated to addressing the needs of women veterans and implementing positive changes in the provision of care in the veterans health care system

WHS. The VA's HSRD program also established a VA Women's Health Research Network to increase the recruitment of women into VA research studies. The progress of women veterans health research in the VA, documented in a series of journal supplements, has guided the VA's efforts to design care for women veterans (107, 108, 109, 110, 111, 112, 113). Research findings that have shaped care include documenting the high incidence and clinical consequences of military sexual trauma among women; high rates of discontinuing VA care after initial contact driven by a lack of clinicians with expertise in women's health issues; a high prevalence of mental health issues among those seeking VA care; complex health care needs; and gaps in reproductive health services. The strong partnership between researchers and clinical leadership has accelerated the impact of research on the care of women veterans. Research briefings with the leadership in Washington, DC, and in regional networks (i.e., Veterans Integrated Service Networks) led to a redesign of women's primary care and changes in VA policy to promote designated women's health providers (4, 6) to address potential gaps in women's primary care (108, 110).

System Change as a Catalyst for Research: Patient Aligned Care Teams and Telehealth

In contrast with the gradual iterative model where research drives practice change, there are examples in the VA where system change drives the research. As a national integrated delivery system, the VA has implemented large national changes when the issues seemed best addressed by uniform policy approaches. Because these initiatives are sometimes undertaken in the absence of conclusive evidence, they create natural experiments, which can become the subject of careful research to assess what worked and what did not, to examine how to refine the programs and to test specific hypotheses about change and improvement.

Patient aligned care teams. In 2009, VA leadership recognized that the primary care system was under stress owing to lagging patient access, increasing rates of clinician burnout and turnover, and inefficient use of staff. The following year, the VA began one of the largest implementations of the patient-centered medical home model in the United States, which the VA called patient aligned care teams (PACTs) (87). Endorsed by leading primary care organizations and payers, the purpose of PACTs was to deliver coordinated, proactive team-based primary care to better address the needs of primary care patients, especially those with chronic diseases. The PACT team is composed of a primary care physician, nurse care manager, and medical assistants, supported by behavioral health coaches, mental health providers, and pharmacists. The underlying architecture of PACTs is based on the chronic care model (8, 101), which involves the use of clinical information systems, evidence-based policies, care coordination, and self-management education to support more effective provider–patient collaboration.

Although the theoretical basis for PACTs is strong, the evidence documenting effects on patient outcomes and costs was relatively limited (39). The VA invested in an evaluation center and five demonstration labs to test innovative approaches to PACTs and to develop survey, clinical, and administrative data to assess implementation and effects on costs, veteran and provider satisfaction, and clinical outcomes. Results from this national evaluation documented that implementation of PACTs varied across the 1,000+ sites of VA care (72). Use of telephone care increased dramatically after PACTs were established, and patient satisfaction improved. Sites that implemented PACTs most effectively had higher quality-of-care scores, lower emergency department use, and fewer hospitalizations for ambulatory care-sensitive conditions compared with sites that implemented PACTs less effectively (72). Overall, the VA has seen an increase in costs of care since the implementation of PACTs owing to increased outpatient visits, which was somewhat, but not

completely, offset by decreased hospitalizations and mental health specialty visits (38). Several studies based on the VA's national PACT implementation initiative shed light on the reasons for the variable implementation, including the potential for provider turnover and burnout, and they can inform additional research as the VA seeks to continue PACT spread and to improve employee engagement (72).

Telehealth. Ensuring timely access to care, especially for specialty care, has been a recurring challenge for the VA, given the widely dispersed patient population and the uneven growth of the veteran population and the supply of clinicians. Beginning in the late 1990s, the VA began to expand telehealth services, including clinical video telehealth to provide access to psychologists and psychiatry services; store-and-forward technology to expand access to diabetic eye screening, radiology services, and cardiology services; and home telehealth services to improve monitoring of patients with chronic conditions. By 2016, VA telehealth services involved 45 specialty areas of care and delivered more than 2 million episodes of telehealth annually (93). In 2009, new initiatives further expanded alternatives to traditional in-person visits, including secure messaging between patients and their primary care team, e-consults to provide virtual consultation from specialists to primary care, and specialty care access networks (SCAN-ECHO) to provide a virtual program of consultation and group learning for primary care providers in areas such as pain management and hepatitis C treatment. Spread of these innovations was accelerated by VA research studies that documented the quality and effectiveness of these services. In telemental health services, which has accounted for 1.8 million encounters since 2003, careful research studies have documented that clinical outcomes are comparable, adherence is higher, and patient satisfaction is superior compared with in-person counseling for conditions including PTSD and depression (21, 29, 30, 35, 50).

AREAS WHERE INFLUENCE OF RESEARCH ON PRACTICE IS INCOMPLETE

In some areas, however, insights from research have not yet been fully applied in practice. The reasons for this persisting gap include external pressures that constrain practice or policy; research that has not addressed the specific decisions facing policy makers; and research in an area that may not yet have matured sufficiently to inform complex issues.

Performance Measurement

Performance measurement illustrates some of the challenges in applying research to policy (3, 68). The VA was an early adopter of system-wide performance measurement, which was a critical component of the reforms in the late 1990s (40, 48, 51, 62, 63). The creation of an Office of Informatics and Analytics (OIA) and a national Corporate Data Warehouse (CDW) increased the ability of managers to examine performance through dashboards that track specific areas of performance at the facility, clinic, or provider level.

Although these refinements to clinical data systems have been helpful, the proliferation of VA performance measures has been more problematic. As initially implemented in the VA, performance measures were linked to a limited number of key strategic goals, and clinical managers were given substantial flexibility in determining how to meet the goals (62, 63). Over the past two decades, however, the number of measures that are reported and publicly released has grown, as new measures were added to track new program priorities and to benchmark against outside organizations (51). In 2004, mimicking the private sector, Congress approved a pay-for-performance

system for VA clinicians. Even though few of the reported measures were actually linked to financial awards, together these shifts increased feelings of measurement overload and a disconnect between measures and important system priorities (7, 17). Furthermore, VA researchers have demonstrated limitations of dichotomous performance measures; they incentivize potential overtreatment, ignore clinically important improvement toward goals, and undervalue patient priorities (17, 37, 52, 53).

The VA access crisis that was first reported in the Phoenix VA medical center in 2014 demonstrates a number of these problems. In 2010, to emphasize the importance of timely access, the VA made the scheduling of appointments within two weeks a performance measure and tied it to leaders' bonuses, despite a number of limitations: The requirement neglected other options available to veterans such as secure messaging or telephone care, ignored the capacity of each facility to meet that target, and did not distinguish on the basis of the clinical need of each patient. The result was that in several facilities, schedulers felt pressure to manipulate scheduling practices in order to make wait times look better.

The VA has applied the lessons from this crisis in several ways. It has removed access measures from those tied to bonuses and has moved to a more patient-centered measure that is based on survey questions from the Consumer Assessment of Health Plans Survey (CAHPS) (92), which asks whether patients were able to receive the care they needed as soon as they needed it. Finally, the organization has focused on a more limited set of high-priority goals and has worked to align performance plans with those goals.

Big Data

With an EHR dating to 1992, big data is not a new concept within the VA, where every day 420,000 patient encounters, 2.4 million lab results, and more than 553,000 pharmacy fills are processed. The creation of the CDW and a secure research environment—the VA Informatics and Computing Infrastructure (VINCI)—to allow researchers and operations managers to access these data with advanced analytic tools has accelerated data research, including natural-language processing and machine-learning techniques.

VA operational programs and researchers have developed several predictive tools derived from big data to tackle some of our most pressing problems (25). One uses data on more than 100 clinical and demographic variables on 4.5 million patients to identify those at highest risk of hospitalization or death (103). Since 2011, this score is provided to all primary care teams, updated monthly, and used to identify the highest-risk patients who need additional interventions or services. More recently, the VA developed the Stratification Tool for Opioid Risk Management (STORM) to identify patients most at risk for adverse outcomes of opioid therapy. It calculates patients' level of risk, displays patient-specific clinical risk factors, and tracks use of recommended risk mitigation strategies (32, 41). In addition, researchers in the VA recently developed and validated a strong suicide predictive model that allowed the identification of VA patients who were at the highest predicted risk for suicide. Risk was increased sixfold among the top 5% who accounted for approximately 24% of all the suicide deaths and 37% of all reported suicide attempts over the course of one year (67).

What is still needed, however, is better evidence to guide how clinicians and health systems can use predictive tools to improve outcomes. In 2016, under a new learning health care system initiative, the VA awarded initial funding for a program of four randomized program evaluations, including the clinical implementation of STORM and the suicide prediction monitoring. These projects will examine the impact of providing this risk information to providers with and without enhanced provider tools to help promote use of the information.

NEW RESEARCH PRIORITIES

Access to Care and Community Networks

Ensuring timely access to care has been both a high priority and a persistent challenge for the VA over the past decade, as the demand for care has outpaced the organizational capacity required to deliver this care. As outlined by Fortney (27) in a VA State of the Art meeting, access is a multidimensional concept that includes actual and perceived access and which includes temporal, financial, cultural, and digital dimensions. In addition to a robust research portfolio on telehealth, the VA has funded a broad variety of studies on access. Among the lessons learned are the necessity to refine concepts of access prioritized by need, the importance of a team-based view rather than using the individual provider as the focus of access, and the need to address tensions between efforts to promote continuity and those to speed access.

Largely missing from the VA research portfolio, however, has been a more complete system-level examination of the effects of interventions that the VA has undertaken on the ability to provide timely care and on the outcomes of that care. Although the VA has pioneered the implementation of telehealth and secure messaging, the cumulative impact of these initiatives on access is complicated and depends on how well they are implemented and how they impact provider workload, efficiency, and turnover. The VA is seeking to improve timely access to mental health care by developing national telemental health centers to serve areas with chronic difficulty in hiring mental health specialists, but other solutions are needed for areas where there is no excess capacity in the system. Overall, more comprehensive research is needed to project the optimal mix of in-person, virtual, and team-based capacity for primary and specialty care to meet the projected demand for various services. As the US and the VA health care systems move toward greater reliance on networks of providers, we need to better understand how to coordinate that care and monitor quality so that we do not achieve access at the expense of integrated, high-quality care.

In response to recent policy shifts, notably the Veterans Choice Act, QUERI supported rigorous national evaluations of this and similar policies on access to care. In doing so, researchers addressed challenges in accessing non-VA care utilization data that will have broad implications for the VA's transition to community networks. QUERI evaluations are also refining access measures to evaluate the impact of the Choice Act's mandated clinic management training (94) and are measuring the cost of providing care to nonveteran family members through the VA's Caregiver Support Program.

Improving Implementation of Best Practices

The external evaluation of the VA, as commissioned under the Choice Act, concluded that "[a] systematic effort is needed to identify unwarranted variation, identify and develop best practices to improve performance, and embed these practices into routine use across the VA system" (70, p. B-3). One approach to more systematically deploy best practices is through the development and testing of implementation strategies, defined as highly specified operationalized methods used to enhance the uptake of effective practices (5). Implementation is seen as an important research priority in a learning health care system (13). Implementation strategies typically try to change behavior among providers or teams of providers. However, until recently, most empirically tested implementation interventions involved the use of financial incentives, with little knowledge regarding whether novel but lower-cost approaches that target intrinsic motivators could work to support providers in implementing best practices. Moreover, the success of many process-improvement strategies, such as Lean Six Sigma, varies without an understanding of how to adapt these strategies across different organizational and leadership contexts (33, 64, 83).
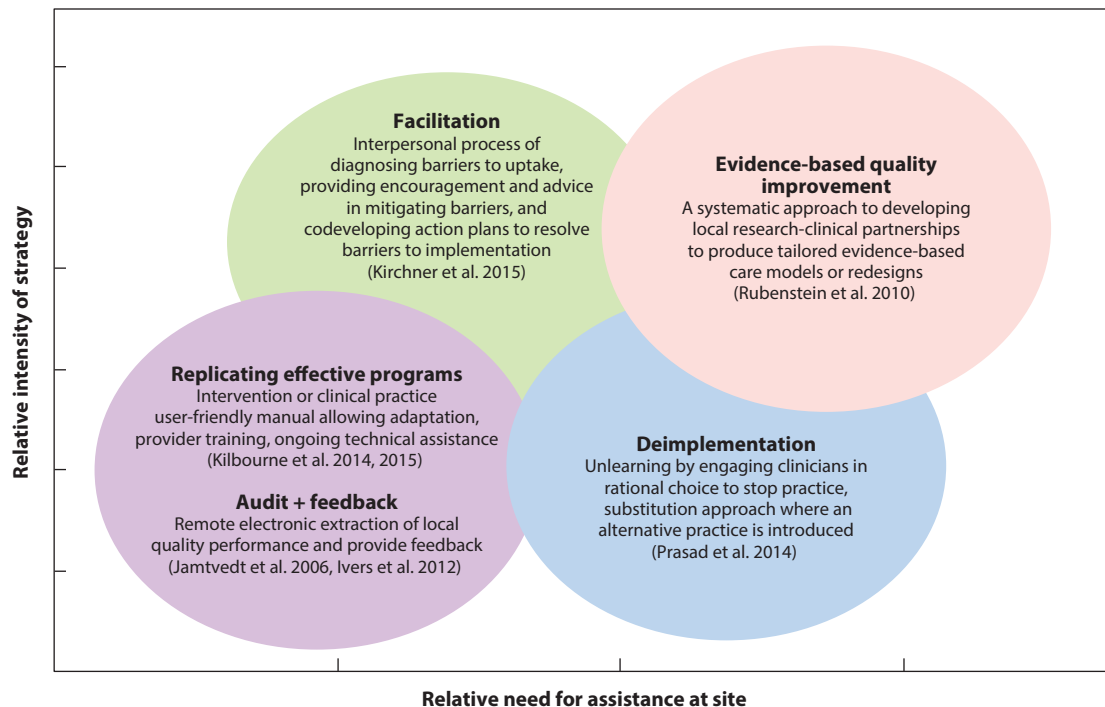
Figure 2

Examples of implementation strategies used by VA QUERI programs. This figure describes implementation strategy examples that are highly specified, theory-based methods used to improve the uptake of effective practices by addressing provider- and/or organizational-level barriers to change. The examples are represented on a horizontal axis, which depicts the relative need for assistance at the site where implementation is occurring, and on a vertical axis, which represents the strategy's relative intensity (time and cost to deploy the strategy).

The VA has been diffusing innovative best practices since the 1990s, notably with the establishment of QUERI. Recently, QUERI updated its national network of programs to focus on developing and testing different implementation strategies based on public health, organizational psychology, and health systems engineering approaches (44, 46, 47, 55, 58, 59, 79, 80, 85) (**Figure 2**). New research is needed to identify which implementation strategies are most effective, given variations in health care practice culture, climate, resources, and provider training, so that providers buy into these strategies and patients can take advantage of effective practices more rapidly.

CONTINUING EVOLUTION OF A LEARNING HEALTH CARE SYSTEM

In its 2013 report, *Best Care at Lower Cost* (43), the IOM outlined core elements of a learning health care system, many of which have been incorporated for some time in the VA, as indicated in **Table 2**. As noted in **Table 2**, however, the VA's experience has illustrated room for further evolution in and refinement of each element. Whereas data and access to evidence-based knowledge are key foundations of a learning health care system, applying that knowledge requires insights from implementation science (5, 55). A more complete learning model would incorporate emergent thinking based on the dynamic sustainability framework, which promotes continuous

Table 2   Elements of the learning health care system in the VA

Element from IOM model for learning health care system	VA component	Lessons learned and areas targeted for future improvement
Real-time access to knowledge	EHR provides access to guidelines, electronic clinical reminders, alerts.	Clinicians report "reminder fatigue" for patients with multiple conditions. Better targeting of information is needed to push information selectively and to promote individualized care.
Digital capture of care experience	Wide array of clinical and administrative data available in corporate data warehouse. Annual survey data on patient experience. Home telehealth provides expanded monitoring of patients with diabetes, heart failure, and other chronic illnesses.	Substantial amount of clinical data still resides in text notes but can be extracted using natural-language processing. Efforts are expanding to capture patient-reported outcomes to guide treatment (e.g., symptom scales in serious mental illness). Pilot efforts to capture patient-reported outcomes via mobile devices.
Engaged, empowered patients	The My HealtheVet Patient portal allows email communication with health care team, access to medical record including clinician notes, and educational information. Blue Button feature allows patients to download records. Peer support programs promote engagement among patients with mental health disorders and other chronic diseases.	Privacy and information security rules can impede patient-centered communication. There is still a limited electronic flow of records between the VA and other health systems. The new mobile health initiative will support patients through tailored smartphone messages.
Incentives aligned for value	Salaried clinicians remove incentives based on volume of care. Financial incentives in the VA are tied to a limited number of clinical quality goals. Global budget encourages efficient use of new technologies.	Evidence on the value of financial incentives for improving clinical performance is conflicting. There are challenges in assessing other important outcomes, including efficiency of practice and provider workload. Credits for virtual care (e.g., email, etc.) are being refined.
Full transparency	The VA is a public agency with public reporting of large volumes of data on quality. Independent researchers publish widely on the quality of VA care. Clinicians' access to multiple clinical dashboards allows them to track quality relative to peers.	Public information may be misinterpreted without appropriate context or comparison. Pressure to benchmark against outside systems may limit the VA's attempts to introduce better quality measures.
Leadership-instilled culture of learning	There are strong academic affiliations in larger VA medical centers; numerous clinicians with dual appointments; and a history of training programs across multiple disciplines.	Learning is promoted across the system through a spread of best practices, rewarding innovation within the system, and through facilitating partnerships with outside innovators. We need to build in careful systems to assess value of different innovations.
Supportive system competencies	There is a strong emphasis on system redesign and "Lean" training	Implementation science should be applied to study approaches to ensuring fidelity to Lean principles and avoid drift.

Abbreviations: EHR, electronic health record; IOM, Institute of Medicine; VA, US Department of Veterans Affairs.

testing of interventions in real-world settings rather than relying on efficacy trials in settings that do not reflect the real world (14).

LESSONS FROM THE VA EXPERIENCE FOR OTHER HEALTH SYSTEMS

The VA research experience lends itself to the following lessons for other systems that seek to implement research findings to improve quality, safety, and efficiency. In a learning health care system, learning results from a combination of rigorous analysis conducted in the context of quality improvement and independent investigations conducted as research.

Advanced health systems such as the VA have established sophisticated analytic program offices that use methods and statistics toward quality improvement efforts rather than to conduct research. As such, they can conduct evaluation and analysis more quickly and efficiently than under the rules of formal research. Such programs benefit, however, from the foundational methodological work enabled by research funding to ensure data quality, to refine analyses, and to examine a more complete set of outcomes over longer periods.

Big Data Needs to be Augmented with Deep Data

Analyses of big data can successfully identify variation and associated patterns, but they are not sufficient to understand the underlying reasons for variation or to develop potential solutions. Combining quantitative and qualitative data can reveal the interplay of leadership, culture, process, and incentives that contributes to variations in quality. Health care is a complex human process and, as such, benefits from the investigative skills of anthropologists, sociologists, organizational behavior experts, and behavioral economists.

Patient-Centered Metrics Are Needed to Assess Progress at the Individual Level

The pursuit of evidence-based care needs to be married to efforts to ensure that care is patient centered and aligned with individual patient goals (88). Expanding the use of patient-reported outcomes and patient-generated treatment goals can ensure that our efforts are aligned with what our patients value most.

Real System Improvement Requires Attention to All Steps of the Translation Pathway

Disseminating comprehensive data on performance does not ensure care improvements. True practice change requires the use of implementation strategies that promote supportive system changes for providers and teams of providers to reduce barriers, align incentives with both provider and patient priorities, and ensure that progress is being captured in data systems.

Translational Researchers Must be Matched with Clinical Leaders

Close working relationships between researchers and clinical leaders, built over time and reinforced through shared interests, have been critical in the VA (57). These relationships are often reinforced by individuals who traverse the research/practice boundary, including researchers who take on policy leadership or clinical leaders who partner in research studies. Additional work is needed to align the incentives of the different parties by increasing rewards for researchers who contribute to clinical improvements and for operations leaders who advance the role of research (57).

Spreading Best Practices Requires a Combination of Top-Down and Bottom-Up Strategies

Ensuring quality across a diverse system sometimes requires a centralized approach to designing and promoting best practices. In preparing to implement lung cancer screening, the VA conducted pilot studies to develop recruitment tools, tracking systems, quality monitors, and estimates of resource implications for a national rollout. In contrast with such top-down models, many innovative best practices have been developed and nurtured by committed local teams. These practices can be spread through bottom-up methods. With support from the USH and QUERI, the VA is launching a national evaluation of the Diffusion of Excellence initiative to determine how facilities are rewarded for sharing their best practices and the extent to which best practice innovations are adopted elsewhere in the VA.

Better Methods Are Needed to Evaluate and Learn from the Numerous Innovations Occurring in Clinical Programs

Progressive health care systems are constantly innovating in order to improve, but they often fail to build in a well-designed evaluation method that would permit rigorous assessment of the effectiveness and value of these innovations. In the VA's Randomized Program Evaluations, researchers work with clinical leaders to design and conduct deeper and more rigorous assessments of important initiatives within the more rapid timeframe expected by clinical operations.

Research and Improvement Efforts Need Better Tools to Reduce Practice Variation Among Facilities, Clinics, and Providers

The critical challenge for the VA and many large health systems is unwanted variation. External reports have highlighted that quality is not delivered consistently across a large system in the VA (70). That variation arises from complex factors and therefore defies attempts at simple fixes. Contributing factors include varying expertise and practice styles among clinicians, varying clinic organization, leadership and resources, and differences in community and regional factors, including those at the patient level (26).

Reducing Variation Will Require Better Strategies to Engage and Assist Low-Performing Sites

Our ability to help struggling practices is hampered by the fact that relationships may be limited between researchers and clinical leaders in lower-performing facilities, which are often smaller and more remote, are less likely to have strong academic affiliations, and often lack other elements that are critical for success (good data, adequate resources, stable staff, and strong leadership) as compared with higher-performing sites. A new initiative in the VA will centralize performance data across the system and develop a more complete package of implementation interventions for lagging facilities.

System Improvement Requires a Focused Set of Performance Measures

A proliferation of clinical measures can conflict with the goal of focusing a system on its highest-priority clinical goals. More attention to how measures are implemented may ensure that clinicians feel a sense of ownership and that the measures align with their sense of professionalism.

CONCLUSIONS

The VA has maintained a strong history of discovery and innovation. It remains the only entity that specifically conducts research related to the unique health issues affecting veterans, through an extensive network of partnerships and clinical investigators embedded in its facilities. VA research has pioneered many medical advances that impact Americans every day and has also led to changes in practice models and systems of care. As the VA addresses current issues, such as access to care, it is looking to build greater integration with community-based medical resources. To provide the best quality of care to veterans, the VA will need to better understand differences in outcomes between care provided inside the VA and care provided outside the VA, as well as to identify gaps in care and care coordination. The integration of community care into the fabric of veteran health care will by necessity change the nature of the research. During a time of disruptive innovation in the greater health care market, VA research will also need to adopt quicker approaches to evaluate technologies and ideas from within and external to the VA. Many of these new disruptions and their potential to advance veteran outcomes and well-being do not lend themselves to traditional study designs or to the timelines associated with standard evaluations. As it has in the past, the VA will need to continue to adapt and change in an environment where rapid change is occurring on a national scale.

SUMMARY POINTS

1. The VA has a robust history of practice-based research that can inform future research directions in a learning health care system, creating a culture of quality and innovation.

2. Major research initiatives in mental health, homelessness, primary care, women's health, implementation science, and health information technology help pave the way for future research priorities.

3. The VA, like other health systems, benefits from a combination of rigorous analysis conducted in the context of quality improvement and independent investigations conducted as research.

4. Lessons learned include the need for researchers to augment learning health care system principles through leveraging big data with deep data to generate more patient- and provider-centered metrics, for more rigorous top-down and bottom-up implementation strategies to support the spread of effective practices especially in lower-performing sites, and for a strengthening of effective research and practice collaboration in all steps of the translation pathway.

FUTURE ISSUES

1. What are the best approaches in a complex health system for integrating the contributions of independent rigorous clinical and health services evaluation and research with the insights from operational analyses of quality conducted by clinical leaders and program managers?

2. How can clinical leaders, providers, and consumers be engaged in all steps of the research translation pathway to inform best practices implementation?

3. What are the optimal implementation strategies and tools for reducing variation in quality and outcomes of care across different settings and organizational contexts?

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