Health Services Research
Evolution and Applications

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KEYWORDS
- Health services research
- Outcomes research
- Health care quality

KEY POINTS
- Health services research is broadly focused on characterizing and improving the access, quality, delivery, and cost of health care.
- Health services research is a multidisciplinary field, engaging experts in clinical medicine and surgery, policy, economics, implementation science, statistics, psychology, and education to improve the care of patients across all specialties.
- Recent health policy changes emphasize the need for rigorous, ongoing assessment of our health care delivery system. Health services research endeavors will become increasingly relevant with accelerating health care costs, medical and surgical innovation, and the expanding population in the United States.

INTRODUCTION
Delivering high-quality, efficient care to all Americans remains an elusive and expensive task. Understanding the organizational structure of our health care delivery system can provide critical insight on strategies to improve the accessibility, effectiveness, and affordability of health care in the United States. In this context, the field of health services research (HSR) is directed at examining all aspects of health care delivery to improve the quality and streamline the allocation of scarce resources. This article summarizes the evolution and distinctive attributes of HSR and present several real-world applications.

THE HISTORY OF HEALTH SERVICES RESEARCH
The beginning of HSR as a formal entity is difficult to define. For example, the first investigation of treatment effectiveness could be considered as early as biblical times. In the Book of Daniel, King Nebuchadnezzar of Babylon decreed that only wine and meat should be consumed to maintain health and prevent disease.\textsuperscript{1} Early examples of evidence-based medicine can also be found in the first century AD, when members of the Song dynasty advocated the health benefits of ginseng through comparative, albeit anecdotal, accounts.\textsuperscript{2} Regardless of its true beginning, throughout history, there are innumerable examples of efforts to identify best practices and improve the delivery of health care. For example, in 1789, the Public Health Service was established as a strategy to ensure appropriate care was given to ailing or injured merchant seamen in the United States.\textsuperscript{3} In 1837, William Farr collected statistical data regarding mortality, morbidity, and disability. Florence Nightingale furthered this work in 1858 with Farr, developing a uniform reporting system of health care practices and outcomes for London Hospitals.\textsuperscript{4}

In the United States, HSR formalized during the mid-twentieth century following medical and surgical innovation and the expansion of the health care workforce. As the cost of health care continued to rise, there was a growing need for research to understand the impact of changes in policy and to develop strategies to improve the quality and accessibility of care. Over the years, HSR has evolved to become a multidisciplinary field, engaging experts from various disciplines to address the complex challenges facing the health care system. This article will provide an overview of the evolution of HSR and highlight some of the key developments and applications in this field.

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technological advances from World War I and World War II.5 Before this, medical care was relatively accessible and inexpensive in the United States. However, effective treatments were lacking for many conditions, such as common infections or pregnancy complications. Military conflict spurred the development of numerous advances in medical and surgical diagnosis and treatment, such as blood transfusions, antisepsis, radiographs, electrocardiograms, and triage systems.4 This explosion of innovation was correlated with not only a rapid decline in morbidity and mortality but also a sharp increase in expenditures, prompting a closer examination of health care delivery.

The term “health services research” was formally coined in 1966.3 At that time, the federal government established a specific study section for grant proposals that were health services oriented.3 In 1968, the National Center for Health Services Research and Development was established under the leadership of Dr Kerr White, a pioneer in HSR in the mid-twentieth century. The National Center for Health Services Research, known today as the Agency for Healthcare Research and Quality (AHRQ), represents one of the first federally funded programs charged with systematically examining health care delivery and quality in the United States. HSR gained further momentum with the appropriation of research funds specific to the purpose of advancing the field of HSR, spearheaded by Dr Paul Sanazaro.5 Today, AHRQ is the primary federal agency focused on the delivery of health care in the United States and funds most of the HSR in the United States. With an annual operating budget of approximately 400 million dollars, more than 80% is directed toward HSR-related grants and contacts and more than 12,000 active health services researchers in the United States.6

WHAT IS HEALTH SERVICES RESEARCH?

HSR has been broadly defined as the study of health care access, cost, and effectiveness, with the purpose of developing successful strategies to organize, manage, finance, and deliver high-quality medical care.5,7 HSR has expanded dramatically to become a multidisciplinary field in which investigators study health care delivery. Collaborators include specialists from clinical medicine, economics, psychology, statistics, education, and policy. With rapid advances in measurement technique, study design, and information technology, HSR has profoundly shaped health care delivery in the United States in the twentieth and twenty-first centuries.

ASPECTS OF HEALTH SERVICES RESEARCH

In general, HSR involves the examination of the effect of specific aspects of the health care system on endpoints, such as clinical outcomes (eg, mortality), quality of life (eg, pain), or cost. Fig. 1 describes a thematic overview of HSR. Nearly all HSR endeavors examine topics in 1 of 3 broad categories—access to care, quality of care, or cost of care—and seek to affect change in the following avenues: outcomes, policy, or system delivery. HSR uses a variety of study methods to accomplish these goals, which are outlined in Table 1. Although not an absolutely inclusive or comprehensive list, HSR studies generally include methodology, access to care, efficacy, quality, cost, or evaluation of effectiveness.

Methodology studies identify the strategies for measuring aspects or characteristics of the health care system. For example, in 2004, the National Institutes of Health has initiated collaborative efforts to improve HRQOL measurement using common data elements and develop a universal metric for comparison across conditions, called Patient-Reported Outcomes Measurement Information System (PROMIS).8,9 Such tools can allow researchers and policy makers capture the outcomes most relevant to patients in an accurate and reliable way. Other examples include identifying tools to capture important outcomes, such

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FIG. 1. Thematic overview of health services research.
as post-operative complications, or analyze outcomes and place findings into an appropriate context.10–12

Most commonly, HSR focuses on studies of treatment effectiveness. Efficacy describes the extent to which a treatment yields its intended effect under ideal circumstances, and efficacy trials are those in which the effects of a specific treatment option are examined in a well-controlled setting with a homogeneous population to examine its performance under ideal conditions.13 These trials are often performed early on in the development of a medical treatment, such as in animal models or small cohorts of highly selected individuals. In an efficacy trial, validity should be maximized because potential sources of bias or confounding can modify the estimates between cause and effect is minimized. Randomized controlled trials are considered the gold standard for describing the effectiveness of a treatment and provide the highest level of evidence of causality.14–16 Despite their advantages, randomized controlled trials are expensive and labor intensive. It is essential to include a sample of adequate size to achieve sufficient power without expending additional funds for unnecessary observations. Clinical trials also require extensive collaboration, organization, and commitment often across multiple centers. Finally, generalizability may be limited in controlled trials due to the stringency of exclusion and inclusion criteria.17

In contrast to efficacy, effectiveness is the ability for a treatment to achieve its intended effect in a typical clinical setting. For example, a drug may be very effective in a cadaver model, or in a selected group of individuals, but does not translate into clinical success. Treatments may not be implemented due to barriers such as provider bias and uncertainty, poor access to health care resources, and patient factors and preferences.18

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Examples of health services research</th>
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<tbody>
<tr>
<td>Type</td>
<td>Definition</td>
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<tr>
<td>Method</td>
<td>Research that focuses on strategies or methods to examine aspects of the health care system</td>
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<tr>
<td>Access</td>
<td>Research that examines the ability of individuals to engage the health care system appropriately</td>
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<tr>
<td>Efficacy</td>
<td>Research that examines the ability of a diagnostic tool treatment or other intervention to change an outcome</td>
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<tr>
<td>Quality</td>
<td>Research that examines the effectiveness and safety of the care delivered to individuals</td>
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<tr>
<td>Cost</td>
<td>Research that examines health care expenditures or costs with or without comparison of benefits</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Research that examines clinical practice in a “real-world” setting or the effectiveness of health system interventions on care</td>
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inherent “noise” in such trials because of greater heterogeneity, effectiveness studies provide more robust measures of treatment effects, providing insight on barriers and facilitators to treatment implementation.

In addition to treatment effectiveness, HSR studies may focus more directly on health care utilization and access to care and identify important disparities. Utilization of health care can include primary care provider visits, emergency care, subspecialist referral, or post-acute care rehabilitation needs. For example, an analysis of administrative data revealed significant disparities in amputation rates by race among patients with peripheral vascular occlusive disease. Furthermore, differences in disease severity at the time of presentation for many conditions may represent profoundly different access to specialist care and disease screening resources.\textsuperscript{21,22} Administrative data can also be leveraged to examine health care expenditures. For example, Medicare spending varies widely across the United States, even after price adjustment analysis.\textsuperscript{23} These differences are not borne evenly by providers, and differences highlight opportunities to streamline care and achieve better value in care.\textsuperscript{24,25}

Defining quality is a fundamental aspect of HSR. One of the oldest, and most widely used, frameworks of HSR was described by Donabedian, which relates the factors that contribute to quality of care (Fig. 2). In this framework, structure includes those variables that describe the setting of health care delivery, such as the facility, available resources, and human resources (surgeon training and expertise).\textsuperscript{26–28} Process of care variables describe aspects of care and clinical practice that patients receive, such as perioperative beta blockage or the use of sequential compression devices or unfractionated heparin to reduce the risk of perioperative venous thromboembolism. Finally, in this model, outcomes describe the end results from treatment. These end results can include clinical events, such as mortality or complication rates, cost, patient-reported outcomes, or patient experiences (eg, satisfaction). In HSR, each of these components has been leveraged to create strategies for quality assessment improvement.\textsuperscript{4} For example, hospitals with greater care capacity, technologic advances, and teaching facilities were correlated with greater ability to rescue patients from major post-operative complications.\textsuperscript{29} Understanding these correlates of improved outcomes can inform strategies to improve overall surgical care.

Although large, population-based studies can provide robust data regarding the quality of care, and studies that evaluate the nuances of cause and effect can provide rich information regarding the delivery of care. For example, qualitative methods facilitate in-depth exploration of topics about which little is known and may therefore better elucidate functional and aesthetic outcomes by revealing patients’ perspectives in their own words without the restrictions of survey answer choices.\textsuperscript{18,19} Qualitative studies can capture phenomena, such as attitudes, value systems, cultural mores, and motivations that are difficult to measure quantitatively because it is constrained by investigator-selected criteria.\textsuperscript{30–32} For example, Aravind and colleagues\textsuperscript{33} conducted semistructured interviews with 20 patients who suffered from open type IIIB or IIIC lower extremity traumatic injuries to examine and determine the effect of amputation or reconstruction on health-related quality of life.\textsuperscript{30} Using qualitative methods, the investigators effectively present a cognitive framework for the psychosocial components of recovery and post-operative disability. Such data can highlight unmet patient needs and be applied toward developing quantitative instruments to measure patient-reported outcomes. Ethnographic studies can provide a root-cause analysis of the factors that result in post-operative complications.\textsuperscript{34} For example, Symons and colleagues\textsuperscript{35} followed patients who had undergone surgery to identify failures in processes of care. In this study, trained observers recorded post-operative events among 50 patients who underwent routine surgical procedures. In this study, most failures were preventable, more than half resulting in patient harm, and were primarily due to communication breakdowns or delays in care.

![Fig. 2. Framework of health care quality described by Donabedian. (Data from Donabedian A. Evaluating the quality of medical care. Milbank Mem Fund Q 1966;44:166–206.)](image-url)
HEALTH SERVICES RESEARCH IN SURGERY: PRACTICAL EXAMPLES

In 2001, the Institute of Medicine defined the standards by which health care delivery in the United States should be considered. In Crossing the Quality Chiasm: A New Healthcare System for the 21st Century, the IOM laid out 6 critical elements: (1) safety, (2) effectiveness, (3) cost-efficient, (4) accessible, (5) patient-centered, and (6) equity. In the field of surgery, the HSR movement has examined the delivery of care by each of these standards and made important contributions in defining variation in care, outcomes assessment, and patient engagement in procedural care.

Variation in Care

Led by John Wennberg, the Dartmouth Institute for Health Policy and Clinical Practice has systematically evaluated variation in medical and surgical care in the United States across a wide range of disciplines over the last 30 years. The Dartmouth Atlas of Health Care (www.dartmouthatlas.org) describes regional differences in the delivery of care, utilization of care, and spending for common conditions and procedures, such as tonsillectomy, joint replacement, major cardiovascular procedures, and general surgery procedures (eg, mastectomy, cholecystectomy). Although variation in care could be attributable to chance alone, wide disparities in care more likely signal important differences in health care quality, including the overuse, underuse, and misuse of resources. A closer look reveals that most differences in health care spending can be attributed to differences in health care utilization. However, care is not accessed proportionally by need (ie, sicker patients do not always receive more health care), and differences in health care spending do not correlate with differences in procedural outcomes. This seminal work has provided a framework for examining provider performance on a population-based level across many disciplines.

Capturing Post-operative Outcomes: How and What to Measure

Quality measures typically compare post-operative clinical outcomes, such as 30-day mortality, readmission, or complication rates (eg, venous thromboembolism). However, to accurately assess performance using outcomes, it is essential to control for differences in case mix across providers. For example, large, tertiary care referral hospitals more frequently perform complex procedures due to differences in hospital infrastructure and available resources. Furthermore, patient clinical and sociodemographic characteristics vary widely among providers. In surgery, multiple approaches have been proposed for risk adjustment and can be applied at the patient level. However, the specific variables and number of variables remain an area of ongoing exploration. In addition to risk adjustment, clinical outcomes can be further refined using reliability adjustment. Random variation due to small sample sizes can introduce statistical “noise” into estimates and limit the power to detect variation across hospitals. Reliability adjustment can substantially influence performance assessment and yield more accurate comparisons.

Quality assessment can be further improved by the use of composite measures of performance to provide a more comprehensive perspective of performance. Composite measures combine multiple indicators of quality that are relevant to a condition or procedure of interest. For example, Dimick and colleagues have created a composite measure of quality combining mortality, reoperation, length of stay, and morbidity indicators to assess outcomes following common surgical procedures. Compared with single risk-adjusted measures of performance, such as mortality, composite measures are better predictors of outcomes following surgery. Composite measures have been successfully applied for key conditions, including myocardial infarction and pneumonia, and are increasingly applied toward surgical care.

However, even when optimally risk and reliability-adjusted outcomes are available, these endpoints may be insensitive for certain procedures. For example, most many procedures in hand surgery are performed to improve symptoms and function, with relatively few readmissions and minimal mortality or serious morbidity risk. Therefore, it is difficult to measure performance precisely based on rare events. Patient-reported
outcomes, such as pain, disability, and social functioning, could provide a more accurate assessment of treatment effectiveness and performance, but are rarely collected in a systematic way, and not typically available on a population-based level in the United States. In the United Kingdom and Sweden, patient-reported outcomes are routinely collected following common surgical procedures and will provide a framework for the implementation of patient-centered quality assessment and improvement going forward in the United States.62–70

**Patient Engagement in Surgery**

In addition to differences in performance, variation in rates of surgery may represent differences in the involvement of the patient in the decision for surgery.71,72 For example, geographic variation in mastectomy rates has prompted concerns that women are not uniformly counseled regarding the surgical treatment of early-stage breast cancer.73–76 In the early twentieth century, the patient-doctor relationship was largely viewed as paternalistic one, with most of the responsibility for clinical decision making resting on physicians. More recently, patients have been redefined as consumers and are empowered to participate in the decision for care, particularly in those situations in which treatment outcomes may be equivocal.77 Although the Internet has dramatically expanded the information that patients have available to them when making health care choices, the accuracy of available resources and their effect on patient knowledge remains inconsistent.78–81

Recently, efforts have been directed on developing and incorporating decision aids and support tools into routine care to help describe surgical risk, details of surgical procedures, and indications for intervention. In this way, HSR has identified pathways to engage patients in their surgical care and improve the decision-making process.71,82,83

**HEALTH SERVICES RESEARCH IN HAND SURGERY**

Recent events in health care reform in the United States underscore the need for robust HSR efforts to critically evaluate and improve our health care system. However, the field of hand surgery is a particularly challenging substrate for HSR. The procedures that encompass hand surgery are diverse and nuanced, such as the surgical management of thumb carpometacarpal arthritis or the fixation of distal radius fractures. Furthermore, relative to other conditions, such as obesity, heart disease, and diabetes, many hand maladies are uncommon, such as ulnar impaction, Dupuytren disease, and congenital hand differences. Although the authors’ subspecialty journals have adopted level of evidence standards, a paucity of high level of evidence studies persists, and there is variable implementation of available data in clinical practice.14,84–88

Finally, hand surgery is relatively safe, with few associated readmissions and low rates of mortality. Therefore, measures of disability, pain, and function are ideal outcomes, but often difficult to capture on a broad level. Nonetheless, the lessons and examples in HSR in other fields, such as general surgery, cardiology, and primary care, can serve as a template for improving the delivery of hand surgery going forward.

In this issue of Hand Clinics, the authors examine several aspects of HSR in more detail to provide a framework and foundation for future efforts to this end in the area of upper extremity care. First, they examine strategies to optimize scientific investigation, including the integration of patient-reported outcomes into research, standards for measuring treatment effectiveness, translating research findings into clinical practice, the principles of comparative effectiveness research, and conceptualizing the evidence available for the practice of upper extremity surgery. They then consider how health care quality can be measured in hand surgery and examine the integration of collaborative quality assessment and improvement in surgery on a population level. Finally, the authors highlight several important health care policy topics in hand surgery, including the development and implementation of clinical guidelines, patient-centered care in hand surgery, the financial infrastructure of health services research support, access to upper extremity care, and the current state and future directions of health care reform.

**REFERENCES**


43. Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. Med Care 2011;49(12):1076–81.


