Disparities in Stroke Care: A Framework for an Integrated Care Model

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Abstract

Purpose

Racial and ethnic disparities exist in access and utilization of acute and chronic neurological care. The impact of this is notable in stroke care, with African-Americans and Hispanics having a greater incidence of stroke, higher rates of recurrent strokes, and the greatest disparities in stroke mortality among younger working-age populations compared to Caucasians. While there are many innovative solutions to certain aspects of disparities in stroke care, our current health care delivery system lacks a cohesive design that can integrate these. This paper provides a framework for the implementation of a value-based integrated care model with the intent of improving outcomes and achieving equity in neurological care.

Methods

Successful value-based healthcare delivery models were analyzed in light of their potential in bridging disparities in care as a whole and specifically for stroke care. The literature on racial and ethnic disparities in stroke care was reviewed and a framework for possible value-based solutions to these disparities was proposed.

Conclusion

While there is increasing recognition of the benefits in value-based health care, broader implications may extend to bridging disparity gaps. This paper highlights key considerations for neurology leaders and healthcare planners in the implementation of a stroke integrated practice unit designed out of consideration for the diverse patient populations they serve.

Description of Scholarly Work

Aims and purpose

African-Americans and Hispanics have more than 2 fold greater incidence of stroke rates, the greatest disparities in stroke mortality among younger working-age populations, higher rates of recurrent stroke, and a greater associated disease burden compared to Caucasians. [4,11–13] There is a need for improved neurological care delivery that could address these disparities. One such solution may be in the form of integrated practice units (IPUs), an emerging concept within value-based healthcare. These are multidisciplinary teams tailored to care for patients with a shared medical condition throughout their entire care cycle.[6] Though this model has shown success across multiple conditions[7] and demonstrated potential in improving access and quality of primary care for minority patients[8], it has yet to be explored as a strategy within neurology to address healthcare disparities. By providing a review the factors that have thus been identified as contributors to disparities in neurologic care and examining prior successful IPU models, this paper aims to provide a framework for an integrated care model with the goal of addressing disparities in stroke care and improving outcomes.

Student contribution

I developed the idea for the scholarly project proposal during my time in the HMS Essentials II course, where key topics were discussed regarding disparities in medicine, in addition to dedicated sections of the course on value-based medicine. From the in-depth discussions in large and small groups, I developed the project design and proposal by applying the ideas discussed in the course and my interest in neurology. As part of the concluding project for this course, I developed the proposal for this project with the intent to submit as a manuscript within the category of "views/reviews" to the *Neurology Journal*. At this point, I sought the mentorship of Dr. Thomas Feely, MD at the Harvard Business School who was instrumental in guiding me to the appropriate literature for understanding value-based medicine, specifically integrated practice units that would be useful in addressing disparities within stroke care. Additionally, I also met with Dr. Nicte Mejia, MD neurologist whom has been a key collaborator in terms of providing literature resources for the completion of this project. My role included writing all sections of

this piece, with Dr. Feely acting as my primary reviewer. We have had multiple iterations of drafts, and he approved this final draft for submission to HMS as part of my scholarly project.

Glossary of Terms

Integrated Practice Unit……..IPU

Acute Stroke Units……..HASU

Acute Stroke Units…… ASU

Background

Stroke is the 5th leading cause of death in the U.S.,[1] and a significant contributor of disability among the working-age population.[2] There is growing recognition that racial and ethnic inequalities exist in the incidence rates of these commonly preventable neurological disorders, as well as in access and utilization of acute and chronic neurological care.[3] African-Americans and Hispanics have higher rates of stroke, greater associated disease burden, and are less likely to see an outpatient neurologist compared to their Caucasian counterparts. [3–5] There has been a call for greater awareness of disparities in neurological care and a change in the way health policy leaders view prevention and treatment of disorders of the nervous system. However, to-date there is still need for improved neurological care delivery that could address these disparities. One such solution may be in the form of integrated practice units (IPUs), an emerging concept within value-based healthcare. These are multidisciplinary teams tailored to care for patients with a shared medical condition throughout their entire care cycle.[6] Though this model has shown success across multiple conditions[7] and demonstrated potential in improving access and quality of primary care for minority patients[8], it has yet to be explored as a strategy within neurology to address healthcare disparities. The goal of this paper is to explore how the IPU concept can be applied to addressing disparities in neurological care. Focusing on stroke care, we note factors identified in the literature as contributors to disparities and propose a framework for an integrated stroke care model suited to support the unique challenges of minority patients.

IPUs include clinicians and nonclinical staff collaborating to address a patient's needs over the full cycle of their care around a specific medical condition and its associated comorbidities.[7] The concept was introduced as part of the innovative value-based healthcare delivery framework proposed in 2006 by Michael E. Porter and Elizabeth Teisberg at the Harvard Business School aimed at realigning healthcare around value for patients[7]. In this framework, value is defined as outcomes important to patients relative to the cost of delivering them. In shifting the payment model to one that rewards value over volume, it aims to dismantle fragmented care within each different department a patient must see. It creates an infrastructure where it is necessary for providers of different specialties to collaborate in

meeting a patient's needs. Other characteristics of value based health care include measuring outcomes and costs for every patient, bundled payments for care cycles, integrating care delivery across separate facilities, expanding services across geography, and adopting enabling technology platforms.[6] At its core, it recognizes the need for collaborative teams equipped to care for a specific population of individuals that often share similar preventative or long-term care needs. One could envision this concept could also be applied to tackling the unique population needs of historically underrepresented groups in the U.S. sharing a medical condition. A delivery model designed with all the appropriate personnel and facilities taking into consideration the specific identified challenges of vulnerable populations, may be a way to not only improve disproportionate rates of stroke and utilization of care, but may also provide long-term heath outcome and cost benefits.

Although racial and ethnic disparities exists across multiple neurological illnesses,[5,9,10] this is especially well documented for stroke, given the magnitude of impact it carries. African-Americans and Hispanics have more than 2 fold greater incidence of stroke rates, the greatest disparities in stroke mortality among younger working-age populations, higher rates of recurrent stroke, and a greater associated disease burden compared to Caucasians. [4,11–13] This burden of illness is expected to become an increasingly greater problem in the coming years as demographic changes in the U.S. are expected to shift towards minority groups making up a larger portion of the population.[14] To address this problem, we propose that a value-based integrated care model may enable the reconfiguration of stroke delivery to bridge disparities in stroke outcomes. IPUs in primary care have already been successful in addressing disparities in underserved populations, as will be discussed in the case of Oak Street Clinic.[14] Furthermore, IPUs have already been successfully implemented for stroke care in London's restructuring of their healthcare system.[15] Given the potential that integrated care models have to improve health outcomes for historically disadvantaged minority populations, these should be important considerations for neurologists and policy makers in finding solutions to address disparities. We focus on stroke care as a case study to frame how this approach could be designed for neurological care.

Analysis of Successful Value-Based Delivery Models

Oak Street Clinic

Oak Street Health Clinic in Chicago has demonstrated that IPUs can be centered not just around medical conditions, but also groups of individuals sharing similar health risks. More importantly, IPUs can be uniquely designed to address vulnerable population's needs and thus have significant potential in bridging healthcare disparities. This primary care clinic has used an IPU approach to tackle chronic illness in the most vulnerable populations of Chicago: low-income elderly dual-eligible Medicare/Medicaid patients.[8] Their core care teams consist of a primary care physician, a nurse practitioner, care manager, informatics specialist, and behavioral health specialists. Working together from the onset of a patient's initial 90-minute appointment, the team determines challenges to health and screens for common problems in the elderly to determine where they fall in a four-tiered health risk category, which determines the rate of follow-up. Additionally, with capitated payments through Medicare Advantage, they are able to support critical components to access that in a traditional model would not be reimbursable including transportation and interventions like community building. In 2016, Oak Street's hospital admission rate was 43% lower than the Chicago benchmark, with similar reductions in Emergency Department visits and 30 day readmission rates.[8] It has since expanded its network and set up additional clinics that care for several of Chicago's low income, often largely African-American communities, groups with historically worse chronic illness outcomes.[9,16,17] Oak Street Clinic demonstrated how improving quality of care through teams equipped to address challenges of distinct patient populations actually lowered costs in the long-term and could have broad implications for addressing healthcare disparities.

London's Restructuring of Stroke Care

Prior to 2009, stroke care in London functioned in a similar manner as it currently does in the majority of the United States. Stroke care was centered around the nearest hospital, yet across different hospitals there was substantial variation in the diagnostic process and subsequent care path.[18,19] In an effort to provide uniformly high treatment for stroke patients regardless of where in London they suffered their stroke, London's Regional Health Authority

prioritized developing a new model of care that was designed and managed by clinicians rather than non-clinical administrators. The resulting new model of stroke care consisted of reorganization around eight "stroke hubs" distributed within London's 5 sectors called Hyper Acute Stroke Units (HASUs) that functioned like an IPU equipped with all the necessary staff and equipment necessary to quickly diagnose, treat, and manage patients during the first 48-72 hours.[15] In this model, there was a major public education campaign regarding common stroke signs and the importance of rapid action to call emergency services ("FAST" campaign). Likewise, London ambulance services were educated on stroke assessment and any patient with stroke signs was directed to the nearest HASU, which in some cases was no longer the nearest hospital, but no more than 30 minutes away. Teams were led by either a neurology consultant or senior stroke physician, who worked week-long HASU shifts every other month and worked in their local hospital stroke unit and outpatient facilities the rest of the time. Other team members included stroke-trained nurses, physiotherapists, speech therapists, dieticians, occupational therapists, and psychologists. After acute management at HASUs, patients could be triaged to one of 24 Acute Stroke Units (ASUs) for further inpatient stroke management, community rehabilitation services, or home.[15]

Many aspects of this model are consistent with the IPU characteristics initially described by Porter, yet others still were missing that may have further improved the model. The most consistent aspect was the overarching goal to improve value for patients by reorganizing teams around a medical condition. This aspect appeared to be successfully achieved, at least in short-term measurements. When outcomes for the new model were measured, acute stroke mortality (measured as 30 days post-stroke) had decreased in London from 15% during April-June 2008 to 7.6% in April-June 2011.[15] In North Central London, which was covered by one main HASU, there was an increase in thrombolysis rates from 3.5% in 2009 to 12% in 2011. In October 2011, thrombolysis rates across London as a whole reached 14%, the highest of any major city at the time.[15] Based on analytic models, one study estimated that the new stroke model compared to the prior had total cost savings of £5.2 million per year at 90 days (95% CI £4.9-£5.5 million; £811 per patient).[20] While the outcome metrics measured in this IPU are important -thrombolysis, mortality, length of stay- these would be considered limited rather

than the ideal long-term sustainable health outcomes proposed for IPUs. Likewise, there was room to expand on the full cycle of care in this model, given incomplete integration with preventative stroke care as well as outpatient follow-up and rehabilitation. Despite this, the London model demonstrates how integrating care and service lines across facilities through IPUs can drive greater volume in appropriate facilities thereby improving patient care overall. Standardizing care has the potential to improve care by providing equality to the system. To address disparities, however, a system should also consider equity, recognizing that to reach the same health status additional support may be needed for vulnerable populations with increased risks and challenges.

Racial-Ethnic Disparities in Stroke Care in the United States

As we consider how the implementation of an IPU aimed at addressing disparities in stroke care may look, it is essential to break down the factors that contribute to differences in care in order to integrate corresponding solutions. Some of the most notable factors previously identified by the 2011 scientific statement review by the American Heart Association/ American Stroke Association on *Racial Ethnic Disparities in Stroke Care*,[5] along with more recent publications will be reviewed bellow. We have set out to highlight the most readily addressable contributing factors to stroke disparities, recognizing these are by no means all-encompassing. It is important to note that while there are increasing numbers of studies looking at disparities among African-Americans and Hispanics, there is less published research on other minority groups including Native-American/Alaskan Natives or Asians.

Differential Burden of Associated Risk factors

Hypertension has been identified as an independent risk factor for stroke across all racial groups, however, it has shown to be more prevalent and associated with more strokes among African-Americans.[21] This is consistent with studies demonstrating that contributions of risk factors for stroke -hypertension, obesity, diabetes, hypercholesterolemia, and smoking- are decreasing, however there is a disparity among African-Americans compared to Caucasians in rates in which these contributing factors have diminished and most notable is the difference observed in hypertension.[9] In the past two decades, there has been a greater decrease in

hazards ratio for hypertension among Caucasians (2.9 [95% confidence interval (CI)], 2.0 to 4.2] to 1.4 [95% CI, 1.1 to 1.9]; P<0.001) than among African-Americans (3.8 [95% CI, 2.1 to 7.0] to 2.2 [95% CI, 1.1 to 4.1]; P=0.20).[9] Among Hispanics, metabolic syndrome was found to be more common compared to both Caucasians and African-Americans.[22] Two different studies analyzing populations of Hispanics, one predominantly of Mexican heritage[23] and the other predominantly of Caribbean Hispanics,[22] both found similar results showing greater prevalence of hypertension, diabetes mellitus, hypercholesteremia, heavy alcohol use, and cigarette smoking in comparison to Caucasians. Even after adjusting for sociodemographic variables, metabolic syndrome was a greater predictor of stroke risk in Hispanics compared to Caucasians.[22] For Native American/Alaskan Natives, the prevalence of at least two stroke risk factors was also greater compared to Caucasians.[16]

Awareness of Stroke Signs

There has been a general lack of consensus regarding disparities in awareness of stroke signs and stroke risk factors among different racial-ethnic groups, however it appears it may be a problem for the population as a whole.[24] A 2008 study assessing racial-ethnic differences in stroke awareness among veterans found that most of those surveyed recognized at least one of five stroke warning signs.[25] However, Hispanics were less likely compared to Caucasians to identify all five and call 911 as their first action (OR .37, 95% CI .24-.58).[25] Similarly, other studies found inadequate knowledge of stroke awareness was more common among minorities surveyed,[26–28]and this disparity was present even in patients with history of prior stroke, particularly among Hispanics.[29] A recent study from the Florida-Puerto Rico CReSD Stroke Registry evaluated differences in time from first symptom onset (FSO) to stroke hospital arrival (SHA) and found no racial-ethnic differences in relatively short EMS intervals.[24] The greatest contributor to elapsed time was in the interval of FSO to 911 call, which was longest among whites and blacks than for Hispanics (302 minutes for both versus 291, p = 0.01).[24] Other studies, however, have noted that ambulance use is less common overall among minorities[30] and it is unclear whether language plays a greater role than ethnicity alone. A prior study of data from 2003 Behavioral Risk Factor Surveillance System population survey found that Spanish-speaking Hispanics are far less likely to know all stroke symptoms (18%), compared

even to English-Speaking Hispanics (31%), African-Americans (41%) and Caucasians (50%) ($p<0.001$).[31]

Cultural Factors Impacting Care

It is not surprising that given a known history of racial discrimination in the U.S., particularly in the form of unjust medical delivery in minority populations[32], that the effects of these may still reverberate today in the form of mistrust. In a nationally representative sample of telephone surveys, many African-Americans and Hispanics had beliefs about discrimination in their healthcare system and those who did, had a greater likelihood of preference for a same-race physician.[33] African-Americans who had physicians that matched their preferences, were more likely to rate their care as excellent.[33] In another study, racially concordant visits among African-American patients and their physicians tended to last longer and have more favorable communication characteristcs.[34] These studies highlight the role of cultural factors impacting patient trust, which likely have implications on care. However, it's possible that members of the team can bridge cultural and communication factors for better care. For instance, there was improved defect-free stroke care (compliance with all eligible quality metrics) among non-English preferring stroke patients who were provided professional medical interpreters compared to those who were not.[35] Furthermore, one study looked at the effect of culturally tailored discharge education strategies.[36] Using community health workers from the patient's underlying population, including bilingual English-Spanish coordinators, the program delivered skill-based stroke education regarding medication adherence and stroke risk reduction skills.[36] Although there was no effect on measurable risk factors when comparing across all groups, among Hispanics there was a statistically significant 9.9 mm Hg–greater systolic blood pressure reduction in the intervention group compared with usual care.[36] This suggests that bridging cultural gaps including language and communication, even via other team members, may lead to improved care.

Differential Quality of Acute Stroke Care

Even after patients present to the hospital, discrepancies in the delivery of care have been noted among different racial and ethnic groups, which may have direct implications on

treatment and outcomes. For instance, time from stroke symptom onset to evaluation is a crucial component of stroke care, yet racial differences in emergency department waiting times (EDWT) were observed in a national sample of patients presenting with ischemic or hemorrhagic stroke.[37] African-Americans, but not Hispanics, had longer EDWT compared to Caucasians (67% longer, P=0.03).[37] Though this study's data was unable to elucidate associations with treatment, it was concerning for its implications on thrombolysis eligibility. Similarly, a study of acute stroke patients across 137 community hospitals, found that patients across all racial groups treated by an attending neurologist were 3.7 times more likely to be treated with tPA compared to an internist attending.[38] However, for unclear reasons only 10.6% of African-Americans compared to 20.3% of Caucasians had a neurologist as their physician attending.[38] Both of the above studies highlight differences in care delivery that may be affect stroke treatment and patient outcomes. In terms of differences in rates of thrombolysis use, one study of 1195 ischemic stroke patients across 42 academic medical centers in the United States found a large significant difference in tPA usage between African-Americans compared to Caucasians (OR 0.24, 95% CI 0.06 to 0.93; P=0.04).[39] This effect persisted even in those who arrived within 3 hours of symptom onset, had no other contraindication to tPA, and patient refusal did not explain the difference.[39] Although this effect was observed nationally, in some regions like the southwest this disparity was not seen.[39] A Chicago study assessing racial disparities in tPA refusal among eligible ischemic stroke patients found that tPA refusal was more common among African-Americans and that this accounted for lower rates of tPA use.[40]

Differential access to hospitals systems, including those that participate in performance measure adherence, may play a role in disparities to care and outcomes. In an attempt to address a growing recognition of differences in evidence-based process performance among different racial/ethnic groups, the American Heart Association/American Stroke Association developed the Get With The Guidelines-Stroke (GWTG-S), a national hospital-based quality improvement program aiming to improve stroke care by consistent adherence to guidelines and outcomes tracking.[41] Several studies have shown that implementation of the program is associated with improved stroke outcomes and greater defect-free care.[18,42] Additionally, adoption of the program overtime was associated with reduced or no longer disparate stroke

care metrics among different racial groups.[43] However, this same study found that disparities in care among similar ethnic groups remained depending on differential hospital access. Hispanics in Puerto Rico compared to Hispanics in Florida showed worse performance in nearly all predefined stroke performance metrics and poorer outcomes measured as part of GWTG-S.[43] Further research into hospital differences between these two groups found that compared to Puerto Rico hospitals, Florida hospitals were more likely to have certified stroke centers and have participated in GWTG-S longer.[19] Although a regional study, it suggested the potential for implementation of quality improvement programs to improve stroke care disparities.

How IPUs Could Address Disparities in Stroke Care

In identifying contributing factors to stroke disparities in the U.S., there is evidence for both increased risk factors in vulnerable populations, as well as systemic factors in our healthcare system playing a role. Some of the population factors detailed here include the increased burden of chronic illness, cultural factors, and population awareness of stroke signs. In terms of systemic factors, we have highlighted the existence of inconsistent care across populations and throughout hospitals and provider organizations. Other still more complex factors not mentioned, but which play a substantial role include socioeconomic, insurance, and financial barriers. In the literature discussed there is also evidence to suggest that aspects that are characteristic of IPUs can mitigate disparities. These include getting the right team members involved to provide more adequate culturally tailored care or the tracking and publishing of outcomes, which is now encouraged through GWTG-S. Currently, there are many novel solutions for individual aspects within disparities to care that would yield greater results if implemented in a system that integrated all of these through an entire care cycle. IPUs could be a way of doing just that. They could address both some of the systemic factors to inequity in care, but also establish the right team members to assume responsibility for patient engagement with their health. Value-based health care delivery requires an entire redesign of the prevailing structure that from the onset entails consideration for a diverse population. We provide a framework of the components that may be needed in the consideration of an IPU for stroke care that is equipped to address disparities.

Building an Equitable Stroke Care IPU

Stroke risk begins long before a cerebrovascular incident happens and continues after hospital discharge into rehabilitation, therefore a full stroke care cycle should include integration and collaboration between three phases of care: pre-stroke, acute stroke, and post-stroke. In an IPU model that recognizes the value of preventative care for stroke, there should be room to reward collaboration with primary care. Additionally, strokes survivors are often left with neurological deficits and requiring inpatient or home rehabilitation with milestones for recovery typically occur over a year or less. Post-stroke care should therefore continue at least one year after stroke.

Pre-Stroke Care

The focus of this phase should be on preventative care including management of stroke risk factors and stroke education. Given the well-known geographic distributions of stroke mortality rates as specific as by zipcode,[4] as well as populations with greatest known risk factors, primary care and neurology could more closely collaborate in an effort to target at-risk-communities. Teams in this phase could be led by primary care physicians, carrying out their normal preventive care work with communities, but additionally having support from neurologists, community health workers, and even community volunteers. Substantial research demonstrates the valuable and often underrecognized role of community workers in improving chronic disease care and health outcomes, particularly for underserved communities in the prevention and control of heart disease and stroke.[44,45] Community workers can play many roles including promoting medication adherence, monitoring health status, and linking patients to resources. Additionally, a trial on tailored approaches to stroke health education (TASHE) is examining the role of community member support in delivering culturally tailored church-based films on stroke education to further increase stroke literacy and awareness in minority populations.[46] With bundled payments that are common to IPUs, greater support could be placed on preventative interventions than would otherwise be less feasible in a fee-for-service model as will be later discussed in bundle payment section to follow.

Acute Stroke

The goal within acute stroke care should be to have the appropriate team and resources to quickly evaluate, treat, follow adequate stroke guidelines, and subsequent transition to rehabilitation regardless of patient background and where a patient experiences their stroke. As previously noted, some of the barriers to overcome include discrepancies in ED waiting times, neurology physician involvement, differential rates of thrombolysis, and differential institutional practices in tracking of outcomes.[37,38,47] From a patent's first encounter with emergency medical services (EMS), to subsequent inpatient care path, there are published guidelines for evaluation in a timely manner. Knowledge of these are part of ACLS training and certification, required by all providers and EMS staff.[48] Despite this, it is clear there may be differential adherence to these given differences in outcomes. As a first step toward a value-based health care delivery shift, institutions would benefit from analysis of their stroke care path, as this time-driven activity-based costing analysis often reveals immediate actionable areas for improvement and cost reduction.[49,50] Particularly with treatment as time sensitive as acute stroke care, this could be a driver for provider engagement and redesign initiatives.

Teams should be led by a stroke neurologist, with support from nursing staff, interpreter services (remote or in-person), speech therapist, occupational therapists, dieticians, psychiatrist, social services, community workers, and neurosurgery. The London model showed that even in cases that resulted not to be strokes, patients benefited from assessment of the stroke IPU team. Non-stroke cases were often other neurologic or psychological illnesses, which benefited from faster adequate neurology follow-up or appropriate referral.[15] By having providers on the team that dedicate a meaningful portion of their time to stroke care, the goal is that volume would be appropriately concentrated to the most suitable providers and ensure more equality of care. This would enable teams to further develop expertise, efficiency, and consistent patterns to published guidelines, while measuring and ultimately improving outcomes for better care.

Providers on the team may not all be necessary for each case and may not all be co-located but can still form an affiliation to work as a team, communicate treatment plans, and

collaborate in coordinating care. The London stroke model met with its core team twice per day to communicate updates on patients in the HASU[15], but technology may enable greater real-time collaboration for team members further away. Given the geographic expanse of the U.S. compared to England, similar adequate coverage with stroke hubs may be difficult to implement. However, making use of technology like mobile clinics and telemedicine could offer a way of geographically expanding IPU care to more remote and often underserved areas of the U.S. Mobile stroke units, or ambulances equipped with imaging system, point-of-care laboratory, telemedicine services, and medication are currently being explored as strategies for improving time to treatment delivery.[51] Though studies are still underway to answer concerns regarding safety, clinical efficacy, and cost-effectiveness, a mobile stroke unit could be an ideal facility for housing the critical components of an acute stroke IPU.

Post-Stroke Care

Post-stroke care should begin in preparation for discharge, into rehabilitation, and include long-term follow up. For many patients, a large portion of post-stroke care is within rehabilitation centers, which can also be the costliest aspect of the care cycle. Some have speculated that bundled payments would enable greater likelihood of appropriate timing of care transition.[52] Additionally, this phase should address associated co-morbidities including post-stroke depression, smoking cessation, and chronic illness management.

This phase of care could be co-led by neurology and primary care physicians, with the support of psychiatry, rehabilitation nurses, physical therapists, pharmacy, and community workers. Given the high risk for recurrence of stroke particularly among minority patients and the potential benefit of culturally-tailored discharge education, there should be a high priority on patient education. At least 48 hours prior to discharge, a rehabilitation nurse, community worker, pharmacy, and neurology physician could collaborate in verifying reconciliation of home and new discharge medications, working to simplify medication regimens and ensure that insurance, transportation, or cost barriers are addressed. Given common neurologic deficits of stroke survivors, the patient and their caregiver should be provided with educational resources in the most appropriate format (visual, audio, written etc.). With the help of

community workers, patients could also receive culturally tailored education and these team members could ensure adequate follow up with short-term (2 week) and long-term (6 and 12 month) telephone check-ins, identifying early on barriers to care, mediation adherence, and provide resources. Quarterly team meetings could ensure that those patients with identified barriers are supported with additional resources as needed.

Outcomes Measurement

Outcome measures that appropriately encompass the collaborative work of multiple providers involved in an IPU are often longitudinal, particularly outcomes most meaning for patients. Therefore, value in an IPU is measured for everything included in a care cycle along with longitudinal outcomes and costs. Programs like GWTG-S have shown that a commitment to tracking stroke outcomes is associated with better care by greater adherence to guidelines over time.[18,19,42] In a similar manner, value-based health care recognizes that what is not measured cannot be managed or improved. However, when it comes to outcomes, process measurement is important but not sufficient because procedures and interventions alone do not always translate to results or outcomes important for patients. Rather than centering around interventional or individual departmental goals, Porter suggests a three-tiered system of outcome measurement (health outcomes achieved, process of recovery, and sustainability of health) that is built in collaboration with patients and that takes into account initial patient conditions and risk factors to allow for risk-adjustment.[6] In 2016 an international standard set of value-based and patient-centered stroke outcomes was established by the International Consortium for Health Outcomes Measurement (ICHOM).[53] These metrics align with Porter's proposal for three-tiered outcomes[54], as depicted in the Figure. It is anticipated that more equitable and effective stroke care may be achieved by utilization of well-defined standard set of outcomes measurements. Ultimately, measuring and publishing value-based outcomes for stroke care including stratification by race, could be a positive driver within and among institutions for improved patient care.

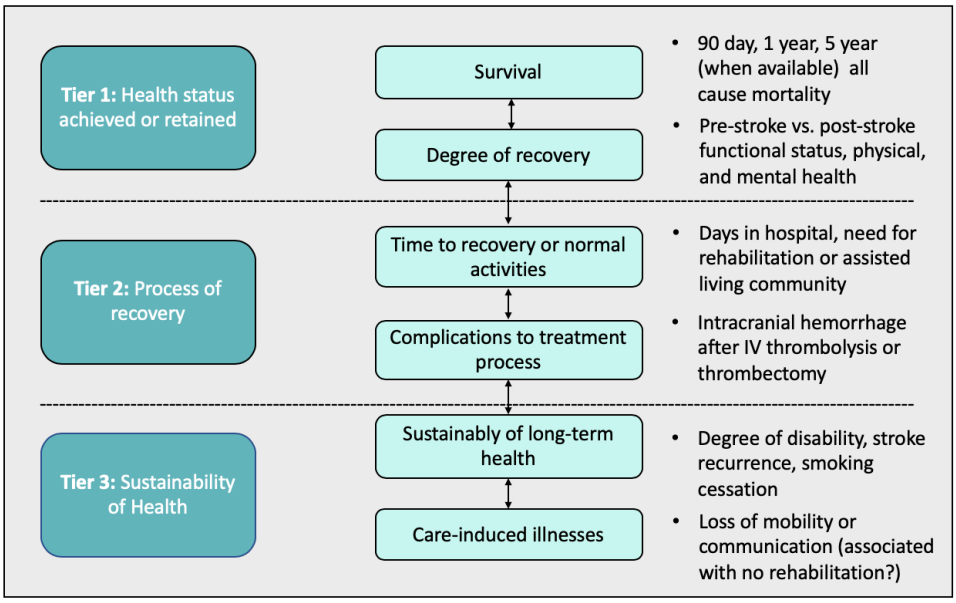

Figure. Examples of patient-centered outcome metrics for stroke patients. Standard set of patient-centered outcomes proposed by ICHOM (bulleted points) and how these align with Porter's proposed three-tiered health outcomes measurement (blue boxes). Adapted from original figure from Porter ME. What is value in health care? N Engl J Med 2010; 363:2477-2481

Moving to Bundled Payments and Cost Measurement

A fundamental aspect to the problem of rising healthcare costs is related to the payment model used in the U.S. for decades, a fee-for-service model that rewards volume over quality of medical delivery. Inherent to the concept of value in medicine is that simply reducing costs is not the end goal. Rather, achieving better health outcomes at lower costs. In a bundled payment system, providers in a team are paid for outcomes achieved for a patient's condition throughout the entire care cycle. In the case of primary and preventative care, bundled payments include all the care needed for a defined segment of the patient population. For instance, low-income elderly or healthy adult. Additionally, payments are risk-adjusted to account for factors like age, initial health status, social and living circumstances that affect patient complexity. This is in contrast to capitated payment systems, in which insurers pay a healthcare organization a single fixed payment per patient (usually per month). While this incentivizes lowering costs, unless applied to a homogenous population, it does not necessarily improve individual patient value or reward care for complex and often vulnerable patient populations. Providers have not been trained to be privy to the financial aspects of medicine.

The recognition that payment models play a crucial role in patient care and even have the ability to further drive disparities in care is an important first step in making changes.

The challenge in this area arises in the necessity for cost measurement, which includes both direct costs implicated in the delivery of care as well as indirect costs like productively lost by patients while undergoing treatment. For this to be measured, enabling technology platforms are needed to reduce the burden of measurement. However, with better understanding of costs, more tangible areas of improvement could drive provider engagement in redesign. Clinical teams with responsibility over a patient's full care cycle would not only be incentivized to collaborate in improving patient care, but also empowered in reaching those goals with freedom to allocate resources within bundled payments, providing services not currently covered by fee-for-service. This would enable patient populations with challenges in accessing care to benefit from resources that may add value, like support from community workers or transportation. There would additionally be greater motivation for collaboration not only within IPUs but also among different IPUs, as previously proposed between primary care and stroke.

Conclusion

Racial and ethnic disparities in neurological illness and access to care exist and this has been well documented for stroke care.[5,10,38] As highlighted in this paper, the causes for this are complex and range from individual risk factors to broader difference in care delivery. At a systems level, this includes the very healthcare model that we operate from. Integrated practice units in fields like primary care have shown the potential in allowing clinicians, the experts in that area, freedom to work together in reconfiguring the delivery of care to better suit the needs of the populations they serve. Thus, enabling clinicians to bridge gaps in disparities. Additionally, in other countries these models have already shown success toward improving stroke care. Neurologists should look to successful models in finding better solutions for improving health equity for the diverse population of patients they serve.

The following are a summary of key considerations for neurologists, health care provider organizations, and policy makers in considering value-based solutions that address disparities in stroke care:

- Through an emphasis on value, integrated practice units provide clinicians the incentive and means to design teams best suited to care for the populations they serve. Taking into consideration drivers of disparities, multiple innovative solutions could be incorporated along an entire care cycle for more equitable care.
- Given the importance of preventative care and stroke education, greater collaborations with primary care should be rewarded in a model that encompasses a full care cycle for stroke, including pre- and post- stroke phases.
- To better assess the collaborative work of a team and improve on value of care delivered across all racial and ethnic groups, it will be necessary to track longitudinal stroke outcomes that are meaningful to patients, including those established by ICHOM.
- Bundled payments could enable providers to better allocate resources according to patient needs and reward them for serving vulnerable communities, often with greater risk factors and complexity of care.

This paper focused on stroke care as a case study, however other neurological illnesses may benefit from this model. Alzheimer's disease and Parkinson's disease for example are illnesses with multifactorial care and noted racial and ethnic care disparities[55,56] that could benefit from greater collaboration with primary care and allocation of resources not currently feasible with fee-for-service. While we have highlighted the benefits of a model that enables reconfiguration of care delivery with the hope of improving patient outcomes, we recognize it is not without its challenges.

Value-based health care delivery represents an entire redesign of the prevailing structure, unlike prior healthcare reform efforts with incremental changes to current system. While it necessarily involves challenges to overcome, it also promises greater rewards. Cultural reluctance to change, the need for specialists to understand costs of overall care cycle, and collaboration between generalist and specialist in providing optimal preventative care are just a few notable challenges that require ongoing efforts. Providers leading initiatives must

comprehensively think about the entire care cycle and actively monitor for practices that add value to care, as well as those with unintended consequences. Particular attention must be placed into ensuring that the care for traditionally medically-underserved populations is becoming more equitable over time as a result of carefully structured care models and systems.

This is the first proposal to provide a framework for how a value-based integrated care model may address disparities within neurological care. Using stroke care as a case study, we highlighted key considerations in the implementation of a stroke integrated practice unit, taking into consideration drivers of racial and ethnic disparities and proposing corresponding solutions along the care cycle. Despite its challenges, integrated care models represent an innovative approach to removing the responsibility of providing equitable and quality care out of individual clinicians and instead allocate that responsibility to the system as a whole.

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