

Financial risk protection for neurosurgical care in Indonesia and the Philippines: a primer on health financing for the global neurosurgeon

Kevin Paul Ferraris, MD, MBA (✉ kpferaris@gmail.com)

Section of Neurosurgery, Department of Surgery, Jose R. Reyes Memorial Medical Center, Manila, Philippines <https://orcid.org/0000-0002-0919-6658>

Maria Eufemia C. Yap, MD, MSc

ThinkWell Global, Manila, Philippines

Maria Cristina G. Bautista, PhD

Department of Economics, Finance and Accounting, Graduate School of Business, Professional Schools, Ateneo de Manila University, Makati, Philippines

Dewa Putu Wisnu Wardhana, MD

Division of Neurosurgery, Department of Surgery, Udayana University Hospital, Faculty of Medicine, Udayana University, Bali, Indonesia

Sri Maliawan, MD, PhD

Division of Neurosurgery, Department of Surgery, Sanglah General Hospital, Faculty of Medicine, Udayana University, Bali, Indonesia

I Md Ady Wirawan, MD, MPH, PhD

Department of Public Health, Faculty of Medicine, Udayana University, Bali, Indonesia

Rohadi Muhammad Rosyidi, MD, PhD

Department of Neurosurgery, West Nusa Tenggara Province Hospital, Faculty of Medicine, Mataram University, Mataram, Indonesia

Kenny Seng, MD

Division of Neurosurgery, Department of Neurosciences, University of the Philippines–Philippine General Hospital, University of the Philippines College of Medicine, Manila, Philippines

Joseph Erroll Navarro, MD

Section of Neurosurgery, Department of Surgery, Jose R. Reyes Memorial Medical Center, Manila, Philippines

Systematic Review

Keywords: health financing, global neurosurgery, strategic purchasing, conditional cash transfer, out-of-pocket expenses, social health insurance

Posted Date: April 28th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-471600/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Which conditions treated by neurosurgeons cause the worst economic hardship among patients in low- and middle-income countries? Might a responsive health financing be the solution to the inequities in the delivery of neurosurgical care? In this review article, we attempt to answer these questions that are relevant to global neurosurgery. Based on the results of a survey of neurosurgeons from Indonesia and the Philippines, socioeconomically disadvantaged patients with malignant intracranial tumors were found to incur the highest out-of-pocket expenses. The surveyed neurosurgeons also observed that treatment of traumatic brain injury may have to require greater financial subsidies. It is therefore imperative to frame health financing alongside the goals of equity, efficiency, and quality of neurosurgical care for the impoverished. Using principles and perspectives from managerial economics and public health, we conceptualize an implementation framework that addresses both the supply and demand sides of healthcare provision as applied to neurosurgery. For the supply side, strategic purchasing enables a systematic and contractual management of payment arrangements that provide performance-based economic incentives for providers. For the demand side, the scheme of conditional cash transfers similarly leverages on financial incentives to reward certain health-seeking behaviors of patients that significantly influence their clinical outcomes. We formulate these health financing strategies in order to ultimately build neurosurgical capacity in LMICs, improve access to care for patients, and ensure financial risk protection.

Introduction

The costs accompanying the provision of neurosurgical care in low middle-income countries (LMICs) constitute as barriers to access among socioeconomically disadvantaged patients (1). For the often life-threatening neurosurgical conditions, financial barriers that need to be overcome frequently cause economic hardships to the household in which a patient belongs to. Families with a patient needing neurosurgical care are at risk for financial catastrophe and impoverishment, and this is especially true in LMICs (2, 3). The increasing costs of healthcare—including neurosurgery—also further burdens the existing health financing mechanisms in the health systems of LMICs. Particularly in low-resource settings of public hospitals where the poorer segments of the population are served, financial risk protection becomes an important consideration (4, 5). The elimination of catastrophic and impoverishing expenditures remains an important goal for health systems to improve the accessibility of neurosurgery. In this article, we explore the most financially catastrophic neurosurgical disorders that are encountered in public neurosurgical centers in Indonesia and the Philippines. We also describe public-health perspectives that may provide insight for potential solutions.

Materials And Methods

Cross-Sectional Survey

The primary aim of the survey was to determine the most commonly encountered neurosurgical conditions that result in financial catastrophe. A secure online survey tool (Google Forms®) was used to disseminate the questionnaire to neurosurgeons currently practicing at public hospitals in Indonesia and the Philippines. Respondents comprised a purposive sample of neurosurgeons invited through the electronic mailing lists of neurosurgical training programs, email to personal contacts, and social media platforms (WhatsApp and Viber). The survey was open between 16th February 2021 and 16th March 2021. Those eligible to complete the survey were neurosurgeons—either as residents or as consultants—whose practice involves a publicly-funded neurosurgical center as part-time or full-time healthcare provider. Duplicates were removed via matching those of an identical name and hospital. Because no patient information was requested from the survey, approval by an institutional review board was not needed.

Application of Public Health Perspectives

Using principles and perspectives from public health, contractual management, and financial management, we proffer potential solutions that can address the gaps in health financing of neurosurgical services in Indonesia and the Philippines. When viewed in a public-health context, the problem of catastrophic and impoverishing expenditures becomes more manageable. Existing frameworks from these disciplines permit exploration of financial risks that burden the patients that can potentially be averted by the roles of various agents in the surgical and health systems.

Results And Discussion

Survey Results

A total of 43 neurosurgeons—29 (67%) from Indonesia and 14 (33%) from the Philippines—had valid responses to the survey. Majority of respondents (31.8%) cited malignant intracranial tumors as the neurosurgical condition that causes the worst economic hardship among patients and their families, followed by traumatic brain injury (27.3%), spinal trauma and spinal cord injury (15.9%), and aneurysmal subarachnoid hemorrhage (15.9%). See *Fig. 1* below.

In terms of out-of-pocket (OOP) expenses for these conditions, malignant intracranial tumors were reported to impose the highest OOP expenses (43.2%), followed by emergency vascular diseases (38.6%), traumatic brain injury (34.1%), and degenerative spine disorders (34.1%).

Among the neurosurgical conditions needing greater financial subsidy, traumatic brain injury (27.3%) needed the most, followed by malignant intracranial tumors (18.2%), aneurysmal subarachnoid hemorrhage (15.9%), and spinal trauma and spinal cord injury (13.6%). See *Fig. 2* below.

Socioeconomic Context of Neurosurgical Care

Few studies have examined the association between patient-level socioeconomic factors and outcomes across the various diseases that are treated by the specialty of neurosurgery—pediatric hydrocephalus (6,

7, 8), craniosynostosis (9), intracranial tumors (10, 11, 12, 13), aneurysmal subarachnoid hemorrhage (14, 15) and stroke (16, 17), traumatic brain injury (18, 19), spine disorders (20) and spinal cord injury (21, 22). Many of these studies describe the more frequently unfavorable outcomes among the inadequately insured and those with lower socioeconomic status. Due to the inherently costly nature of neurosurgical interventions, many of the socioeconomically disadvantaged patients seek the necessary care from public hospitals (4, 5). Whereas such public neurosurgical centers in Indonesia and the Philippines are mandated by legislation and government regulation to provide healthcare at minimum or zero cost, the reality is that many patients still incur out-of-pocket expenses (23, 24). These expenses are often catastrophic and push their families into impoverishment. Financial catastrophe from accessing surgery remains prevalent in LMICs, and most of those exposed to such financial risk live in sub-Saharan Africa and Southeast Asia (1).

Supply and Demand Sides of Neurosurgical Care

There are many reasons for the still prevalent out-of-pocket expenses in LMICs particularly in Indonesia and the Philippines. From the demand side of the healthcare system—the patients—both medical and non-medical costs account for the financial catastrophe suffered by poor patients following hospitalization and surgical operation (2). Surgical conditions are also known to result in a greater household poverty effect relative to other health problems and diseases (25). Poverty plays a role in reducing the affordability of transportation costs and caregiving expenses, while prolonged hospitalization results in income regression, unemployment, and opportunity costs for both the patient and the caregiver. The sociocultural disadvantage of lower levels of education among the poorer patients contributes to the more advanced presentation of disease at the time of first consultation. Inadequate health insurance also contributes to hesitancy in timely health-seeking behavior—a problem that poses a disadvantage to patients' outcomes after treatment as well as their prognosis. Furthermore, it does not help that any neurosurgical intervention, or any surgical treatment for that matter, is perceived to be costly and expensive (1).

From the supply side of the health system—the healthcare providers—publicly-funded hospitals generally provide the needed wide range of emergency and elective neurosurgical care for poor patients. These hospitals are primarily financed from taxation and are appropriated a yearly budget from the national government through the Department or Ministry of Health, or from local or state-run universities. Many public hospitals do not have the bare minimum neurosurgical implements, surgical intensive care units, and even a computed tomography scanner. These complicate the usual treatment pathway for a neurosurgical patient—turning it into a cumbersome navigation around a generally disjointed referral network of hospitals (4, 5, 26). Despite the finite resources that beset government-financed hospitals, neurosurgical care provision in most centers has been largely sustained by the presence of an academic neurosurgical training program. The few hospitals with neurosurgical residency programs in Indonesia and the Philippines are generally better equipped to handle the more complicated and full range of neurosurgical diseases and conditions (27). And yet, like many of the public hospitals in low-resource settings, the efficiency of care is hampered by bureaucratic processes and protocols (1). Commonplace

problems like the breakdown of equipment can take time to repair. The purchase of new equipment often gets encumbered in elaborate procurement processes (28). In these respects, the financing of purchasing and patient management can have an important impact on the quality and efficiency of neurosurgical care.

Health Financing: An Important Health Systems Function

Broadly, health financing comprises the mechanisms by which money is mobilized to fund and pay for health-sector activities, and how the funds are raised, used, and paid out to achieve health-related outputs (29). Financing and payment arrangements determine how much money is available or paid out, who bears the financial burden, who controls the funds, whether healthcare costs are controlled, and which groups or actors are given the incentive (30). A chief method of health financing is by way of health insurance. The organization of funds and the pooling of risks are the foremost functions of a health insurance scheme. Many countries, including both Indonesia and the Philippines, have some form of social health insurance (SHI) that is overseen or managed by the government. Health financing, in a pragmatic sense, is also a matter of policy. These policies and regulations create powerful incentives that influence the actions of individuals and organizations in a given healthcare system.

Socioeconomically disadvantaged patients who seek healthcare services are often price-sensitive. The out-of-pocket expenses they bear affect the volume and timeliness of healthcare they use, which in turn influences their overall health outcomes (29). As far as their healthcare utilization is concerned, the reach of social health insurance coverage in public hospitals is therefore paramount. Universal health coverage and a high degree of responsiveness in curbing out-of-pocket expenses on the part of SHI can improve the accessibility of surgical services, including that of neurosurgery.

Expanded Functions for Social Health Insurance

SHI at the national level acts as a payer for health care goods and services in a country. The Badan Penyelenggara Jaminan Sosial Kesehatan (BPJSK) is the single SHI agency in Indonesia while its counterpart is the Philippine Health Insurance Corporation (PHIC) in the Philippines (23, 24). In the face of limited resources in the public health sectors of Indonesia and the Philippines, SHI agencies have to do “strategic purchasing”—essentially to be cost-conscious and efficient in their payment of services from healthcare providers. Financial incentives or other mechanisms can motivate surgical providers to improve quality and efficiency of care, or to respond to increased patient demand. Similarly, poor patients respond to cost savings in the treatment of their illnesses. SHI agencies can certainly play a role in providing incentives—in the form of conditional cash transfers, for example—for improving intermediate indicators of treatment success as well as clinically important outcomes. See *Fig. 3* below for the framework describing the important role of SHI in influencing the demand and supply sides of healthcare.

Potential Health Financing Solutions

Supply-Side Financing: Strategic Purchasing of Neurosurgical Services

Ideally, the role of SHI is to ensure that adequate resources are mobilized to meet the service entitlements of insured patients—ideally the whole population—and thus achieve “universal health coverage.” While financial risk pooling is an important function of SHIs in terms of equity considerations and financial risk protection for the insured, the added function of strategic purchasing can drive quality and efficiency of healthcare provision (1, 29, 31). Certain strategic purchasing methods can modify healthcare providers’ behaviors in their treatment decisions and ultimately influence the quantity, quality, and efficiency of neurosurgical care for example. The choice of which disease condition to subsidize is a matter of policy and executive decision, but is mostly founded on data on the costs of treatment, the burden of the disease, and the cost-effectiveness of interventions (32). Assuming the role of strategic purchaser, the SHI agency selectively enters into a contract with neurosurgical care providers. Providers in this sense would mean the hospital or institution including the neurosurgeons and allied health professionals. The purchaser and the provider then agree on a provider payment method for a standard treatment regimen.

Consider for example—traumatic brain injury (TBI)—for which the current standards of neurosurgical management are entrenched in universally accepted clinical practice guidelines (33). The prehospital management of a brain-injured patient is time-critical. While the workforce consideration of a low neurosurgeon-to-population ratio remains a perennial problem in Indonesia and the Philippines (27), the situation is exacerbated by financial considerations whereby a poor TBI patient often gets rushed to the emergency department of a much farther public hospital despite the proximity of a private hospital with neurosurgical services at the time of injury. This adverse selection by private hospitals presents an added disadvantage for an already economically disadvantaged patient who suffers from TBI, and whose clinical outcome could have been better were it not for a delayed neurosurgical treatment.

Conceptually, strategic purchasing allows buying of health services for certain groups of patients and uses financial levers and payment schemes that influence the behavior of providers including hospitals and neurosurgeons (32, 34). As the results of our survey in this study indicate, TBI is thought to require greater financial subsidies, similarly found in other studies (18, 19, 35). The case for subsidizing the full costs of treatment for patients with TBI is also justified by its cost-effectiveness (36). Strategic purchasing can realize this through contractual arrangements that would link attractive payment mechanisms to the goal of broadened access to emergency neurosurgical care for TBI patients who are brought to a nearest facility that happens to be a private, for-profit hospital. A catastrophic illness benefit package may be formulated by both the BPJSK and PHIC that would elevate the financial incentive for all neurosurgical providers to accept and manage TBI patients regardless of socioeconomic status (37, 38). Greater acceptability of this mechanism by neurosurgical providers are afforded by strategic purchasing because costing and payment schedules are negotiated and prearranged in collaboration with the providers themselves. The payments from the SHI agency to neurosurgical providers can be further complemented by an element of pay for performance (29), with a proportion of the fixed payment withheld and paid according to patient outcomes assessment and even other indicators such as timeliness of the surgical operation. In this way, the goal of quality and greater access to care can be achieved for the neurosurgical management of patients with TBI.

A prospective payment scheme brought about by strategic purchasing can also enable the pooling of paid-out funds on the part of provider hospitals to accrue future savings (32). The increased generation of revenue at the level of the hospitals can result in upfront investments that will finance the capital outlay costs for scaling up infrastructure and equipment needs, e.g., expansion of neurosurgical bed capacity, addition of dedicated neurosurgical operating theaters, or procurement of costly neurosurgical equipment. In this manner, the improved capacity of the provider hospital can increase neurosurgical volume and again, the goals of quality and better access to neurosurgical care can be achieved. In Table 1 below, we summarize other examples of strategic purchaser-provider arrangements.

Table 1
Purchaser-Provider Contractual Management for Health Financing.

Strategic purchasing functions*:	Examples for neurosurgery:
1. Providing an appropriate range of services and locations relative to the distribution of the population by means of effective gatekeeping and referral	<ul style="list-style-type: none"> • Assignment of tiered neurosurgical centers (e.g., higher level and lower level) with a predefined catchment population based on geography and complexity of disease condition • Creation of centers of excellence for certain neurosurgical disease conditions based on available expertise of subspecialist neurosurgeons
2. Selecting providers for accreditation	<ul style="list-style-type: none"> • Designating and credentialing private hospitals that are capable of accepting and managing traumatic brain injury and emergency neurovascular diseases • Selective contracting and progressive policy of deliberated reimbursement of expenses by accredited private hospitals that are incurred during emergency operations for indigent patients with traumatic brain injury and stroke
3. Implementing provider payment methods efficiently, as in a prospective payment system	<ul style="list-style-type: none"> • Creation of a catastrophic illness benefit package for traumatic brain injury and/or malignant intracranial tumors • Capitation funding for every indigent patient who gets admitted in a private hospital on an emergency basis and needs life-saving neurosurgical intervention
4. Making use of monopsonistic purchasing power	<ul style="list-style-type: none"> • Public-private partnership and debt financing for the capital outlay of infrastructure projects • Economies of scale purchasing arrangements for neurosurgical consumable implements
5. Introducing generic essential drugs, devices, or implants lists	<ul style="list-style-type: none"> • Creation of a medicines access program for disease-altering drugs, e.g. temozolamide for patients with gliomas • Consignment and purchasing arrangements for steady supply of cranial and spinal implants and instrumentation
6. Monitoring provider performance in terms of quality and efficiency	<ul style="list-style-type: none"> • Establishing a prospective database of outcomes report following surgery and adjuvant chemoradiotherapy for patients with gliomas • Merit-based payment and reimbursement of neurosurgical centers based on volume-outcome relationships, e.g. high-volume centers doing > 10 intracranial aneurysms per year will have seamless financing for purchase of aneurysm clips
7. Ensuring mutual accountability between purchasers and providers through timely payments to healthcare providers and appropriate audit systems	<ul style="list-style-type: none"> • Checks and balances system that would minimize fraud and pilferage of payments and reimbursements, e.g. repeated neuroimaging of neurosurgical patients will have to be easily cross-checked through linkage with information technology systems • Strict penalty system for breach in contracts when it comes to timeliness of reimbursements, especially for time-critical and life-threatening neurosurgical operations

Strategic purchasing functions*:**Examples for neurosurgery:**

*Adapted from: Trisnantoro L, Hendrartini J, Susilowati T, Miranti PAD, Aristianti V. Chapter 3: A critical analysis of selected healthcare purchasing mechanisms in Indonesia. In: Honda A, McIntyre D, Hanson K, Tangcharoensathien V. ed. by. *Strategic Purchasing in China, Indonesia, and the Philippines (Comparative Country Studies, Vol. 2 No. 1 2016)*. Geneva: World Health Organization; 2016. p. 124.

Demand-Side Financing: Conditional Cash Transfers for Neurosurgical Patients

Neurosurgical patients, herein considered the demand side of healthcare provision, constitute an important stakeholder as well in terms of health financing. Despite the fact that surgery in public hospitals is completely subsidized by the BPJS in Indonesia and the PHIC in the Philippines—at little to zero cost for indigent patients—there remain substantial financial barriers (32). Frequently, financial catastrophe comes from non-medical costs of care such as the cost of transportation and living expenses of the caregiver (1, 2). For socioeconomically disadvantaged patients in the Philippines, even in-person outpatient follow-up after neurosurgery entails catastrophic expenses and may cause adverse life events that can negatively impact health-seeking behavior overall (39).

The results of our survey show that out-of-pocket expenses surrounding the management of those with malignant intracranial tumors are a prevalent form of health financing in Indonesia and the Philippines. For majority of patients with brain cancer in Indonesia and the Philippines, the standard Stupp protocol for the treatment of glioblastoma could bankrupt their families—often resulting in the patient never receiving or completing the disease-altering adjuvant chemotherapy and radiotherapy. Because adjuvant chemotherapy for glioblastoma is carried out on an outpatient basis—consultations at the oncology clinic during the course of the patient’s ongoing intake of oral drugs (temozolamide)—SHIs especially PHIC are currently not fully responsive in the aspect of financing. The responsibility of payment for the adjuvant treatments is frequently left to the hospital’s social welfare division or external charitable organizations (38). In the Philippines, the PHIC pays for a so-called “Z Benefit” package for the full treatment course of certain catastrophic illnesses including early breast, colon, and rectum cancers, but not brain cancer. In Indonesia, treatment costs for recurrent glioblastoma are no longer paid for by the BPJS. This results in dismal follow-up at baseline and at worst, poor long-term survival among patients with malignant intracranial tumors.

The case for subsidizing the full costs of treatment for patients with glioblastoma is justified by its cost-effectiveness (40) and the fact that brain cancer is one of the leading neurological causes of mortality in the Southeast Asian region that are relevant to the neurosurgeon (41). While full subsidies for the Stupp protocol through some form of strategic purchasing appears to be the preeminent solution, the added strategy of using cash transfers for patients with glioblastoma can modify the behavior of the demand-side of neurosurgical care provision. Cash transfers—in which recipients are given some amount of money, often conditional on their adherence to a desired behavior—have been used by social welfare programs to reduce poverty and to incentivize salutary action for a number of public-health interventions

(42, 43). Determining the optimal amount of cash transfers can be difficult and controversial but recent evidence from a modelling study suggests a dose-response relationship between the amount of money given and compliance to scheduled surgery (44). The modelling study by Strader et al. noted that until after baseline costs of surgery are paid for by the purchaser—and thus becomes free for the patient—only then can any incremental increase in the amount of cash transfer be expected to improve compliance.

Conditional cash transfers for patients with glioblastomas may be done to decrease the no-show rate in follow-up consultation schedules and improve the all too common problem of loss to follow-up. The direct provision of cash for indigent patients can be made contingent on their adherence to adjuvant treatment following neurosurgical operation for glioblastoma. In turn, the families' non-medical costs are also subsidized. Furthermore, conditional cash transfers also have positive externalities and can be expected to increase the propensity of the household members to have some degree of trust in the systems of healthcare provision and health financing. In this manner, financial barriers to neurosurgical services are actually lowered and a system is in place to reward beneficial health-seeking behavior that ultimately impacts patient outcomes.

Conclusion

Neurosurgical patients living in Indonesia and the Philippines who are socioeconomically disadvantaged to begin with have the added challenges of incurring out-of-pocket expenses and risking financial catastrophe whenever they navigate the health system for treatment. This situation calls for a more robust and responsive health financing for neurosurgical services. From an economic perspective, health financing for neurosurgery entails the proposition for addressing the demand (patient) or supply (provider) sides of healthcare provision. Strategic purchasing enables a systematic and contractual management of payment arrangements that provide performance-based economic incentives for providers that can in turn help achieve the goals of quality and efficiency of neurosurgical care provision. Conditional cash transfers similarly leverage on financial incentives to reward certain health-seeking behaviors of patients that significantly influence their clinical outcomes. These health financing strategies are formulated in order to ultimately build neurosurgical capacity in LMICs, improve access to care for patients, and ensure financial risk protection. It is hoped that this article provides a framework for implementation and grants a basic understanding of health financing that can inform policy and advocacy work among neurosurgeons globally.

Declarations

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Meara JG, Leather AJM, Hagander L, Alkire BC, Alonso N, Ameh EA, et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet*. 2015 Aug;386(9993):569–624.
2. Shrimpe MG, Dare AJ, Alkire BC, O'Neill K, Meara JG. Catastrophic Expenditure to Pay for Surgery: A Global Estimate. *Lancet Glob Health*. 2015 Apr 27;3(0 2):S38–44.
3. Anderson GA, Ilcisin L, Kayima P, Abesiga L, Portal Benitez N, Ngonzi J, et al. Out-of-pocket payment for surgery in Uganda: The rate of impoverishing and catastrophic expenditure at a government hospital. *PLoS One*. 2017 Oct 31 [cited 2020 Feb 16];12(10).
4. Andayani NLPEP, Marthias T, Putri LP: Public hospital governance in Indonesia. In: Huntington D, Hort K. ed. by. *Public Hospital Governance in Asia and the Pacific, Vol 1*. Geneva: World Health Organization Western Pacific Regional Publications, 2015. pp 26–63.
5. Picazo OF: Public hospital governance in the Philippines. In: Huntington D, Hort K. ed. by. *Public Hospital Governance in Asia and the Pacific, Vol 1*. Geneva: World Health Organization Western Pacific Regional Publications, 2015. pp 186–221.
6. Kulkarni AV, Cochrane DD, McNeely PD, Shams I. Medical, social, and economic factors associated with health-related quality of life in Canadian children with hydrocephalus. *J Pediatr*. 2008;153(5):689–695.
7. Attenello FJ, Ng A, Wen T, et al. Racial and socioeconomic disparities in outcomes following pediatric cerebrospinal fluid shunt procedures. *J Neurosurg Pediatr*. 2015;15(6):560–566.
8. Walker CT, Stone JJ, Jain M, et al. The effects of socioeconomic status and race on pediatric neurosurgical shunting. *Childs Nerv Syst*. 2014;30:117–122.
9. Hoffman C, Valenti AB, Odigie E, Warren K, Premaratne ID, Imahiyerobo TA. Impact of health disparities on treatment for single-suture craniosynostosis in an era of multimodal care. *Neurosurg Focus*. 2021 Apr 1;50(4):E13.
10. Berkman JM, Dallas J, Lim J, et al. Social determinants of health affecting treatment of pediatric brain tumors. *J Neurosurg Pediatr*. 2019;24(2):159–165.
11. Cyprich J, Pangal DJ, Rutkowski M, et al. Comparative preoperative characteristics and postoperative outcomes at a private versus a safety-net hospital following endoscopic endonasal transsphenoidal resection of pituitary adenomas. *J Neurosurg*. 2020;1(aop):1–8.
12. Tseng M-Y, Tseng J-H, Merchant E. Comparison of effects of socioeconomic and geographic variations on survival for adults and children with glioma. *J Neurosurg Pediatr*. 2006;105(4):297–305.
13. Younus I, Gerges M, Schwartz TH, Ramakrishna R. Impact of Medicaid insurance on outcomes following endoscopic transsphenoidal pituitary surgery. *J Neurosurg*. 2020 Mar 20;134(3):801–6.
14. Attenello FJ, Wang K, Wen T, et al. Health disparities in time to aneurysm clipping/coiling among aneurysmal subarachnoid hemorrhage patients: a national study. *World Neurosurg*. 2014;82:1071–

1076.

15. Strickland BA, Mert M, Ravina K, et al. Discrepancy in Neurologic Outcomes Following Aneurysmal Subarachnoid Hemorrhage as a Function of Socioeconomic Class. *World Neurosurg.* 2020;138:e787-e794.
16. Cruz-Flores S, Rabinstein A, Biller J, et al. Racial-ethnic disparities in stroke care: the American experience. A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke.* 2011; 42:2091–2116.
17. Wen T, Attenello FJ, He S, et al. Racial and socioeconomic disparities in incidence of hospital-acquired complications following cerebrovascular procedures. *Neurosurgery.* 2014;75:43–50.
18. Dewan MC, Rattani A, Gupta S, et al. Estimating the global incidence of traumatic brain injury. *J Neurosurg.* 2018;130(4):1080–1097.
19. Elahi C, Rocha TAH, da Silva NC, et al. An evaluation of outcomes in patients with traumatic brain injury at a referral hospital in Tanzania: evidence from a survival analysis. *Neurosurg Focus.* 2019;47(5):E6.
20. Elsamadicy AA, Kemeny H, Adogwa O, et al. Influence of racial disparities on patient-reported satisfaction and short- and long-term perception of health status after elective lumbar spine surgery. *J Neurosurg Spine.* 2018;29(1):40–45.
21. Leidinger A, Kim EE, Navarro-Ramirez R, et al. Spinal trauma in Tanzania: current management and outcomes. *J Neurosurg Spine.* 2019;31:103–111.
22. Jorge A, White MD, Agarwal N. Outcomes in socioeconomically disadvantaged patients with spinal cord injury: a systematic review. *J Neurosurg Spine.* 2018;29(6):680–686.
23. Mahendradhata Y, Trisnantoro L, Listyadewi S, et al. *The Republic of Indonesia Health System Review. Health Systems in Transition.* 2018; 8(2):1–328.
24. Dayrit MM, Lagrada LP, Picazo OF, et al. *The Philippines Health System Review. Health Systems in Transition.* 2018; 8(2):1–315.
25. Hamid SA, Ahsan SM, Begum A. Disease-specific impoverishment impact of out-of-pocket payments for health care: evidence from rural Bangladesh. *Appl Health Econ Health Policy.* 2014; 12:421–33.
26. King M, Bewes P, Cairns J, Thornton J, ed. by. *Primary surgery, vol 1. Non-trauma.* Oxford: Oxford University Press, 1990.
27. Ferraris KP, Matsumura H, Wardhana DPW, Vesagas T, Seng K, Ali MRM, et al. The state of neurosurgical training and education in East Asia: analysis and strategy development for this frontier of the world. *Neurosurg Focus.* 2020 Mar 1;48(3):E7.
28. Hort K, Maunganidze N. Public hospital governance: emerging issues and key lessons, in Huntington D, Hort K. ed. by. *Public Hospital Governance in Asia and the Pacific, Vol 1.* Geneva: World Health Organization Western Pacific Regional Publications, 2015. pp 300–320.
29. Roberts MJ, Hsiao W, Berman P, Reich MR. *Getting Health Reform Right: A Guide to Improving Performance and Equity.* New York: Oxford University Press, 2004, p 1–219.

30. Wiysonge CS, Paulsen E, Lewin S, et al. Financial arrangements for health systems in low-income countries: an overview of systematic reviews. *Cochrane Database Syst Rev.* 2017;2017(9).
31. Loevinsohn B, Harding A. Buying results? Contracting for health service delivery in developing countries. *Lancet.* 2005; 366: 676–81.
32. Honda A, McIntyre D, Hanson K, Tangcharoensathien V. ed. by. *Strategic Purchasing in China, Indonesia, and the Philippines* (Comparative Country Studies, Vol. 2 No. 1 2016). Geneva: World Health Organization; 2016. pp. 1–234.
33. Carney N, Totten AM, O'Reilly C, Ullman JS, Hawryluk GWJ, Bell MJ, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. *Neurosurgery.* 2017 Jan 1;80(1):6–15.
34. Bautista MCG. The PhilHealth Case—Health Care Contracts and Social Contract in Social Health Insurance. In: Schuhmann R, Eichhorn B. ed. by. *Contractual Management: Managing Through Contracts.* Berlin: Springer-Verlag GmbH Germany; 2020. pp. 337–354.
35. Dijkstra JTJM van, Dijkman MD, Ophuis RH, Ruiters GCW de, Peul WC, Polinder S. In-hospital costs after severe traumatic brain injury: A systematic review and quality assessment. *PLoS One.* 2019 May 9;14(5):e0216743.
36. Whitmore RG, Thawani JP, Grady MS, Levine JM, Sanborn MR, Stein SC. Is aggressive treatment of traumatic brain injury cost-effective? *J Neurosurg.* 2012 May;116(5):1106–13.
37. Trisnantoro L, Hendrartini J, Susilowati T, Miranti PAD, Aristianti V. Chapter 3: A critical analysis of selected healthcare purchasing mechanisms in Indonesia. In: Honda A, McIntyre D, Hanson K, Tangcharoensathien V. ed. by. *Strategic Purchasing in China, Indonesia, and the Philippines* (Comparative Country Studies, Vol. 2 No. 1 2016). Geneva: World Health Organization; 2016. p. 102–157.
38. Picazo OF, Ulep VGT, Pantig IM, Ho BL. Chapter 4: A critical analysis of purchasing health services in the Philippines. In: Honda A, McIntyre D, Hanson K, Tangcharoensathien V. ed. by. *Strategic Purchasing in China, Indonesia, and the Philippines* (Comparative Country Studies, Vol. 2 No. 1 2016). Geneva: World Health Organization; 2016. p. 158–224.
39. Ferraris KP, Golidtum JP, Zuñiga BKW, Bautista MCG, Alcazaren JC, Seng K, et al. Recapitulating the Bayesian framework for neurosurgical outpatient care and a cost-benefit analysis of telemedicine for socioeconomically disadvantaged patients in the Philippines during the pandemic. *Neurosurg Focus.* 2020 Dec 1;49(6):E14.
40. Uyl-de Groot CA, Stupp R, van der Bent M. Cost-effectiveness of temozolomide for the treatment of newly diagnosed glioblastoma multiforme. *Expert Rev Pharmacoecon Outcomes Res.* 2009 Jun;9(3):235–41.
41. GBD 2015 Neurological Disorders Collaborator Group: Global, regional, and national burden of neurological disorders during 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Neurol.* 2017; 16:877–897.
42. Robertson L, Mushati P, Eaton JW, Dumba L, Mavise G, Makoni J, et al. Effects of unconditional and conditional cash transfers on child health and development in Zimbabwe: a cluster-randomised trial.

Lancet. 2013 Apr;381(9874):1283–92.

43. Harman L, Bastagli F, Hagen-Zanker J, Sturge G, Barca V. Cash transfers: what does the evidence say? [Internet]. Overseas Development Institute; 2016 [cited 2021 Apr 1]. Available from: <https://www.odi.org/sites/odi.org.uk/files/resource-documents/10747.pdf>
44. Strader C, Ashby J, Vervoort D, Ebrahimi A, Agbortoko S, Lee M, et al. How much is enough? Exploring the dose-response relationship between cash transfers and surgical utilization in a resource-poor setting. *PLoS One*. 2020 May 14;15(5):e0232761.

Figures

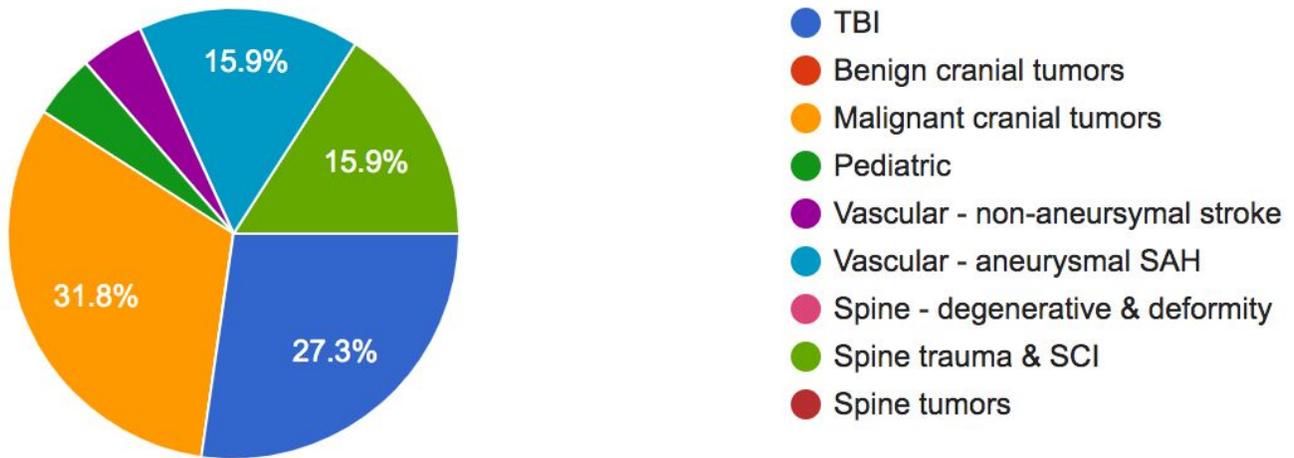


Figure 1

Neurosurgical conditions causing the worst economic hardship among patients.

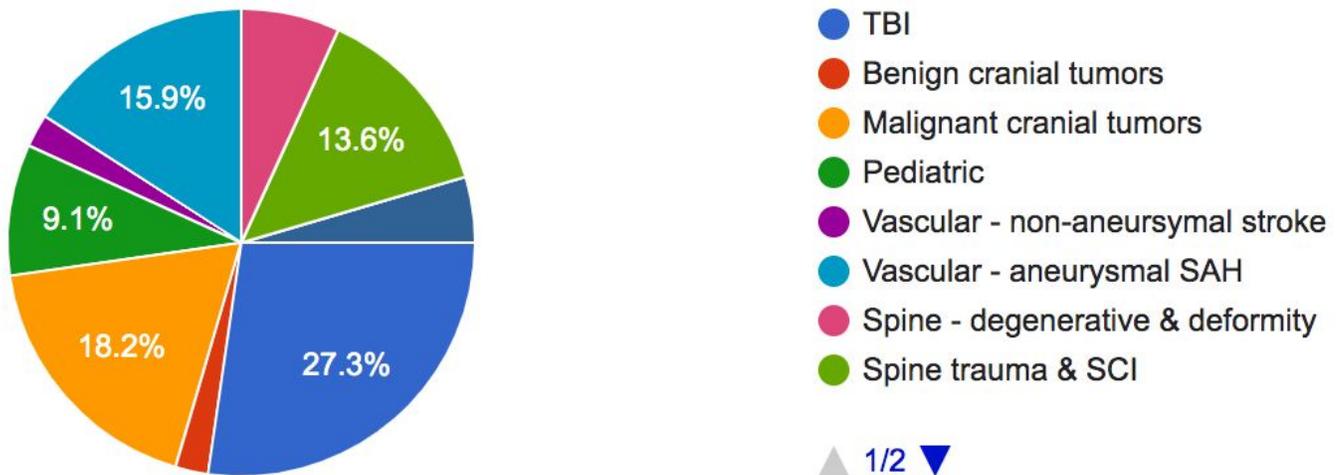


Figure 2

Neurosurgical conditions necessitating greater financial subsidy.

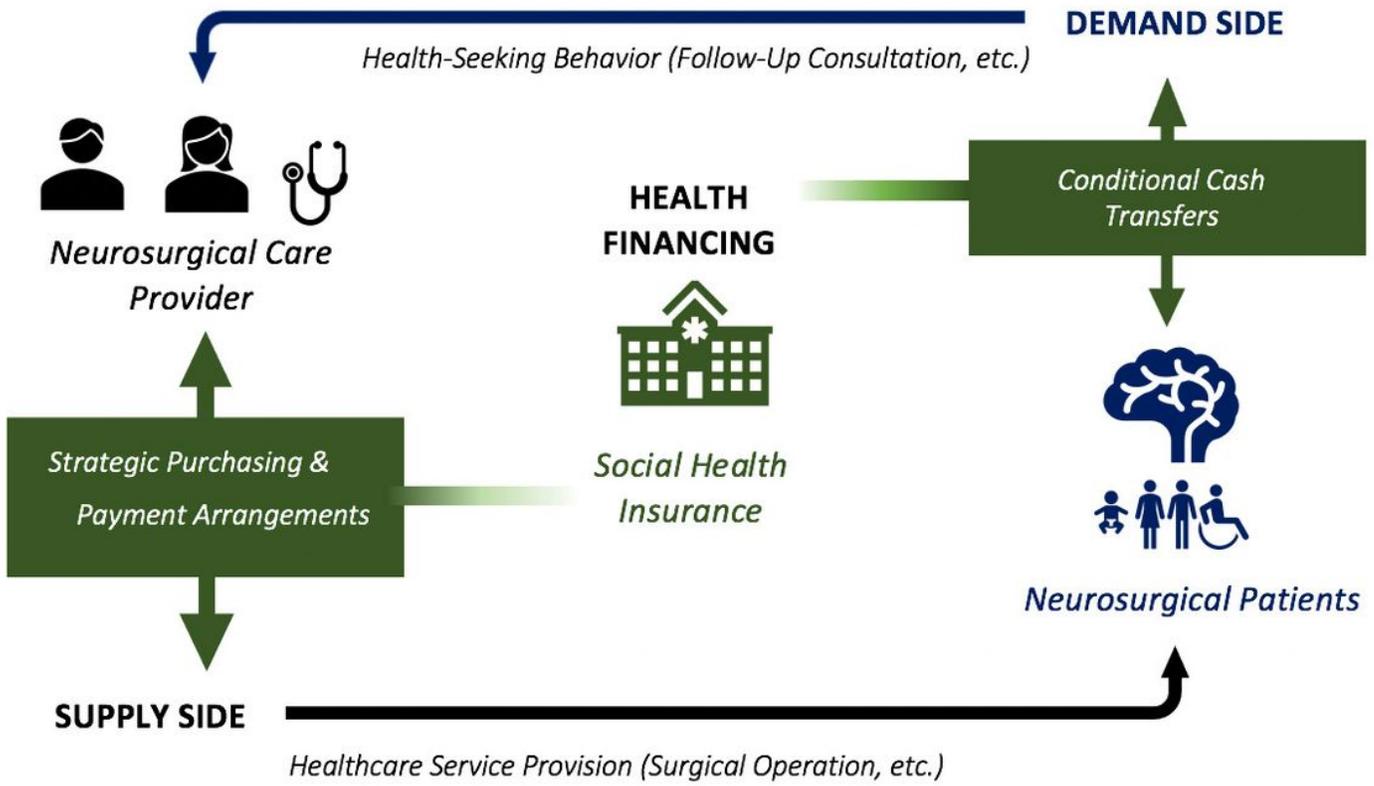


Figure 3

Framework for policy and implementation of health financing as applied to neurosurgery.