EDITORIAL

Support for Obamacare?

R. Loch Macdonald, MD, PhD

Division of Neurosurgery, St. Michael's Hospital, Labatt Family Centre of Excellence in Brain Injury and Trauma Research, Keenan Research Centre for Biomedical Science and the Li Ka Shing Knowledge Institute of St. Michael's Hospital, Department of Surgery, University of Toronto, Ontario, Canada

IN this issue of the *Journal of Neurosurgery*, McCutcheon et al. analyze 667,522 patients from the Nationwide Inpatient Sample (NIS) who underwent a craniotomy or spinal surgery for traumatic extraaxial intracranial hematoma (epidural or subdural) or spinal fracture between 1998 and 2009.⁶ There were 190,412 patients with head injuries and 477,110 with spine injuries. Craniotomy was performed in approximately 20% of cases and spinal surgery in 7% of cases. The key finding was that after adjusting for factors that may or may not be important in determining whether surgery is indicated, uninsured patients were less likely to undergo surgery and, in the case of head injuries, had a higher mortality rate than insured patients. The authors conclude that there is a need for universal health care coverage. The data seem to provide support for the concepts in Obamacare.

This paper is timely given the ongoing debate on health care funding in the US. The US does not have universal health care like some other countries such as Canada, France, Germany, Japan, and the United Kingdom. According to the WHO, universal health care is associated with better health outcomes and higher quality of life.¹⁰ However, the WHO report did not advocate specifically for a state-run system of universal health care. The report indicated that the situation in each country would require specific approaches. Perusing some of the abundant literature on the subject, the US spends more per capita on health care than the other countries mentioned above, yet its citizens have the shortest life expectancy, highest infant mortality, and lowest satisfaction with their health care system (www.marketwatch.com/health-care/reform/snapshot). I am not an economist and I have limited knowl-

edge of this subject, but, on the other hand, there must be a relationship between the lack of universal health care in the US and the superiority of the US regarding new drug development and medical technology advances.⁵ The basis may originate in the distinct founding principles of the US compared with other, older countries. One analysis that was potentially biased towards the US found that the majority of new drugs were developed at biotechnology companies or universities in the US. While not directly related to universal health care, it would be counterproductive if maneuvers to implement such a system inadvertently stymied the intellectual productivity of the system. Simplistically, these companies want to make money, and they happen to sell most of their drugs, which presumably are safe and usually efficacious, at least according to the FDA, and the US spends almost twice as much money on health care per capita as other countries.

There are several key points about the current analysis. One point concerns the outcome measures used and whether key factors affecting them can be adequately adjusted for in the NIS data. For the head-injury group, key prognostic factors would be age, level of consciousness on admission (specifically the motor score on the Glasgow Coma Scale), pupillary reactivity, and findings on the admission CT scan, according to the International Mission for Prognosis and Analysis of Clinical Trials in traumatic brain injury.⁹ The authors could account for some of these, although the level of consciousness and motor score are not specifically available. The CT findings are important because some appear to be available in the NIS, and they can have differing effects on outcome. Steyerberg et al. reported that an epidural hematoma was prognostically fa-

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avorable, whereas traumatic subarachnoid hemorrhage was unfavorable.⁹ The analysis performed by McCutcheon et al. had few epidural hematomas, so the outcomes would be driven more by subdural hematomas. In their revised version of the paper, they included epidural versus subdural hematoma in the analysis, so the question is addressed as best as it can be. Also, subarachnoid hemorrhage might be able to be determined from the NIS, and could perhaps be assessed.

What matters in the end is the outcome of the patient, not whether he or she had surgery or not. McCutcheon and colleagues do find that mortality was higher in the head injury group that was uninsured. Thus, there was a correlation between lower likelihood of craniotomy and death. There were significant differences in the groups according to race and age, and while they can be adjusted for statistically, adjustment in multiple regression is not the same as randomization, and one cannot be certain that it will completely negate any biases. For example, why would age over 65 not differ in terms of operation by insurance status? The authors speculate this is because this group can receive Medicare or that they are unlikely to undergo surgery anyway. Knowing the causes of death might provide more information here. If it is because they can get Medicare, and this truly impacts the overall outcome, then this is a fundamentally important finding because it means lives are at stake based on whether you can pay. In addition, in their revision the authors have used propensity matching to match patients with and without insurance for prognostic factors for mortality. This statistical technique has been suggested to be closer to actual randomization in some cases than multivariate regression.⁷ They found that patients who were insured were more likely to undergo surgery. My question again is that it is not surgery that matters but the outcome of the patient, so unless I am misinterpreting the analysis, the matching was not performed to determine if having surgery actually had any impact on mortality.

It is difficult to draw conclusions about some of the other correlations (frequency of craniotomy in relation to residency program, hospital volume, and for/not for profit) without knowing more about the indications for surgery. Arguments can be made for these factors increasing or decreasing the use of surgery. Higher rates of surgery at for-profit hospitals have been reported before, and the financial incentive is one possible explanation.¹ High-volume centers are more likely to have neurosurgical residency programs and to follow guidelines.^{3,8} There are a lot of subdural hematomas, and the International Classification of Diseases, Ninth Revision (ICD-9) does not distinguish acute from chronic. So could it be that there is more incentive to operate on a small, chronic, subdural hematoma in an insured patient, who will in turn be very likely to do well. The difference in surgery rates according to sex is troubling, although I was not sure if this affected mortality. Furthermore, the differences in surgery according to race do not fit into any coherent story. One could speculate exhaustively on the many biases that could affect the mortality outcome.

The spine fracture analysis is equally interesting and more difficult to draw firm conclusions from. In particular, the indications for surgery for spine fractures are less well

defined than for intracranial extraaxial hematomas, and spine surgery rates vary more by center than many other procedures.² The question is whether the rate of surgery has any effect on clinical outcome. As the authors point out, there was no effect on mortality but the overall mortality rate was low, and neurological function is a more important outcome. The NIS has discharge disposition data, with these as the options: home, unknown, against medical advice, short-term hospital, home health care, skilled nursing facility, intermediate care, dead, and other. This may not, however, be detailed enough for spine injuries.

One way to examine the effect of insurance status could be to compare rates of surgery and outcomes between countries with different health care funding models. We analyzed mortality after spontaneous subarachnoid hemorrhage in the NIS and the Canadian Discharge Abstract Database.⁴ Canada has universal health care coverage and less than 2% of the population is not covered. Interestingly, death from spontaneous subarachnoid hemorrhage, also a critical illness like the intracranial extraaxial hematoma group studied here, was higher with lower socioeconomic status in the US but not in Canada. Part of this association was due to the higher number of uninsured patients in the lower socioeconomic status groups.

The authors also comment that the mortality difference is not likely to be due to a patient having delayed access to the hospital. However, I did not see any data on time from injury to admission. Some other questions are what the overall outcome was, for example, for all of the patients with traumatic brain injury. There are data in the NIS on discharge status, which can be used as a rough estimate of outcome, in addition to mortality that was used here. It would be interesting to know if overall outcome from traumatic brain injury varied with insurance status. If it is a multivariate analysis, determining whether surgery is an independent factor associated with mortality would bolster the conclusions.

How do these results inform decisions about health care and concepts such as universal insurance? The authors conclude that uninsured patients have less access to surgery. There are certainly multiple lines of circumstantial and correlative evidence provided, but given the limitations of this data set, it might be more scientifically rigorous to conclude that after adjusting for some factors that might influence the need for surgery and for mortality, this subset of patients with head injuries who did not undergo surgery were more likely to die. This is still a powerful statement. Higher-level medical evidence such as randomized study data are not going to be available, so analyses such as this one may be all that can be obtained in order to inform policy makers on how to provide health care for their countries.

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Response

Brandon A. McCutcheon, MPP,¹ and Bob S. Carter, MD, PhD²

¹Department of Surgery, and ²Division of Neurosurgery, University of California, San Diego, California

We thank Dr. Macdonald for providing such a thoughtful editorial to our article. In his editorial, Dr. Macdonald highlights many of the salient challenges underlying current health policy debates. He also illuminates many of the limitations those working with “big data” face in their research endeavors.

Dr. Macdonald opens with a discussion regarding the merits of various health system designs. He acknowledges that any health funding arrangement inherently faces tradeoffs. By citing literature that demonstrates improvements in health outcomes under universal care he illustrates some of the potential advantages of a system such as “Obamacare,” which has the goal of improving access to health care more broadly. Thereafter he cautions that such health care funding schemes may have unintended consequences, including stymieing research and development of novel therapeutics. Dr. Macdonald’s argument demonstrates the complexity of health system design and the inherent tradeoffs legislators make with regard to politics, economics, and ethics. The old adage “there is no free lunch” holds true.

One of the metrics on which health systems may be evaluated is access to care. In our current study, we sought to investigate how insurance status might influence a patient’s access to acute neurosurgical interventions. We demonstrate that uninsured individuals with traumatic intracranial bleeds and spinal vertebral fractures are less

likely to receive operative management. Our study provides an interesting test case because it investigates treatment decisions in a high-acuity scenario in which barriers to care ought to be at their lowest because of the well-developed trauma systems that exist in the US.

Dr. Macdonald raises an interesting point, that it may have been more germane to investigate outcomes such as mortality rather than access to surgery itself. We believe that both questions of access and outcome are of interest. Indeed, in the cranial trauma cohort, a higher mortality rate was observed for the uninsured. Dr. Macdonald correctly notes that we cannot completely elucidate the underlying causes of the observed association between insurance status and operative management. For example, he points out that this observation could reflect either poor access to a lifesaving surgical procedure in uninsured patients (as the mortality data suggest) or overutilization of surgical procedures in insured patients. Other unmeasured and unadjusted factors that correlate with insurance status could also play a role. We believe our paper adds to others that have demonstrated access problems in neurosurgery related to insurance status and serves as a call for further investigation into the root causes of this observation.^{1–3}

Dr. Macdonald accurately highlights the limitations that data scientists currently face in research efforts of this nature. The statistical inference techniques we use are in some sense very mature; they have continued to evolve since Legendre first published the technique of least squares, the basis for modern regression, in 1805.⁴ Nonetheless, application of big data analytics to health care research is still very much in its infancy, and the acquisition of granular, high-fidelity data remains a formidable challenge to those seeking to answer clinically relevant questions.

One criticism surrounding big data in health care emerges from the conventional wisdom that randomized controlled trials (RCTs) represent the gold standard of clinical research. However, as Dr. Macdonald notes, RCTs may be limited by practical and ethical considerations and are less suitable in the early stages of research when hypothesis are being generated and early levels of evidence are being developed.

For many research questions, big data offers an attractive solution. The advantages of these analytical approaches include low cost and a large, generalizable patient population. The fundamental challenge of big data is that results are in the form of statistical associations and causality must be inferred by additional lines of evidence. Discerning whether these associations represent statistical confounding or are suggestive of an underlying causal relationship is not straightforward. Dr. Macdonald highlights this important point. He describes some of the key prognostic factors associated with traumatic brain injury including Glasgow Coma Scale score, pupillary reactivity, and CT features. While the current state of ICD-9 coding as well as the granularity of data maintained in the NIS provide us some insight, the current study cannot directly account for all of these prognostic factors.

Nonetheless, we anticipate that the role of big data in medicine and neurosurgery is likely to continue to grow in prominence. As with Moore’s law in computing power,

it is almost certain that the resolution of data will continue to increase. As the quantity and quality of the data at our fingertips improves, we can more accurately approximate the results of randomization. Techniques such as propensity score matching, as Dr. Macdonald notes, can help and often allow researchers to achieve similar baseline patient populations. The increasing ubiquity of electronic health records, techniques such as natural language processing, and the advent of specialty-specific data sets such as the National Neurosurgery Quality and Outcomes Database (N²QOD) will allow clinicians to perform ever finer risk adjustments that more effectively approximate the effect of randomization. By comparison, the fundamental problems with RCTs (cost and questions of generalizability) are unlikely to improve in the future, as they are primarily problems of human resources rather than technology. It is, therefore, interesting to speculate whether the role of

big data in clinical science will ultimately surpass that of RCTs.

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