More than 30 years after initial reports demonstrated the feasibility of intra-arterial or endovascular therapies for the treatment of acute ischemic stroke, big data have finally established requisite evidence for the safety and efficacy of thrombectomy. Cautious enthusiasm for this breakthrough is tempered, as we await the bigger data of these trials to understand the constellation of variables that ensured success. Noninvasive imaging, including multimodal computed tomography and MRI as used in recent endovascular trials, has dramatically advanced since that time, providing snapshots or profiles of the collaterome in a given patient. Data-driven analyses will provide the most potent argument to distinguish comprehensive stroke centers from interventional-ready sites. These trials may provide insight on the future role of telestroke, for intravenous thrombolysis and remote imaging review of multimodal computed tomography or MRI to streamline patient transfer for endovascular therapy. Rather than concluding that recent trials have answered the most important question regarding endovascular therapy, even more data are needed to effectively translate such success and extend such potential benefit to the greatest number of stroke patients encountered on a daily basis.
be gleaned from these big and bigger data emerging from recent trials.

Successful revascularization with endovascular therapy for acute ischemic stroke is defined by good clinical outcome at 90 days, largely influenced by the baseline pathophysiology or collateral status of a given individual at stroke onset [6]. Such impact of collateral circulation in endovascular stroke therapy was recognized many years ago, by interventional pioneers [7,8]. Noninvasive imaging, including multimodal computed tomography (CT) and MRI as used in recent endovascular trials, has dramatically advanced since that time, providing snapshots or profiles of the collateral in a given patient [9]. The collateral is the elaborate neurovascular architecture within the brain that regulates and determines the compensatory ability, response and outcome of cerebrovascular pathophysiology. Imaging selection, defined virtually across the trials, is therefore pivotal in triage for endovascular therapy. The relatively small populations recruited in these successful trials compared with their projected sample sizes is likely explained by the use of imaging to enrich patient selection [2,10,11]. Core volumes, mismatch and collateral grade on multimodal CT or MRI may identify ideal candidates and similarly, malignant patterns that portend abysmal outcomes. Implementation of the optimal imaging approach for selection of endovascular therapy candidates may leverage the specific advantages and avoid the logistic difficulties of either multimodal CT or MRI in a particular environment or clinical scenario [12,13]. Ongoing evaluation of wide scale use of these techniques will be important to help advance these imaging goals in the clinical context. Furthermore, a particular imaging technique may not be superior to another as availability and expertise to translate imaging results into medical decision-making are paramount. In sum, the success of an interventional procedure is not defined by the device alone, but by the interaction of the treatment approach with baseline pathophysiology, readily delineated with imaging expertise and indispensable data.

The paradigm or entire approach to endovascular stroke therapy, from prehospital triage to the angiography suite, intensive care unit, rehabilitation and beyond may also encompass essential data elements [14]. Recent endovascular stroke trials have utilized distinct systems of care, processes, integration of various specialists, and timelines. These logistic details now become incredibly important practical aspects for planning wide-scale implementation of endovascular therapy in routine clinical practice. Even before full publication of final trial results, these issues emerge with sundry political implications. Endovascular stroke therapy has been termed ‘surgery’, eliciting debate regarding the role of various medical specialists. Oddly, neurological expertise in acute stroke management has not been emphasized as the focus has been centered on the interventional procedure rather than the entire process of patient care. The distribution or transfer of stroke patients within a geographic region and role of comprehensive stroke centers has also been raised. Interestingly, these recent trials were not solely conducted at comprehensive stroke centers and numerous questions remain regarding data on the optimal process of care. If experienced interventional specialists are available at a hospital, then why are other components of a comprehensive stroke center required? Data-driven analyses will provide the most potent argument to distinguish comprehensive stroke centers from interventional-ready sites. These trials may provide insight on the future role of telestroke, for intravenous thrombolysis and remote imaging review of multimodal CT or MRI to streamline patient transfer for endovascular therapy. Data from larger scale endovascular registries have revealed that arbitrary time windows are irrational without understanding the degree of collateral status [15-17]. In brief, stroke patients with poor collaterals require rapid triage to endovascular therapy to achieve reasonable outcomes, whereas those patients with robust collaterals may achieve excellent clinical outcomes with endovascular therapy at much later times. These data on collateral status and relative time windows may be leveraged in telestroke models that incorporate expert review of multimodal imaging in sync with patient evaluation at a remote hospital, triaging patients based on collateral status as an important determinant of outcomes after endovascular stroke therapy. Rather than concluding that recent trials have answered the most important question regarding endovascular therapy, even more data are needed to effectively translate such success and extend such potential benefit to the greatest number of stroke patients encountered on a daily basis [2,10-13].

The next phase in endovascular stroke therapy is likely the most critical. Phase IV studies or post-marketing surveillance are important stages of therapeutic development, yet registries are often disparaged. Several endovascular stroke therapy device registries have been launched, but collecting extensive data cannot be underemphasized. We need to understand how the variables described above in recent trials relate to implementation of endovascular stroke therapy in routine clinical practice. Detailed and centrally adjudicated variables regarding process of care, imaging, angiography, diverse patient outcomes and costs are needed to understand the most critical determinants of improved stroke care with endovascular therapy. Specific time intervals in the process of care, such as door-to-imaging versus picture-to-puncture or total procedure time, must be evaluated with respect to impact on ultimate outcomes and importance of data obtained or decision-making during such distinct intervals [18,19]. This data-driven approach mirrors the philosophy of precision medicine revolutionizing healthcare in other disorders [20].

Big and bigger data in endovascular stroke therapy provide momentum that capitalizes on the vast efforts to expand treatment options for stroke patients over the past three decades. Similar to informed consent by our patients, our informed medical therapeutic decision-making in endovascular therapy is contingent on data that are now increasingly available. It is no longer acceptable to reduce extensive datasets to identify singular variables such as time to treatment in disregard for baseline pathophysiology when the potential of big data allows us to refine endovascular therapy based on sophisticated informatics. Further progress in endovascular stroke therapy will emerge from the data science of imaging for patient selection, systems
engineering and practical implementation of such stroke care across various geographical regions.

Financial & competing interests disclosure
The author has no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

References