Editorial

Healthcare utilization trends in lumbar disc replacement: population-based administrative data

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In the paper entitled "*National trends in the utilization of lumbar disc replacement for lumbar degenerative disc disease over a 10-year period, 2010 to 2019*", Upfill-Brown *et al.* conducted a retrospective cohort study using population-based administrative data from the National Inpatient Sample in the United States (1). Authors aimed to determine national trends in lumbar disc replacement and lumbar fusion procedures and investigated the association between surgery type and hospitalization cost, length of stay, non-home discharge destination and complications during initial hospitalization after surgery. They found that the frequency of lumbar disc replacement surgeries decreased between 2010–2013 and remained constant until a slight increase occurred in 2019 (1). Upfill-Brown *et al.* also showed, after propensity score matching, lumber disc replacement patients had significantly lower complication rates, incurred fewer hospital costs and experienced a significantly shorter length of hospital stay than lumbar fusion patients (1).

We commend Upfill-Brown *et al.* for obtaining a large, nationally representative sample of over 8,000 lumbar disc replacement patients. Authors accessed data which contain hospitalization information from over 40 states and cover more than 95% of the population (1). Use of administrative data offered a clear advantage over relying on clinical trial data in that real-world surgical trends were obtainable and generalizable. We also congratulate authors on their use of propensity score matching to balance numerous patient baseline characteristics across lumbar fusion and lumbar disc replacement groups. This method of controlling for confounding is especially relevant in the lumbar degenerative disc disease setting where physicians may recommend a specific type of surgery based on certain patient characteristics, which themselves could be associated with surgical outcomes.

There are limitations to the study conducted by Upfill-Brown *et al.*, notably that outcomes were assessed short-term between surgery and initial hospital discharge. This precluded the assessment of reoperations, an outcome that helps address long-term patient safety in the spinal surgery setting. Compared to incident surgeries, reoperations are more than twice as likely to result in complications for lumbar fusion patients (2) and, in severe cases, can lead to the removal of lumbar disc implants (3). The collection of long-term follow-up data is warranted to investigate differences in reoperation rates between lumbar fusion and disc replacement. According to a meta-analysis of randomized controlled trials assessing outcomes five-year post-spinal surgery, relative risk of reoperation has been shown to be 48% lower for lumbar disc replacement versus fusion (4). This suggests that benefits of disc replacement are revealed years after surgery, which highlights the importance of collecting and analyzing long-term data for these procedures.

The study was also constrained in the evaluation of costly resources used long-term by patients. For example,

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long-term post-operative opioid use by patients undergoing spinal surgery (which was not evaluated by Upfill-Brown *et al.*) could be as high as 52% (5). Research has also shown that many spinal surgery patients chronically use opioids long-term after operations; a study of workers' compensation subjects who underwent lumbar fusion in the United States showed that over 50% of patients were chronic opioid users 3-year post-surgery, and these patients had almost $30,000 greater medical costs per person than non-chronic users (6). This suggests that the financial burden of spinal surgery on healthcare systems may persist beyond initial hospitalization, in part due to the long-term use of opioids by patients.

Furthermore, the burden of patient complications occurring after surgery until initial hospital discharge may have been underestimated by Upfill-Brown *et al.* We assume in-hospital complication rates were captured 3.51 [standard deviation (SD): 2.73] and 2.59 (SD: 1.84) days after surgery for fusion and disc replacement patients, respectively, based on mean hospital length of stay (1). However, this follow-up time may have been too brief; a previous observational study on lumbar fusion spinal surgery patients in the United States showed that complication rates rose from 14% immediately after surgery to almost 25% at 30 days post-operation, with the greatest increases in complication frequencies occurring between 10 and 20 days post-surgery (7).

Lastly, there were confounders unevaluated in the study that may have biased analytical associations between surgery type and study outcomes. Although Upfill-Brown *et al.* accounted for certain pre-operative patient conditions co-occurring with lumbar degenerative disc disease using the Elixhauser index, a diagnosis not captured was spondylolisthesis (1). Up to 33% of lumbar fusion surgical patients may have this condition (8), whereas spondylolisthesis contraindicates lumbar disc replacement (1). Moreover, spondylolisthesis patients undergoing lumbar fusion revisions have been shown to have 3.4 times greater odds of achieving clinical improvement after surgery (9). Therefore, there is evidence that spondylolisthesis is related both to the type of surgery a patient receives and post-operative outcomes and may have confounded the observed relationships in the study conducted by Upfill-Brown *et al.* Other variables associated with spinal surgery outcomes not captured in the study included pre-operative physical disability and the type of surgical approach used (anterior, lateral or posterior) (10,11). However, it is unclear whether these patient and surgical characteristics are considered by surgeons when recommending a surgery, since most studies evaluating lumbar fusion and lumbar disc replacement have been randomized controlled trials (where patients are allocated to a surgery type by investigators).

The results in the study of Upfill-Brown *et al.* are consistent with those found in the literature in that lumbar disc replacement shows advantages over lumbar fusion with respect to fewer complications, reoperations, and costs. Despite these promising results, lumbar disc replacement is not commonly conducted in the United States; Upfill-Brown *et al.* showed less than 1% of surgeries performed in 2019 to treat lumbar degenerative disc disease were disc replacement procedures (1). Authors suggested physician concerns with long-term surgical complications and reoperations may partly account for low procedural uptake, although these apprehensions are difficult to explain given the results of quantitative research in this setting (1). To further rationalize the low number of lumbar disc replacements performed by surgeons, qualitative research could be conducted to better understand clinician perspectives impacting their surgical recommendations. Another partial explanation for low uptake may relate to the financial burden placed on patients by their choice of lumbar disc replacement, in that only three of the 14 major health insurers in the United States cover this procedure (1). A possible reason for this lack of coverage could be that few observational studies have assessed the incremental financial benefits of lumbar disc replacement over lumbar fusion, which may be of interest to insurance companies aiming to base coverage decisions on real-world data. One European prospective cohort study showed hospital costs of primary surgery and subsequent revisions were 35% higher for patients undergoing lumbar fusion versus disc replacement surgery (12). However, the costs of resources often used by spinal surgery patients such as drugs, and rehabilitation and physiotherapy services were not assessed (6,13). A future study in the lumbar degenerative disc disease setting could use administrative-level data to conduct an economic evaluation on lumbar disc replacement versus lumbar fusion and comprehensively assess healthcare costs.

In sum, the study by Upfill-Brown *et al.* used a large, nationally representative administrative-level patient sample to uncover recent, generalizable trends in the lumbar disc replacement surgery setting and suitably used propensity score matching to control for confounding. However, important confounding variables may have been overlooked in the assessment of associations between surgery type and

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patient outcomes. Additionally, the short-term assessment of outcomes prevented the ascertainment of data on reoperations, post-discharge complication rates, and opioid use. Upfill-Brown *et al.* showed that, while rates of lumbar disc replacement surgery increased in 2019, overall uptake of the procedure remained low, despite previous clinical research showing benefits of disc replacement over lumbar fusion (1). Further research is needed to understand the reasons behind low uptake among physicians; with this knowledge, quantitative research can be designed specifically to address physician concerns to help ensure the continual improvement of treatment options for lumbar degenerative disc disease.

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