Expanding RN Scope of Practice to Include Lumbar Puncture

A quality improvement initiative helps nurses gain new practice skills while improving patient access to specialty care.

ABSTRACT

The competing demands of caring for high-acuity patients, reducing health care costs, and improving access to specialty care are complex challenges facing all health care providers. One approach—empowering nurses to expand their scope of practice—has been successfully employed for two decades by the nurse and physician leadership of a neurology department in an urban academic medical center. This article discusses the department’s implementation of a quality improvement initiative to enhance access to neurology services in an ambulatory clinic by extending nursing practice to include lumbar puncture. Outcomes data from 2005 to 2016 demonstrate that through the department’s comprehensive instructional program, RNs have competently and safely acquired new skills that have led to an expansion of their traditional roles, improved patient access to specialty care, and reduced costs.

Keywords: lumbar puncture, neurology, nursing, quality improvement, spinal tap

The competing demands of caring for high-acuity patients, reducing health care costs, and improving access to specialty care are complex challenges facing all health care providers. One approach—empowering nurses to expand their scope of practice—has been successfully employed for two decades by the nurse and physician leadership of a neurology department in an urban academic medical center. This article discusses the department’s implementation of a quality improvement initiative to enhance access to neurology services in an ambulatory clinic by extending nursing practice to include lumbar puncture. Outcomes data from 2005 to 2016 demonstrate that through the department’s comprehensive instructional program, RNs have competently and safely acquired new skills that have led to an expansion of their traditional roles, improved patient access to specialty care, and reduced costs.

BACKGROUND

Lumbar puncture has been widely practiced since the late 1800s. The most notable contributor to the practice was Heinrich Irenaeus Quincke, who identified the usefulness of lumbar puncture as a diagnostic tool in clinical practice. The indications for lumbar puncture are numerous, and the collection of cerebral spinal fluid is the only way to diagnose certain diseases.

In 1982, a sister hospital within the Mayo Clinic Health System, located in Rochester, Minnesota, pioneered the practice of RN-performed lumbar puncture.
in the ambulatory setting. Lumbar puncture was not, however, a traditionally recognized nursing practice at our urban academic medical center, which is part of the Mayo Clinic Arizona campus in Phoenix/Scottsdale and provides acute and ambulatory care services across several specialties. This changed in the late 1990s, when a collaborative effort between physicians and nurses in the Department of Neurology led to the development of a comprehensive instructional program for RNs to perform lumbar puncture. The department's physician chair and nurse manager led this QI initiative, which was designed to ensure that the training program and competency validation were consistent with medical education standards. The impetus was to delegate lumbar puncture to RNs, thus enabling physicians to see more patients in the department's ambulatory clinic.

The effort began with a proposal brought to our institution's clinical practice committee (made up of physicians, the chief nursing officer, and administrators, including nurse administrators) for approval. The chief nursing officer and nurse manager then approached the Arizona State Board of Nursing to request an advisory opinion, which would serve as an official opinion regarding diagnostic lumbar puncture as a nursing practice in our state. This process consisted of providing the board with information from the literature and regarding the standard of care, both locally and nationally; any existing statements or opinions from professional organizations; and details about training requirements. The proposal was endorsed by our state board of nursing, and our nursing leadership and a board member collaborated to draft the advisory opinion. The draft was reviewed at the next board meeting, subsequently approved and published, acknowledging that lumbar puncture was within nurses’ scope of practice and in accordance with our state’s nurse practice act.7

In 1998, our institution wrote its policy regarding this practice. We had the advantage of being able to adopt the program used by our sister hospital, modifying it based on the Arizona State Board of Nursing’s advisory opinion. One year later, RNs began performing diagnostic lumbar puncture in the ambulatory setting. Physicians, fellows, and residents continue to perform therapeutic lumbar puncture in our ambulatory clinic and for all inpatients.

In 2016, the advisory opinion came up for a scheduled review. We were not able to find information in the literature regarding lumbar puncture as a nursing practice, and few state boards of nursing recognize the practice. (Nurses in Mayo Clinic facilities in Rochester, Minnesota, and Jacksonville, Florida, perform lumbar puncture, and the state boards of nursing in those states and ours recognize this practice.) For this reason, the Arizona State Board of Nursing asked our nursing leadership to present outcomes data in support of the practice and to share information about our initiative. We provided the state board of nursing with data from 2005 to 2016, capturing practice trends and the effect of staff turnover. This article discusses the implementation of this QI initiative. The comprehensive instructional program we instituted is described, as are the outcomes data we collected and presented to the Arizona State Board of Nursing during its advisory opinion review.

METHODS

Within the Department of Neurology’s ambulatory clinic, the decision to perform a lumbar puncture is made by the consulting physician, who places the order for an RN to perform the procedure. Clinical problems that warrant diagnostic lumbar puncture include migraine, headache, and other headache complaints; movement disorders; cognitive impairment; suspected bacterial or viral infections; myopathies and neuropathies; neurodegenerative diseases; fever; and cancer-related conditions. The department is generally staffed by 32 neurologists, 10 residents, three fellows, five NPs, 16 RNs, and five LPNs. Currently, three RNs are deemed competent to perform lumbar puncture.

Intervention. The comprehensive instructional program developed by our department evaluates competency in performing lumbar puncture through a three-step process (see Attaining Lumbar Puncture Competency). To be selected to take part in this program, a nurse must be interested in obtaining
Attaining Lumbar Puncture Competency
A comprehensive instructional program for RNs.

Step 1: Course of instruction
- Independent review of study materials
- Anatomy and physiology of the brain, spine, spinal cord, and meninges
- Indications and contraindications for performing lumbar puncture
- Complications and adverse effects associated with lumbar puncture
- Nursing care responsibilities and documentation
- Patient education
- Managing comfort, pain, and sedation
- Pharmacology
- Laboratory and radiology data
- Didactic lumbar puncture course led by a neurologist to reinforce study materials and answer questions
- Psychomotor skill and technique training
- Review instructional video, “How to Perform a Lumbar Puncture”
- Observe at least five lumbar puncture procedures performed by a Department of Neurology physician or an RN competent in lumbar puncture on patients of various sizes and in various positions

Step 2: Competency examination
- Test consists of 50 multiple-choice questions
- Score of at least 80% is required before RN can begin supervised practice

Step 3: Supervised lumbar puncture
- RN must complete five lumbar puncture procedures under the direct supervision of a Department of Neurology physician
- RN must complete another 45 lumbar puncture procedures supervised by either a Department of Neurology physician or an RN competent in lumbar puncture
- Competency validation tool is used to document the 50 supervised lumbar punctures performed by the nurse
specimen, success rate data were monitored through chart review. A successful attempt was defined as the nurse’s ability to collect the cerebral spinal fluid specimen in one or two attempts. If the RN could not obtain a fluid specimen in two attempts, the patient was referred to the radiology department for fluoroscopy-guided lumbar puncture. Postprocedural complication rates were monitored. Complications included post-lumbar puncture headache, infection, bleeding, cerebral herniation, minor neurologic symptoms, and back pain.

**Analysis.** The purpose of the data analysis was to identify trends that would indicate the potential for patient harm and thus require revising the instructional program or evaluating the procedural technique.

**Ethical considerations.** The QI initiative was reviewed and deemed exempt from oversight by our medical center’s institutional review board.

**RESULTS**

From 2005 to 2016, a total of 3,175 patients had lumbar puncture performed by a nurse at our clinic. Demographic data are summarized in Table 1. Of these RN-performed lumbar puncture procedures, 3,029 (95.4%) were successful (see Figure 1). No adverse events were reported that were related to infection, bleeding, cerebral herniation, minor neurologic symptoms, or back pain. A common postprocedural lumbar puncture complication, post–lumbar puncture headache, was reported in 217 or 6.8% of patients (see Figure 2). Interventions included administering over-the-counter medications or fluids, promoting rest, and treatment with an epidural blood patch.

A lumbar puncture appointment is usually scheduled for 60 minutes. New evaluation appointments and consultations with the department’s neurologists are scheduled for 60 minutes, and return-visit appointments with these specialists are scheduled for 30 minutes. Therefore, a neurologist can potentially provide one consultation or evaluation or two return-visit appointments in the hour it takes to perform a lumbar puncture. Since this program was implemented, RN-performed lumbar punctures have resulted in the availability of 3,175 additional physician-hours.

**DISCUSSION**

This comprehensive instructional program sufficiently prepares nurses to integrate the knowledge, skills, ability, and judgment required to perform a lumbar puncture safely and competently. Data analysis showed a high rate of successful attempts with a low postprocedural complication rate for RN-performed lumbar puncture. These findings support nurses’ contributions to providing cost-effective care and improving access to specialty neurology care while providing favorable patient outcomes.

**Successful attempt rates.** An extensive review of the literature yielded only one retrospective study addressing lumbar puncture attempt rates by physicians. In that study of 326 patients, 81% of attempted lumbar puncture procedures were successfully completed by resident physicians, postresidency physicians, and new physicians. The nurses in our department had an overall successful attempt rate of about 95% from 2005 to 2016. During 2012 and 2013, however, a considerable decrease in the number of successful lumbar punctures occurred. We determined that this was because of staff turnover and the need to train new nurses in the lumbar puncture technique. As new learners, these RNs performed similarly to the new physicians in the above-mentioned study, demonstrating that continued practice is necessary.

**Table 1. Demographic Data (N = 3,175)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1,760 (55.4)</td>
</tr>
<tr>
<td>Male</td>
<td>1,415 (44.6)</td>
</tr>
<tr>
<td><strong>Reason for lumbar puncture</strong></td>
<td></td>
</tr>
<tr>
<td>Migraine, headache, or other headache-like symptoms</td>
<td>629 (19.8)</td>
</tr>
<tr>
<td>Myopathy or neuropathy</td>
<td>568 (17.9)</td>
</tr>
<tr>
<td>Movement disorder</td>
<td>418 (13.2)</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>339 (10.7)</td>
</tr>
<tr>
<td>Neurodegenerative disease</td>
<td>268 (8.4)</td>
</tr>
<tr>
<td>Bacterial or viral infection</td>
<td>246 (7.7)</td>
</tr>
<tr>
<td>Normal pressure and other hydrocephalus-like findings</td>
<td>235 (7.4)</td>
</tr>
<tr>
<td>Other, including research study patients</td>
<td>145 (4.6)</td>
</tr>
<tr>
<td>Abnormal radiologic imaging</td>
<td>99 (3.1)</td>
</tr>
<tr>
<td>Cancer-related disease</td>
<td>94 (3)</td>
</tr>
<tr>
<td>Optic or vision-related complaint</td>
<td>73 (2.3)</td>
</tr>
<tr>
<td>Seizure disorder</td>
<td>48 (1.5)</td>
</tr>
<tr>
<td>Fever</td>
<td>13 (0.4)</td>
</tr>
<tr>
<td>Age, mean years (SD)</td>
<td>54.8 (16.6)</td>
</tr>
</tbody>
</table>
Complication rates. The complications associated with lumbar puncture include post–lumbar puncture headache, which Harley and colleagues note is the most commonly cited postprocedural complication, estimated to occur in 30% to 60% of patients.\textsuperscript{10} Complication rates such as these, however, indicate average risks.\textsuperscript{11} Meningitis is a rare complication of lumbar puncture.\textsuperscript{12} Patients who have thrombocytopenia or other bleeding disorders are at increased risk for developing a spinal hematoma after lumbar puncture.\textsuperscript{13} Cerebral herniation is a rare but fatal outcome.\textsuperscript{14} Post–lumbar puncture headache, for instance, occurred in less than 7% of patients who had an RN-performed lumbar puncture at our clinic. This is a significantly lower percentage than the range cited by Harley and colleagues, perhaps because of the different patient populations studied.\textsuperscript{10,15}

Procedural technique may also have contributed to the lower post–lumbar puncture headache rates in our clinic. Our clinicians use a small-bore (20-to-22-gauge) beveled needle that is inserted with the bevel parallel to the long axis of the spine and replacing the stylus before withdrawing the needle contributes to a lower incidence of post–lumbar puncture headache.\textsuperscript{15} It has been asserted recently by Nath and colleagues that the use of atraumatic needles when performing lumbar puncture may reduce the incidence of postprocedure headache.\textsuperscript{16} However, when our department conducted a trial of the use of atraumatic needles in 2015, we found that use of these needles led to an increase in the incidence of post–lumbar puncture headache, whereas the use of beveled needles did not.

Cost. Nurses performing diagnostic lumbar puncture can help to reduce the cost of the procedure. According to the U.S. Department of Labor, the mean annual salary for RNs is $72,180 (or $34.70 per hour), whereas physicians’ salaries average $205,560 (or $98.83 per hour).\textsuperscript{17,18} Therefore, based on salary alone, there is a 65% cost reduction associated with RN-performed lumbar puncture. In our department, the nurses and physicians bill under the same Current Procedural Terminology codes, so they are reimbursed at the same rate. The time allotted for a lumbar puncture appointment is 60 minutes regardless of which provider performs the procedure.
The total cost of training one nurse to perform lumbar puncture is approximately $4,324.77. This total, calculated using the mean hourly RN ($34.70) and physician ($98.83) pay rates, is based on several factors: four hours of education and 50 hours of supervised lumbar puncture performance ($1,873.80); clinical staff time that includes four hours of education and five hours of lumbar puncture supervision by a neurologist ($889.47); and 45 hours of practice supervised by a nurse competent in lumbar puncture ($1,561.50). If a nurse is reimbursed at the mean hourly rate of $34.70 for performing this one-hour procedure, she or he would need to complete 125 lumbar punctures for the facility to recoup its training costs (this number is calculated by dividing the total training costs by the average hourly RN reimbursement rate). Managing RN turnover is thus crucial to curtailing training costs.

**Turnover rates.** According to the 2017 National Health Care Retention and RN Staffing Report, the RN turnover rate in 2016 in the region in which our state is located was 18.4%. Collins and colleagues have suggested that strategies to decrease RN turnover include innovation, autonomy, recognition, achievement, and the ability to grow. We believe that creating an institutional culture to advance nursing practice contributes to a lower turnover rate. Nurses who perform lumbar puncture are recognized by our institution as experts in this practice, which is validated by our outcomes data.

**Limitations.** The context of this QI initiative is ambulatory practice, and the initiative has not been evaluated in the inpatient setting. However, inpatient demand for this practice is growing exponentially. The changing complexity of the health needs of inpatients has led to an increase in the number of diagnostic lumbar punctures performed. Future initiatives are needed to evaluate this nursing practice outside the ambulatory setting, such as in acute care or emergency nursing.

Patient-experience data specific to this QI initiative were not collected. Although we have received no negative reports from patients about nurses performing lumbar puncture, this qualitative information may benefit future initiatives.

**CONCLUSIONS**

The Arizona State Board of Nursing renewed its advisory opinion about nurse-performed lumbar puncture in March 2017 with the following recommendations:

---

**Figure 2.** Incidence of Post–Lumbar Puncture Headache After RN-Performed Lumbar Punctures, 2005–2016
it limited the procedure to adult patients only, required informed consent, and expanded RN educational requirements regarding specific adverse effects or complications of the procedure. These learning requirements now include information about intractable postprocedural headache, drainage from the lumbar puncture site, a dural tear that requires a patch or closure, spinal hematoma requiring emergent surgical evacuation, infectious meningitis, and transient lower extremity pain. The board also commended our program for becoming the gold standard for this practice. Nurses in our department’s ambulatory clinic now perform an average of 280 lumbar punctures annually. They have maintained an overall success rate of about 95% and a complication rate of 6.8% for post–lumbar puncture headache, and no adverse events have been reported.

Our experience, particularly in terms of the partnership with our state’s board of nursing and collaboration between the nurses and physicians in our department, has enhanced nursing practice by fostering innovation and autonomy. Although our project was specific to an ambulatory neurology clinic, we believe the framework can be used in other facilities and states to further expand nurses’ scope of practice to include lumbar puncture and other procedures, such as bone marrow biopsies and punch-and-shave skin biopsies, which are already performed by nurses at our institution. The outcomes presented in this article highlight the importance of leveraging nurses’ scientific knowledge and adaptive capacity to promote greater nurse autonomy while simultaneously improving patient access to specialized care and reducing health care costs. ▼

Jennifer Ernst is a clinical nurse specialist in the Department of Nursing at the Mayo Clinic in Scottsdale, AZ, where Catherine R. Youse is a nurse administrator. Christine D. Aliory is an RN in the Department of Nursing at the Mayo Clinic Hospital in Phoenix. The authors wish to thank Michelle A. Larson, DNP, RN, NE-BC, for assistance with data analysis and Jennifer M. Hart, RN, PCCN, for assistance with data mining. Contact author: Jennifer Ernst, ernst.jennifer@mayo.edu. The authors have disclosed no potential conflicts of interest, financial or otherwise.

REFERENCES