Comparison Study

Pain Medicine Board Certification Status Among Physicians Performing Interventional Pain Procedures in the State of Florida Between 2010 and 2016

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Background: The US Department of Health and Human Services has recommended that physicians performing interventional pain procedures be credentialed based on criteria-based guidelines and minimum training requirements.

Objectives: To quantitatively assess gaps in certification related to pain medicine fellowship requirements, we studied the distribution of such procedures in Florida between 2010 and 2016.

Study Design: This research involved a retrospective analysis with a sample size of n = 1,885,442 interventional pain procedures.

Setting: Data describing interventional pain procedures performed in Florida between January 2010 and December 2016 were obtained from the Florida Department of Health. The National Provider Identifier file and board certification lists from the American Board of Medical Specialties (ABMS), the American Board of Pain Medicine (ABPM), and the American Board of Interventional Pain Physicians (ABIPP) corresponding to this time frame were also obtained.

Methods: The datasets were linked to determine the specialty of physicians performing interventional pain procedures, and whether or not they were pain medicine diplomates of the ABMS, the ABPM, or the ABIPP. The similarity index Θ was calculated for the distribution of interventional pain procedure codes among medical specialty groups, and with respect to the practitioners' pain medicine board certification status.

Results: Of the interventional pain procedures, anesthesiologists performed 63.5%, physiatrists 19.1%, neurologists or psychiatrists 5.2%, and other practitioners 12.3%. Among procedures performed by anesthesiologists, physiatrists, and psychiatrists or neurologists, 66.2%, 50.3%, and 50.4% were by ABMS pain board-certified practitioners, respectively. Practitioners without ABMS pain medicine boards performed 45.8% of interventional pain procedures. Practitioners without such boards from either the ABMS, ABPM, or ABIPP performed 37.7%. There was very large similarity ($\Theta > 0.9$) in the distribution of procedures comparing ABMS pain medicine board-certified practitioners to non-ABMS pain medicine board-certified anesthesiologists, physiatrists, or all other specialties.

Limitations: In countries other than the United States, where pain medicine board certification is relatively recent, there may be a higher percentage of interventional pain procedures performed by individuals without certification than we report. In "opt-out" states, where nurse anesthetists can independently perform interventional pain procedures, the percentage of interventional pain procedures performed by individuals without physician pain medicine board certification may also be higher. The datasets we used do not contain information to allow assessment of outcomes or effectiveness resulting from pain medicine board certification.

Conclusions: Approximately one-third of interventional pain procedures were performed by physicians without at least 1 of the 3 pain medicine board certifications. In addition, the practitioners performed very similar distributions of procedures (i.e., those without pain medicine board certification, overall, have not restricted their practice). These results suggest the need for additional accredited pain medicine fellowship training positions for newly graduated residents.

The results also show that, for the recommendations of the Department of Health and Human Services to be satisfied, physicians without board certification performing intervention procedures would need to obtain ABPM or ABIPP certification, or ABMS certification after completion of a full-time Accreditation Council of Graduate Medical Education pain medicine fellowship.

Key words: Chronic pain, education, medical, graduate, specialty boards

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The Office of the Assistant Secretary of Health of the US Department of Health and Human Services has identified several gaps related to the performance of interventional pain procedures (1). Their recommendations included the following, quoted directly:

- Only clinicians who are credentialed in interventional pain procedures should perform interventional procedures.
- Establish criteria-based guidelines for properly credentialing physicians who are appropriately trained using interventional techniques to help diagnose, treat, and manage patients with chronic pain.
- Establish credentialing criteria for minimum requirements for training physicians in interventional pain management.
- Clearly identify physicians who specialize in pain management by their training. This identification should be determined by Accreditation Council of Graduate Medical Education [ACGME]-accredited pain medicine programs and by well-recognized credentials, such as the American Board of Pain Medicine [ABPM] and the American Board of Interventional Pain Physicians [ABIPP].

Board certification for pain medicine currently can be obtained from 3 certifying boards: the American Board of Medical Specialties (ABMS), the ABPM, and the ABIPP. The ABMS, through the American Board of Anesthesiology, the administering board, has required specialized fellowship training since 2000 (2). In contrast, the ABPM and the ABIPP do not have fellowship requirements, with board certification in pain medicine based on documentation of relevant clinical practice and passage of a knowledge-based examination. Both the ABPM and the ABIPP require candidates to hold ABMS certification in a primary specialty to be eligible for board certification in pain medicine (3,4).

The ABMS is the largest grantor of board certification in pain medicine. The ACGME and individual pain medicine fellowship programs need to estimate how many trainee positions are necessary to match the needs of the public for interventional pain medicine specialists. Based on the Department of Health and Human Services' fourth recommendation (see earlier text), the unmet needs for more fellowship-trained physicians can be assessed using the percentage of care being provided to patients by practitioners without board certification in pain medicine. ACGME-accredited pain medicine programs have the challenge that fellows come from different primary specialties (e.g., anesthesiology, physical medicine and rehabilitation, neurology, and psychiatry).

Because one of the critical competencies in pain medicine is achieving competency in performing interventional pain procedures, the ACGME pain medicine fellowships are typically run by departments of anesthesiology (91 of 103 programs listed as of 2019) (5). In addition, the American Board of Anesthesiology is the administering ABMS medical board, developing and managing the pain medicine certification examination. We examine in the current study whether, in practice, after ABMS pain medicine certification, diplomates from the various primary specialties engage in the performance of such procedures equally often and in similar relative distributions.

Methods

The University of Miami institutional review board determined that this study does not constitute human subject research, pursuant to 45 Code of Federal Regulations 46, on January 9, 2019. In conducting this study, we followed the Reporting of Studies Conducted using Observational Routinely-Collected Health Data (RECORD) statement (6).

Overview of Data Used

The database used comprised 7 years of deidentified outpatient data from all nonfederal health care

facilities in the state of Florida. We used the National Provider Identifier (NPI) for the provider identified as performing each interventional pain procedure to merge the patient visit data with lists of pain medicine board certification. Florida was suitable for this study because its data included not only hospital-owned facilities but also nonhospital-affiliated ambulatory surgery centers and physician offices. Following the Department of Health and Human Services' recommendations (i.e., bulleted items earlier in the text), we evaluated results based on the physicians' pain medicine board certification status.

Specific Data Sources

This retrospective study was performed using the quarterly public-use dataset files for all ambulatory and outpatient surgical procedures (including pain- and nonpain-related interventions) performed in the state of Florida from 2010 through 2016 (7). There were n = 32,997,229 rows in the main table (each representing a unique patient visit) and n = 100,401,305 rows of procedures (including both interventional pain and other surgical procedures) in the linked procedural table. We limited our analysis to data starting in 2010 because ambulatory procedure reporting in Florida prior to that year was optional and substantively incomplete. Statewide reporting became mandatory in the first quarter of 2010. The datasets were licensed from the Agency for Health Care Administration, Florida Center for Health Information and Transparency, and work was performed pursuant to a data use agreement dated May 18, 2017. Supplementary datasets used to perform the current study included the NPI database file (n = 5,756,857 rows) (8), the Current Procedural Terminology Fourth Edition (CPT) surgery codes (n = 5367 rows) (9), and the Center for Medicare and Medicaid Services health care provider taxonomy codes (n = 856 rows) (10). All data files were uploaded into a Microsoft SQL Server database (Microsoft Corporation, Redmond, WA) for analysis.

Encounter Inclusion and Exclusion Criteria

The ambulatory data files provide information for each outpatient patient encounter, including the NPI of the operating or performing provider ("practitioner") and the CPT or Healthcare Common Procedure Coding System codes (11) of all procedures performed during the encounter. Because NPIs are unique and persistent over time, this allowed identification of the procedures performed by each practitioner. Encounters were excluded if any of the CPT codes on the single day of the encounter had a "SurgeryCode" value = 2, indicating that a major therapeutic procedure was performed. We excluded these encounters because our focus was on interventional pain procedures performed for chronic pain, and it was unlikely that a patient would undergo an interventional pain procedure and a nonpain-related surgical procedure on the same day. We matched the CPT codes to the list of procedures performed for the treatment of chronic pain conditions, as previously described (Table 1, Supplemental Table S1) (12). Each such procedure was included separately in the analysis, attributed to the NPI of the operating or performing practitioner. For example, if a patient underwent 2 interventional pain procedures during an encounter, there would be 2 rows in the study dataset, and thus 2 procedures counted as having been performed. Consequently, we were studying the numbers and types of procedures performed, not the number of patients treated.

Determination of the Specialty of Practitioners

The NPI of the performing practitioner was linked to the NPI database, which provided information on the name associated with the NPI (which could be an individual health care provider, a facility, or a professional corporation) and up to 15 self-reported Healthcare Provider Taxonomy Codes (for example, one practitioner might have listed the following taxonomies: Other Service Providers, Specialist, Allopathic and Osteopathic Physicians, Pain Medicine, Interventional Pain Medicine; another practitioner might have listed Allopathic and Osteopathic Physicians, Anesthesiology, Allopathic and Osteopathic Physicians, Pain Medicine). If any of the health care provider taxonomy codes indicated that the practitioner was an anesthesiologist, he or she was classified as such. In rare circumstances (< 1% of the total number of unique NPIs in the studied dataset) in which the taxonomy codes did not provide sufficient information to determine the specialty of the practitioner (e.g., an organizational NPI was listed), the website for the National Plan and Provider Enumeration System (13) was queried to determine if an individual was associated with the organizational NPI. For example, if the organizational NPI included the name of a physician and a corporate designation (e.g., John Q. Smith, MD, PC), the NPI of the listed physician (i.e., John Q. Smith, MD) was used to determine the specialty. If the taxonomy codes were ambiguous as

Table 1. *Interventional pain procedures performed with a prevalence of at least 0.5% of the total (n = 1,885,442).*

CPT Code	Description	Prevalence (SE) %	Low-Back Pain Injection Procedure?*
62311	Lumbar epidural	20.47 (0.03)	Y
64483	Lumbar or sacral transforaminal epidural injection, with imaging guidance, 1st level	17.94 (0.03)	Y
64493	Paravertebral facet joint or facet joint nerve; lumbar/sacral, 1st level	12.09 (0.02)	Y
64484	Lumbar or sacral transforaminal epidural injection, with imaging guidance, each additional level	10.63 (0.02)	Y
62310	Cervical or thoracic epidural	8.02 (0.02)	N
62623/64636	Paravertebral facet joint neurolysis; lumbar/sacral, each additional level	5.92 (0.02)	Y
62622/64635	Paravertebral facet joint neurolysis; lumbar/sacral, single level - neurolysis	5.05 (0.02)	Y
64490	Cervical or thoracic facet joint injections, 1st level	4.98 (0.02)	N
64633	Paravertebral facet joint neurolysis; cervical/thoracic, single level	1.75 (0.01)	N
64479	Transforaminal epidural; cervical/thoracic, single level, with imaging guidance	1.18 (0.01)	N
63650	Percutaneous implantation neuro-electrodes	0.94 (0.01)	N
64640	Destruction by neurolytic agents, other peripheral nerve or branch	0.79 (0.01)	N
64450	Other peripheral nerve or branch	0.68 (0.01)	N
64480	Transforaminal epidural; cervical/thoracic, each additional level, with imaging guidance	0.65 (0.01)	N
62264	Percutaneous lysis of epidural adhesions, multiple sessions; 1 day	0.53 (0.01)	N
64520	Injection, lumbar or thoracic (paravertebral sympathetic)	0.50 (0.01)	N

Abbreviation: SE, standard error.
*Procedures involving an injection for relief of low-back pain (62311, 62622, 62623, 64635, 64475, 64483, 64484, 64493, 64636) accounted for 74.2% of the total number of chronic pain injections.

to the specialty of the practitioner (e.g., only listed as "specialist"), then an internet search was performed using demographic information from the NPI database to identify the specialty. If the NPI was for a multidisciplinary practice with several specialties, or if the organization was a surgery center, then the practitioner specialty was classified as unknown. In the state of Florida, only physicians are licensed to perform interventional pain procedures. Thus for tabulation purposes, we categorized each practitioner as an anesthesiologist, physiatrist, neurologist or psychiatrist, orthopedic surgeon, neurosurgeon, or, if the specialty was indeterminant, as a physician in another specialty. Because Florida is not an "opt-out" state with respect to Medicare and Medicaid billing, nurse anesthetists cannot bill independently for interventional pain procedures, unlike in some states (14). Also, advanced practice nurses or physician assistants are not permitted to bill for such interventions. Although there were a few hundred such records in the database with nonphysicians listed as the performing practitioner, these were considered as coding errors and included in the "physician in another specialty" category.

Determination of Practitioners' Pain Medicine Board Certifications

A list of NPIs for all practitioners who performed interventional pain procedures in the Florida dataset was submitted to the ABMS by the primary author (R.H.E.). The ABMS provided a file indicating which practitioners had a subspecialty certification in pain medicine from the ABMS and the date of primary certification (see Acknowledgments). Practitioners not matching the ABMS list were checked against the Web sites of the American Board of Anesthesiology (15), Physical Medicine and Rehabilitation (16), and the combined board for Psychiatry and Neurology to determine if any diplomates had been missed (17). The list of diplomates of the ABPM was downloaded from its Web site (3) and matched to the physicians performing interventional pain procedures in Florida. Similarly, diplomates of the ABIPP were downloaded from its Web site (4) and matched. For matching using the ABPM or ABIPP lists, the names of the practitioners and associated demographic information were used, as NPIs were not provided in the downloaded file. There was some overlap in pain medicine diplomates who had been certified by multiple boards

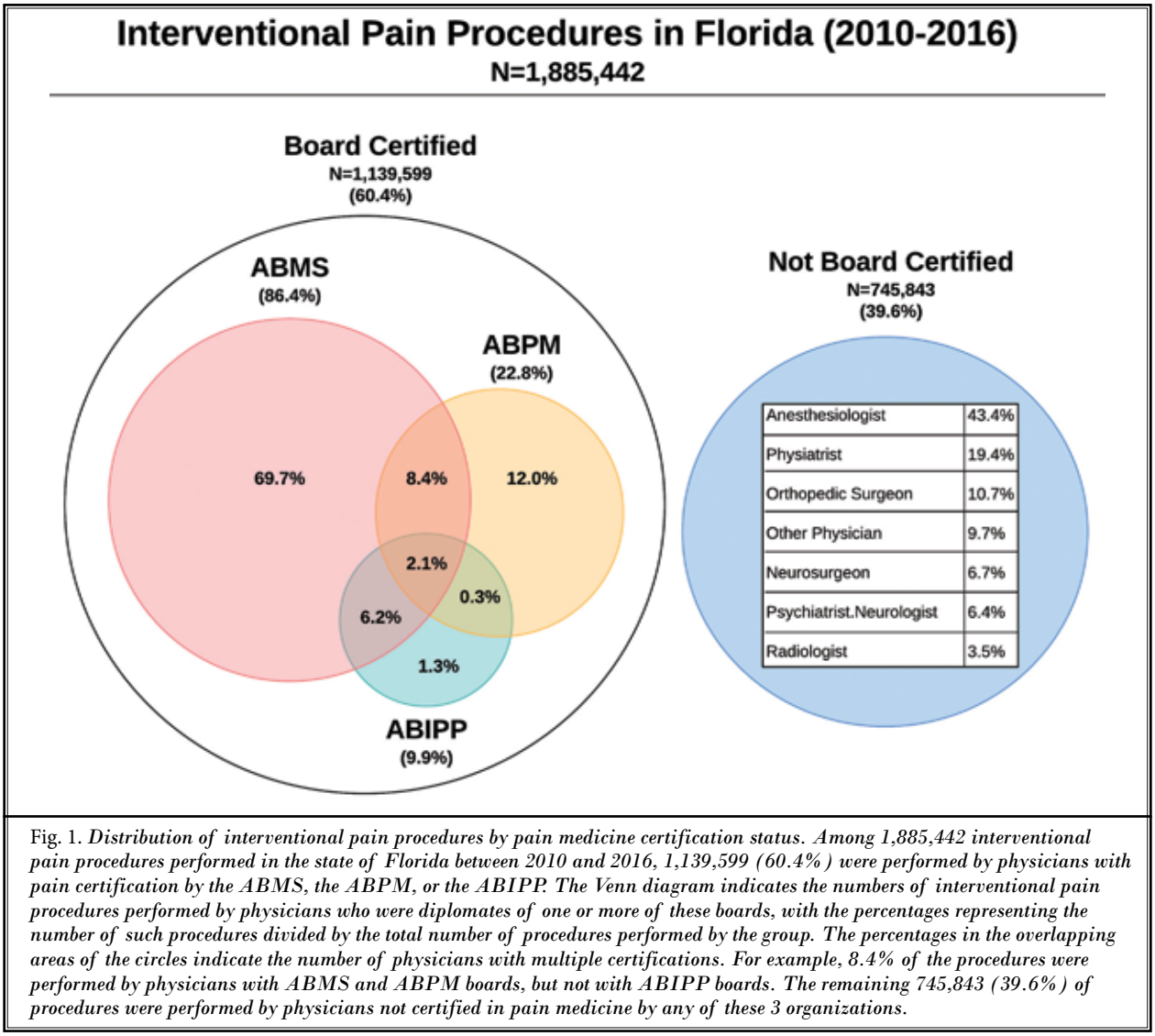

Fig. 1. *Distribution of interventional pain procedures by pain medicine certification status. Among 1,885,442 interventional pain procedures performed in the state of Florida between 2010 and 2016, 1,139,599 (60.4%) were performed by physicians with pain certification by the ABMS, the ABPM, or the ABIPP. The Venn diagram indicates the numbers of interventional pain procedures performed by physicians who were diplomates of one or more of these boards, with the percentages representing the number of such procedures divided by the total number of procedures performed by the group. The percentages in the overlapping areas of the circles indicate the number of physicians with multiple certifications. For example, 8.4% of the procedures were performed by physicians with ABMS and ABPM boards, but not with ABIPP boards. The remaining 745,843 (39.6%) of procedures were performed by physicians not certified in pain medicine by any of these 3 organizations.*

(Fig. 1), but for the purpose of this analysis, all such individuals were included in their respective groups.

Statistical Analysis

The similarity index (Θ), reviewed in a recent statistical grand rounds (18), is a quantitative assessment of the extent to which 2 groups share the same characteristics. The similarity index between 2 groups performing a set of procedures (e.g., physicians with ABMS board certification versus anesthesiologists without board certification in pain medicine) is a pairwise assessment by procedure, like a correlation coefficient (18-23). To understand this index, first envision that an interventional pain procedure was selected at random from among all the procedures performed by practitioners in group A (e.g., ABMS pain medicine board-certified physicians). Then, consider an interventional pain procedure to have been selected from among practitioners in group B (e.g., anesthesiologists without pain medicine board certification) (18). The probability that the 2 selected procedures are of the same type of procedure (i.e., the same CPT code) is the numerator of the similarity index. The denominator normalizes the range to be from 0.0 (when there is no overlap) to 1.0 (when the distribution of types of procedures is identical between groups) (18). Higher values of Θ indicate greater similarity between the groups. Values of the similarity index are characterized as very large

($\Theta > 0.90$), large ($0.80 \leq \Theta \leq 0.90$), moderate ($0.30 \leq \Theta < 0.80$), and small ($\Theta < 0.3$) (18,21). The asymptotic standard error of the similarity index was calculated using equation 20 in Reference 15. Reported standard errors of proportions were asymptotic.

The Mann-Kendall test for trend was used to evaluate changes among years in the number of performed interventional pain procedures, normalized by the annual population of Florida.

Results

Interventional Pain Procedures in the State of Florida

Between January 2010 and December 2016 there were 1,971,556 procedures performed on an ambulatory basis in Florida that matched one of the interventional pain procedure codes listed in Table 1. Of these, 86,114 (4.4%) were excluded because the patient underwent a major therapeutic procedure on the same date as the interventional pain procedure. Consequently, 1,885,442 procedures were attributed to the care of patients with chronic pain. There were no trends over time for an increase or decrease either in the total annual number of procedures performed, adjusted for the yearly state population (24), or in the percentage of procedures (52.3% ± 0.3%) performed by ABMS pain medicine diplomates (Fig. 2). Thus the data were pooled for analysis. Most of the procedures (72.1%; $P < 0.001$ vs. 50%) involved injections for the treatment of low-back pain (Table 1) (25).

Medical Specialties of Practitioners Performing Interventional Pain Procedures

Among the n = 1,885,442 interventional pain procedures analyzed, 63.5% ± 0.04% were performed by anesthesiologists, 19.1% ± 0.03% by physiatrists, 5.2% ± 0.02% by neurologists or psychiatrists, and 12.3%

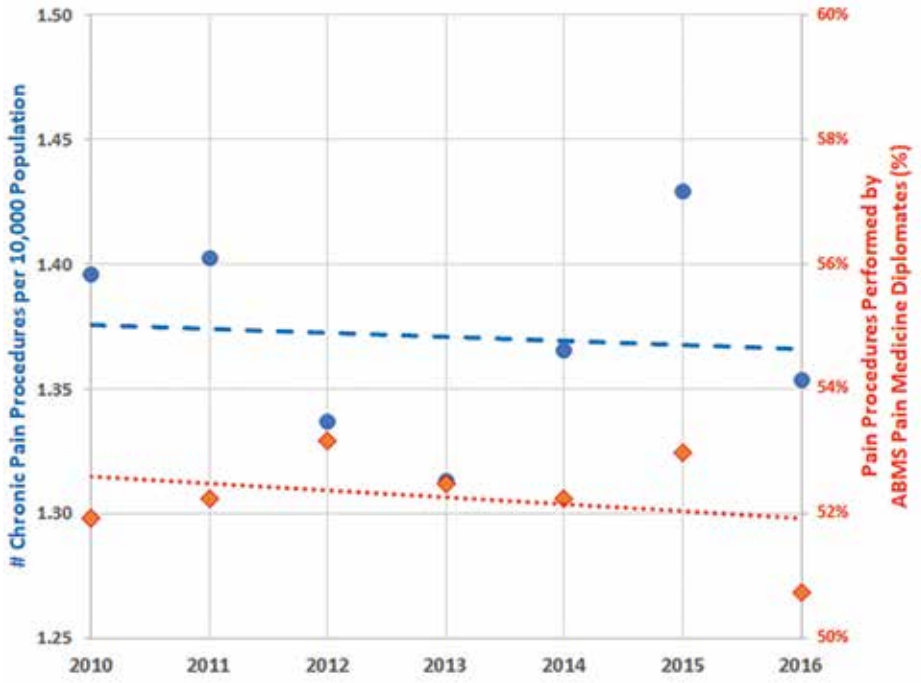

Fig 2. *Interventional pain procedure volume per year in the state of Florida. The numbers of interventional pain procedures performed per 10,000 population each year between 2010 and 2016 on an ambulatory basis were determined among all practitioners (circles, linear regression line as dashed line) and among all American Board of Medical Specialty Pain Medicine diplomates (diamonds, linear regression curve as dotted line). There were no significant trends either upward or downward over time for either variable (each Mann-Kendall P value = 0.5). An average of 269,349 (4,376 standard error) interventional pain procedures was performed yearly, with 52.3% (0.3% standard error) performed by ABMS Pain Medicine diplomates.*

± 0.02% by other physicians. Thus the vast majority of interventional pain procedures in Florida (87.7% ± 0.02%) were performed by practitioners in specialties potentially eligible for board certification in pain medicine by the ABMS. Anesthesiologists who were board certified in pain medicine by the ABMS performed 42.7% ± 0.64% of the total number of interventional pain procedures, whereas anesthesiologists lacking such credentials performed 21.4% ± 0.51% of these procedures. Among physiatrists, the percentages were 9.6% ± 0.59% and 9.4% ± 0.67%, respectively, and among psychiatrists and neurologists, 2.6% ± 0.19%, respectively. The percentage of such procedures performed by ABMS pain medicine diplomates were 66.2% ± 0.04% among anesthesiologists, 50.3% ± 0.08% among physiatrists, and 50.4% ± 0.16% among psychiatrists and neurologists. Overall, 45.8% ± 0.04% of interventional pain procedures were performed in Florida by practitioners who were not ABMS pain medicine diplomates, and 37.7% ± 0.04% by practitioners who were not diplomates of either the ABMS, the ABPM, or the ABIPP.

There were 617 physicians self-designated as a specialist in pain medicine in the NPI database who performed interventional pain procedures in Florida. Among these, 57.2% ± 2.0% were ABMS pain medicine diplomates, and 64.8% ± 1.9% were diplomates of either the ABMS, the ABPM, or the ABIPP. The remaining 35.2% were not board certified by any of these organizations. There were 238 physicians self-identifying as a specialist in interventional pain medicine (i.e., a taxonomy code different from pain medicine). Among these, 55.0% ± 3.2% were diplomates of the ABMS and 66.4% ± 3.1% were diplomates of either the ABMS, ABPM, or the ABIPP. Thus approximately one-third of physicians representing themselves as interventional pain medicine specialists lacked a pain medicine board certification noted as "well-recognized" by the Office of Health and Human Services (1).

In Florida, as of 2016, the ABMS pain medicine diplomates were comprised of 286 anesthesiologists (68.1% of the total), 109 physiatrists (26.0%), and 25 neurologists or psychiatrists (6.0%) (26). There was one family medicine physician, 0 radiologists, and 0 emergency medicine physicians certified as such. We were unable to locate analogous numbers for the medical specialties of ABPM or ABIPP diplomates.

Similarity Between ABMS Diplomates and non-ABMS Pain Medicine Certified Practitioners

We compared the relative distributions of the different types of interventional pain procedures among practitioners performing the procedures. All standard errors were < 0.004 (Table 2), and thus not repeated. There was very large similarity in types of performed procedures among all practitioners with ABMS pain medicine certificates, and those without such certification who were anesthesiologists (Θ = 0.98), physiatrists (Θ = 0.95), or all

Table 2. *Similarity in the distribution of interventional pain procedures performed by practitioners who were board certified in pain medicine by the ABMS and those without such credentials.*

Non-ABMS Group	% of All Procedures*	All ABMS versus Non-ABMS Group		All ABMS versus Non-ABMS Group Excluding Anesthesiologists		All ABMS versus Non-ABMS Group Excluding Anesthesiologists and Physiatrists	
		Similarity Θ†	SE	Similarity Θ†	SE	Similarity Θ†	SE
Anesthesiologist	21.36%	0.98	0.0004				
Physiatrist	9.49%	0.95	0.0009				
Psychiatrist/neurologist	2.56%	0.70	0.0027				
Neurosurgeon	2.68%	0.65	0.0035	0.97‡	0.0005‡	0.93	0.0009
Orthopedic surgeon	4.33%	0.90	0.0017				
Physician (other)	3.86%	0.71	0.0026				
Radiologist	1.39%	0.71	0.0035				

Abbreviation: SE, standard error.

*Percentages of the total number of interventional pain procedures (n = 1,885,442) performed by the non-ABMS certified group.

†The similarity theta (Θ) reflects the extent to which 2 groups are performing the same distribution of procedures. Similarity is classified as very high (Θ > 0.90), high (Θ ≥ 0.80), moderate (0.3 ≤ Θ < 0.80), and low (Θ < 0.3) (18,21).

‡For this comparison, all non-ABMS groups excluding anesthesiologists were combined and compared with all ABMS groups.

other specialties combined (Θ = 0.93). Thus ABMS pain medicine board certification did not change the distribution of the types of procedures performed.

To try to understand better the very large similarities in the relative distributions of types of procedures performed by physicians with and without ABMS pain medicine board certification, we repeated analyses while categorizing types of procedures into those for treatment of low-back pain or for other conditions. With respect to nonlow back interventional pain procedures (Table 3), ABMS pain medicine diplomates had very similar distributions of the various types of procedures compared with nondiplomate anesthesiologists (Θ = 0.97) and nondiplomate physiatrists (Θ = 0.89) (Table 3). For low-back pain interventional pain procedures, there was large similarity between the ABMS pain medicine diplomates and nondiplomates who were anesthesiologists (Θ = 0.99), physiatrists (Θ = 0.97), and orthopedic surgeons (Θ = 0.93), and moderate similarity with the other groups (Table 4). These results suggest a relative uniformity of practice with respect to the types of interventional pain procedures being performed in patients with low-back pain, irrespective of the physician's specialty or APMS pain medicine board certification status (25).

Similarity Between ABMS, ABPM, and ABIPP Pain Medicine Diplomates

To assess the contribution of pain physicians board certified by the ABPM or the ABIPP to the interventional

Table 3. *Similarity in the distribution of interventional pain procedures performed by practitioners who were board certified in pain medicine by the ABMS and those without such credentials, excluding lumbosacral interventional pain procedures.*

Non-ABMS Group	All ABMS versus non-ABMS group (excluding lumbosacral interventional pain procedures, n = 525,484)		
	Similarity Θ*	SE	Procedures Performed by Non-ABMS Group
Anesthesiologist	0.97	0.0008	21.66%
Physiatrist	0.89	0.0028	7.86%
Psychiatrist/neurologist	0.68	0.0068	3.24%
Neurosurgeon	0.36	0.0049	4.57%
Orthopedic surgeon	0.59	0.0066	4.29%
Physician (other)	0.48	0.0059	4.77%
Radiologist	0.16	0.0044	2.23%

Abbreviation: SE, standard error.
*The similarity theta (Θ) reflects the extent to which 2 groups are performing the same distribution of procedures. Similarity is classified as very high (Θ > 0.90), high (Θ ≥ 0.80), moderate (0.3 ≤ Θ < 0.80), and low (Θ < 0.3) (18,21).

Table 4. *Similarity in the distribution of interventional pain procedures performed by practitioners who were board certified in pain medicine by the ABMS and those without such credentials, including only lumbosacral interventional pain procedures.*

Non-ABMS Group	All ABMS versus Non-ABMS Group (only including lumbosacral interventional pain procedures, n = 1,359,958)		
	Similarity Θ*	SE	Procedures Performed by Non-ABMS Group
Anesthesiologist	0.99	0.0004	22.50%
Physiatrist	0.97	0.0007	11.65%
Psychiatrist/neurologist	0.71	0.0032	2.34%
Neurosurgeon	0.78	0.0045	1.95%
Orthopedic surgeon	0.93	0.0017	4.34%
Physician (other)	0.73	0.0030	3.52%
Radiologist	0.78	0.0052	1.06%

Abbreviation: SE, standard error.
*The similarity theta (Θ) reflects the extent to which 2 groups are performing the same distribution of procedures. Similarity is classified as very high (Θ > 0.90), high (Θ ≥ 0.80), moderate (0.3 ≤ Θ < 0.80), and low (Θ < 0.3) (18,21).

Table 5. Similarity for all interventional pain procedures between ABMS diplomates certified in pain medicine and pain physicians with ABPM or ABIPP pain certification.

Non-ABMS Group	All ABMS versus Non-ABMS Group (n = 1,885,442)		
	Similarity Θ*	SE	Procedures Performed by Non-ABMS Group
ABPM, not ABMS	0.82	0.0021	7.27%
ABIPP, not ABMS, not ABMP	0.71	0.0056	0.78%
ABIPP, not ABMS	0.73	0.0050	0.95%

Abbreviation: SE, standard error.
*The similarity theta (Θ) reflects the extent to which 2 groups are performing the same distribution of procedures. Similarity is classified as very high (Θ > 0.90), high (Θ ≥ 0.80), moderate (0.3 ≤ Θ < 0.80), and low (Θ < 0.3) (18,21).

treatment of patients with chronic pain, we compared the similarity among all interventional pain procedures of the ABMS pain medicine diplomates to diplomates of the other 2 pain medicine boards (Table 5). There was moderate similarity in the distribution of the types of interventional pain procedures performed by ABMS pain medicine diplomates and physicians board certified by either of the other organizations (Θ = 0.71-0.82).

Discussion

The primary motivation for our study was to contribute to the assessment of future pain medicine fellowship training workforce requirements, and to identify associations with recommendations by the Department of Health and Human Services regarding certification of interventional pain specialists. Our premise of comparing percentages of cases performed by physicians with and without pain medicine board certification to assess the number of training positions needed is similar to the approach used in evaluating anesthesia workforce needs (27-29).

These data indicate that in the state of Florida between 2010 and 2016, approximately one-third of the interventional pain procedures were performed by physicians who were not certified in pain medicine by the ABMS, the ABPM, or the ABIPP. Although approximately half the physicians performing interventional procedures for chronic pain self-identified as pain medicine specialists, approximately 40% of those physicians were not diplomates of the ABMS, and 35% were not certified by either the ABMS, the ABPM, or the ABIPP. The results of the current study, the previously reported long wait times for initial evaluation of patients in pain clinics, findings for rural hospitals, and the adverse effects of prolonged delays in management of chronic pain indicate that the availability of more board-certified pain medicine physicians would better address the population health demand (14,31,32).

Our findings quantify, for Florida, the gap described qualitatively in the Health and Human Services report, and support their recommendations that more training positions and credentialing of pain medicine physicians are needed (1). We emphasize that our study neither addresses issues related to the appropriateness of the interventional pain procedures that were performed nor outcomes related to the pain medicine board certification status of practitioners. Thus even though many interventional pain procedures are performed by physicians without pain medicine fellowship training and/or board certification, the administrative data cannot be used to link the presence of pain medicine board certification to improved patient outcomes.

The focus of our study was primarily related to quantification of future training needs for fellowship programs in pain medicine that are approved by the ACGME (e.g., those offered by the authors' anesthesia departments). The ABPM and the ABIPP provide pathways for established interventional pain physicians to secure certification in pain medicine without fellowship training. Of note, approximately 17% of ABMS pain medicine diplomates also had credentials from either the ABPM or the ABIPP (Fig. 1). However, the ABPM and ABIPP pathways are no longer appropriate for new graduates of residency training programs, given that ACGME-certified fellowship training in pain medicine is available. To fulfill the ABPM and ABIPP practice requirements, recently graduated residents not completing a pain medicine fellowship would need to practice pain medicine for several years without sufficient training or credentialing beyond the limited exposure to pain medicine during residency. That would run counter to the recommendations of the Department of Health and Human Services (see the bullet points earlier in the text) (1). In a recent survey of physical medicine and rehabilitation residency program directors, only 20% reported graduates as well prepared to perform inter-

ventional spine procedures for pain management, and 63% considered incoming fellows to be at the beginner level (33). New evidence in the spinal cord stimulation literature for chronic pain also suggests that provider volume (34) and specialty (35) influence trial-to-implant ratios. Furthermore, pain fellowship directors consider fellowship training as the most valuable modality for learning implantation (36). Notwithstanding, obtaining ABPM or ABIPP board certification is a reasonable option for physicians with a primary ABMS board certification already practicing pain medicine, including those who are already diplomates of another pain medicine board (Fig. 1).

Our results demonstrate that the distributions of interventional pain procedures performed by non-ABMS pain medicine board-certified anesthesiologists, physiatrists, or all other specialties have very large similarity ($\Theta \geq 0.93$) compared with ABMS diplomates. An implication of these very large similarities among non-ABMS diplomates is that their proportion of the total fee for service payments for interventional pain procedures will be approximately equal to the proportion of the total number of such procedures they perform (i.e., 52.9% = 42.7% + 9.6% + 2.6%). In contrast, there is only moderate similarity among the ABMS pain medicine diplomate group and most of the individual specialties of physicians not board certified in pain medicine by the ABMS (Table 2). Thus patients presenting for care to physicians without ABMS pain medicine board certification have a different distribution of underlying pain conditions, appropriate for the individual specialty. This is especially so for procedures other than used for the treatment of low-back pain, for which similarities were relatively low for neurosurgeons and radiologists ($\Theta < 0.4$) (Table 3).

Our data show that the population-adjusted number of interventional pain procedures performed in Florida between 2010 and 2016 was stable. This finding is consistent with a similar lack of trend shown by Manchikanti et al (37) (their Figs. 1 and 2) for epidural injections for spinal pain or other interventional pain procedures between 2010 and 2014 in the Medicare population. In a follow-up study, Manchikanti et al (38) found a population-adjusted decrease of 3.9% in the performance of interventional pain procedures in the Medicare population between 2009 and 2016, reversing the trend that had been observed in the previous decade (37). There had been a substantial (27.8%) increase in the number of composite spinal injection procedures in the US Medicare population between 1993 and 1999, during which time the US population increased by 7.4% (39). In 1999, most of these procedures were performed by anesthesiologists (overall 80.6%), with a lesser number by physiatrists (5.3%), and only a small percentage performed by radiologists (2.7%) (39). A similar predominance of anesthesiologists was observed among physicians self-declaring as pain medicine specialists in Ohio in 2002 (40). In our study, the percentage of interventional pain procedures performed by anesthesiologists was lower (63.5%), and the percentage by physiatrists was higher (19.1%), perhaps reflecting a shift in the distribution of specialties taking care of patients with chronic pain.

Limitations

First, the study was conducted in a country (United States) that has had pain medicine board certification for 25 years. In contrast, other countries, such as Canada, have provided such certification only recently (41). Consequently, the percentage of interventional pain procedures performed by physicians with pain medicine board certification in the United States may be even larger than performed by similarly credentialed physicians in some other countries. Our study was possible because US federal and state government agencies release provider-level data in the public interest of better understanding issues related to the delivery of health care.

Second, the single state studied, Florida, has some features that do not apply uniformly in the United States. For example, in Florida, nurse anesthetists cannot bill independently for interventional pain procedures. In the 17 states where nurse anesthetists are allowed to practice and bill independently ("opt-out" states) (42), to the extent that these practitioners are doing interventional pain procedures, the gap in credentialing and training articulated by the Health and Human Services report would be magnified because only physicians are eligible for pain medicine board certification (14). This would increase the need for more training programs in those states compared with the estimates using the Florida data.

Third, we considered a physician to be board certified in pain medicine based on the date of their primary certification. We did not adjust for any subsequent abandonment of this credential. However, excluding individuals whose pain medicine certification had lapsed would increase the gap in the number of patients being cared for by physicians without pain medicine board certification, and thus also increase the need for more

ACGME pain medicine training positions. Thus our conclusions are unchanged.

Fourth, the data we used do not allow insight into other aspects of the treatment of patients with chronic pain, such as medication management and psychological support. This is because the Florida database does not include information related to opioid or other prescribed drugs, patients cannot be tracked in terms of the number of encounters or complications, and dates of service are limited to the quarter and year. Our analysis of similarity among pain medicine diplomates and other practitioners is thus limited to the distribution of interventional pain procedures they are performing. No conclusions related to outcomes or effectiveness resulting from pain medicine board certification can be reached from our study.

Conclusions

Approximately one-third of interventional pain procedures in the state of Florida between 2010 and 2016 were performed by physicians without at least one of the 3 pain medicine board certifications. In addition, the practitioners performed very similar distributions of procedures (i.e., those without pain medicine board certification have not, at least overall, restricted their practice). These results suggest the need for additional accredited pain medicine fellowship training positions for newly graduated residents. The results also show that for the recommendations of the Department of Health and Human Services to be satisfied, pain medicine physicians without board certification would need to obtain ABPM or ABIPP certification, or ABMS certification after completion of a full-time ACGME pain medicine fellowship.

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