

Test Utilization for Distal Peripheral Neuropathy in Geriatric Medicine

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Background: Continuing medical education (CME) serves an important purpose in today's healthcare; especially when its dealing with laboratory medicine. CME's have demonstrated improvement in provider knowledge; however, more research is needed to observe improvement in practice. The evaluation of utilizing recommended tests by the American Academy of Neurology (AAN) for Distal Symmetric Polyneuropathy (DSP) could be improved within Geriatric Medicine by utilizing a continuing medical education intervention.

Methods: A mixed methods research design was used to measure the pre and post intervention time frames of the geriatricians' appropriate test utilization and their AAN recommended high yield test order utilization for polyneuropathy. A group of 11 geriatricians participated in this study by attending a synchronous, one-time, virtual CME presentation presented by a Doctorate of Clinical Laboratory Scientist student. The patient encounters utilized in the study were, patients > 18 years of age with either an ICD-10 G60.3 or a G60.9 diagnosis code.

Results: The pre and post survey comparison findings indicated most geriatricians were aware of the AAN recommended guidelines and high-yield tests, but still struggled to recall and document all recommended high-yield tests. However, when comparing the geriatricians appropriate test utilization and their high-yield test utilization, a statistical significance was found for this cohort.

Conclusion: This study suggests a continuing medicine education intervention not only can provide knowledge, but can also produce significant appropriate and high-yield test utilization from within a specialized medical department.

Keywords: American Academy of Neurology, Continuing Medical Education, Doctorate of Clinical Laboratory Sciences, Distal Peripheral Neuropathy, Neuropathy

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Introduction

Patients 65 years-of-age and older, suffering from distal peripheral neuropathy (DPN), are not equally evaluated across different medical specialties and currently there is inconstant appropriate test utilization.¹ The evidence-based test guideline for distal symmetric polyneuropathy (DSP) was created by the American Academy of Neurology (AAN) in 2009 and was re-certified in January of 2022. Within the general population, approximately 2 - 7% are affected by a peripheral neuropathy disorder.^{2,3,4} If a peripheral neuropathy is not discovered early when symptoms start to appear, a life altering morbidity (ex. neuropathic pain, falls, disability) can be the next phase of the disorder.⁵ This lack of discovery could be the result of pre-pre-analytical error. Pre-Pre-analytical error is defined as not knowing what laboratory test(s) to order before creating a patient's laboratory order.⁶

The literature findings show test utilization errors for DPN happen in more than one area of medicine. This inappropriate test usage indicates the need for a continuing medical education (CME) in-service over the recommended test utilization for distal peripheral neuropathy. It is very important for providers to stay up-to-date on new medical recommendations to decrease misdiagnoses and increase better patient outcomes.⁷ There are multiple ways to obtain continuing medical education (CME). Types of CME opportunities come from medical lectures (live face-to-face, live-virtual, or recorded), online learning (eLearning), and also medical education pamphlets.⁸ However, the effectiveness of the CME used to teach is different for all types; especially if the provider is or is not interactive with the learning material. Literature shows 79% of CME material does show to improve knowledge; but may not have overall success in improving patient outcomes.^{8,9}

The American College of Chest Physicians (CHEST) created evidence-based educational guidelines to support continued medical learning. Two of the CHEST recommended guidelines are: "We recommend that both live

and multiple media be used to maintain or improve physician practice performance" and "We recommend that CME interventions be used to improve physician performance".¹⁰ Both of these guidelines have a graded recommendation level of a 1C; which states "Strong recommendation, low-quality or very-low-quality evidence".¹⁰ Currently, there is little research evaluating geriatric medicine provider usage of the AAN recommended test guideline for DPN after providing a live, one-time, virtual continuing medical education intervention.

The objective of this study was to describe the test utilization by all medical providers, compare the geriatricians self-reported knowledge of the AAN recommended test guideline before and after a CME intervention, and statistically compare pre vs post-test utilization only by the geriatricians.

Operational definitions

- Appropriate utilization of appropriate tests: using only the following AAN recommended tests initially within one year of utilizing the diagnosis codes G60.3 or G60.9 (CBC, CMP, TSH, Glucose monitoring either fasting only, HgbA1c, or the addition OGTT, B12 with or without Methylmalonic acid and Hcy and Serum protein electrophoresis with Immunofixation).
- Overutilization of appropriate test: using more than just the appropriate recommended test initially within one year of utilizing the diagnosis codes G60.3 or G60.9.
- Underutilization of appropriate tests: using less than all of the appropriate recommended tests after one year of utilizing the diagnosis codes G60.3 or G60.9.

Materials and Methods

Methodology design

This study used an overall mixed methods research design to measure the pre and post intervention time frames. The specific study designs used to answer the research questions

were: Quantitative Nonexperimental descriptive statistics, Quantitative Quasi-experimental nonequivalent comparison group design, and a mixed methods Qual-Quant survey design. The data for the questions were analyzed and graphed using SPSS data software.

The sample population being evaluated in this research study was from one large teaching hospital in the Gulf Coast region of the United States. The intervention study group evaluated were geriatricians at the large teaching hospital. The inclusion criteria for the retrospective data collection was: all patients with an ICD 10 G60.3 (Idiopathic Progressive Neuropathy) and/or G60.9 (Hereditary and Idiopathic Neuropathy diagnosis code, Unspecified), patients \geq 18 years old, male or female, all providers from the large teaching hospital who utilized the ICD 10 G60.3 (Idiopathic Progressive Neuropathy) and/or G60.9 (Hereditary and Idiopathic Neuropathy diagnosis code, Unspecified), retrospective date range was July 1, 2022 - September 21, 2022, and prospective date range was November 14, 2022 - February 18, 2023.

There were no exclusions for provider years of experience, gender, or ethnicity; however, exclusions for patient data were: any patient chart without an ICD-10 G60.3 or a G60.9 diagnosis code, < 18 years of age, and any restricted patient charts. There were two cohorts in this study: medical providers and patient charts. The demographics for both cohorts can be found in Table 1 and 2.

Data collection

Initially retrospective data was collected and a patient chart review was conducted evaluating the providers use of the recommended test guideline by the American Academy of Neurology for distal symmetric polyneuropathy. Descriptive statistics were used to tabulate and analyze each EMR designation operational definition (Appropriate Utilization, Overutilization, Underutilization).

The information obtained from this retrospective search was used to create a continuing medical education presentation for the

Table 1. Provider Demographics

Characteristic	Providers
Sex	
Female	495 (54.5)
Male	413 (45.5)
Provider Credentials	
Medical Doctor Faculty	544 (60.0)
Nurse Practitioner	121 (13.0)
Physician Assistant	29 (3.0)
Fellows and Residents	97 (11.0)
Other	117 (13.0)
Specialty Department	
Neurology	18 (2.0)
Geriatric Medicine	12 (1.5)
Family Medicine	72 (8.8)
Internal Medicine	34 (4.0)
Other	675 (83.7)

Note: Data are n (%)

Table 2. Patient Demographics

Characteristic	Patients
Mean Age, years	71
Sex	
Female	341 (65.5)
Male	180 (34.5)
Ethnicity	
Caucasian	428 (82.1)
Black or African American	80 (15.4)
Asian	7 (1.3)
American Indian / Alaska Native	4 (.8)
Native Hawaiian / Other Pacific Islander	1 (.2)
Other	1 (.2)

Note: Data are n (%)

geriatric medicine group. The topic of the education covered the details of the American Academy of Neurology recommended test guideline. For example, the important details of the health screening tests (CBC, CMP and TSH) and the use of the high yield tests (Glucose Monitoring (Fasting, HgbA1c, or OGTT)), serum B12 with metabolites (methylmalonic acid with or without homocysteine), and serum protein immunofixation electrophoresis).

In advance of the presentation, a pre-survey test for self-reported knowledge over the recommended test guideline was created using Likert style and open-ended questions. Once the pre-survey test was ready it was then distributed to the geriatrician providers. After the presentation, a post-survey test was distributed to the geriatrician providers to test again for self-reported knowledge using the

same open-ended and Likert style questions. Following the post-survey test, a prospective patient chart review was performed using the same inclusion criteria as the retrospective search. This chart review measured the continuing medical education intervention outcome and the chart review timeframe used was November 14, 2022 - February 18, 2023.

Research instrumentation

The research questions were measured using two different instruments; IBM SPSS® Statistics Version 28 software and a web-based survey. The SPSS software was used to measure the retrospective and prospective quantitative data obtained from the electronic medical record data. An electronic medical record is a digital charting tool and its main purpose is to retain patient medical information and history. EMRs are used by different types of medical professionals and are secured for patient privacy. However, EMR's reliability depends on the consistency of each provider and the internal validity depended on the accuracy of information the patient provides.¹¹

The second instrument was a web-based survey. The survey was created using quantitative Likert scale questions and qualitative Open-ended data questions. The survey tested the providers self-reported knowledge pre and post intervention. The survey was distributed to the providers using the online software "Qualtrics". To evaluate if the survey measured the overall appropriate information and contains the steps to support the instrument, the validity was examined using "Content validity" by a survey expert¹² and also reviewed by 6 non-participating study medical providers using a cognitive interview method. However, none of the non-participating reviewers had a geriatric specialty.

Data Analysis

The data analysis for this study was performed using mixed-methods to determine the significance of the intervention. The IRB approved this as a QA/QI project not requiring additional IRB review.

Results

To obtain the study's findings, the total number of retrospective encounters was 326. Also, the total number of prospective encounters was 224. The data was calculated and analyzed using descriptive statistics, thematic analysis, and paired t-tests using IBM SPSS® Statistics Version 28 software. All tables and charts were created using Microsoft Excel.

Descriptive statistics

All medical departments

Fourteen different medical departments utilized the diagnosis codes G60.3 and/or G60.9 during the study period; however, there were four main medical departments: Neurology, Geriatric, Family Medicine, and Internal Medicine. The total number of encounters each department had during the retrospective time frame is reported in Figure 1.

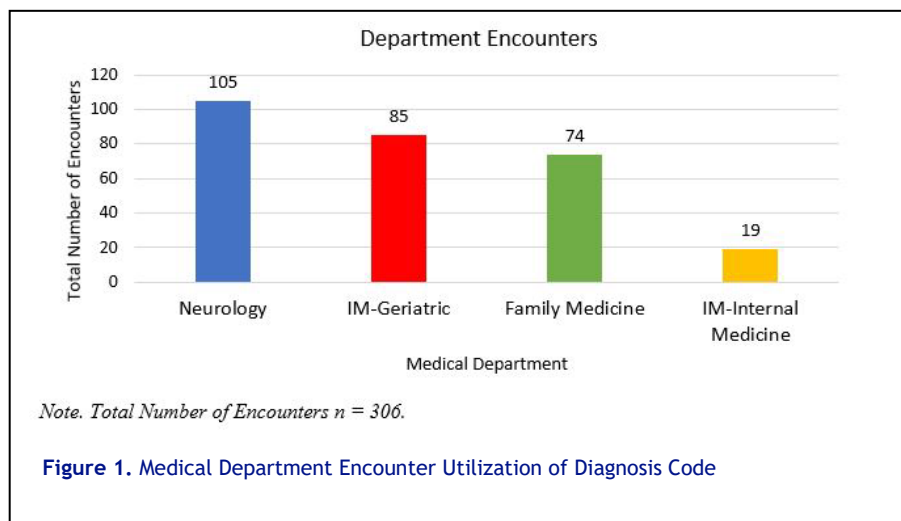


Figure 1. Medical Department Encounter Utilization of Diagnosis Code

The total mean and standard deviation of all laboratory tests ordered day of service (DOS) for a G60.3 and a G60.9 diagnosis code for each provider department were reported in Table 3. To examine appropriate test ordering, this study evaluated the use of 10 AAN

appropriate orderable tests: CBC, CMP/BMP, TSH, Fasting Glucose, Oral Glucose Tolerance Test (OGTT), HgbA1c, B12, Methylmalonic Acid (MMA), Homocysteine (HCY), Serum Protein Electrophoresis and Immunofixation. The total mean and standard deviation of DOS appropriate AAN recommended tests ordered for a G60.3 and/or G60.9 diagnosis code for each provider department were reported in Table 4. The ratio findings for appropriate to overall DOS tests ordered show the Family Medicine and Internal Medicine departments had a ratio of .63; whereas, the Neurology and Geriatric dept had a ratio of .41 and .43, see Table 4.

Table 3. Mean and Standard Deviation of DOS Tests Utilized at Encounter per Department

Department	N	Mean	SD
Neurology	105	4.74	4.731
IM-Geriatric	85	9.89	6.678
Family Medicine	74	4.74	3.558
IM-Internal Medicine	19	5.16	3.655

Note: ^a Total Number of Encounters n = 306.

^b Departments with less than 5 encounters omitted from table

Table 4. Mean, Standard Deviation, Appropriate to Overall DOS Tests Utilized per Department

Department	N	Mean	SD	Ratio (A/O)
Neurology	105	1.96	2.291	.41
IM-Geriatric	85	4.24	2.580	.43
Family Medicine	74	3.01	2.338	.63
IM-Internal Medicine	19	3.26	2.051	.63

Note: ^a Total Number of Encounters n = 306.

^b Departments with less than 5 encounters omitted from table

The data for overutilization (O), underutilization (U), and appropriate (A) utilization for a G60.3 and G60.9 diagnosis code utilized within all departments pre and post continuing medical education intervention are reported in Table 5.

Table 5. Overutilization, Underutilization, Appropriate Utilization Pre and Post Intervention

Department	Pre-Intervention (n=306)				Post-Intervention (n=215)			
	n	Over	Under	App	n	Over	Under	App.
Neurology	105	17	85	3	82	13	63	6
IM-Geriatric	85	0	85	0	44	0	43	1
Family Medicine	74	1	73	0	65	0	64	1
IM-Internal Medicine	19	0	18	1	15	1	14	0

Note. a n = Total Encounter per Dept. Over = Overutilization. Under = Underutilization. App. = Appropriate Utilization. b Departments with less than 5 encounters omitted from table.

Survey

Descriptive and Thematic Analysis

A group of 11 geriatricians participated in the study by attending a virtual synchronous CME intervention presented by a DCLS. The demographics of the Geriatrician participants can be seen in Table 6.

Table 6. Geriatrician Demographics

Characteristic	Providers
Sex	
Female	9 (81.8)
Male	2 (18.2)
Provider Credentials	
Medical Doctor Faculty	6 (54.5)
Nurse Practitioner	5 (45.5)

Note: Data are n (%) unless otherwise indicated

Table 7. Awareness of Recommended Guideline Pre-Intervention

Category	Example	Count	Percent
Sensory	Microfilament/ Tuning fork	4	~36%
Blood Work + Sensory	AAN has recommended labs and nerve studies	1	~9%
No Response		6	~55%

Note: Total Number of Responses n = 11.

Table 8. Awareness of High-Yield tests Pre-Intervention

Category	Example	Count	Percent
Sensory	"Microfilament"	1	~9%
Blood Work	"B6, B12, and other vitamin and electrolyte deficiency laboratory results"	2	~18%
History	"Tailored to the patient history/physical"	1	~9%
No Response		7	~64%

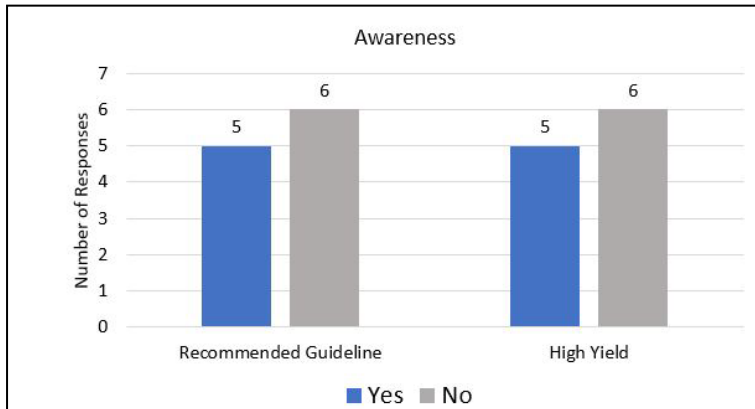
Note: Total Number of Responses n = 11.

The pre-survey utilized quantitative closed-ended Likert scale style questions and qualitative open-ended style questions. The pre-survey qualitative open-ended responses

were grouped into themes, categorized, and then quantified. Each open-ended question started with a closed-ended (Yes/No) answer choice, but included an openend-

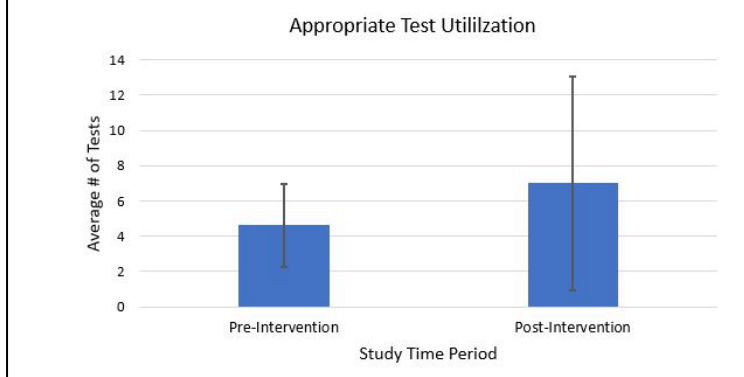
ed response if the individual chose “Yes”. The responses to the closed-ended portion tabulated and are shown in Figure 2. These particular figures are then followed by the thematic coding scheme for each question’s qualitative write-up in Table 7 and 8.^{13,14}

The post-survey used quantitative closed-ended Likert scale style questions and qualitative open-ended style questions. The qualitative open-ended responses were grouped into themes, categorized, and then quantified. Each open-ended question started with a closed-ended (Yes/No) answer choice, but included an open-ended response if the individual chose “Yes”. The responses to the closed-ended portion tabulated and are shown in Figure 3. These particular figures are then followed by the thematic coding scheme for each qualitative write-up for each question in Table 9 and 10.^{13,14}



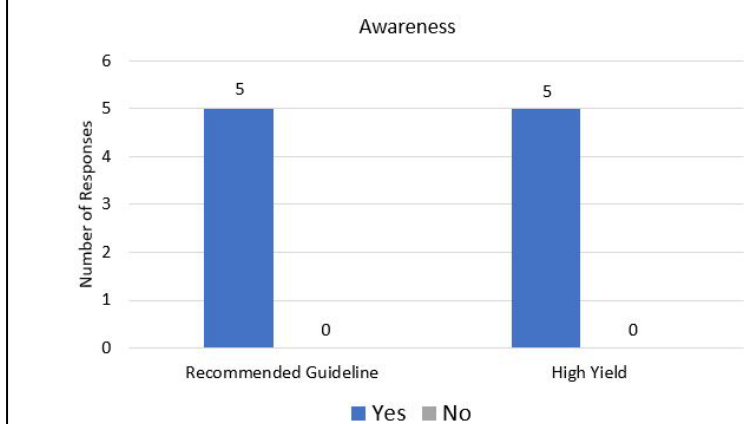
Note. Total Number of Responses $n = 11$.

Figure 2. Questionnaire Response to Awareness of Recommended Guideline and High-Yield Tests



Note: ^a Average Number of Reviewed Encounters $n = 44$. ^b Pre-Intervention $M = 4.61$; $SD = 2.374$. ^c Post-Intervention $M = 7$; $SD = 6.054$.

Figure 3. Questionnaire Response to Awareness of Guideline and High-Yield Tests



Note. Total Number of Responses $n = 5$.

Figure 4. Mean and Standard Deviation of DOS Appropriate Test Utilization, Pre and Post-Intervention

The post-survey used quantitative closed-ended Likert scale style questions and qualitative open-ended style questions. The qualitative open-ended responses were grouped into themes, categorized, and then quantified. Each open-ended question started with a closed-ended (Yes/No) answer choice, but included an open-ended response if the individual chose “Yes”. The responses to the closed-ended portion tabulated and are shown in Figure 3. These particular figures are then followed by the thematic coding scheme for each qualitative write-up for each question in Table 9 and 10.^{13,14}

Inferential Statistics

Pre vs post Geriatrician recommended test utilization

A one-tailed paired samples t -test was conducted to evaluate whether geriatric providers improved DOS utilization of appropriate tests for a G60.3 and/or G60.9 diagnosis code after a CME intervention. The results indicated that the mean for the post-interventions DOS appropriate test utilization ($M = 7.00$, $SD = 6.054$) was significantly greater than the mean for the pre-interventions DOS appropriate test utilization ($M = 4.61$, $SD = 2.374$), $t(43) = -2.155$, $p = .018$. The standard effect size index, Cohen’s d , was .325. There was a 95% confidence interval and the mean difference between the pre and post findings was .02 to .626. See Figure 4.

A one-tailed paired samples t -test was conducted post-intervention to evaluate whether geriatric providers improved ordering appropriate tests the DOS plus 12 months prior use of a G60.3 and/or G60.9 diagnosis code. The results indicated that the mean for

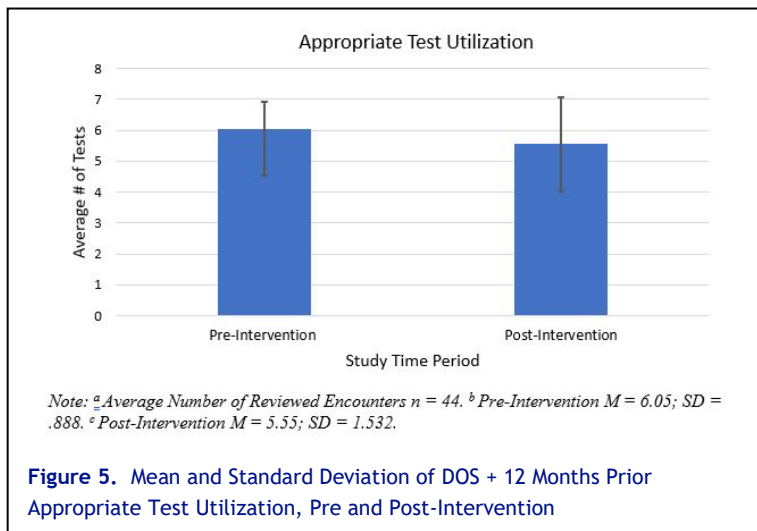


Table 9. Awareness of AAN Guideline Post-Intervention

Category	Example	Count	Percent
Blood Work Only	“CBC, TFT’s, CMP, ESR, B12 with MMA/HCY, SPEP, Glucose monitoring”	1	20%
Blood Work + Sensory	“B12, B6, and Microfilament”	1	20%
No Response		3	60%

Note: Total Number of Responses $n = 5$.

Table 10. Awareness of High-Yield tests Post-Intervention

Category	Example	Count	Percent
Sensory	“EMG”	1	20%
Blood Work + Sensory	“B6, B12, other vitamins and microfilament”	1	20%
AAN Only	“B12, Glucose, and SPEP”	1	20%
No Response		2	40%

Note: Total Number of Responses $n = 5$.

the post-interventions appropriate test utilization for the DOS ordered tests plus tests ordered 12 months prior of the diagnosis code ($M = 5.55$, $SD = 1.532$) was significantly less than the mean for the pre-interventions appropriate test utilization for the DOS ordered tests plus tests ordered 12 months prior of the diagnosis code ($M = 6.05$, $SD = .888$), $t(43) = 1.758$, $p = .043$. The standard effect size index, Cohen’s d , was .265. The confidence 95% confidence interval for the mean difference between the pre and post findings was $-.037$ to $.564$. See Figure 5.

A one-tailed paired samples t -test was conducted to evaluate whether geriatric

providers improved the use of DOS utilization of high-yield tests for a G60.3 and/or G60.9 diagnosis code after a CME intervention. The results indicated that the mean for the post-interventions high-yield test utilization ($M = 1.86$, $SD = 1.564$) was significantly less than the mean for the pre-interventions high-yield test utilization ($M = 2.48$, $SD = 1.267$), $t(43) = 1.707$, $p = .047$. The standard effect size index, Cohen’s d , was .257. The confidence 95% confidence interval for the mean difference between the pre and

post findings was $-.044$ to $.556$.

Discussion

Pre-pre-analytical order errors happen daily due to providers inadequate laboratory medicine knowledge.⁶ Continuing medical education over a laboratory medicine topic offers providers the ability to learn and keep up-to-date on appropriate test utilization. After presenting the AAN DSP guidelines to a group of geriatricians’ significant improvement of knowledge and test utilization was found.

All medical departments interpretation

Descriptive statistics were used to find all areas of medicine that utilized the diagnosis codes and compared the guideline test utilization differences. This review identified 4 main medical departments who ordered tests most often for these diagnosis codes. The medical departments were Neurology, Geriatric Medicine, Family Medicine, and Internal Medicine. The findings for these areas of medicine were expected since these particular medicine departments typically see older-in-age patients who are at risk, tested for, and diagnosed with a distal peripheral neuropathy.^{2,15, 16} By evaluating the departments test utilization, it was determined that all medicine departments discovered underutilized of the recommended guideline and the recommended tests. However, the findings for the geriatric department having the highest average of tests ordered the day of service and

the highest number appropriate tests ordered day of service was not expected. This could be explained due to the age group of patients seen by the geriatricians and older-in-age patients do have a higher incidence of having other conditions present which could require blood work more often and some tests could be the same tests found in the AAN recommendation.¹⁷

Survey interpretation

Descriptive statistics and thematic analysis were used to analyze the pre and post-survey questions. The findings from this analysis showed an increase in geriatrician self-reported knowledge after the continuing medical education. The increase shows how important it is for providers to continue to learn and stay current on recommended test guidelines. This finding is also affirmed in articles written by Bloom and Moore; it is essential to stay up-to-date on new medical information.^{7,18} Overall, when reviewing the total number of responses submitted by the participants for the pre and the post-survey, both surveys did have an above average returned response rate of approximately 40 - 60%.

Pre vs Post Geriatric Department Utilization

Each test utilization measured after the CME was statistically significant; however, all of these statistical measurements did have small effect size. The small effect size also agrees with the findings stated by Marinopoulos and Baumann, "Strong recommendation, low-quality or very-low-quality evidence".¹⁹ The significant findings for the improved order pattern could have actually been caused by other reasons. For example, natural change in the provider's knowledge of the guideline. Also, this could be due to the age group studied; since older in age patients have a higher incidence of having multimorbidity conditions requiring more regular blood work order utilization.¹⁷

Limitations

This study has potential limitations which could have led to inaccurate statistical

findings. The sample size of this research study was small at one large teaching medical hospital in the Gulf Coast region of the United States. The findings most likely do not accurately represent an overall finding of a larger group of geriatricians in multiple regions.

The intervention was only provided to the geriatrician department and not all medicine departments at the large teaching hospital. By not including other medical department at the same facility, decreases the strength of the intervention because there is no way to know how the other specialties would have performed.

Not all of geriatric providers were included in the study's pre vs post-findings because some geriatricians did not have a patient scheduled during the study time-period or the provider did not utilize the study's particular diagnosis codes for their patient with DPN symptoms. Also, to increase the power of this analysis, the study could have monitored each geriatrician change in test order behavior before and after the intervention for the same patient instead of comparing the geriatricians test utilization improvement for different patients seen post-intervention.

Conclusion

This study compared a small group of geriatricians' self-reported knowledge over the recommended AAN guidelines and appropriate test utilization for DSP. The findings provided that a continuing medicine education intervention can produce significant results from within a specialized medical department.

Future implications to improve this study would be to compare a larger group of geriatricians using the AAN DSP CME intervention, and also a computerized clinical decision support system (CCDSS). A CCDSS could notify providers immediately of the AAN DSP test recommendation once a peripheral neuropathy diagnosis code is utilized and may reduce annual laboratory costs.

In summary, there will always be a need for continued medical education to support and improve provider knowledge. However, this research study not only found improvement in provider knowledge, but also a significant difference on provider appropriate test utilization.

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Declaration of Interest Statement

The authors report there are no competing interests to declare.

Data availability

The data findings of this study are available from the corresponding author, KK, upon reasonable request.

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