Improving compliance with Intersocietal Accreditation Commission (IAC) reporting standards: A serial comparison of 523 labs over seven years

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Background. **The aim of this study was to evaluate reporting compliance of laboratories applying for serial accreditation by the Intersocietal Accreditation Commission (IAC) and compare compliance based on laboratory characteristics.**

Methods. **All laboratories applying for IAC accreditation for the first time in 2008 and then twice more (2011-2014) were evaluated for compliance with 18 reporting elements. The elements were ranked into three severity groups (high/moderate/low).**

Results. **Reports from 523 laboratories were evaluated. The percentage of laboratories with reporting issues by cycle was 66.2% for cycle 1, 36.7% for cycle 2, and 43.8% for cycle 3 ($p < .001$). For most of the 18 elements, there was a significant decrease in the percentage of labs with issues. Less moderate and high severity errors were seen over time. Also, the mean non-compliant elements per laboratory decreased from 5.78 ± 2.72 at cycle 1, down to 1.25 ± 1.77 at cycle 3.**

Conclusions. **In facilities applying for 3 consecutive IAC accreditation cycles, reporting compliance with IAC Standards improved between cycles 1-2 and 1-3. No significant improvement occurred between cycles 2-3. Although the quality of reports improved overall, problems remain in quantifying myocardial perfusion defects, documenting report approval date, and integrating stress and imaging reports. (J Nucl Cardiol 2018;25:2044–52.)**

Key Words: Nuclear cardiology • reporting • compliance • accreditation • Intersocietal Accreditation Commission

Abbreviations

ASNC	American Society of Nuclear Cardiology
CBNC	Certification Board of Nuclear Cardiology
IAC	Intersocietal Accreditation Commission
MPI	Myocardial perfusion imaging

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INTRODUCTION

The goal of the nuclear cardiology imaging report is to communicate relevant image findings and implications related to a patient's clinical condition clearly, thoroughly, and accurately. The report should assist the referring physician in making clinical management decisions. The form and content of reports can be highly variable among facilities despite the availability of several published guidance documents.[1,2]

As part of the Nuclear/PET accreditation process, the Intersocietal Accreditation Commission (IAC) evaluates reporting characteristics based on compliance with the *IAC Standards and Guidelines for Nuclear/PET Accreditation* (Standards).[3] The Standards rely on the opinions of experts and the published guidelines from related professional organizations such as the American Society of Nuclear Cardiology (ASNC).[4] The Standards define minimum levels of quality and explicitly list required reporting elements necessary for complete and consistent reporting of nuclear medicine studies.

A previous study in 2011 by Tilkemeier et al. found a high degree of non-compliance of myocardial perfusion imaging reports with the IAC Standards.[5] Following the publication of these findings, professional organizations such as ASNC and the American College of Cardiology along with the IAC engaged in numerous educational efforts to improve reporting of nuclear cardiology studies. The methods included lectures at national and local meetings, webinars, published articles, enhanced dissemination and awareness of the Standards, and increased accreditation application feedback. The impact of these efforts on reporting compliance is unknown.

The IAC database provides a unique opportunity to measure laboratory reporting compliance longitudinally over multiple 3-year accreditation cycles. The aims of this study were: (1) to evaluate myocardial perfusion reporting compliance with the IAC Standards in laboratories applying for serial accreditation from January 2008 through March 2015, and (2) to compare reporting compliance based on the laboratory characteristics of accreditation cycle, facility type, physician nuclear cardiology certification, and geographic region.

METHODS AND MATERIALS

We performed a retrospective, descriptive study using anonymized data from the IAC database to evaluate compliance of myocardial perfusion imaging (MPI) reports with the IAC Standards by laboratories applying for initial accreditation and subsequent reaccreditation.[3] The IAC accreditation cycle is three years. For reaccreditation, laboratories submit identical application materials for evaluation. All laboratories that applied for accreditation for the first time in 2008 and then twice more (January 2011- March 2015) were included in the study. Three applications per laboratory were evaluated spanning the period from January 2008 thru March 2015. Note, the initial study by Tilkemeier evaluated laboratories applying for 1st time IAC accreditation and/or reaccreditation in 2008.

Facility Characteristics

The facility characteristics evaluated included cycle of accreditation (first, second, or third), facility type (hospital-based vs. non-hospital-based), the number of physicians on staff certified by the Certification Board of Nuclear Cardiology (CBNC), and geographic region of the United States (Northeast, Midwest, South, and West).[6]

Reporting Compliance

Two independent, trained IAC peer reviewers determined reporting compliance based on 18 required reporting elements identified in the IAC Standards (Table 1). The peer reviewers evaluated three to five reports from each laboratory with the IAC technical staff adjudicating any discrepancies between reviewers.[5,7]

Using the method previously described by Tilkemeier et al, the 18 reporting elements were ranked based on relative importance using a scale from 1 to 5 (1 = very important thru 5 = least important) by experts from the Nuclear/PET Board of Directors.[5] Based on the importance of score rankings, the elements were placed into three severity categories of high (score <2.0), moderate (score ≥ 2 and <3), and low (score ≥ 3) importance. Laboratories were stratified into these groups according to the highest severity non-compliant reporting elements. For the high group, labs were non-compliant with any reporting element of high importance. For the moderate group, labs had full compliance with all high importance reporting elements and non-compliance with any reporting element of moderate importance. The low group had full compliance with all high and moderate importance elements and non-compliance with any reporting element of low importance (Table 1). A fourth group (4) incorporated laboratories with all reporting elements compliant.

Approval from an Institutional Review Board was not required. Neither patient data nor facility private/identifiable information was collected, and the results were reported in aggregate. The study did not qualify as human subject research.

Statistical Analysis

The data were analyzed using SPSS for Windows (version 22.0; Chicago, IL) and R (version 3.2.3; Vienna, Austria). The data were cleaned and examined for outliers, normality of distribution, and correlations. The laboratory characteristics were summarized using number and percentage for categorical variables and the mean (±standard deviation) for continuous variables. For the 18 reporting elements, the number and percentage of laboratories with deficiencies were calculated

Table 1. Number of laboratories and mean reporting issues by accreditation cycle ($N = 523$)

Required Component, N (%)	Cycle				p-value	Pairwise p-values		
	Average over 3 cycles (%)	1	2	3		1:2	1:3	2:3
High Severity								
Defect quantification (size, severity, type and location)	22.9	121 (23.1)	129 (24.7)	109 (20.8)	.32	NA	NA	NA
Timeliness	7.8	43 (8.2)	17 (3.3)	62 (11.9)	<.001	<.001↓	.06	<.001↑
Indication	6.5	81 (15.5)	12 (2.3)	9 (1.7)	<.001	<.001↓	<.001↓	.65
Wall motion findings	3.7	32 (6.1)	4 (0.8)	22 (4.2)	<.001	<.001↓	<.001↓	<.001↑
Nomenclature or standardization	1.6	24 (4.6)	0 (0)	1 (0.2)	<.001	<.001↓	<.001↓	1.0
Succinct impression	1.4	20 (3.8)	1 (0.2)	3 (0.6)	<.001	<.001↓	<.001↓	.63
Moderate Severity								
Date of report approval	22.6	188 (36.0)	93 (17.8)	74 (14.2)	<.001	<.001↓	<.001↓	.10
Radiopharmaceutical dose	11.0	87 (16.6)	35 (6.7)	50 (9.6)	<.001	<.001↓	<.001↓	.09
Signature	9.6	93 (17.8)	17 (3.3)	41 (7.8)	<.001	<.001↓	<.001↓	<.001↑
Description of procedure	9.6	78 (14.9)	29 (5.5)	44 (8.4)	<.001	<.001↓	<.001↓	.09
Pharmacologic dose/route	9.2	59 (11.3)	47 (9.0)	38 (7.3)	.07	NA	NA	NA
Low Severity								
Integration of stress and imaging report	18.3	141 (27.0)	83 (15.9)	64 (12.2)	<.001	<.001↓	<.001↓	.10
Gender	12.6	123 (23.5)	42 (8.0)	32 (6.1)	<.001	<.001↓	<.001↓	.25
Referring physician	6.6	63 (12.1)	15 (2.9)	26 (5.0)	<.001	<.001↓	<.001↓	.11
Demographic data	4.3	5 (1.0)	38 (7.3)	25 (4.8)	<.001	<.001↑	<.001↑	.10
Age/birth date	4.2	58 (11.1)	4 (0.8)	4 (0.8)	<.001	<.001↓	<.001↓	1.0
Typographical errors	4.1	48 (9.2)	12 (2.3)	4 (0.8)	<.001	<.001↓	<.001↓	0.08
Radiopharmaceutical route of administration	3.1	6 (1.2)	18 (3.4)	24 (4.6)	.004	.03↑	.004↑	.42
Overall		(346) 66.2	192 (36.7)	229 (43.8)	<.001	<.001	<.001	.02

↓ = downward improving trend , ↑ = upward worsening trend, NA = not applicable due to lack of overall trend significance,
■ = Most deficiencies, ■ = Medium deficiencies, ■ = Least deficiencies

overall and by individual element. The overall mean (±standard deviation) deficiencies and mean deficiencies by accreditation cycle were calculated for each of the reporting elements. The average number of CBNC certified physicians was determined along with whether there were any CBNC physicians on staff.

Comparisons

Separate paired comparisons of the individual reporting elements were made for the same laboratories applying for serial accreditation across three cycles. Included were laboratories applying for accreditation for the first time in 2008, applying for reaccreditation in 2011 and then again for reaccreditation a third time in 2014. Laboratories often reapply early or late, so the year is approximate. Individual reporting elements were analyzed using Cochran's Q non-parametric test to examine differences by laboratory across the three cycles. Post hoc p value comparisons were made using the Benjamini-Hochberg method for pairwise comparisons among the cycles. For paired comparison of mean reporting deficiencies, repeated measures ANOVA were used to analyze the sum of reporting issues for each lab across the cycles. Pairwise comparisons among the cycles were made using Bonferroni post hoc analyses. Paired comparisons were also made for the percentage of laboratories with issues based on severity group. Similar analyses were used to compare differences in mean reporting issues per facility by facility type, CBNC certified physicians on staff, and region. For all tests, p values $<.05$ were indicative of statistical significance.

RESULTS

There were 774 first-time applicants in 2008. Of those, 523 had full data across all three cycles from January 2008 thru March 2015 and were evaluated for compliance with the IAC Standards. The number of labs with at least one CBNC certified physician on staff increased over all three accreditation cycles from 27.0% for cycle 1, 47.0% for cycle 2, and 66.9% for cycle 3 ($p < .001$). The mean number of CBNC certified physicians per laboratory also increased over all three cycles from 0.50 ± 1.11 in cycle 1 to 1.49 ± 1.82 in cycle 3 ($p < .001$).

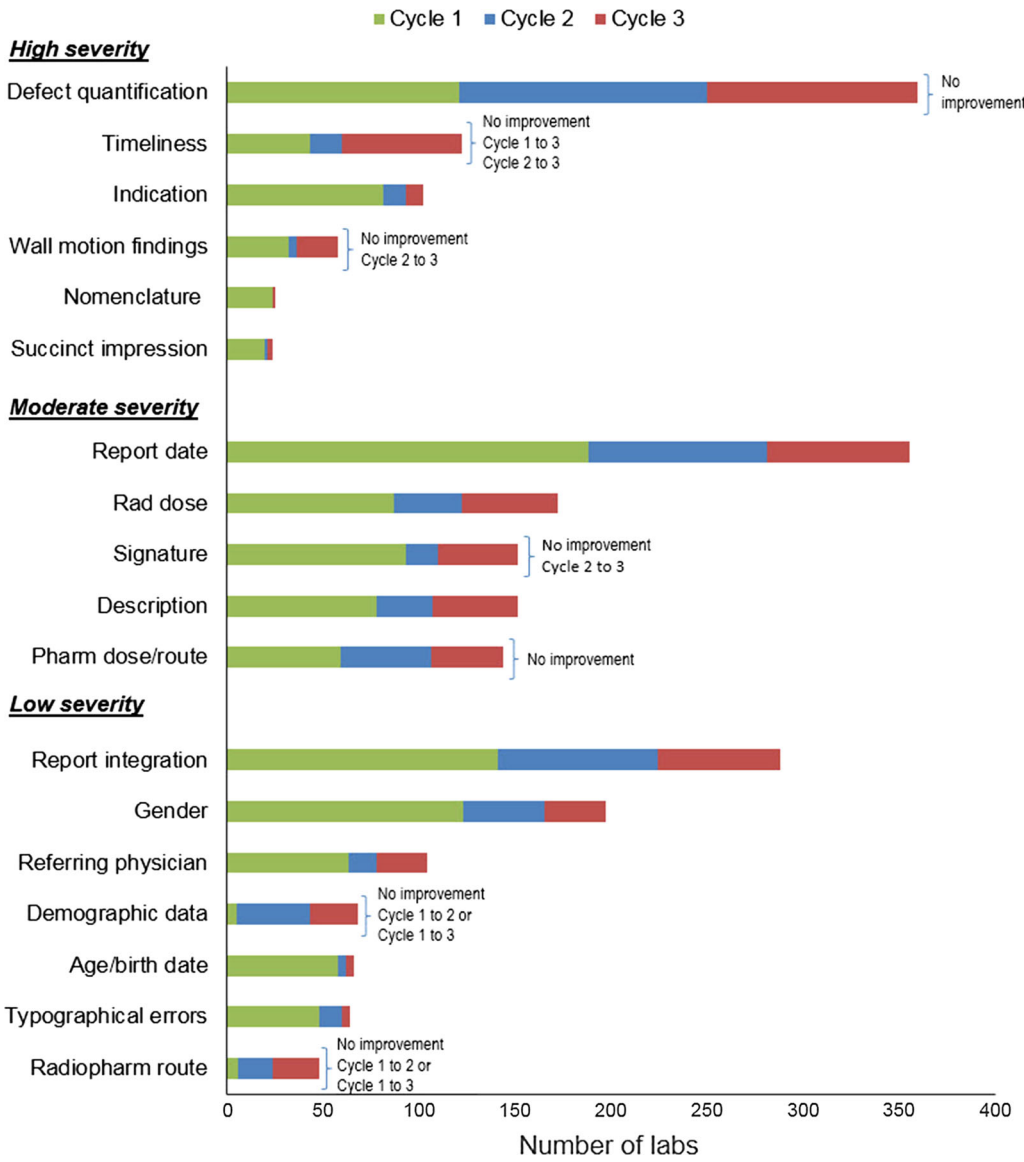

Figure 1. Number of laboratories with reporting issues for 18 individual elements by severity group.

Across all three cycles, the average percentage of laboratories with reporting issues is 48.9%. The least compliant reporting element overall based on the number of labs with issues was quantification of myocardial perfusion defects (22.9%) followed by documentation of report approval date (22.6%) and integration of the stress and imaging reports (18.3%) (Table 1). However, date of report approval and integration of reports showed the greatest improvement over the three cycles along with recording of patient gender. The three most compliant elements were reporting of a succinct impression (1.4%), use of standardized nomenclature (1.6%), and documentation of the route of radiopharmaceutical administration (3.1%).

Pairwise Comparisons

The percentage of laboratories with reporting issues by cycle is 66.2% for cycle 1, 36.7% for cycle 2, and 43.8% for cycle 3 ($p < .001$). The pairwise comparisons demonstrated that for most of the reporting elements, there was a significant decrease in the percentage of labs with issues from cycle 1 to 2 and cycle 1 to 3 (Figure 1). However, the percentage of labs with reporting issues did not change significantly over all three accreditation cycles for quantification of myocardial perfusion defects ($p = .32$) and documentation of pharmacologic stress agent exact dose and route of administration ($p = .074$). Comparing cycle 1 to cycle 2, there was a significant difference for reporting of facility demographic data

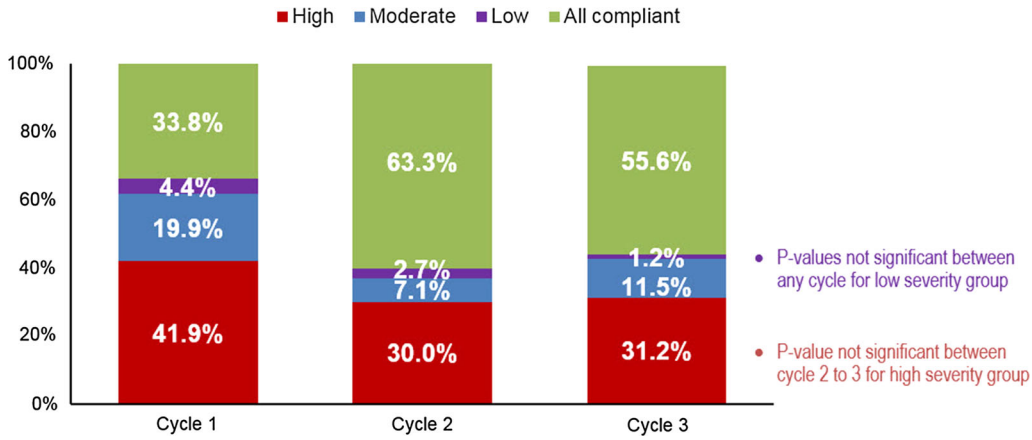

Figure 2. Percentage of labs with report issues grouped by severity across three accreditation cycles between January 2008 and March 2015.

which increased from 1.0% to 7.3% of laboratories ($p < .001$) and reporting of radiopharmaceutical route of administration which rose from 1.2% to 3.4% ($p = .03$). Comparing cycle 1 to cycle 3, again, reporting of demographic data and documentation of radiopharmaceutical route of administration increased significantly, 1.0% to 4.8% ($p < .001$) and 1.2% to 4.6%, respectively. Between cycles 2 and 3, there was no significant change in the percentage of labs with errors for almost all of the reporting elements. However, signature, timeliness of reports, and reporting of wall motion findings all increased ($p < .001$).

Severity Group Comparisons

Using the three severity groups determined from the reporting element importance ranking, laboratories were categorized based on the highest severity, non-compliant element in their reports. Beginning with the highest severity group, there was a significant decrease in the percentage of labs with non-compliant elements from cycle 1 to 2 (41.9% to 27.0%, $p < .001$) and cycle 1 to 3 (41.9% to 31.2%, $p < .001$) (Figure 2). There was no significant difference between cycle 2 to 3 ($p = .115$). For the moderate severity group there was a significant decrease between cycle 1 to 2 (19.9% to 7.1%, $p < .001$) and cycle 1 to 3 (19.9% to 11.7%, $p < .001$); however, there was a significant increase between cycle 2 to 3 (7.1% to 11.5%, $p = .007$). For the low severity group, there was a significant decrease across all three cycles ($p = .006$), but there were no significant differences between any of cycles. Finally, the percentage of laboratories with compliant reports—no reporting issues—rose from 33.8% in cycle 1 to 63.3% in cycle 2 ($p < .001$) but decreased to 56.2% in cycle 3 ($p = .0.12$). In general, these findings demonstrate a trend toward labs with fewer non-compliant elements in the high and moderate groups balanced by an increase in the percentage of labs with all elements compliant. The number of labs with compliant reports nearly doubled between cycle 1 to 2 but dropped somewhat between cycle 2 to 3.

Mean Reporting Issues

The mean non-compliant elements per laboratory decreased significantly from 5.78 ± 2.72 in cycle 1 to 1.17 ± 1.81 in cycle 2 ($p < .001$). Between cycles 2 and 3, there was no significant difference (1.17 ± 1.81 to 1.25 ± 1.77, $p = 1.00$).

Pairwise Comparisons: Facility Type

Most of the laboratories evaluated were non-hospital-based (>92%). For cycle 1, there was no difference in the mean non-compliant elements between hospitals and non-hospitals ($p = .823$) (Figure 3). However, in cycle 2 there was a significant difference between the two types with non-hospitals demonstrating more errors (hospitals 0.60 ± 1.08 vs. non-hospitals 1.20 ± 1.83, $p = .015$). The results were very similar for cycle 3 (hospitals 0.64 ± 1.20 vs non-hospitals 1.29 ± 1.80, $p = .004$). Comparisons between cycles 1 to 2 and 1 to 3 showed a significant decrease for both facility types ($p < .001$ for all). However, comparisons between cycle 2 to 3 were not significant for either type ($p = 1.0$ for both).

Pairwise Comparisons: CBNC on Staff

As mentioned above, the number of labs with at least one CBNC certified physician on staff increased

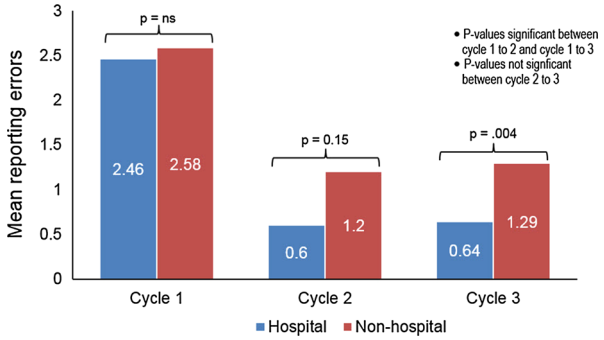

Figure 3. Mean non-compliant elements by facility type for each accreditation cycle. *ns* not significant.

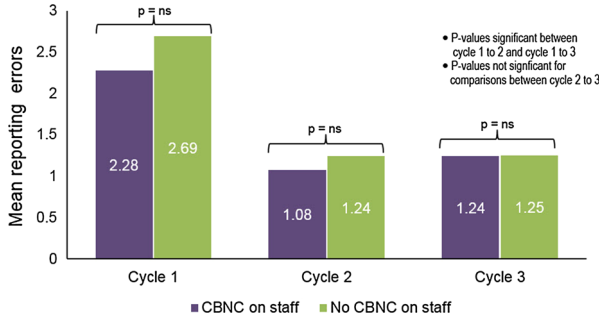

Figure 4. Mean non-compliant elements for laboratories with and without physicians certified by the Certification Board in Nuclear Cardiology (CBNC) on staff for each accreditation cycle. *ns* not significant.

and the mean number of CBNC certified physicians per laboratory also increased over all three cycles. After controlling for this increase in the number labs with CBNC certified staff over all three cycles, there is no difference in mean non-compliant elements between labs with and without CBNC physicians on staff for all three cycles 2 and 3 (Cycle 1—$p = .10$, Cycle 2—$p = .30$ and Cycle 3—$p = .10$) (Figure 4). Comparisons between cycles 1 to 2 and 1 to 3 showed a significant decrease for both staff groups ($p < .001$ for all). However, comparisons between cycle 2 to 3 were not significant for either type ($p = 1.0$ for both).

Pairwise Comparisons: Geographic Region

Across all three cycles, the South represented the greatest proportion at 58.0% with the remaining regions evenly distributed at 16.3% in the Midwest, 13.8% in the West, and 11.9% in the east. The number of labs per region was constant over the three cycles. There was no difference in the mean number of errors between regions for all three cycles (cycle 1 $p = .367$; cycle 2 $p = 0.69$; cycle 2 $p = 0.349$) (Figure 5). There was a significant decrease in the mean errors between cycle 1 to 2 and cycle 1 to 3 for all regions ($p < .001$ for all), but there was no significant difference for any of the regions between cycles 2 and 3 ($p = 1.0$ for all).

DISCUSSION

This study evaluated compliance of MPI reports with the IAC Standards and compared characteristics of 523 laboratories applying for serial accreditation by the IAC. The results demonstrated significant improvement in reporting compliance from 33.8% 1st accreditation cycle to 63.3% the 2nd cycle, and then down to 56.2% the 3rd cycle. Over time, less moderate and high severity issues were seen. In addition, the mean non-compliant elements per laboratory decreased significantly from 5.78 ± 2.72 down to 1.25 ± 1.77. For most of the 18 variables, there was improvement between cycle 1 to cycle 2 and cycle 1 to cycle 3, although no difference was seen between cycle 2 to 3. Despite overall improved reporting compliance, problems remain in quantifying perfusion defects (24.7% at cycle 3), documenting the date of report approval and finalization (14.2% at cycle 3), and integrating stress and imaging findings (12.2% at cycle 3).

In a similar study, Tilkemeier et al. uncovered a high degree of nuclear cardiology reporting errors with only 42.8% of labs compliant that applied for accreditation during the 2008 calendar year.[5] The two studies differed on the time of data collection and level of accreditation cycle. The earlier study evaluated all labs applying for accreditation in 2008, whether they were first time applicants or applying for reaccreditation one or multiple times, offering a snapshot of deficiencies in that year. Our study evaluated only first-time applicants in 2008 and followed these same labs over two subsequent accreditation periods to assess improvement. Research on reporting errors is scarce, and studies concerning quality in cardiac imaging are void of information regarding quality gaps and their effect on patient care and outcomes.[8]

Our results are notable in that comparing accreditation cycles 1 to 2 and 1 to 3, uncovered a general decline in reporting issues. Conversely, there was no significant change in the percentage of laboratories with issues between cycle 2 and cycle 3. In 2008 (cycle 1) accreditation of nuclear cardiology laboratories was mostly voluntary. Many laboratories became accredited then to earn 3rd party recognition of being a quality facility. In 2008, Congress passed the Medicare Improvements for Patients and Providers Act which required all non-hospital, advanced diagnostic imaging facilities to be accredited by January 1, 2012, as a

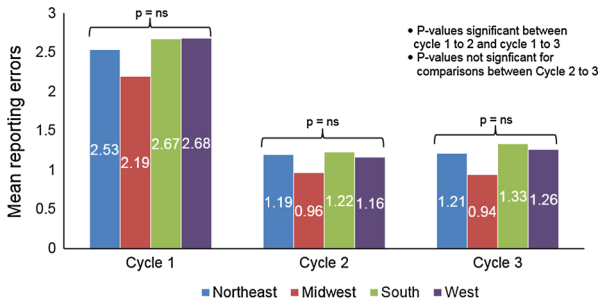

Figure 5. Mean non-compliant elements by United States geographic region for each accreditation cycle. *ns* not significant.

condition of reimbursement.[9] Thus, laboratories receiving voluntary accreditation in the past now had to maintain accreditation to be paid for services. It is possible that this threat of decreased reimbursement motivated facilities to be more diligent. However, this effect waned between cycle 2 and 3 as reflected in the overall decline in compliant labs from 63.3% to 55.64 ($p = .012$).

Between cycles 2 and 3, there was a significant decrease in compliance for three reporting elements; wall motion findings, timeliness, and signature, with several possible explanations. Between the later cycles, the Standards for signing reports became stricter requiring password protection and documentation of electronic signature instead of the previous utilization of a the document with scanned signatures.[3] Additionally, more rigorous requirements for the description for regional wall motion abnormalities were implemented to include classification of global function (normal, mildly reduced, moderately reduced, severely reduced, hyperdynamic) and regional wall motion (normal, mild hypokinesis, moderate hypokinesis, severe hypokinesis, akinesis, dyskinesis).[2] Likewise, the Standards for report turnaround time dropped from four days down to two.

It is concerning that issues in quantifying myocardial perfusion defects persisted throughout all three cycles and that it remains the most problematic element. Accurate reporting of the size (small, medium and large), severity (mild, moderate, severe), type (reversible, persistent, fixed), and location (17-segment model) is essential in communicating abnormal findings to the referring physician.[2]

The results of this study demonstrate that the number of labs with CBNC certified physicians and the mean CBNC per lab increased over time. These findings mirrored the improved overall compliance with reporting Standards from the beginning of our study to the end. However, after controlling for the increase in the number of CBNC physicians, there was no difference in the mean errors between labs with and without CBNC physicians on staff for any cycle. This implies a halo effect that once there is one CBNC certified physician on staff in the lab, reports become compliant and, thus, more CBNC certified physicians do not result in better compliance and fewer errors.

A nuclear cardiology report is a form of one-way communication. Therefore, it must thoroughly characterize the findings to provide the most information. Several surveys in the literature document referring physician's preference for detailed explanations of abnormal imaging findings.[10-12]

A study by Tragardh et al. found that referring physicians have a good understanding of the presence or absence of ischemia versus infarction.[13] However, they underestimate the extent of ischemic and infarcted areas of myocardium. Nonspecific communication of myocardial perfusion defects limits the referring physician's ability to guide and counsel the patient about a plan of care. Myocardial perfusion quantification is especially vital because treatment may be different based on the extent of the disease. For instance, small areas of ischemic myocardium are usually treated with medical therapy, whereas for large areas of myocardium, intervention may be recommended.[14] Ineffective MPI reporting increases the probability a patient could receive inadequate or inappropriate care. There is a documented relationship between breakdowns in communication and patient outcomes.[15]

Tilkemeier et al. and the RANZCR project both suggest reporting templates as one possible solution to reduce poor reporting quality and error.[5,16] In our study, the use of templates may account for the small number of issues in the lowest severity group. However, persistent errors related to more subjective elements found in the moderate and highest severity elements are not adequately remedied by templates alone.

Errors in medicine are inevitable. The potential for fallibility must be accepted. The literature suggests that up to 15% of clinical cases have some degree of diagnostic error leading to incorrect diagnosis.[17] This error likely results in upwards of 80,000 deaths per year. Diagnostic imaging error is around 2% to 4%, but this likely misses the adverse effects of delayed or poor communication. Moreover, a literature review in 2001 suggested the clinically significant error in all of radiology ranges from 2% to 20% depending on radiological investigation.[18] Renfrew et al. classified errors in cases presented at problem case conferences. Of those errors, poor communication accounted for 10% where abnormalities were correctly identified and interpreted; however, the message failed to reach the relevant clinician.[19]

How can nuclear cardiology be more proactive in reducing diagnostic imaging error? Franc and Cohen

suggest that systems-based interventions to reduce diagnostic error in imaging may be helpful; however, these types of intervention are scarce and rarely applied.[8] A recent survey by Jerome et al. of laboratory perception of the value of accreditation found that most respondents felt that accreditation improves nuclear cardiology report standardization (84%), completeness (81%), and timeliness 69%).[20] The above statistics and findings highlight the value of accreditation, and our study supports this initiative. Accreditation ensures an objective baseline standard of care and provides an apparatus for implementing quality improvement.

LIMITATIONS

This study was a retrospective review of nuclear cardiology facilities applying for serial accreditation by the IAC. The accreditation process is dynamic with the revision of the Standards on a regular basis to reflect changes in practice. Modifications of the Standards may have caused variations in the way elements are evaluated over time. The IAC database was not designed for research but to manage accreditation and the results of this study are only generalizable to IAC facilities. Whether or not the accreditation process along with educational measures caused improved reporting cannot be determined. However, there appears to be an association between accreditation, educational measures, and improved reporting.

Although it is often assumed, compliant or complete reporting has no documented link to improved patient outcomes. Of the 18 elements evaluated, some may play a more important role in patient care than others. For instance, the low importance reporting elements such as reporting of demographic data certainly influence patient management less than the high importance elements such as myocardial perfusion defect quantification. Further, this study did not investigate the usefulness of compliant reporting to the referring physician.

Finally, our study is also limited as only labs that applied for accreditation three times (1st accreditation followed by two reaccreditation applications) during our study period were included. There were 774 first time applicants in 2008. Of those, 631 applied for reaccreditation three years later, and of those, only 523 applied for reaccreditation the second time three years after that. The decrease in the number of labs applying for reaccreditation during our study period is most likely due to two factors. First, labs frequently fail to apply for reaccreditation at exactly three years and most often apply late without penalty. The IAC allows a 60-day grace period with no lapse in accreditation. Therefore, these labs were excluded. Second, over the past decade, there has been an increasing trend toward practice mergers and hospital-owned cardiology practice. A 2012 survey by the American College of Cardiology noted that 24% of cardiology practices were hospital-owned compared to 8% in 2007.[21] Nuclear cardiology accreditation is not required for hospital reimbursement. This may result in fewer reaccreditation applications due to mergers or labs foregoing accreditation.

NEW KNOWLEDGE GAINED

Paired comparisons of reporting compliance for the same laboratories applying for serial accreditation demonstrated compliance with reporting standards improved with laboratories committing fewer and less severe errors. Despite overall improved reporting compliance, problems remain in quantifying perfusion defects necessitating additional efforts to improve.

CONCLUSION

Communication of the results of any diagnostic test must be clear and accurate. The results of this study demonstrate that reporting compliance with the IAC Standards significantly improved between accreditation cycles 1 and 2 and between cycles 1 and 3. No significant improvement was seen between cycles 2 and 3. This study also found substantial report non-compliance with the IAC Standards for quantification of myocardial perfusion defects, documentation of report approval date, and integration of the stress and imaging reports problematic over all three accreditation cycles. Identifying reporting deficiencies is important to help target strategies for continued the improvement of nuclear cardiology report quality.

Author Contributions

Study concept and design: Tilkemeier and Farrell. Acquisition, analysis, or interpretation of data: All authors. Drafting of the manuscript: All authors. Critical revision of the manuscript for important intellectual content: All authors. Statistical analysis: Ewing. Obtained funding: Not applicable. Administrative, technical, or material support: Farrell. Study supervision: Tilkemeier and Farrell.

Disclosure

Farrell is an employee of the Intersocietal Accreditation Commission. Maddux, Ewing, and Tilkemeier have no conflicts of interest. No financial support was received for this research.

References

1. Cerqueira MD. The user-friendly nuclear cardiology report: What needs to be considered and what is included. J Nucl Cardiol. 1996;3:350-5.
2. Tilkemeier PL, Cooke CD, Grossman GB, McCallister BD, Ward RP. Standardized reporting of radionuclide myocardial perfusion and function. J Nucl Cardiol. 2009;16:650.
3. The IAC Standards and Guidelines for Nuclear/PET Accreditation. Ellicott City, MD: Intersocietal Accreditation Commission; 2012:47.
4. Holly TA, Abbott BG, Al-Mallah M, et al. Single photon-emission computed tomography. J Nucl Cardiol. 2010;17:941-73.
5. Tilkemeier PL, Serber ER, Farrell MB. The nuclear cardiology report: Problems, predictors, and improvement. A report from the ICANL database. J Nucl Cardiol. 2011;18:858-68.
6. U.S. Census Bureau, Economic Census: Regions and Divisions. http://www.census.gov/econ/census/help/geography/regions_and_divisions.html. Accessed 14 Aug 2014.
7. Intersocietal Accreditation Commission Policies and Procedures 2015. http://www.intersocietal.org/iac/legal/policies.htm Accessed 21 June 2016.
8. Franc B, Cohen J. Diagnostic error in medicine: A critical role for diagnostic imaging in finding and facilitating solutions. Appl Radiol. 2014;43:3-4.
9. H.R. 6331 - 110th Congress: Medicare Improvements for Patients and Providers Act of 2008'' Rangel C, trans. 110th ed2008.
10. McLoughlin RF, So CB, Gray RR, Brandt R. Radiology reports: How much descriptive detail is enough? Am J Roentgenol. 1995;165:803-6.
11. Gunderman R, Ambrosius WT, Cohen M. Radiology reporting in an academic children's hospital: What referring physicians think. Pediatr Radiol. 2000;30:307-14.
12. Lafortune M, Breton G, Baudouin JL. The radiological report: What is useful for the referring physician? Can Assoc Radiol J. 1988;39:140-3.
13. Tragardh E, Hoglund P, Ohlsson M, Wieloch M, Edenbrandt L. Referring physicians underestimate the extent of abnormalities in final reports from myocardial perfusion imaging. EJNMMI Res. 2012;2:27.
14. Hachamovitch R, Rozanski A, Shaw LJ, et al. Impact of ischaemia and scar on the therapeutic benefit derived from myocardial revascularization vs. medical therapy among patients undergoing stress-rest myocardial perfusion scintigraphy. Eur Heart J. 2011;32:1012-24.
15. Reiner BI. Strategies for radiology reporting and communication. Part 1: Challenges and heightened expectations. J Digit Imaging. 2013;26:610-3.
16. Pool F, Goergen S. Quality of the written radiology report: A review of the literaure. J Am Coll Radiol. 2010;8:634-43.
17. Graber ML. The incidence of diagnostic error in medicine. *BMJ Qual Saf*. 2013;22 Suppl 2:ii21-ii27.
18. Goddard P, Leslie A, Jones A, Wakeley C, Kabala J. Error in radiology. Br J Radiol. 2001;74:949-51.
19. Renfrew DL. E A Franken J, Berbaum KS, Weigelt FH, Abu-Yousef MM. Error in radiology: Classification and lessons in 182 cases presented at a problem case conference. Radiology. 1992;183:145-50.
20. Jerome SD, Farrell MB, Godiwala T, et al. Facility perception of nuclear cardiology accreditation: Results of an Intersocietal Accreditation Commission (IAC) survey. J Nucl Cardiol. 2015;22:496-503.
21. ACC's 2012 Practice census shows continued changes in practice landscape. American College of Cardiology website. http://www.acc.org/latest-in-cardiology/articles/2012/07/24/11/55/acc-practice-census-2012. Accessed 7 April 2017.