The Accreditation of Ultrasound Practices

Impact on Compliance With Minimum Performance Guidelines

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Objective. To determine the effectiveness of the American Institute of Ultrasound in Medicine (AIUM) accreditation program in improving compliance with standards and guidelines for the performance of obstetric and gynecologic ultrasound examinations. ***Methods.*** Scores of case studies of accreditation applications were compared with their respective scores at the time of reaccreditation 3 years later. To account for the element of time, scores of applications that recently completed first-time accreditation were also compared as a control group. ***Results.*** Individual obstetric case studies, as well as the average of all obstetric and gynecologic case studies, showed highly significant improvement with the reaccreditation application when compared with the initial accreditation application 3 years earlier (all $P < .001$). The proportion of practices successfully meeting obstetric and gynecologic AIUM accreditation requirements improved significantly with reaccreditation (obstetric, 57.3% for accreditation compared with 86.6% for reaccreditation; gynecologic, 60% for accreditation compared with 91.9% for reaccreditation; $P < .001$). Furthermore, reaccreditation scores were significantly higher than scores of recent first-time applications for obstetric case studies as well as scores of the average of obstetric and gynecologic case studies (all $P < .05$). ***Conclusions.*** Our study confirms that practices that sought and received ultrasound accreditation were able to improve the scores of case studies and compliance with published minimum standards and guidelines for the performance of obstetric and gynecologic ultrasound examinations when reevaluated 3 years after the initial application scores. This improvement should translate into an enhancement of the quality of ultrasound practice. ***Key words:*** accreditation; certification; performance guidelines; ultrasound.

Abbreviations
AIUM, American Institute of Ultrasound in Medicine; CME, continuing medical education; IQR, interquartile range; RADIUS, Routine Antenatal Diagnostic Imaging with Ultrasound

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Ultrasonography is an operator-dependent imaging modality. Several studies have documented that the efficacy of obstetric ultrasonography, especially with regard to the detection of fetal abnormalities, is dependent on the expertise of the operator.[1–4] In the Routine Antenatal Diagnostic Imaging with Ultrasound (RADIUS) trial, the detection of fetal abnormalities was almost 3-fold higher when the sonologist was highly trained in ultrasonography.[1] Indeed, the RADIUS trial would have shown a benefit to routine ultrasonography in low-risk women had the overall detection rate of fetal abnormalities in the trial been that of sonologists in referral centers (35%).[5] Furthermore, European studies have reported a significant difference in the detection of fetal abnormalities

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between tertiary care and non–tertiary care centers.[2] On the basis of the findings of the RADIUS trial, the American Institute of Ultrasound in Medicine (AIUM) and the American College of Radiology initiated voluntary accreditation of ultrasound practices with the ultimate goal of improving the quality of ultrasonography in the United States.

The AIUM established the voluntary accreditation of ultrasound practices in the United States and Canada in 1996.[6] Accreditation by the AIUM is provided for practices rather than individuals. Ultrasound practices seeking AIUM accreditation must show evidence of physicians' training in ultrasonography, credentialing of sonographers performing ultrasound examinations, continuing medical education (CME) for physicians and sonographers, and the presence of protocols and procedures to ensure proper and safe practice of ultrasonography. In addition to the above requirements, practices applying for accreditation must submit 4 case studies for each specified area of accreditation (obstetrics, gynecology, breast, and abdomen). These case studies are scored by independent reviewers according to established criteria that conform to the minimum standards and guidelines for ultrasound practices as developed by the AIUM.[7,8] As of December 2003, 940 practices have received ultrasound accreditation, and 82 practices have been denied accreditation (AIUM Accreditation Department database, December 2003). Accreditation is offered for 3 years, after which practices must apply for reaccreditation.

The objective of this investigation was to determine the effectiveness of the AIUM accreditation program in improving ultrasound practice patterns by comparing scores of ultrasound cases submitted by practices at the initial accreditation application with those of cases submitted by the same practices at their reaccreditation application 3 years later.

Materials and Methods

This study was approved by the Institutional Review Board of Eastern Virginia Medical School. Data were collected on-site from the AIUM offices in Laurel, Maryland. A random sample of consecutive applications (group A) that successfully completed an initial accreditation cycle (group A1) and a reaccreditation cycle (group A2) 3 years later for obstetrics and gynecology was chosen for review. This sample of applications was provided for review by AIUM staff who had no detailed knowledge of the study. A second list of applications (group B) that recently completed first-time accreditation in obstetrics and gynecology was also reviewed as a control group. Group B consisted of practices that received AIUM ultrasound accreditation in 2002 and 2003 and represented the most recently accredited practices in the AIUM database.

Practices applying for AIUM accreditation are required to submit ultrasound case studies for review as part of the accreditation application. These case studies are scored by independent reviewers, and the scoring of case studies is designed to reflect the degree of compliance with the minimum criteria for a complete examination as published by the clinical standards and practice guidelines of the AIUM.[7,8] The AIUM accreditation requires that each case study score at least 75% and the average of all case studies reach 85% or higher. Practices that do not attain these minimum standards on their initial submission of case studies are afforded the opportunity to resubmit case studies for review before a final decision is rendered on their application. For the sake of this study, scores of case studies that were initially submitted were compared.

In addition to the initial scores of the 4 obstetrics and 4 gynecology case studies submitted with each application, data collection from each practice included the number of physicians and sonographers, the number of ultrasound systems, and the total number of ultrasound procedures per year.

Statistical analysis was conducted with the use of frequencies and relative frequencies for categorical data. Continuous data were described with the median, range (minimum and maximum), and interquartile range (IQR) because continuous variables were non-normally distributed on the basis of the Shapiro-Wilk test and confirmed by visual examination with box plots and Q-Q plots.

To determine whether initial scores of case studies improved for practices receiving AIUM accreditation, the accreditation scores (group A1) were compared with reaccreditation scores (group A2) by the Wilcoxon signed rank test. These comparisons were made for each obstetric cases 1 through 4 as well as for the arithmetic average of all obstetric and gynecologic cases. Obstetric case 1 represented the first-trimester

ultrasound case study; obstetric cases 2 and 3 represented second-trimester ultrasound studies; and obstetric case 4 represented the third-trimester ultrasound study. To compare the level of improvement in scores of case studies between obstetric and gynecologic cases, mean and median differences in accreditation (group A1) and reaccreditation (group A2) scores were compared by the paired *t* test because the difference in improvement was normally distributed on the basis of Shapiro-Wilk test results. Additionally, the proportion of practices successfully earning accreditation with the initial submitted scores of case studies (scores of at least 75% on each of the 4 submitted case studies and at least 85% as an average of all submitted case studies) were compared for the accreditation (group A1) and reaccreditation (group A2) applications by the McNemar test.

To account for the effect of time on improvement in scores of case studies, initial accreditation scores of group A1 and reaccreditation scores of group A2 were compared with initial accreditation scores of group B by either the independent samples *t* test or the Wilcoxon rank sum test as appropriate. Additionally, the proportion of practices successfully earning accreditation with the initial submitted scores of case studies (scores of at least 75 % on each of the 4 submitted case studies and at least 85% as an average of all submitted case studies) were compared for group A (A1 and A2) and group B applications by the χ^2 test.

SAS software (SAS Institute Inc, Cary, NC) was used for all data management and analysis. The level of significance was set at $P \leq .05$ for all hypothesis tests and confidence interval construction.

Results

Group A (accreditation and reaccreditation) consisted of 82 practices, and group B (recent accreditation) consisted of 97 practices. The typical practice applying for AIUM accreditation had 3 physicians (range, 1–26) and 2 sonographers (range, 0–13) and performed 2413 ultrasound procedures (range, 298–21,145) per year.

The initial scores of the obstetric and gynecologic case studies submitted with the accreditation (group A1) and reaccreditation (group A2) applications are compared in Table 1. Obstetric case studies 1 through 4 as well as the average of all obstetric and gynecologic case studies showed highly significant improvement with the reaccreditation application (all $P < .001$). The median improvement in scores of case studies for the first obstetric case (first trimester) was 4 points (IQR, –0.75 to 10.75); for the second obstetric case (second trimester) it was 4.7 points (IQR, 0 to 13); for the third obstetric case (second trimester) it was 6 points (IQR, –0.5 to 15); and for the fourth obstetric case (third trimester) it was 5.5 points (IQR, –0.5 to 15). The median improvement in the average of all obstetric case scores was 5.25 points (IQR, 1.15 to 12). The median improvement in the average of all gynecologic case scores was 5.38 points (IQR, –0.23 to 11.88). The mean difference in improvement of scores between obstetric and gynecologic case studies was 1.07 points (95% confidence interval, –1.23 to 3.36) ($P = .36$). Figure 1 shows improvements in scores of obstetric and gynecologic case studies between the accreditation (group A1) and reaccreditation (group A2) applications.

The proportion of practices successfully meeting accreditation requirements with the initial submitted scores of obstetric case studies was 57.3% for the accreditation applications (group

Table 1. Comparison of Scores of Case Studies Between Initial Accreditation (Group A1) and Reaccreditation (Group A2) Applications

	Score, Median (Range)	
Case Studies	**Initial Accreditation (Group A1)**	**Reaccreditation (Group A2)**
Obstetric 1	91.5 (62–100)	96 (65–100)*
Obstetric 2	90 (34–100)	96 (78–100)*
Obstetric 3	91 (46–100)	95.7 (70–100)*
Obstetric 4	88 (36–100)	95.2 (56–100)*
Obstetric average	88.2 (53–99)	94.5 (72–100)*
Gynecologic average	89.7 (60–100)	94.9 (78–100)*

*Reaccreditation scores were significantly higher for all cases ($P < .001$ for all).

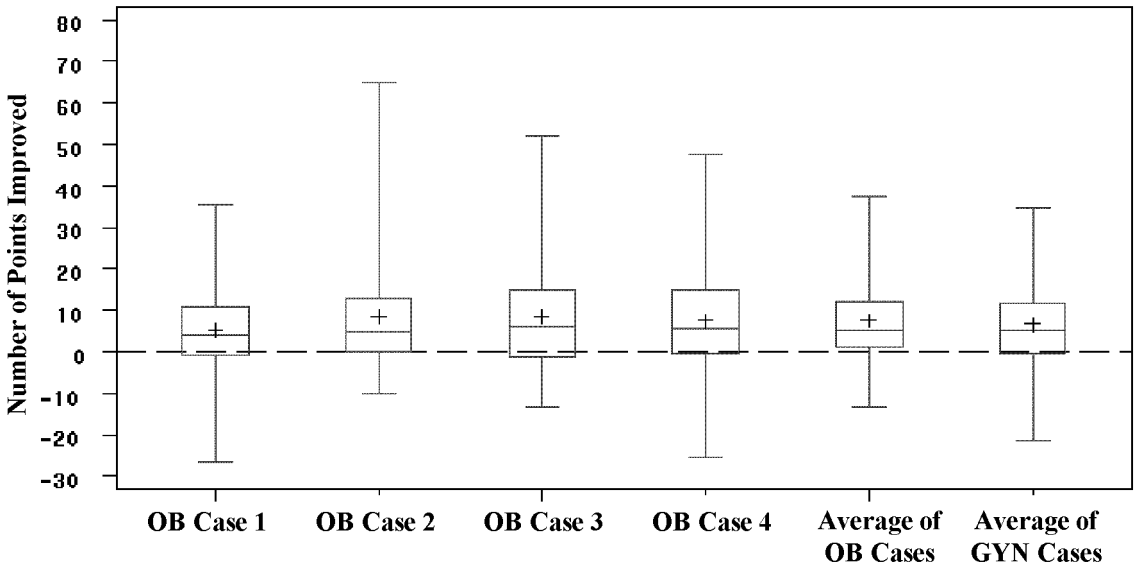

Figure 1. Improvement in scores of case studies with the reaccreditation application. Box plots show the distribution of improvement of scores measured as the difference between reaccreditation (group A2) and first accreditation (group A1) scores. From top to bottom, the lines represent the maximum difference, 75th percentile, median, 25th percentile, and minimum difference. Plus signs represent the mean difference. A difference of 0 (dotted reference line) implies no change in score; positive differences imply improvement in scores over time; and negative differences indicate a worsening of scores. GYN indicates gynecology; and OB, obstetrics.

A1) compared with 86.6% for the reaccreditation applications (group A2) ($P < .001$). Similarly, 61.4% of practices successfully earned gynecologic accreditation with the first accreditation application (group A1) compared with 91.9% for the reaccreditation application (group A2) ($P < .001$). Furthermore, 23 (78.1 %) of 32 practices that did not meet accreditation requirements with the submitted obstetric scores of the initial accreditation (group A1) successfully met the requirements with the submitted scores of the reaccreditation application (group A2).

Scores of initial case studies were also compared between practices from group A1 (accreditation) and group A2 (reaccreditation) with practices from group B (recent accreditation) to account for the element of time. Practices in group B underwent first accreditation in the same time frame as group A2 underwent reaccreditation. There was no significant difference in the proportion of applications whose scores successfully met the AIUM requirements for accreditation between groups A1 and B (obstetrics, 57.3% [group A1] versus 68.8% [group B]; $P = .13$; gynecology, 61.4% [group A1] versus 64.4% [group B]; $P = .73$). Furthermore, no significant differences were noted for the average gynecologic scores of case studies (median A1 = 89.7 versus median B = 91.5; $P = .89$), the first obstetric case study (median A1 = 91.5 versus

Table 2. Comparison of Scores of Case Studies Between Recent Accreditation (Group B) and Reaccreditation (Group A2) Applications

	Score, Median (Range)		
Case Studies	**Recent Accreditation (Group B)**	**Reaccreditation (Group A2)**	***P****
Obstetric 1	93.5 (56–100)	96 (65–100)	.018
Obstetric 2	95 (45–100)	96 (78–100)	.047
Obstetric 3	93 (30–100)	95.7 (70–100)	.007
Obstetric 4	87 (28–100)	95.2 (56–100)	.001
Obstetric average	92 (45–100)	94.5 (72–100)	.003
Gynecologic average	91.5 (41–100)	94.9 (78–100)	<.001

*Reaccreditation scores were significantly higher for all cases.

median B = 93.5; $P = .25$), the third obstetric case study (median A1 = 91 versus median B = 93; $P = .25$), and the fourth obstetric case study (median A1 = 88 versus median B = 87.1; $P = .25$). However, group B case studies scored significantly higher than group A1 studies for the second obstetric case study (median B = 95 versus median A = 90; $P = .03$) and the average of obstetric case studies (median B = 92.1 versus median A1 = 88.25; $P = .01$). When reaccreditation scores of group A2 were compared with initial accreditation scores of group B, median reaccreditation scores (group A2) were significantly higher than scores of group B for all individual obstetric case studies (1–4) as well as the scores of the average obstetric and gynecologic case studies, as seen in Table 2. Additionally, 86.6% of group A2 practices successfully met the AIUM requirements for obstetric accreditation compared with 68.8% of group B ($P = .005$). Similarly, 91.9% of group A2 practices successfully met the AIUM requirements for gynecologic accreditation compared with 64.4% of group B ($P < .001$).

Discussion

The AIUM ultrasound accreditation program was designed to improve the quality of ultrasound examinations in the United States and Canada.

Our study shows that practices that seek and receive ultrasound accreditation were able to improve the scores of case studies and compliance with AIUM minimum standards and guidelines for the performance of obstetric and gynecologic ultrasound examinations. Clinical standards and practice guidelines of the AIUM are intended to provide the medical ultrasound community with guidelines for the performance and recording of high-quality ultrasound examinations.[7,8] The standards and guidelines reflect what the AIUM considers the minimum criteria for a complete examination in each area, and practices are encouraged to go beyond the standards and guidelines to provide additional services and information as needed by their patients.[7] Around 40% of practices initially seeking accreditation were operating below the AIUM standards and guidelines for the performance of ultrasound examinations. Our results show a highly significant improvement in scores for all obstetric and gynecologic case studies when the scores of practices seeking accreditation were compared with their respective scores at the time of reaccreditation 3 years later. Indeed, 85% of case studies, submitted by practices seeking reaccreditation, met the AIUM standards and guidelines for the performance of ultrasound examinations, a highly significant improvement from the original accreditation applications.

Improvement in scores of case studies and compliance with AIUM standards and guidelines in accredited practices may be explained by the process of accreditation, which involves a thorough and continued evaluation of the practice. Physicians of practices that seek accreditation must provide evidence of training in ultrasound by completing an approved residency program, fellowship, or postgraduate training that includes the equivalent of at least 3 months of diagnostic ultrasound training under the supervision of a qualified physician, during which the trainees will have evidence of being involved with the performance, evaluation, and interpretation of at least 300 sonograms. In the absence of formal training, documentation of clinical experience could be acceptable, providing evidence of 100 hours of CME activity dedicated to ultrasound and evidence of being involved with the performance, evaluation, and interpretation of at least 300 sonograms within a 3-year period. By the time of reaccreditation, practices must show evidence of 30 CME credits in ultrasound for every physician and sonographer in the practice, and all practice sonographers must be certified in ultrasound. Practices that acquire ultrasound accreditation must adhere to the standards and guidelines for ultrasound examinations as published by the AIUM and must show evidence of protocols and quality assurance measures to ensure the proper and safe performance of ultrasound examinations. Noted deficiencies in case studies when submitted by practices seeking accreditation are communicated back to the respective medical directors. The medical directors are therefore afforded the opportunity to modify their ultrasound practices to conform to the standards and guidelines for ultrasound examinations. This constructive process of review and communication results in increased familiarity of sonologists and sonographers with the standards and guidelines of ultrasound examinations and directly translates into improved compliance and enhancement of ultrasound practice patterns.

Our findings suggest that the AIUM accreditation program is meeting its goal to improve ultrasound practice patterns.

It is also possible that ultrasound practices that are applying for reaccreditation (group A2) are already familiar with the accreditation process and submit initial cases for reaccreditation that conform to the AIUM published standards and guidelines for the performance of ultrasound examinations. This familiarity with the AIUM accreditation process rather than an overall improvement in the quality of ultrasound examinations may have accounted for improvement in scores. Our current data cannot address this issue. It is logical to deduce, however, that an increased awareness and familiarity with the AIUM published standards and guidelines, compliance with the CME requirements for physicians and sonographers, and the requirement for certification of sonographers for practices seeking accreditation should lead to improved quality of ultrasound practice. Future studies should address this issue.

Several studies have confirmed that improvement in operator experience and image quality over time allows for a higher detection rate of congenital abnormalities by ultrasonography.[9–11] Given that our comparison groups (groups A1 and A2) were separated by time (at least 3 years), we needed to determine whether the effect of time could totally account for the improvement in scores. To address this issue, a control group (group B) was chosen for comparison, which represented a list of practices that applied for and received accreditation in 2002 and 2003. This time frame was 3 years after group A1 applied for accreditation (1998–2001), roughly the same time as group A2 applied for reaccreditation. When we compared group A1 with group B, no significant difference was noted in the proportion of applications that successfully met the AIUM requirements for accreditation. Indeed, no significant difference was noted for the average gynecologic, first obstetric, third obstetric, and fourth obstetric case studies between groups A1 and B. These findings suggest a lack of selection bias between groups A1 and B. Furthermore, practices from group A2 (reaccreditation) showed significantly higher scores for all obstetric case studies as well as the average obstetric and gynecologic case studies when compared with practices from group B that were applying for AIUM accreditation for the first time (Table 2). These findings confirm that the process of accreditation itself, rather than the element of time, played a significant role in the improvement in scores of all case studies that was seen when the initial accreditation applications (group A1) were compared with the reaccreditation applications (group A2) submitted 3 years later. The element of time and the growing familiarity with the AIUM standards and guidelines for the performance of ultrasound examinations may explain higher scores for group B for the second obstetric and average obstetric case studies when compared with group A1.

In conclusion, our study shows that ultrasound accreditation adds value to the practice by improving compliance with AIUM minimum standards and guidelines for the performance of ultrasound examinations, which should translate into an enhancement of the quality of ultrasound practice.

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