ORIGINAL ARTICLE

RELIABILITY OF CHART AUDIT FOR ASSESSMENT OF RADIOLOGY REPORTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

INTRODUCTION: Written radiology reports are the prime output of radiology departments of any hospital. However, procedures to assess and improve quality of these reports are virtually non-existent. In the present study, we evaluated the reliability of chart audit as a tool for assessing radiology reports at a tertiary-care hospital. **MATERIALS AND METHODS:** A cross-sectional study was carried out at the Department of Radiology of Aga Khan University Hospital (Karachi, Pakistan). Forty five (45) radiology reports pertaining to different specialties and reported between October and December, 2014 were selected. These reports were prepared by three different residents in second, third and fourth years of their residency. The final report was signed by different consultant radiologists at our hospital. Each report was assessed by four assessors using the "Bristol Radiology Report Assessment Tool (BRRAT)." Assessors were two faculty members with more than five years of experience and two year V residents. **RESULTS:** Mean overall assessment score of radiology reports was 6.54/10 ± 0.14 (standard error of mean). Cronbach's alpha (α) co-efficient was calculated to be 0.760, suggestive of good internal consistency. Pearson's correlation coefficients for intra-faculty, intra-resident and inter-observer correlations were 0.796, 0.715 and 0.736 respectively. **CONCLUSION:** These results indicate that chart audit using BRRAT is a reliable method for assessing written radiology reports. This tool may be used for work-place based assessment of radiology reports, which can potentially lead to improvements in overall quality of radiology reports.

Keywords: Chart audit, Bristol Radiology Report Assessment Tool, Workplace-based assessment, Reliability analysis

Introduction

Medical charts are documents that systematically record the process of patient care during the course of a patient's illness.[1] In the specialty of radiology, written radiology reports are similar to medical charts in that they can elicit specific information about processes of patient care including diagnosis, record keeping and decision making.[2] At the same time, radiology reports reflect the abilities of the writer to effectively interpret and communicate radiological findings to patient's primary care providers.[3] In this context, technically correct, elaborate and unambiguous radiology reports are crucial for efficient and effective patient care.[4]

Despite the importance of radiology reports, methods and tools to teach and assess radiology reports are relatively scarce. The daunting task of preparing a technically correct, informative and accurate radiology report is often carried out by radiology residents. While consultant radiologists ultimately review these reports, substantial improvement in the quality of a

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poorly-written report is not always possible, especially when pressed against time.[5] In Pakistan, no systematic method or curriculum is currently employed to teach and/or assess reporting skills of radiology residents.[6] Less than one hour of didactic teaching is devoted to teaching reporting skills in residency programs in the United States and United Kingdom.[7] These facts necessitate the development and implementation of procedures and mechanisms that can be used to enhance reporting skills of radiology residents on one hand and improve overall quality of radiology reports on the other.

Chart audits systematically review the care provided by trainees and physicians, which can enable them to reflect on their work and improve.[8] In the field of radiology, audit of radiology reports using workplace-based assessment (WPBA) tools can be potentially used to improve quality of radiology reports and enhance reporting skills of radiology residents.[9] However, low inter-observer agreement and limited reliability have hindered the widespread use of such tools till now.[10,11] In the present study, our aim was to evaluate the reliability of chart audit for the assessment of radiology reports at our department.

Materials and Methods

A descriptive (cross-sectional) study was carried out in the Department of Radiology at Aga Khan University Hospital in April, 2015. Forty five (45) reports of three common radiologic modalities i.e. magnetic resonance imaging (MRI), ultrasonography (US) or computed tomography (CT), were included in this study. Normal reports were excluded from consideration as they use a predefined template. These reports pertained to different organ-systems of the body including neurologic, pulmonary, gastrointestinal, genitourinary and musculoskeletal systems. These reports were prepared by three radiology residents, who were in their second, third and fourth years of residency. All reports were signed by different consultant radiologists of our institution.

In order to ensure confidentiality and reduce bias, all reports were anonymized by the principal investigator of this study (NN) prior to assessment. Moreover, resident names or other identifiers were not recorded in this study. Unique code numbers were allotted to residents and only these codes were used to identify residents. Patient data or content contained in radiology reports was not recorded. Confidentiality of all patients and residents was strictly maintained. Data to access was restricted and only the principal investigator (NN) had full access to the data.

Assessment of Reports

Each report was assessed by two faculty members and two year V residents. Faculty members had at least five years of experience in reporting general radiological scans, whereas year V residents had completed four years of post-graduate training in radiology. Note that this fulfils the current requirement for sitting the Fellowship of College of Physicians & Surgeons (FCPS) examination in diagnostic radiology in Pakistan.[12]

In order to identify an appropriate tool for carrying out chart audit, discussions were held with ten faculty members of our department. This was done in order to identify attributes and criteria that should be used to judge radiology reports. Based on consensus among faculty members, it was decided to use a tool that had been previously validated in the developed world viz. Bristol Radiology Report Assessment Tool.[13] This tool contains 19-items that assess four different aspects of a radiology report: (1) technical aspects; (2) clarity and structure; (3) conclusions; and (4) clinical implications. Each item can be graded as above expectation, meets expectation, below expectation or not applicable. In addition to these 19 items, assessors also give an opinion regarding the complexity of the report (low, average or high) and an overall (global) assessment score ranging from 1 (below expectation) to 10 (above expectation).

Sample Size

As previously reported by Wallis et al,[13] if four assessors rate 45 reports using BRRAT, the generalizability coefficient (G) for the global assessment

score can reach 0.80. Based on this calculation, we included four assessors and 45 reports in the present study.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) version 20 (IBM, Chicago, Illinois), GraphPadInStat version 3.0 (GraphPad, San Diego, California) and GraphPad Prism version 6.0 (GraphPad, San Diego, California) were used for the purpose of data entry, analysis and interpretation. For qualitative variables, frequencies [n] (percentages [%]) were computed, while mean ± standard error of mean was calculated for quantitative variables. Each of the 19 items of BRRAT were graded as per the response of the assessors: '+2' for *above expectations*, '+1' for *meets expectations*, '0' for *not applicable* and '-1' for *below expectations*. Cronbach's alpha (α) coefficient was calculated as a measure of internal consistency (using SPSS). This was reported both individually for each assessor and collectively for all assessors. Pearson correlation coefficient (r) was calculated as a measure of intra-faculty, intra-resident and inter-assessor agreement (using SPSS). Bland-Altman plot and scatterplots were also used to depict the agreement between assessors (using GraphPad Prism). To further detect differences between the four assessors, we decided to use a statistical test to compare the overall assessment scores assigned by the four assessors. In consultation with a statis-tician, Friedman test with Dunn's post-test correction was applied (using GraphPadInStat). For all comparisons, p-value (post-correction) of less than 0.05 was considered statistically significant.

Results

Of the 45 reports included in the study, most were deemed to be average (n=34, 76%) in complexity by all four assessors, while another 9 reports were deemed to be highly complex (n=9, 20%). Most of the included reports were of computed tomography (n=21 %) or magnetic resonance imaging (n=14, %) as shown in (Fig. 1A). Neurologic (n=17, %), respiratory (n=10, %) and gastrointestinal (n=9, %) systems were the most common systems to which these reports pertained (Fig. 1B).

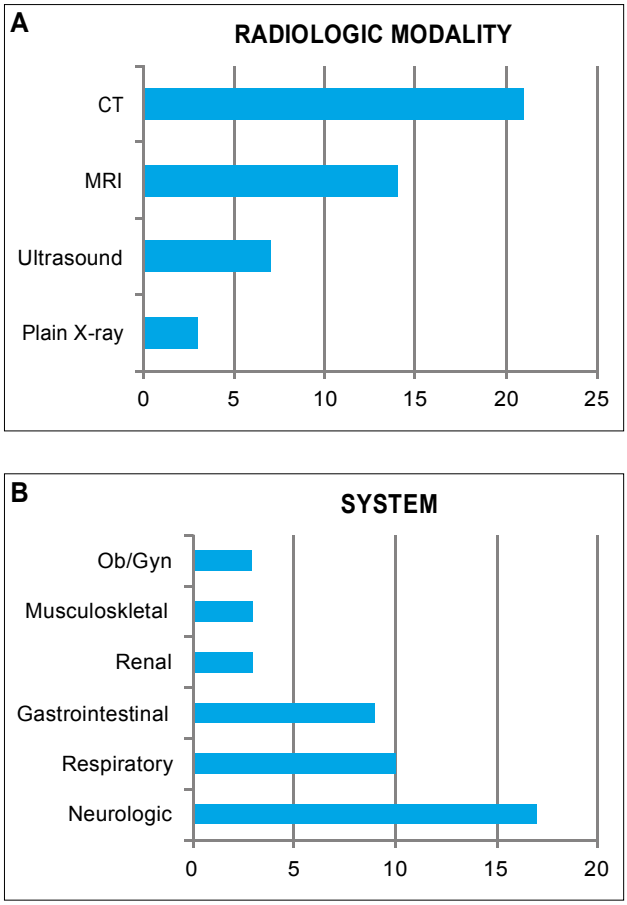


Figure 1: Frequency of different: **A.** radiologic modalities; and **B.** organ-systems, to which radiology reports pertained.

The mean score (along with 95% confidence interval) for each of the 19 items of BRRAT are shown in (Fig. 2). The lowest mean scores were noted for items 6 ("Are the quality and limitations of current study suggested?"), 13 ("Is diagnostic confidence stated if in doubt?"), 15 ("Is the differential diagnosis clear?"), 16 ("Where appropriate is there documented discussion with the referring clinician?"), 18 ("Is further investigation/intervention/follow-up suggested, and if so, with clear purpose?") and 19 ("Where appropriate is adequate focus on response to treatment given?"). The overall assessment scores assigned by the four assessors are depicted in (Fig. 3). Mean overall assessment scores for faculty 1, faculty 2,

resident 1 and resident 2 were 6.24 ± 0.17, 6.49 ± 0.16, 6.78 ± 0.18 and 6.67 ± 0.16 respectively.

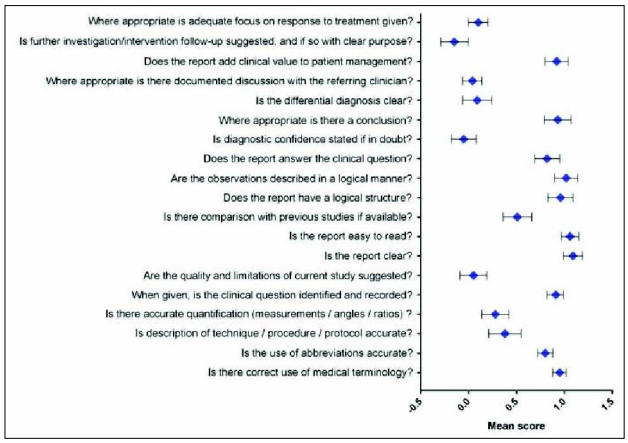


Figure 2: Mean score for 19 items of the Bristol Radiology Report Assessment Tool.

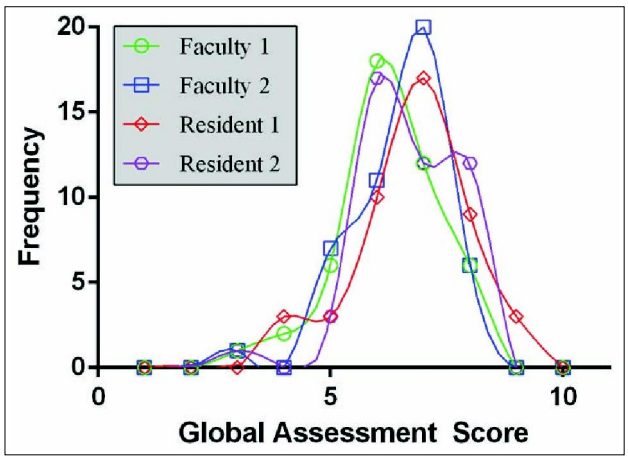
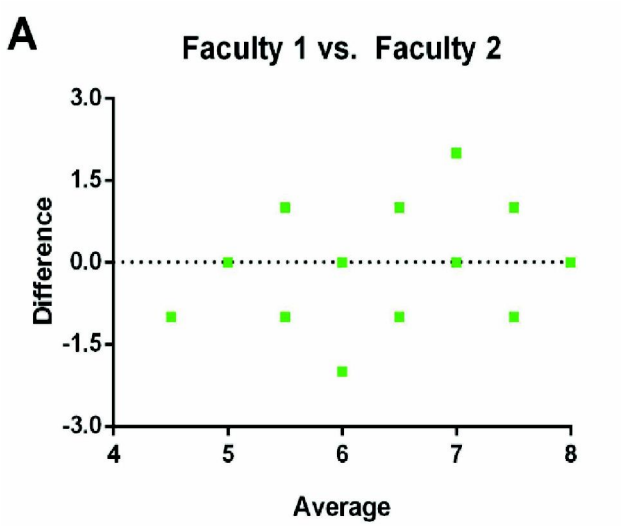
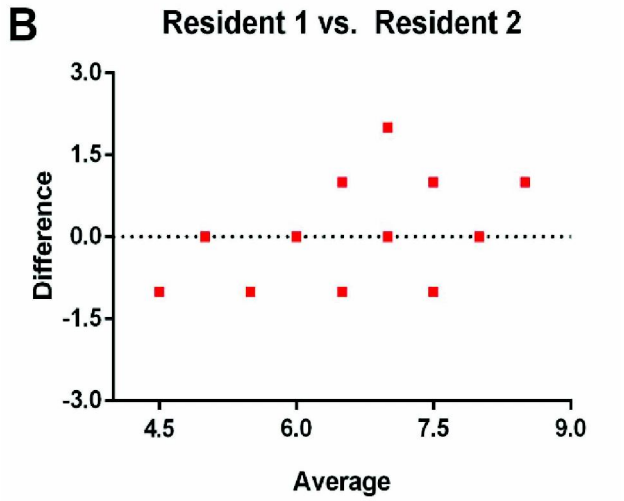
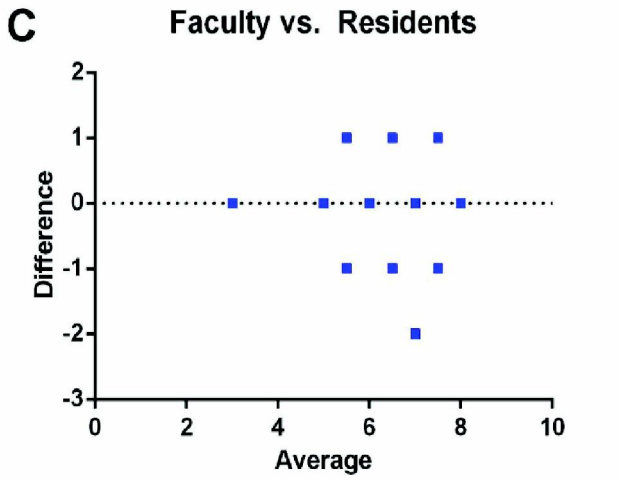


Figure 3: Frequency of overall assessment scores assigned to reports by the four assessors.

Cronbach's alpha (α) coefficients for faculty 1, faculty 2, resident 1 and resident 2 were 0.691, 0.729, 0.802 and 0.780 respectively. When all assessors were analyzed together, Cronbach's alpha coefficient was computed to be 0.760. Bland-Altman plots for inter-faculty, inter-resident and inter-observer agreement are shown in (Fig. 4A, 4B and 4C) respectively. Pearson correlation coefficients (r) for inter-observer, inter-faculty and inter-resident agreement were 0.738, 0.715 and 0.736 respectively. Comparisons of overall assessment scores assigned by these assessors are depicted in (Fig. 4D, 4E and 4F).







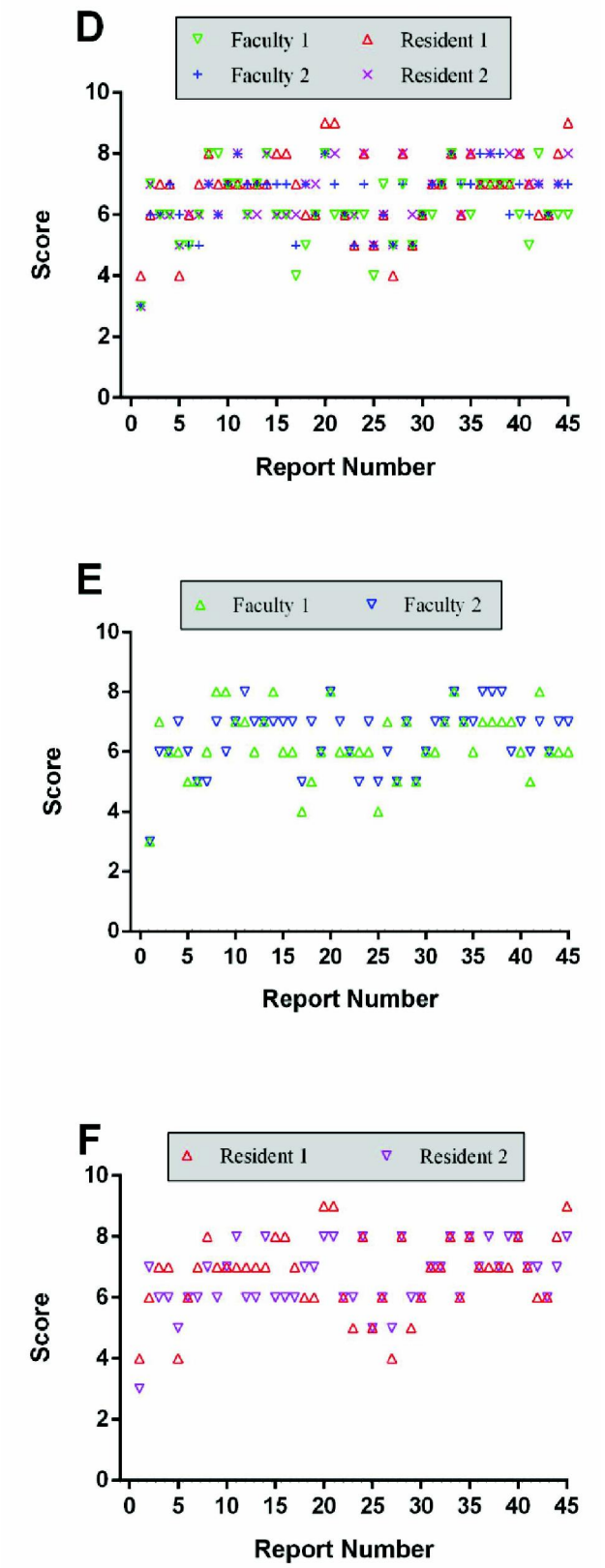


Figure 4:A, B, C. Bland-Altman plots; and **D, E, F.** Point graphs, for inter-faculty, inter-resident and inter-observer agreement.

Discussion

As mentioned previously, there is no formal method of teaching report writing skills to radiology residents in Pakistan. Even in the developed world, didactic activities with regards to report writing skills are very limited.[4] Therefore, it is of considerable interest to develop WPBA tools that can be used to assess and continuously improve quality of radiology reports.[9] In this preliminary cross-sectional study, we evaluated the reliability of chart audit using BRRAT for assessing radiology reports at our department.

BRRAT was initially developed and validated in the United Kingdom in the year 2013.[13] Although this tool is believed to have construct validity and alignment, only scarce literature has evaluated this claim.[14] To the best of our knowledge, no study from the developing world has validated the use of this tool for assessing radiology reports in resource-limited healthcare settings. In the present study, we evaluated BRRAT using four assessors and 45 radiology reports at our department. Validation of chart audit using BRRAT would be useful to develop a WPBA tool that can be used in radiology departments of different teaching hospitals of Pakistan to improve quality of radiology reports.[15,16]

Results of our study provide useful insights into reporting skills of radiology residents. In the present study, we included 45 reports that pertained to nearly every organ-system of the body. Moreover, we included reports of conventional imaging as well as cross-sectional imaging including CT, MRI and US. Most reports (76%) included in our study were ave-rage in complexity, which reflects that the sample of reports selected for this study were similar to the type of reports encountered by residents in actual clinical practice. Moreover, these results were also similar to those reported previously.[13]

BRRAT is a tool that assesses radiology reports using 19 items dispersed across four domains viz. technical aspects, clarity & structure, conclusion and consideration of clinical implications. In the first domain, most reports did not adequately mention the limitations and quality of the radiographic study. In some reports, protocol of the study and radiographic measurements were not accurately mentioned. On the other hand, most reports met the assessors' expectations with respect to their clarity

and structure. With regards to the third domain (conclusion), most reports did not mention the degree of diagnostic confidence and many of them did not adequately address the differential diagnosis. Moreover, most reports did not meet the assessor's expectations with respect to reporting clinical implications of the report; in particular, discussion with referring clinicians, response to treatment and need for follow-up studies were not satisfactorily addressed. These results are of interest as they reveal the areas where radiology reports most commonly fall short of expectations.[4,17] Thus these results can be used to design targeted strategies for improving quality of radiology reports and enhance reporting skills of radiology residents.[18,19]

One major impediment in the implementation of chart audits is their limited reliability.[10,11] In the present study, one of our prime objectives was to evaluate the reliability of chart audit using BRRAT. Cronbach's alpha (α) coefficients were calculated, which showed that the tool used in this study had strong internal consistency. Moreover, Pearson's correlation (r) coefficients for inter-faculty, inter-resident and inter-observer agreement indicated strong agreement between the assessors. These results established the reliability of chart audit using BRRAT for assessing radiology reports. By establishing the reliability of this technique, we provide evidence for the use of this WPBA tool for assessing and potentially improving quality of radiology reports. This tool can also be potentially used in formative assessments to build reporting skills of radiology residents.

While this study utilized BRRAT for assessment of radiology reports, few other scales have also been developed for this purpose.[20] These scales have not enjoyed widespread popularity because their reliability and validity remains questionable.[21] It has been established previously that summative methods of assessment require a high degree of validity and at times, this can compromise reliability.[22,23] Consequently, literature published previously on BRRAT suggests that BRRAT should be used primarily as a WPBA tool.[13] By using BRRAT for formative assessment, residents can identify their areas of consistent weakness and work towards improving those weaknesses. As in our study (as well as previous literature), several reports of one radiology resident need to be assessed by different assessors in order to improve reliability and consistency.[24] This can be achieved by conducting multiple assessment sessions on a regular basis, which can allow residents to receive continuous feedback and avail opportunities for improving their reporting skills.[25,26]

The results of this study have provided some evidence for the use of chart audit (using BRRAT) for the assessment of radiology reports. This workplace-based assessment tool is of interest as it can be potentially used to improve quality of radiology reports and develop reporting skills of radiology residents.[9] In the light of the results of this study, we would be able to introduce and implement targeted inter-ventions for rectifying weaknesses in radiology reports of our department. Furthermore, these results are encouraging in that this tool can be extended to be used in other teaching hospitals and institutions of Pakistan as well.

Before concluding, it is important to bear in mind the limitations of this study. The first and foremost limitation of this study was that the sample size for this study was small (45 reports), which barred us from performing sub-group analysis (i.e. comparison of residents of year II vs. III vs. IV). Secondly, in this study, we did not assess radiology reports pertaining to fluoroscopy and nuclear medicine scans, which are often more complex than conventional radiology reports. Additionally, our study was performed in a single tertiary-care hospital in Pakistan with state-of-the-art radiological facilities. Therefore, the results of this study may not be generalizable to all hospitals of Pakistan where radiologic facilities are often limited. However, this study is still of considerable importance as it shows that chart audit (using BRRAT) is reliable and can be used for assessment of radiology reports. The results of this study are encouraging in that they can be used for implementation of such work-based assessment tools in radiology departments of other tertiary care hospitals of Pakistan.

This study can also be used as a foundation for carrying out further research in this direction in Pakistan. Producing accurate, unambiguous and elaborate reports is a prime task of all radiologists, but, little formal teaching is dedicated towards teaching reporting skills to radiology residents.[7,15] In the light of the results of this study, this workplace-based assessment tool can be used to continuously assess and improve quality of radiology reports on one hand,

and improve reporting skills of radiology residents on the other. Prospective studies in the future can then build along the lines of this study and document the effectiveness of this tool in improving reporting skills of radiology residents over time.

Conclusion

Chart audit using Bristol Radiology Report Assessment Tool is a reliable method for assessing radiology reports. This workplace-based assessment tool may be utilized in radiology departments for continuously assessing and potentially improving quality of radiology reports.

CONFLICTS OF INTEREST:
The authors declare that they have no conflict of interest regarding this study.

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