HOW AND WHY TO MIGRATE TO A STRUCTURED AND CONTEXTUALIZED RADIOLOGY REPORT?

¿Cómo y por qué migrar hacia el informe radiológico estructurado contextualizado?

Camilo Alberto Caicedo Montaño[1]
Rodrigo Andrés Martínez de los Ríos[1]
Rodolfo Mantilla Espinosa[1]
Claudia Patricia Dávila Valdés[2]

Key words (MeSH)
Radiology information system
Diagnosis, computer-assisted
Medical informatics

Palabras clave (DeCS)
Sistemas de información radiológica
Diagnóstico por computador
Informática médica

Summary

Structured reporting in radiology fulfill three fundamental characteristics: they have a uniform structure that answers a clinical question, they are the product of standardized checklists or of knowledge trees previously arranged with multidisciplinary clinical teams, and they are incorporated in option-selection boxes available in electronic reporting systems. Among the main advantages of migrating towards structured reporting are the uniformity and high quality of the report, the increase in intra and interobserver concordance, as well as the reduction of the diagnostic error rates and a significant improvement in communication with the clinical practitioner. This thematic review covers the essential characteristics of the structured report, the arguments for and against it, the recommended steps for its implementation, and the future opportunities for improvement.

Resumen

Los informes estructurados contextualizados cumplen tres características fundamentales: tienen una estructura uniforme que responde una pregunta clínica, son el producto de listas de chequeo estandarizadas o de árboles de conocimiento previamente concertados con equipos clínicos multidisciplinarios y se construyen a partir de cuadros de selección de atributos incorporados en los sistemas de informe electrónicos, adicionalmente, el atributo *contextualizado* hace referencia a la capacidad del informe de responder las preguntas clínicas de la situación actual del paciente, otorgando información relevante de forma concisa y clara a los médicos tratantes. Dentro de las principales ventajas de migrar hacia el informe estructurado se encuentran la uniformidad y la alta calidad del informe, el aumento en la concordancia intra e interobservador, así como la reducción de las tasas de error diagnóstico y una mejora significativa en la comunicación con los médicos tratantes. Se presenta una revisión temática que abarca las características esenciales del informe estructurado contextualizado, los argumentos a favor y en contra de este, los pasos recomendados para su implementación y las oportunidades de mejora hacia el futuro.

[1]Resident Doctor of Radiology and Diagnostic Imaging, Fundación Universitaria Sanitas. Bogotá, Colombia.

[2]Radiologist. Department of Radiology, Clínica Universitaria Colombia. Associate Professor of Radiology, Fundación Universitaria Sanitas. Bogotá, Colombia.

Introduction

The radiology report is the main means of communication between radiologists and treating clinicians and is one of the parameters for evaluating the quality of a diagnostic imaging service (1, 2). The reports have a high variability in terms of language, length and style (3), which remained virtually unchanged between 1930 and 1990 (4, 5). However, in recent years the revolution in medical informatics has allowed them to be transformed, and computerized systems for the digital archiving of medical images (PACS, acronym for Picture Archiving and Communication System) now have applications that allow the generation of structured and uniform reports, with more effective analysis, which provide the clinician with a higher quality result (4).

In this thematic review article, four main aspects are analyzed: the components of a structured report, the advantages and disadvantages involved in its realization, the processes required for its implementation and what are the opportunities for improvement in the future.

1. What is a structured report in context?

Structured reports, as their name indicates, are the result of applying a logical structure to the radiological report, therefore, they fulfil three basic conditions:

- They have a uniform structure, whose main objective is to answer a clinical question, going beyond personal patterns or existing institutional templates (6).
- They are the result of a pre-established checklist or knowledge tree, i.e. a set of disease-specific questions and answers that allow a systematic approach to imaging (7) and are previously discussed with an interdisciplinary clinical team (4) (Figure 1).
- They are written using attribute selection tables incorporated into the PACS, and with marking of representative images for diagnosis (4, 6) (figure 2).

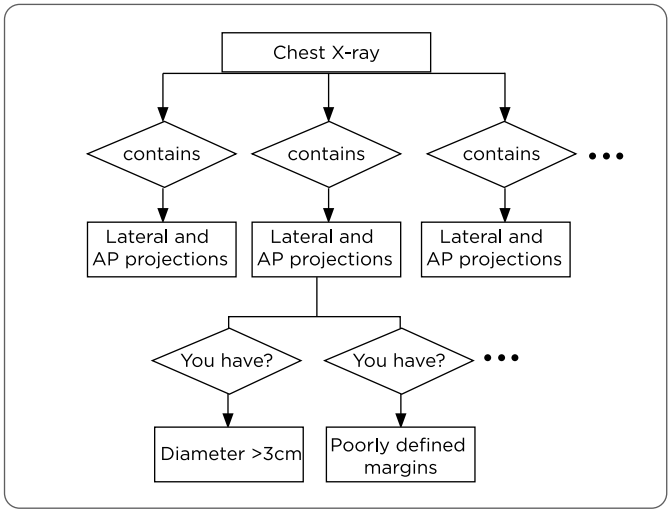

Figure 1. Example of a knowledge tree. as mL and mg (12).
Source: Translated and adapted by Hussein and collaborators (6).

Figure 2. Example of a structured report incorporated into a PACS
Source: Taken from Bernaldo-de-Quirós and collaborators (4).

- A structured report should have: the title of the study, clinical data, previous studies for comparison, technique, findings - organized by subtitles according to the organ or system -, conclusions - numbered and ranked according to order of importance (3, 8-9) - and, if applicable, recommendations and standardized classifications. The proposed structure is flexible, as the report must be adapted to the patient's context and be able to adequately answer the clinical questions generated by the treating physicians, i.e. it must be disease oriented, not merely describing the technique, the visualized anatomical structures or the identified findings.
- Likewise, the radiological report, both structured and prose, must have the following attributes in terms of form:
- It has a font, spacing, numbering, indentation and use of standardized capital letters for the whole institution (10).
- It uses the lexicon standardized by the Radiological Society of North America (RSNA) for the denomination of the studies (RadLex®)(11) and by the Unique Codes of Health Procedures (UCHP) currently valid in Colombia (12).
- It mentions the contrast media with a generic name, the dose administered and whether it required a nephroprotection protocol (12).
- It uses impersonal language, avoiding words such as "I observe" or "we see" (13).
- It is written in present and tacit, preferring "the tumor displaces the ventricle" to passive time options such as "the ventricle is being displaced by the tumor" (13). In the case of interventional radiology, the procedure is described in past tense and the findings in present tense (12).
- It is written directly, avoiding redundant language such as "is displayed" or "has been found" (12).
- It avoids conditional language; it does not use words such as "looks like" or "could be treated" (13).
- It is based on word economy, that is, it avoids the use of unnecessary words that do not add value to the report (13).
- Does not include incomplete words, avoids phrases such as "spondylolysis" or "listesis", when the correct term is spondylolisthesis (12).
- Does not use acronyms and checks for proper writing of units
- Reserve for really necessary cases phrases like "correlate with clinical" or "if clinically indicated" (13).

- It does not include judgements on the medical act of the treating physician, such as "fracture incorrectly corrected" (13).
- It avoids cacophony, that is, it does not repeat words that are included among themselves, such as "tendinitis of the supraspinous tendon" (13).
- It does not use double negatives such as "cannot be ruled out", or isolated negatives that detract from the report as "non-specific" or "not observed" (13).
- It avoids terms offensive to the patient such as "technically limited by the patient's constitution" (13).
- In cases that require comparison of measures with previous studies, include the use of tables or hyperlinks (14).
- Always include all the findings, clarifying whether a finding is incidental (13) and whether it has pathological implication or not (14).
- Describe the findings where they apply and the conclusions at the end, in the subtitle Conclusion, do not repeat (12).
- In the conclusion there are a maximum of three differential diagnoses, to avoid confusion for the clinician (7, 13, 15).
- The conclusion clarifies if there are critical findings and how they are communicated to the treating physician (16).
- It includes the radiation dose in those studies based on ionizing radiation (17). In interventional radiology procedures it includes the time of exposure to radiation (18).
- In interventional radiology procedures that include biopsy sampling, it describes what type of biopsy was performed, the number of samples obtained and the preparations made (18).
- It includes in the signature of the study all the people involved in the reading, including the residents with their full names (19).
- It includes, if necessary, the evidence that supports the conclusion or recommendations (6) and the classification according to the existing reporting and information systems (BI-RADS, LI-RADS, among others).
- There are no transcription errors, as the report is properly reviewed before validation (1).

In practical terms, you can consult examples of the recommendations in the RSNA RadReport® initiative of structured reports, which allows you to view and apply for structured reports in Spanish and English (16, 17, 20) (figure 3).

2. Why migrate to structured reporting?

Multiple benefits and obstacles are described in the literature (table 1) (3, 21-33).

The experiences of implementing structured reporting have varied among institutions and countries. For example, in the United States it is estimated that only 51% of radiologists use it consistently, in Belgium 55% and in Italy 46% (1). In closer countries, such as Chile, studies have been conducted on the impact on the clinician of the radiological report (27); however, there is still no published information regarding the structured report.

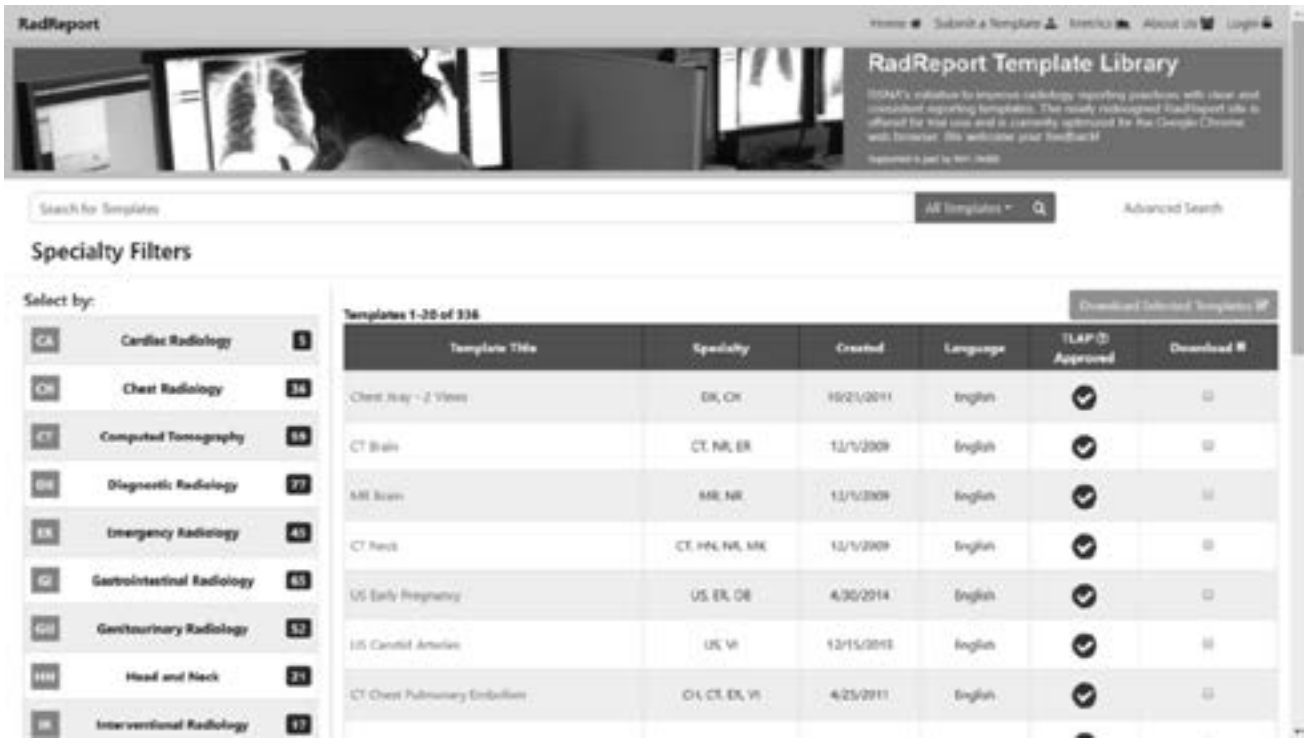

Figure 3. RSNA Structured Reporting Initiative (RadReport®).
Source: Taken from RSNA (20).

Table 1. Benefits and Obstacles of Structured Reporting

Benefits	Obstacles
It increases the quality of the report, ensuring the use of standardized language and the response to the questions already agreed upon with the clients.	There is a high resistance to change.
Increases intra observer and inter observer agreement	It has a slow, time consuming learning curve (34).
Reduces the diagnostic error rate.	It is considered a "myopia" phenomenon, which increases concentration on the report rather than on the image (34).
Reduces clinical knowledge bias.	Increased time needed to report.
Increases identification of clinically significant incidental findings.	Some patterns increase errors if not read carefully.
Decreases the frequency of errors of omission, syntax and semantics.	Some applications have multiple clicks, commands, and menus.
Ensures a high degree of report completeness	There is a fear of oversimplifying the report.
Stimulates the search for research information.	There is no global consensus for the application of structured reporting.
It is used as an indicator of quality in radiology services.	It requires a high degree of investment in PACS.
Promotes evidence based medicine by integrating clinical and radiological information in an appropriate manner.	In the clinician it creates a sense of stereotyping in the report.
Reduces the need for additional studies when they are not indicated.	The use of checklists is considered to "reduce the curiosity of the radiologist".

3. How to migrate to the structured report?

Although there are multiple proposals in the literature, the most accepted was recently published by Stanford University (14), which postulates ten steps to implement structured reporting in an institution. A summary is presented in table 2 (10).

4. The future of structured reporting: opportunities for improvement

The structured report remains a topic of discussion and even further adaptations are envisaged and should be made. The most relevant of these are described below:

- The construction and use of the structured report should be formally incorporated into the curriculum of residency programs (15, 35), emphasizing the medico-legal and ethical nature of the report, both because of the misdiagnosis and the lack of description of the findings.
- Recommendations for communication of findings should be incorporated into the reports, in accordance with the clinical practice guidelines developed by the American College of Radiology (ACR) (15).
- There should be a move towards structured and contextualized reporting, with alternative reporting methods available according to the indication of each study (7).
- Applications based on artificial intelligence and available on the web should be developed that allow the automatic calculation of scales and risk calculators (17, 36).
- Promote in parallel the review of the proposed structured reports by peers outside each institution (3).
- Accompany the implementation of the structured report of measurements based on value and not on volume (3, 33, 37), in accordance with the Radiology Cares® initiative of the RSNA.
- Where possible, integrate the reports of hybrid studies with the report generated by nuclear medicine, and the reports of procedures that include biopsy, with the pathology results (3). This allows you to move closer to precision radiology and to have a solid foundation for when radiomics studies increase in demand.
- Include the institutional mail of the radiologist and the resident in charge of reading, to allow feedback from the clinicians (3).
- Where possible, include patient-friendly information links, such as those developed by Radiology Info® at RSNA and ACR. It has even been proposed to develop simplified reports, with common language, that are understandable to patients (3, 38).

Table 2. Steps for the implementation of the structured report

Step	Components
Step 1. Managing the system	Assign a person responsible for the transformation, with sufficient motivation and knowledge of the subject.
Step 2. Institutional commitment	Verify that institutional and financial support is in place before continuing the process. If the PACS required to generate structured reports is not available, manage its purchase or upgrade. Present the project to radiologists and residents of the service, explaining that personal patterns will be disabled or deleted.
Step 3. Creating the Committees	Based on the most relevant clinical issues, organize committees to initiate discussion on how structured reports should be constructed.
Step 4. Change management strategy	Prepare the radiologists and residents of the service for the change, emphasizing the benefits to the patients and to the working group.
Step 5. Launching the project	Set a project goal, for example, to achieve 95% structured reporting for the volume of a given study.
Step 6. Construction meeting	Delegate tasks to committee members to begin building the new reports. Ideally, anonymously.
Step 7. Development and follow-up	Allocate the time needed for the preparation of new reports and monitor progress.
Step 8. The editing process	Check the uniformity of the text between the different structured reports.
Step 9. Project management	Start the application of the structured report, incorporating them into the PACS and be open to feedback from all radiologists and residents to make any necessary adjustments.
Step 10. Governance and management	Continue to make modifications to the reports as required and, through the committees, make ongoing assessments of the content. Be sure to maintain commitment and monitor the proposed goal.

5. Conclusions

La tendencia a migrar al informe estructurado está basada en las venThe tendency to migrate to the structured report is based on the advantages it represents in terms of quality, standardization and reduction of errors. The implementation process requires that the report meets three essential characteristics and that there is a strong institutional commitment that allows the fulfillment of the ten steps proposed by Stanford University. Likewise, there are challenges and opportunities for improvement in the framework of value-based radiology, integration with other specialties such as nuclear medicine and pathology, and emerging areas such as artificial intelligence, radiomics and precision radiology.

References

1. Ausilio FO. Calidad en radiología:evaluación de estructura, procesos y resultados. San Fernando de Valle de Catamarca, Argentina. Salud Areandina. 2010;1(2):22-43.
2. Schiavon F, Grigenti F. The structured report and PACS. En:Schiavon F, Grigenti F. Radiological reporting in clinical practice. Milán, Italia: Springer Science & Business Media; 2008. pp. 106-8.
3. Ganeshan D, Thi-Duong PA, Probyn L, Lenchik L, McArthur TA, Retrouvey M, et al. Structured reporting in radiology. Acad Radiol. 2018;25:66-73.
4. Bernaldo-de-Quirós FG, Plazzotta F, Campos F, Kaminker D, Martínez MF, López-Osornio A, et al. Creación de un sistema de reportes estructurados, codificados y estándares. InfoLAC [internet]. 2008, AAIM [citado 2019 may. 2]. Disponible en: www.researchgate.net/publication/255647450_Creacion_de_un_Sistema_de_Reportes_Estructurados_Codificados_y_Estandares
5. Langlotz CP. Radiology reporting best practices. En: Langlotz CP, The radiology report: A guide to thoughtful communication for radiologist and other medical professionals. North Charleston, SC: CreateSpace, 2015. cap. 3.
6. Hussein R, Engelmann U, Schroeter A, Meinzer HP. DICOM structured reporting. Part 1. Overview and characteristics. RadioGraphics. 2004;24:891-6.
7. Mamlouk MD, Chang PC, Saket RR. Contextual radiology reporting: A new approach to neuroradiology structured templates. AJNR Am J Neuroradiol. 2018;39(8):1406-14.
8. Khan CE Jr, Langlotz CP, Burnside ES, Carrino JA, Channin DS, Hovsepian DM, et al. Toward best practices in radiology reporting. Radiology. 2009;252 (3):852-6.
9. Heye T, Gysyn V, Boll DT, Merkle EM. Journal Club: Structured Reporting: The voice of the customer in an ongoing debate about the future of radiology reporting. J Am Coll Radiol. 2018;211(5):964-70.
10. Larson DB. Strategies for implementing a standardized structured radiology reporting program. RadioGraphics 2018;38:1705-16.
11. Noumeir R. Benefits of the DICOM structured report. J Digital Imag. 2006;19(4):295-306.
12. Bermúdez-Muñoz S. Del informe radiológico estructurado. Rev Colomb Radiol. 2016;27 (4):4535.
13. Martí-Bonmatí L, Tardáguila F, Bonmatí J. El informe radiológico: estilo y contenido (II). Radiología. 2004;46(4):199-202.
14. Kim DC, Herskovits EH, Johnson PT. Science to practice: IT solutions to drive standardized report recommendations for abdominal aortic aneurysm surveillance. AJR. 2018;15(6):865-9.
15. Cramer JA, Eisenmenger LB, Pierson NS, Dhatt HS, Heilbrun ME. Structured and templated reporting: An overview. Applied Radiology [internet]. 2014 [citado 2019 mar. 5]. Disponible en: www.appliedradiology.com/articles/structured-and-templated-reporting-an-overview
16. Stroopen-Rometti M. El radiólogo, el paciente y el informe radiológico estructurado. Sociedad Mexicana de Radiología e Imagen [internet]. 2010 [citado 2019 abr. 15]. Disponible en: www.smri.org.mx/memorias/rad2010/platicas/administracion/stoopen.pdf
17. Morgan TA, Helibrun ME, Kahn CE Jr. Reporting Initiative of the Radiological Society of North America: Progress and New Directions. Radiology. 2014;273(3):642-5.
18. Society of Interventional Radiology. Standardized Reporting User Guide [internet]. 2017 [citado 2019 may. 5]. Disponible en: www.sirweb.org/practice-resources/guidelines-by-document-type/guidelines-by-service-line/
19. Williamson KB, Steele JL, Gunderman RB, Wilkin TD, Tarver RD, Jackson VP, et al. Assessing radiology resident reporting skills. Radiology. 2002;225(3):719-22.
20. Radiological Society of North America. RadReport Template Library [internet]. 2019 [citado 2019 may. 5]. Disponible en: radreport.org/
21. Faggioni L, Coppola F, Ferrari R, Neri E, Regge D. Usage of structured reporting in radiological practice: results from an Italian online survey. Eur Radiol. 2017;27(5):1934-43.
22. Park SB, Kim MJ, Ko Y, Sim JY, Kim HJ, Lee KH. Structured reporting versus free-text reporting for appendiceal computed tomography in adolescents and young adults: Preference survey of 594 referring physicians, surgeons, and radiologists from 20 hospitals. Korean J Radiol. 2019;20(2):246-55.
23. Gunderman RB, McNeive LR. Is structured reporting the answer? Radiology. 2014;273 (1):7-9.
24. Wallis A, McCoubrie P. The radiology report—are we getting the message across? Clin Radiol. 2011;66(11):1015-22.
25. Reiner BI, Knight N, Siegel EL. Radiology reporting, past, present, and future: the radiologist's perspective. J Am Coll Radiol. 2007;4(5):313-9.
26. Kahn CE Jr, Heilbrun ME, Applegate KE. From guidelines to practice:How reporting templates promote the use of radiology practice guidelines. J Am Coll Radiol. 2013;10(4):268-73.
27. Said D, Bravo-Grau S, Andrews A, Aronsohn F, Castro M. ¿Qué espera el clínico del informe radiológico? Rev Chil Radiol. 2012;18(3):111-6.
28. Guimaraes CV, DeFlorio RM, Averill LW, Walters KE, Beasley RA, Donnelly LF. Implementation of standardized reports within a pediatric health care system with geographically dispersed sites. J Am Coll Radiol. 2015;12(12):1293-5.
29. McWilliams JP, Shah RP, Quirk M, White SB, Dybul SL, Ahrar J, et al. Standarized reporting in IR: A prospective multi-institutional pilot study. J Vascular Intervent Radiol. 2016;27(12):1779-85.
30. Hawkins CM, Hall S, Zhang B, Towbin AJ. Creation and implementation of department-wide structured reports: An analysis of the impact on error rate in radiology reports. J Digit Imaging. 2014;27(5):581-7.
31. Bosmans JML, Peremans L, Menni M, De Schepper AM, Duyck PO, Parizel PM. Structured reporting: if, why, when, how—and at what expense? Results of a focus group meeting of radiology professionals from eight countries. Insights Imaging. 2012;3(3):295-302.
32. European Society of Radiology. ESR paper on structured reporting in radiology. Insights Imaging. 2018;9(1):1-7.
33. Durack JC. The value proposition of structured reporting in interventional radiology. AJR. 2014;203(4):734-8.
34. Weiss DL, Langlotz CP. Structured reporting: patient care enhancement or productivity nightmare? Radiology. 2008;249(3):739-47.
35. Collard MD, Tellier J, Chowdhury AS, Lowe LH. Improvement in reporting skills of radiology residents with a structured reporting curriculum. Acad Radiol. 2014;21(1):126-33.
36. Stewart SA, Rajaraman M, Costa AF. Web-based tool for standardized reporting of thyroid ultrasound studies. AJR. 2017;210:1-4.
37. Caicedo-Montaño CA, Gómez-Rivadeneira A, Díaz-Garzón FG, Muñoz-Escobar A, Isaza-Ruget MA. Hacia la atención en salud basada en el valor: Revisión de la literatura. Rev Médica Sanitas. 2017;20(3):164-73.
38. Radiological Society of North America. RadiologyInfo.org [internet]. 2019 [citado 2019 jun. 15]. Disponible en: www.radiologyinfo.org/

Correspondence:

Camilo Alberto Caicedo Montaño
Clínica Universitaria Colombia
Carrera 22B # 66-46
Bogotá, Colombia
cacaicedomo@unisanitas.edu.co

Received for evaluation: July 1, 2019
Accepted for publication: August 7, 2019