



# How to Create a Great Radiology Report

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The radiology report represents the sum of a radiologist's highest level of synthesis and insight into a patient's condition. It is the most important product that radiologists generate to help direct patient care. Despite the self-evident importance of clear and effective radiology reporting, radiologists usually receive little or no formal reporting education during training. Instead, it is learned in a piecemeal and often indirect fashion through occasional correction and imitating the reports of other radiologists. The audience of the radiology report extends far beyond the ordering provider and includes patients and their families, medical support staff, subspecialty providers, other radiologists, and research interests. Creating a report that fulfills the needs of this diverse group is a formidable if not quixotic ambition. However, there are certain key principles to reporting the imaging findings, impression, and recommendations that serve as a guide and promote careful consideration about how reports are understood. The findings section should emphasize short, informative, and factual observations while avoiding inappropriate interpretation, excessive use of terms of perception, and redundancy. The impression is the thoughtful synthesis of the meaning of the findings leading to a diagnosis, a differential diagnosis, and management recommendations. Creating a clear and impactful impression allows radiologists to provide the highest level of clinical care and direction but takes time and effort beyond simply restating the findings. The impression should use language that is understandable, memorable, and actionable. Reporting skills require ongoing attention and must adapt to the evolving practice patterns and communication styles in medicine.

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## Introduction

The radiology report represents the sum of a radiologist's highest level of synthesis and insight into a patient's condition and is the most important way that radiologists contribute to patient care. In most instances, it is the only communication with referrers. Clearly communicating the diagnosis or differential diagnosis, clinical implications of radiologic findings, and recommendations for further management is a complex skill that requires ongoing effort and attention throughout training and practice. As the practice and communication of medicine evolve, radiologists need to adapt their reporting methods (1). Compared with the systematic accumulation of medical facts that pertain to the practice of radiology, crafting a radiology report is a more artisanal, reflective, and creative process.

Since the beginning of radiology, concerns about the content and style of reporting have been raised with striking eloquence and familiarity with current issues (2,3). These similarities suggest that while the practice context and reporting contents have changed, the professional challenges that radiologists face while reporting

## TEACHING POINTS

- Clearly communicating the diagnosis or differential diagnosis, clinical implications of radiologic findings, and recommendations for further management is a complex skill that requires ongoing effort and attention throughout training and practice. As the practice and communication of medicine evolve, radiologists need to adapt their reporting methods. Compared with the systematic accumulation of medical facts that pertain to the practice of radiology, crafting a radiology report is a more artisanal, reflective, and creative process.
- The findings section is for the factual observations about the study and reflects the thought process of the radiologist, relies on technical language for precision, and provides the basis for the subsequent formulation.
- The impression is the thoughtful synthesis of the meaning of the findings leading to a diagnosis or differential diagnosis and recommendations for further management. It represents the sum of all the efforts in interpreting the imaging study and answering the clinical question. It should use clear unambiguous phrasing similar to that used when speaking directly to an ordering provider or presenting at a multidisciplinary team meeting.
- Leading the impression with the favored diagnosis or differential diagnosis is a foundational step to promoting clear communication, as it anchors the impression and provides a context for the reader to understand the relevant findings. Impressions that start by jumping into detailed findings are likely to overwhelm the reader with seemingly stray facts and little provided basis for understanding them until a specific diagnosis is mentioned.
- One of the most challenging aspects of pulling together a cohesive impression is to provide appropriate recommendations. It is a major way that radiologists take responsibility for the study and advance patient care, particularly for unexpected or incidental findings. The best way to learn how to give appropriate recommendations comes from follow-up. Specifically, attend to how radiology reports are understood by and impact the actions of the medical team, biopsy results, hospital courses, and operative notes.

persist, resulting in similar patterns of wayward reporting for each generation (4,5). Yet very few radiology residents receive formal education in radiology reporting, with 86% of residents reporting 1 hour or less of didactic instruction annually (6).

Trainees often learn the art of reporting in a more passive, subconscious, and inconsistent manner throughout training by reading reports of other radiologists to acquire the basic language and structure, receiving occasional feedback from attending radiologists at the workstation, and imitating the style of a few admired senior colleagues or co-residents. Sporadic one-on-one interactions with attending radiologists often provide residents with idiosyncratic advice, which itself is the product of a style that has similarly developed from unstructured career-long accretion (5–8). More recently, many teachable moments with minor (but nonetheless important) refinements or corrections are at risk of being overlooked, as attending radiologists remotely edit and sign the

reports throughout the busy workday or after the resident has completed an off-hours shift and is no longer on service.

Consequently, trainees can overestimate their reporting maturity unless they routinely and carefully review the final report for changes. Although newer computer applications help facilitate the comparison of preliminary and final reports by highlighting these changes side by side, the rationale for such changes is not always self-evident and may be lost without direct instruction.

The complex relationship among the patient, treatment team, and radiologist also contributes to patterns of problematic reporting. Radiologists frequently have to interpret an imaging study with limited clinical data and without the opportunity to personally assess the patient. Despite the ordering provider's expectation for the radiologist to deliver a clear answer to the clinical question, a definitive diagnosis may be out of reach because of inherent limitations of the modality, imaging findings that lack specificity, or even technical inadequacies of the study. Some radiologists may be tempted to cope with this uncertainty by simply restating findings, employing excessive qualifying language, shifting responsibility back to the ordering provider, or providing vague recommendations (9,10).

The advent of structured reporting has been met with a mixed response (11–14). The typical checklist style of reporting promotes consistent organization, which is valued by ordering providers and patients (11,12). Structured templates facilitate reporting the findings with brief observations, reserving the impression for the synthesis and meaning of the findings with actionable information (13). In contrast, free-text dictation can more frequently blur the lines between the findings and impression as it reflects the radiologist's active thought process.

Some radiologists lament a loss of art, creativity, and freedom of expression when staring at the blank fields of a template they are told to populate (14). This is not without some basis, as poorly crafted structured reporting templates may artificially fragment related or overlapping processes into subcategories and disrupt a cohesive synthesis. This is particularly the case with multicompartamental pathologic conditions (15). Structured reports are best considered a guide or tool rather than the rule for reporting. If a template fails to help organize ideas, facilitate synthesis, and promote clear communication, then it should be revised or discarded.

This article outlines foundational principles of clear concise radiology reporting and is intended for trainees and practicing radiologists alike (Fig 1). Trainees can learn these principles

in a thoughtful and systematic way throughout training rather than variably at the workstation. Practicing radiologists who have settled into a reporting style for many years will benefit from a tune-up, as a passive approach to reporting may lead to bad habits over time.

The emphasis in this article is on the findings section and the impression. The header portion (clinical notes, technique, and comparison) is considered beyond the scope of this discussion. Points of disagreement are expected, as regional and personal stylistic preferences abound, but the authors hope that these do not diminish the value of exploring this important topic.

### Speaking Like a Radiologist

Understandably, there is great excitement at the beginning of radiology training when learning to speak like a radiologist. Much of the technical language is necessary and created to accurately characterize radiologic findings (eg, interlobular septal thickening, diffusion-restricting, heterogeneous low-level internal echoes). Other terminology acts as an aide-mémoire and is striking in its imagery (eg, racing car ventricles, snowman cardiac silhouette, onion skin periosteal reaction).

While progressing through radiology training, this language becomes intertwined with active evaluation and forms the basis by which images are understood. Thus, verbally reporting is more than a mere accounting for the facts of the study and forms a central part of image evaluation and interpretation, acting as a sounding board for the radiologist and ultimately leading to a diagnosis or differential diagnosis.

Carefully crafted reports provide invaluable insight into the radiologist's mind for trainees developing their own reporting skills and referring physicians looking for a greater understanding of the study. In contrast, poorly structured descriptions generated from a disorganized record of every passing observation result in rambling confusing reports and leave the reader with a shopping list of stray ideas and little direction (16).

Unlike medical or surgical specialists who directly see and treat patients, radiologists have a unique referral position on the medical team by providing a written assessment of the patient's condition that is intended to be read, understood, and acted upon by other practitioners. In other words, the radiology report is primarily a direct communication (and often the sole interaction) between the radiologist and the ordering provider about the patient. Thus, while the technical elements of reporting are essential for the evaluation by the radiologist, the ordering provider is looking for a clear diagnosis or differential diagnosis and recommendations without radiology jargon (10,17,18).

1. Deliver the goods. Anchor the impression with the favored diagnosis or differential diagnosis followed by the key findings supporting it.
2. State it clearly. The impression should use phrasing similar to speaking directly to a provider or presenting at a multidisciplinary conference and avoid the technical language used only by radiologists.
3. Keep it relevant. Avoid clinically insignificant items in the impression that do not require the ordering provider's attention or action.
4. Think about next steps. Provide thoughtful detailed recommendations that help the ordering provider reach a specific diagnosis or direct the next steps in management.
5. Continue to grow. Tweak your reporting and understand its broad impact by asking providers for feedback and by following up biopsy results, hospital courses, and procedural and operative notes.

**Figure 1.** Reporting tune-up. The top five takeaways for improving your radiology reports are listed.

### Pathology report

Microscopic description: Epithelioid neoplasm with highly pleomorphic cells set in a desmoplastic stroma with necrosis, positive for cytokeratins AE1/AE3, p40, CK5/CK6, and high-molecular-weight cytokeratin.  
Diagnosis: Poorly differentiated squamous cell carcinoma.

### Radiology report

Findings: 3.0-cm hepatic segment 3 mass with intermediate T2 signal intensity, homogeneous arterial enhancement, washout with rim-capsular enhancement, and restricted diffusion.  
Impression: 3.0-cm segment 3 hepatocellular carcinoma.

**Figure 2.** How pathology and radiology reports parallel each other. The technical language of the microscopic description carries little meaning to those outside of pathology, similar to the MRI signal characteristics in the findings section for those outside of radiology. In contrast, the diagnosis and impression convey universally understandable information for all readers.

It is helpful to empathize with the ordering provider when considering how to balance these conflicting needs. A typical pathology report provides a parallel experience for the radiologist. One skims the report for an understandable answer to the question "What is the diagnosis?" with little understanding or appreciation of the technical language applied within the specialty that leads to it. Consider how the microscopic description and diagnosis parallel the findings and impression sections of an MRI report (Fig 2).

These observations help define parameters by which the two major parts of the radiology report

**Table 1: Key Principles for the Findings Section with Examples**

Key Principle	Before Revision	After Revision
Use short informative phrases that emphasize factual observations.	There are likely small pleural effusions on the basis of blunting of the posterior costophrenic angles, which appear new compared to prior.	New blunting of the costophrenic angles.
Fragments are acceptable if they are not stylistically awkward.	The small bowel is diffusely dilated. There is a small amount of fluid in the right paracolic gutter.	Diffusely dilated small bowel. Small amount of fluid in the right paracolic gutter.
Avoid interpretation (leave it for the impression).	There is a 3.5 × 2.2-cm complex left ovarian cyst with internal septa. It does not have Doppler flow. This most likely represents a hemorrhagic cyst or less likely endometrioma.	3.5 × 2.2-cm complex left ovarian cyst with internal septa and no Doppler flow.
Appropriately bury incidental findings with an assessment to avoid uncertainty and unnecessary workup.	There is a similar 1.5-cm fat-attenuation round right adrenal nodule.	Small benign right adrenal nodule, unchanged for 3 years.
Avoid excess use of terms of perception.	There are numerous enlarging nodules visualized in the right lung.	Numerous enlarging right lung nodules.
Avoid redundancy.	Redemonstration of liver masses that show interval increase in size compared to the previous examination.	Enlarged liver masses.
Keep it organized. Group disease processes in a cohesive description and consider using lists for multiple similar items.	There are three hypoenhancing liver masses. The first is near the inferior vena cava and measures 2.4 cm. The second is abutting the falciform ligament and measures 1.2 cm. The third is in the left hepatic lobe and measures 3.0 cm.	Liver masses as follows: Caudate lobe, 2.4 cm Segment 4a abutting the falciform, 1.2 cm Segment 2, 3.0 cm

Note.—These examples may seem overly compact and are intended to illustrate the principles rather than a specific recommended dictation style.

should be considered. The findings section is for the factual observations about the study and reflects the thought process of the radiologist, relies on technical language for precision, and provides the basis for the subsequent formulation. The impression is a direct communication to the ordering provider about the meaning of the findings with a diagnosis or differential diagnosis and recommendations and should avoid use of radiology jargon.

In the following sections, key principles for the findings, impression, and recommendations are discussed in detail with examples. Note that several examples of brief language may seem unnaturally compact to the reader and are not intended to serve as an exact model but rather to stimulate thought about the meaning carried by commonly used language and filler phrases.

Readers are encouraged to develop their own carefully crafted style that combines personal preferences, institutional needs, and principles of clear communication. The authors hope that any point of disagreement with this article does not cause the greater message to be lost. Learning how to craft a great radiology report is a

worthwhile endeavor in providing the best possible patient care.

## Key Principles for the Findings Section

### Save Interpretation for the Impression

The findings section comprises short informative phrases describing the pertinent positive and negative observations about a study (Table 1). Findings emphasize facts and should avoid interpretation or synthesis intended for the impression. Blurring the lines between the findings and impression by repeating partial or complete impression statements in both sections creates unnecessarily long repetitive reports with an increased risk of internal discrepancies. Changes to the diagnosis or differential diagnosis as additional findings are uncovered need to be made in both the findings and the impression. This is often the case when trainees have their reports reviewed and revised by attending radiologists who may tweak the impression but overlook revising similar statements in the findings.

An important exception is for so-called buried findings, which are not included in the impression because they are incidental, benign, or not



clinically significant (such as benign renal cysts). Clearly labeling buried findings as benign or of no clinical significance is a great service to ordering providers and reassuring to the patient, who will likely find misleading or inappropriately alarming information when trying to determine the significance with an internet search (19–21).

Radiologists associate many findings with benignity without necessarily being explicit (eg, cyst, adrenal adenoma, hamartoma), but many ordering providers and patients do not do the same (22). This confusion can result in unnecessary worry and inappropriate follow-up studies to ensure that a benign finding is unchanged, which is costly to the patient and frustrating for the radiologist to interpret. Giving a clear assessment of a buried finding also serves as an important internal check for radiologists who need to consider the questions “Does this finding have clinical implications?” and “Should anything be done about it?” rather than leaving a loose-ended statement for the referrer to sort out. While an essential part of a radiologist’s duty starts with identifying the finding, it ends with assessing the finding’s importance and determining if any further evaluation is required.

Appropriately assessing buried findings can also serve an important role in communicating with other radiologists reading future images and can help avoid expending time repeating a detailed assessment. At times, reaching the conclusion that a finding is benign may require a thorough evaluation of comparison studies, information from a detailed chart review, or even communication with the ordering provider that may be difficult for future radiologists to repeat consistently. In this way, the findings section can serve a valuable role in radiologist-to-radiologist communication, promoting consistency and efficiency for future reports (eg, “Unchanged benign retroperitoneal lymphocele first seen on MR lumbar spine localizer images 5 years ago.”).

### Use Terms of Perception Sparingly

While it can be tempting to translate the experience of image perception into the dictated findings by adding terms of perception such as “is seen,” “is noted,” “is demonstrated,” “is visualized,” and their more objective counterparts “there is” and “is present,” they add no meaningful information to the report and should be used sparingly. Perception is assumed in the act of describing. For example, “There are multiple loops of dilated small bowel visualized within the pelvis. There is a small amount of ascites noted in the pelvis” contains multiple references to the radiologist’s perception (“there are,” “visualized,” and “noted”) that can be omitted without a change in meaning,

as follows: “Multiple dilated small bowel loops in the pelvis. Small pelvic ascites.”

This concept is particularly relevant in structured reporting, which provides a header and an assumed sentence structure by which information is understood (eg, the header “Lungs” implies “In the lungs, there are the following observations made by the reader”). Similarly, in a conventional narrative report, the global header “Findings” implies “The following observations have been made by the interpreting radiologist” and promotes the use of short sentences or fragments. Occasional use of perception terms may be appropriate for stylistic reasons (particularly when starting a description), as a report made entirely of fragments can be difficult to read and risks compromising understanding.

### Avoid Redundancy

By definition, redundant words can be omitted from the report without a loss of meaning. Redundancy can be particularly challenging to avoid when trying to make a comparison because many commonly dictated terms or phrases reference the fact that a comparison has been made or that a change has occurred. Thus, making a comparison can result in a surprising number of redundant terms combined into a single sentence.

Consider the following example: “There is redemonstration of the right hepatic lobe mass. Compared to the previous study dated August 4, 2015, there has been an interval increase in size.” In this example, there are five terms that convey that a comparison is being made: “redemonstration,” “compared to,” “previous study,” “there has been,” “interval,” and “increase.” The text can be reworded to simply state “The right hepatic lobe mass has enlarged compared to August 4, 2015” without any loss of meaning.

The redundancy in this example is caused by an overemphasis on the radiologist’s perception upon first seeing the liver mass (“There is redemonstration of the right hepatic lobe mass”), but without yet making a meaningful observation about it. Then the comparison is emphasized (“Compared to the previous study dated...”), followed by a common redundant structure used for comparison (“interval increase”).

Creating the second shorter version requires noticing the mass, evaluating the mass, and making a comparison before dictating anything, and it can be challenging to withhold commentary while doing so. Therefore, it may be helpful to practice shifting emerging observations to an internal dialogue until a more concise and

integrated statement can be made. Alternatively, longer statements can be revised to their essence after initial dictation. This is clearly more time consuming and impractical for busy clinical days but becomes less necessary as these habits are reinforced and become second nature.

Over time, radiology neologisms or pet phrases propagate and find widespread use throughout a practice but have little meaning. For example, the term *redemonstration* is often used in radiology reporting to emphasize a finding that is "again seen" or "again noted," and it is a radiology neologism specific to some geographic areas and rarely used outside of the specialty. Using the term requires comment about the stability or change compared with prior studies, which implies its "redemonstration" to the radiologist.

*Interval* is also commonly used in reporting and similarly emphasizes that a finding is being compared over the passage of time but requires the specific comparison date and what change has occurred, both of which imply the passage of an interval and obviate its use. Therefore, both terms can safely be omitted as redundant, as illustrated in the preceding example.

It may seem unnatural or even unfair that the careful deliberation of the radiologist is distilled into a few short phrases rather than displaying the pomp of longer more complex sentences. Some may also view the length of the report as a way that radiologists demonstrate thoroughness and care while reading the study and be concerned that terse reports are viewed as cursory, overly confident, or cavalier.

However, excess length of observations is frequently more related to undue emphasis on perception, redundant sentence structure, and overly detailed descriptions than to conveying sophisticated ideas. For example, "Again noted are multiple peripherally enhancing complex peripancreatic collections with thickened and irregular walls, which have not changed in size or configuration since the prior exam" can be truncated to "Unchanged complex peripancreatic collections."

Radiologists who complain that ordering providers do not routinely read the findings section should consider how challenging a typical report may be to understand without a radiology residency to learn the crucial technical and superfluous redundant phrasing. Improving report clarity increases reader engagement and confidence and may actually decrease radiologist liability by encouraging the reader to contact the radiologist if they detect a discrepancy or have questions (16,23).

Practically, the ability to be confident and concise in reporting depends on the level of training,

experience, and expertise (10,24). For the early radiology resident, lengthy descriptions of the findings and instances of redundancy inevitably expand when the report is appropriately used for an active sounding board. In fact, an overly brief report for a resident may signal overconfidence or little appreciation of the key findings. These verbose descriptions are often necessary and must flourish early in training. After gaining greater experience and confidence in training and early practice, radiologists' reporting skills will continue to mature as they develop an appropriate balance between concision and completeness.

### Keep It Organized

Clear communication remains paramount even while verbally processing the findings and can be improved by briefly considering how the findings should be organized best before making detailed descriptions. Many practices have adopted structured reporting for cross-sectional studies, which provides an organized structure for reporting the findings. Well-designed templates allow the most common disease processes to be grouped into a cohesive narrative, but there are inevitable cases that span multiple sections (25–29).

For example, it might be difficult to determine how to dictate a complex case of necrotizing pancreatitis that involves the pancreas, gastrointestinal tract, ascites, and vasculature, which are listed as separate sections in the structured report. While the radiologist recognizes this as a cohesive disease process, the template promotes artificially splitting up the many features into their respective sections. Instead, a cohesive disease process should remain as a unified comprehensive description and can remain in the most relevant section, potentially with an identifying header that categorizes the disease process and serves as a marker for the reader looking for greater detail (eg, "manifestations of necrotizing pancreatitis are as follows" or "widespread abdominal or pelvic masses involving the following locations").

There are several disease processes or findings that can be described by using lists to help facilitate follow-up and treatment planning, which are often far easier to understand than free-flowing blocks of text. Consider the following examples that describe pulmonary nodule follow-up on a CT image:

Multiple lung nodules have decreased in size since the prior examination. For example, the right lower lobe nodule measures  $3 \times 4$  mm, previously  $5 \times 3$  mm. Another nodule in the left upper lobe abutting the pleura measures  $5 \times 2$  mm, previously  $6 \times 3$  mm. A larger right upper lobe paramediastinal nodule results in

bronchial obstruction and measures  $6 \times 5$  mm, previously  $8 \times 6$  mm.

Compare the earlier list to a revised list with the same information:

Lung nodules (compared to April 5, 2017):

1.  $3 \times 4$  mm (previously  $5 \times 3$  mm) right lower lobe.
2.  $5 \times 2$  mm (previously  $6 \times 3$  mm) subpleural left upper lobe.
3.  $6 \times 5$  mm (previously  $8 \times 6$  mm) paramediastinal resulting in bronchial obstruction.

Numbered lists help to keep the reader mentally organized, convey a sense of logic, assist with treatment planning and prioritization, and make follow-up easier for radiologists and ordering providers. The free-flowing block paragraph approach is at first more natural and reflects the active thought process of the radiologist while reviewing the study. It takes time and practice to prospectively identify opportunities to use numbered lists. The authors have found that going back and revising a block of text to make lists is a helpful step in reinforcing this approach and making the use of lists more reflexive over time.

## Key Principles for the Impression

### Overview

The impression is the thoughtful synthesis of the meaning of the findings leading to a diagnosis or differential diagnosis and recommendations for further management. It represents the sum of all the efforts in interpreting the imaging study and answering the clinical question. It should use clear unambiguous phrasing similar to that used when speaking directly to an ordering provider or presenting at a multidisciplinary team meeting. It is advisable to assume that the impression is usually the only part of the report read by the referring clinicians, who often only read the findings when the impression is unclear (30). The emphasis in the impression should be on actionable clinically significant information (31,32).

Forming a good impression can take as long or longer than describing the entirety of the findings. It is difficult to be wrong when simply restating the findings. Therefore, synthesis also involves an element of risk and raises the stakes, as it helps direct patient care.

Several key principles help guide crafting impactful and helpful impressions (Tables 2, 3). The overarching principle for creating clinically relevant impressions is to deliver information that is understandable, memorable, and actionable while avoiding radiology jargon (16–18,22,23). With the goals of maximal clar-

ity and comprehension, radiologists should use language common to all medical specialties and state the impression in a similar direct way one would use to review the study in person or on the phone with the ordering provider.

### Know Your Audience

The scope of the radiology report extends far beyond the radiologist and ordering provider. While the request for the study is generated by the ordering provider, there are many audiences of the radiology report (21,24,23). Each has different and often conflicting needs, creating substantial difficulty in composing a single report that suits every reader (Table 3). Compounding this, radiologists have few opportunities to receive or solicit feedback about the clarity and content of their reports from the referring clinician. Referring providers may be hesitant to express confusion or uncertainty about the contents of a report for fear of appearing unsophisticated, potentially leading the radiologist to overestimate the universal intelligibility of radiology's complex lexicon and uncommon sentence structure.

Many common impressions can be simply stated and more readily understood by a larger audience. This does not need to come at the expense of medical sophistication or completeness but rather favors the universal medical lexicon from medical school over specialty-specific technical terminology from residency. In addition, simple ideas can also be unnecessarily padded by formal sentence structure, perhaps to give a more official appearance to the report.

For example, "There is redemonstration of multiple liver lesions consistent with metastases, which have increased in size in the interval" delivers a simple message: "Liver metastases have enlarged." While the latter may seem terse, it is what the ordering provider extracts from the report and requires no translation. It reflects the clear phrasing a radiologist would use to present the case at a multidisciplinary team meeting, which is a good general benchmark for crafting the impression.

Furthermore, the fear of litigation can obfuscate reporting in several ways. Undue attention may be paid to incidental findings that are highly unlikely to be clinically important, a clear diagnosis may be understated in the unlikely event that an alternative diagnosis is true (eg, "findings concerning for"), liability may be shifted toward the ordering provider (eg, "clinical correlation advised"), or blanket statements of uncertainty may be used, leaving the ordering provider with little sense of probability of a diagnosis or the best next steps for management (eg, "cannot be excluded"). Paradoxically, instead of providing protection, a lack of clarity may actually increase

**Table 2: Key Principles for the Impression with Examples**

Principle	Before Revision	After Revision
Lead with the diagnosis when possible followed by a helpful high-level summary of the key findings relevant to understanding the extent of disease.	Extensive peritoneal disease with large-volume ascites, peritoneal nodularity, omental thickening, and serosal implants, consistent with peritoneal carcinomatosis.	Peritoneal carcinomatosis with large-volume ascites, extensive omental thickening, and serosal implants.
Avoid technical language that is regularly used or understood only by radiologists. Use clear language that is familiar to the ordering provider. Ask yourself: How will the impression sound when read aloud on morning rounds?	Rounded 1-cm masslike area of T2 hyperintensity, heterogeneous enhancement, and mild diffusion restriction in the pons, concerning for brainstem glioma. Neurosurgical consultation recommended.	Suspected 1-cm rounded brainstem glioma in the pons. Neurosurgical consultation recommended.
Avoid redundancy. Often, the conclusion of the report can be stated in a clear straightforward manner.	Redemonstration of multiple lung nodules, which have undergone microwave ablation. There are similar expected treatment changes without definite enhancement to suggest local recurrence. No new lesions to suggest metastases.	Similar ablated lung metastases without recurrence or new lesions.
Avoid including clinically insignificant findings that do not require the ordering provider's attention.	There is diverticulosis without diverticulitis.	"There is diverticulosis without diverticulitis" omitted from the impression.
Make appropriate recommendations for the next step. This can be difficult to learn but is done best by following up patient biopsy results, operative notes, and hospital course.	Indeterminate ill-defined soft-tissue mass in the right gluteal region. Clinical correlation recommended.	Ill-defined right gluteal mass could represent an injection granuloma, hematoma, or neoplasm. Correlate with physical examination and patient history for trauma or injection. If there is concern for neoplasm or this finding enlarges, evaluation for biopsy is recommended.

Note.—These examples may seem overly compact and are intended to illustrate the principles rather than a specific recommended dictation style.

**Table 3: Audiences of the Radiology Report and Their Needs**

Report Audience	Needs from the Report
Reporting radiologist	A place to organize thoughts A sounding board during synthesis Employ technical accuracy Provide complete evaluation
Other radiologists	Provide enough detailed information to help guide follow-up examinations efficiently
Primary care providers	Clear specific recommendations for treatment, follow-up, or additional evaluation
Subspecialty physicians	Fewer specific recommendations Greater detail for staging and treatment planning
Patients	Understandable report with little specialized language No ambiguity about the significance of findings
Billing or coding staff	Specific language required to adequately bill for the examination
Researchers	Structured information with standardized language allowing population of data registries and research
Lawyers	Sufficiently thorough and protective language to avoid the risk of malpractice



malpractice risk, as obscure language is more likely to be misunderstood (23,33).

It can be helpful to imagine being the receiver of the report when trying to determine the amount of information to include in the impression. Ordering providers want the clinical questions answered directly along with any other important, clinically relevant, and actionable observations with clear recommendations (31). This allows them to explain the results to the patient and confidently direct the next steps.

Including benign incidental findings in the impression (eg, “diverticulosis without diverticulitis,” “3-cm right renal cyst,” “gallbladder adenomyomatosis”) rightly prompts the ordering provider to wonder why the radiologist decided to inform them about it and what sort of action needs to be taken (22). This uncertainty can lead to patient anxiety and inappropriate follow-up examinations that are costly to patients and waste the time of both ordering providers and radiologists.

Radiologists need to carefully consider the cost of including extraneous information in the impression that they do not actually want the ordering provider to think about, inform the patient about, or order follow-up examinations for. Including such information decreases radiologic competence and directs attention away from more clinically relevant and pressing items. The complete catalog of incidental items can remain in the findings section for the more fastidious readers.

### Lead with the Diagnosis

Leading the impression with the favored diagnosis or differential diagnosis is a foundational step to promoting clear communication, as it anchors the impression and provides a context for the reader to understand the relevant findings. Impressions that start by jumping into detailed findings are likely to overwhelm the reader with seemingly stray facts and little provided basis for understanding them until a specific diagnosis is mentioned. Using a basic structure for the impression can help to keep the radiologist organized and provide clarity to ordering providers as they advance patient treatment (Figs 3, 4).

While many diagnoses can be stated simply and need no further supporting details (such as “infectious pneumonia” or “uncomplicated sigmoid diverticulitis”), it is often appropriate to modulate the likelihood of a diagnosis (eg, “definite,” “suspected,” or “possible”) and include key positive or negative findings that lead the radiologist to conclude the diagnosis and may be relevant for treatment planning (34).

The impression should contain enough of a summary of the disease process to stand alone for

### Key structural components of an impression:

- a = Favored diagnosis
- b = Key findings supporting that diagnosis
- c = Alternative diagnoses and reasons for considering them
- d = Recommendations for reaching a definitive diagnosis or treatment (examination, laboratory tests, testing, follow-up, consultation)

### Example impressions with each component labeled:

(a) Suspected lymphangitic carcinomatosis (b) evidenced by patchy and nodular septal thickening, perilymphatic nodules, and medium pleural effusions. (c) Edema is felt unlikely to cause this pattern given the nodularity. (d) May consider diagnostic thoracentesis or attention at follow-up imaging.

(a) Suspected malignant mass of the transverse colon (b) evidenced by a circumferential enhancing mass causing partial obstruction. (c) Ischemic or inflammatory strictures are unlikely because of the extent of masslike thickening. (d) Suggest a gastroenterology consultation with consideration for colonoscopy and biopsy to help reach a definitive diagnosis.

**Figure 3.** Basic structure that can help organize the impression. Starting with the favored diagnosis anchors the impression, followed by key imaging findings that support the diagnosis. The other possible items in the differential diagnosis are covered next by discussing alternative diagnoses and reasons for considering them. Finally, the radiologist can guide the ordering provider by making recommendations for reaching a definitive diagnosis or treatment.

most readers and not require a careful reading of the findings. Providing some basic details or justification about how a diagnosis was reached can help convey a level of care and thoroughness from the interpreting radiologist. This is particularly relevant for complex cases that require prolonged and nuanced discussion in a multidisciplinary setting to determine the next appropriate steps. In these cases, an overly terse impression may fail to convey the amount of thorough and thoughtful work the radiologist has put into evaluating the case and omit important details that help direct treatment.

### Avoid Technical Language

The impression should not require an internet search to be understood by the ordering provider. In the findings section, radiologists can employ the full range of technical vocabulary acquired in training to most accurately characterize observations. In contrast, the impression should avoid technical language that is only meaningful to radiologists.

When reporting on an MR image, the technical language characterizing the MRI findings is often at the forefront of the radiologist’s mind while transitioning to crafting the impression. The radiologist has just finished dictating this description and may even feel eager to share these interesting observations with the reader, imagining that they

	Before	After
<b>Chest Radiography</b>	<p><b>Findings</b> There are normal contours of the heart and mediastinum. There is redemonstration of multifocal pulmonary opacities, which have worsened compared to the previous examination. There are likely small pleural effusions on the basis of blunting of the posterior costophrenic angles, which appear new compared to prior.</p> <p><b>Impression</b> Interval increase in pulmonary opacities compared to the previous examination. There is blunting of the posterior costophrenic angles, which likely represents small pleural effusions, new from prior.</p>	<p><b>Findings</b> Normal contours of the heart and mediastinum. Worsening multifocal pulmonary opacities. New blunting of the costophrenic angles.</p> <p><b>Impression</b> Worsening multifocal pneumonia with new small effusions.</p>
<b>Abdominal CT (Relevant Sections Only)</b>	<p><b>Gastrointestinal Tract</b> There are several dilated fluid-filled loops of small bowel visualized throughout the abdomen and pelvis. There is an apparent transition point in the right lower quadrant where the bowel caliber gradually tapers to a point. No mass is visualized. This is consistent with small-bowel obstruction. Mesenteric edema is present. There is no evidence for free intraperitoneal air.</p> <p><b>Impression</b> Dilated fluid-filled loops of small bowel that transition in the right lower quadrant, consistent with small bowel obstruction.</p>	<p><b>Gastrointestinal Tract</b> Dilated fluid-filled loops of small bowel that gradually transition in the right lower quadrant. No mass. Mesenteric edema. No free intraperitoneal air.</p> <p><b>Impression</b> Small bowel obstruction with transition point in the right lower quadrant, likely due to adhesions.</p>
<b>Abdominal CT (Relevant Sections Only)</b>	<p><b>Liver</b> Redemonstration of multiple liver lesions concerning for metastases. All of the lesions show interval increase in size consistent with disease progression. The largest lesion visualized in the right hepatic lobe measures approximately 3.2 cm, compared to the prior study on April 25, 2018, where it measured 2.5 cm. There are no new masses identified.</p> <p><b>Impression</b> Compared to April 25, 2018, there is interval increase in the size of multiple liver lesions consistent with metastasis.</p>	<p><b>Liver</b> Numerous liver masses have grown since April 25, 2018. Right hepatic lobe mass measures 3.2 cm (versus 2.5 cm). No new masses.</p> <p><b>Impression</b> Growth of numerous liver metastases since April 25, 2018.</p>
<b>Head CT (Relevant Sections Only)</b>	<p><b>Findings</b> There is a lentiform hyperattenuating collection along the right frontal convexity. This results in mass effect and effacement of the sulci. There is midline shift of 5 mm. Narrowing of the lateral ventricles is visualized.</p> <p><b>Impression</b> There is a lentiform-shaped hyperattenuating collection along the right lateral ventricle most concerning for an epidural hematoma, resulting in mass effect and narrowing of the lateral ventricles.</p>	<p><b>Findings</b> Lentiform hyperattenuating collection along the right frontal convexity, resulting in sulcal effacement, narrowing of the lateral ventricles, and midline shift of 5 mm.</p> <p><b>Impression</b> Right frontal epidural hematoma resulting in mild mass effect.</p>

**Figure 4.** Practical application. Review the example “Before” reports and attempt your own revisions, comparing your changes with those provided in the example “After” reports. These excerpts help tie together many of the key principles discussed for the findings and impression.

share an affinity for such technical details. However, the specifics of T2 signal intensity, enhancement patterns, and diffusion restriction are not of interest to the oncologist asking if the adrenal metastasis is smaller after chemotherapy (35).

It is also important to exercise caution when using the terminology of other specialties that relates to clinical diagnoses, such as “chronic obstructive pulmonary disease,” or that inadvertently directs treatment. For example, when reporting restaging results where liver metastases have grown, stating “progressive metastatic disease in the liver” carries implications for which therapies and clinical trials the patients are eligible for and limits the treatment options that the oncologist can offer a patient (36). Such cases can be just as accurately reported as “Growth of liver metastases. The largest lesion measures 4.0 cm versus 3.0 cm on October 10, 2019” without using loaded words that carry therapeutic implications beyond the awareness of the radiologist.

### Embrace the Role of Revision

It is usually not feasible or advisable to try to get the impression right on the first try. Crafting the impression is often an iterative process because the radiologist is leveraging the sounding board function of the report while trying to synthesize the meaning of the findings, not uncommonly reaching a satisfactory conclusion only after a few minutes of deliberation. The details of the radiologist’s thought process or rationale for arriving at the diagnosis often emphasize technical observations, which hamper clear communication to the ordering provider. Revision promotes clear communication and reinforces positive patterns that help train the radiologist to dictate future studies more efficiently.

Therefore, after reaching a satisfactory conclusion, the impression should be reviewed and reworked as necessary so as to provide the clearest and most unambiguous synthesis and recommendations.

### Managing Challenging Cases

For challenging cases where the diagnosis remains unclear, radiologists are called to engage their full depth of training and knowledge to care for patients meaningfully and uniquely. In these cases, it can be particularly tempting or even unavoidable to blur the lines between findings and impression, resulting in a lack of clear clinical direction. There are several reasons why such difficulties can arise, each with specific ways to help overcome them.

**Knowledge Gap.**—When the radiologist sees the findings but does not know the meaning, success-

fully interpreting such a case may require pausing the clinical work to perform an internet or literature search or even prolonged reading of several articles to help determine the significance of the findings. However, this is not often feasible in the face of increasing examination volumes and pressure on turn-around time expectations, and it may be appropriate to provide a preliminary interpretation followed by an addendum when time allows further investigation.

Consulting colleagues who can provide expertise beyond that of an individual radiologist can be invaluable. However, asking for advice assumes a collegial work environment that welcomes collaboration and a willingness of the asker to be vulnerable to colleagues who may find the case in question straightforward, potentially exposing a weak area or misjudgment. Clear communication often requires a combination of dedication, time, teamwork, and humility.

**Inadequate Examination.**—In these cases, it is appropriate to provide a differential diagnosis and recommend a specific imaging examination that adequately depicts the finding of concern. Providing a preliminary differential diagnosis is helpful to inform colleagues what the specific concerns are to guide their future interpretation. It is prudent to specifically state which aspect of that examination should be evaluated (enhancement, relationship to surrounding structures, series and image numbers, etc), which guides the future reader’s interpretation and also asks the important question “Will the study I am recommending actually help answer the clinical question, or is there a more direct route that should be pursued?”

**Unknown Imaging Findings.**—In the rare cases in which the significance of a strange imaging finding cannot be determined, it can be appropriate to highlight this directly and include an honest personal touch, such as “This is an unusual finding, and I am unsure of the clinical significance” (5,10). This can help to emphasize the radiologist’s care and experience that has contributed to this assessment. Proposing follow-up is often appropriate and can be modulated by the patient’s own preferences. In cases where both biopsy and short-term imaging follow-up can be justifiably recommended, the final decision can be made on the basis of the degree of clinical suspicion and the patient’s preferences and tolerance for uncertainty (22).

**Nuanced Treatment.**—When dealing with indeterminate imaging findings in an elderly patient or a patient with many comorbidities, what findings to investigate further and what to ignore can

be less straightforward and beyond the scope of the radiologist. In these situations, consulting subspecialists for treatment recommendations can be particularly valuable given the subspecialist's ability to address whether the results of further testing would be considered for intervention (10,31,35).

Although it may be tempting to view navigating these situations as going the extra mile, it is more appropriately considered as fulfilling the principal duty of the radiologist, which is to be the expert who helps solve challenging cases. Carefully doing so will improve patient outcomes and avoid the cost and morbidity of unnecessary testing and intervention. A unifying principle that many physicians find helpful when navigating challenging cases is to provide the sort of care they would want for a family member, close friend, or even themselves, which helps to personalize an often abstract problem.

### Make Appropriate Recommendations

One of the most challenging aspects of pulling together a cohesive impression is to provide appropriate recommendations. It is a major way that radiologists take responsibility for the study and advance patient care, particularly for unexpected or incidental findings. The best way to learn how to give appropriate recommendations comes from follow-up. Specifically, attend to how radiology reports are understood by and impact the actions of the medical team, biopsy results, hospital courses, and operative notes.

**Strength of the Recommendation.**—Some ordering providers may interpret a recommendation as an obligation, which carries medicolegal implications and forces all but the most confident of subspecialists to follow the recommendation. Subtle variability in the language may not carry much difference in meaning with primary care providers, who are less likely to vary from the direction of the radiologist (31). In many cases, it may be appropriate to soften the strength of the recommendation and use phrases like “suggest” or “may consider,” which allow the ordering provider room to make a different decision. Decreasing the strength of the language is often appropriate since the radiologist may not have all of the relevant information when interpreting the study. Direct recommendations can be saved for the truly clear-cut and emergent findings that require urgent attention or intervention.

**What to Recommend.**—When dealing with an unknown cancer diagnosis, it is appropriate for the radiologist to identify the safest target for biopsy to expedite the workup by reducing requests to biopsy inappropriate or unsafe tar-

gets. While radiologists commonly recommend additional imaging examinations, it is imperative to carefully consider how the results of a positive, negative, or equivocal study would result in a more definitive diagnosis. If the results would not contribute to a more definitive diagnosis, then a biopsy (when suspicious) or follow-up examination (when stability would be reassuring) is most appropriate.

When recommending additional examinations, it is best to specifically state which aspect of that examination should be evaluated (enhancement, relationship to surrounding structures, etc) to help direct the future reader's thought process. When dealing with unknown or challenging cases that exceed a radiologist's comfort level, recommending subspecialty evaluation or discussion in a multidisciplinary conference setting for management and follow-up recommendations is often appropriate (10,35).

### Role of a Dedicated Recommendations Section

—Some practices make the habit of including a recommendations section separate from the impression, rather than combining the impression and recommendations into a single block of text (37). This approach provides clear-cut recommendations in an accessible checklist style, on which the ordering provider can efficiently act. However, using a dedicated recommendations section runs the risk of giving recommendations extra weightiness that may not always be intended (31). It is reasonable to consider this approach when there are several recommendations that benefit from the clarity of a dedicated list.

### Conclusion

The radiology report represents the distillation of a decade or more of medical training. There are key principles that help to craft the findings, impression, and recommendations to promote clear actionable reporting. The findings section emphasizes short, informative, factual phrases that provide an accurate radiologic description of all abnormalities with pertinent negatives. The impression reflects the radiologist's greatest insights into the meaning of the findings, leading to a diagnosis, differential diagnosis, and recommendations, and is the opportunity to provide the most direct and meaningful patient care. Reporting is a continual work in progress that matures throughout a career with experience, confidence, and follow-up.

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