A Quick Guide to Writing a Teaching Case Study

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Case studies published in the *Journal of Nuclear Medicine Technology* are brief chronologic or logical descriptions of a clinical experience that aim to share a technical outcome associated with an instrumentation or patient care scenario or demonstrate a unique finding associated with a nuclear medicine procedure. Although brief by necessity, case studies provide enough relevant detail to educate the reader about a clinical condition coupled with a diagnostic or therapeutic procedure. Case studies do not have to be about bizarre clinical conditions. Case studies can be about quality issues that directly impact the imaging or therapeutic procedure, protocol modifications when a clinical scenario requires out-of-the-box decisions, new techniques developed to address unique or difficult situations, or something as simple as an artifact that resulted in an unusual image finding. The sections of a case study, including the introduction, case report, discussion, and conclusion, are explained. The goal of this article is to teach new authors how to write a teaching case study.

Key Words: case study; writing; quality issues; artifacts

J Nucl Med Technol 2023; 51:323–326
DOI: 10.2967/jnmt.123.266660

Can I be honest? I have never really been a big fan of case studies. I always thought the purpose of a case study was to describe some unusual finding or bewildering patient scenario. And to tell the truth, I have had a rather mundane career as a nuclear medicine technologist over the past 40 y. Not once have I seen a patient with situs inversus or dextrocardia. So why would I bother to read a case study about some weird thing I will never see? Because I was wrong about case studies.

I have learned that case studies do not have to be about the bizarro; they can be about practical, real-life situations that teach or provide pointers to improve scan quality. At least, that is the aim of case studies published in the *Journal of Nuclear Medicine Technology* (*JNMT*). Therefore, I have a new respect for case studies, and the aim of this article is to teach you how to write a teaching case study that gets published.

WHAT IS A CASE STUDY?

A case study published in the *JNMT* is usually a brief chronologic account of a patient scenario and the subsequent imaging procedure or therapy. Although case studies are brief by necessity, they provide enough relevant detail to inform or educate. The overarching goal is to enhance the reader's knowledge of a clinical condition coupled with a diagnostic or therapeutic procedure. A case study worthy of reading has a practical message and educational purpose (*1*).

Think of a case study as an anecdote aiming to share an experience, provide information for the optimum care of a patient, or convey a clinical message. On the hierarchy of scientific evidence, case studies sit on the second-to-last rung, right above editorials and expert opinions (*2*). However, they serve an essential educational purpose because they can demonstrate findings not usually seen in textbooks and provide a visualization of a disease process or new technique (*1*).

A case study should contain no more than 1,000 words. This word limit includes all data: title page, abstract, text, disclosure, acknowledgments, references (maximum of 10), figure legends (maximum of 5), and tables. The maximum number of authors is limited to three for case studies. Additional required components include high-quality images and a completed copyright form.

WHY WOULD ANYONE WANT TO WRITE A CASE STUDY?

The question of why anyone would want to write a case study is a good one, and there are several possible motivators. First, writing a case study for the *JNMT* is an opportunity to educate. Many new radiopharmaceuticals and therapies are available, and as a profession, we are only beginning to learn how to use them. There is a strong probability that your laboratory has experienced a problem and developed a unique way to deal with it. For instance, a case study published in 2021 by Peacock et al. described a ^{177}Lu-DOTATATE therapy performed without antiemetics because the patient was allergic to many classes of antiemetics (*3*). The authors questioned whether aggressive antiemetic prophylaxis is necessary for all patients, especially those receiving compounded instead of commercial lysine/arginine amino acid solutions.

Another reason to write a case study for the *JNMT* is to share experiences. When coronavirus disease 2019 (COVID-19) hit in 2020, no one knew how it would affect nuclear medicine imaging. Several case studies published in 2021 were the first to describe the effects of COVID-19 on ^{18}F-FDG PET/CT scans for oncologic evaluations, reactive axillary lymphadenopathy after COVID-19 vaccinations on

Received Sep. 9, 2023; revision accepted Sep. 26, 2023.
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Published online Nov. 14, 2023.

^{18}F-FDG PET/CT, and mask contamination during ^{131}I therapy imaging (*4–6*).

Finally, writing a case study is an excellent opportunity to get published in a peer-reviewed journal. It is a much simpler type of manuscript to write than a full research manuscript, and it can be a way to learn how to write scientifically. It is an excellent way to start your publication career.

WHAT MAKES A CASE INTERESTING?

What it is that makes a case interesting is a hard question to answer, but generally, anything out of the ordinary but plausible can be interesting—and by out of the ordinary, I do not mean rare or bizzarro. For instance, a 2022 case study described γ-camera contamination after imaging a patient who received ^{131}I ablation therapy 3 d beforehand (*7*). The case study described how the problem was identified, investigated, and corrected. It was caused by an anxious patient sucking on the ends of her hair while waiting for her scan.

Any situation requiring a protocol modification can be interesting. For instance, a case study soon to be published in the *JNMT* describes how to perform a cardiac PET study on a patient with a body mass index of 71.

Other things that make a case study interesting include situations indicative of an emerging problem (as in the COVID-19 case studies); cases that require critical analysis on the part of the technologist, medical health physicist, or interpreting physician; or cases that result in a change in clinical practice.

WHAT ARE SOME CASE STUDY IDEAS?

Any quality issue can be written up as a case study. For instance, a case study from 2017 describes the double whammy of a whole-body bone scan with both collimator contamination and patient motion (*8*). Unusual or novel occurrences are interesting. Another case study from 2017 depicted spleen uptake on a bone scan due to sickle cell anemia (*9*).

Artifacts are always popular choices for a case study. Bashir et al. described a bizarre (their words, not mine) ring artifact on SPECT/CT imaging. A case by Qutbi and Asli illustrated misleading results on a Meckel diverticulum scan due to an incorrect zoom factor (*10,11*). Other clinical issues might include handling a tricky patient, deviating from the standard protocol, or improperly prepping a patient for a scan and its effect on the study's outcome, which can be fascinating reading.

Finally, anything with titillating subject matter is appropriate for a case study and will attract readers. For instance, in the June 2018 issue of the *JNMT,* there was a case study about the effects of dextroamphetamine and amphetamine on dopamine transporter imaging for Parkinson disease (*12*). Another case, in December 2018, described enlarged lymph nodes on an ^{18}F-FDG scan in a patient with ruptured breast implants (*13*).

WHAT ARE THE COMPONENTS OF A CASE STUDY?

Usually, case studies are presented chronologically or logically and follow a standard formula. The key is to provide enough detail to allow readers to draw their own conclusions. On this note, negative findings must also be included if relevant. The typical case study sections include the introduction, case report, discussion, and conclusion (Table 1).

Introduction

The introductory section usually starts with a bit of background about the condition or situation, explains why the case is noteworthy (gaps in knowledge), and then states the purpose for presenting the case. For example, the purpose of the case might be to teach, demonstrate, clarify, or show off. (If I ever scan a patient with situs inversus, I am writing it up and showing off.)

TABLE 1
Case Study Sections

Section	Component
Introduction	Background
	Why the case study is noteworthy
	Purpose or aim
Case report	Patient demographic data
	Clinical indication
	Patient history, including symptoms, risk factors, medications, and other diagnostic tests
	Procedure outline
	Image or study findings
	Correlative findings or comparisons to other diagnostic tests
	Interpretation and diagnosis
	Treatments and outcomes
Discussion	Teaching points and lessons learned
	Previous literature findings
Conclusion	Key points
	Suggestions and recommendations
	Take-home message

In the introduction, it is essential to catch the readers' attention early by explicitly stating what is interesting about the case or why it is worth reading. If there was something particularly challenging about the case, describe this challenge in the introduction. At times, it may be helpful to place the case in historical context by explaining what is new or atypical about the case or how it is similar to other cases. Also, it never hurts to relate the case to the readers or demonstrate what is in it for them if they read it.

Case Report

The case report section typically starts with basic patient demographics such as age, sex, race, height, and weight. Provide relevant deidentified information and no more than is necessary. For example, if race is not essential to the case, do not mention race. However, if abnormal findings are prevalent for a specific race, then mention it. Maintaining patient confidentiality is critical.

After the demographic information, the clinical indication or chief complaint should be stated next. At times, mentioning the appropriateness or inappropriateness of the indication for the specific scan is important. For example, the central point of a gastric emptying case study to diagnose gastroparesis may be that it was inappropriate because the patient was detoxing from heroin and taking suboxone (buprenorphine and naloxone [Indivior UK Ltd.]; buprenorphine is a synthetic opioid that decreases gastric motility) (*14*).

A pertinent patient history, including symptoms, risk factors, medications, and other relevant imaging, test, or clinical findings, usually follows the indication. The patient's history provides context for the reader. For example, the medical history for a solid gastric emptying study could state, "The patient was hospitalized for heroin detoxification and being treated with suboxone and metoclopramide. The patient also has a history of hiatal hernia and gastroesophageal reflux."

Next, outline the procedure, including any deviations from the standard procedure—the key word here is *outline*. There is no need to provide every protocol detail or parameter—just state what is important or out of the ordinary. Hopefully, the case followed the published guidelines and best practices. If not, write up the case anyway and explain why the test did not work as expected. For example, if you were tempted to use macaroni and cheese for a gastric emptying meal instead of the standard Egg Beaters (ConAgra Foods), toast, jam, and water, and not surprisingly, the result was a false negative, by all means, write it up so that other technologists can learn (*15*).

After the outline of the procedure, describe the image or study findings. Communicate the pertinent positive findings such as the intensity, size, location, inhomogeneity, or pattern of uptake. Comment on the negative findings as well, if applicable. Discuss quantitative results along with the reference values. Finally, mention any correlative findings (e.g., CT portion of a SPECT/CT scan) or any comparisons to other imaging studies such as MRI, ultrasound, or laboratory results.

Regarding the findings section, a case study is just plain dull without images. Include images that demonstrate the point. There is no need to include every image if some are not relevant. Use circles and arrows pointing out the abnormalities to make it easy for the reader to understand. Also, mention the study quality and its effect on the results. For example, if it took the patient 20 min to only eat 50% of the gastric meal, mention that fact and explain how that situation impacted the scan result.

The last part of the case report section is the scan interpretation and diagnosis. To highlight what the reader should look for on future scans, it is important to explain what the image findings demonstrate. To further enhance the case study's educational value, include potential treatments and patient outcomes, if possible.

Discussion

Although it may feel as if the case study write-up is complete after the interpretation is given, it is not. Just describing the case is not enough. There needs to be a discussion section that explains the teaching point, the lessons learned, or why anyone should care about your case study. The discussion should reiterate the case study's purpose that was stated in the introduction. It should also address any questions that might occur to the reader, such as, "Why would anyone use macaroni and cheese for a gastric emptying meal?"

The discussion should tie the case study back to the literature. Literature searches are not something to be despised or avoided. A search of the literature will demonstrate what is already known and published about such cases or can support why something did or did not happen.

Conclusion

The last section of a case study is the conclusion, which is usually short and often the only thing the reader reads word for word after skimming the rest of the article. The conclusion summarizes the key points, provides suggestions or recommendations, and reemphasizes what is noteworthy or meaningful about the case. End the conclusion with a strong take-home message such as, "Do not use macaroni and cheese for solid gastric emptying meals. Follow the guideline standard meal."

CONCLUSION

Case studies do not have to be about bizarre patient scan findings. They can be about practical, real-life patient scenarios that teach and provide pointers to improve scan quality. The goal of *JNMT* case studies is to enhance the reader's knowledge about a clinical condition coupled with the diagnostic or therapeutic procedure. They are valuable because they can visually demonstrate findings not usually seen in textbooks or describe new techniques. Case studies can be about quality issues, artifacts, unusual patient characteristics, or anything with interesting subject matter.

Case studies provide an excellent opportunity for new authors, including technologists, residents, and nuclear medicine physicians, to become published. The sections of a case study include the introduction, case report, discussion, and

conclusion. The introduction provides background and explains why a case is noteworthy. The case report includes patient demographics and history and the clinical indication, outlines the procedure, describes and interprets the imaging or study findings, and gives the treatment or the outcome. The discussion communicates the teaching point and the lessons learned. Finally, the conclusion summarizes the key points, provides suggestions or recommendations, and ends with a strong take-home message.

Hopefully, this article has inspired you to write up something interesting that occurred in your laboratory. I promise you, it is easier than you think. Do not be like me, waiting around for a sexy case of situs inversus or dextrocardia. Submit a case study to the *JNMT* now.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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Erratum

In the article "PET/MRI Assessment of Acute Cardiac Inflammation 1 Month After Left-Sided Breast Cancer Radiation Therapy," by Chau et al. (*J Nucl Med Technol.* 2023;51:133–139), Michael Kovacs was omitted as an author. The correct author list is provided below. The authors regret the error.

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