

### Improved Scatter Correction to Eliminate Halo Artifacts for $^{68}\text{Ga}$ -Labeled Radiopharmaceuticals in PET Imaging

**TO THE EDITOR:** We read with interest the article by Lindemann et al. titled “Improving  $^{68}\text{Ga}$ -PSMA PET/MR Hybrid Imaging of the Prostate with Un-renormalized Absolute Scatter Correction” (1). The authors present a modified PET scatter-correction algorithm to improve halo artifacts sometimes seen around the bladder and kidneys in  $^{68}\text{Ga}$ -PSMA PET images. The scatter estimation for these tracers is challenging due to 2 reasons. The first is the extremely high signal-to-background ratio in the bladder and kidneys, which is difficult to capture in traditional scatter-estimation algorithms that assume the spatial distribution of scatter to be low frequency. The second is due to prompt  $\gamma$ -ray coincidence events that cannot be distinguished from positron emission coincidence events.

Scatter-estimation algorithms are most commonly based on single scatter simulation with either relative or absolute scaling. This study introduces un-renormalized absolute scatter correction, which omits the last scaling step of the standard scatter correction. This modification was found to significantly reduce the halo artifact around the bladder and improves PET/MR hybrid imaging of the prostate.

Previously published work cited by the authors includes suppression of the halo artifact through absolute scatter scaling and reduction of the maximum allowed scatter fraction. The authors also cite the potential for double scatter simulation to improve total scatter estimation, which may further improve  $^{68}\text{Ga}$ -PSMA PET imaging.

However, the paper fails to mention another published method that demonstrated significant reduction of the halo artifacts. Wangerin et al. showed that improvements to the PET scatter algorithm significantly decreased or completely eliminated halo artifacts for  $^{68}\text{Ga}$ -PSMA-11 and also for  $^{68}\text{Ga}$ -RM2 in the kidneys and bladder regions (2).

There were 2 significant modifications to the scatter algorithm that helped to account for the highly targeted uptake and prompt  $\gamma$ -emission of these  $^{68}\text{Ga}$ -labeled radiopharmaceuticals. The first improved the single scatter estimation through optimization of the subsampling methodology that is used to limit the computation time. The second improved the scatter scaling step by adding an additive offset factor to the model. The conclusions were that image reconstruction with the improved scatter-correction algorithm mitigated washout artifacts and recovered diagnostic image quality in  $^{68}\text{Ga}$ -PSMA-11 studies, indicating that the use of diuretics may be avoided.

We think that *The Journal of Nuclear Medicine* readership will benefit from increased awareness of this alternative approach to improved scatter correction when using  $^{68}\text{Ga}$ -labeled radiopharmaceuticals.

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2. Wangerin KA, Baratto L, Khalighi MM, et al. Clinical evaluation of  $^{68}\text{Ga}$ -PSMA-II and  $^{68}\text{Ga}$ -RM2 PET images reconstructed with an improved scatter correction algorithm. *AJR*. 2018;211:655–660.

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### Reply to: Improved Scatter Correction to Eliminate Halo Artifacts for $^{68}\text{Ga}$ -Labeled Radiopharmaceuticals in PET Imaging

**REPLY:** After reading our ahead-of-print article (1), Wangerin et al. pointed out that their paper (2) might be interesting for *The Journal of Nuclear Medicine* readership with regard to the subject matter of un-renormalized absolute scatter correction on  $^{68}\text{Ga}$ -PSMA PET quantification in PET/MRI of the prostate. Therefore, we will reference their paper in the final published version of our article (1). We thank Dr. Wangerin for informing us of their publication and its relevance to our article.

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### The Martinique Principles

**TO THE EDITOR:** Recently, the Martinique Working Group (MWG), composed of representatives from the American Thyroid Association (ATA), the European Association of Nuclear Medicine (EANM), the European Thyroid Association (ETA), and the Society of Nuclear Medicine and Molecular Imaging (SNMMI), published a white paper referred to as “The Martinique Principles” (1).

As defined by Wikipedia (2), “. . . a white paper is an authoritative report or guide that informs readers concisely about a complex issue and presents the issuing body’s philosophy on the

matter. It is meant to help readers understand an issue, solve a problem, or make a decision.” Although not infrequently, “white papers” are characterized as exactly that: mostly “white with very little black ink used to communicate nothing of substance,” *tout au contraire!* The article by Tuttle et al. (1), referred to as “The Martinique Principles,” documented multiple important accomplishments.

First and foremost, this white paper documents the important establishment of an honest and collegial discussion of differences of practices and opinions regarding the diagnosis and management of differentiated thyroid cancer among prominent members of 4 societies. Arguments can be divisive or constructive. This group’s efforts were constructive and help us all move toward understanding and resolving controversial issues, thereby hopefully improving patient care. Again, the establishment of this new collegial dialogue is the foremost accomplishment of the MWG as demonstrated in this white paper from the 2108 meeting.

Second, the MWG compiled 9 principles (Supplemental Fig. 1 [supplemental materials are available at <http://jnm.snmjournals.org/>]), and the reader is encouraged to read the entire article for a more detailed discussion and appreciation of the value of these principles. Overall, the 9 principles established a valuable foundation from which to proceed. In addition, each principle has its specific value, and I have selected several of the 9 principles to present examples of the value of the individual principles themselves.

Third, and as an example of the above, the MWG established common terminology for the discussion of  $^{131}\text{I}$  therapies based on a combination of definitions proposed by Cooper et al. (3) and Van Nostrand et al. (4) and further supported by Haugen et al. (5). These terms are  $^{131}\text{I}$  remnant ablation,  $^{131}\text{I}$  adjuvant treatment, and  $^{131}\text{I}$  treatment of known locoregional or distant metastases. These definitions are based on different objectives of those  $^{131}\text{I}$  therapies (Supplemental Table 1). In order to make any dialogue about controversies more productive and less confusing, it is paramount that we use the same terms with the same meanings. The MWG established common terminology that was accepted by all the members of the MWG of the 4 societies. I encourage the members of the SNMMI to also accept and use these terms. To use different terms or to use the same terms but with our own individual definitions and objectives will only aggravate the futility of our discussions of controversies. The MWG has achieved reasonable and workable terminology for  $^{131}\text{I}$  therapies.

Fourth, the MWG presented various viewpoints followed by constructive discussions regarding 3 controversial areas (i.e., indications for  $^{131}\text{I}$  adjuvant treatment, the amount of activity for  $^{131}\text{I}$  adjuvant treatment, and what is radioiodine refractory disease). These presentations and discussions allowed a better understanding of the arguments of the opposing sides and that we need better evidence-based medicine.

There are other benefits specific to the individual principles, which I do not discuss here. However, there are also less frequently discussed benefits from “The Martinique Principles,” such as the following 2 examples. By developing the 9 principles through sharing the differences of opinion and, hopefully, understanding those differences better, the MWG will help influence the development of future guidelines to continue to incorporate the spectrums of expert opinions and recognize the frequently inadequate evidence available to us. In addition, I believe that the 9 principles will offer facilitators of Continuing Medical Education programs a document for “needs assessment” to encourage more presentations discussing the various viewpoints of these 3 controversies.

These presentations will, in turn, help practicing physicians to better individualize their care to a specific patient in a specific facility in a specific location of the world.

In summary, the MWG and its past 2018 and 2019 meetings have been extremely valuable in organizing our collaborative efforts to establish common terminology, to help identify areas of differences of opinions, to better understand what our differences are, and to recognize that, overall, our intentions of improved diagnosis and management of patients with differentiated thyroid cancer are aligned.

It is now the tasks of the MWG and its present and future members to continue the honest and collegial dialogue in order to move forward toward an ever-better understanding of best practices for our patients with differentiated thyroid cancer.

In the end, follow those who seek the truth and not those who think they know the truth.

## ACKNOWLEDGMENTS

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