Global contrast in nuclear medicine.

Geoffrey M Currie
Hosen Kiat
Janelle M Wheat

Australian School of Advanced Medicine, Macquarie University, Sydney, Australia and Centre for Research in Complex Systems, Charles Sturt University, Wagga Wagga, Australia.

Correspondence:
Geoff Currie
Email: gcurrie@csu.edu.au
A few decades ago the expression *it’s like comparing apples and oranges* was widely used when arguing the relative merits of $^{99m}$Tc based radiopharmaceuticals with the more traditional $^{201}$Tl chloride in myocardial perfusion imaging. Recent articles in the *Journal of Nuclear Medicine Technology* (JNMT) highlighted that this same expression might be equally relevant when discussing the provision of nuclear medicine services across the developed world.

For many years, developed countries in the northern hemisphere have enjoyed reliable and cost effective supply of cyclotron produced radionuclides while those in the southern hemisphere, particularly Australia, relied on importing cyclotron produced nuclides from the northern hemisphere. In the early 1990’s the Australian National Medical Cyclotron was constructed to meet the local needs for cyclotron produced PET and general nuclear medicine radionuclides. Unfortunately, the investment failed on both fronts and the system was commercially de-commissioned this year leaving Australia with only a handful of compact cyclotrons dedicated to PET tracer production. While cyclotron produced radionuclides are readily and cost effectively available in the northern hemisphere (eg. $^{123}$I MIBG), the southern hemisphere is confronted with relative cost prohibition. Indeed, while the majority of nuclear medicine texts cite the importance of $^{123}$I in thyroid imaging, it is not generally employed in Australia.

The global $^{99m}$Tc crisis, however, should be more accurately described as a compartmented-global crisis because the impact in the southern hemisphere has been minimal. Dated reactors and lack of new reactor installations in the northern hemisphere will produce recurring $^{99m}$Tc supply stress. Indeed, the Society of Nuclear Medicine Technologists (SNMTS) recently launched an awareness campaign to attempt to protect the $^{99m}$Tc based imaging industry. The “*Got $^{99m}$Tc?*” t-shirt is part of that initiative. Furthermore, cyclotrons are being looked at to produce $^{99m}$Tc more reliably (1) which casts the industry back to the pre-$^{99}$Mo/$^{99m}$Tc generator era of daily deliveries, unreliable service (particularly after hours) and carrier related issues with image quality. Changes to clinical practice have been proposed to accommodate the lack of $^{99m}$Tc; Pagnanelli and Basso reported in a recent JNMT article (2) on the clinical utility and protocols for $^{201}$Tl myocardial perfusion studies; a regression to days gone by due to lack of $^{99m}$Tc. The use of $^{67}$Ga citrate and $^{111}$In WBC in preference to $^{99m}$Tc WBC in infection provides another example. In the same journal, Buck et al. (3) reported that the proliferation of PET/CT in the USA was well in excess of global trends; perhaps a measure of funding policy and an adoption of technology not reliant on $^{99m}$Tc supply. With reference to the former, the USA enjoys a much greater clinical diversity of rebates than the much more prescriptive and restrictive policy in Australia. It would be an interesting exercise to gain a snapshot of whether the global $^{99m}$Tc shortage has seen an associated increase in the number of $^{18}$F ion bone scans or, indeed, a tendency to favour a move toward $^{13}$N ammonia myocardial perfusion than a regression to $^{201}$Tl. One consolation in this scenario is that patients are retained in nuclear medicine. Anecdotal evidence from the United Kingdom suggests that, for example, bone scanning may only be performed on a single
day per week which has encouraged more widespread reliance on anatomical imaging. At a time when anatomical imaging is challenging traditional strongholds of nuclear medicine (e.g., cardiac CT or MRI and CT angiography for pulmonary embolism), the lack of $^{99m}\text{Tc}$ provides little resistance.

In the southern hemisphere there could not be a greater contrast. There are numerous new reactors, including in Australia and South America, and high production capabilities in South Africa. There is no shortage of $^{99m}\text{Tc}$ and, indeed, it is used in preference to cyclotron produced radionuclides like $^{67}\text{Ga}$ citrate and $^{201}\text{Tl}$. The hemispheric gap is perhaps best highlighted by the comparatively rapid adoption of $^{99m}\text{Tc}$ based radiopharmaceuticals for myocardial perfusion and the virtual absence of $^{123}\text{I}$ and $^{111}\text{In}$ based radiopharmaceuticals in clinical practice in Australia. Similarly, the availability of $^{99m}\text{Tc}$ in the southern hemisphere sees a relatively higher dependence on $^{99m}\text{Tc}$ WBC over $^{67}\text{Ga}$ citrate for infection imaging, $^{99m}\text{Tc}$ MIBI over $^{201}\text{Tl}$ chloride in oncology, and $^{99m}\text{Tc}$ based ventilation agents like aerosols and Technegas over $^{81}\text{Kr}$ (which is not clinically available). Nonetheless, at the time of writing Australia had suffered its own version of a $^{99m}\text{Tc}$ crisis with the national reactor closed for routine maintenance causing ‘shock waves’ through the nuclear medicine community. Those most significantly affected suffered two weeks of lower yields on $^{99}\text{Mo}/^{99m}\text{Tc}$ generators (for example one of the worst cases drawn to our attention received only 60% of their anticipated calibrated activity). Furthermore, those relying on centralised pharmacies had dose capping measures employed, for example a 10% reduction in dispensed doses across the board. Locally, the ‘shock waves’ appeared more severe than reality because $^{99}\text{Mo}$ has enjoyed a large production surplus for many years which has seen generators routinely ‘topped up’ leaving departments counting on larger activities than ordered and paid for. Indeed, previous global $^{99m}\text{Tc}$ crises have simply seen Australian departments get the activity ordered and paid for (rather than the top up).

While the USA enjoys 6.5 PET/CT scanners per million people and Europe has 1.2 PET/CT scanners per million people (3), Australia gets by with less than 0.5 PET/CT scanners per million people. Furthermore, states like Texas, Florida, New York and Pennsylvania each have a population less than that of Australia, yet they each have between 10 and 16 times more PET/CT scanners servicing their populations. Thus, the relative abundance of $^{99m}\text{Tc}$ might be offset be a relative absence of other novel non $^{99m}\text{Tc}$ SPECT tracers and scarcity of PET/CT services. Moreover, the bulk of the medical literature globally reflects practice in the northern hemisphere and the discordance between the hemispheres may not be reflected in said literature. Consequently, the scourge that is the $^{99m}\text{Tc}$ crisis in the Northern hemisphere may be perceived as a global issue and change referral patterns and clinical practice unnecessarily in the Southern hemisphere. Conversely, the expectation in Southern hemisphere for access to PET/CT services and/or novel tracers might fall frustratingly short of the actual capabilities.
A comparison of nuclear medicine status and service provision between the two hemispheres highlights different capabilities and different barriers and these are not always reflected in the typically northern hemispheric driven journal publications. A comparison of nuclear medicine status and service provision between the two hemispheres is like comparing *apples and oranges*, or *baseball and cricket* perhaps.
REFERENCES

