The Northern Territory, Australia

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Having done all my medical education and training in Melbourne, Australia, I decided to spend my second year of neurology training in the Northern Territory. It is a very different world to medicine in Melbourne, being a unique and beautiful region of Australia, often forgotten and undiscovered by many Australians.

THE NORTHERN TERRITORY
Situated in the centre of Australia, the Northern Territory is the third largest state in Australia and is roughly the size of France, Spain and Italy combined (figures 1 and 2). It has a unique environment that ranges from arid desert down south to tropical regions on the coast in the north. The Northern Territory is often considered the quintessential Australian outback and boasts many stunning sites such as Kakadu (figure 3), Litchfield National Park, Katherine Gorge (figure 4) and the world famous Uluru (previously known as Ayers Rock). The year is divided into two seasons, wet and dry, with high temperatures, high humidity and monsoonal rain dominating the wet season. Darwin, the capital city, is the most northern Australian capital and is the main city in the territory.

The first documented arrival of Indigenous people to Australia and the Northern Territory through land bridges from south-east Asia dates back to roughly 50,000 years ago. European settlement arrived in 1770 and to the Northern Territory in the early 1800s. It is a sparsely populated region, with a population of 211,945. Most live in the 'Top End' (165,517), the northern region of the Northern Territory, of whom 120,586 reside in Darwin. Twenty-eight per cent of the population are indigenous, compared with 2.5% nationally.1 There is a large socioeconomic disparity between the Northern Territory and the rest of the country. Health outcomes are also considerably poorer in indigenous patients compared with non-indigenous patients.4

NEUROLOGY IN THE NORTHERN TERRITORY
There are more than 400 neurologists in Australia. The population per neurologist in Australia ranges from 40,000 to 80,000.3 In the Northern Territory, there has been only one neurologist for the last 25 years, Dr Jim Burrow. He arrived in the early 1990s as the first neurologist for the region. With the so few physicians in the Northern Territory, he also practised general medicine alongside neurology. Now a stand-alone neurology service with a neurology trainee and another junior doctor, time is spent between inpatient management and a busy outpatient department (including EEG, nerve conduction studies and a botulinum toxin clinic) at the Royal Darwin Hospital, which services the 'Top End' of the Territory. The southern region of the state is serviced by a visiting neurologist from Adelaide.

The neurology team runs nine half-day outpatient clinics per week. Roughly five to eight patients attend each clinic with a mixture of new presentations and clinical reviews. Given the vast distance of the territory, many patients south of Darwin drive 3–4 hours to come to clinic. Patients on the eastern coast of the Northern Territory are flown into Darwin, a 1 hour flight as opposed to driving over 1000 km of unsealed roads. During the wet season, most roads in these areas are impassable due to flood waters. A large percentage of indigenous patients live in small rural communities ranging from 500 to 2000 people and many come from smaller outback stations that are further isolated. Three or four times a year, the neurology team flies out to several large towns and communities to run clinics and perform nerve conduction studies. Patients living in outback stations...
or nearby communities are driven in to attend these clinics. Patients who require further investigations are flown to Darwin where these can be expedited in an outpatient setting (figure 5).

Stroke is the most common inpatient presentation to the hospital. Most acute strokes in the Top End are transferred to the Royal Darwin Hospital. The stroke incidence of 138 per 100,000 in non-indigenous patients is similar to the rest of Australia. However, the indigenous population has a three times higher incidence (307 per 100,000), a younger age of onset (10 years), higher case fatality, higher stroke recurrence and more comorbidities than non-indigenous patients. The year 2016 was the first year that thrombolysis of acute ischaemic strokes was introduced at the Royal Darwin Hospital. This was coupled with a code stroke service with early mobilisation of the neurology, medical and intensive care teams to assess and manage acute stroke patients presenting to the emergency department.

There is no neurosurgical service in the Northern Territory so all neurosurgical patients are managed between the neurology department and the trauma service. General surgeons in Darwin can perform basic burr holes, extraventricular drains and hemicraniectomies, but most cases are flown down to the closest neurosurgical service in Adelaide, 3.5 hours by air. A visiting neurosurgeon attends a clinic in Darwin every 3–4 weeks.

The Northern Territory has tropical and exotic infections that are rarely seen elsewhere in Australia. Many of these present predominantly in the indigenous community but can affect anyone. One of which is *Burkholderia pseudomallei* (melioidosis), which is almost synonymous with the Northern Territory. A bacterium that causes severe pneumonia and prostatitis in immunocompromised patients, its prevalence rises exponentially during the wet season. Severe cases lead to central nervous system (CNS) infiltration causing abscess, rhombencephalitis and transverse myelitis. Cryptococcal meningitis and CNS cryptococcomas are also a not uncommon presentation in even immunocompetent patients.

Leprosy used to be prevalent in indigenous patients in the 1970s but over time its incidence has reduced drastically. Unfortunately, the disease is yet to be completely eradicated and there are still one or two new cases per year. There is also a very high prevalence of neuroimmunological disease, especially in the indigenous population. The indigenous population has a high prevalence of systemic lupus erythematosus and
Sjögren’s syndrome that anecdotal experience suggests present and manifest in an atypical manner. Severe and early myositis and CNS involvement are not uncommon and require aggressive management. Patients with multiple sclerosis and neuromyelitis optica spectrum disorder are also regularly managed at the Royal Darwin Hospital.

East Arnhem Land (the most eastern region of the Northern Territory) and the island Groote Eylandt have a high prevalence of spinocerebellar ataxia 3 (SCA3, Machado–Joseph disease) with roughly 100 patients. The initial presentation of this syndrome was observed in the 1960s and named Groote Eylandt syndrome. It was initially attributed to poisoning with manganese that was mined in the area. Later studies found no correlation between manganese concentrations and disease, and it was later discovered the syndrome was truly SCA3. It was initially thought that the gene had been passed through Portuguese—Macassan traders 300 years earlier. However, further genetic testing in 2012 confirmed that the gene mutation likely originated from Asia and was not the Portuguese variant.

The Northern Territory has some of the most picturesque and beautiful scenery in the continent and is often considered the quintessential Australian outback. It is sparsely populated and faces many socioeconomic issues. Though understaffed, there is a fascinating variety of neurological cases that makes work in the Northern Territory both rewarding and challenging.

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