

Assessing the adequacy and sustainability of the Northern Territory health workforce with respect to burden of disease and injury, 2009–2021: an analysis of administrative data

Yuejen Zhao, Jo Wright, Renu Unnikrishnan, Ramakrishna Chondur, Danielle Green

The known: Life expectancy at birth is shorter in the Northern Territory than elsewhere in Australia, and the number of health workers per resident higher.

The new: When burden of disease and injury rather than population size is used as the benchmark, the Northern Territory health workforce is about 22% smaller than needed to match the national health workforce level.

The implications: The Northern Territory health workforce will face increasing pressure unless the number of health workers is increased to handle the high burden of illness, and to meet the health care requirements of Indigenous people.

Population health cannot be improved without an adequate, high quality health workforce.¹ Health workforce needs are expected to increase substantially in Australia because of population growth and ageing, as well as changes in the epidemiology of disease and injury.^{2,3} Access to health services depends on the geographic distribution of the health workforce; in Australia, it is concentrated in major cities,⁴ and may therefore not reflect population health needs.⁵ These needs can be assessed as the burden of disease, measured in disability-adjusted life-years (DALYs),⁶ a summary statistic of mortality and morbidity that combines life years lost to premature deaths and disabilities caused by illness and injury.⁷

The Northern Territory includes 1% of the Australian population, but 18% of its area; 26% of NT people are Aboriginal or Torres Strait Islander (Indigenous) people, 75% of whom live in remote areas.⁸ About 3% of the national population are Indigenous Australians.⁸ The burden of disease for Indigenous people is higher in the NT than elsewhere in Australia, and their health outcomes are poorer; their life expectancy at birth is about 15 years shorter than for non-Indigenous Territorians.⁹ Life expectancy at birth is lower in the NT than in all other states and territories.^{9,10}

Australian governments recognise that improving Indigenous health in partnership with Aboriginal and Torres Strait Islander communities requires equity in needs-based health workplace planning beyond matching its size to that of the population.¹¹ Health workforce shortages and high turnover hamper health service delivery in remote areas of the NT.¹² Greater efforts are needed to meet the health care needs of Indigenous people,¹³ and, to close Indigenous health gaps, health workforce planning must be evidence-based.⁹ However, it is unknown whether the NT health workforce is adequate for dealing with the burden of disease in the NT.

We therefore assessed the adequacy of the NT health workforce with respect to both population size and burden of disease,

Abstract

Objectives: To assess the adequacy of the Northern Territory health workforce with respect to population size and burden of disease, overall and by selected health specialties; to assess its sustainability by investigating changes in workforce numbers.

Study design: Analysis of Australian Health Practitioner Regulation Agency (AHPRA) health workforce data (2013–2021) and burden of disease data (disability-adjusted life-years, DALYs) drawn from national and NT burden of disease studies (and projected for 2019–2021).

Setting, participants: NT and Australian health workforces, 2009–2021.

Main outcome measures: Adequacy of the NT health workforce, assessed as the ratio of the mean annual numbers of NT health workers per 1000 population or health workers per 1000 DALYs (2009–2013 and 2014–2018) to those of the Australian workforce (2013 and 2018); sustainability of the NT health workforce, defined as the number of health workers per 1000 population or per 1000 DALYs increasing between 2013 and 2021.

Results: The number of health workers per 1000 population was slightly higher in the NT than for Australia in both time periods (2009–2013 v 2013: 23.30 v 21.79 per 1000 population, 6.9% larger; 2014–2018 v 2018: 25.79 v 23.47 per 1000 population, 9.9% larger); however, it was smaller with respect to burden of disease (2009–2013 v 2013: 82.6 v 107.4 health workers per 1000 DALYs, 23.1% fewer; 2014–2018 v 2018: 91.5 v 117.1 per 1000 DALYs, 21.8% fewer). In particular, 464 more nurses and midwives (11.4% more than the mean for 2013–2021), 196 more physiotherapists (115%), 189 more psychologists (102%), 152 more pharmacists (79%), and 144 more dentists (106%) are needed in the NT to match the corresponding numbers of health workers by disease burden for Australia as a whole. The number of Aboriginal health practitioners per 100 000 DALYs fell during the study period.

Conclusion: Health worker population density alone does not reliably assess health workforce needs; burden of disease information is important for workforce planning that meets population health needs. The NT health workforce needs to be increased by about 28% to reflect the population burden of disease and injury. Shortages in the NT health workforce must be eliminated to close health gaps between Indigenous and non-Indigenous Australians.

overall and by selected health specialties, by comparing it with the national health workforce. We also investigated changes in workforce numbers to assess its sustainability. This study is part of the fourth NT burden of disease study (stage 3).¹⁴

Methods

We used burden of disease information to assess the size and skill mix of the health workforce, as recommended by the

World Health Organization.¹⁵ We obtained health workforce data for Australia and the NT from the Australian Health Practitioner Regulation Agency (AHPRA) database using the Australian Department of Health and Aged Care Data Tool (<https://hwd.health.gov.au/datatool>). This tool can be used by government and non-government organisations for monitoring and planning the health workforce, forecasting future workforce needs, and informing the education and supply of a qualified workforce. At the time of writing (July 2023), the database covered the period 1 January 2013 – 31 December 2021. We analysed health workforce data both overall and for 38 health professions; we included only people employed in their registered professions in Australia (as did the Australian Institute of Health and Welfare [AIHW] in their recent analysis⁴). Data for the paramedical health workforce were available only from 1 January 2019.

We calculated the size of the health workforce both as number of workers (person-years) and as fulltime position equivalents (working hours as proportion of standard number of work hours⁴); if the number of fulltime equivalents is greater than the number of workers, it indicates that employees are working longer than standard work hours. Estimated resident populations for the NT and Australia were obtained from the Australian Bureau of Statistics website.⁸ The Aboriginal health practitioner workforce was assessed with reference to population and burden of disease data for the Indigenous population.⁷ All other professions were assessed using total population data and burden of disease data (DALYs) drawn from national and NT burden of disease studies.^{7,14,16,17} Because of its small population, we aggregated NT data for two five-year periods, 2009–2013 and 2014–2018. The size of the health workforce for 2009–2013 was estimated from the 2013 data.

We assessed the adequacy of the overall NT health workforce by dividing the number of health practitioners by the total population number (health workers per 1000 population) or by total disease burden (health workers per 1000 DALYs). We respectively compared the NT values for 2009–2013 and 2014–2018 with Australian threshold values for 2013¹⁷ and 2018⁷ as ratios. For our primary analysis, sufficiency of supply was defined as the number of health workers per 1000 DALYs being at least as high for the NT as for Australia (ratio of one or more). For individual professions, results are reported as health workers per 100 000 population or 100 000 DALYs (overall burden of disease).

We estimated annual change in health workforce size from 2013 to 2021 (with respect to population or burden of disease) as the linear regression slope. NT burden of disease data were projected for 2019–2021, using linear extrapolation of the annual total DALYs because the relevant data have not yet been reported.¹⁴ An increase in number between 2013 and 2021 was deemed to indicate sustainability of supply, a decline non-sustainability of supply.

Finally, we used differences between the NT and Australia in the number of health workers per 100 000 DALYs in 2014–2018 (the most recent available data) to estimate the current need for more health workers in each profession. For example: during 2013–2021 the mean number of nurses in the NT was 5866 per 100 000 DALYs, in Australia 6537 nurses per 100 000 DALYs; we multiplied the difference (0.00671 per DALY) by the annual health burden in the NT during 2014–2018 (the most recent data available; 69 209 DALYs), yielding the need for 464 additional nurses. The estimated mean numbers of health workers in the

NT and Australia by profession during 2013–2021 are provided in the [Supporting Information](#) (table 1).

Ethics approval

The NT Department of Health and Menzies School of Health Research Human Research Ethics Committee approved this study (HREC 2020-3860).

Results

For 2009–2013, the aggregate total of registered health workers in the NT was 27 135 person-years, or 5427 health workers per year; the aggregate for 2014–2018 was 31 670 person-years, or 6334 health workers per year. Similarly, the aggregate number of fulltime equivalents increased from 28 305 (5661 per year) during 2009–2013 to 32 416 (6483 per year) during 2014–2018 ([Box 1](#)). During both periods, the number of fulltime equivalents exceeded that of health workers, particularly for medical and paramedical professionals (data not shown).

Health worker numbers with respect to population and disease burden: overall

For both time periods, the NT health workforce comprised 1.1% of the national health workforce, a slightly larger proportion than its population proportion (1.0%), but smaller than its proportion of the national disease burden (1.4%). The number of health workers per 1000 population was slightly higher in the NT than for Australia (2009–2013 *v* 2013: 23.30 *v* 21.79 per 1000 population, 6.9% larger; 2014–2018 *v* 2018: 25.79 *v* 23.47 per 1000 population, 9.9% larger) ([Box 1](#); [Box 2](#)).

During 2009–2013, there were 82.64 health workers per 1000 DALYs in the NT (23.1% fewer than the 2013 national level), and 91.52 per 1000 DALYs during 2014–2018 (21.8% fewer than the 2018 national level) ([Box 1](#); [Box 2](#)).

The rises in the overall numbers of health workers and fulltime equivalents by population or disease burden between the two time periods were similar for the NT and Australia. The number of NT health workers per 1000 DALYs during 2014–2018 would need to increase by 28% to achieve the national level (ie, $[117.08 - 91.52]/91.52$) ([Box 1](#)).

Health worker numbers with respect to disease burden: by speciality

The number of health workers with respect to disease burden was lower in the NT than in Australia overall for 28 of 38 specialities; the differences were greatest for nurses and midwives (670.6 per 100 000 DALYs), physiotherapists (283.9 per 100 000 DALYs), psychologists (272.6 per 100 000 DALYs), pharmacists (219.6 per 100 000 DALYs), and dentists (207.7 per 100 000 DALYs) ([Box 3](#)). These figures indicate that 464 more nurses and midwives (11.4% more than the mean number for 2013–2021), 196 more physiotherapists (115%), 189 more psychologists (102%), 152 more pharmacists (79%), and 144 more dentists (106%) are needed to match the corresponding numbers of health workers per 100 000 DALYs for Australia ([Box 4](#)).

The annual increases in the numbers of health workers by disease burden were lower in the NT than in Australia overall for 20 of 38 specialities. The differences were greatest for Aboriginal health practitioners (difference between NT decrease and national increase: 30.8 per 100 000 DALYs per year), psychologists (15.6 per 100 000 DALYs per year), and paramedical health workers (11.6 per 100 000 DALYs per year) ([Box 3](#)).

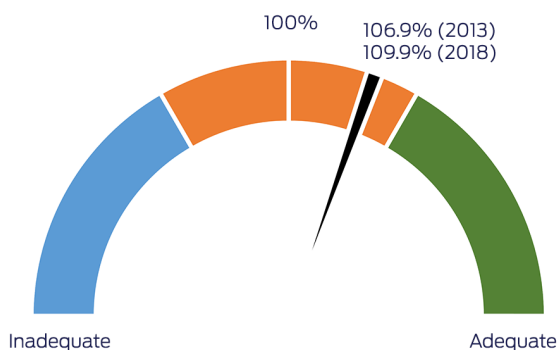
1 Population, health workforce, and burden of disease, Northern Territory (2009–2018) and Australia (2013 and 2018)

Characteristic	Northern Territory		Australia		Ratio	
	2009–2013	2014–2018	2013	2018	NT 2009–2013 v Australia 2013	NT 2014–2018 v Australia 2018
Population						
All people	232 947	245 568	23 128 129	24 982 688	0.010	0.010
Indigenous people	68 215	73 906	698 583	778 064	0.098	0.095
Disability-adjusted life-years						
All people	65 671	69 209	4 691 450	5 008 057	0.014	0.014
Indigenous people	37 210	38 885	204 431	239 942	0.182	0.162
Disability-adjusted life-years per person						
All people	0.282	0.282	0.203	0.200	1.390	1.406
Indigenous people	0.545	0.526	0.293	0.308	1.864	1.706
Health workers*						
Health workers per 1000 population	23.30	25.79	21.79	23.47	1.069	1.099
Health workers per 1000 disability-adjusted life-years	82.64	91.52	107.43	117.08	0.769	0.782
Fulltime equivalents*						
Health workers per 1000 population	24.30	26.40	20.35	21.47	1.194	1.230
Health workers per 1000 disability-adjusted life-years	86.20	93.68	100.33	107.11	0.859	0.875

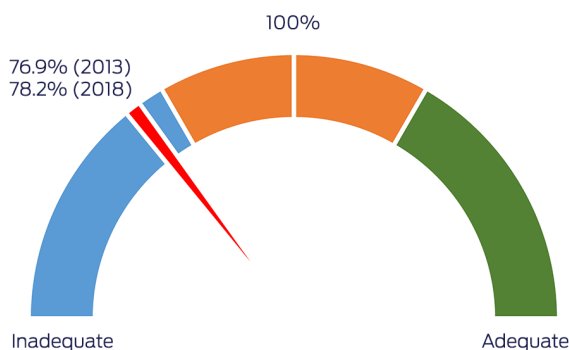
* Mean annual number for the Northern Territory is reported. † Based on 2013 data, as workforce data were not available for 2009–2012. ◆

2 Comparison of the sizes of Northern Territory and Australian health workforces with respect to population size and burden of disease, 2009–2013 v 2013 and 2014–2018 v 2018*

A. Health workers with respect to population



B. Health workers with respect to burden of disease



* That is: Northern Territory:Australia ratios for health workers per 1000 population and health workers per 1000 disability-adjusted life-years. The data for this figure are included in Box 1. ◆

Health workers with respect to population: by specialty

Absolute differences between the NT and Australia in the numbers of health workers relative to population were not as marked as for numbers with respect to disease burden. For example, the differences for general practitioners were 13.1 more per 100 000 population (Supporting Information, table 2) and 93.8 fewer per 100 000 DALYs in the NT (Box 3). The estimated required annual growth in the number of Aboriginal health practitioners based on population was 4.9% (11.0/223.5 per 100 000 population; Supporting Information, table 2); based on disease burden it was 7.4% (30.8/418.5 per 100 000 DALYs; Box 3).

Discussion

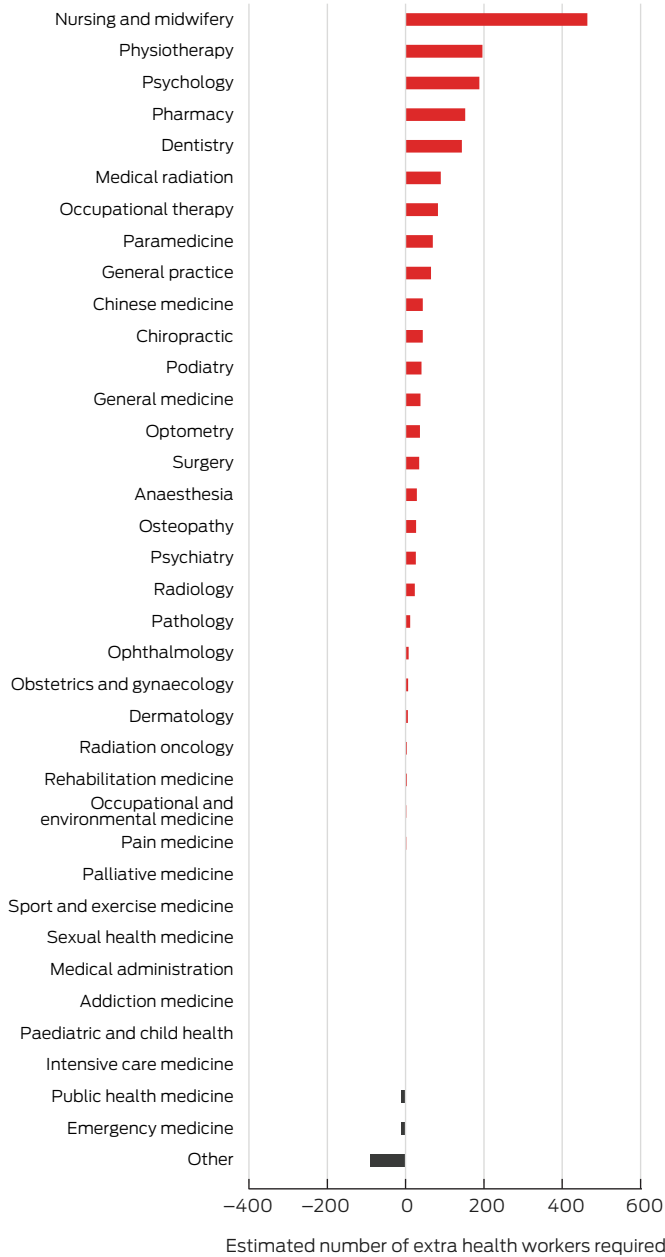
Our analysis indicates that the size of the NT health workforce, relative to its population size, was about 10% larger than the Australian health workforce during 2009–2018 (Box 1). This finding was consistent with those of a recent AIHW report⁴ and our earlier study¹⁸ that the number of health workers per NT resident is higher than for Australia. However, another AIHW report noted a severe shortage of health workers in rural and remote areas of Australia, including in the NT.¹⁹ Geographic maldistribution of the health workforce results in widespread mismatching of health services with health needs in remote and very remote areas, but population-based

3 Size and annual change in size of the Northern Territory and Australian health workforces with respect to overall burden of disease, 2013–2021, by profession*

Profession	Health workers/100 000 DALYs			Annual change in health workers/100 000 DALYs		
	Northern Territory	Australia	Difference	Northern Territory	Australia	Difference
Nursing and midwifery	5866.4	6537.0	-670.6	76.6	65.2	11.4
Other medical practitioners	857.8	727.5	130.4	9.8	8.3	1.6
Aboriginal health practitioners [†]	418.5	132.2	286.3	-11.9	18.9	-30.8
General practice	396.3	490.1	-93.8	17.6	10.2	7.4
Pharmacy	275.9	495.5	-219.6	5.7	6.0	-0.38
Psychology	268.1	540.7	-272.6	-2.6	13.1	-15.6
Physiotherapy	246.0	529.9	-283.9	8.4	19.3	-10.9
Occupational therapy	235.5	354.9	-119.4	11.7	19.2	-7.4
Paramedicine [‡]	230.4	330.8	-100.4	4.0	15.6	-11.6
Dentistry	196.3	404.0	-207.7	-0.92	3.7	-4.6
Medical radiation	148.6	278.1	-129.5	4.7	5.7	-1.0
General medicine	104.7	159.6	-54.9	5.6	4.8	0.80
Emergency medicine	56.1	37.8	18.3	4.9	2.6	2.3
Surgery	51.8	102.3	-50.5	-0.32	0.89	-1.2
Anaesthesia	46.4	88.0	-41.6	1.6	1.5	0.11
Optometry	46.2	99.0	-52.7	-0.32	2.0	-2.4
Paediatric and child health	41.2	40.6	0.5	1.5	1.7	-0.1
Podiatry	32.7	91.1	-58.3	1.0	2.4	-1.3
Psychiatry	31.9	70.0	-38.1	1.6	1.2	0.39
Chiropractic	31.8	95.0	-63.2	-0.61	1.02	-1.6
Obstetrics and gynaecology	26.2	35.8	-9.6	0.33	0.32	0.02
Public health medicine	20.8	4.9	15.9	-1.4	-0.03	-1.41
Chinese medicine	16.4	79.8	-63.4	-0.54	-0.55	0.01
Intensive care medicine	14.3	13.5	0.8	0.56	0.46	0.11
Pathology	11.0	27.9	-16.9	0.16	-0.01	0.18
Ophthalmology	7.6	18.7	-11.1	0.54	0.05	0.50
Radiology	7.6	41.5	-33.8	-0.05	0.81	-0.86
Medical administration	4.6	4.4	0.2	-0.50	-0.05	-0.45
Palliative medicine	4.6	5.0	-0.4	0.15	0.26	-0.10
Rehabilitation medicine	4.3	8.7	-4.4	-0.04	0.22	-0.27
Osteopathy	3.7	42.8	-39.1	1.0	2.0	-1.0
Addiction medicine	2.5	2.1	0.4	0.30	0.01	0.29
Radiation oncology	2.4	7.1	-4.7	0.26	0.11	0.16
Sport and exercise medicine	2.4	2.3	0.1	0.18	0.05	0.13
Dermatology	1.9	10.2	-8.3	-0.30	0.18	-0.48
Occupational and environmental medicine	1.9	4.8	-2.9	0.06	-0.08	0.13
Sexual health medicine	1.9	1.8	0.1	0.19	0.01	0.17
Pain medicine	0.5	2.9	-2.4	0.27	0.18	0.09

DALY = disability-adjusted life-year. * Sources: references 4, 7, 14, 16, 17. † Based on burden of disease among Aboriginal and Torres Strait Islander people. ‡ Data available only for 2019–2021. ◆

4 Number of additional health workers needed for the Northern Territory health workforce to match number with respect to burden of disease for the Australian health workforce, 2013–2021, by speciality*



* Aboriginal health practitioners data not shown because Northern Territory and Australian numbers are not comparable. ♦

assessments at the state or territory level do not detect local pockets of mismatch.¹⁹

Our analysis provides a clear reason for the number of health workers by population being larger in the NT than Australia overall: the greater burden of disease in the NT (41% more DALYs per person in 2014–2018 than for Australia in 2018). The number of health workers per 1000 DALYs, however, was about 22% lower in the NT than for Australia overall. That is, the population-based assessment of the adequacy of the health workforce does not take into account differences between health needs in the NT and Australia. The population proportion of

Indigenous people in the NT (26% in 2021) is larger than for Australia (3%),⁸ and the burden of disease was more than three times as high for Indigenous as for non-Indigenous people in the NT during 2014–2018.¹⁴ The 22% shortfall in health workers with respect to disease burden places pressure on the NT health workforce; to achieve parity with the national level, its size needs to be increased by about 28%.

Our assessment of the adequacy of the health workforce with respect to burden of disease indicates that NT health services need 464 more nurses and midwives. This is alarming, as nurses and midwives comprise the largest single group of registered health professionals. There is both anecdotal and research evidence for large numbers of unfilled remote area nurse positions across the NT, resulting in overworked health workers, high staff turnover, and low patient satisfaction.^{12,20} Remote area nurses provide ambulance, emergency, acute, and chronic disease care that in urban centres is normally provided by general practitioners and ambulance paramedics. This broader scope of practice increases the need for nurses and midwives in remote and very remote areas, and partially explains the large nursing and midwifery workforce in the NT.

Our finding that the supply of health workers with respect to the burden of disease was also lower than the national level for most other specialties is consistent with the recent AIHW health workforce report that the five to ten locations with the greatest need for more workers in each professional category were in the NT.¹⁹ The undersupply with respect to burden of disease means that the number of health care staff treating diseases and injuries is insufficient.

The skills mix of the NT health workforce is also inadequate; for example, the numbers of physiotherapists and psychologists are not sufficient to meet health care needs. Our findings are consistent with previous reports on the health workforce in the NT, including shortages of remote area nurses and midwives,^{19,20} physiotherapists,²¹ psychologists,^{19,22} and Aboriginal health practitioners.²³ The 51 fulltime equivalent dentistry positions per 100 000 NT people in 2022 was the lowest level in Australia.⁴ The corollary of the low numbers of specialists in the NT is the relatively high number of “other medical practitioners”, including junior clinicians. The fulltime equivalent numbers for many professions were higher than the number of specialists, indicating that health professionals often work longer than standard hours, probably reflecting understaffing relative to patient needs. Another possible explanation is that clinicians in other states devote a greater proportion of their time than NT clinicians to non-clinical roles, such as research, teaching, and policy development.

Aboriginal health practitioners in the NT deserve special attention. The number of Aboriginal health practitioners relative to disease burden fell during the study period (Box 3), despite increases in the size of the Indigenous population.^{7,16} Further, remote primary care services rely on Aboriginal health practitioners as essential team members. Our findings indicate that this decline means that the size of the Aboriginal health practitioner workforce will become inadequate to meet demand. Community-based Aboriginal health practitioners in the NT play important roles in collaborating with other health professionals to strengthen and deliver integrated primary care services in remote areas.

Our analysis is the first to use empirical burden of disease data to assess health workforce needs in Australia. The AIHW has recognised the limitations of the population density approach by incorporating Indigenous population, land size, and

remoteness data as variables in its assessments of health needs.¹⁹ However, burden of disease is a more direct measure of health needs, and this approach is now seen by WHO as the standard for measuring population health needs.¹⁵

Limitations

Our analysis was largely based on the AHPRA National Health Workforce Dataset as provided by the Department of Health and Aged Care; the reliability of our findings depends on the data quality. The data were originally collected from state and territory professional registration boards and surveys managed by AHPRA covering only part of the health workforce; some details, such as locum arrangements, were not available in the dataset. Nevertheless, the AHPRA workforce dataset is the most accurate and complete available. Secondly, the 38 health profession categories did not cover all NT health specialities; for example, neither nephrologists nor geriatricians were separately listed, and general nurses were not distinguished from remote area nurses and midwives. The workforce assessments were based on overall burden of disease rather than specific disease categories. Profession-specific analysis by disease burden in areas such as paediatric medicine, oncology, endocrinology, nephrology, and geriatric medicine, is planned for the next phase of this project, as is more detailed geographic analysis using NT Department of Health individual-level data. Thirdly, national values were used as comparators for the assessment of workforce adequacy. This is not appropriate for some professions, including Aboriginal health practitioners, who largely work with Indigenous people in primary care clinics, so that the national value does not reflect need in the NT, where the proportion of Indigenous residents is large. The higher burden of disease among Indigenous people requires a larger number of Aboriginal health practitioners. Further, information on the age, sex and Indigenous composition of the workforce was not available, nor the impact of remoteness fully captured. Continuous, comprehensive monitoring of the workforce, including information on age, sex, Indigenous status, and location, is needed. Contributors to health care cost other than burden of disease were not considered by our analysis, but service delivery costs in the NT are higher than elsewhere in

Australia because of its low population density, the remoteness of many communities, and the lack of economies of scale. We did not assess the impact of the coronavirus disease 2019 (COVID-19) pandemic. Finally, estimating burden of disease depends more on data quality than population estimates; burden of disease data beyond 2018 are not yet available because of delays in reporting. Workforce data for the period 2009–2012 were estimates, as AHPRA data were not available.

Conclusion

Our analysis provides both overall and profession-specific assessments that could inform future workforce planning in the NT. Health worker population density alone is insufficient for reliably assessing health workforce needs; burden of disease information is important for workforce planning that meets population health needs. Linking population and burden of disease with health workforce data provides stronger evidence for health workforce planning across health professions than conventional population-based assessments. Burden of disease information should be used for health workforce planning at the national level, as it reflects the heterogeneity of needs by states and territory. We found that the size of the NT health workforce needs to be increased by about 28% to reflect the population level of disease and injury to achieve parity with the national level of health care workers. Shortages in the NT health workforce need to be eliminated to close health gaps between Indigenous and non-Indigenous Australians.

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Competing interests: No relevant disclosures.

Data sharing: The data underlying this report will not be available for sharing. Australian health workforce data, including for the Northern Territory, are available from the Australian Department of Health and Aged Care (<https://hwd.health.gov.au/datatool>). ■

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Supporting Information

Additional Supporting Information is included with the online version of this article.