



Health Workforce Modelling, Northern Territory, Technical Report for the Medical Workforce Model

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Acknowledgements

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Abbreviations

ABS	Australian Bureau of Statistics
AHW	Aboriginal health worker
AIHW	Australian Institute of Health and Welfare
AR-DRG	Australian Refined Diagnosis Related Group
BoD	Burden of disease and injury
CDU	Charles Darwin University
COPD	Chronic obstructive pulmonary disease
DALYs	Disability adjusted life-years
DHF	Department of Health and Families
FTE	Full-time equivalent
GP	General practitioner
HCSLF	Health and community services labour force
HGP	Health Gains Planning Branch, NT Department of Health and Families
IHD	Ischaemic heart disease
LFS	Labour force survey
NHWT	National Health Workforce Taskforce
NT	Northern Territory
NTG	Northern Territory Government
PIPS	Personnel information and payroll system

Summary

The Northern Territory Medical Workforce Model (the medical model) projects the requirement for, and supply of, medical practitioners from 2006 to 2022. The medical model was produced as part of the Health Workforce Modelling Project established by the Strategic Workforce Committee of the Department of Health and Families (DHF) to inform workforce planning by projecting future numbers of health professionals in the Northern Territory (NT).

Method

Growth in population and patterns of population ill health were used to project the future need for treatment and the medical workforce required to meet that need. To estimate the supply of medical practitioners, the current workforce was moved forward in time based on expected inflows and outflows of practitioners and important trends and influences including migration, average working hours and ageing.

The key data sources for the model were:

- The Burden of Disease and Injury in the Northern Territory, 1999-2003 (Zhao Y, You J and Guthridge S, DHF)
- Population estimates (Northern Territory Government/Charles Darwin University)
- National hospital cost data (Australian Government Department of Health and Ageing)
- Census data (Australian Bureau of Statistics, published by the Australian Institute of Health and Welfare)

Results

The model indicated that, based on the current service level, growth in the supply of medical practitioners over the period 2006 to 2022 would exceed the growth in demand for their services. The proportion of medical practitioners aged over 50 was expected to increase due to ageing of the current workforce and positive net migration in older age groups.

Despite the greater supply, the NT would still be likely to have substantially fewer medical practitioners available to meet the per capita health need than may be available at a national level. The key risks for growth in the supply of medical practitioners were the high levels of mobility in the workforce, particularly in the younger age groups. Key pressure points in demand were identified as the requirements of elderly Territorians aged 65 years and over and demand from the whole population for cardiology, oncology and neurology services.

Conclusions

Growth in the supply of medical practitioners in the NT should exceed the growth in demand from population growth and ageing based on the current level of services. The expansion will, however, depend on the NT continuing to attract and retain medical practitioners at past levels and funds being available to support such an increase in the workforce. If growth in the supply of medical practitioners were to exceed growth in

demand, it could provide the opportunity to address unmet need and may contribute to closing the gap in health status between Indigenous and non-Indigenous Territorians.

The modelling highlighted the key influences on the NT workforce. Most critical was mobility with large inward and outward flows of medical practitioners occurring each year. Any change in these movements could have a substantial impact (positive or negative) on the size and age profile of the medical workforce. Increasing the graduate intake could have a positive impact on the medical workforce, but needs to be backed by initiatives to encourage young practitioners to stay in the NT.

The results of the modelling confirm the importance of retention strategies to maximise the size and productivity of the workforce and to minimise recruitment costs. It is also hoped that the projections will facilitate more sophisticated discussion in the NT about the demand and supply of medical practitioners by highlighting minimum growth requirements and key areas of vulnerability in supply and demand.

A limitation of the model was the lack of reliable information on the size and characteristics of the current medical workforce including graduates. Improving the availability and quality of this data and information on exits and re-entries into the workforce would enhance the modelling.

Introduction

The distribution of medical practitioners in Australia is uneven with numbers becoming less plentiful the more distant communities are from major urban areas.¹ Regional and remote areas also tend to be more reliant on overseas-trained health professionals for the provision of services.² In addition to these difficulties, national supply and demand modelling by the National Health Workforce Taskforce (NHWT) has indicated that future requirements are expected to exceed the local supply of medical practitioners despite large increases in Australian medical school places since 2000.² These issues are of particular concern to the Northern Territory (NT) as it has limited ability to train medical practitioners, but a large need for their services, particularly in remote Indigenous communities.

To ensure that services remain available, the NT needs to be informed on the likely demand for, and supply of, medical practitioners. Although the NHWT modelling has projected future requirements based on state-level information, its standardised approach did not adequately account for the specific circumstances of the NT. In particular, it poorly accommodates the issues of interstate migration and the unmet needs of the NT Indigenous population. The NHWT model also used data sources that poorly estimated the size and characteristics of the NT workforce.

The NT Health Workforce Modelling Project, established by the Strategic Workforce Committee of the Department of Health and Families (DHF), sought to inform workforce planning by projecting future numbers of health professionals in the NT. The project aimed to identify the best approach to modelling the health workforce and to incorporate variables of specific importance to the NT. The project's purpose was to produce estimates of the supply of, and requirements (demand) for, medical and nursing professionals and to compare workforce levels in the NT with the national average. Ethical approval for the project was obtained from the Human Research Ethics Committee of the NT Department of Health and Families and Menzies School of Health Research.

A summary of the results of the project are provided in another report along with a review of prior approaches to workforce modelling. The review explains the choice of approach for the NT modelling and it is recommended that it be read in conjunction with this report. This report is the second publication from the project and provides projections of the demand for, and supply of, medical practitioners from the NT Medical Workforce Model (the medical model). It also explains the technical approach and sources of data used in the modelling and the model's limitations.

The report is structured as follows: first, the medical model's information requirements, potential data sources and issues associated with the data are discussed. Second, projections from the demand and supply modules of the model and a gap analysis between the two are presented. This section includes discussion on the modelling approach, baseline projections and sensitivity analyses on key variables and assumptions in the modules. Third, pressure points with regard to specialties and specific demographic groups are investigated, followed by a comparison of the current NT medical workforce with the national average. Finally, the implications of the modelling are discussed and conclusions drawn.

Data parameters for the NT medical workforce model

The medical model projects the requirements for, and supply of, medical practitioners over the period 2006 to 2022. There are two components to the medical model: a demand module, which projects the future need for the services of medical practitioners; and a supply module, which projects the future size and structure of the medical workforce. This section of the report discusses the two modules in turn. The variables for each module are listed and an appraisal made of potential sources of data to populate the model. Limitations of the chosen data source are noted and recommendations made for improvements.

Demand module data parameters

The demand module used a needs-based approach to project the requirement for medical practitioners. Table 1 summarises the variables required for this approach and the data source for each variable used in the modelling.

Table 1 Parameters and data sources for the medical demand module

Variable	Data source
Population	NT Government/Charles Darwin University estimates based on ABS data
Health need	Zhao Y, You J, Guthridge S. Burden of Disease and Injury in the Northern Territory 1999-2003. Darwin: DHF, 2009.
Medical weights	Department of Health and Ageing. National Hospital Cost Data Collection, Cost Weights for Primary AR-DRG Version 5.1, Round 11 (2006-07), Northern Territory.
2006 medical workforce	Number parameter from supply module.
Expansion factor	User defined (set at zero i.e., no expansion)

Population

The level of health need will change with the size, age distribution and other characteristics of the population.³ The population variable provided an estimate of the size of the population in each year of the projection period. It required segmentation into sub-groups to capture differences in the nature and occurrence of disease and injury of importance in the NT, namely, age, gender and Indigenous status.^{4,5}

Projections of the NT population developed by the NT Government and Charles Darwin University (NTG/CDU) were used in the module. The NTG/CDU projections were based on data compiled from the Australian Bureau of Statistics (ABS) and other sources on population numbers, migration, births and deaths. It was available for the desired sub-groups and ensured that the model used the same data source as projections by other NT Government agencies.

Health need

Usage of health services tends to be driven by ill health in the population and the health status variable measured this need. Potential measures of ill health were

disease incidence and prevalence, mortality, health risks and subjective measures of health status.^{3,6}

The burden of disease and injury (BoD) uses a number of these measures to form a summary measure of population ill health.⁷ Its unit of measure is a disability adjusted life year (DALY), which incorporates both fatal (years of life lost due to premature mortality) and non-fatal outcomes ('healthy' years lost due to disability).⁷ It also captures the incidence, duration and severity of conditions. The NT has produced estimates of DALYs for the key demographic groups of interest, thereby making the BoD data suitable for use in the demand module.

An alternative to the BoD would be to base the needs approach on risk factors. DALYs can be attributed to present and past exposure to social and environmental risks, physiological states and lifestyle behaviours. Fourteen (14) well-known risk factors were investigated in a national BoD study, but they only explained 32% of the total burden of disease and injury in 2003.⁴ Thus, substantial additional work would be required to identify and attribute further amounts of the BoD to other health risks before they would be suitable as a measure of health need for the demand module.

Another potential measure of health need would be information on self-reported health status, which was available from the ABS' General Social Survey and the National Aboriginal and Torres Strait Islander Health Survey.^{8,9} This information was, however, based on responses from people aged 15 years or over. Similar information was not available for children under the age of 15 years. A further issue with self-reported health status was that although it has been found to be a good predictor of health service utilisation,¹⁰ it may be prone to a number of reporting biases. These biases include a tendency for Indigenous Australians to report being in better health than the general population despite the greater occurrence of mortality and morbidity in that population.¹¹

The BoD provided a more comprehensive assessment of ill health than a singular analysis of mortality, incidence or prevalence and was a more objective measure of ill health than subjective measures such as self-reported health status. Consequently, it was chosen for use in the demand module. There were, however, some potential weaknesses with this data source. First, BoD studies only occur periodically, thereby limiting the ability to update the module. Second, the most recent BoD study was based on the occurrence of disease and injury during the period 1999-2003. It is not clear that these incidence patterns will be applicable over the entire projection period particularly if they are still evolving due to trends in obesity and other lifestyle diseases. Finally, it may be more effective to address some diseases contributing to the BoD through non-medical avenues such as allied health services, dental care and public health campaigns.

Medical weight

DALYs were available for 36 population sub-groups across 190 categories of disease and injury. The categories were condensed to 185 groups (BoD groups) for the workforce models. BoD groups may comprise more than one category of disease, for example, diarrhoeal diseases included bacterial, protozoal and viral intestinal infections. The necessary treatments for each BoD group needed to be identified in order to determine the workforce required to meet the health need. Treatments would, however, vary depending on the specific disease, its severity and patient characteristics (regimes may differ depending on age, comorbidity, preferences, social circumstances, etc). Treatment may occur in the primary, secondary and/or tertiary care sectors.

Data did not exist to map BoD groups to treatments in the primary care sector (first level of care outside of hospitals); however, they could be mapped to hospital treatments by using Australian Refined Diagnosis Related Groups (AR-DRGs). Estimates of the medical resources (medical weights) required to treat an AR-DRG were available from costings of hospital separations through the National Hospital Costs Data Collection. NT and national data were available. NT data were chosen to reflect NT workforce practices and the most recent collection (Round 11; 2006-07) was used in the module. The mapping process and derivation of medical weights is described in subsequent sections of this report.

Medical workforce

A starting workforce was required to translate the needs projection into medical practitioner numbers. The starting workforce was set at the headcount number of working practitioners from the supply module to reflect the total number of practitioners providing services regardless of their provision of hours. Issues with this data source are discussed under the section on the module's data parameters.

Expansion

It is possible that the starting workforce does not adequately meet the health needs of the population or that there is an intent to expand the type or quantity of services offered (through technology, policy decisions, etc). These situations can be accommodated through the Expansion variable, which allows workforce planners to increase the growth in each period by a specified amount. The expansion variable was not applied in the modelling and was set at zero (i.e., no expansion) in each period.

Supply module data parameters

The supply module of the medical model used a stock and flow approach to project the supply of medical practitioners. Table 2 summarises the variables required for the module and the data source for each variable used in the modelling.

Number, age and sex of medical practitioners

The supply module required a profile of the current medical workforce segmented by age and sex in order for the module to incorporate flows associated with these factors. This initial stock formed the foundation for the projection and influenced future flows. Accordingly, the accuracy and level of detail of the stock was important for the overall quality of the projection. Four potential sources for estimating the NT medical workforce were identified:

- medical registrations;
- the Australian Institute of Health and Welfare's (AIHW) Medical Labour Force Survey;
- the ABS 2006 Census; and
- a compilation of estimates of different sub-sections of the workforce using DHF personnel data or the National Public Hospital Establishments data (public sector workforce) and Medicare or General Practice NT data (private sector workforce).

To practise in the NT, medical practitioners must be registered through the Health Professions Licensing Authority (HPLA). Practitioners may hold registration, but provide few or no services (e.g., retirees, those in non-clinical roles) or only temporarily

provide services (e.g., locums, visiting practitioners). The age and sex of individual registrants could be obtained from the HPLA, but it does not record registrants' frequency or length of work in the NT. Medical Board approval would be required to obtain registration information outside of that collected for the AIHW Medical Labour Force (MLF) survey. Historical information would also be difficult to obtain as the registration database only contains current registrations.

Table 2 Parameters and data sources for the medical supply module

Variable	Data source
Number (headcount)	Working population – Australian Institute of Health and Welfare Health and Community Services Labour Force 2006 (AIHW HCSLF) Non-working population – AIHW Medical Labour Force Survey 2007
Age	AIHW HCSLF
Sex	AIHW HCSLF
Average working hours	AIHW Medical Labour Force Survey 2007
Full-time equivalent benchmark	Medical Officers (Northern Territory Public Sector) Workplace Agreement 2008-2010
Graduates	Unpublished data from Royal Darwin and Alice Springs hospitals; Australian Government Department of Education, Employment and Workplace Relations, Students 2006 [full year]: selected higher education statistics.
Immigration	ABS Census (multiple years)
Emigration	ABS Census (multiple years)
Retirement exits	ABS Retirement and Retirement Intentions Survey, Australia, Jul 2006 to Jun 2007, Cat no. 6238.0
Maternity exits and re-entry	Health Gains Planning (HGP) NT Midwives Collection, Mothers and Babies, 2005; HGP population estimates 2005, unpublished data based on ABS data; ABS Social Trends 2007, Article Maternity Leave Arrangements, Cat no. 4102.0
Mortality and morbidity	HGP, Factsheet: Mortality in the NT, 2006.
Working hours trend	AIHW Medical Labour Force publications
Productivity trend	DHF Business Objects Database, Hospital Activity Reporting 5 year Universe; and Annual Reports

The AIHW presents data on the Australian medical workforce drawn from the MLF survey, which asks medical practitioners renewing their registration demographic and labour force questions.¹² In 2006, the AIHW estimated that there were 773 clinicians practising in the NT and provided a breakdown by five-year age groups and sex.¹² The estimate may not, however, be reliable as it was derived using responses to the 2007 MLF Survey as no survey was conducted in 2006.¹² Furthermore, the response rate for the 2007 MLF Survey was only 29%.¹³ Response rates to the survey tend to be much lower in the NT than in other jurisdictions and have declined in most years since 2002 when 49% of registered practitioners responded to the survey.¹² Survey responses were applied to the number of registrants so if practitioners who are no longer in the NT or only providing partial services were not adequately represented in the responses, this method will upwardly bias the estimate of the number of NT clinicians.

The AIHW also produces a Health and Community Services Labour Force (HCSLF) publication based on census data. The most recent publication showed that there were

559 medical practitioners (including medical administrators) in the NT at the 2006 Census, a number substantially lower than the MLF estimate.¹⁴ This result arose despite the Census occurring during the Dry Season, a period when workforce numbers tend to be higher.¹⁵ Additional tables available on the AIHW website provided a breakdown of NT practitioners by age (five-year grouping) and sex, making this source suitable for use in the supply module.

A final option for the starting stock would be to construct it from estimates of sub-sections of the workforce or limit the scope of projections to those sub-sections. In 2006-07, National Public Hospital Establishments data showed that there were 347 full-time equivalent (FTE) salaried medical practitioners working in NT public hospitals.¹² This figure understates the number of public sector practitioners as it would omit those working in non-hospital settings. Data on all DHF medical practitioners would provide a more comprehensive estimate of public sector employees. According to DHF's Business Objects corporate reporting tool there was an average of 383 FTE medical officers in the 2006-07 financial year. The DHF Annual Report indicated a higher figure of 402, but this was based on a single pay period in the Dry Season when numbers are typically higher.¹⁶ An age and sex breakdown could be obtained by accessing individual records for DHF personnel from the Department of Corporate and Information Services' Personnel Information and Payroll System (PIPS), but there may be a cost associated with obtaining this data. Ethics clearance may also be required each time this information is accessed to update the module. It will also omit practitioners employed on service contracts rather than as DHF staff.

Medicare provides estimates of the number of general practitioners (GPs) and in 2006-07, its data indicated that there were 101 FTE GPs in the NT.¹⁷ The General Practice Network NT publishes lists of GPs working in the NT and these indicated that there were about 126 GPs (excluding District Medical Officers) working in the Top End and remote areas of the NT.¹⁸ Neither of these sources provided the number of GPs by age and sex as required by the module.

The DHF and Medicare data add to a figure similar to the 2006 Census data, but they are likely to omit medical practitioners working for the Department of Defence and other Australian Government bodies, private hospitals, private companies and non-government organisations such as Aboriginal community controlled health services. A methodology would also have to be devised to allocate GP numbers to age and sex groups. The 2006 MLF estimates appear too high when compared with data from other sources and HPLA registration data does not provide an estimate of the actual working population of practitioners. The 2006 Census figure was similar to a combined DHF and Medicare estimate and data were available at a suitable demographic level. Accordingly, it was used in the model.

Use of census data means, however, that the supply module's stock can only be refreshed every five years. There was also a substantial delay between the 2006 Census and the publication of the AIHW HCSLF (the 2006 data was not published until 2009). Data could be obtained earlier from the ABS, but a cost would be incurred. It may, however, be possible to reduce this cost by obtaining the information as part of a wider request by a number of agencies that wish to access workforce or other information from the census. Obtaining the data directly may also allow data to be obtained in narrower age groupings (ideally single year groupings), which would improve the modelling of ageing and retirements in the module.

Census data will not capture people who are medical practitioners, but were not working in that role at the time of the census, for example, they were on maternity leave, studying or working in a non-medical role. The MLF survey would be a potential source for estimating the proportion of non-working practitioners. Raw data from the

2007 MLF Survey was available as DHF administers the survey in the NT. Medical practitioners participating in the survey were informed that the information was gathered for the purpose of national, state/territory and regional planning so its use was appropriate in this project. Few non-working practitioners responded, but as indicated earlier, the low response rate means that this source is not reliable. It was decided to set the non-working population at zero; a decision that may have understated the potential workforce.

Should response rates to the MLF survey increase or registration data improve with the commencement of the national registration scheme in 2010, these data sources could replace the census as the data source in the supply module. Alternatively, PIPS data could be used and the model restricted to projecting the DHF workforce, but ethics clearance and costs may be associated with this source.

FTE benchmark, average working hours and trends in working hours

The FTE benchmark is the average hours that a medical practitioner would be expected to work in a full-time position. This information was used to count the FTEs required in each year of the projection period and to determine the additional supply of hours by the existing workforce. In the NT, the majority of medical practitioners are employed by DHF and the hours of a full-time public sector Medical Officer are 38 hours per week.¹⁹ In contrast, the AIHW assumes that a FTE medical practitioner works 45 hours per week; however, in 2006 the average hours worked by clinicians was only 43.6 hours and this figure has been declining over time.¹² There were also substantial differences between the fields of medicine with primary care practitioners (40% of the workforce) working an average of 39.5 hours per week while specialists (35% of the workforce) worked an average of 45.0 hours per week.¹² Removing time spent on non-clinical work lowered these figures.¹² It was decided to use 38 hours as the FTE benchmark to reflect the agreed hours for medical practitioners in the public sector workforce. It is also similar to the average hours worked by practitioners in the primary care sector (GPs).

Actual average working hours differ by age and sex with males and younger workers tending to work longer hours.¹² There are two potential sources for data at this level – AIHW MLF survey and ABS census. Census data would need to be obtained from the ABS and would include hours worked in all jobs not just medical roles.²⁰ The MLF survey provides estimates of total hours in clinical and related work, but the AIHW does not publish NT data by age and sex (only the average for each sex). Australian data was available separately by age or sex. Data by age and sex could be obtained at cost from the AIHW.

The raw data from the NT 2007 MLF Survey were available to derive average working hours by age and sex based for practitioners who worked (to some degree) in the NT. It generated average working hours of 44 and 38 hours for males and females, respectively. The AIHW's Australian averages were similar (46 and 38 hours, respectively) but their NT estimates (47 and 40 hours, respectively) were higher. The divergence may be due to differences in this study's methods including the treatment of outliers, which were adjusted based on responses to other survey items and judgement. The results were also not scaled against the number of registrants as occurs in the AIHW MLF publications. Equally, however, the difference could reflect bias in the responses. The response rate to the 2007 MLF Survey was low relative to the number of registrations; however, compared with the number of practitioners from the 2006 Census, it would have equated to a response rate of about 40%. Census data could be used as an alternative source or to crosscheck the MLF survey results.

The MLF survey provides trend data on average working hours for medical practitioners by sex. Only four years of NT data were available and this showed a decline in average working hours followed by a rise in 2006. This variation may reflect bias in the responses rather than genuine trends. Australian data were available over a ten-year period and showed a decline over time although for females the decline appeared to have stopped with average hours stabilising at just under 38 hours. For males, there has been a steady decline in each of the last five years and over the decade the average annual decline was 1%. This trend was continued in the module, but its application capped at 38 hours (i.e., when average working hours reached 38 hours, further reductions were not applied). This decision reflects an assumption that the decline was expected to be due to full-time practitioners reducing their overtime in order to achieve a better work/life balance rather than other factors such as older practitioners choosing to work in part-time rather than full-time. No adjustment was applied to the average working hours for females.

Graduates

The NT does not yet have a medical school, but there are students studying through the NT Clinical School who complete their placements in the NT. The supply module did not include contributions from these students. A medical school will be established in the NT; however, data is not yet available on the likely flow and profile of graduates.²¹ Royal Darwin and Alice Springs hospitals take interns (students in their first postgraduate year) and the hospitals provided the numbers by age group and sex for 2009. In 2009, there are 28 interns (about half females), four more than in previous years. This increase was reflected in the supply module and maintained over the period. Figures in hospital bulletins suggested that the age/sex split between males and females may vary between years, but no records are kept of graduate demographics. It was decided to enter graduates into the under 30 years age group, which is consistent with anecdotal evidence. Graduates were also assumed to be 56% female, which is consistent with the current gender mix of students.²²

Migration

Interstate and international movements are key flows to and from the stock of medical practitioners. Potential sources for migration flows are DHF exit interview data, registration board data, the Australian Government Department of Immigration and Citizenship (DIAC) and the ABS. DHF exit interviews allow interstate movement to be recorded as a reason for leaving; however, its usefulness as a data source was low because it only covered DHF staff and not all exiting staff complete interviews. Furthermore, it does not capture inward or internal (intrastate) migration. Registration board data showed medical practitioners on conditional (overseas) registration by age and sex. Although this was the required level of detail, the data do not indicate whether individuals are past or new entrants. Registration board data cannot inform on international emigration or interstate migration. DIAC provides statistics on immigration and emigration; however, it does not identify migrants in the medical profession or provide age and sex information at a state level.^{23,24}

NT Treasury had sourced ABS data from the last five censuses on present and past place of usual residency by professional group including medical practitioners. This data captured interstate migration and international immigration, but not international emigration. Figures were available by age (10-year groupings) and sex for 2006, but not previous census years. This source was chosen as it captured most forms of migration and rates could be calculated at a suitable level of detail for the supply module.

The one-year probability of immigration was calculated by dividing the number of arrivals in the medical practitioner population by the total medical population. Arrivals in 1996, 2001 and 2006 were adjusted for interns using the 2006 intake to avoid double counting with the graduate variable. Immigration in 1986 and 1991 was much higher suggesting graduates were taken in those years, but their number is unknown so no adjustment was made. This omission may mean that the immigration rates are biased in an upward manner for practitioners aged under 30.

The probability of emigration was calculated by dividing the number of departures by the previous year's population (from which they departed). The previous year's population was determined based on where practitioners advised they were one year previously. This method will underestimate the emigration rate as it omits practitioners who moved to overseas destinations (i.e., were not captured in the census at all). An allowance was made for this circumstance in the medical model by increasing the emigration rate.

Migration rates could be calculated on the basis of age group or sex. Age group was selected because, based on the 2006 data where rates by age and sex could be jointly determined, greater differences were evident between age groups than between the sexes. The average probability of immigration and emigration from the five censuses was used so that the estimates would be less sensitive to random fluctuations in any census year. Emigration probabilities were applied to the workforce of the previous period while immigration probabilities were used to derive the total workforce in the present period. Averaging resulted in the probabilities shown in Table 3 being applied in the module.

Table 3 Migration rates for medical supply module

Age Group	Emigration	Immigration
Under age 30	0.43	0.40
30-39	0.28	0.30
40-49	0.14	0.12
50+	0.04	0.07

Obtaining future census data by age and sex could refine the migration variables. A limitation with this source is that it combines international and national migration and makes it difficult to model scenarios relating to these respective flows. Given the current data sources, the error in estimating these flows separately may increase uncertainty in the model without a commensurate benefit in terms of modelling convenience. Between censuses, the ABS compiles data on interstate and international and publishes the data annually through its migration report (cat. no. 3412.0) and on-line quarterly through its population report (cat. no. 3101.0). These data sources do not provide information on medical practitioners, but may be useful for assessing broad trends (increased or decreased movement) that could be used to adjust the census estimates.

Retirements

Registrations and other data suggest that medical practitioners, particularly males, may continue to work well past the standard retirement age of 65.¹² Potential sources of data on exits due to age-related retirement include exit interviews, ABS data and

studies on retirement from the literature. Issues with exit interviews were noted in the previous section. The ABS Retirement and Retirement Intentions Survey presents data on the age at which people intend to retire by age cohort, state or industry (health care and social assistance).²⁵ Intentions were available by age groups so rates could be calculated for different cohorts to reflect the likelihood of retirements for the different age groups in the module. This information was not, however, available by sex.

Two other sources were found in the literature: Schofield and Beard's analysis of attrition in different cohorts of GPs based on ABS census data;²⁶ and Bacon's study of the dynamics of work and retirement using the ABS Retirement and Retirement Intentions Survey 1994.²⁷ The former study could be used as it provided figures based on GPs, but it was only available by age group not by sex. Bacon provided figures for both age and sex, but the figures are based on the whole population and the information was rather dated.

Retirements were assumed to occur in practitioners aged over 50. No age related retirements were assumed to occur below 50 years of age. In the final age group (65+), retirement exits could only be bluntly incorporated using an annual rate derived for the whole group. Male practitioners were assumed to have all retired by age 81 (i.e., they retired at the end of their 80th year) and for female practitioners, retirement was assumed by age 76. The ABS data generated an annual retirement rate of over 3% for practitioners aged 50+. This compared favourably with Schofield and Beard's estimate of 4%. A more specific breakdown to reflect the age groupings in the module resulted in the annual retirement probabilities shown in Table 4 being used in the module.

Table 4 Retirement rates for medical supply module

Age Group	Males	Females
50-54	0.02	0.02
55-59	0.02	0.02
60-64	0.10	0.10
65+	0.06	0.09

Maternity

Maternity absences were calculated using four data components:

- the proportion of women likely to have a birth;
- the proportion of birthing women likely to take leave for maternity;
- the average length of maternity leave; and
- the proportion of women who return at the end of their leave.

Maternity data specific to female medical practitioners were not found so data for the general population were used (see Table 2 for the sources). The proportion of women likely to have a birth varied by age and was estimated based using the rate in the NT non-Indigenous population as this was likely to be representative of the majority of NT female doctors. The proportion of women who take leave was 73% and the average duration of leave was 34 weeks. No data were available on the proportion of women returning from leave so this was set at one (i.e., all return).

A weakness of this approach was that it did not allow for women who exit the workforce to care for existing children, but not following a birth. In addition, it does not allow for male medical practitioners who may take paternity leave. If information from PIPS was available on maternity and paternity leave, it may be possible to improve estimates of the proportion of medical practitioners taking this leave, the duration of the exit and likelihood of a return. This source would, however, reflect the characteristics of the public sector, which may differ to those of the private sector, particularly if it tends to be a younger population (e.g., more medical practitioners in early postgraduate years).

Mortality and morbidity

Non-indigenous death rates in the NT indicate that in the current population of 129 doctors aged over 50 years there would be one to two deaths per annum.²⁸ This estimate was based on mortality in the general population. Medical practitioners may, however, have lower levels of mortality than the general population because their knowledge and higher socio-economic status may have a positive influence on their health.^{29,30} Thus, there may be even fewer exits due to mortality.

Data could not be found on exits from the medical profession due to morbidity, but exit interviews for nurses indicated that 1% of exits (over multiple years of data collection) were due to health reasons. The literature suggests that stress, burnout and other mental health conditions may be issues for medical practitioners due to the nature of their work environment, but they did not necessarily result in doctors exiting from the workforce.^{31,32}

Although the supply module has the capacity to include exits due to mortality and morbidity, it is not clear that they occur to such an extent as to substantially refine the projection. Inclusion of this variable would make little difference to the results with one death per annum reducing numbers at the end of the projection period by less than 1%. Rather, their inclusion may simply increase uncertainty. Further data, perhaps from exit interviews (although the issues associated with using this data are noted), are needed to better quantify the amount of exits due to death and disability and to assess whether they are sufficiently important to include in the module.

Productivity

The output (productivity) of medical practitioners will be influenced by their hours of work and their abilities. Reductions in productivity that occur due to reduced hours of work were addressed by the trend variable for hours of work. The productivity variable adjusts for other factors, for example, reductions in the number of clinical cases seen due to increasing complexity, a less experienced workforce or increasing administrative demands; or increases in productivity as a result of workforce reform or the introduction of new technology.

It is difficult to measure productivity in the medical workforce, particularly if there is also a change in the quality of outputs.³³ A crude measure based on separations and FTE medical staff drawn from DHF's Annual Reports was used to evaluate whether there had been notable changes in output in NT hospitals. The data showed that the number of same-day separations per medical worker was relatively consistent between 2005-06 and 2007-08. The number, however, of multi-day separations per medical worker decreased by 8%. A number of factors could have contributed to this result and further investigation is needed to determine the drivers behind this trend and whether it is a temporary or longer-term phenomenon.

The productivity variable was set at 1 in the supply module (i.e., no change in productivity), but further development and measurement of this variable is

recommended. It is possible that with the ageing of the population an associated increase in the incidence and prevalence of chronic disease may require longer consultations in the non-hospital setting and longer lengths of stay in hospitals. These factors could reduce medical practitioners' productivity in terms of patients seen and thus, effectively lower the supply of practitioners. Equally, however, new technology and work practices or a more stable workforce could improve productivity.

Projections from the medical model

Demand module

The demand module used a needs-based approach for the projection of workforce requirements to capture the differential in health need between sub-groups in the population. It used growth in population and patterns of population health to project the future need for treatments and thus, the required workforce to meet that need. The following sections explain the techniques used and assumptions made in the application of this approach and present a projection from 2006 to 2022 of the requirement for medical practitioners in the NT. The sensitivity of the projections to changes in the key variables is also discussed.

Modelling techniques and assumptions

Population numbers and BoD were segmented into 36 groups on the basis of Indigenous status (Indigenous, non-Indigenous), sex (females, males) and age group (0-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 75+). The level of BoD was assumed to be the same for all years of the projection period. To derive the level of ill health in each year of the projection period, the BoD was converted to a per capita rate by dividing the DALYs by the population in the BoD study. This per capita rate was then applied to the relevant population group. The amounts for the individual population groups were then summed to give the total amount of ill health for each BoD group and the sum of the amounts for all the BoD groups represents the total (ill) health status of the NT population in a given year of the projection period.

As noted previously, the BoD groups were mapped to AR-DRGs to determine the necessary treatment. The mapping was achieved by, first, mapping the BoD groups to categories under the International Statistical Classification of Diseases and Related Health Problems (ICD-10-AM). Second, AR-DRGs were matched to the ICD-10-AM codes, thereby indirectly generating a list of AR-DRGs for each of BoD group. Each list was ranked on the number of hospital separations and the AR-DRG with the greatest number of separations was selected to represent the BoD group unless another AR-DRG was likely to better distinguish the relative resource requirements of the group. For example, chemotherapy was the major AR-DRG for several cancer BoD groups so other AR-DRGs were used to represent their relative demand for medical services. Finally, the relative medical resources (medical weight) for the selected AR-DRGs were derived using direct costs from the National Hospital Cost Data Collection. Direct costs are primarily comprised of salary expenses for ward medical, critical care, operating rooms, emergency departments and specialist procedure suites. The medical weight for an AR-DRG was calculated using the following formula:

$$\text{Medical weight AR-DRG}_x = \frac{\text{Average direct cost for AR-DRG}_x}{\text{Average direct cost for AR-DRG}_{\text{ALL}}}$$

It is noted that operational areas other than ward medical will also include costs for other staff including nurses, Aboriginal Health Workers and personal care assistants. Provided that AR-DRGs use all these resources to a similar degree this inclusion should make little difference to the weights. That is, the weights will be unbiased provided that AR-DRG₁ uses medical resources in the same proportion as other staff (a% of medical resources, a% of nursing resources, etc), AR-DRG₂ uses staff resources in similar proportions (b%) and so forth.

The medical weight calculation resulted in AR-DRGs with a higher requirement for the services of medical practitioners having higher medical weights than AR-DRGs with lesser requirements. Total ill health for each BoD group was multiplied by the medical weight for the AR-DRG allocated to the BoD group to give the medical requirements. The requirements were then totalled for all the BoD groups to give the total medical requirement for each year in the projection period.

To project the required workforce, growth in medical requirements between periods was applied to the medical workforce from the previous period. The headcount number of practitioners from the supply module was used as the starting workforce in 2006. The demand module implicitly assumed that the current ratio of full-time to part-time practitioners would remain the same across the projection period. It also assumed that the starting workforce was adequate to meet the needs in that period. If there were shortages or the current workforce was not meeting needs, the expansion factor could be used to increase the growth between periods.

A number of other assumptions underpin the demand module and these are shown in Table 5. The module assumed that BoD would be the same in all periods of the projection. That is, the present gap in health between Indigenous and non-Indigenous Territorians would remain. Initiatives have been put into place (including those beyond the health sector) that could reduce in the BoD in the Indigenous population. Should the BoD reduce, the module would assume that the requirement for medical practitioners is lower. This circumstance may not be true, however. Rather, the focus of health care may change from restoring to maintaining health (e.g., increased emphasis on preventive health) or to achieving greater levels of 'healthiness'. Further, it may not be possible to reduce services and retain the lower BoD if they can only be sustained by ongoing provision of preventive services.

Table 5 Assumptions in the medical demand module

Variable	Assumptions
Burden of disease and injury (BoD)	No change in incidence, severity and duration of disease over projection period.
Medical weight	Workforce requirements are the same across health sectors (primary, secondary and tertiary) and types of staff (e.g., part-time, full-time). No technology impacts, workforce substitution or redesign. Current treatments are efficient.
2006 medical workforce	2006 workforce meets the health needs in that period. No change in FTE/headcount ratio over projection period.
Expansion	No additional growth in future periods.

Use of medical weights based on the hospital-based treatments meant that the module implicitly assumed that relative workforce requirements were the same in other sectors. If severity is the primary driver of workforce requirements, this assumption might be reasonable. That is, a person with a more serious condition would be likely to use more GP services than a person with a less severe condition. It may differ, however, if use of GP and hospital services occurs at different points in the disease cycle. For example, admission to hospital for diabetes related conditions is likely to occur when the condition has reached a particularly severe stage (e.g., diabetic foot procedures) and requires considerable medical attention. Conversely, attendance at the GP to receive a check or prescription may more frequent. Current practices in the NT are also assumed to be efficient. That is, the lowest cost inputs are used in the production of health and

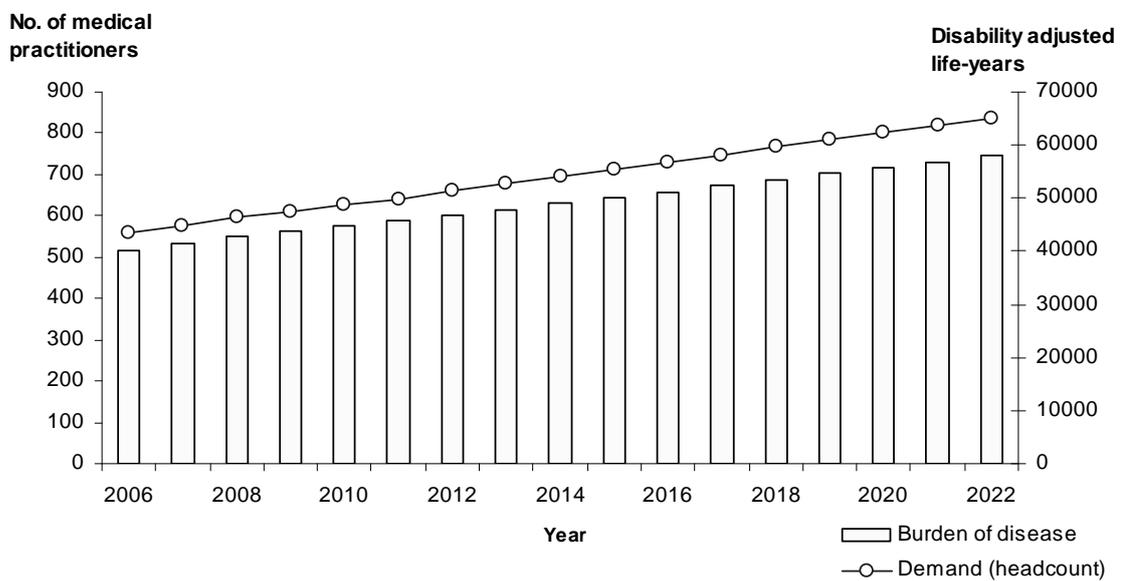
policy choice or the number and type of practitioners available do not adversely affect cost.

Keeping medical weights constant across the projection period assumed that there would be no changes in technology that reduce or increase the need for medical practitioners. Similarly, no major workforce redesign or substitution was assumed to occur. Should this not be the case, the demand module could be amended to incorporate these issues by revising the use of the expansion factor or including further factors. Productivity change was adjusted for in the supply module not the demand module. Thus, the requirement for medical practitioners remains the same, but supply would increase or decrease depending on the productivity of the workforce.

Projections of the demand for medical practitioners

A baseline projection of the requirement for medical practitioners in the NT is presented in Figure 1. Over the 16-year period, the requirement for practitioners increased by 50% from 559 practitioners in 2006 to 838 practitioners in 2022. Over the same period, the BoD was projected to increase by 44%. In 2006, the major contributors to the BoD were: type 2 diabetes (11%); anxiety and depression (9%); ischaemic heart disease (IHD; 8%); chronic obstructive pulmonary disease (COPD; 4%); and road traffic accidents (3%). In 2022, diabetes was still the leading contributor, but IHD had become the second greatest contributor and road traffic accidents was replaced by renal disease (nephritis and nephrosis) as the fifth largest contributor to BoD.

Figure 1 Demand for NT medical workforce, 2006 to 2022



This movement was due to the larger growth rates in IHD and renal disease (64% and 70%, respectively) compared with anxiety and depression and road traffic accidents (23% and 25%, respectively). The growth in BoD from type 2 diabetes was 52%. Other BoD groups including eye diseases, other mental disorders and some types of cancer had larger growth rates, but they made only small contributions (less than 1%) to the overall burden even by the end of the projection period.

In terms of the need for medical practitioners, the top five areas of requirement in 2006 were IHD, diabetes, COPD, breast cancer and road traffic accidents. Together they

accounted for 32% of medical requirements. By 2022, vascular conditions (stroke, aortic aneurysm) had replaced road traffic accidents in the top five, and the contribution to the medical requirement had risen to 34%. Aboriginal Territorians accounted for 52% of the medical requirement in 2006, despite their comprising less than one third of the population. This contribution was still the same in 2022 and there was only a small increase in their population proportion.

Sensitivity analyses

Analyses were conducted on key variables of the demand module to determine the sensitivity of the results to changes in inputs and methods. Issues investigated were: greater growth in the NT population; the use of different medical weights; and an increase in chronic disease. The results of the needs approach were also compared with projections from utilisation and trends approaches.

Table 6 shows the results of the sensitivity analyses. A 'high' population estimate based on greater levels of net interstate migration was used to check the impact of population change. In this estimate, the population was 8% higher in 2022 than in the baseline estimate. Use of the high estimate progressively increased the medical workforce requirement over the projection period and resulted in a 4% increase (33 more medical practitioners) in requirements by 2022. The lesser increase in demand relative to the increase in population was likely to be due to immigrants tended to be of working age and in relatively good health. If the population were to increase due to other causes such as a rise in births, particularly in the Indigenous population, the impact on demand may be more substantial.

Table 6 Summary of sensitivity analyses on variables in the medical demand module

Scenario	No. of practitioners			Difference from baseline		
	2006	2014	2022	2006	2014	2022
<i>Baseline</i>	559	695	838			
Population – high migration	559	707	871	0%	2%	4%
National medical weights	559	687	818	0%	-1%	-2%
Maximum medical weights	559	707	861	0%	2%	3%
Increase chronic disease 5%	559	703	848	0%	1%	1%

Medical weights based on national rather than NT data were used in the model to investigate whether there may be structural or other arrangements in the NT that influenced the requirements for medical practitioners. Use of national medical weights reduced the workforce requirement in 2022 by 2% (20 fewer practitioners).

The NT medical weights were based on the cost weight of the AR-DRG with the most separations for the BoD group. Other AR-DRGs may have fewer separations, but the treatment may be more resource intensive. The primary and secondary AR-DRGs for each BoD group were determined and out of these two options, the AR-DRG with the greatest resource requirement was chosen for the medical weight. AR-DRGs were also evaluated by a health professional experienced in data analysis and revised where they were considered not to best represent the likely treatment for the BoD group. Use of the revised weights in the model increased the workforce requirement in 2022 by 3% (23 additional practitioners).

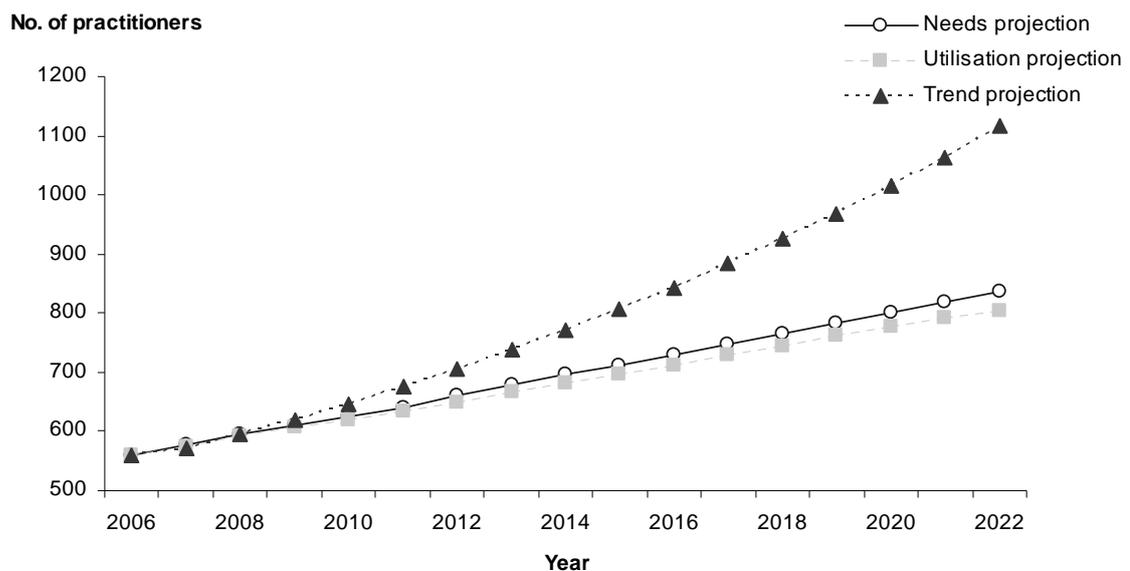
A key concern is the impact of chronic disease. If incidence rises (due to better diagnosis or the impact of lifestyle risk factors such as obesity) or prevalence increases with improvements in survival, there may be a greater demand for medical services. To show the relative impact of an increase in chronic disease, the BoD for heart disease, diabetes, cancer and chronic respiratory disease groups were increased by 5% and maintained (no further increases) throughout the projection period. It increased the workforce requirement by 1% (10 more practitioners in 2022).

Alternative projection methods

Two alternative projections were developed to assess the reasonableness of the needs approach – an utilisation approach and a trends approach. Utilisation rates were derived using separations by AR-DRG, Indigenous status, sex and age groups from DHF's submission to the National Admitted Patient Minimum Dataset 2007-08. This approach would reflect policy, funding and other influences on the workforce in that year. The trends approach used historical growth in separations and the relationship between medical workforce numbers and separations to project the demand for the medical workforce. Data sources were the DHF Business Objects corporate reporting tool and DHF annual reports. Annual growth in separations ranged from 2% to 10%. Over a 13-year period, the compound growth rate was 6%. A regression analysis showed that for every 1000 additional separations, the FTE number of DHF medical staff was likely to increase by 4.7 persons ($R^2=0.966$).

As shown in Figure 2, the utilisation approach produced a more conservative estimate of future workforce requirements than the needs approach. It estimated that 803 medical practitioners would be required in 2022, 4% less than the needs projection. In contrast, the trends approach estimated that 1116 medical practitioners would be required in 2022, 33% more than the needs approach.

Figure 2 Needs, utilisation and trends projections of the NT medical workforce, 2006 to 2022



Supply module

The supply module used a stock and flow approach to project the supply of NT medical practitioners. This approach identified the size and activity of the current workforce (stock), sources of inflows and outflows from the stock, and important trends or influences on the stock and flows. To project future supply, the initial stock was moved forward based on expected inflows and outflows and allowing for the impact of important trends and influences on the stock. The following sections explain the techniques and assumptions used in the demand module and present a projection of the supply of NT medical practitioners for the period 2006 to 2022. The sensitivity of the projections to changes in the key variables is also discussed.

Modelling techniques and assumptions

The stock of medical practitioners consisted of males and females divided into nine age groups (<30, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64 and 65+). The headcount number of medical practitioners in the initial year of the project was the number of working practitioners. Provision was made for a non-working population and it was assumed any one in this population would return to work in the following year and be subject to flows during that period. No provision was made for the existence of a shortfall in the initial stock. This omission implicitly assumed that the current workforce was producing the intended level of services. Table 7 lists these and other assumptions of the supply module (as outlined in previous sections).

Table 7 Assumptions in the medical supply module

Variable	Assumptions
Number	Starting non-working population assumed to be zero. The initial non-working population would return to work in the next year. Current workforce is producing the intended level of services.
Age	1/5 of an age group is moved to following age group each year
FTE benchmark	No change in average hours of full-time practitioner
Graduates	56% of interns will be female. Numbers stay constant from 2009 onward. Maternity and exits for other reasons are not applied to graduate medical practitioners in their first year.
Immigration and emigration	No gender differences in migration rates
Retirements	Retirements start from age 50 onward Maximum retirement age is 80 for males, 75 for females
Maternity	All women return from maternity leave
Other exits and re-entries	No other exits and re-entries

The module used the FTE benchmark to calculate FTE supply and FTE resources.³⁴ FTE supply measures the number of FTE workloads being performed by the workforce. It was calculated by dividing the total hours worked by the FTE benchmark.³⁴ In contrast, FTE resources capped the contribution of medical practitioners working over the FTE benchmark at one to ensure additional hours provided by practitioners are not seen as actual FTE workers.³⁴ Thus, if the FTE benchmark was 38 hours, a practitioner who worked 45 hours would be one FTE under the FTE resources method and 1.2 FTE

under the FTE supply method. A practitioner who worked 19 hours would be 0.5 FTE in both models. The difference between FTE supply and FTE resources represented the extra hours contributed by the workforce.³⁴ Reductions in the average hours worked or growth in the proportion of older or female practitioners who typically work shorter hours would be expected to reduce the extra hours contributed by the workforce.

In each year of the projection, the module applied emigration rates to the workforce of the previous period (including maternity exits who are assumed to re-enter) to account for interstate movements. The remaining workforce was then aged one year by moving one-fifth of each age group to the following age group. Adjustments were made for maternity leave, retirements and other exits then graduates were added to the workforce. Finally, the number of workers was divided by the probability of not being an immigrant (one minus the probability of in-migration) to derive the total workforce (headcount number) for that year including immigrants.

The final stage of the supply projection was to adjust for productivity changes. Average working hours for male medical practitioners were adjusted downward over the projection period, but the reduction was capped at 38 hours as noted previously. The capacity existed to increase or decrease the actual number of practitioners to account for other changes in productivity, but this facility was not used.

Projections of the supply of medical practitioners

A baseline projection of the supply of medical practitioners in the NT is presented in Figure 3. It shows the headcount numbers, FTE supply and FTE resources over the period 2006 to 2022. Over the 16-year period, the number of practitioners was projected to increase by 74% from 559 practitioners in 2006 to 975 practitioners in 2022. The gap between headcount numbers and actual FTE (FTE resources) widened from 13 FTE in 2006 to 31 FTE in 2022. Conversely, the additional supply of labour from the workforce (FTE supply minus FTE resources) narrowed from 75 FTE in 2006 to 44 FTE in 2022 (41% reduction). This decline was driven by the reduction in the average working hours of males and an increase in the proportion of female and older practitioners (who tend to work shorter hours).

Figure 3 NT medical workforce supply, 2006 to 2022

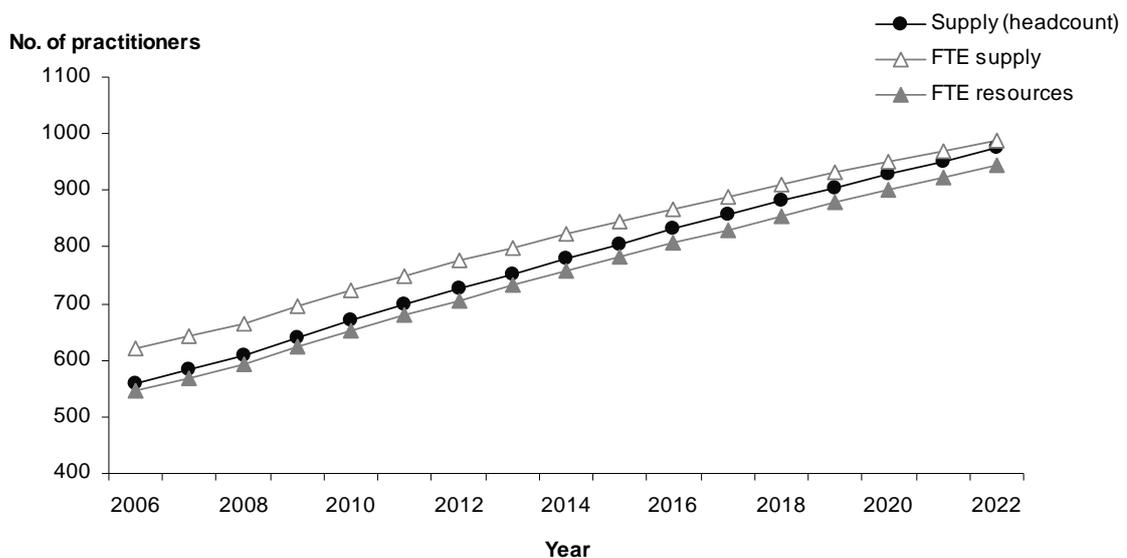
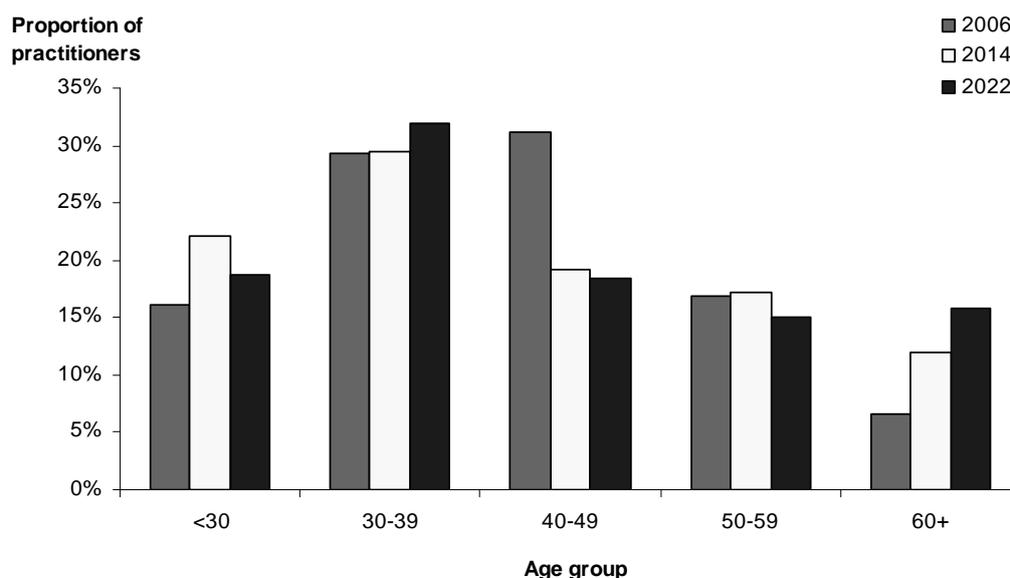


Figure 4 shows the change in the age distribution of the workforce over the projection period. The key area of change was the increase in practitioners aged over 60 years with their proportion increasing from 7% in 2006 to 16% in 2022. The ageing of the workforce and positive net migration drove the increase in this age group. The largest decline was seen in the 40-49 age group. Initially, this group comprised the largest proportion of the workforce (31%). By 2022, however, it only accounted for 18% of the workforce. The decline was due to ageing in early years of the model and negative net migration over the projection period. The proportions of the 30-39 and 50-59 age groups were more stable over time with migration offsetting ageing flows. The proportion of the youngest group of practitioners rose with an increase in graduates in 2009, but then declined as ageing movements offset the graduate intake. There were large migration in-flows in the under 30 age group, but they contributed little to growth as out-flows were almost as large.

The proportion of females in the NT medical workforce increased over the projection period from 45% in 2006 to 49% in 2022. The increase was likely to be due to the bias in graduate numbers towards females. Mobility did not affect the ratios as migration rates were the same for males and females.

Figure 4 Age distribution of NT medical workforce, selected years: 2006, 2014 and 2022



Sensitivity analyses

Sensitivity analyses were conducted to investigate the impact on the projections of changes in key variables and assumptions in the supply module. Scenarios relating to the following factors were analysed: graduate numbers, working and FTE hours, mobility trends, maternity leave and retirements. Table 8 summarises the results from these analyses.

A key input in the supply module was the number of graduates and their number were held constant from 2009 onward. The number of Australian medical graduates is predicted to increase substantially in coming years (81% between 2005 and 2012)³⁵ and there may be pressure to increase training and intern places in the NT in order to accommodate their number. Increasing the number of graduates by 50% to 42 from 2012 onward increased the number of medical practitioners in 2022 by 23% (from 975 to 1196) compared with the initial estimate (the baseline).

Table 8 Summary of sensitivity analyses for medical supply module

Scenario	Headcount				Difference from baseline		
	2006	2014	2022		2006	2014	2022
<i>Baseline</i>	559	779	975				
Graduates increase 50%	559	840	1196		0%	8%	23%
Increase maternity exits	559	756	929		0%	-3%	-5%
Retired at 66 years	559	732	882		0%	-6%	-9%
Mobility zero	559	707	840		0%	-10%	-14%
Mobility 2006 rate	559	574	706		0%	-26%	-28%
Mobility 2006 rate, except 65+	559	546	589		0%	-30%	-40%
Scenario	FTE supply				Difference from baseline		
	2006	2014	2022		2006	2014	2022
<i>Baseline</i>	621	823	988				
FTE 45 hours	524	712	881		-16%	-13%	-11%
Working hours constant	621	856	1065		0%	4%	8%

An important form of exits is maternity leave. These exits may have been conservatively estimated because eligible female medical practitioners would be entitled to take 52 weeks of leave (14 paid weeks) and potentially up to six years of unpaid leave.¹⁹ If it were assumed that all pregnant female practitioners were eligible for and took 52 weeks of maternity leave (no change in the proportions likely to have a birth and returning after a birth), it would reduce the number of medical practitioners in 2022 by 5%.

A source of concern for workforce planners is the ageing of the workforce and the retirement decisions of different cohorts of workers. A substantial number of medical practitioners choose to work well past the standard retirement age of 65 so the module assumed all male practitioners had retired by their 81st year and female practitioners by their 76th year. Changing these assumptions so that all medical practitioners aged 66 or more in 2007 retired, and in subsequent years, practitioners worked up to and including their 65th year before retiring, lowered the projected number of practitioners in 2022 by 9%.

Mobility in the medical workforce is high. Based on the average from five censuses, positive net migration was expected in all age groups except for 40-49 year olds. Not only does migration increase the workforce, it can offset the impact of ageing. If there was no inwards or outwards migration, in 2022 there would be 135 (14%) fewer medical practitioners than in the baseline projection.

For 2006, data were available to calculate migration probabilities by sex and age. It generated probabilities that were markedly different to the five-census average. In 2006, net migration was negative except for male practitioners aged 40 years and over. Female practitioners were less likely to come or go from the NT than male practitioners and mobility differed most notably from males in the 50 years and over age group. In 2006, 10% of male practitioners aged 50 had moved to the NT and none left. In contrast, no female practitioners in this age group arrived in the NT, but 9% left. When

the 2006 trends were used in the supply module, it resulted in a 28% reduction (269 fewer practitioners) in 2022. There was also considerable structural change with the proportion of female practitioners reducing from 45% in 2006 to 26% in 2022. The proportion of the workforce aged 50 years and over increased from 24% to 75%. These shifts are driven by a combination of ageing, positive net migration of older male practitioners and negative net migration of older female practitioners. With a shift to a greater proportion of older practitioners, there were much fewer additional hours contributed by the workforce in 2022 (4 FTE compared with 62 in 2006).

It may be reasonable to suggest that the migration patterns seen in older practitioners are likely to reflect those of people aged under 65, with those aged 65 years and over being likely to stay where they are currently practising until retirement. When inward and outward migration in the 65+ age group was set at zero (2006 probabilities applied to other age groups), the supply of practitioners was reduced further – down 40% to 589 practitioners in 2022, and the age distribution was less skewed; however, practitioners aged 50 years and over still comprised 59% of the workforce in 2022.

The model reduced working hours by 1% per annum for male practitioners, but prevented further reductions once 38 hours per week was reached. If there were no decline in average hours, the additional hours (FTE supply) provided by the workforce would be 7% higher in 2022 than in the baseline. Although this result would suggest a larger supply of working hours might be possible, the converse may occur if the reductions for male practitioners were greater and there was also a reduction in the average hours for females.

The AIHW uses 45 hours as the FTE benchmark.¹² Setting the average hours for a FTE medical practitioner at this figure rather than 38 hours reduced the additional supply of hours from the workforce by 11% in 2022. The reduction was even greater in earlier years of the model when male practitioners were contributing more additional hours. Actual FTEs (FTE resources) would be 9% less in 2022.

Gap analysis

When the baseline scenarios from the demand and supply modules are put together (Figure 5), the supply of medical practitioners was projected to be greater than the requirement based on growth in needs resulting from changes in the population. This result contrasts with the NHWT modelling, which suggested that there would be a shortfall.³⁶ The divergence arises from differences in the approach to estimating demand and migration. For demand, the NHWT model applied a constant annual increase of 4% based on population growth with weightings for Indigenous status and the elderly. The needs approach of the medical model produced an annual growth rate of 3% at the beginning of the projection period, which then declined over the projection period to 2% in the final year. In terms of supply, the NHWT model sets inward and outward migration at the same rate while the NT model used an average migration rate based on data from five censuses. The high growth in demand and zero migration in the NHWT model meant that demand exceeded supply.

Even though the needs approach produced a growth estimate similar to the NHWT model at the beginning of the projection period, growth in later periods was lower. This estimate may represent a lower bound estimate of demand particularly if incidence is increasing or that more of the population are surviving and require ongoing medical support to manage their condition (the prevalence of disease is increasing). The trends approach may capture some of these requirements and represent an upper bound estimate of demand. In contrast, on the supply side, the baseline estimate could be an

upper bound estimate. The 2006 Census indicated that more medical practitioners (excluding graduates) left the NT than came to it. Furthermore, those leaving tended to be young while those arriving tended to be older (50+). These trends may indicate future challenges that the NT will face in attracting and retaining medical practitioners. Figure 6 presents these four scenarios.

Figure 5 Demand and supply of NT medical practitioners, 2006 to 2022

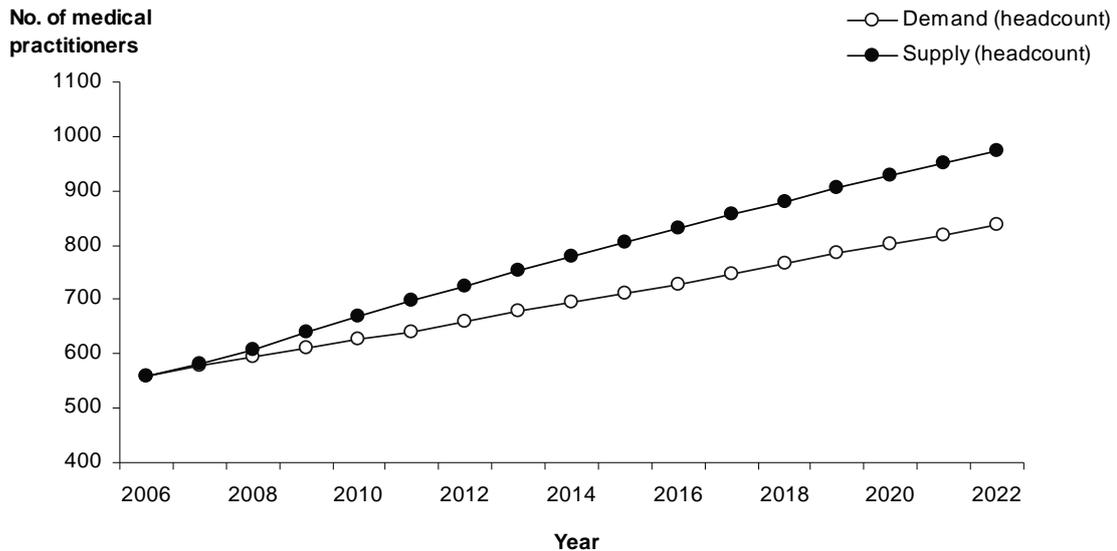
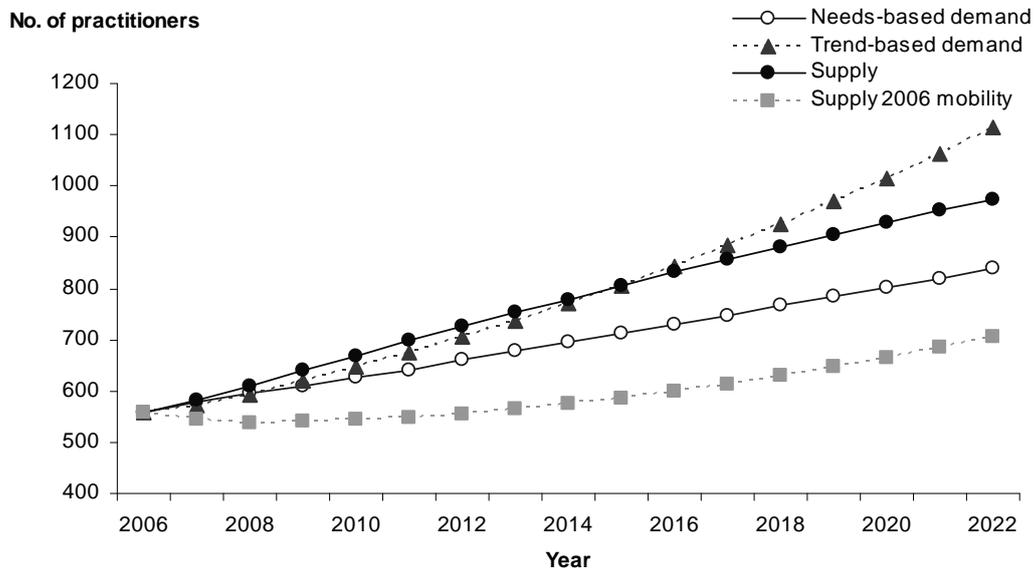


Figure 6 Alternative scenarios of medical demand and supply, 2006 to 2022



If the trends projection were to better represent future requirements than the needs projection, it would mean that, initially, the supply of medical practitioners would exceed demand. After 2015, however, circumstances would reverse and by 2022 there would be a shortfall of 141 medical practitioners. Circumstances could worsen if the NT was less successful at attracting and retaining medical practitioners. If the migration patterns from the 2006 Census were to continue, the shortfall in 2022 between the

trends projection and supply based on 2006 migration rates would be 410 practitioners. Even with the more conservative needs projection there would be a shortfall of 269 practitioners. In addition to the shortfall, the NT would have an aged workforce (up to three quarters aged over 50) leaving it vulnerable to retirement decisions and practitioners who are less willing to work additional hours.

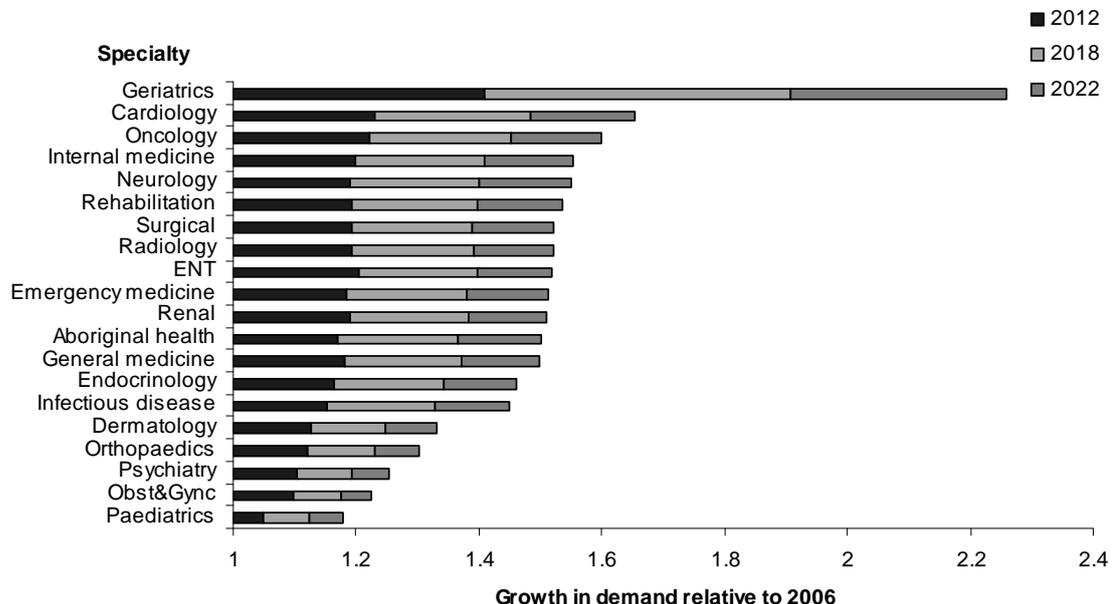
Other analyses

Medical specialties

The projected demand for medical services does not fall evenly across diseases or groups within the population. To examine the relative impact on areas likely to need specialist medical resources, ‘Specialty’ areas were identified by either the relevant population (Paediatrics – age 14 years and under; Geriatrics – age 65 year and over; Aboriginal Medicine) or allocation of BoD groups to a disease-based specialty based on the judgement of a health professional experienced in data analysis.

As shown in Figure 7, the greatest growth was expected to occur in servicing the needs of elderly people. Demand for medical services from this group more than doubled over the projection period. Their major medical service requirements were for heart disease, COPD, diabetes, dementia and lung cancer. Demand from Indigenous Territorians was expected to grow by 50% over the projection period. As with the elderly, heart disease, diabetes and COPD were key drivers of demand for Indigenous Territorians, but their other major requirements – renal disease and road traffic accidents – differed. In terms of specific disease groups, the key pressure points for medical services will be the increase in demand for cardiology (65%), oncology (60%), internal medicine (55%), neurology (55%) and rehabilitation (54%) services.

Figure 7 Growth in medical demand by specialty, selected years relative to base year of 2006



Note: 2006 is base year and not shown
 ENT – Ear, nose and throat Obst&Gync – Obstetrics and gynaecology

The supply of specialists in the NT was not projected due to their small number, high turnover and the lack of a sound data source. The MLF survey identifies specialists in the NT by the area in which they practice and their qualification. The low response rate to the survey means, however, that many specialists may not have been identified and

estimates based on those who did respond may be biased. The reliability of census data on specialists was unclear as there was no other source against which it could be compared. Furthermore, specialists are coded to categories based on the level of detail provided by respondents, which may vary between individuals and censuses. In contrast, the MLF survey requires respondents to select from defined categories.

Benchmark analysis

A key issue for the NT is the adequacy of the current number of medical practitioners. To investigate this matter, the NT workforce was compared with the national average. The number of medical practitioners per 1000 population was used as an indicator of availability and practitioners per 100 disability adjusted life years was used as a measure of the practitioners available to treat the amount of disease and injury in the population. Table 9 shows the results of this comparison.

Table 9 Comparison of national and NT medical workforces by population and burden of disease, 2006

	Population	Medical practitioners (MP) per 1000 population	Age standardised disability adjusted life-years (DALYs) per 1000 population	MP per 100 DALYs
NT	210,627	2.65	198.6	1.34
Australia	20,697,880	2.75	132.4	2.08

Sources:

ABS. Australian demographic statistics, June 2008. Cat. no. 3101.0, Table 4. Canberra: ABS, 2008.

AIHW. Health and community services labour force 2006, Table A4.6. Cat. no. HWL 43. Canberra: AIHW, 2009.

Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez A. The burden of disease and injury in Australia 2003, Table 5.5. Cat. no. PHE 82. Canberra: AIHW, 2007

The comparison revealed that the number of medical practitioners per capita in the NT was similar to the national average (2.7 per 1000 population compared with 2.8 nationally). The burden of disease in the NT was, however, 1.5 times (50% more) than that in the nation as a whole. When matched to the number of medical practitioners, it meant that there were far fewer doctors available in the NT to meet the health needs of the population than at a national level. In the NT, there was only 1.3 medical practitioners for every 100 disability adjusted life years compared with 2.1 medical practitioners nationally.

The analysis was based on the headcount number of medical practitioners. AIHW data suggested that NT medical practitioners tend to work longer hours than average,¹² which may compensate for their lower number. This additional pressure may, however, take a toll on the workforce and contribute to the high rates of mobility with practitioners leaving to take up less demanding jobs elsewhere. The lower number may also reflect the nurse-based model of care in remote areas where medical practitioners provide visiting rather than permanent services in communities.³⁷ Regardless of these factors, the NT may still be disadvantaged because these ratios do not account for the additional demand associated with the high levels of comorbidity in Indigenous patients, cultural and linguistic factors and the professional isolation of practitioners in remote communities.

Although the NT appears worse off, the national figure should be interpreted with caution. It is not clear that it represents efficient and effective health care. Rather, it

could reflect over-servicing or historical legacies unrelated to the need for health services. In this regard, the National Health and Hospitals Reform Commission noted that Australia has more general practitioners per 100,000 persons than New Zealand, the United Kingdom, Canada and the United States of America.¹ What the figures do appear to suggest is that the NT is an area of low supply where increasing the medical workforce could generate greater benefits than might be achieved from their placement elsewhere in Australia.

Discussion

The baseline projections from the NT Medical Workforce Model indicated that in 2022 there would be 137 more medical practitioners than was necessary to meet the additional demand for services from a growing and ageing population. This result depends, however, on the NT's ability to continue to attract and retain medical practitioners and the availability of funding to support growth in their numbers.

The projection of supply was based on historical trends in the migration of medical practitioners and the positive inflows of the past are likely to be reflective of employment opportunities at DHF, as the primary employer of medical practitioners (about three quarters of the workforce). DHF annual reports indicated that between 2000-01 and 2006-07, its medical workforce grew by 48%.³⁸ Over the same period of time, hospital separations per 100,000 population grew by 33%.³⁹ This expansion meant that in addition to meeting the needs of extra members of the population, more services were supplied in per capita terms. The expansion in services was more than twice that of the nation as a whole (13%).³⁹ In contrast, there was little expansion in the number of GP and other professional attendances funded through Medicare both in the NT and nationally.⁴⁰

Despite the growth in hospital services, the NT medical workforce in 2006 was still addressing a larger burden of disease and injury per practitioner than the Australian medical workforce as a whole. The higher level of disease and injury is largely due to the poorer health of Indigenous Territorians and the relative size of this population. Indigenous Territorians have a life expectancy at least 16 years lower than their non-Indigenous counterparts and comprise 32% of the NT population, a proportion far larger than in any other Australian state or territory.^{28,41} For the health gap to narrow, and the NT's burden of disease and injury to decline, further increases in the number of services per capita are likely to be needed. Such an increase could occur if the circumstances projected by the medical model were achieved and medical services being delivered were efficient and effective.

For such growth to occur, DHF would need to be appropriately funded and able to attract and retain the desired number of practitioners. Over the past five years, DHF's medical recruitment costs have grown by 177%.⁴² This growth is in part likely to reflect the need to keep a larger number of positions filled; a task made difficult by the high levels of mobility in the medical workforce. It may also reflect increasing difficulties in attracting medical practitioners and the need to obtain them from more expensive sources, for example, international rather than interstate recruits. These difficulties mean that extra funding is not only required to support growth in medical positions, but also recruitment costs.

The NT's requirement for medical practitioners is, however, small compared with the large pool of interstate doctors upon which it could potentially draw. Moreover, recent expansions in university placements present an opportunity to secure more medical graduates at the beginning of their career. The NT appears to be an attractive location for young practitioners so enticing them to come to the NT may be relatively easy and would provide a steady, reliable source of growth. The challenge will be to retain them as younger practitioners appear equally prepared to leave if employment and training opportunities are perceived to be better elsewhere.⁴³

A further vulnerability for the NT is the age structure of its workforce. The baseline projection indicated that there would only be a relatively modest increase in the proportion of practitioners over 50 years of age (from 24% to 31%), but this

circumstance could change dramatically depending on migration trends. Any shift toward an older workforce will affect productivity as older practitioners tend to work shorter hours and their long-term availability will be depend on their retirement plans.

Ageing is also an issue on the demand side. Ageing in the NT population over the projection period was expected to result in a doubling of the medical needs of people aged over 65. This increase was more than twice that of the other demographic group with high health needs – Indigenous Territorians. Meeting the health needs of older people may be more resource intensive and increase the need for geriatricians who specialise in their care. From a disease perspective, key areas of growth in specialty services are expected to be cardiology, oncology and neurology.

Trends in average working hours may be important for the NT. NT medical practitioners tend to work longer hours than Australian practitioners as a whole. Consequently, the NT will be more vulnerable to reductions in working hours as new cohorts are less willing to spend so much time in the workplace. Pressuring practitioners to maintain longer hours than they wish may be counterproductive as it could increase burnout or exits to other careers and interstate locations where conditions are more favourable.

Estimates of maternity exits may have been conservative and no allowance was made for departures due to death or disability. This situation was largely due to an absence of data and may have biased the supply projections in an upward manner. Future research is recommended to quantify the nature, volume and duration of non-migratory exits from the medical workforce.

Undoubtedly, the key issue for the NT is the mobility of the medical workforce. On one hand, it enables practitioner numbers to increase and people exiting due to retirement, maternity, emigration or other factors to be replaced (so the reduction in workforce is temporary rather permanent). On the other hand, it leaves the NT vulnerable to the possibility that outflows could exceed inflows and it may enhance the ageing of the workforce. A further issue is its effect on productivity. The model assumed that the current workforce was efficient and effective, but with the high levels of turnover in the NT, practitioners may be less productive than in more stable environments where they are familiar with their patients, the work setting and characteristics peculiar to the jurisdiction. While it is hard to assess this impact, when national rather than NT weights were used in the demand module of the model, there was a reduction in workforce requirements.

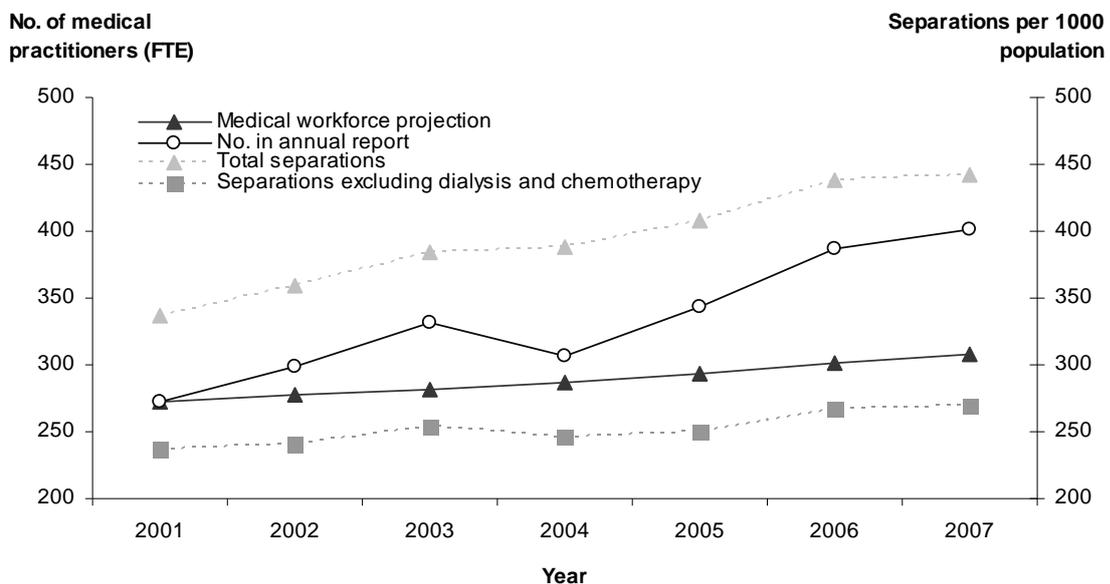
The difference could, however, reflect circumstances in the NT that unavoidably increase the requirement for medical services, for example, the higher levels of comorbidity and late presentation in Indigenous patients, minimum workforce requirements and an inability to achieve economies of scale or scope in health services. Beyond hospitals, there are other issues. Many remote NT communities have small populations with high health needs. Practitioners provide visiting services rather than being based in the community because there is insufficient work for a full-time position or a lack of practitioners to provide permanent services in isolated areas. Loss of time in travel and the need to provide services to small populations will reduce the productivity of the medical workforce. The model made no allowance, however, for the additional workforce requirement imposed by these issues. Further work is needed to quantify these impacts and to consider how they should be incorporated in the model.

There are other aspects of the model that may contribute to the uncertainty of the projections. Key issues are the assumptions of the needs approach, the use of hospital data to determine medical workforce requirements, the quality of the data for the supply module and the impact of funding, infrastructure and other constraints. These issues are discussed further in the following paragraphs.

Better data on the existing NT medical workforce – their number, age, working hours and exits and re-entries due to factors other than migration – would enhance the quality of the supply projections. Obtaining data by single-year age groups would improve the calculation of age-related effects and retirement exits. More reliable data on working hours would improve estimates of FTEs and productivity. The 2006 Census data was judged to be the most reliable estimate of the NT medical workforce (public and private sector), but it only provides a snapshot at a specific point in time every five years. Occupation is also based on a classification of people’s responses rather than registration with a professional body. The implementation of national registration scheme in 2010 may better identify medical practitioners working full-time in the NT and improve response rates to the MLF survey. At present, the low NT response rate combined with a high number of registrants, few of whom may be working full-time or residing long-term in the NT, means that this source of data is unreliable for the purpose of modelling. With improvement it could be a more detailed and regular source of information on the NT medical workforce than the census.

A needs approach was chosen for the modelling to avoid constraints from factors that limit the use of services such access, policy and funding. Accordingly, it was unsurprising that it yielded higher growth in demand than an utilisation approach, which would be affected by those factors. The needs projection was, however, lower than the trends projection of the demand for medical services. This result suggested that two assumptions of the needs approach may need to be reconsidered. The model assumes that health needs in 2006 were suitably met and BoD would remain constant over the projection period. Thus, growth in demand is due to population growth and ageing. Trends in recent periods indicate that this may not be the case (Figure 8).

Figure 8 Projected and actual NT medical practitioners numbers and service provision, 2001 to 2007



As shown in Figure 8, over the period 2001 to 2007, DHF medical practitioner numbers increased by a much larger extent than a needs approach would have projected (76 more practitioners).³⁸ Consistent with this rise, separations increased from 360 to 480 per 1000 persons.³⁹ Had health needs been fully met, it would have been unlikely that hospital services per person would have needed to increase by this extent. The large

differential in health status between Indigenous and non-Indigenous Territorians also suggests that health needs are not being met and more resources are needed than are currently provided to reduce the gap.

There is a concern that chronic disease may increase in the future and this may mean that the BoD would also increase. A 5% increase in the BoD from chronic disease increased the requirement for medical practitioners by 1%. Mortality trends, however, appear to be declining for most chronic diseases,⁴⁴ suggesting that if incidence is increasing it may be due to temporary factors such as improved detection rather than a worsening of the underlying causes of disease. It could also be that health systems are becoming better at saving people, but survivors may place greater demands on medical resources than if they had died. The additional demand may come from on-going care to manage the condition that they would otherwise have died from, an increased likelihood of contracting other diseases if their initial illness is a risk factor for other diseases and that survivors may now contract illnesses associated with old age because they live longer.

The incidence-based BoD used in the demand module may not adequately reflect these impacts. The method used the present value of the current and future effects of new disease to predict the medical requirement in each year. The actual effect and the accompanying medical requirement could occur over many years. Thus, in any given year medical practitioners would be treating both new and existing cases. It may also result in patients with both new and long-term illnesses and they may have more complex care needs than those with a singular needs. Together these issues may necessitate greater growth in the workforce than suggested by the summary value of the effects of new cases in a year.

These issues suggest that the needs approach is likely to be a lower bound estimate of demand for medical services, which would maintain the health of the population at current levels. Clearly, it is desirable to address the health gap between Indigenous and non-Indigenous Territorians and more generally, efforts are being made to improve survival and avoid the occurrence of disease in the NT population as a whole. Further research is needed to develop an approach that captures demand from new and existing cases of disease and the resources required for the prevention of disease and improvements in survival.

Another limitation of the demand module is the data source for the medical weights. These weights were based on hospital sector activity; however, it is not the only sector that services people's health requirements. In many cases, the initial service point is the primary care sector. Hospital-based medical weights may not be representative of the medical requirements in this and other sectors, but the direction of any potential bias is unclear. Future research should develop weights for other sectors and determine the relative contribution of each sector to overall demand.

The needs approach was chosen so that the demand projection would not be curbed by economic, policy, infrastructure or other constraints. The projected growth in the medical model could not occur without fiscal support from governments. Infrastructure may also limit growth. Capital costs, particularly to build a new hospital, can be large and need to be prioritised against other capital works so these investments tend to be lumpy in nature. Using existing infrastructure more intensively will only be possible if it is located in the areas of growth. Even this option may constrain workforce numbers if it results in bottlenecks and other problems with the flow of patients that mean the growth in output from extra medical staff begins to diminish (diseconomies of scale) and further additions become less useful. These issues suggest that the projections from the model need to be interpreted within the context of fiscal, economic and other known constraints.

Conclusion

Contrary to the common concern about a shortage of medical practitioners, the projections from the NT Medical Workforce Model indicated that growth in the supply of medical practitioners over the period 2006 to 2022 would exceed the growth in requirements for their services. This result would, however, depend on two key factors – first, that the NT can continue to attract and retain medical practitioners at past levels and second, funding was available to support such growth. Should the projected increase in supply occur, there would be a greater number of practitioners available to address the burden of disease and injury in the NT and the number of services provided per capita could be increased. If allocated where need was greatest, such an increase could contribute to closing the gap in health status between Indigenous and non-Indigenous Territorians.

In addition to the needs of Indigenous Territorians, a key pressure point in medical requirements is likely to be the needs of elderly patients. Growth in demand from this segment of the population is expected to more than double. Other areas of specialty that are likely to experience strong demand are cardiology, oncology and neurology.

A critical issue for the NT are the migration patterns of medical practitioners. The NT is good at attracting practitioners with strong inflows, but large outflows indicate that it is less successful at retaining them. Of particular concern is the recent increase in the outflow of young practitioners. When the most recent migration trends were used in the model, outflows substantially reduced the overall numbers of medical practitioners and enhanced the impact of ageing. If these trends continue, the NT would have difficulty in expanding its medical workforce to meet the health needs of its population. It would also be dependent on an older workforce and therefore, more vulnerable to changes in their retirement decisions and levels of participation.

An increase in the flow of medical graduates in coming years provides an opportunity for the NT to increase its intake and this would be likely to have a lasting effect on the size of the workforce especially if backed by initiatives that encourage more of them to remain for longer periods in the NT. More generally, encouraging all practitioners to stay longer in the NT would have the benefit of not only maximising the size of the workforce, but it may also enhance productivity and minimise recruitment costs.

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