JAMES COOK UNIVERSITY AUSTRALIA

Integrating Health Care Planning for Health and Prosperity in North Queensland

A GAP ANALYSIS OF HEALTH NEEDS AND SERVICES IN THE NORTHERN QUEENSLAND REGION

JUNE 2022

Developed by the Integrating Health Care Planning for Health and Prosperity in North Queensland (IHCP-NQ) Project team

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Abbreviations

FTE	Full Time Equivalent
HHS	Hospital and Health Service
IRSD	Index of Relative Socio-economic Disadvantage
LGA	Local Government Area
NDSS	National Diabetes Support Scheme
PHN	Primary Health Network
PPH	Potentially Preventable Hospitalisations
PYLL	Years of Life Lost
SA2	Statistical Area Level 2
SA3	Statistical Area Level 3

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Executive Summary

This *Integrating Health Care Planning for Health and Prosperity in North Queensland* project brings together key public and private health system partners across northern Queensland, including Hospital and Health Services, Primary Health Networks and the Community Controlled Health Sector to take a regional approach to strengthening the integration of care and place-based planning of workforce and service implementation in North Queensland. The project builds on findings and recommendations made in the Health Service Delivery Situational Analysis that was informed by widespread stakeholder engagement across northern Australia and a comprehensive review of existing knowledge (1).

The project region consists of 39 Local Government Areas (LGAs) in northern Queensland extending from the Mackay and Isaac region across to the Boulia region in the south, and to the Gulf Country region and Torres Strait in the north. The project region is a diverse setting with a mixture of farming, mining and Aboriginal and Torres Strait Islander communities in the more rural and remote areas, and places of higher density, urban living in major regional townships on the east coast. There are many similarities in health challenges and service delivery across the project region, with small, dispersed populations in challenging geographies.

To obtain a broad understanding of unmet health need in the project region, a gap analysis was undertaken. The gap analysis took a pragmatic approach drawing on key principles of health care equity to develop a composite Index of Unmet Need. This Index integrated the Index of Population Health Need (which was developed using indicators of known determinants of health, current and projected health need and service need) and the Index of Service Availability (which was developed using indicators of workforce and geographic access). The approach focused on identifying differences in relative population health need and service availability between places by drawing on available parameters that are known to be important in addressing health inequities.

Analysis of the indicators enabled ranking of the LGAs according to relative population health need, relative service availability and relative unmet need. The LGAs of Torres Strait Island, Napranum and Mapoon were found to have the greatest unmet need relative to other LGAs in the project region meaning that compared with other LGAs, these LGAs experienced the greatest disparity in health needs relative to service availability. The LGAs of Burke, Doomadgee, Hope Vale, Kowanyama, Lockhart River, Mornington, Northern Peninsula Area and Pormpuraaw were found to have relatively higher population health need and lower service availability compared with other LGAs in the project region and, like Torres Strait Island, Napranum and Mapoon, may be considered as areas of priority for health and service intervention. On the other hand, the LGAs of Townsville and Cairns had the highest service availability and lowest population health need across the project region. Importantly, the Index scores reported in this gap analysis are relative measures across the project region and not indicative of sufficiency. Moreover, all places in the project region are in remote to regional northern Queensland and are known to be relatively underserved and have generally poorer population health by comparison to metropolitan settings.

The Index of Unmet Need presents a way of integrating and responding to data about places, though there are some limitations of the analysis. The overall composite Index of Unmet Need highlights areas of greater unmet need and this information may be used to prioritise places for further place-based planning processes. The Index of Population Health Need and the Index of Service Availability are useful as together these indices highlight places of possible service opportunity and/or threat to population health which should be explored more deeply in a second stage analysis at local level.

The gap analysis of the project region presented in this report serves as part of early place-based planning processes aimed at identifying imbalances between health services and need across northern Queensland. It accompanies the Northern Queensland Health Atlas, an online interactive platform presenting population, health status, hospital utilisation, workforce, health care provision and service location data in map form (Northern Queensland Health Atlas; https://arcg.is/5a4Xq). This gap analysis is intended as a beginning point for local level consultations with community and key stakeholders about priority areas for action for the *Integrating Health Care Planning for Health and Prosperity* in North Queensland project. Further, an understanding of support from project partners and local willingness to engage in health service re-design will be critical in assessing readiness to embark on further place-based planning initiatives at a 'place'.

The guiding principles underlying the priority actions for stronger, more effective, equitable, efficient health systems in the north, recommended in the Health Service Delivery Situational Analysis (1), are crucial to consider in terms of identification of priority areas to trial further place-based planning processes in the project region.

(i) Strong community co-design, ownership and engagement
The priorities of communities are essential in place-based planning. This gap analysis is a starting point and further planning processes must be informed by community priorities and views about what initiatives are most needed and likely to be successful locally.

(ii) Cross-sectoral planning, action and coordination
Understanding the readiness and willingness of local communities, health care providers and project partners (particularly HHSs and PHNs in the project region) to engage with further place-based planning processes is imperative as this will inform and influence the relevance and success of any initiative implemented.

(iii) Equal care and outcomes based on need
This gap analysis (and the companion Northern Queensland Health Atlas; https://arcg.is/5a4Xq) highlights the diversity of needs of populations, challenges for service provision and unmet need across the project region. To maximise learning about what works best in different contexts, a range of different community types and regions will be needed to move into the next phases of place-based planning.

Introduction

Integrating health care planning in northern Queensland

Investing in the health workforce and related improvement in models of care can be a strong economic driver for prosperity; a health community is a necessary pre-requisite for economic development. There are many similarities in health challenges and service delivery across Northern Australia, with small, dispersed populations in challenging geographies. Despite this, lack of coordination in planning and delivery of health services across the spectrum from community to primary to hospital care leads to inefficiencies, duplication, gaps and less than optimal health and economic outcomes.

This *Integrating Health Care Planning for Health and Prosperity in North Queensland* project brings together key public and private health system partners across northern Queensland, including Hospital and Health Services, Primary Health Networks and the Community Controlled Health Sector to take a regional approach to strengthening the integration of care and place-based planning of workforce and service implementation in northern Queensland. The project addresses the question: How do we best develop and implement processes for prioritising integrated place-based planning to the unique contexts of NQ? There are four main project phases:

(i) Development of an interactive map displaying various indicators of health and services across the project region using Geographic Information System (GIS) technology.

(ii) Identify gaps in service provision and integration in collaboration with place-based stakeholders in different operational contexts to identify priority communities to trial place-based planning processes, where more effective models of care or redistribution/integration of services to best meet need may be particularly beneficial

(iii) Design and pilot implementation of new, or modified models of care in collaboration with communities and partners.

(iv) Monitoring and evaluation of process, outcome and impact of place-based planning processes.

The project builds on findings and recommendations made in the Health Service Delivery Situational Analysis that was informed by widespread stakeholder engagement across northern Australia and a comprehensive review of existing knowledge (1). The principles underlying the situational analysis also guide all aspects of the project (Box 1).

Box 1. Guiding principles for priority actions for stronger, more effective, equitable, efficient health systems in northern Australia.

- Equal care and outcomes based on need
- Addressing social, cultural and environmental determinants of health
- Cross-sectoral planning, action and coordination
- Strong community co-design, ownership and engagement
- Local workforce capacity building
- Innovation in health service delivery and workforce to respond to need
- Two-way health system strengthening with regional neighbours

Project setting

The project region consists of 39 Local Government Areas (LGAs) located in northern Queensland (Figure 1). An LGA is a government administrative area defined by the Queensland

Government that is identified as a Regional Council (R), Shire (S), Town (T) or City (C)[1]. The LGAs of Cairns, Townsville and Mackay have the largest populations with resident populations of over 117,000 people, 168,000 people and 196,000 people, respectively. The communities within these LGAs are mostly regionally located. The rest of the LGAs have smaller populations and are in rural and remote areas of northern Queensland. Many of these LGAs consist of farming and mining communities. Fourteen LGAs are in remote areas and have a high proportion (over 45%) of Aboriginal and Torres Strait Islander population.

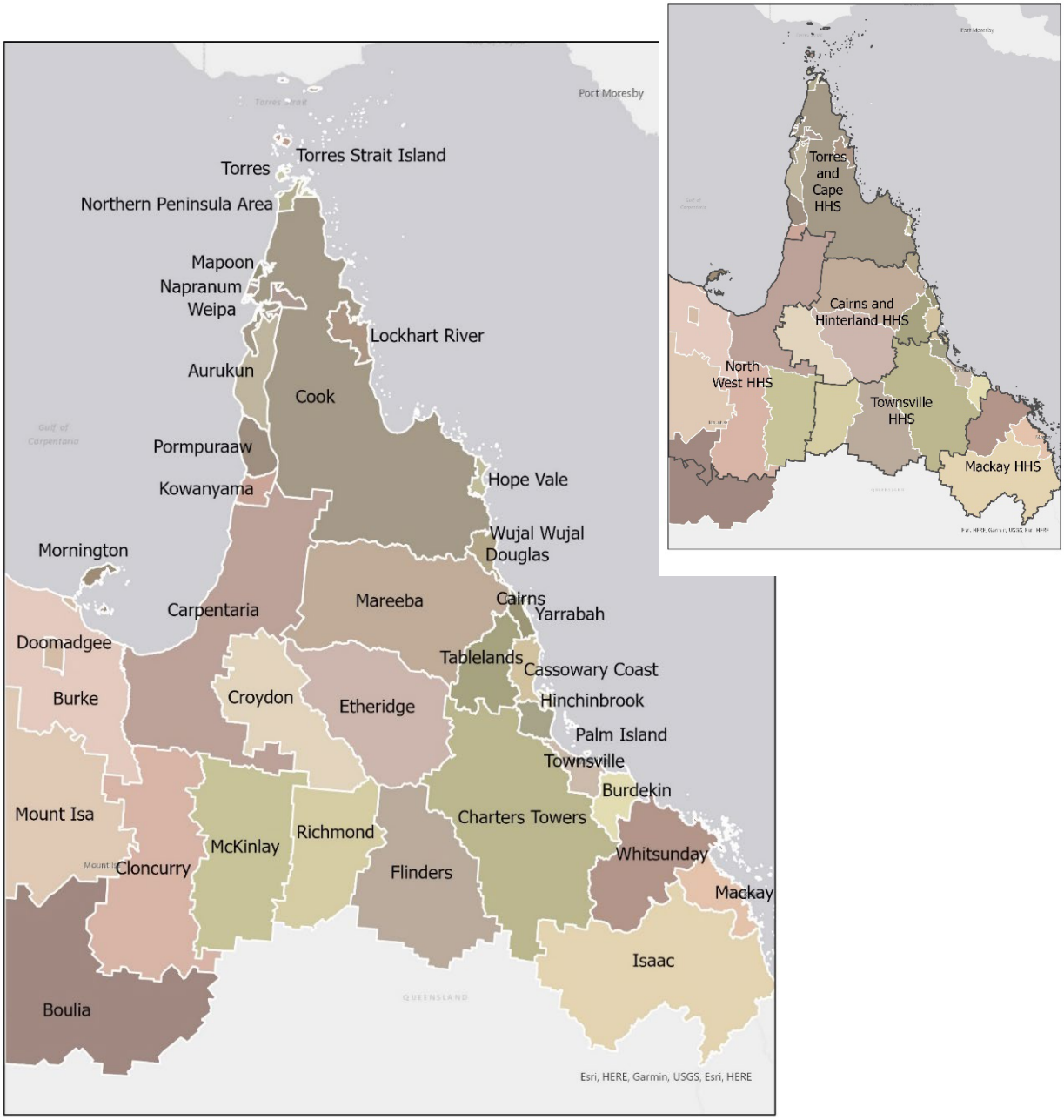

Figure 1. A map of northern Queensland showing the boundaries and names of LGAs in the project region[1] and Hospital and Health Service boundaries.

[1]Throughout the main text of this document LGAs are referred to without reference to the type of LGA (Regional Council, R; Shire, S; Town, T; City, C). Refer to Appendix D for this level of information.

There are five Hospital and Health Services (HHS) that provide public health hospital, outpatient and community services in the project region (Figure 1). Each HHS has a referral hospital and a mixture of district and rural hospitals, multipurpose health services and community health clinics. The regional centres of Cairns, Townsville and Mackay have private hospital services and a variety of other private health services including for example general practitioner, physiotherapy, psychology and nutrition services. Private health services in the more rurally located LGAs are lacking in number and specialty compared with the regional centres. LGAs in the project region face challenges of health workforce shortage and maldistribution of workforce, and often experience high turnover of health workforce.

Two Primary Health Networks (PHN), Western Queensland PHN and North Queensland PHN, work across the project region. PHNs are independent organisations funded by the Australian Department of Health tasked with improving the efficiency, effectiveness and coordination of services in the primary health care sector. PHNs aim to minimise gaps and duplication and improve support for community health care needs.

Gap analysis of the project region

The gap analysis of the project region presented in this report informs the second phase of the overall project. It serves as part of early place-based planning processes aimed at identifying imbalances between health services and need across northern Queensland. It accompanies the Northern Queensland Health Atlas, an online interactive platform presenting population, health status, hospital utilisation, workforce, health care provision and service location data in map form (Northern Queensland Health Atlas; https://arcg.is/5a4Xq). The interactive map draws on publicly available datasets at the lowest geographic level possible and provides a foundation for understanding health need and service availability in the region.

Stakeholder engagement and consultation at community levels and analysis of more localised data are necessary to obtain a comprehensive picture of unmet need and services. This gap analysis is intended as a beginning point for local level consultations with community stakeholders about priority areas for action for the *Integrating Health Care Planning for Health and Prosperity in North Queensland* project. Further, an understanding of support from project partners and local willingness to engage in health service re-design is an important factor is assessing readiness to embark on further place-based planning initiatives at a 'place'.

Methods

Approach

A pragmatic approach drawing on key principles of health care equity was used to obtain a broad understanding of unmet health need in the project region. Health care equity, for the purposes of this gap analysis, refers to the opportunity to equal care and outcomes based on need (1). The approach focused on identifying differences in relative population health need and service availability between places by drawing on available parameters that are known to be important in addressing health inequities.

Rationale

A composite Index of Unmet Need was developed to rank LGAs (the unit of 'place' for this analysis) in the project region according to the levels of health need and service availability at each place. The ranking of places was undertaken with similar intent as other health-related rankings used locally and internationally. Health rankings, such as America's Health Rankings and the Urban Health Index, are developed using various methods that integrate health indicators and health determinants at the

place level to identify areas of health disparity (2). In Australia, health-related rankings have been used to prioritise places of potential workforce need and service gaps (3-5).

Health rankings may be used to compare health and health need between regions and to monitor this over time. Health rankings are commonly used as a tool to begin discussions about challenges experienced within and across places (6) and this is the primary purpose of the composite Index of Unmet Need reported in this gap analysis. In line with the aim of achieving a broad understanding of unmet need in the project region, and to help account for the limitations of available data, the Index scores were grouped into higher-order categories of unmet need.

Importantly, the Index scores reported in this gap analysis are relative measures across the project region and not indicative of sufficiency. Moreover, all places in the project region are located in remote to regional northern Queensland and are known to be relatively underserved and have generally poorer population health by comparison to metropolitan settings.

Composition of the Index of Unmet Need

The **Index of Unmet Need** is a composite index consisting of the ***Index of Population Health Need*** and the ***Index of Service Availability***. The ***Index of Population Health Need*** consists of the *Index of Need* and the *Index of Service Need*. It is based on indicators of known determinants of health, current and projected health need and service need. The ***Index of Service Availability*** is based on workforce and geographic access indicators of service availability. The methods for calculating the indices have been adapted from an analysis of after-hours service need conducted in Australia (5) and follow similar conceptual logic as that used to inform development of health rankings in general.

The Indices integrate a number of indicators at the place level. The definition and rationale for the inclusion of each indicator may be found in Table 1, Table 2 and Table 3. The data for most indicators were sourced from reliable datasets in the public domain and at a geographic level that corresponded entirely with LGAs or could be applied responsibly to LGAs with little modification. Some indicators were created or modified slightly by the project team. Data sources and details of any modifications are found in Appendix A.

Table 1. Indicators that constitute the Index of Population Health Need.

Indicator	Definition	Rationale
Remoteness	A category assigned to a LGA that categorises locations according to their population size and remoteness from capital cities. See Appendix A for details about how this indicator was modified from the Modified Monash Model 2019 (MMM) for use in this gap analysis.	People living in rural and remote areas are known to have poorer health outcomes than people living in metropolitan areas experiencing, for example, higher rates of hospitalisation, chronic disease and potentially avoidable deaths. These settings are also characterised by poorer accessibility to health services and health professionals that amplifies with increasing remoteness. Rural and remote communities have higher unemployment rates than metropolitan communities and may experience less educational opportunities.

Indicator	Definition	Rationale
Aboriginal and Torres Strait Islander population (%)	The proportion of people identifying as being of Australian Aboriginal origin, Torres Strait Islander origin, or both Australian Aboriginal and Torres Strait Islander origin in the Australian Bureau of Statistics Census (2016).	Australian Aboriginal and Torres Strait Islander people experience poorer health and wellbeing than non-indigenous Australians. Improving the health of this population is a national priority.
Population aged 65 years and over (%)	The proportion of resident population estimated to be aged 65 years and over for the year 2020.	One in six Australians is aged 65 years and over. Older people often have complex health needs requiring coordination of care between primary care, hospital and social care sectors.
Change in population - 2021 to 2031 (%)	The percentage change in estimated resident population from 2021 to 2031.	Changes in population sizes over time affect projected need in a region. This indicator was used as a marker of expanding service need.
Change in population aged 65 years and over - 2021 to 2031 (%)	The percentage change in estimated resident population aged 65 years and over from 2021 to 2031.	Changes in population sizes over time affect projected need in a region. Australia has an increasingly older population. Areas with larger older populations will likely experience increased demand for services and changes in types of services and health professional skills.
Index of Relative Socio-economic Disadvantage (IRSD) (Score)	The IRSD indicates geographic areas of relative disadvantage on a scale of most disadvantaged (lower score) to least disadvantaged (higher score).	Disparities in health outcomes are associated with increasing socioeconomic disadvantage.
Prevalence of diabetes (%)	The proportion of people with diabetes (all types) registered in the National Diabetes Support Scheme (NDSS).	Type 2 diabetes mellitus (the most common form of diabetes in Australia) is a chronic disease that is mostly controllable with lifestyle modifications, yet has a major impact on premature morbidity, mortality and PPHs in the region. There is a lack of data about the prevalence of chronic diseases (at small area level) across the project region. Diabetes has been used as a proxy indicator as registration through the National Diabetes Support Scheme (NDSS) facilitates reporting.

Table 2. Indicators that constitute the Index of Service Need.

Indicator	Definition	Rationale
Total Potentially Preventable Hospitalisations (PPH) (age-standardised rate)	The age-standardised rate for Total PPH as defined by the National Health Agreement.	PPH data are defined by sets of acute, chronic and vaccine preventable conditions for which hospitalisation could be avoided with effective primary health care and/or better coordination of care. These data are used in Australia as an indicator of primary and community health service effectiveness (7).
Potential Years of Life Lost under 75 years of age (PYLL) (person-years per 1,000)	The total number of potential years of life lost by an individual due to premature death (death before 75 years of age).	PYLL is an indicator of premature mortality reflecting premature deaths that could have been avoidable with effective public health interventions (8).

Table 3. Indicators that constitute the Index of Service Availability.

Indicator	Definition	Rationale
General Practitioner workforce (FTE/10,000)	Full-time equivalent General practitioners (vocationally and non-vocationally registered) per 10,000 population.	The number and full-time equivalent (FTE) of General Practitioners per population is a common indicator of primary health care service availability. This analysis uses FTE/10,000 population to allow for comparisons to be made across the project region. Importantly, in LGAs with populations under 10,000 people, FTE/10,000 population can be misleading and care should be taken when interpreting such an indicator in the context of small populations.
Nursing and midwifery workforce (FTE/10,000)	Full-time equivalent nurses (enrolled nurses, registered nurses and midwives) per 10,000 population.	The count and full-time equivalent (FTE) of Nurses per population is a common indicator of service availability. This indicator is particularly important across the project region as nurses often support rural and remote health care in the current landscape of maldistribution of General Practitioner workforce. This analysis uses FTE/10,000 population to allow for comparisons to be made across the project region. Importantly, in LGAs with populations under 10,000 people, FTE/10,000 population can be misleading and care should be taken when interpreting such an indicator in the context of small populations.

Indicator	Definition	Rationale
Primary health care facilities per 1,000 km^2	The number of primary health care facilities (in public and private sector) per 1,000km^2	This indicator is a baseline measure of geographic accessibility to primary health care.
Distance to a major referral hospital (km)	The geodesic (straight-line) distance from the centroid of an LGA to the major referral hospital (in the Hospital and Health Service that the LGA is within).	This indicator is a baseline measure of geographic accessibility to a major referral hospital (within a Hospital and Health Service catchment).

Calculating the Index of Unmet Need

Data for each indicator at LGA level were imported into Microsoft Excel. The data were normalised so that all data shared a common scale (of 0-1), and data points within an indicator maintained their position (being proportional to the minimum and maximum indicator value; see Appendix B for more details). LGAs with known severe travel challenges[2] were given additional weight in the indicator for distance to a referral hospital.

Each Index was calculated by separately summing the indicators in each Index and dividing by the number of indicators in that Index. The composite Index of Unmet Need was then calculated using the following expression:

$$\text{Composite Index of Unmet Need} = \frac{\overbrace{\textit{Need Index} + \textit{Service Need Index}}^{\text{Population Health Need Index}}}{\text{Service Availability Index}}$$

The resulting scores for the overall Index of Unmet Need, the Population Need Index and the Service Availability Index were categorised using their respective distributions (see Appendix C for more information). The cut-off value for greater need or lower service availability was determined by the mean for normally distributed data or the median for non-parametric data. The final scores were also visualised in map form. The dataset was imported into ArcGIS Pro (9), appended to an LGA ESRI shapefile (10) and displayed.

Findings

Population Health Need Index and Service Availability Index

The scores for the Population Health Need Index and Service Availability Index were calculated (see Appendix D for scores). The normal distribution of the scores was used to group the LGAs into broad categories. LGAs with a score equal to or greater than the mean were categorised as areas of greater health need or lower service availability. The other two categories were formed using the standard deviation of each Index – whereby one standard deviation from the mean was the cut-off point between the categories (see Appendix C). The resulting LGAs in each category for each Index are found in Figure 2 and Figure 3. The Indices are also displayed in map form in Figure 4 with the Service Availability Index overlayed on the Population Health Need Index.

[2] 'Severe travel challenges' were defined as seasonal severe disruptions to road travel, or travel by sea or air as the only means of transport.

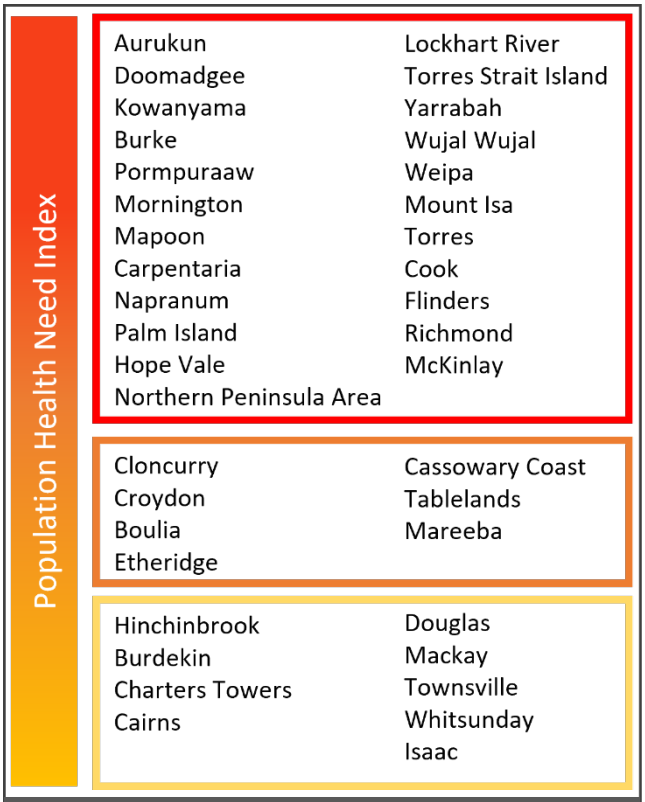

Figure 2. LGAs categorised as places of greater health need (red), moderate health need (orange) and lower health need (yellow) according to the Population Health Need Index.

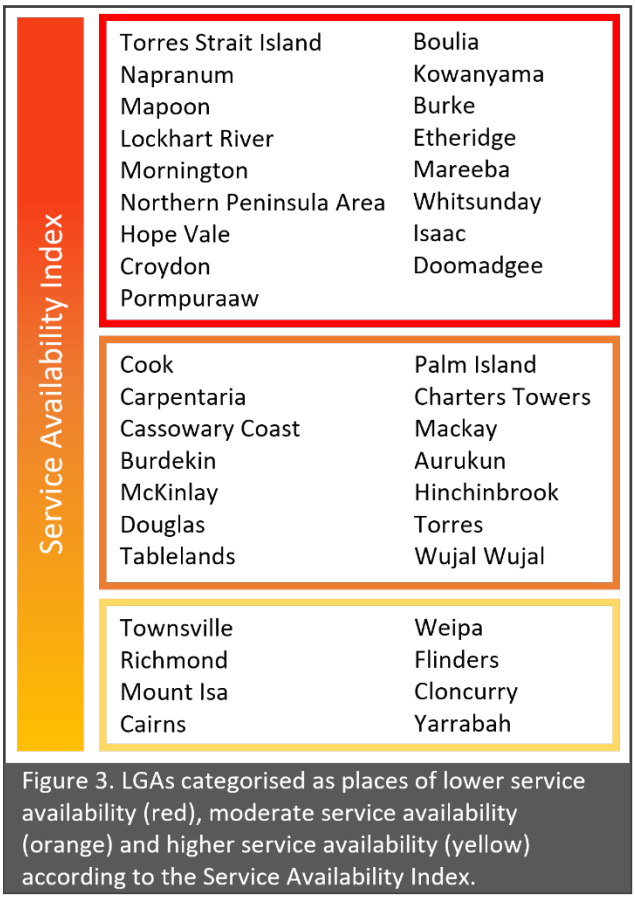

Figure 3. LGAs categorised as places of lower service availability (red), moderate service availability (orange) and higher service availability (yellow) according to the Service Availability Index.

Population Health Need Index

Key points

This Index consists of the sum of the Need Index (7 indicators) and the Service Need Index (2 indicators).

- The LGAs of Aurukun, Doomadgee, Kowanyama, Napranum, Palm Island and Weipa were within the top 20% of rankings for five or more indicators.
- Of these, Aurukun, Kowanyama, Palm Island and Weipa have an estimated projected population increase for people aged 65 years and over (2021 to 2031) of at least 81% with Weipa having the highest projected change of 139.4%.
- Potential years of life lost due to premature mortality and total potentially preventable hospitalisations were highest in Aurukun, Burke, Carpentaria, Doomadgee, Flinders, Kowanyama, McKinlay, Mornington, Mount Isa, Pormpuraaw and Richmond.

Service Availability Index

Key points

This Index consists of four indicators capturing general practitioner and nursing workforce per 10,000 and geographic access to primary health care facilities and major referral hospitals.

- The LGAs of Boulia, Burke, Croydon, Etheridge, Lockhart River, McKinlay, Mapoon, Mornington, Napranum, Torres Strait Island and Whitsunday were within the top 20% of rankings for two or more indicators.
- Of these, Mapoon, Mornington, Napranum, Torres Strait Island and Whitsunday had the lowest levels of general practitioner and nursing workforce FTE per 10,000 population relative to the rest of the project region.
- Low service availability was compounded for Mapoon, Napranum and Torres Strait Island with these LGAs being amongst the LGAs with the poorest geographic access to major referral hospitals.

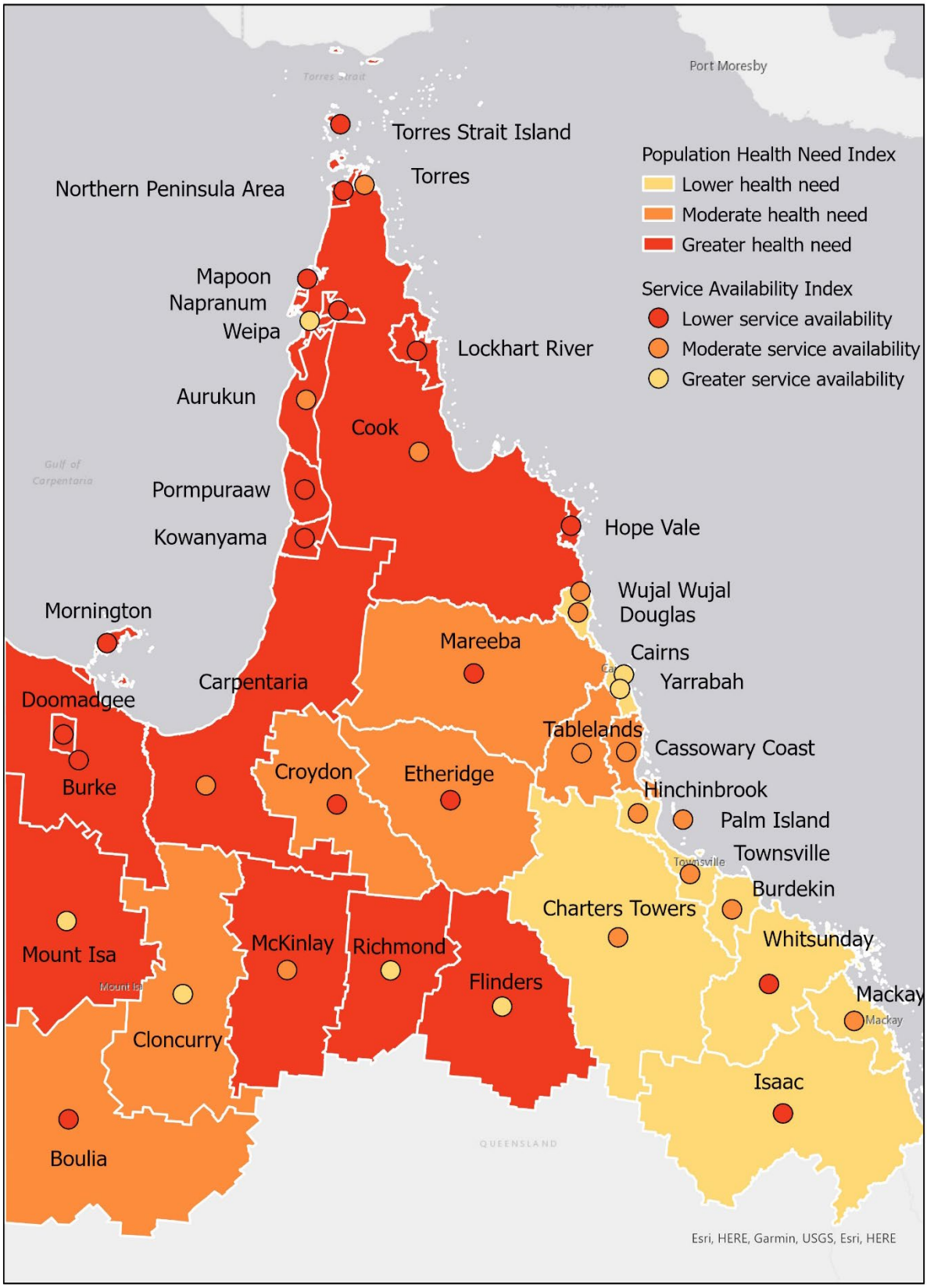

Figure 4. LGAs categorised according to the Population Health Need Index overlayed with categories of the Service Availability Index.

Composite Index of Unmet Need

The Index of Unmet Need was calculated using the Index of Population Health Need and the Index of Service Availability (see Appendix D) as described in the Methods section. The distribution of the scores was used to categorise LGAs in the project region into broad categories of unmet need. Three LGAs, Torres Strait Island, Napranum and Mapoon, were found to have extremely high scores in comparison with other LGAs and were considered as outliers. These LGAs were categorised as having the greatest unmet need relative to the rest of the project region. LGAs with scores equal to or greater than the median were categorised as being places of greater unmet need. The second and first quartiles were categorised as being places of moderate and lower unmet need, respectively. The resulting LGAs in each category are found in Figure 5 and displayed in map form in Figure 6.

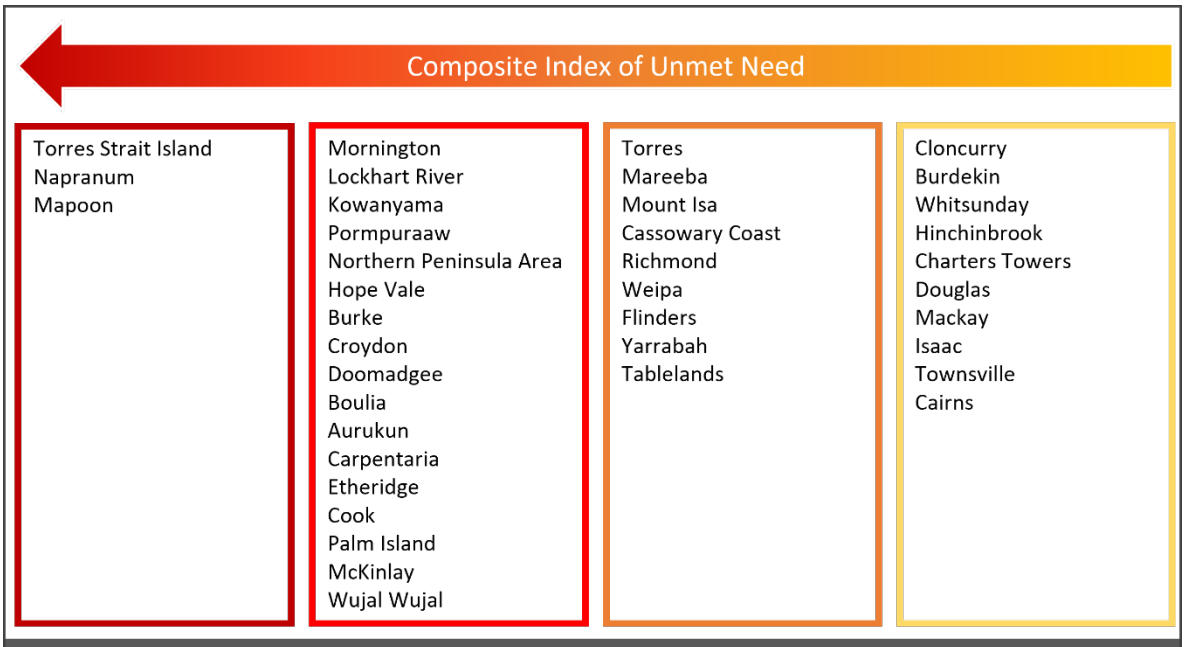

Figure 5. LGAs categorised as places of greatest unmet need (maroon), greater unmet need (red), moderate unmet need (orange) and lower unmet need (yellow) according to the composite Index of Unmet Need.

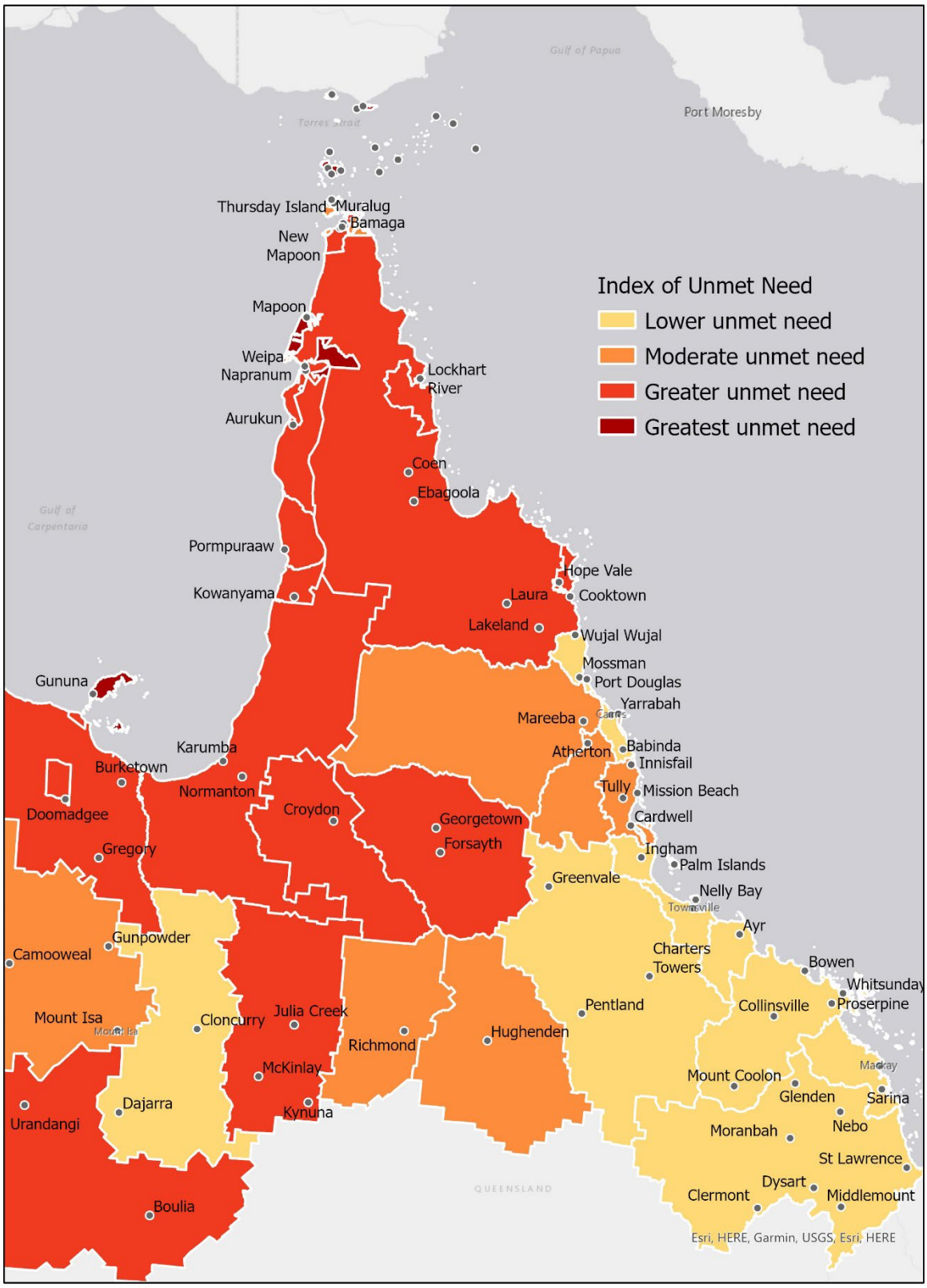

Figure 6. LGAs categorised according to the Index of Unmet Need (displayed with town names to aid navigation of the project region).

All LGAs categorised as places of greatest and greater unmet need were characterised by relatively high population health need, high remoteness and relatively low service availability. The LGAs of Torres Strait Island, Napranum and Mapoon were found to be places of greatest unmet need across the project region. The profiles for each of these LGAs are described in Figure 7.

	Torres Strait Island (R)	Napranum (S)	Mapoon (S)
	Population 2020: **5,178** Aboriginal or Torres Strait Islander population: **94.5%** Projected population change aged 65 years and over: **47.8%** High relative disadvantage: **IRSD Decile 2**	Population 2020: **1,099** Aboriginal or Torres Strait Islander population: **96.3%** Projected population change aged 65 years and over: **36.7%** High relative disadvantage: **IRSD Decile 1**	Population 2020: **339** Aboriginal or Torres Strait Islander population: **92.8%** Projected population change aged 65 years and over: **49%** High relative disadvantage: **IRSD Decile 2**
	Modified Monash Model **7** **Remote setting**	Modified Monash Model **7** **Remote setting**	Modified Monash Model **7** **Remote setting**
Chronic conditions	Prevalence diabetes: **8.4%**	Prevalence diabetes: **13.1%**	Prevalence diabetes: **14.1%**
Service need	Total PPH (age-standardised) **6069 per 100,000** Person-years of life lost due to premature mortality: **43.1 per 1,000**	Total PPH (age-standardised) **6069 per 100,000** Person-years of life lost due to premature mortality: **71.7 per 1,000**	Total PPH (age-standardised) **6069 per 100,000** Person-years of life lost due to premature mortality: **71.7 per 1,000**
	General practitioners: **0** Nurses: **26.5 FTE per 10,000**	General practitioners: **0** Nurses: **9.1 FTE per 10,000**	General practitioners: **0** Nurses: **50.1 FTE per 10,000**
	Primary health care: Public services on main islands usually with nurses, Aboriginal and Torres Strait Islander Health Workers plus visiting services Major referral hospital: **Cairns Hospital 836km**	Primary health care: Aboriginal Community Controlled Health Organisation with comprehensive services plus visiting services Major referral hospital: **Cairns Hospital 618km**	Primary health care: Public service with nurses, Aboriginal and Torres Strait Islander Health Workers plus visiting services Major referral hospital: **Cairns Hospital 679km**

Figure 7. The LGAs found to have the greatest unmet need relative to LGAs in the rest of the project region.

The LGAs of Burke, Doomadgee, Hope Vale, Kowanyama, Lockhart River, Mornington, Northern Peninsula Area and Pormpuraaw were found to be relatively worse off in both population health need and service availability compared with other LGAs in the project region (refer Figure 4) and, like Torres Strait Island, Napranum and Mapoon, may be considered as areas of priority for health and service intervention. On the other hand, the LGAs of Townsville and Cairns had the highest service availability and lowest population health need across the project region.

With this in mind, it makes sense that the LGAs between these two extremes may be first prioritised as places for potential health intervention according to the Index of Unmet Need and then, second, scrutinised using the Population Health Needs Index and Service Availability Index to further understand unmet need and potential opportunities and threats. For example, in the category of greater unmet need, the LGAs of Croydon, Etheridge and Boulia were found to have relatively moderate population health need and lower service availability. These LGAs may be viewed as

places of priority for further exploration due to the potential negative implications of lower service availability in an area of greater population need.

LGAs categorised as having relatively moderate unmet health need were mostly characterised by higher population health need and higher service availability (Figure 4 and 5) that would need to be explored more deeply in a second stage analysis at local level. This may present an opportunity for health intervention and a place for priority consultations given the potential 'head-start' from a service perspective. Alternatively, and more likely, this may highlight the great disparity in health needs in these LGAs despite apparent relatively greater service availability. Regardless, this is a starting point for further exploration using place-based planning processes.

LGAs categorised as having relatively lower unmet need overall had lower population health need and moderate to greater service availability, with the exception of Cairns, Townsville, Isaac and Whitsunday. As described previously, Cairns and Townsville were found to be places with the lowest unmet need relative to other LGAs in the project region. Isaac and Whitsunday LGAs were found to have relatively lower population health need and lower service availability. All LGAs in the category of lower unmet need, particularly Isaac and Whitsunday, may be areas explored further to obtain an understanding of threats to population health in settings of less underlying disadvantage, but low service availability.

Discussion

The gap analysis undertaken within the project region used a pragmatic approach that ranked LGAs (the geographic unit for this analysis) into four categories of unmet need. This was achieved using three Indices: the composite Index of Unmet Need, the Population Health Need Index and the Service Availability Index. The Indices integrated several indicators at the place level that were chosen from publicly available data to best reflect broad drivers of health need and to capture a sense of service need and service availability. Together, the Indices serve to prioritise places according to unmet need and identify places for further exploration as part of early place-based planning processes in the project region. This gap analysis can be used to stimulate or inform stakeholder consultations at the community level.

The gap analysis of the project region identified similar places of service need as reported by other organisations. Health Workforce Queensland ranked areas (Statistical Area Level 2; SA2) in the Northern Queensland region according to workforce need. They reported the SA2 regions of Torres Strait Islands, Croydon-Etheridge, Aurukun, Tablelands, Herberton, Palm Island, Kowanyama, Cape York, Collinsville and Northern Peninsula within the top ten areas of possible workforce need (11). These regions all fall within LGAs that have been identified in this gap analysis as having relatively lower levels of service availability. A survey of general practitioners, practice managers, nurses and midwives and allied health practitioners sought views on workforce or service gaps in Cairns and Hinterland HHS, Mackay HHS, Torres and Cape HHS and Townsville HHS. In all HHSs, except for Townsville HHS, general practitioners were identified by survey participants as a possible serious workforce or service gap (11). Participants working in Torres and Cape HHS also reported nursing and midwifery as an important gap. Psychology was identified within the top three of workforce or service gaps in all four HHSs.

In the Western Queensland region, the SA2 regions of Carpentaria and the Mount Isa Region were identified as places of possible workforce need (12). The Mount Isa Region consists of the LGAs of Mount Isa and Cloncurry. This region was identified in our gap analysis of the project region (which included LGAs in both northern and western Queensland) as having relatively greater service

availability. However, the two analyses both demonstrate that Carpentaria is a place of greater workforce need. Analysis of survey findings of general practitioners, practice managers, nurses and midwives and allied health practitioners (total of 40 participants) working in the North West HHS reported that general practitioners were a possible serious primary care workforce or service gap. Other serious workforce gaps were reported for most professions with psychology, sonography and dentistry ranked highest by survey participants (12).

To inform further exploration of population health need across the project region, the Northern Queensland Health Atlas (https://arcg.is/5a4Xq) provides data on many indicators of health, health behaviours, health status, service utilisation and workforce. Other useful reports about health need are the Primary Health Network (PHN) Needs Assessment reports provided by the two PHNs (Western Queensland PHN and Northern Queensland PHN) working in the project region (13, 14). The Health Service Delivery Situational Analysis is another useful resource about health needs and services in northern Australia (1).

This gap analysis relied on publicly available data for LGAs which are moderately sized, administratively bound geographic areas relating to Regional Council, Shire, Town and City government areas. These areas are made up of many communities each with unique aspects relating to, for example, population demographics, social organisation, economy and environment (the nuances of which are not captured at LGA geographic level). Moreover, Aboriginal and Torres Strait Islander communities have unique and diverse cultural needs and are usually rurally or remotely located presenting challenges of access, disadvantage and isolation. Communities with high numbers of fly-in fly-out workers have differing needs that may vary with seasonal or specific project timelines. The socio-demographics of this group (often younger in age and relatively advantaged) likely masks underlying issues of the more permanent resident population. Contextualised understandings of communities can only be gained through community and stakeholder consultation and exploration of data at smaller levels of place and lower levels of aggregation.

Next steps

The project team has collaborated with stakeholders (clinical and consumer) in different operational contexts to identify priority communities to trial place-based planning processes, where more effective models of care or redistribution/integration of services to best meet need may be particularly beneficial. This prioritisation needs to consider clinical governance barriers to co-design (e.g. lack of sharing of health records), institutional disincentives to integration (policy and funding drivers for siloed care), cultural competence and patient flow. It is critical to incorporate understanding amongst the consortia of local contexts, recognising the difference between theoretical availability of services and actual accessibility, acceptability and usage. Further consultation with local stakeholders within prioritised communities will confirm participation in place-based planning processes in phase 2 of the project.

The guiding principles underlying the priority actions for stronger, more effective, equitable, efficient health systems in the north, recommended in the Health Service Delivery Situational Analysis (1), are crucial to consider in terms of identification of priority areas to trial further place-based planning processes in the project region.

1. Strong community co-design, ownership and engagement

The priorities of communities are essential in place-based planning. This gap analysis is a starting point and further planning processes must be informed by community priorities and views about what initiatives are most needed and likely to be successful in their region.

2. Cross-sectoral planning, action and coordination
   Understanding the readiness and willingness of local communities, health care providers and project partners (particularly HHSs and PHNs in the project region) to engage with further place-based planning processes is imperative as this will inform and influence the relevance and success of any initiative implemented.

3. Equal care and outcomes based on need
   This gap analysis (and the companion Northern Queensland Health Atlas; https://arcg.is/5a4Xq) highlights the diversity of needs of populations, challenges for service provision and unmet need across the project region. To maximise learning about what works best in different contexts, a range of different community types and regions will be needed to move into the next phases of place-based planning.

Strengths and limitations

Interpreting data on the myriad of health and service indicators available is extremely challenging. The Index of Unmet Need presents a way of integrating and responding to data about places. The overall composite Index of Unmet Need highlights areas of greater unmet need and this information may be used to prioritise places for further place-based planning processes. The Index of Population Health Need and the Index of Service Availability are useful as together these indices highlight places of possible service opportunity and/or threat to population health which should be explored more deeply in a second stage analysis at local level to obtain contextualised information. It would be possible to create similar indices with a thematic focus, for example, to investigate health and services for older people or maternal care.

The Indices developed in this gap analysis used the most reliable data that are readily available in the public domain, at the lowest level of aggregation possible. Workforce data were sourced from the National Health Workforce Dataset (NHWDS), and for LGAs with small populations and low numbers of workforce (counts of 3 or less), data were suppressed affecting the Service Availability Index for those areas. Moreover, the NHWDS is also limited by the use of Australian Health Practitioner Regulation Agency (AHPRA) data and self-reported data collected through an annual workforce survey. Importantly, it is likely that services provided by locum or visiting health professionals are not captured in this dataset.

LGAs were the chosen geographic unit for this analysis and there are important considerations when interpreting data at this level. Several LGAs, Mapoon (S), Napranum (S) and Weipa (T), in the Torres and Cape region have small geographic areas and interlock with each other. In practice, people residing in Mapoon and Napranum have better geographic access than captured by the Indices due to the close proximity of Weipa and services available there. Further, some LGAs may be large and sparsely populated, or the population density may be higher in a particular part of an LGA. This aspect of geographic access was not captured in the indicators used in this analysis. Likewise, the influences of geographic barriers such as rivers and mountains were not captured in this analysis.

Unmet need was defined in this analysis as population health need in relation to service availability and drew on indicators that were considered important, and were available, in the project region. There are many other indicators that may also be important and have not been included. For example, the Clinical Services Capacity Framework (CSCF) category or type of hospital (according to

the Queensland Rural and Remote Health Service Framework) could have been incorporated. Moreover, unmet health need and service need are more complex than can be captured through analysis of indicators at a moderate level of data aggregation. Also, service availability is one component of access to care and the Indices developed in this analysis exclude other components such as quality, effectiveness, appropriateness and acceptability.

While data for this analysis were readily available, modifications needed to be made to some indicators that were only available at a larger level of aggregation. For example, the PPH data were only available at SA3 level which is a higher level of aggregation than LGA level data. Finally, other health-related rankings use more refined methods with stronger statistical foundations. The methods used in this analysis were appropriate for the level of data available.

There are also other ways to gain an understanding of unmet need and methods vary depending on purpose. Health surveys aim to capture self-reported data about occasions where care was not met and about barriers to care (15). Such surveys may also consider each component of unmet care separately to allow investigation of particular barriers such as financial barriers (16). Longitudinal studies, with data linkage to other health datasets, may be useful in understanding non-use of services, delays in care and associations with health (17). Qualitative studies can also inform about underlying factors for gaps in care from both a consumer and provider perspective. Other methods include provider audits, simulation and modelling, and mixed methods studies that use more than one data source.

Appendix A. Indicators, data sources and modifications

Table A.1. Indicators used in developing the Index of Need

Indicator	Definition	Modifications	Data source
Remoteness	A category assigned to a LGA that categorises locations according to their population size and remoteness from capital cities.	Created by the project team based on the Modified Monash Model (MMM). The MMM is based on Statistical Area Level 1 units therefore some LGAs consist of several MMM categories. The proportion of population living in each MMM category per LGA was calculated. The most urban category for the MMM was chosen and used as the base indicator value. A value of 0.5 was added to the base value if more than 10% of the population lived in more rural categories. A value of 1 was added to the base value if 50% or more of the population lived in more rural categories. This allowed for an LGA with a more rural versus urban character to be captured in the remoteness indicator.	Modified Monash Model 2019 (18)
Aboriginal and Torres Strait Islander population (%)	The proportion of people identifying as being of Australian Aboriginal origin, Torres Strait Islander origin, or both Australian Aboriginal and Torres Strait Islander origin in the Australian Bureau of Statistics Census (2016).	The count for estimated Aboriginal and Torres Strait Islander Australians and non-indigenous Australians was used to calculate the proportion of Aboriginal and Torres Strait Islanders in each LGA.	Australian Bureau of Statistics (19)
Population aged 65 years and over (%)	The proportion of resident population estimated to be aged 65 years and over for the year 2020.	The project team calculated the proportion of population aged 65 years and over directly from the dataset.	Australian Bureau of Statistics (20)
Population change - 2021 to 2031 (%)	The percentage change in estimated resident population from 2021 to 2031.	The project team calculated the percent change in total population directly from the dataset.	Queensland Government (21)

Indicator	Definition	Modifications	Data source
Change in population aged 65 years and over - 2021 to 2031 (%)	The percentage change in estimated resident population aged 65 years and over from 2021 to 2031.	The project team calculated the percent change for the population aged 65 years and over directly from the dataset.	Queensland Government (21)
Index of Relative Socio-economic Disadvantage (IRSD) (Score)	The IRSD indicates geographic areas of relative disadvantage on a scale of most disadvantaged (lower score) to least disadvantaged (higher score).	N/A	Australian Bureau of Statistics (22)
Prevalence of diabetes (%)	The proportion of people with diabetes (all types) registered in the National Diabetes Support Scheme (NDSS).	Data are for the number of registrants on the National Diabetes Services Scheme with any type of diabetes. Data for Croydon (S) were unavailable. The median prevalence for the project region was used for this LGA.	Diabetes Australia (23)

Table A.2. Indicators used in developing the Index of Service Need

Indicator	Rationale	Modifications	Data source
Total Potentially Preventable Hospitalisations (PPH) (Age-Standardised Rate)	The age-standardised rate for Total PPH as defined by the National Health Agreement.	These data were only available at Statistical Area Level 3 (SA3). Some LGAs crossed SA3 boundaries. The proportion of population within boundaries that intersected was calculated and used to inform decisions about the PPH value to use. The PPH value corresponding to the area with the largest population was used.	Australian Institute of Health and Welfare (24)
Potential Years of Life Lost under 75 years of age (PYLL) (person-years)	The total number of potential years of life lost by an individual due to premature death (death before 75 years of age).	N/A	Australian Institute of Health and Welfare (25)

Table A.3. Indicators used in developing the Index of Service Availability

Indicator	Rationale	Modifications	Data source
General Practitioner workforce (FTE/10,000)	Full-time equivalent General practitioners (vocationally and non-vocationally registered) per 10,000 population.	The Estimated Resident Population 2020 was used to calculate the FTE of General Practitioners per 10,000 population. Data for Mapoon were unavailable. AHPRA registration data indicates the absence of any medical doctors in this LGA (https://www.ahpra.gov.au/Registration/Registers-of-Practitioners). These data were used for this indicator. In addition, counts and FTE of practitioners of 3 or below are randomly assigned a value of 0 to 3. AHPRA registration data accessed on 21 February 2022 was used to obtain the counts for affected LGAs and the corresponding FTE was assumed to be equivalent to this count.	*Workforce* National Health Workforce Dataset (26) *Estimated Resident Population* Australian Bureau of Statistics (20)
Nursing and midwifery workforce (FTE/10,000)	Full-time equivalent nurses (enrolled nurses, registered nurses and midwives) per 10,000 population.	The Estimated Resident Population 2020 was used to calculate the FTE of General Practitioners per 10,000 population. Data for Mapoon were unavailable in the data source. AHPRA registration data indicates the presence of a registered nurse and enrolled nurse in this LGA (https://www.ahpra.gov.au/Registration/Registers-of-Practitioners). These data were used for this indicator. In addition, counts and FTE of practitioners of 3 or below are randomly assigned a value of 0 to 3. AHPRA registration data accessed on 21 February 2022 was used to obtain the counts for affected LGAs and the corresponding FTE was assumed to be equivalent to this count.	*Workforce* National Health Workforce Dataset (27) *Estimated Resident Population* Australian Bureau of Statistics (20)

Primary health care facilities per 1,000km^2	The number of primary health care facilities (in public and private sector) per 1,000km^2	This indicator was created by the project team based on a dataset of the locations of primary health care centres in the project region (also created by the project team). The area of LGAs was used to calculate this indicator.	*Location data* Project team based on publicly available data *Area of LGAs* Australian Bureau of Statistics (10)
Distance to a major referral hospital (km)	The geodesic (straight-line) distance from the centroid of an LGA to the major referral hospital (in the Hospital and Health Service that the LGA is within).	The distance (straight-line) from the centroid of each LGA to the major referral hospital for that LGA was measured by the project team. Distance measurements for LGAs in the Torres and Cape HHS were to Cairns Hospital which is the major referral hospital for that HHS.	Project team

Appendix B. Calculating the Indices

The Index of Population Health Need and the Index of Service Availability were calculated using the following process.

1. Select indicators with consideration for rationale for their inclusion, availability of data at the appropriate geographic level, accessibility of data and reliability of data.
2. Modify data if necessary and appropriate so that all data are using the same geographic unit (LGA in this analysis).
3. Import data into Microsoft Excel with LGAs in rows and indicators in columns.
4. Normalise each indicator so that they share a common scale (of 0 to 1).

   Consider the direction that indicators should run. They should all be in the same direction.

   For this analysis, indicators for the *Need Index* and *Service Need Index* were calculated so that high need was equivalent to a high normalised value.

   For indicators where a high indicator value is equivalent to greater need, use the following formula, where X is the indicator value:

$$X_{\text{normalised}} = \frac{X - X_{\text{minimum}}}{X_{\text{maximum}} - X_{\text{minimum}}}$$

   For indicators where a high indicator value is equivalent to lower need, use the following formula, where X is the indicator value:

$$X_{\text{normalised}} = \frac{X_{\text{maximum}} - X}{X_{\text{maximum}} - X_{\text{minimum}}}$$

   For this analysis, indicators in the Index of Service Availability were calculated so that high service accessibility was equivalent to a high normalised value. This was necessary for the calculation of the Index of Unmet Need.
5. Assign weights if appropriate. In this analysis, LGAs with known severe travel challenges[3] were given additional weight in the indicator for distance to a referral hospital.
6. Calculate the *Need Index* and *Service Need Index* by separately summing the indicators for each LGA in each Index and dividing by the number of indicators in that Index.
7. Sum the *Need Index* and *Service Need Index* to create the Population Health Need Index.
8. Calculate the Service Availability Index by summing the indicators for each LGA and dividing by the number of indicators in the Index.

[3] 'Severe travel challenges' were defined as seasonal severe disruptions to road travel, or travel by sea or air as the only means of transport.

9. The composite Index of Unmet Need is then calculated using the following expression:

$$\text{Composite Index of Unmet Need} = \frac{\overbrace{\textit{Need Index} + \textit{Service Need Index}}^{\text{Population Health Need Index}}}{\text{Service Availability Index}}$$

10. For ease of reference, multiply the Indices scores by a factor of 10.

Appendix C. Categorising the Indices

The resulting scores for the overall Index of Unmet Need, the Population Need Index and the Service Availability Index were categorised using their respective distributions. Importantly, the categories that were formed indicate unmet need, population need and service availability of an LGA *relative* to other LGAs in the project region. For example, in the Service Availability Index, a LGA categorised (or having a score) indicating higher service availability does not necessarily indicate that an LGA has sufficient services. Further, given the indicators included in that Index, an understanding of appropriateness or quality of services cannot be gained from the categorisation.

The Population Health Need Index and Service Availability Index were categorised using the normal distribution of the scores.

Table C.1. Basic descriptive statistics for the Indices.

	Population Health Need Index (score)	**Service Availability Index** (score)
Mean	9.36	3.06
Standard Deviation (SD)	3.06	1.32
Range	15.20 to 3.78	0.38 to 5.24

Table C.2. Scores used to form each category of the Population Health Need Index.

Category	**Population Health Need Index** (score)
Greater population health need Mean score to highest score	9.36 to 15.20
Moderate population health need Mean score minus 1 SD	6.29 to 9.35
Lower population health need Minimum score to (mean score minus 1 SD)	3.78 to 6.28

Table C.3. Scores used to form each category of the Service Availability Index.

Category	**Service Availability Index** (score)
Lower service availability Lowest score to mean score	0.382 to 3.060
Moderate service availability Mean score plus 1 SD	3.061 to 4.380
Greater service ability (Mean score plus 1 SD) to maximum score	4.381 to 5.243

Similarly, the distribution of scores was used to categorise the Index of Unmet Need. This Index was not normally distributed therefore the median and quartiles were used to categorise the data.

Table C.4. Basic descriptive statistics for the Index of Unmet Need

	Minimum	1st Quartile	Median	3rd Quartile	Maximum
Index of Unmet Need (score)	11.16	18.94	25.51	53.69	281.08

The box plot in Figure C.1 shows three clear outlier data points. The LGAs for these scores were categorised as having greater unmet need compared with other LGAs in the project region.

The category for great unmet need included LGAs with scores between the median and highest score (excluding outliers). Moderate unmet need was categorised as LGAs with scores in the second quartile, and lower unmet need was categorised as LGAs with scores in the first quartile.

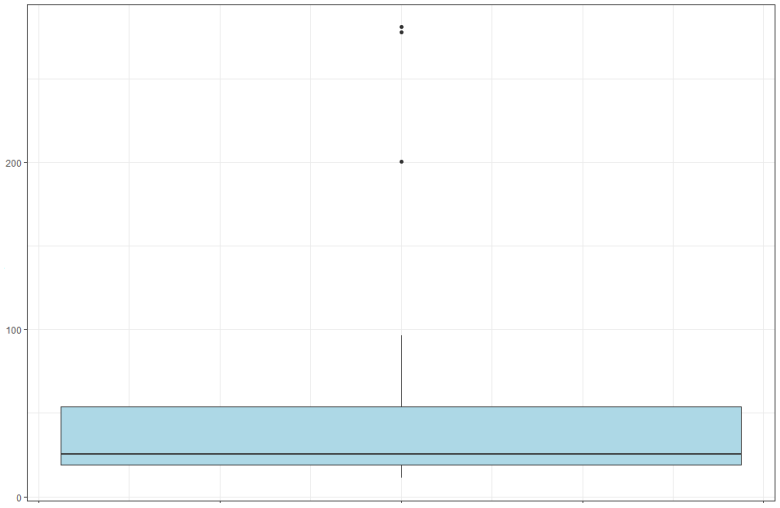

Figure C.1. Box plot of the Index of Unmet Need scores

Appendix D. Final scores for each Index

Table D.1. Population Health Need Index scores

Rank	LGA	Population Health Need Index Score
1	Aurukun (S)	15.20
2	Doomadgee (S)	13.66
3	Kowanyama (S)	13.48
4	Burke (S)	13.33
5	Pormpuraaw (S)	13.19
6	Mornington (S)	13.13
7	Mapoon (S)	12.59
8	Carpentaria (S)	12.56
9	Napranum (S)	12.33
10	Palm Island (S)	11.56
11	Hope Vale (S)	11.52
12	Northern Peninsula Area (R)	11.07
13	Lockhart River (S)	10.99
14	Torres Strait Island (R)	10.74
15	Yarrabah (S)	10.58
16	Wujal Wujal (S)	10.41
17	Weipa (T)	10.21
18	Mount Isa (C)	10.08
19	Torres (S)	10.05
20	Cook (S)	10.04
21	Flinders (S) (Qld)	10.02
22	Richmond (S)	9.71
23	McKinlay (S)	9.38
24	Cloncurry (S)	9.11
25	Croydon (S)	7.99
26	Boulia (S)	7.66
27	Etheridge (S)	7.65
28	Cassowary Coast (R)	7.41
29	Tablelands (R)	7.11
30	Mareeba (S)	6.75
31	Hinchinbrook (S)	6.05
32	Burdekin (S)	5.75
33	Charters Towers (R)	5.33
34	Cairns (R)	5.07
35	Douglas (S)	5.00
36	Mackay (R)	4.94
37	Townsville (C)	4.89
38	Whitsunday (R)	4.77
39	Isaac (R)	3.78

Table D.2. Service Availability Index scores

Rank	LGA	Service Availability Index scores
1	Torres Strait Island (R)	0.382
2	Napranum (S)	0.443
3	Mapoon (S)	0.627
4	Lockhart River (S)	1.327
5	Mornington (S)	1.363
6	Northern Peninsula Area (R)	1.569
7	Hope Vale (S)	1.700
8	Croydon (S)	1.701
9	Pormpuraaw (S)	1.789
10	Boulia (S)	1.811
11	Kowanyama (S)	1.817
12	Burke (S)	2.206
13	Etheridge (S)	2.307
14	Mareeba (S)	2.922
15	Whitsunday (R)	2.943
16	Isaac (R)	2.944
17	Doomadgee (S)	2.954
18	Cook (S)	3.181
19	Carpentaria (S)	3.209
20	Cassowary Coast (R)	3.392
21	Burdekin (S)	3.428
22	McKinlay (S)	3.464
23	Douglas (S)	3.505
24	Charters Towers (R)	3.524
25	Tablelands (R)	3.541
26	Palm Island (S)	3.796
27	Mackay (R)	3.847
28	Aurukun (S)	3.861
29	Hinchinbrook (S)	3.997
30	Torres (S)	3.999
31	Wujal Wujal (S)	4.079
32	Townsville (C)	4.384
33	Richmond (S)	4.467
34	Mount Isa (C)	4.504
35	Cairns (R)	4.547
36	Weipa (T)	4.766
37	Flinders (S) (Qld)	4.858
38	Cloncurry (S)	5.115
39	Yarrabah (S)	5.243

Table D.3. Composite Index of Unmet Need scores with the Population Health Need Index and Service Availability Index categories for each LGA.

Rank	LGA	Index of Unmet Need Score	Population Health Need Index category	Service availability Index category
1	Torres Strait Island (R)	281.085		
2	Napranum (S)	277.988		
3	Mapoon (S)	200.598		
4	Mornington (S)	96.331		
5	Lockhart River (S)	82.823		
6	Kowanyama (S)	74.183		
7	Pormpuraaw (S)	73.731		
8	Northern Peninsula Area (R)	70.541		
9	Hope Vale (S)	67.746		
10	Burke (S)	60.439		
11	Croydon (S)	46.950		
12	Doomadgee (S)	46.252		
13	Boulia (S)	42.292		
14	Aurukun (S)	39.356		
15	Carpentaria (S)	39.148		
16	Etheridge (S)	33.184		
17	Cook (S)	31.566		
18	Palm Island (S)	30.448		
19	McKinlay (S)	27.065		
20	Wujal Wujal (S)	25.511		
21	Torres (S)	25.126		
22	Mareeba (S)	23.093		
23	Mount Isa (C)	22.372		
24	Cassowary Coast (R)	21.858		
25	Richmond (S)	21.733		
26	Weipa (T)	21.420		
27	Flinders (S) (Qld)	20.617		
28	Yarrabah (S)	20.180		
29	Tablelands (R)	20.071		
30	Cloncurry (S)	17.806		
31	Burdekin (S)	16.781		
32	Whitsunday (R)	16.194		
33	Hinchinbrook (S)	15.141		
34	Charters Towers (R)	15.135		
35	Douglas (S)	14.272		
36	Mackay (R)	12.839		
37	Isaac (R)	12.837		
38	Townsville (C)	11.158		
39	Cairns (R)	11.156		

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