Accessibility of the Australian population to an ICU, and of ICUs to each other

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ABSTRACT

Objective: To use a geographic information system to qualitatively and quantitatively illustrate the geospatial relationship of the Australian population to intensive care resources.

Design, setting and participants: Intensive care unit data were sourced from the Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation critical care resources survey (2007–2008) and adult patient database (2002–2008), and postcode data (2006) from the Australian Bureau of Statistics. Remoteness was classified within remoteness categories and the Accessibility/Remoteness Index of Australia Plus. Distance was the difference between two postcode's centroids.

Results: Ninety-one public ICUs were identified. Of these, 50 (54.9%) were in a major city, 24 (26.4%) were inner regional, 15 (16.5%) were outer regional, one (1.1%) was remote and one (1.1%) was very remote, compared with 64.2%, 20.8%, 11.7%, 1.9% and 1.4% of the population, respectively ($P = 0.324$). Median population distance to the closest ICU was 35.9 km and closest Level 3 ICU was 54.8 km. This varied by state/territory, ranging from 7.6 km to the closest ICU for the Australian Capital Territory to 161.7 km for Western Australia. Overall, 84.8% of the Australian population were 0–50 km from an ICU, 12.9% were 51–300 km, 2.3% were 301–1500 km, and 0.01% were > 1500 km. This varied among the states/territories. A Level 3 ICU was the closest ICU for 65.4% of the population, a Level 2 for 27.6% and a Level 1 for 7%. Median distance between any two ICUs was 21.1 km. Generally, the distance between Level 3 ICUs was shorter than the distance to a Level 1 or Level 2 ICU.

Conclusions: The distribution of Australian ICUs and the Australian population was similar. However, accessibility varied by state/territory.

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Social inclusion and social justice are key priorities in health care provision for both governments and the World Health Organization.[1,2] Health care decisions are influenced by many factors, including cost, service type, availability and quality, distance, time and available transport to access such services, as well as medical workforce.[3-5] These factors may act as barriers to appropriate utilisation of existing health services.[6] Attempts at reform and restructuring of existing services have been implemented to meet changes in supply and demand, contain costs and improve service delivery. Regionalisation of health care to achieve economies of scale has been one such strategy, which has generated public and professional concern.[7,8] Regionalisation of health services can have outcome benefits for some patients, including adult and paediatric intensive care,[9-11] trauma[12,13] and stroke.[14]

Accessibility to health care is an important indicator of equitable health resource provision and distribution.[15] Accessibility of health services, based upon space/distance and the relative location of the population, can be explored with a geographic information system (GIS).[16,17] A GIS is a computer-based system that stores, manipulates, analyses and visualises spatial data. The integration of health-related and geographically referenced data enables users to visualise trends and relationships over space and time, and so report on the impact of policies such as those aimed at reducing health care inequalities. Examples have included evaluating regional variation in accessibility to health services (eg, primary care,[18,19] mammography,[20] acute stroke care[21]), planning for new services (eg, coronary intervention,[22] trauma[23,24]) and mapping disease (the earliest example being John Snow's 1854 map of the London cholera outbreak).

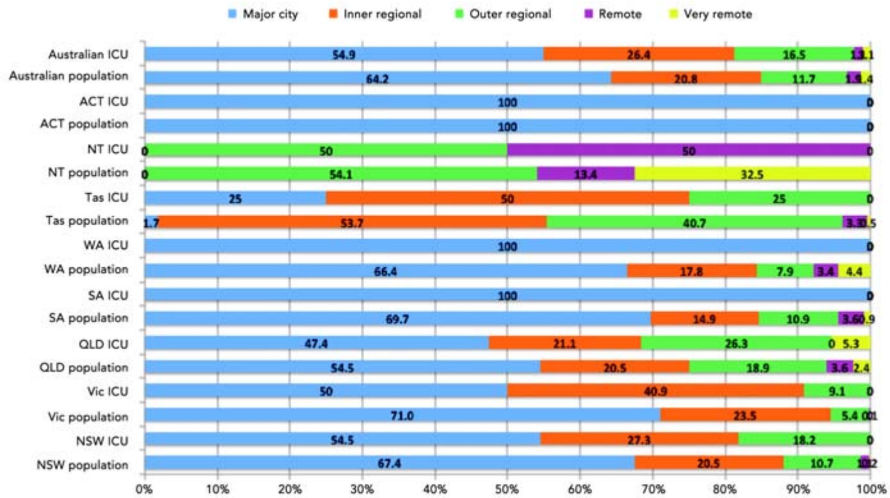
To date, the geographic comparison of resources related to intensive care units has been conducted at the level of whole-of-country comparisons, revealing wide variation in ICU beds per head of population[25] as well as number and size of ICUs.[26] However, such comparisons are crude, as health systems, geography and population distribution varies greatly between countries and provides only scant insight as to equity and accessibility.

The purpose of this study is to explore the geospatial relationship of the Australian population and ICUs, so as to qualitatively and quantitatively illustrate the population's access to ICU services, and of one ICU to another.

Methods

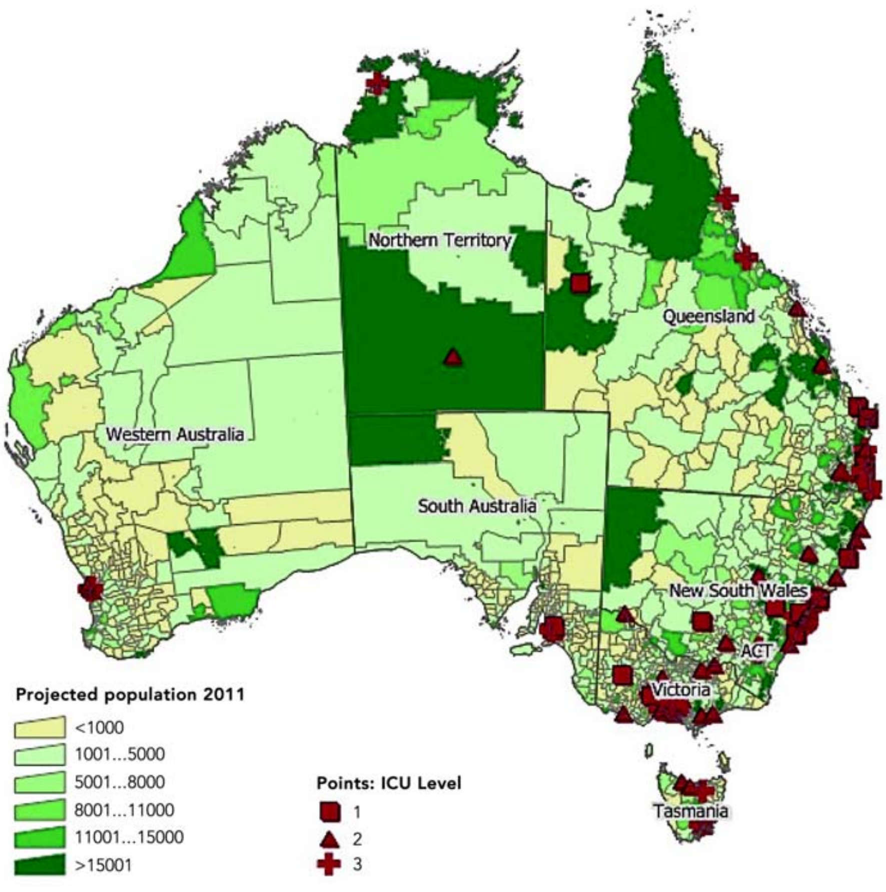
Location, descriptors and bed details of ICUs were sourced from the Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation critical care resources survey (2007–2008)[27] and adult patient database

Figure 1. Australian, regional population and intensive care unit remoteness categories



ACT = Australian Capital Territory. NT = Northern Territory. Tas = Tasmania. WA = Western Australia. SA = South Australia. Qld = Queensland. Vic = Victoria. NSW = New South Wales.

Figure 2. Projected population growth and distribution of intensive care units



(2002–2008), and Australian Bureau of Statistics (ABS) postcode data (2006). Data were integrated, analysed and mapped using GIS software (MacroHealth Solutions, Woody Point, QLD, Australia).

The geospatial reference were the Australian postcode. Distance was the distance between centroids of each postcode. Distance between population and ICUs within the same postcode was considered to be 0 km. Distances were grouped into categories, based on feasible choice of patient transport vehicle: road vehicle (0–50 km), helicopter (50–300 km), fixed-wing turbine propeller aircraft (300–1500 km) or jet aircraft (> 1500 km).

Classification of remoteness was based on the Accessibility/Remoteness Index of Australia Plus (ARIA+) (2006) and remoteness area codes, sourced from the ABS. ARIA+ is an index value (continuous variable) between 0 and 15 that represents the remoteness of a point based on the physical road distance to the nearest town or service centre in each of five population-size classes (the higher the value, the more remote). The remoteness classification groups areas into categories that have similar, but not identical, characteristics of remoteness. The ABS has five categories of remoteness: major cities, inner regional, outer regional, remote and very remote. Under this classification, no area in Victoria is classified as very remote, no area in Tasmania is a major city (Hobart is classified as inner regional), no area in the Northern Territory is a major city or inner regional (Darwin is classified as outer regional), and the entire Australian Capital Territory is classified as a major city.[28,29]

Postcode populations were based on 2006 ABS Census data. Only postcodes from mainland Australia, Tasmania, and Cocos, Christmas and Lord Howe Islands were included. Postcodes with populations of zero and those that related to a PO Box were excluded, leaving 2478 for analysis. Australian states and territories (regions) were the ACT, New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria and Western Australia.

ICUs were categorised based on the College of Intensive Care Medicine classification:[30] Level 1 (capable of immediate resuscitation and short-term cardiorespiratory support); Level 2 (provides high standard of general intensive care, including complex multisystem support, in keeping with the hospital's delineated responsibilities); or Level 3 (a tertiary referral ICU, providing multisystem, comprehensive care). Private ICUs were excluded.

Statistical analysis was performed using SPSS, version 18.0 (IBM, Armonk, NY, USA). Categorical data were analysed using the χ^2 test for comparisons; continuous data were not normally distributed and so were reported as median and interquartile range (IQR) (25% and 75% quartiles), and/or minimum and maximum. Comparative analysis was done using Kruskal–Wallis one-way analysis of variance, and Mann–Whitney and Kolmogorov–Smirnov non-parametric tests. Associations were explored using Pearson's correlation coefficient. Statistical significance was set at $P < 0.05$.

Results

We identified 143 responding ICUs. Excluding private ICUs, there were 91 (63.6%) public hospital ICUs: 42 (46.2%) Level 3, 37 (40.7%) Level 2, and 12 (13.2%) Level 1.

Distribution of ICU resources

The distribution of all ICUs was not significantly different to that of the entire Australian population, based on their postcode location, within their corresponding region (Figure 1 and Figure 2). Of Australian ICUs, 50 (54.9%) were in a major city, 24 (26.4%) were inner regional, 15 (16.5%) were outer regional, one (1.1%) was remote and one (1.1%) was very remote, compared with distributions of the Australian population of 12 707 523 (64.2%), 4 125 340 (20.8%), 2 323 739 (11.7%), 378 204 (1.9%) and 270 637 (1.4%), respectively ($P = 0.324$), and distributions of Australian postcodes of 891 (36%), 620 (25%), 657 (26.5%), 190 (7.7%) and 120 (4.8%), respectively ($P = 0.001$). These proportions differed among the regions. For example, all ICUs in SA and WA were within major city postcodes, compared with 69.7% and 66.4% of their respective populations.

The remoteness categories for ICUs differed significantly based on the ICU level, with lower levels located more remotely. Of Level 3 ICUs, 32 (76.2%) were in a major city, seven (16.7%) were inner regional, three (7.1%) were outer regional, none were remote and none were very remote, compared with Level 2 ICUs (15 [40.5%], 13 [35.1%], eight [21.6%], one [2.7%] and none, respectively) and Level 1 ICUs (three [25%], four [33.3%], four [33.3%], none and one [8.3%], respectively) ($P = 0.004$).

Hospitals within major city postcodes had significantly more ICU beds and admissions compared with other postcodes (Table 1). In contrast, inner regional, outer regional, remote and very remote postcodes were not significantly different: for hospital beds, $P = 0.180$; physical ICU beds, $P = 0.823$; available ICU beds, $P = 0.769$; ventilated ICU beds, $P = 0.725$; and total ICU admissions, $P = 0.785$. A postcode's ARIA was inversely related to its number of ICU beds and admissions. The median ARIA rating for ICU postcodes (0; interquartile range [IQR], 0–0.56) was lower than the median for Australian postcodes (1.54; IQR, 0–3.89) ($P < 0.001$).

A region's population, and not geographical size, correlated with number of hospital beds ($R = 0.980$; $P < 0.001$ v $R = -0.017$; $P = 0.969$), available ICU beds ($R = 0.990$;

Table 1. Distribution of hospital and intensive care unit beds, by remoteness category

Remoteness category	No. of ICUs	Population	Median hospital beds, (IQR)*	Median physical ICU beds, (IQR)†	Median available ICU beds, (IQR)†	Median ventilator ICU beds, (IQR)†	Median total ICU admissions, (IQR)†
Major city	50	12 707 523	417 (244–581)	12 (6–18)	10 (6–16)	11.5 (6–17)	640 (388–1259)
Inner regional	24	4 125 340	208 (149–257)	6 (4–10)	5 (3–10)	5 (3–10)	308 (131–380)
Outer regional	15	2 323 739	143.5 (98–277)	5.5 (3–7.3)	5.5 (3–7.3)	4 (2–7.3)	343 (112–482.3)
Remote and very remote	2	648 841	117 (70–164)	4.5 (2–7)	4 (2–6)	4 (2–6)	254 (166–343)
Pearson correlation with ARIA+ rating (*P*)			– 0.402 (< 0.001)	– 0.329 (0.001)	– 0.328 (0.001)	– 0.354 (0.001)	– 0.318 (0.004)

ARIA+ = Accessibility/Remoteness Index of Australia Plus. IQR = interquartile range (25%–75%). Physical ICU bed = a single patient care location fully configured to ICU standards; an actual bed (or bed equivalent), not a bed space. Available ICU bed = a bed in use or immediately available, which has advanced life support capability and is fully staffed and funded; the number of available beds cannot exceed physical beds. Ventilator ICU bed = a physical ICU bed plus a ventilator. * $P = 0.016$. † $P < 0.001$.

$P < 0.001$ v R = – 0.045; $P = 0.916$) and ventilator ICU beds (R = 0.994; $P < 0.001$ v R = – 0.053; $P = 0.900$).

Regional population and distance from an ICU

The median distance of Australian postcodes to their closest ICU was 35.9 km (IQR, 9.0–102.9 km); maximum distance was 3324.3 km (postcode 6799; population 571). Median distance to the closest Level 3 ICU was 54.8 km (IQR, 12.1–193.5 km), and maximum distance was 3324.3 km (Table 2).

Of the Australian population, 84.8% live within 0–50 km of any ICU, 12.9% within 51–300 km, 2.3% within 301–1500 km, and 0.01% > 1500 km. This varied significantly

Table 2. Distance between intensive care units and proportion of the population closest to an ICU, by region and ICU level

Region	Population	ICU level within each region (no. [%])	Median distance to closest ICU (km)	Maximum distance to closest ICU (km)	Proportion of population closest to ICU level	Total available ICU beds	ICU beds per 100 000 population
Australian Capital Territory	322 408						
Level 3		2 (100%)	7.6	30.0	100%		
Total		2 (100%)	7.6	30.0	100%	17	5.3
New South Wales	6 536 933						
Level 1		5 (15.2%)	57.1	636.4	7.8%	15	0.2
Level 2		15 (45.5%)	52.0	436.4	31.5%	80	1.2
Level 3		13 (39.4%)	6.8	224.1	60.7%	167	2.6
Total		33	23.8	636.4	100%	262	4.0
Northern Territory	193 051						
Level 2		1 (50%)	308.3	453.9	14.1%	6	3.2
Level 3		1 (50%)	47.3	623.6	85.9%	8	4.2
Total		2	63.2	623.6	100%	14	7.4
Queensland	3 889 023						
Level 1		5 (26.3%)	28.4	638.7	15.0%	12	0.3
Level 2		7 (36.8%)	68.3	732.8	33.4%	36	0.9
Level 3		7 (36.8%)	18.2	786.4	51.5%	90	2.3
Total		19	36.1	786.4	100%	138	3.5
South Australia	1 509 229						
Level 1		1 (16.7%)	20.3	222.7	16.7%	2	0.1
Level 2		2 (33.3%)	115.0	683.2	34.0%	14	0.9
Level 3		3 (50%)	15.2	738.7	49.3%	58	3.8
Total		6	53.4	738.7	100%	74	4.8
Tasmania	475 515						
Level 2		2 (50%)	37.7	178.6	24.9%	5	1.0
Level 3		2 (50%)	31.1	195.1	75.1%	16	3.3
Total		4	31.7	195.1	100%	21	4.3
Victoria	4 925 541						
Level 1		1 (4.5%)	83.5	151.1	1.2%	2	0.04
Level 2		10 (45.5%)	43.4	248.5	30.8%	45	0.9
Level 3		11 (50%)	10.0	89.1	68.0%	148	3.0
Total		22	32.2	248.5	100%	195	4.0
Western Australia	1 953 743						
Level 3		3 (100%)	161.7	1358.5	100%	52	2.7
Total		3	161.7	1358.5	100%	52	2.7
Australia	19 805 443						
Level 1		12 (13.2%)	60.0	638.7	7.0%	31	0.2
Level 2		37 (40.7%)	52.6	1045.9	27.6%	186	0.9
Level 3		42 (46.2%)	19.7	3324.3	65.4%	556	2.8
Total		91	35.9	3324.3	100%	773	3.9

among the regions and ICU levels. The proportion of the Australian population within 50 km of a Level 3 ICU was 74.6%, and ranged from 100% in the ACT to 53.7% in the NT ($P < 0.001$), while 11.6% of the Australian population was more than 300 km from a Level 3 ICU, ranging from 34.6% in the NT to none in the ACT (Table 3).

A Level 3 ICU was the closest ICU for 65.4% of the Australian population, a Level 2 ICU was closest for 27.6%, and a Level 1 ICU was closest for 7%. Closeness to a Level 3 ICU also varied significantly among the regions, ranging from 100% in the ACT to 49.3% in SA (Table 2).

There was a significant correlation between a region's geographical area and median ARIA+ with the population's median distance from any ICU ($R = 0.793$; $P = 0.019$ and $R = 0.798$; $P = 0.017$) and from a Level 3 ICU ($R = 0.750$; $P = 0.032$ and $R = 0.778$; $P = 0.023$), but not the size of the population ($R = -0.313$; $P = 0.451$ v $R = -0.256$; $P = 0.541$). There was no significant correlation between a region's number of ICU beds, or ICU beds per population, with the population's distance to any ICU ($R = -0.289$; $P = 0.49$ v $R = -0.371$; $P = 0.34$) or to a Level 3 ICU ($R = -0.004$; $P = 0.99$ v $R = 0.033$; $P = 0.94$).

Table 3. Regional area, ARIA+ rating and distance to closest intensive care unit and Level 3 ICU

Region	Land area (km^2)	Median ARIA+ rating (IQR)*	Distance category (km)	Population (%) within distance category to closest ICU	Population (%) within distance category to closest Level 3 ICU
Australian Capital Territory	2358	0	0–50	100	100
New South Wales	800 642	0.40 (0–2.87)	0–50	86.9	75.5
			51 – 300	12.5	22.3
			301 – 1500	0.6	2.2
			> 1500	0	0
Northern Territory	1 349 129	6.06 (3.09–12.63)	0–50	54.1	39.9
			51–300	25.1	11.1
			301–1500	20.9	35.1
			> 1500	0	13.9
Queensland	1,730,648	1.89 (0.01–5.49)	0–50	82.7	67.7
			51–300	14.3	21.9
			301–1500	3.1	10.4
			> 1500	0	0
South Australia	983 482	1.37 (0–4.46)	0–50	77.5	77.9
			51–300	21.1	20.2
			301–1500	1.4	1.8
			> 1500	0	0
Tasmania	68 401	3.02 (2.2–4.75)	0–50	82.7	52.6
			51–300	17.4	47.4
			301–1500	0	0
			> 1500	0	0
Victoria	227 416	1.09 (0–2.35)	0–50	91.3	79.8
			51–300	8.7	19.2
			301–1500	0	1.0
			> 1500	0	0
Western Australia	2 529 875	3.55 (0.10–7.11)	0–50	73.4	73.8
			51–300	14.8	14.6
			301–1500	11.7	11.5
			> 1500	0.01	0.01
Australia	13 588 524	1.42 (0–3.81)	0–50	84.8	74.6
			51–300	12.9	20.7
			301–1500	2.3	4.6
			> 1500	0.01	0.1

ARIA+ = Accessibility/Remoteness Index of Australia Plus. IQR = interquartile range. * $P < 0.01$

Distances between ICUs

The median distance between any two Australian ICUs was 21.1 km (IQR, 7.8–82.5). This varied significantly among the regions (Table 4). For all regions other than Tasmania, the median distance between Level 3 ICUs was shorter than the median distance from a Level 3 to a Level 1 ICU. Among Level 1 ICUs, five (41.7%) were within 50 km of their closest Level 3 ICU, whereas five (41.7%) were within 51–300 km and two (16.7%) were within 301–1500 km of their closest Level 3 ICU. This compares with 15 (40.5%), 18 (48.6%) and four (10.8%) Level 2 ICUs, and 30 (71.4%), 11 (26.2%) and no Level 3 ICUs, respectively ($P = 0.009$).

A region's geographical and population size had no significant correlation with the distance between any two ICUs ($R = 0.157$; $P = 0.710$ and $R = -0.397$; $P = 0.331$). The size of a region's population correlated with the number of ICUs ($R = 0.982$; $P < 0.001$) but not with the region's proportion of ICUs that were Level 3 ($R = -0.494$; $P = 0.214$) or total available ICU beds ($R = -0.290$; $P = 0.486$).

Discussion

Our study's findings demonstrate the regionalisation of Australian ICU resources, particularly higher-level resources. Using a GIS to map and analyse geocoded Australian ICU and population data highlighted similarities in their distributions, both being located predominantly along the coastline, but with regional variations. Almost 85% of the Australian population is within 50 km of an ICU, and for 65% of the Australian population, the closest ICU was a Level 3. Level 3 ICUs were concentrated, being closer to each other than to a Level 1 or Level 2 ICU. Based on distance alone, for the majority of interhospital transfers from a lower to a higher Level ICU, an aircraft was the most appropriate mode of travel.

ICU level and the number of ICU and hospital beds declined as the ARIA+ rating increased. However, these measures were similar across the inner/outer regional and remote categories, suggesting that ICU regionalisation is predominantly within the major city category. For 35% of the Australian population, the closest ICU is a Level 1 or 2,

Table 4. Shortest distance between different levels of intensive care units, by region

Region	From ICU level	To ICU level	No. of ICUs	Distance (km) Median*	Minimum	Maximum
Australian Capital Territory	Level 3	Level 3	2	12.0	12.0	12.0
New South Wales	Level 1	Level 3	5	92.6	20.1	312.5
	Level 2	Level 3	15	90.5	6.3	275.2
	Level 3	Level 3	13	10.9	4.0	62.2
	Any ICU	Any ICU	33	21.9	4.0	198.0
Northern Territory	Level 2	Level 3	1	1298.0	1298.0	1298.0
Queensland	Level 1	Level 3	5	153.0	8.2	862.1
	Level 2	Level 3	7	31.3	2.2	447.8
	Level 3	Level 3	7	66.3	4.9	289.4
	Any ICU	Any ICU	19	27.8	2.2	597.3
South Australia	Level 1	Level 3	1	13.7	13.7	13.7
	Level 2	Level 3	2	11.6	2.5	20.7
	Level 3	Level 3	3	7.7	7.7	9.8
	Any ICU	Any ICU	6	7.7	2.5	9.9
Tasmania	Level 2	Level 3	2	85.2	55.7	114.8
	Level 3	Level 3	1	162.7	162.7	162.7
	Any ICU	Any ICU	3	57.4	55.7	162.7
Victoria	Level 1	Level 3	1	177.3	177.3	177.3
	Level 2	Level 3	10	137.5	1.6	336.8
	Level 3	Level 3	11	9.6	3.2	78.1
	Any ICU	Any ICU	22	16.7	1.6	78.2
Western Australia	Level 3	Level 3	3	6.7	6.7	9.1
Australia	Level 1	Level 3	12	122.5	8.2	862.1
	Level 2	Level 3	37	97.6	1.6	1298.0
	Level 3	Level 3	42	9.8	3.2	289.4
	Any ICU	Any ICU	91	21.1	1.6	1246.9

* $P < 0.001$ for comparison of median distances from any ICU to any ICU between the regions.

which are smaller, more remote, generally do not provide the complete range of clinical services, and thus are more likely to require the transfer of a patient to a higher level ICU.[31,32] Most such transfers are within the capacity of a road vehicle, as 75% of the population and almost half of all Level 1 and 2 ICUs are within 50 km of a Level 3 ICU. However, for 5% of the population and 12% of the non-Level 3 ICUs, transport to a Level 3 ICU necessitates, based on distance alone, fixed wing aircraft, and for an intermediate number, a helicopter or prolonged road transport. In contrast, transfers of patients between Level 3 ICUs, typically due to lack of bed availability, are not infrequent,[33] occur over a shorter distance, and are achievable by road transport. These findings suggest that ICU-to-ICU inter-hospital patient transfers by air are likely to be from lower to higher ICU levels, and are potentially of greater clinical complexity than transfers to equivalent ICUs by road.

There was regional variation in access to ICUs, particularly higher-level ICUs. A region's geography and remoteness correlated with distance to an ICU, and its population size correlated with total number of hospital/ICU beds but not with ICU beds per population. For example, all the population of the ACT and over 90% of Victoria (both geographically smaller regions) were within 50 km of an ICU, whereas the populations of WA, SA and the NT (all with large geographies and sparsely populated interiors) had less access to an ICU. In contrast, NSW and Queensland (both large but with a more populated interior) had an intermediate level of population access to ICUs. Thus, the challenge of providing equitable population access to ICUs is likely to vary by region, as may the effect upon patient outcome. Similarly, the type and potential efficacy of strategies and infrastructure necessary to promote equitable access (eg, transport services,[31,34] telehealth,[35] critical care networks[35]) is likely to vary among the regions. The relationship of access and patient outcomes[36] and the efficacy of strategies to ameliorate inequity need further evaluation, particularly within each region's environment.

In keeping with the regionalisation of ICUs, there was no correlation between a region's geographical and population size with the distance between any ICU. Although the number of ICUs correlated with population size, the proportion of ICUs that were Level 3 and the number of beds per population did not correlate with population or geography, and differed significantly among the regions. Further exploration is required to account for this regional variation in ICU resources.

This study highlights the utility of a GIS to integrate, and to qualitatively and quantitatively illustrate, ICU resources and geopolitical information. It provides a baseline measure of the Australian population's accessibility to ICU resources. Such information can be used to inform current and assist with future planning of location and distribution of ICU and patient transport resources. The study also showed that measures of accessibility change with time. Health planners can use measures of accessibility to monitor the impact of any future policy initiatives (eg, health service regionalisation, disaster planning, etc) or to monitor and respond to any alterations in population and/or health resources that may occur over time. Ideally, accessibility should be linked to patient outcomes. This could be achieved by combining geocoded patient demographic and health services information, as we have done, with patient illness and outcome data. In doing so, GIS could be used to "map" the patient's geographic and temporal journey from illness/injury onset until time of resolution.

The accuracy of this analysis is influenced by the accuracy, precision and timeliness of the geocoded information. Our ICU dataset was large and reliable.[37] We chose available population data, which although collected independently, was from a similar time period. The ICU data had been collected without the intention of future GIS analysis, so we were restricted to postcode locations. Our distance measurements were based on centroids of postcodes, which are less accurate than other more precise measures of physical location. The use of centroids, however, is an accepted method, particularly for whole-of-population measures.[38] This information is time dependent, as future population changes not only alter their geographical distribution but also a postcode's ARIA+ and remoteness category,[28] as will future changes in ICU levels.

In summary, our findings suggest that across Australia, the distribution of ICU resources reflects that of the population, although accessibility to ICUs varies between regions. There is regionalisation, particularly among the higher level ICUs. Across all regions, air transport is required, based on distances between ICUs. This type of information, derived through the use of GIS technology, is useful to evaluate current and plan for future resource utilisation, as well as to monitor the impact of changes in population or service provision over time.

Competing interests

None declared.

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