Prevalence of surgery in Indigenous people with cancer: a systematic review and meta-analysis

Saira Sanjida,[a,] Gail Garvey,[b] Roxanne Bainbridge,[c] Abbey Diaz,[b,d] Federica Barzi,[a] Sherry Holzapfel,[e] Michael Y. Chen,[f] Harry Collin,[g] Yaqoot Fatima,[h] Xiang-Yu Hou,[i] and James Ward[a]*

[a]Poche Centre for Indigenous Health, Faculty of Health, Medicine and Behavioural Sciences, The University of Queensland, Queensland, Australia
[b]School of Public Health, Faculty of Health, Medicine and Behavioural Sciences, The University of Queensland, Queensland, Australia
[c]Indigenous Future Centre, Faculty of Business, Economics and Law, The University of Queensland, Queensland, Australia
[d]Yardhura Walani National Centre for Aboriginal and Torres Strait Islander Wellbeing Research, The Australian National University, Australian Capital Territory, Australia
[e]Aboriginal and Torres Strait Islander Health, Metro North Hospital and Health Service, Queensland, Australia
[f]School of Medicine, Faculty of Health, Medicine and Behavioural Sciences, The University of Queensland, Queensland, Australia
[g]Royal Brisbane and Women's Hospital, Queensland, Australia
[h]Thompson Institute, University of the Sunshine Coast, Queensland, Australia
[i]Broken Hill University Department of Rural Health, The University of Sydney, New South Wales, Australia

The Lancet Regional Health - Western Pacific 2025;57: 101527

https://doi.org/10.1016/j.lanwpc.2025.101527

Summary

Background As cancer incidence increases globally, so does the prevalence of cancer among Indigenous peoples. Indigenous peoples face significant barriers to healthcare, including access to and uptake of surgery. To date, the synthesis of access to and uptake of surgery for Indigenous peoples living with cancer has not yet been reported.

Methods We conducted a systematic literature review and meta-analysis of access to and uptake of surgery for Indigenous peoples in Canada, Australia, New Zealand, and the United States. Five databases were searched to identify studies of Indigenous adults with cancer and those who received surgery. The Joanna Briggs Institute critical appraisal tools were used to assess the quality and inclusion of articles. Random effect meta-analyses were conducted to estimate the pooled prevalence of surgery in Indigenous people with cancer.

Findings Of the 52 studies in the systematic review, 38 were included in the meta-analysis. The pooled prevalence of surgery in Indigenous people with cancer was 56.2% (95% confidence interval (CI): 45.4–66.7%), including 42.8% (95% CI: 36.3–49.5%) in the Native Hawaiian population, 44.5% (95% CI: 38.7–50.3%) in the Inuit and 51.5% (95%CI: 36.8–65.9%) in Aboriginal and Torres Strait Islander people. Overall, Indigenous people received marginally less cancer surgery than non-Indigenous people (3%, 95% CI: 0–6%). Indigenous people were 15% (95% CI: 6–23%) less likely to receive surgery than non-Indigenous people for respiratory cancers. Remoteness, travel distance, financial barriers, and long waiting times to receive surgery were factors cited as contributing to lower access to surgery for Indigenous people compared to non-Indigenous people.

Interpretation Efforts to improve access and use of cancer services and surgery for Indigenous peoples should be multilevel to address individual factors, health services and systems, and structural barriers. These determinants need to be addressed to expedite optimal care for Indigenous peoples, especially those living in outer metropolitan areas.

Funding The Research Alliance for Urban Goori Health (RAUGH) funded this project. GG was funded by an NHMRC Investigator Grant (#1176651).

Keywords: Surgery; Cancer; Health system; Health services; Indigenous people; Social determinants; Systematic review; Meta-analysis

---

*Corresponding author.
E-mail address: s.sanjida@uq.edu.au (S. Sanjida).

Research in context

Evidence before this study

Variations in healthcare service delivery models and cancer types meant that the existing literature presented inconclusive evidence on inequities in access to cancer surgery among various Indigenous populations.

To systematically identify the surgical prevalence between Indigenous and non-Indigenous people with cancer and the contributing factors, we searched five databases (PubMed, CINAHL, Scopus, Web of Science, and Embase) for publications to June 15, 2024, using the main keywords ('Indigenous people' AND 'surgery' AND 'cancer'). Fifty-two studies were included in the systematic review and 38 in the meta-analysis. The pooled prevalence of surgery in Indigenous people with cancer was 56.2% (95% CI: 45.4–66.7%). The prevalence of surgery was higher in Indigenous people in the USA (59.3%, 95% CI: 46.3–71.6%) and New Zealand (59.2%, 95% CI: 29.6–85.6%) compared to Australia (51.5%, 95% CI: 36.8–65.9) and Canada (44.5%, 95% CI: 36.8–65.9%). The difference in surgical treatment was 15% less receiving surgery towards Indigenous people with respiratory system cancer. Remoteness, travel distance, lack of health funds and long waiting times for surgery were the main barriers to accessing surgery for Indigenous people.

Added value of this study

This study provides the latest global and systematic evidence of the surgery prevalence for cancer treatment for Indigenous people. Indigenous people received less surgery for cancer due to individual factors, health services and systems, as well as structural barriers.

Implications of all the available evidence

Health system-wide changes are required to improve healthcare service delivery from diagnosis to surgery to close further the gap in access to surgery for Indigenous people with cancer. Changes could include supporting patients to navigate the system and coordinate their surgical care. From policymakers to leaders within Indigenous communities, all must collectively work using co-design strategies to significantly improve the healthcare service outcomes of Indigenous populations with cancer.

Introduction

Cancer is a leading cause of fatal and non-fatal disease burden globally. It is estimated that the number of new cancer cases will increase from 19.3 million in 2020 to 29.4 million worldwide by 2040, with over one in five people being diagnosed with cancer in their lifetime.[1–5] Surgery is used to remove primary and metastatic cancer; the global demand for cancer surgery is predicted to increase by 50% from 2018 to 2040.[1] However, access to surgical care for cancer treatment is unequal between and within countries and between populations.[1] Only one-quarter of people with cancer worldwide were able to afford and receive safe or timely surgery for cancer treatment in 2015.[6] The reported reasons include access to and availability of surgical services.[2,3,6]

Inequitable access to cancer surgery among Indigenous people has previously been reported.[7–9] The reasons for lower cancer surgery among Indigenous people are multi-faced, and they may include access to cancer and surgical services, particularly in regional and remote areas,[10] late diagnosis,[10] differential practices across the public and/or private healthcare systems,[11] poor communication among patients and healthcare professionals,[10] collaboration among healthcare professionals and care coordination,[12] institutional racism,[13,14] affordability (including insurance status, costs, travel costs),[15] culturally safe workforce[16] and perceived lack of privacy and cultural safety in the healthcare service.[13,14] However, the synthesis of data to show the overall prevalence of access to surgery among Indigenous people with cancer, relative to non-Indigenous people, has not yet been undertaken. Previous studies have found wide variation in uptake of surgery prevalence among Indigenous peoples, dependent on cancer type, ranging from 5.5%[17] in lung cancer to 91.7%[18] in breast cancer. Further, differences have also been shown for the uptake of surgery between Indigenous and non-Indigenous peoples, such as prostate cancer (39.1% vs. 53.5%, respectively).[19] These proportion differences could be due to differences in cancer types,[18] patient groups,[20,21] health systems,[22] and study sample size.[22,23] This makes it difficult to comprehensively understand the real-world situation of access to surgery among Indigenous people with cancer.

This review is part of the research collaboration, the Research Alliance for Urban Goori Health (RAUGH),[24] a partnership of the University of Queensland Poche Centre for Indigenous Health, Metro North Hospital and Health Services (tertiary healthcare service provider) and the Institute for Urban Indigenous Health (community controlled healthcare service provider). A co-design approach, community engagement, and consultation with Indigenous members helped to explore the current research gaps.[25] Cancer and surgery are two major priority areas identified by health services collaborators.[24] This systematic review and meta-analysis were conducted to determine the surgical prevalence of cancer for Indigenous peoples and to identify the healthcare service gaps and barriers to surgery access for cancer patients. The primary value of the review is that the results will be used to inform the direction of healthcare policy and/or practice at the local community service provider level and potentially for health service providers in other countries.

The team applied a critical decolonising approach to assessing the evidence in the review.[25] Critical decolonising approaches are not about '*rejecting all theory or research or Western knowledge. Rather, they are about centreing our [Indigenous] concerns and world views and then coming to know and understand theory and research from our own [the perspectives of Indigenous peoples that are useful] perspectives and for our own purposes*' (page 39).[26] This review aimed to build upon existing knowledge and develop a counter-narrative to Western analyses with relevance, practical application and vision for Indigenous nations.[27] We intended to uncover and consider how colonial ideologies and power dynamics prevail and continue to shape the experiences of cancer care and access to surgical procedures for Indigenous peoples and communities.

Pragmatically, several key strategies ensured the integrity of the application of this approach.[25] Firstly, the research areas were instigated by partnering with Indigenous community-controlled health services and providers. Second, we targeted literature that reflected diverse perspectives of Indigenous nations – hence the inclusion of Canada, Australia, New Zealand, and the United States (CANZUS). Third, we reflected on the positionality and potential biases of the team and included different perspectives in the authorship team, including four senior Aboriginal leaders and authors who inherently bring a critical decolonising lens to the work. Finally, in assessing the literature, we considered how Western philosophies and practices could influence the research questions and aims, methods, and interpretations offered in the papers, thus, knowledge production more broadly.

Methods

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines,[28] and the protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42022364660).

Search strategy and selection criteria

Five databases (PubMed, CINAHL, Scopus, Web of Science, and Embase) were used to identify studies exploring surgical cancer treatment in Indigenous people (Supplementary Table S1). After consultation with an experienced librarian, the key Medical Subject Heading terms and keywords used to identify relevant studies were applied. Studies published until June 15, 2024, were assessed for eligibility using EndNote X9.[29]

Studies were eligible for inclusion following PICO methods if they reported the number of adult Indigenous people who underwent surgical treatment for cancer or compared the prevalence of Indigenous with non-Indigenous cancer patients. No limits were placed on the studies regarding patient clinical characteristics, including cancer type and stage of cancer at diagnosis. Studies were selected from the four countries, who are all signatories to the United Nations Declaration on the Rights of Indigenous Peoples, that Indigenous peoples have a right to access healthcare without discrimination.[30] The CANZUS nations have all been colonised, and in the process, Indigenous traditional healthcare systems have been replaced by colonial settler healthcare systems as the dominant form of healthcare. Variations between the four nations exist in geographical settings and the cultural diversity of Indigenous peoples, but a similarity to all is the deep cultural beliefs about peoples' connection to and belonging to the country, which intimately relates to health and wellbeing.[30,31]

The review included cross-sectional, cohort, and other epidemiological studies but excluded clinical trials and ecological study designs. Qualitative, case, and case-series studies were also excluded, as were studies that did not report original research findings (e.g., commentaries, reviews, and study protocols). Only English language studies were included. Studies that reported on children and/or adolescents (<18 years) were excluded as the prevalence of surgery and the factors that affect access and receipt of surgery are thought to be vastly different to that for adult cancer patients.[32]

One author (SS) systematically assessed the identified studies against the eligibility criteria. Initially, titles and abstracts were assessed to remove duplicates. The remaining studies were retrieved and evaluated against the eligibility criteria. The reference lists of the included studies and relevant review studies were searched manually for additional eligible studies. A second author (XH) checked the reasons for including and excluding studies at every screening step. Any disagreement regarding eligibility was resolved through discussion (SS and XH). Studies that reported data from the same study participants for different but relevant study outcomes (such as healthcare service outcomes) were included in the systematic review. For these studies, the one with the largest sample size and more cancer types was selected for inclusion in the meta-analysis. For example, the study by Banham et al., 2019[33] which included participants with different cancer types, was included in this meta-analysis. In contrast, the study by Banham et al., 2019[34] which contained only breast cancer patients from the same overall cohort, was excluded from the meta-analysis.

Data extraction

Data pertaining to study and participant characteristics, absolute measures of cancer surgery prevalence, and factors associated with an unequal prevalence of cancer surgery were extracted from the included studies and presented in Supplementary Table S2. An author (SS) developed an Excel spreadsheet with a random sample (study number, n = 5) of the included studies. Once the data extraction structure (including study and patient characteristics and the personal and health system factors contributing to the variation between Indigenous and non-Indigenous people) was completed, one author (SS) extracted data from the remaining studies. A second author (XH) extracted data from a 10% sample of the included studies, and discrepancies in the data extraction were low and resolved by discussion. A third author (FB) checked the data used for the meta-analyses.

Quality assessment

A critical appraisal tool for prevalence studies was used to assess the quality of the included studies.[35] It consists of nine questions with four rating scales, yes, no, unsure and not applicable (Supplementary Table S5). The 'yes' response was rated as '1', and the rest were '0'. The total quality score (number of 'yes' answers) is presented in Table 1, including the study and patient characteristics. Two authors (XH and SS) appraised the studies using this tool and resolved discrepancies through discussion.

Meta-analysis

STATA software Version 18.0 (StataCorp, College Station, Texas, USA) was used for the analyses. The *metaprop* command was used to generate the pooled prevalence of surgery in Indigenous people.[41] Random effect meta-analysis models were used to synthesise the prevalence estimates from different studies and explore heterogeneity between studies. The Freeman-Tukey double arcsine transformation was performed using back-transformation on the overall pooled estimates.[41] The *metan* command was used to perform random effect meta-analyses of the prevalence ratio of cancer surgery comparing Indigenous vs. non-Indigenous people. The random-effects inverse-variance model of DerSimonian-Laird was used.[42] A forest plot graphically displayed the individual and pooled estimates of the studies with a corresponding 95% confidence interval (CI). Measures of heterogeneity between studies were presented in the forest plot, including Cochran's Q test and Higgins's I^2 test statistic (quantifying respectively the amount and percentage of between studies variation due to true heterogeneity rather than sampling error), and the 95% predictive interval and its variance Tau^2 (measuring how trustworthy the pooled effects are).[43] Leave-one-out meta-analyses were performed to investigate each study's influence on the overall estimate. Sub-group analyses were carried out to determine whether studies and patient characteristics were associated with the variation in the prevalence of cancer surgery. A funnel plot visually evaluated the publication bias of the included studies in the meta-analysis.[44]

Role of the funding source

The funder of the study had no direct or indirect role in the study design, data collection, data analysis, interpretation, or manuscript writing.

Results

Study selection

A PRISMA flow diagram of the inclusion of studies is presented in Fig. 1. In total, 963 studies were retrieved from database searches and 36 from a manual search of reference lists. After removing duplicates, the titles and abstracts of 611 studies were screened, and 146 full-text studies were assessed against the eligibility criteria. Finally, 52 studies were included in the systematic review.[17–23,33,34,36–40,45–81]

A total of 38 out of 52 studies were selected for meta-analysis, with the remaining excluded due to complete or partially duplicated data (Table 1, Fig. 1). Of the studies included in the meta-analysis, 34 reported information for Indigenous and non-Indigenous people who received cancer surgery and were included in the meta-analysis of the prevalence ratio. The remaining four studies included prevalence data for Indigenous people only.[46,52,56,58] Four studies[18–21] presented the proportion of surgery data according to two or three types of cancer (e.g., lung, breast and bowel cancer in Fitzadam et al., 2021 study[20]). For these studies,[18–21] surgery prevalence data for each specific cancer was extracted, included in the meta-analysis and shown as a separate 'study' in the forest plot. Therefore, the total number of studies included in the meta-analysis (forest plot) was 44 (Fig. 2, Table 2), and 40 studies (Table 3, Supplementary Fig. S1) presented the prevalence ratio for Indigenous and non-Indigenous people.

Meta-analysis: the pooled prevalence of surgery in Indigenous and non-Indigenous people

The meta-analysis of cancer surgery prevalence (Fig. 2) showed substantial variance between studies (56.2%, study prevalence ranged between 5.5% and 97.2%) primarily due to study heterogeneity (I^2: 99.6%). The 95% prediction intervals indicated that the true pooled prevalence estimates ranged between 1% and 100%. After removing the studies where the outcome was all types of cancer,[33,46,56,63] the overall pooled prevalence did not materially change (Table 2). The prevalence ratio meta-analysis indicates that Indigenous people were marginally less likely (3%, 95% CI: 0–6%) than non-Indigenous people to receive cancer surgery (Table 3, Supplementary Fig. S1).

Between studies, heterogeneity was high, and the true pooled prevalence ratio estimate ranged between 0.86 and 1.09, indicating the need for caution in interpreting the pooled estimate. After excluding the studies that reported all types of cancer,[33,63] there was also a 3% lower likelihood of receiving surgery (prevalence ratio: 0.97, 95% CI: 0.95–1.00) for Indigenous compared to non-Indigenous patients (Table 3).

The symmetrical funnel plot (Supplementary Fig. S2) showed no evidence of publication bias on reported cancer prevalence and use of surgery. Supplementary Fig. S3 indicated that small studies with large effect sizes might be more likely to be

Author-Year, Timeline[a]	State/Region/Province, Country	Indigenous people in CANZUS nations	Indigenous people		Non-Indigenous people[b]		Cancer type	Quality score
			Total number	Surgery received N (%)	Total number	Surgery received N (%)		
Retrospective data collected study								
1. Abdel-Rahman- 2021, 2010–2015	USA	American Indian/Alaska Native	11	1 (9.1)	1592	225 (14.1)	Colorectal	8
2. Asmis-2015, 2000–2010	Baffin region, Canada	Inuit	216	82 (38.0)	NC	NC	All	8
3. Bartholomew-2023, 2010–2015	Auckland, Waikato, Wellington, Christchurch, New Zealand	Māori	465	89 (19.1)	5055	1139 (22.5)	Breast	8
4. Seneviratne-2014, 2005–2010	Waikato, New Zealand	Māori	226	186 (82.3)	1159	1023 (88.3)	Breast	8
5. Seneviratne-2015, 1999–2012	Waikato, New Zealand	Māori	287	120 (41.8)	1853	631 (34.0)	Breast	8
6. Tin Tin- 2018, 2000–2014	Auckland, Counties Manukau, Waitemata, Waikato, New Zealand	Māori	1283	1173 (91.4)	12,387	11,557 (93.3)	Breast	8
7. Basnayake-2020, 2010–2014	Northern Territory, Australia	Aboriginal and Torres Strait Islander	91	5 (5.5)	226	37 (16.4)	Lung	7
8. Chen-2021, 2004–2015	USA	Native American	81	32 (39.5)	14,425	5359 (37.1)	Larynx	8
9. Cruz-2022, 2004–2016	USA	American Indians/Alaska Natives	1017	939 (92.5)	237,124	218,578 (92.2)	Renal	8
10. Gachupin-2022, 2007–2016	Arizona, USA	American Indians/Alaska Natives	319	275 (86.1)	4587	4230 (92.2)	Renal	8
11. Cueto-2011, 1992–2003	USA	Native American	1188	712 (59.9)	184,792	120,854 (65.4)	Colorectal	8
12. Dalwadi-2019, 2004–2012	USA	American Indian	198	114 (57.6)	61,920	41,096 (66.3)	Lung	8
13. Schoephoerster-2023, 2004–2017	USA	American Indians/Alaska Natives	613	380 (62.0)	195,736	129,214 (66.0)	Lung	8
14. Dockery-2018, 1997–2016	Oklahoma, USA	American Indian	55	32 (58.2)	NC	NC	Cervical	6
15. Fang-2020, 2010–2015	USA	American Indian/Alaska Native	337	313 (92.9)	101,227	95,640 (94.5)	Bladder	6
16. Fesinmeyer-2010, 1973–2006	USA	American Indian/Alaska Native	1050	266 (25.3)	197,896	62,443 (31.5)	Lung	8
17. Smith-2011, 1988–2006	USA	American Indian/Alaska Native	274	188 (68.6)	68,864	51,577 (74.9)	Lung	8
18. Fitzadam-2021, 2009–2012	New South Wales, Australia	Aboriginal and Torres Strait Islander	230	27 (11.7)	8597	1363 (15.9)	Lung	8
			191	168 (88.0)	13,255	11,742 (88.6)	Breast	
			166	139 (83.7)	12,163	9994 (82.2)	Bowel	
19. Freeman-2024, 2004–2020	USA	American Indian/Alaska Native	101	6 (5.9)	30,671	1083 (3.5)	Lung	8
20. Herbach-2023, 2000–2017	USA	American Indian/Alaska Native	890	790 (88.8)	214,715	196,781 (91.6)	Lung	8
21. Garvey-2018, 2010–2012	Queensland, Australia	Aboriginal and Torres Strait Islander	155	103 (66.5)	NC	NC	All	8
22. Gibberd-2016, 2001–2010	New South Wales, Australia	Aboriginal and Torres Strait Islander	120	37 (30.8)	6757	2666 (39.5)	Lung	8
23, 24. Gurney-2022,[c] 2007–2019	New Zealand	Māori	866	290 (33.5)	2460	676 (27.5)	Liver	8
			953	384 (40.3)	3192	990 (31.0)	Stomach	8
25, 26. Gurney- 2024,[c] 2007–2019	New Zealand	Māori	5601	762 (13.6)	22,268	3849 (17.3)	Lung	8
								8
27, 28. Hall-2004,[c] 1982–2001	Western Australia, Australia	Aboriginal and Torres Strait Islander	64	25 (39.1)	14,123	7557 (53.5)	Prostate	7
			274	26 (9.5)	12,439	1542 (12.4)	Lung	8
29. Hill-2010, 1996–2003	New Zealand	Māori	301	286 (95.0)	328	312 (95.1)	Colon	8
30. Lanier-1987, 1980–1985	Alaska, USA	Alaskan Native	19	7 (36.8)	NC	NC	Liver	5
31. Lawrenson-2020, 2011–2018	Waikato, Lakes, Bay of Plenty, Tairawhiti, New Zealand	Māori	169	67 (39.6)	414	205 (49.5)	Lung	8
32. Li-2003, 1992–1998	USA	American Indian	322	304 (94.4)	124,612	120,146 (96.4)	Breast	8
33. Liu-2004, 1995–2001	USA	Native Hawaiian	229	98 (42.8)	1165	615 (52.8)	Lung	8
34. Liu-2019, 1973–2014	USA	American Indian/Alaska Native	600	444 (74.0)	56,421	44,921 (79.6)	Gastric	8
35. Sharan-2024, 2004–2014	USA	Native American	643	393 (61.1)	164,406	105,134 (63.9)	Gastric	8
36. Popp-2024, 2004–2019	USA	Native American	1204	984 (81.7)	277,914	230,069 (82.8)	Rectal	8
37. Ramsey-2010, 1997–2003	Washington, USA	American Indians/Alaska Natives	218	200 (91.7)	19,700	17,399 (88.3)	Breast	8
			99	59 (59.6)	5930	4218 (71.1)	Colorectal	
			119	17 (14.3)	7558	1697 (22.5)	Lung	
38. Schiefelbein-2022, 2004–2017	Wisconsin, USA	Native American	53	11 (20.8)	8437	1723 (20.4)	Pancreas	8
39. Shaw-2003, 1996–2001	Far North Queensland, Australia	Aboriginal and Torres Strait Islander	18	16 (88.9)	143	142 (99.3)	Breast	6
40. Supramaniam-2014, 2001–2007	New South Wales, Australia	Aboriginal and Torres Strait Islander	288	245 (85.1)	27,562	24,501 (88.9)	Breast	8

(Table 1 continues on next page)

Author-Year, Timeline[a]	State/Region/Province, Country	Indigenous people in CANZUS nations	Indigenous people		Non-Indigenous people[b]		Cancer type	Quality score
			Total number	Surgery received N (%)	Total number	Surgery received N (%)		
(Continued from previous page)								
41. Taylor-2022, 2007–2016	USA	American Indians/Alaska Natives	502	220 (56.6)	21,464	9858 (45.9)	Head and neck	8
42. Tomita-2016, 2006–2013	South Australia, Australia	Aboriginal and Torres Strait Islander	14	6 (42.8)	2851	785 (27.5)	Colorectal	6
43. Weir-2016, 2001–2011	New South Wales, Australia	Aboriginal and Torres Strait Islander	278	212 (76.3)	29,499	23,292 (79.0)	Colorectal	8
Retrospective matched/random data collected study								
44. Banham-2019,[c] 1990–2010	South Australia, Australia	Aboriginal and Torres Strait Islander	77	56 (72.7)	77	68 (88.3)	Breast	7
45. Banham-2019,[c] 1990–2010	South Australia, Australia	Aboriginal and Torres Strait Islander	777	408 (52.5)	777	488 (62.8)	All	8
46. Chen-2024, 2005–2017	Nunavik, Canada	Inuit	67	44 (65.7)	129	57 (44.2)	Lung	7
47. Moore-2014, 1998–2004	Queensland, Australia	Aboriginal and Torres Strait Islander	956	494 (51.7)	869	549 (63.2)	All	8
48. Valery-2006, 1996–2002	Queensland, Australia	Aboriginal and Torres Strait Islander	815	388 (47.6)	810	469 (57.9)	All	8
49. Coory-2008, 1996–2002	Queensland, Australia	Aboriginal and Torres Strait Islander	158	16 (10.1)	152	39 (25.6)	Lung	8
50. Signal-2014, 2006–2008	North Island, New Zealand	Māori	172	65 (37.8)	163	54 (33.1)	Stomach	8
51. Swart-2013, 2006–2008	New Zealand	Māori	72	70 (97.2)	76	74 (97.4)	Rectal	6
52. Wampler-2004, 1973–1996	USA	American Indian/Alaska Native	511	406 (79.4)	2044	1671 (81.7)	Breast	8

NC: No comparator. [a]Table presented the alphabetical order of the authors and then grouped them into similar timelines of data collection and cancer type. [b]If there were two or more groups of non-Indigenous people, their total number was calculated and presented as non-Indigenous people. [c]Two Banham et al., 2019,[33,34] Gurney et al., 2022,[36,37] Gurney et al., 2024[38,39] and Hall et al., 2004[19,40] studies presented the same data with different healthcare outcomes.

Table 1: **Study and patient characteristics of included studies in the systematic review (n = 52).**

published than small studies with small effect sizes, thus suggesting publication bias. The leave-one-out analysis indicated minor variations in the prevalence rate (±1%) of surgery in Indigenous people and the prevalence ratio (−1%) of surgery for cancer treatment in both groups (Supplementary Figs. S4 and S5).

Subgroup analysis

Table 2 presents the prevalence of surgery in Indigenous people with cancer by study and patients' characteristics. There was a large variation in surgery prevalence by country, sample size, Aboriginal population, and cancer type according to the body system. Between studies, heterogeneity was high across all the subgroups. Studies conducted on Indigenous peoples in Canada (44.5%, 95% CI: 38.7–50.3%) and Australia (51.5%, 95% CI: 36.8–65.9%) found a relatively low prevalence of cancer surgery compared to New Zealand (59.2%, 95% CI: 29.6–85.6%) and USA (59.3%, 95% CI: 46.3–71.6%).

Low prevalence rates of surgery were observed in patients with respiratory (28.0%, 95% CI: 17.7–39.7%) followed by hepatobiliary systems cancer (30.0%, 95% CI: 21.6–39.2%); in contrast, surgery rates were high in patients with reproductive system cancer and urinary cancer (80.8%, 95% CI: 71.2–87.6% and 92.5%, 95% CI: 91.0–93.8%, respectively).

Table 3 presents the prevalence ratio of surgery in Indigenous people compared to non-Indigenous people by study and patients' characteristics. Indigenous people with respiratory tract cancer were 15% (95% CI: 6–23%) less likely to receive surgery than non-Indigenous people. The other subgroup analyses showed results consistent with the overall estimate.

Factors contributing to the disparities in surgery prevalence between Indigenous and non-Indigenous people with cancer

While this review explored the prevalence of cancer surgery in Indigenous people, we also extracted the data from papers to find the reasons that may impact surgery prevalence between Indigenous and non-Indigenous people. We subsequently categorised the contributing factors into individual, health services and systems, and structural determinants.

Individual factors. Several studies explored individual factors associated with reduced cancer surgery or cancer treatment, among Indigenous peoples compared to their non-Indigenous counterparts.[21,33,34,55,59,60,63,68,73,75] Individual factors included: advanced-stage cancer at diagnosis,[33,60,75] having comorbidities,[59] aged over 40 years,[21] lack of knowledge about cancer or surgery, or refusing surgery.[56] In addition, one study identified patient and practitioner interaction as a reason for reduced surgery or treatment.[60]

Health services and systems factors.

Waiting time to receive surgery. Nine studies[18,22,36,38,61,63,65,68,77] reported waiting time to receive surgery for cancer treatment. In Australia, the mean waiting time from diagnosis to treatment (including surgery) for Aboriginal and Torres Strait Islander people was similar to that of non-Indigenous people (14 days and 12 days, respectively, p = 0.20) overall,[63] and specifically for lung cancer (27.3 vs. 28.0 days)[61] and

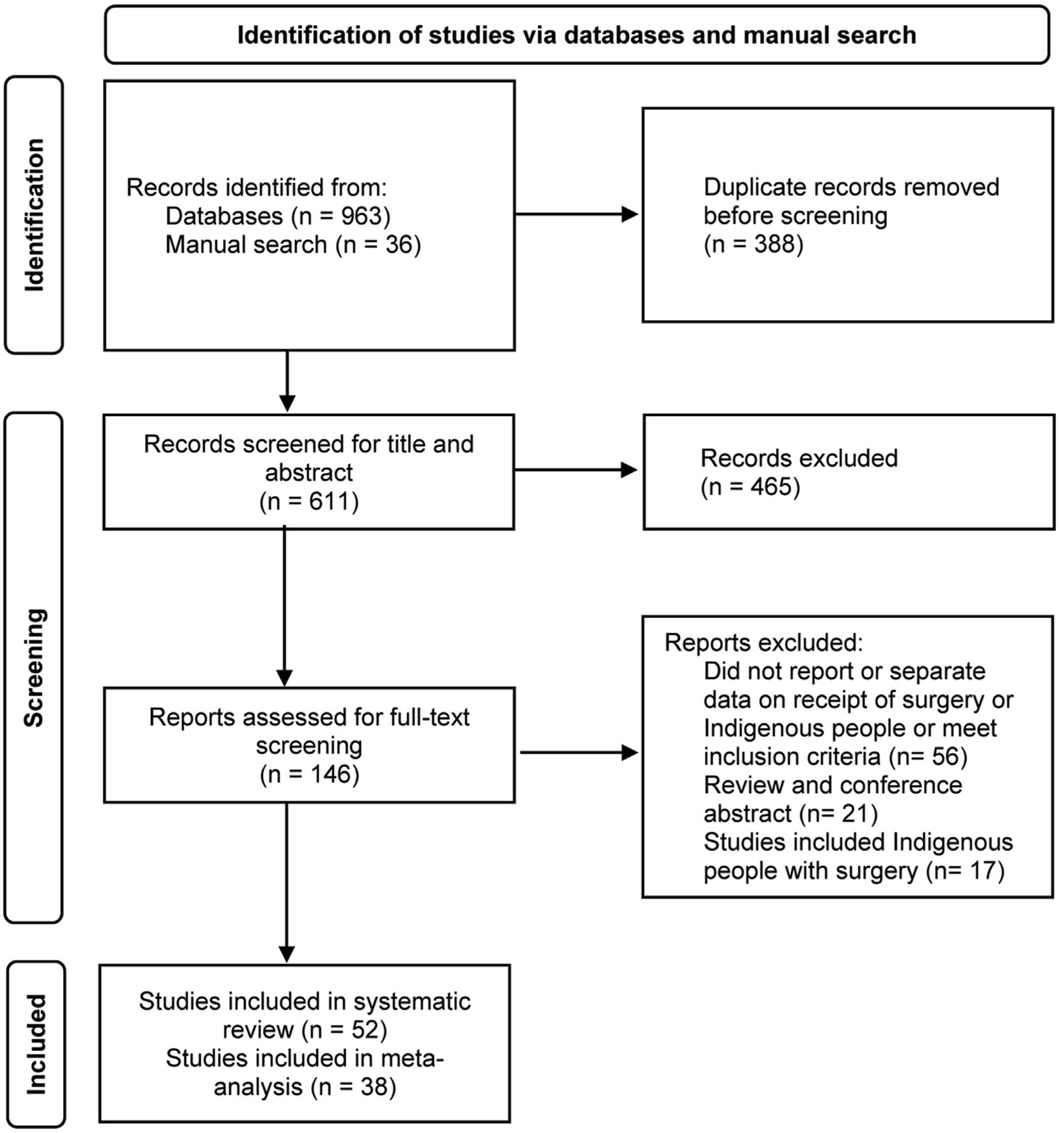

Fig. 1: PRISMA flow diagram for inclusion of studies in the systematic review and meta-analysis.

breast cancer (15 vs. 14 days).[68] American Indians and Alaskan Natives with non-metastatic cancer in the USA received surgery sooner than non-Indigenous people (colorectal cancer: (odds ration, OR) 1.48; 95% CI: 0.35–6.24); but not for breast cancer (OR, 0.78; 95% CI: 0.47–1.28) and lung cancer (OR, 0.78; 95% CI: 0.23–2.59).[18] Another study also found longer wait times for surgery for Native Americans compared to White Americans diagnosed with rectal cancer (96.5 vs. 79.4 days, respectively); of note, the disparity in time to surgery correlated with age at diagnosis in Native Americans (<50 vs. ≥ 50 years of age: 110 vs. 92 days).[77] The difference in the mean time from diagnosis to the first treatment of breast cancer for Māori and non-Māori in New Zealand was reported in two studies (41 vs. 30 days, $p < 0.001$)[22] and (37.1 vs. 30.4 days, $p < 0.005$).[65] The highest median time difference between the first surgery and diagnosis was reported for stomach cancer (Māori vs. European: 48 vs. 83.5 days).[36]

Access to specialists or surgeons. Four studies (one from Australia and three from New Zealand) explored access to general and specialist surgeons.[20,57,67,69] A similar proportion of general and specialist colorectal surgeons in New Zealand operated on Māori and non-Māori.[57,69] However, specialists of upper gastrointestinal surgeons performed less surgery for Māori than non-Māori (38% vs. 80%).[67]

Structural determinants.

Health fund status and whether receiving surgical treatments in public or private sectors. Some

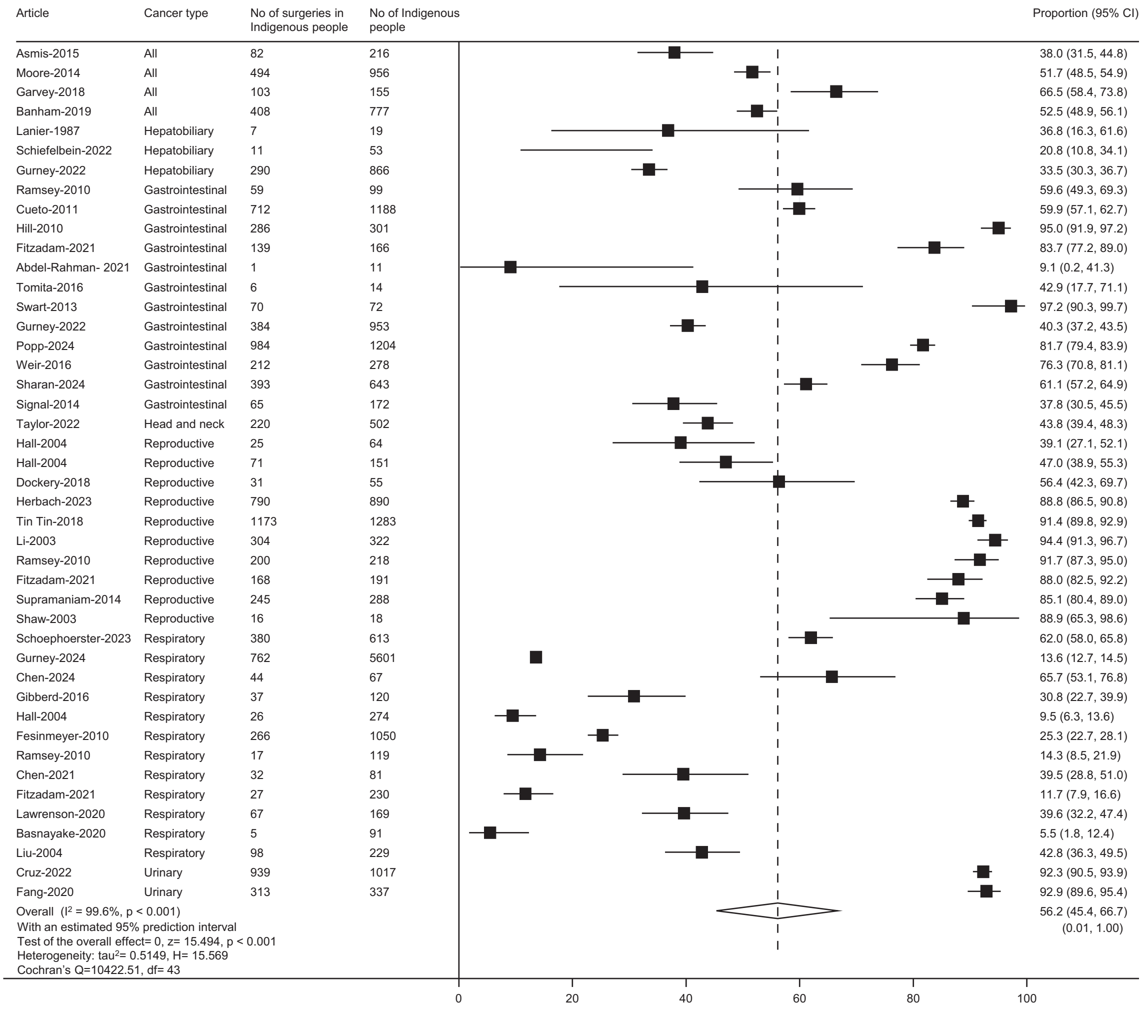

Fig. 2: Forest plot: Pooled prevalence of surgery in Indigenous people with cancer.

studies[20,22,37,48,57,65,67,69] reported that the health insurance status of Indigenous people could affect their surgical treatment of cancer. In Australia and New Zealand, base-level universal healthcare is available and enables access to specialist services, yet there are often lengthy wait times for appointments across the primary, secondary, and tertiary settings. Private health insurance can increase a person's options and reduce wait times. Studies in these two countries showed that Indigenous people were less likely to have private health coverage than non-Indigenous people.[20,22,48]

Lower uptake of private health insurance impacts access to surgical treatment in hospitals. In New Zealand, Māori patients were more likely to receive surgical procedures in small hospitals[67,69] and public hospitals without a cancer centre[57] than in large hospitals or a cancer centre. A significantly lower proportion of Māori women received breast cancer surgery in the private sector (8.0% vs. 32.5%, $p < 0.001$) compared to European women.[64] Additionally, Māori women had longer wait times for surgery than European New Zealand women in public hospitals (38.9 vs. 35.5 days, $p = 0.18$), but shorter wait times in private hospitals (14.6 vs. 19.7 days, $p = 0.06$).[64] Māori visited high-volume hospitals for minor hepatectomy for liver cancer (such as one minor hepatectomy/week) more frequently (3.36, 95% CI: 1.6–7.04) than European New Zealanders.[37]

Residential remoteness and travel distance. Several studies categorised Indigenous peoples' residential status into urban and rural/remote regions. Indigenous people with cancer were more likely to live in rural/remote areas compared to non-Indigenous people in Australia and New Zealand.[17,20–22,39,48,73,78] Three studies reported the travel distance for surgical cancer treatment.[20,37,52] In Australia, Aboriginal and Torres Strait Islander people with lung, breast and bowel cancer travelled further than non-Indigenous people diagnosed with these cancers (mean kilometres (km): lung 104 vs. 31 km; breast 73 vs. 20 km; bowel: 85 vs. 31 km).[20] The longest travel distance was found in the Gurney et al.

studies[37,39] from New Zealand, where Māori with liver (120 km vs. 56 km)[37] and lung (57 km vs. 34 km)[39] cancer travelled for longer distances compared to Europeans New Zealanders; minimal difference was found for stomach cancer (median, 22 vs. 21 km).[38] However, it is acknowledged that data is biased toward regional and urban areas, with few studies focused on remote areas, where travel distances to cancer surgery services are likely much greater.

Quality assessment of the included studies

The quality assessment of the 52 included studies using the critical appraisal tool is presented in Supplementary Table S3. Forty-two studies met all eight quality assessment criteria and scored a maximum of eight points (Table 1). All studies met the requirements of quality assessment criteria- "sample in an appropriate way," "subjects and settings described in detail," "valid methods" and "condition measured." Forty-seven studies used "appropriate sampling frames" to select their sample/cohort, and 43 included adequate "sample sizes". The "response rate" criterion was noted as 'not applicable' for all studies because of the secondary data analysis in their study designs. Most included studies had high-quality scores, probably due to the samples of the whole population rather than the targeted section of the population, which showed the results' uniformity and accuracy.

Discussion

This systematic review and meta-analyses provided new evidence for the extent of the disparity in cancer surgery receipt for Indigenous peoples compared to non-Indigenous peoples and the reasons underlying these disparities. It also enabled us to analyse some major determinants impacting Indigenous people's access to surgery, including individual, health services and systems, and broader structural factors within different healthcare systems. The findings can improve healthcare access, treatment and services for Indigenous people. Overall, we found marginally lower access to surgery for Indigenous people than non-Indigenous people, as well as variance in cancer surgery by population and type of cancer.

The review included studies within the four CANZUS nations, which have similar histories of colonisation of Indigenous peoples and their lands and similar advanced economies, available medical and health-related infrastructure, well-established healthcare systems and research. While the enduring legacy of European colonisation is shared across the CANZUS countries, it has commonly involved land theft, forced assimilation policies, systematic discrimination in sociopolitical systems, and disparities in health and social outcomes. There is heterogeneity in cultures, histories, lived experiences, geographic environments, and

Subgroup	Number of studies[a]	Prevalence, 95% confidence interval	I^2 statistic (%)
Overall[b]	44	56.2 (45.4–66.7)	99.6
A. Study characteristics			
1. Published in the year range			
≤2000	1	36.8 (16.3–61.6)	–
2001–2005	6	54.4 (20.3–86.4)	99.2
2006–2010	5	59.9 (20.8–92.7)	99.6
2011–2015	6	63.7 (49.2–77.1)	98.1
2016–2020	10	56.7 (37.2–75.2)	99.1
≥2021	16	53.3 (34.0–72.2)	99.8
2. Country			
Australia	15	51.5 (36.8–65.9)	98.7
Canada	2	44.5 (38.7–50.3)	–
New Zealand	8	59.2 (29.6–85.6)	99.8
USA	19	59.3 (46.3–71.6)	99.3
3. Database			
Nationwide	16	57.9 (39.8–75.0)	99.8
State-wide	28	55.1 (43.0–66.9)	99.0
4. Data collection (years)[c]			
1–5	8	60.8 (32.0–86.2)	98.9
6–10	14	59.9 (42.9–75.8)	98.8
11–15	14	53.0 (33.6–71.9)	99.8
16–20	7	55.2 (33.1–76.3)	99.3
≥21	1	25.3 (22.7–28.1)	–
5. Sample size category			
Less than 150	13	41.4 (24.1–59.8)	96.2
151–300	15	59.1 (41.8–75.3)	99.1
300 and more	16	64.4 (46.6–80.3)	99.8
6. Quality score			
Total score 8	34	55.3 (43.2–67.2)	99.7
Less than score 8	10	59.1 (33.7–82.2)	98.0
B. Patient characteristics			
1. Inclusion of patient in the study			
A single type of cancer	35	57.8 (44.3–70.7)	99.7
Two or more types of cancer	9	52.9 (45.3–60.4)	94.5
2. Indigenous population			
Aboriginal and Torres Strait Islander	15	51.5 (36.8–65.9)	98.7
American Indian and/or Alaska Native	18	60.2 (46.8–72.9)	99.3
Māori	8	59.2 (29.6–85.6)	99.8
Native Hawaiian	1	42.8 (36.3–49.5)	0
Inuit	2	44.5 (38.7–50.3)	0
3. Gender			
Male	1	39.1 (27.1–52.1)	–
Female	9	83.6 (77.1–90.0)	95.9
Both	34	48.7 (37.6–59.9)	99.5
4. Cancer type in the body system			
All	4	52.0 (44.4–59.4)	90.2
Hepatobiliary	3	30.0 (21.6–39.2)	0
Gastrointestinal	12	66.3 (53.7–77.8)	98.6
Reproductive	10	80.8 (71.2–87.6)	96.7
Respiratory	12	28.0 (17.7–39.7)	98.8
Urinary	2	92.5 (91.0–93.8)	0
Other-Head and neck	1	43.8 (39.4–48.3)	0

[a]Four out of thirty-eight studies (Fig. 1) presented the datasets of two or three types of cancer[18–20,37] and were considered separate studies in the meta-analysis. Therefore, the total number of studies in the meta-analysis was 44. [b]After excluding the studies (n = 4) that included all types of cancer,[33,46,56,63] the pooled prevalence rate was 56.5% (95% CI: 44.5–68.2%). [c]The total years of data collection were calculated from the data collection timeframe and then categorised into five-year intervals.

Table 2: **Subgroup analyses of factors associated with variation in pooled surgery prevalence in Indigenous people with cancer.**

Subgroup	Number of studies[a]	Prevalence ratio, 95% confidence interval	I^2 statistic (%)
Overall[b]	40	0.97 (0.94–1.00)	57.1
A. Study characteristics			
1. Published in the year range			
2001–2005	6	0.90 (0.82–0.99)	55.5
2006–2010	5	0.92 (0.84–1.01)	86.0
2011–2015	5	0.93 (0.87–1.00)	79.9
2016–2020	8	0.94 (0.89–0.98)	73.7
≥2021	16	1.00 (0.96–1.04)	86.2
2. Country			
Australia	14	0.91 (0.86–0.97)	71.3
Canada	1	1.46 (1.14–1.93)	–
New Zealand	8	1.01 (0.94–1.09)	92.3
USA	17	0.96 (0.94–0.98)	69.9
3. Database			
Nationwide	16	0.97 (0.93–1.00)	87.8
State-wide	24	0.95 (0.92–0.98)	72.9
4. Data collection (years)[c]			
1–5	7	0.99 (0.93–1.04)	46.2
6–10	13	0.94 (0.90–0.98)	76.6
11–15	13	0.98 (0.94–1.03)	90.3
16–20	6	0.97 (0.95–1.00)	24.7
≥21	1	0.80 (0.72–0.89)	–
5. Sample size category			
Less than 1000	7	0.99 (0.91–1.08)	71.9
1001–10,000	12	0.92 (0.79–1.06)	89.0
10,001–100,000	12	0.96 (0.92–1.00)	78.9
100,000 and more	9	0.96 (0.94–0.98)	74.7
6. Quality score			
Total score 8	32	0.95 (0.93–0.98)	83.3
Less than score 8	8	0.99 (0.91–1.07)	68.9
B. Patient characteristics			
1. Inclusion of patient in the study			
A single type of cancer	34	0.97 (0.95–1.00)	80.5
Two or more types of cancer	7	0.90 (0.85–0.96)	66.2
2. Indigenous population			
Aboriginal and Torres Strait Islander	14	0.91 (0.86–0.97)	71.3
American Indian and/or Alaska Native	16	0.97 (0.95–0.99)	68.5
Māori	8	1.01 (0.94–1.09)	92.3
Native Hawaiian	1	0.81 (0.69–95.1)	–
Inuit	1	1.48 (1.14–1.93)	–
3. Gender			
Male	1	0.73 (0.54–0.99)	–
Female	8	0.98 (0.96–1.00)	38.6
Both	31	0.95 (0.91–0.98)	84.5
4. Cancer type in the body system			
Any	2	0.82 (0.78–0.88)	0
Hepatobiliary	2	1.21 (1.08–1.35)	0
Gastrointestinal	12	1.00 (0.94–1.04)	79.4
Reproductive	9	0.98 (0.96–1.00)	46.5
Respiratory	12	0.85 (0.77–0.94)	74.5
Urinary	2	1.00 (0.98–1.01)	11.8
Other-head and neck	1	0.95 (0.86–1.05)	–

[a] Four out of thirty-eight studies (Fig. 1) presented the datasets of two or three types of cancer[18–20,37] and were considered separate studies in the meta-analysis. Four studies[46,52,56,58] did not include the non-Indigenous population. Therefore, the total number of studies in the meta-analysis was 40. [b] After excluding the studies (n = 2) that included all types of cancer,[33,63] the pooled prevalence rate was 0.97 (95% CI: 0.95–1.00). [c] The total years of data collection were calculated from the data collection timeframe and then categorised into five-year intervals.

Table 3: **Subgroup analyses of factors associated with Indigenous people and non-Indigenous people with cancer.**

healthcare needs between and within these populations.[31] Due to a shared history of brutal colonisation in each of the four CANZUS nations, both historical and contemporary issues associated with colonisation have had a lasting impact on Indigenous people's health and well-being outcomes.[82] As such, each country's Indigenous population experiences significant health disparities between the dominant colonial settler population and themselves.[83] Combining research findings from these four countries must be done and interpreted cautiously.

All four CANZUS countries have important healthcare system performance domains (access, safety, and efficient services),[84] means similar healthcare data is collected. However, the performance of the healthcare system varies among these nations. Canada and the USA ranked tenth and eleventh in overall healthcare system performance in measuring care process, access to care, administrative efficiency, equity and healthcare outcomes.[85] Both countries showed poor outcomes for individual performance measurements (including access to care, equity, and healthcare outcomes). However, their healthcare expenditure (16.8% for the USA and 10.8% for Canada) as a percentage of gross domestic product is higher than that in Australia (9.4%) and New Zealand (9.1%).[85] This review also showed heterogeneity in surgical treatment in the Indigenous population among the four nations. The prevalence of cancer surgery was lowest for Inuit people in Canada (n = 2, 44.5%) and Native Hawaiians in the USA (n = 1, 42.8%). The study with Native Hawaiians was published between 2001 and 2005 (Table 1),[61] which was a time period preceding The United Nations Declaration of Indigenous Peoples' Rights in 2007, and thus a time when Indigenous people faced more discrimination in getting access to healthcare services.[86] Canadian studies were in the small sample size group (below 150 patients),[75] which showed a prevalence of 41.4% in comparison to large sample size groups (59.1% for 151–300 and 64.4% for >300 patients) (Table 2). More research warrants exploring the current access to surgery for Native Hawaiians and the Canadian Indigenous population.

According to the Commonwealth Fund Report 2021,[85] Australia ranked third, and New Zealand ranked sixth in the healthcare system performance globally. Both nations deliver healthcare services through universal (government-funded) and private (user costs) insurance. In our research, the prevalence of surgery for Maori with cancer in New Zealand was 59.2%, whereas just over half of Aboriginal and Torres Strait Islanders in Australia (51.5%) had received surgery for cancer treatment (Table 2). Compared to non-Indigenous people, Aboriginal and Torres Strait Islanders were less likely to receive surgical treatment (9%, 95% CI: 3–14%) (Table 3). The barriers to accessing healthcare services for Aboriginal and Torres Strait Islander people in Australia include long waiting times and gaps in transitional care between primary and tertiary systems.[13] Access to public and private healthcare services varies within and between the country.[87–89] For example, in New South Wales, Australia's most populated state, there are fewer surgical outpatient clinics than in other states; patients often have to go privately,[90,91] and there is no access to free hospital transport services (e.g., ambulance), although it is freely accessible in Queensland and Tasmania.[92] Sometimes, there can be clinical reasons why surgery was deemed unsuitable for Indigenous patients (such as multiple comorbidities and advanced-stage cancer)[33,59,60,74,75] or received treatment elsewhere.[46]

Considering the type of cancer, over one-quarter (28.0%) of Indigenous people with respiratory system cancer received surgical cancer treatment (Table 2), and this prevalence was 15% lower for Indigenous than surgery prevalence in non-Indigenous people (Table 3). Differences between Indigenous and non-Indigenous peoples in lung cancer surgery prevalence were also reported.[17,18,48,51,59,61,75] Reasons for these differences were associated with ethnicity[51] and reported to be due to unsure tissue diagnosis,[17,54] and not having private insurance.[19] Clinical risk factors for lung cancer surgery, such as pulmonary function and cardiovascular fitness, were unknown in these studies.[93] Therefore, the complex nature behind the low surgery access for Indigenous people with lung cancer needs further research that addresses both population behaviours and health services.

Our meta-analysis found marginal disparities in accessing surgical care between Indigenous and non-Indigenous peoples with cancer. Undoubtedly, individuals (such as reluctance to receive surgery, remoteness of living locations and travel distance to services) and social determinants (such as lack of health insurance), to various extents, influence the disparities. It is still unclear the impact of structural determinants such as health insurance on access to surgery among Indigenous people with cancer in Australia and Canada due to the lack of studies on these determinants. The prevalence of cancer surgery for American Indians and/or Alaskan Natives was higher (60.2% vs. 51.5%) than that for Aboriginal and Torres Strait Islander people in Australia (Table 2). The marginal differences in surgery prevalence ratio (3% lower) between American Indians and/or Alaskan Natives and non-Indigenous people (Table 3) might be due to the selection of the population from metropolitan and urban areas,[23,49,60,77] and the availability of income potential for private health insurance funding to accelerate timely access to surgery,[94] which relates to the affordability of access to surgery.

Our review found discrepancies in timely access to surgical care services for cancer treatment within the healthcare system. Theoretically, the healthcare providers would follow an optimal cancer care pathway by providing surgical cancer treatment immediately after diagnosis.[61,95] According to the international guidelines for surgical treatment in cancer, the waiting time should not exceed 14 days to see a specialist, and the start of treatment should be within 31 days.[96] However, only four studies reported that their diagnosis to surgery time met the allowed waiting time for Indigenous people in the USA and Australia.[61,63,68,97] In studies conducted in New Zealand, waiting times to see specialists and receive surgery exceeded recommendations for Māori.[22,65,69] Coordination of primary, secondary and tertiary care services requires further investigations to identify the delays in surgical care using the referral pathways. The availability of linked datasets from primary or community service care is underresearched to find the actual reasons (for example, general practitioner visits, coordination of different healthcare services using referrals, clinical details of disease conditions, etc.) for delaying access to surgical treatment. Overall, this study warrants further investigation on mapping whole pathways using real-world datasets for Indigenous people.

Structural determinants such as lack of Indigenous representation in healthcare provision, underfunding and unavailability of resources were identified for Inuit with lung cancer in Nunavik, Canada.[75] Maori with lung cancer in New Zealand living outside the urban area had to access a public hospital with a noncancer facility.[38,57] Some regional healthcare services in Australia provide private care free of charge due to the unavailability of public access in those areas, which improves access to services.[21] The challenge of accessing surgery for people may still exist for people living in urban areas. It was reported that urban/metropolitan healthcare services in the USA had barriers to surgery due to the higher patient load, flexibility of hospital schedule, and higher referrals compared to available services.[79] Therefore, there is no one-size-fits-all solution to address all issues. Greater clarity on the gaps in the health system could be achieved by utilising linked datasets of primary, secondary and tertiary healthcare services to map access, utilisation and healthcare coordination.

Limitations

There was a possibility of people who were not identified as Indigenous patients. For example, there was a well-known undercounting or missing of Aboriginal and Torres Strait Islander people in administrative data collected in Australia.[98] This review focused on high-income countries, which could be different from low-income countries with varying healthcare systems. The countries of CANZUS have different healthcare systems and models of cancer care, including different guidelines in cancer care, which might contribute to the high heterogeneity in this study. Due to the wide variation of data, we could not investigate the prevalence of surgery associated with other contributing factors (including age, clinical stage of cancer, surgery type, and other clinical factors such as comorbid conditions).

Heterogeneity exists across and within Indigenous populations in these nations with unique cultures, histories, lived experiences, and geographic locations. The availability of published data allowed further analysis of access to cancer surgery, social determinants of health, and other relevant factors among Indigenous populations. Determining access to cancer surgery, which affects cancer outcomes, across different countries for Indigenous populations provides key learnings that can contribute to improvement in access, treatment, and services.

Conclusion

Indigenous people were marginally less likely to receive surgical cancer treatment than non-Indigenous people in high-income CANZUS nations. To close the gap completely, the healthcare systems need to undertake additional initiatives to improve access to surgery for Indigenous people with cancer, such as reducing the waiting time between diagnosis and surgical intervention. The collective effort among the stakeholders in CANZUS nations needs to address the social determinants of health for Indigenous people beyond the healthcare sector, encompassing policymakers and leaders within the Indigenous communities.

Contributors

This study was a part of the Research Alliance for Urban Goori Health (RAUGH) project, which aimed to close the gap in life expectancy and achieve health equality for urban First Nations Peoples in greater Brisbane North, through applied research in priority areas in healthcare pathways - across the continuum of care and the lifespan. JW, XH and SS conceptualized the study. XH and SS conducted the literature search, eligibility assessment, data extraction, quality assessment, accessed and verified the data. SS and FB conducted the meta-analyses, including interpretation of the results. Four leading national Indigenous health researchers in the research areas of cancer care services (GG, a Kamilaroi woman), methodology (RB, a Gunggari/Kunja woman), community-controlled health (SH, a Yidinji woman) and epidemiology (JW, a Pitjantjatjara and Narrunga man) reviewed the manuscript. All co-authors contributed to the writing of the manuscript and approved the final version. All authors attest that they meet the authorship criteria.

Data sharing statement

Data is available upon reasonable request to the corresponding author.

Declaration of interests

AD is the current president of the Australasian Epidemiology Association. The rest authors declare no competing interests.

Acknowledgements

This research was supported by the Research Alliance for Urban Goori Health (RAUGH, a tripartite partnership of the Poche Centre for Indigenous Health at The University of Queensland, Metro North Hospital and Health Service, and the Institute for Urban Indigenous Health). The salaries of authors XH and SS were funded by the RAUGH. Although not directly funding this work, (SS, JW) acknowledge funding from the Royal Brisbane and Women's Hospital Foundation. This grant supported and contributed to the environment that stimulates this work. The salary of GG was funded by an NHMRC Investigator Grant (#1176651).

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2025.101527.

References

1 Meara JGD, Leather AJMMS, Hagander LP, et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet*. 2015;386(9993):569–624.

2 Perera SK, Jacob S, Wilson BE, et al. Global demand for cancer surgery and an estimate of the optimal surgical and anaesthesia workforce between 2018 and 2040: a population-based modelling study. *Lancet Oncol*. 2021;22(2):182–189.

3 WHO Organization. *Stand together against cancer - world cancer day 2023*; 2023. https://www.who.int/multi-media/details/stand-together-against-cancer—world-cancer-day-2023. Accessed January 23, 2023.

4 De Souza JA, Hunt B, Asirwa FC, Adebamowo C, Lopes G. Global health equity: cancer care outcome disparities in high-, middle-, and low-income countries. *J Clin Oncol*. 2016;34(1):6–13.

5 Atlas TC. *The burden of cancer*. American Cancer Society; 2019. https://canceratlas.cancer.org/wp-content/uploads/2019/09/CA3_TheBurdenofCancer.pdf. Accessed January 15, 2024.

6 Sullivan RP, Alatise OIMD, Anderson BOP, et al. Global cancer surgery: delivering safe, affordable, and timely cancer surgery. *Lancet Oncol*. 2015;16(11):1193–1224.

7 de Jager E, Gunnarsson R, Ho Y-H. Surgical services for breast cancer patients in Australia, is there a gap for aboriginal and/or Torres Strait Islander women? *World J Surg*. 2022;46(3):612–621.

8 BABA Guadagnolo, Petereit DGDG, Coleman CNCN. Cancer care access and outcomes for American Indian populations in the US: challenges and models for progress. *Semin Radiat Oncol*. 2016;27(2):143–149.

9 Chynoweth J, McCambridge MM, Zorbas HM, et al. Optimal cancer care for Aboriginal and Torres Strait Islander people: a shared approach to system level change. *JCO Glob Oncol*. 2020;2020(6):108–114.

10 Anderson K, Diaz A, Parikh DR, Garvey G. Accessibility of cancer treatment services for Indigenous Australians in the Northern Territory: perspectives of patients and care providers. *BMC Health Serv Res*. 2021;21(1):95–113.

11 Bygrave A, Whittaker K, Aranda S. *Inequalities in cancer outcomes by Indigenous status and socioeconomic quintile: an integrative review*. Sydney: Cancer Council Australia; 2020.

12 de Witt A, Matthews V, Bailie R, et al. Communication, collaboration and care coordination: the three-point guide to cancer care provision for Aboriginal and Torres Strait Islander Australians. *Int J Integr Care*. 2020;20(2):1–16.

13 Sanjida S, Garvey G, Ward J, et al. Indigenous Australians' experiences of cancer care: a narrative literature review. *Int J Environ Res Public Health*. 2022;19(24):16947.

14 Bill L, Frazer B. Cultural safety training framework for oncology care providers. In: Garvey G, ed. *Indigenous and tribal peoples and cancer*. Cham: Springer Nature Switzerland; 2024:279–282.

15 de Jager E, Levine AA, Udyavar NR, et al. Disparities in surgical access: a systematic literature review, conceptual model, and evidence map. *J Am Coll Surg*. 2019;228(3):276–298.

16 AIHW. *Australian Institute of Health and Welfare: cultural safety in health care for Indigenous Australians: monitoring framework*; 2023. https://www.aihw.gov.au/reports/indigenous-australians/cultural-safety-health-care-framework/contents/summary. Accessed November 27, 2024. Updated 2 July 2023.

17 Basnayake TL, Valery PC, Carson P, De Ieso PB. Treatment and outcomes for Indigenous and non-Indigenous lung cancer patients in the Top End of the Northern Territory. *Intern Med J*. 2021;51(7):1081–1091.

18 Ramsey SD, Zeliadt SB, Blough DK, Lopez K, Buchwald D. Cancer care of American Indians and Alaska natives and other racial groups enrolled in public and private insurance plans. *Poverty Public Policy*. 2010;2(1):17–35.

19 Hall SE, Bulsara CE, Bulsara MK, et al. Treatment patterns for cancer in Western Australia: does being Indigenous make a difference? *Med J Aust*. 2004;181(4):191–194.

20 Fitzadam S, Lin E, Creighton N, Currow DC. Lung, breast and bowel cancer treatment for Aboriginal people in New South Wales: a population-based cohort study. *Intern Med J*. 2021;51(6):879–890.

21 Gibberd A, Supramaniam R, Dillon A, Armstrong BK, O'Connell DL. Lung cancer treatment and mortality for Aboriginal people in New South Wales, Australia: results from a population-based record linkage study and medical record audit. *BMC Cancer*. 2016;16:1–11.

22 Tin Tin S, Elwood JM, Brown C, et al. Ethnic disparities in breast cancer survival in New Zealand: which factors contribute? *BMC Cancer*. 2018;18:1–N.PAG.

23 Schiefelbein AM, Krebsbach JK, Taylor AK, et al. Treatment inequity: examining the influence of non-hispanic black race and ethnicity on pancreatic cancer care and survival in Wisconsin. *Wis Med J*. 2022;121(2):77–85. and 93.

24 RAUGH. *The research alliance for urban Goori health: RAUGH priority areas*; 2022. https://www.raugh.org.au/. Accessed December 23, 2022.

25 Huria T, Palmer SC, Pitama S, et al. Consolidated criteria for strengthening reporting of health research involving Indigenous peoples: the CONSIDER statement. *BMC Med Res Methodol*. 2019;19(1):173–179.

26 Smith LT. *Decolonizing methodologies: research and Indigenous peoples*. 2nd ed. London: Bloomsbury Academic & Professional; 2012.

27 Bainbridge R, McCalman J, Redman-MacLaren M, Whiteside M. The SAGE handbook of current developments in grounded theory. In: *55 city road*. London: SAGE Publications Ltd; 2019:629.

28 Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.

29 *EndNote*; 2023. https://endnote.com/. Accessed June 6, 2022.

30 Gover K. Settler-state political theory, 'CANZUS' and the UN declaration on the rights of Indigenous peoples. *Eur J Int Law*. 2015;26(2):345–373.

31 Anderson K, Elder-Robinson E, Gall A, et al. Aspects of wellbeing for Indigenous youth in CANZUS countries: a systematic review. *Int J Environ Res Public Health*. 2022;19(20):13688.

32 Children Ci. *What are the differences between cancers in adults and children?*; 2019. https://www.cancer.org/content/dam/CRC/PDF/Public/9177.00.pdf. Accessed January 20, 2024. Updated October 14, 2019.

33 Banham D, Roder D, Eckert M, Howard NJ, Canuto K, Brown A. Cancer treatment and the risk of cancer death among Aboriginal and non-Aboriginal South Australians: analysis of a matched cohort study. *BMC Health Serv Res*. 2019;19(1). N.PAG-N.PAG.

34 Banham D, Roder D, Keefe D, et al. Disparities in breast screening, stage at diagnosis, cancer treatment and the subsequent risk of cancer death: a retrospective, matched cohort of aboriginal and non-aboriginal women with breast cancer. *BMC Health Serv Res*. 2019;19(1). N.PAG-N.PAG.

35 Munn Z, McLinSc SM, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *Int J Evid Based Healthc*. 2015;13(3):147–153.

36 Gurney J, Sarfati D, Stanley J, Kerrison C, Koea J. Equity of timely access to liver and stomach cancer surgery for Indigenous patients in New Zealand: a national cohort study. *BMJ Open*. 2022;12(4).

37 Gurney J, Whitehead J, Kerrison C, Stanley J, Sarfati D, Koea J. Equity of travel required to access first definitive surgery for liver or stomach cancer in New Zealand. *PLoS One*. 2022;17(8 August).

38 Gurney J, Davies A, Stanley J, et al. Access to and timeliness of lung cancer surgery, radiation therapy, and systemic therapy in New Zealand: a universal health care context. *JCO Glob Oncol*. 2024;10:e2300258.

39 Gurney J, Davies A, Stanley J, et al. Equity of travel to access surgery and radiation therapy for lung cancer in New Zealand. *Support Care Cancer*. 2024;32(3):171.

40 Hall SE, Holman CD, Sheiner H. The influence of socio-economic and locational disadvantage on patterns of surgical care for lung cancer in Western Australia 1982-2001. *Austral Health Rev*. 2004;27(2):68–79.

41 Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. *Arch Public Health*. 2014;72(1):1–10.

42 Harris RJ, Bradburn MJ, Deeks JJ, Altman DG, Harbord RM, Sterne JAC. Metan: fixed- and random-effects meta-analysis. *STATA J*. 2008;8(1):3–28.

43 Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557–560.

44 Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ*. 1997;315(7109):629–634.

45 Abdel-Rahman O. A real-world, population-based study for the outcomes of patients with metastatic colorectal cancer to the liver with distant lymph node metastases treated with metastasectomy. *J Comp Effect Res*. 2022;11(4):243–250.

46 Asmis TR, Febbraro M, Alvarez GG, et al. A retrospective review of cancer treatments and outcomes among Inuit referred from Nunavut, Canada. *Curr Oncol*. 2015;22(4):246–251.

47 Chen S, Dee EC, Muralidhar V, Nguyen PL, Amin MR, Givi B. Disparities in mortality from larynx cancer: implications for reducing racial differences. *Laryngoscope*. 2021;131(4):E1147–E1155.

48 Coory MD, Green AC, Stirling J, Valery PC. Survival of Indigenous and non-Indigenous Queenslanders after a diagnosis of lung cancer: a matched cohort study. *Med J Aust*. 2008;188(10):562–566.

49 Cruz A, Dickerson F, Pulling KR, et al. Impacts of neighborhood characteristics and surgical treatment disparities on overall mortality in stage I renal cell carcinoma patients. *Int J Environ Res Publ Health*. 2022;19(4).

50 Cueto CV, Szeja S, Wertheim BC, Ong ES, Tsikitis VL. Disparities in treatment and survival of white and native American patients with colorectal cancer: a SEER analysis. *J Am Coll Surg*. 2011;213(4):469–474.

51 Dalwadi SM, Lewis GD, Bernicker EH, Butler EB, Teh BS, Farach AM. Disparities in the treatment and outcome of stage I non-small-cell lung cancer in the 21st century. *Clin Lung Cancer*. 2019;20(3):194–200.

52 Dockery LE, Motwani A, Ding K, et al. Improving cancer care for American Indians with cervical cancer in the Indian Health Service (IHS) system — navigation may not be enough. *Gynecol Oncol*. 2018;149(1):89–92.

53 Fang W, Yang Z-Y, Chen T-Y, Shen X-F, Zhang C. Ethnicity and survival in bladder cancer: a population-based study based on the SEER database. *J Transl Med*. 2020;18(1):1–11.

54 Fesinmeyer MD, Goulart B, Blough DK, Buchwald D, Ramsey SD. Lung cancer histology, stage, treatment, and survival in American Indians and Alaska natives and whites. *Cancer*. 2010;116(20):4810–4816.

55 Gachupin FC, Lee BR, Chipollini J, et al. Renal cell carcinoma surgical treatment disparities in American Indian/Alaska natives and hispanic Americans in Arizona. *Int J Environ Res Publ Health*. 2022;19(3).

56 Garvey G, Cunningham J, Janda M, He VY, Valery PC. Psychological distress among Indigenous Australian cancer survivors. *Support Care Cancer*. 2018;26(6):1737–1746.

57 Hill S, Sarfati D, Blakely T, et al. Ethnicity and management of colon cancer in New Zealand: do Indigenous patients get a worse deal? *Cancer*. 2010;116(13):3205–3214.

58 Lanier AP, McMahon BJ, Alberts SR, Popper H, Heyward WL. Primary liver cancer in Alaskan natives. 1980-1985. *Cancer*. 1987;60(8):1915–1920.

59 Lawrenson R, Lao C, Brown L, et al. Management of patients with early stage lung cancer - why do some patients not receive treatment with curative intent? *BMC Cancer*. 2020;20(1):1–9.

60 Li CI, Malone KE, Daling JR. Differences in breast cancer stage, treatment, and survival by race and ethnicity. *Arch Intern Med*. 2003;163(1):49–56.

61 Liu DMK, Kwee SA. Demographic, treatment, and survival patterns for Native Hawaiians with lung cancer treated at a community medical center from 1995 to 2001. *Pac Health Dialog*. 2004;11(2):139–145.

62 Liu G, Xu M, Gao T, et al. Surgical compliance and outcomes in gastric cancer: a population-based cohort study. *J Cancer*. 2019;10(4):779–788.

63 Moore SP, Green AC, Bray F, et al. Survival disparities in Australia: an analysis of patterns of care and comorbidities among Indigenous and non-Indigenous cancer patients. *BMC Cancer*. 2014;14(1):517.

64 Seneviratne S, Campbell I, Scott N, Coles C, Lawrenson R. Treatment delay for Māori women with breast cancer in New Zealand. *Ethn Health*. 2015;20(2):178–193.

65 Seneviratne S, Campbell I, Scott N, Kuper-Hommel M, Round G, Lawrenson R. Ethnic differences in timely adjuvant chemotherapy and radiation therapy for breast cancer in New Zealand: a cohort study. *BMC Cancer*. 2014;14.

66 Shaw IM, Elston TJ. Retrospective, 5-year surgical audit comparing breast cancer in Indigenous and non-Indigenous women in Far North Queensland. *ANZ J Surg*. 2003;73(9):758–760.

67 Signal V, Sarfati D, Cunningham R, Gurney J, Koea J, Ellison-Loschmann L. Indigenous inequities in the presentation and management of stomach cancer in New Zealand: a country with universal health care coverage. *Gastric Cancer*. 2015;18(3):571–579.

68 Supramaniam R, Gibberd A, Dillon A, Goldsbury DE, O'Connell DL. Increasing rates of surgical treatment and preventing comorbidities may increase breast cancer survival for Aboriginal women. *BMC Cancer*. 2014;14(1):163.

69 Swart EM, Sarfati D, Cunningham R, et al. Ethnicity and rectal cancer management in New Zealand. *N Z Med J*. 2013;126(1384):42–52.

70 Taylor DB, Osazuwa-Peters OL, Okafor SI, et al. Differential outcomes among survivors of head and neck cancer belonging to racial and ethnic minority groups. *JAMA Otolaryngol Head Neck Surg*. 2022;148(2):119–127.

71 Tomita Y, Karapetis CS, Roder D, et al. Comparable survival outcome of metastatic colorectal cancer in Indigenous and non-Indigenous patients: retrospective analysis of the South Australian metastatic colorectal cancer registry. *Aust J Rural Health*. 2016;24(2):85–91.

72 Valery PC, Coory M, Stirling J, Green AC. Cancer diagnosis, treatment, and survival in Indigenous and non-Indigenous Australians: a matched cohort study. *Lancet*. 2006;367(9525):1842–1848.

73 Weir K, Supramaniam R, Gibberd A, Dillon A, Armstrong BK, O'Connell DL. Comparing colorectal cancer treatment and survival for Aboriginal and non-Aboriginal people in New South Wales. *Med J Aust*. 2016;204(4):56.e51–56.e58.

74 Bartholomew K, Ghafel M, Tin Tin S, et al. Receipt of mastectomy and adjuvant radiotherapy following breast conserving surgery (BCS) in New Zealand women with BCS-eligible breast cancer, 2010-2015: an observational study focusing on ethnic differences. *BMC Cancer*. 2023;23(1):766.

75 Chen Y, MacIsaac S, Young M, et al. Nunavimmi puvakkut kaggutimik aanniaqarniq: Qanuilirqitaa? Lung cancer in Nunavik: how are we doing? A retrospective matched cohort study. *CMAJ Can Med Assoc J*. 2024;196(6):E177–E186.

76 Herbach EL, Nash SH, Lizarraga IM, et al. Patterns of evidence-based care for the diagnosis, staging, and first-line treatment of breast cancer by race–ethnicity: a SEER-medicare study. *Cancer Epidemiol Biomark Prevent*. 2023;32(10):1312–1322.

77 Popp R, Bansal S, Sharan S, et al. Disparities in time to treatment initiation for rectal cancer patients: an analysis of demographic and socioeconomic factors. *Front Oncol*. 2024;14.

78 Schoephoerster J, Praska C, White M, et al. A nationwide analysis of disparities in guideline-concordant care in American Indians and Alaska Natives with stage I non-small cell lung cancer. *J Thorac Dis*. 2023;15(11):5891–5900.

79 Sharan S, Bansal S, Manaise HK, et al. Time to treatment disparities in gastric cancer patients in the United States of America: a comprehensive retrospective analysis. *Front Oncol*. 2024;14:9.

80 Smith CB, Bonomi M, Packer S, Wisnivesky JP. Disparities in lung cancer stage, treatment and survival among American Indians and Alaskan Natives. *Lung Cancer*. 2011;72(2):160–164.

81 Wampler NS, Lash TL, Silliman RA, Heeren TC. Breast cancer survival of American Indian/Alaska Native women, 1973-1996. *Soz Praventivmed*. 2005;50(4):230–237.

82 Gone JP, Hartmann WE, Pomerville A, et al. The impact of historical trauma on health outcomes for Indigenous populations in the USA and Canada: a systematic review. *Am Psychol*. 2019;74(1):20–35.

83 Smallwood R, Woods C, Power T, Usher K. Understanding the impact of historical trauma due to colonization on the health and well-being of Indigenous young peoples: a systematic scoping review. *J Transcult Nurs*. 2021;32(1):59–68.

84 Braithwaite J, Hibbert P, Blakely B, et al. Health system frameworks and performance indicators in eight countries: a comparative international analysis. *SAGE Open Med*. 2017;5:2050312116686516.

85 Schneider ECS, Arnav S, Doty MM, et al. *Mirror 2021 — reflecting poorly: health care in the U.S. Compared to other high-income countries*. Commonwealth Fund; 2021:1–38.

86 Oldham P, Frank MA. 'We the peoples...': the united nations declaration on the rights of Indigenous peoples. *Anthropol Today*. 2008;24(2):5–9.

87 Martin D, Miller AP, Quesnel-Vallée A, Caron NR, Vissandjée B, Marchildon GP. Canada's universal health-care system: achieving its potential. *Lancet*. 2018;391(10131):1718–1735.

88 Australia Co. *Department of health and aged care: the Australian health system*; 2019. https://www.health.gov.au/about-us/the-australian-health-system. Accessed January 25, 2024. Updated 7 August 2019.

89 Health Mo. *New Zealand health system*. 2023. Updated 11 July 2023. Accessed January 31, 2024.

90 Cronshaw D. *Public hospitals had 'fewer and fewer outpatient clinics', AMA says, as the NSW Surgical Care Taskforce gets to work*. Newcastle/Hunter; 2023.

91 Association AM. *Shining a light on the elective surgery 'hidden' waiting list*. 2022.

92 Ross S. *Ambulance costs around Australia: why is it free in some states and not others?* ABC News; 2018.

93 Armstrong P, Congleton J, Fountain SW, et al. Guidelines on the selection of patients with lung cancer for surgery. *Thorax*. 2001;56(2):89–108.

94 Rudolfson N, Shrime MG, Alkire BC. Modelling why 70 per cent of the world's population lack access to surgery. *Br J Surg*. 2023;110(4):500–501.

95 Goodwin EA, Burhansstipanov L, Dignan M, Jones KL, Kaur JS. The experience of treatment barriers and their influence on quality of life in American Indian/Alaska Native breast cancer survivors. *Cancer*. 2017;123(5):861–868.

96 Excellence NIfHaC. *Suspected cancer: recognition and referral*; 2015. https://www.nice.org.uk/guidance/ng12. Accessed December 15, 2021.

97 Taparra K, Dee EC, Dao D, Patel R, Santos P, Chino F. Disaggregation of asian American and pacific Islander women with stage 0-II breast cancer unmasks disparities in survival and surgery-to-radiation intervals: a national cancer database analysis from 2004 to 2017. *JCO Oncol Pract*. 2022;18(8):OP2200001–e2201264.

98 Christensen D, Davis G, Draper G, et al. Evidence for the use of an algorithm in resolving inconsistent and missing Indigenous status in administrative data collections. *Aust J Soc Issues*. 2014;49(4):423–443.