Stage at diagnosis for Māori cancer patients: disparities, similarities and data limitations

Jason Gurney, James Stanley, Chris Jackson, Diana Sarfati

ABSTRACT

Māori are more likely than non-Māori to get cancer, and once they have cancer they are less likely to survive it. One frequently proposed explanation for this survival disparity is differences between these groups in terms of stage at diagnosis—whereby Māori may be less likely to be diagnosed at an earlier stage, when treatment is more feasible and outcomes are better for the patient. However, this simple explanation ignores the true complexity of the issue of stage at diagnosis as a driver of survival disparities, and makes critical assumptions about the quality of available staging data. In this manuscript we draw on New Zealand Cancer Registry and available clinical audit data to explore this issue in detail. We found that Māori are less likely than European/Other patients to have localised disease and more likely to have advanced disease for several commonly diagnosed cancers; however, we also found that this was not the case for several key cancers, including lung and liver cancer. There is evidence that Māori have more advanced disease at diagnosis for each of the cancers for which we currently have a national screening programme, reinforcing the importance of achieving equity in access to these programmes. Missing stage information on our national registry undermines our ability to both a) monitor progress towards achieving early diagnosis, and b) examine and monitor the role of stage at diagnosis as a driver of survival disparities for several important cancers for Māori, including lung, liver and stomach cancers.

Māori are more likely than non-Māori to get cancer,[1] and once they have cancer they are less likely to survive it.[1,2] One frequently proposed explanation for the observed survival differences between Māori and non-Māori New Zealanders is differential stage at diagnosis—whereby Māori may be less likely to be diagnosed at an earlier stage, when treatment is more feasible and outcomes are better for the patient.[1,3,4]

The New Zealand Cancer Registry (NZCR) is the primary source of population-level stage information for all new cases of malignant cancer diagnosed in New Zealand. The typical protocol followed by the NZCR when attributing cancer stage involves registrars manually attributing stage primarily on the basis of pathology reports following tumour excision, but also using additional information from hospitalisation records, death certificates and autopsy reports—all of which must be available in the four-month period after the cancer was first diagnosed.[5,6] For this reason, cancer staging is most complete for cancers where the primary and first treatment is surgical. To complicate matters, if neo-adjuvant therapy (such as chemotherapy or radiotherapy) is given prior to surgery, this will undermine the accuracy of the pathological staging of this cancer (since these therapies will often alter the stage). Furthermore, since the NZCR has minimal access to quality clinical staging information, they are often unable to attribute stage in cases where only a biopsy is provided or if a cancer is only diagnosed clinically without any pathology report (eg, via imaging).

Because of these limitations, the quality of data used to investigate this important prognostic indicator is sometimes not robust. For

some cancers, there are a high proportion of cases in the NZCR which are missing stage data, and for some of these cancers Māori patients are more likely than other patients to be recorded as 'unstaged'.[7] We also know that those in the 'unstaged' group are generally more likely to have more advanced disease (and associated poor outcomes), but this is not always the case.[7] This differential ascertainment of stage has (at least) two important implications: first, for at least some cancers, there is a disparity between Māori and non-Māori in the completeness of stage data on our national cancer registry. Second, the unstaged cancer issue means that it is difficult to definitively compare the distribution of cancer stage between Māori and non-Māori for a cancer where the proportion of missing stage is high, or where the level of missingness is differential by ethnicity.

Drawing on both administrative health data and more granular clinical notes data, this manuscript considers the extent to which any apparent disparity in stage between Māori and non-Māori is due to differences in data collection and/or recording by ethnicity, including whether completeness varies by cancer type. We also aim to combine these data sources to specifically explore the extent to which Māori are more likely than non-Māori to have more advanced disease at diagnosis, and to explore the characteristics of these cancers—for example, whether these cancers have a tendency to be amenable to early diagnosis, or have a more complex diagnostic pathway.

Methods

Data for this study were extracted from two sources: the NZCR and from previously published clinical note audits, for which study methods have been published elsewhere.[4,8–11] In terms of NZCR data, the current study included those diagnosed with a new malignancy between 2007–2016, as reported to the NZCR (n=196,967). Individuals were excluded if they had haematological malignancies, for which stage is never recorded in the NZCR.[6] Prioritised ethnicity was taken from the NZCR,[12] and was categorised as Māori, Pacific, Asian or non-Māori/Pacific/Asian (European/Other); however, primary analyses were restricted to comparing Māori with the European/Other population. The European/Other population were used as the reference group, since they represent the majority population in New Zealand. While all cancer types were included (excluding haematological cancers), we have focused on reporting the 10 highest-incidence cancers for Māori over the study period. All other cancers are presented in the Appendix (Appendix Tables 1–4).

For the NZCR data, cancer stage at diagnosis was based on the SEER Summary Stage method for recording stage, which largely reflects the anatomical spread of disease,[13] with this stage classified as 'A' to 'F' on the NZCR.[6] We categorised stage into Local ('B'), Regional ('C' and 'D'), Advanced ('E') and Unknown ('F').[14]

We reviewed several previously published clinical note audits. Breast cancer data were extracted from published data from the Auckland and Waikato Breast Cancer Registers, which included 12,390 female patients diagnosed with breast cancer between 2000–2013.[4,15] Colon and rectal cancer data were extracted from published data from the PIPER study, which included 3,660 patients diagnosed with colon cancer and 1,334 patients diagnosed with rectal cancer between 2007–2008.[9] Lung cancer data were extracted from published data from the Midland Lung Cancer Registry, which included 2,057 patients diagnosed with lung cancer between 2011–2015.[15] Stomach cancer data were extracted from published data from the C3 study, which included 335 patients diagnosed with stomach cancer between 2006–2008. In each of these studies, hospital notes reviews were carried out by the respective research teams and clinical staging was attributed according to the TNM clinical staging system for each cancer. Since the SEER and TNM staging systems differ in terms of how non-metastatic disease is attributed, these stages were not compared between the NZCR and notes review data sources (only distant/Stage IV and unstaged disease were included in this comparison).

Statistical analysis

For this study, two main comparisons were made: first, we compared stage at diagnosis on the NZCR between Māori and European/Other patients across all stages of diseases. Secondly, we compared data from the NZCR

to available clinical audit data on advanced and unstaged disease, for both Māori and European/Other patients.

For the NZCR data, crude descriptive analysis was used to describe the number of patients diagnosed with each cancer type by ethnicity, with stage of disease at diagnosis stratified within cancer type. To adjust for differences in population age structure between ethnic groups we directly age standardised the data to the total New Zealand cancer population from 2007–2016, giving age-standardised proportions by ethnic group. This population includes everyone diagnosed with any cancer over this time period, and was used because of the likely similarities between the age structure of this standard population and the cancer-specific populations under investigation.[11,16,17]

We compared the odds of having a given stage of disease at diagnosis between ethnic groups using unconditional logistic regression, adjusted for differences in age between groups. Results are presented as odds ratios with 95% confidence intervals. An informal descriptive comparison between NZCR and clinical notes review data was made. Further formal statistical testing was not conducted, since the existing data sources were only available in a summarised form.

Data management and analysis were performed in SAS v9.3 and Microsoft Excel. Ethical approval for the study was received from the University of Otago Human Ethics Committee (Health), reference #HD18/056.

Results

The age-standardised proportion of cancers diagnosed by stage as recorded in the NZCR is presented in Figure 1 for Māori and European/Other populations, restricted to the 10 most common cancers for Māori. Age-adjusted odds ratios comparing the likelihood of local, regional, distant and unknown stage of disease at diagnosis between Māori and European/Other patients are presented in Figure 2. The patterning of differing stage by ethnicity varied substantially by cancer type; the most substantial differences were observed for prostate cancer, wherein Māori patients were much less likely to have localised disease and much more likely to have metastatic disease than European/Other patients. On the other hand, Māori lung cancer patients appeared less likely to be diagnosed with distant metastases than European/Other patients. There was no difference by ethnicity in stage distribution for liver cancer. Complete data for all cancers and all ethnicities are presented in the Appendix (Appendix Tables 2–4).

A comparison of NZCR staging data with that derived from audits of clinical notes review data is shown in Table 1, with the key observations of this comparison further detailed in the Discussion. In brief, there was substantial difference between the NZCR and clinical notes review data in terms of the proportion of unstaged cancers, wherein stage tends to be more complete for notes review data. The most extreme example of this was observed for liver cancer, wherein only a third (~35%) had a stage on the NZCR compared to 100% in clinical notes review data. However, in this case there was no clear difference between ethnic groups in terms of stage completeness between the NZCR and clinical notes review data.

In terms of metastases, the NZCR tended to underestimate the proportion of patients with advanced disease relative to notes review data. However, both data sources tended to show the same trend in terms of ethnic differences in the proportion of metastatic disease. In other words, while the selection of data source altered the absolute proportion of Māori and European/Other patients observed to have advanced disease, it did not meaningfully alter the size of the difference between the two ethnic groups (Table 1).

Figure 1: Stacked bar chart showing the age-standardised distribution of NZCR stage of disease at diagnosis for the 10 most common cancers among Māori between 2007–2016, stratified by cancer type and ethnicity.

Figure 2: Forest plot (odds ratio with 95% confidence interval) comparing age-adjusted odds of NZCR local, regional, distant and unknown stage for Māori compared with European/Other patients, for the 10 most common cancers among Māori.

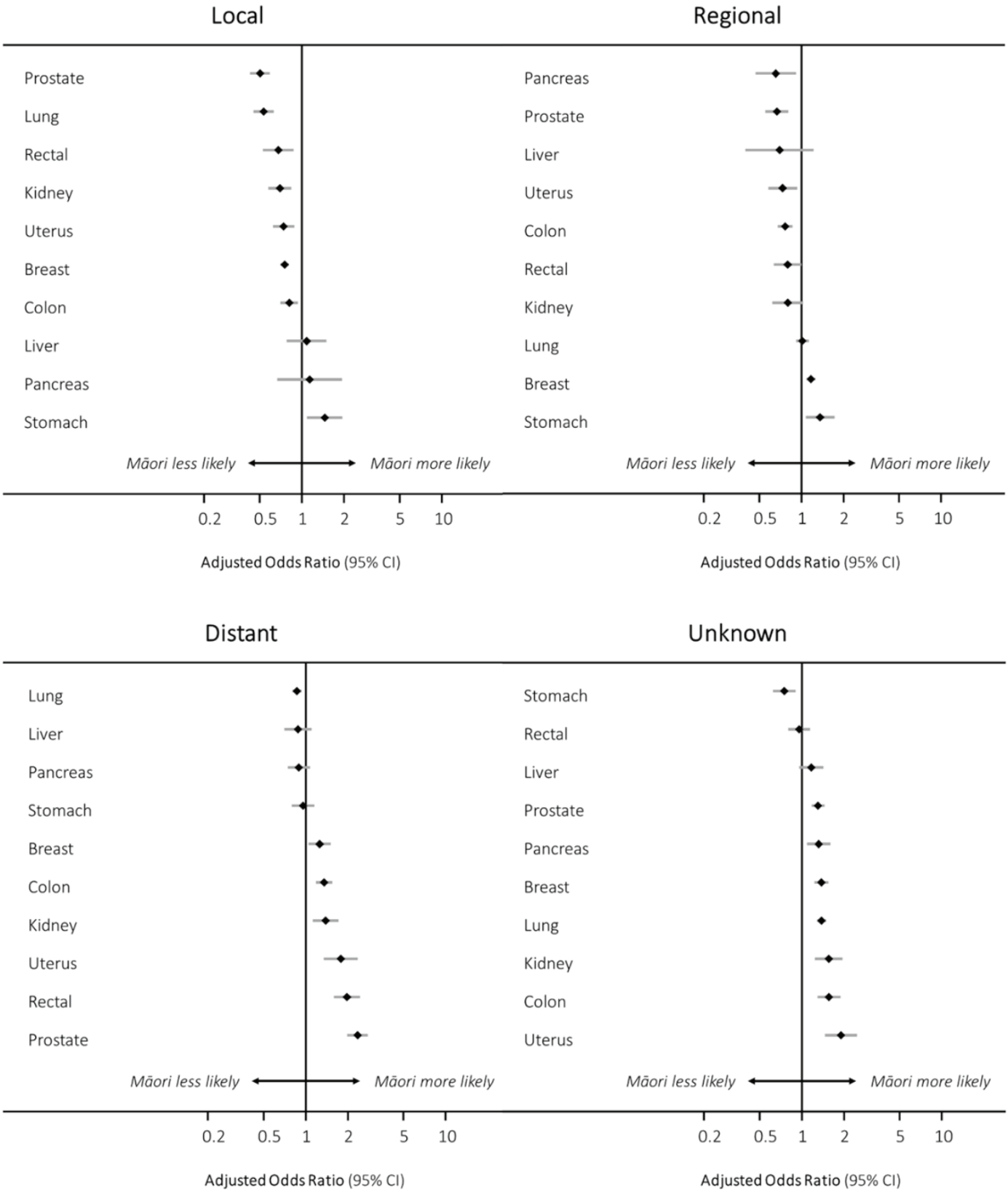

Table 1: Comparison of New Zealand Cancer Registry staging data with clinical notes review staging data, for distant/metastatic and unstaged disease. Ethnicity groupings for NZCR cohort have been altered to match the groupings used in each clinical stage study, to support comparability. All percentages are crude (unadjusted). Percentages refer to the proportion of patients with that given stage of disease within the given data source.

	SEER Stage	**n**	**%**	**n**	**%**	**Clinical stage**	**n**	**%**	**n**	**%**
Breast[a]	**NZCR, 2007–2016**					**Auckland and Waikato BCR, 2000–2013**				
		Māori		NZ European			Māori		NZ European	
	Distant	147	4%	645	3%	Metastatic (IV)	88	8%	351	4%
	Unknown	407	11%	2,034	10%	Unknown	0	0%	0	0%
Colon[b]	**NZCR, 2007–2016**					**PIPER study, 2007–2008**				
		Māori		Non-Māori/Pacific			Māori		Non-Māori/Pacific	
	Distant	341	30%	4,471	22%	Metastatic	42	29%	775	22%
	Unknown	137	12%	2,335	11%	Unknown	13	9%	267	8%
Rectal[b]	**NZCR, 2007–2016**					**PIPER study, 2007–2008**				
		Māori		Non-Māori			Māori		Non-Māori	
	Distant	129	24%	961	13%	Metastatic	40	29%	217	18%
	Unknown	224	42%	3,077	43%	Unknown	5	4%	55	5%
Lung[c]	**NZCR, 2007–2016**					**Midlands LCR, 2011–2015**				
		Māori		Non-Māori			Māori		Non-Māori	
	Distant	1,763	44%	7,577	46%	Metastatic (IV)	375	57%	830	59%
	Unknown	1,509	38%	5,929	36%	Unknown	23	4%	64	5%
Liver[d]	**NZCR, 2007–2016**					**C3 Study, 2006–2008**				
		Māori		Non-Māori			Māori		Non-Māori	
	Distant	140	23%	550	23%	Metastatic (IV)	33	34%	35	38%
	Unknown	392	64%	1,549	65%	Unknown	0	0%	0	0%
Stomach[e]	**NZCR, 2007–2016**					**C3 study, 2006–2008**				
		Māori		Non-Māori			Māori		Non-Māori	
	Distant	267	37%	1,033	33%	Metastatic (IV)	85	49%	73	45%
	Unknown	238	33%	1,437	46%	Unknown	0	0%	5	3%

[a]Clinical stage data from Tin Tin et al.[4] Stage data were missing for n=5 of 12,390 breast cancer patients (0.04% of total cohort), but this was not presented by ethnicity. [b]Clinical stage data from Jackson et al.[9] [c]Clinical stage data from Lawrenson et al.[15] [d]Clinical stage data from Chamberlain et al.[16] [e]Clinical stage data from Signal et al.[11]

Discussion

We have brought together available data on ethnic differences in stage of cancer at diagnosis from both the NZCR and previously published clinical audits. Each of these sources has its strengths and weaknesses: NZCR data has breadth (because it is mandated to capture all diagnosed malignancies), while the clinical audit data has depth (because it draws on more granular clinical notes data). Because of the complexities associated with staging many cancers, the depth that clinical audit data provides is preferable when comparing stage distribution between groups; however, the time and resource required to conduct such reviews means that such data are only available for a few cancers, and in some instances these reviews are specific to one

region. Clinical audit data is also updated with varying regularity or not at all, so has limited use for ongoing monitoring.

Where data from both sources are available (Table 1), we can make several observations. The first is that a very high proportion of several common cancers are unstaged on the NZCR (this is further discussed below). Secondly, if we assume that the clinical audit data are the gold-standard, then there appears to be a tendency for the proportion of metastatic disease to be underestimated on the NZCR (for both Māori and European/Other patients)—with these patients misclassified into other stage categories. Since both data sources are comparable in terms of how they define distant metastases (any metastases beyond the regional lymph nodes triggers the attribution of distant disease on the SEER staging system,[18] and of Stage IV disease on the clinical [TNM] staging system), this tendency for underestimation is likely linked to the issue of unstaged cancers on the NZCR. Thirdly, and perhaps most crucially, when comparing the data sources we observe that the *relative* differences between Māori and European/Other patients in the likelihood of metastatic disease remains broadly the same, regardless of whether we are using NZCR or clinical audit data (even though these differences vary across cancer types). In other words, both data sources tend to paint the same picture regarding whether Māori patients are more, less or as likely to have distant metastases at diagnosis compared to European/Other patients.

Bearing in mind these factors regarding the data sources, we have addressed a number of key questions below.

Are there real differences between Māori and non-Māori in terms of stage of disease at diagnosis?

For those cancers most commonly diagnosed among Māori, there is a tendency for Māori to be less likely to be diagnosed with localised disease than European/Other patients. The strongest examples were observed for prostate (age-adjusted OR 0.50, 95% CI 0.43–0.59) and lung cancers (age-adjusted OR 0.53, 95% CI 0.45–0.63), but this was seen to a lesser extent for rectal, kidney, uterine, breast and colon cancers (age-adjusted ORs ranging from 0.68–0.81). Māori also appear more likely to be diagnosed with distant (metastatic) disease for the same cancers (age-adjusted ORs ranging from 1.25–2.35), with the exception of lung cancer (age-adjusted OR 0.87, 95% CI 0.80–0.93). These observations regarding metastatic disease are echoed by the clinical audit data: while acknowledging substantial unstaged disease on the NZCR, the clinical notes review and NZCR data largely agree that Māori with breast, colon and rectal cancers are more likely to be diagnosed with metastatic disease (Table 1). In summary, it is clear that there remains substantial unmet need in terms of timely diagnosis for Māori for several cancers.

However, these observations are not true for all cancer types. For example, in both the NZCR and clinical audit data Māori appear to be marginally less likely to be diagnosed with metastatic lung and liver cancers than European/Other patients, and differences for pancreatic and stomach cancers are negligible. It is also important to note that we cannot fairly compare the distribution of local, regional and advanced stage cancer between Māori and European/Other groups without knowing how this distribution might be altered had all cancers been staged on the NZCR (the issue of unstaged data is further discussed later). For this reason, the comparison of stage distribution in Figures 1 and 2 should be interpreted with caution.

Is there a pattern underlying cancers for which Māori are diagnosed with more advanced disease?

What is clear from both the NZCR and clinical audit data (where available) is that Māori are more likely than European/Other patients to be diagnosed with metastatic disease for those cancers for which national screening programmes are now in place (breast, colon, rectal, and cervical; see Appendix Tables 3 and 4 for cervical cancer data). Although many of these cancers are diagnosed outside of these programmes, this observation reinforces the importance of our national screening programmes as levers by which ethnic disparities in cancer stage at diagnosis can be either reduced or exacerbated.[19]

Both NZCR and clinical audit data point to a disparity between Māori and European/Other patients in the stage of disease at

diagnosis for both colon and rectal cancers. These observations highlight the need for careful monitoring of Māori access to our new national bowel screening programme, as well as renewed investment in the care pathway to ensure equitable access to early symptom recognition and referral, followed by best-practice diagnosis and treatment for Māori patients.[20,21]

Māori also appear more likely than European/Other patients to be diagnosed with metastatic prostate cancer (and less likely to be diagnosed with localised disease), which may reflect disparities in the uptake of prostate-specific antigen (PSA) testing. A recent general population study found that asymptomatic Māori men were half as likely to be screened with a PSA test than asymptomatic non-Māori men (age-adjusted risk ratio 0.52, 95% CI 0.48-0.56).[22] Greater rates of opportunistic screening in asymptomatic European/Other men means that proportionally more of these men are being diagnosed with localised (often indolent) disease compared to Māori men—which effectively increases the denominator of European/Other men with localised disease, thereby altering stage comparisons between ethnic groups.[23] However, it remains unknown whether Māori men with early symptoms of prostate cancer are less likely to undergo a PSA test, digital rectal examination (DRE) and/or other follow-up care than symptomatic non-Māori men; any disparity in the context of examining symptomatic men is more likely to confer an important impact on patient survival than disparities in the uptake of opportunistic screening. The issue of whether or not PSA-based opportunistic screening leads to a reduction in mortality from prostate cancer remains controversial, and the benefit-to-harm ratio problematic.[24]

Outside of cancers with established (or expanding) screening programmes, we also observed that Māori appear more likely to have advanced disease for cancers with relatively complete data on the NZCR (eg, testicular, melanoma, uterine and kidney cancers[7]). This observation would support the need for heightened vigilance in primary care to support symptom recognition and early detection of these cancers for Māori patients—as well as additional attention on ensuring Māori have equal timely access to such care.

How important is stage of disease as a driver of the survival disparities between Māori and non-Māori New Zealanders?

Stage at diagnosis is an important indicator of prognosis. Given the enduring and substantial disparities in cancer survival for Māori New Zealanders, it is tempting to attribute the bulk of this disparity to later diagnosis for Māori compared to non-Māori patients. As highlighted above, there are examples where Māori are more likely to have advanced disease at diagnosis—and in some contexts such as breast cancer, this disparity directly contributes to poorer survival outcomes.[4,25]

However, there are counter-examples: for example, Māori patients with stomach, liver and lung cancer are 25% more likely to die from their cancer compared to non-Māori patients,[1] but both the NZCR and clinical notes review data (Table 1) show no evidence of a strong difference between Māori and non-Māori in the likelihood of advanced disease at diagnosis for these cancers. In other words, the survival disparities observed for these cancers cannot be explained by differential stage of disease.

Because of this variability between cancers, and because of the limitations of the available data (discussed later in this section), it is important to consider factors beyond stage at diagnosis in understanding differences in cancer survival between Māori and non-Māori, particularly in the absence of strong evidence from comprehensive reviews of clinical records. It is important to note that substantial cancer survival disparities persist between Māori and non-Māori even after adjusting for stage at diagnosis,[26] and that many other factors besides stage contribute to survival inequities for a given cancer. These include disparities in access to high-quality cancer services,[8,26,27] under-treatment of cancer patients who have comorbidity,[28] and many other service- and patient-level factors. In summary, stage is an important prognostic factor, but it is not the only important prognostic factor.

How much of the differences in stage at diagnosis are driven by limitations in the way that data are collected and reported by our national registry?

For several key cancers, NZCR staging data is inadequate for ascertaining the stage at diagnosis (particularly for Māori), and a review of clinical notes is required to gauge what is actually happening. A key example is lung cancer, where 38% of Māori (and 36% of European/Other) patients remained unstaged on the NZCR, compared to only 4% in the clinical review performed by Lawrenson et al (Table 1).[15]

This problem is largely driven by two key factors: 1) the manner in which cancer stage is attributed on the NZCR, which is dictated by a need to adhere to international best-practice in managing a high-quality cancer registry in terms of comparability, validity, timeliness and completeness;[29,30] and 2) the clinical reality of cancer staging, which is a dynamic process for many cancers (especially when surgical resection is not necessarily the first or primary treatment). This is a topic of considerable ongoing discussion: on the one hand, there is a move towards more comprehensive clinical staging information being made available on the NZCR, and on the other a move towards cancer-specific clinical registries that sit parallel to the NZCR (prime examples being breast cancer and prostate cancer). Both of these strategies are in varying stages of progress across the cancer spectrum in New Zealand.[5,15]

In terms of cancer survival disparities for Māori, the issue of unstaged cancer on the NZCR (or more broadly the absence of clinical staging data) is of crucial importance for two key reasons: firstly, it undermines our ability to use our national registry to monitor national or regional progress towards achieving early diagnosis for key cancers such as stomach (44% unstaged overall) and liver (65%). Secondly, the way that stage of disease is systematically attributed (or not attributed) on the NZCR undermines our ability to use our national registry to understand how cancer stage might drive our observed survival disparities. A key example of this is haematological cancers: all blood cancers (including leukaemia, lymphoma and myeloma) are automatically attributed a stage 'G' ('Non-Applicable') when entered onto the NZCR—driven by the NZCR adherence to the SEER staging system, which attributes cancer stage based on the extent to which it has spread from the organ of origin. Because of this caveat, we are entirely prevented from using NZCR data to understand the role of early diagnosis as a driver of the 60% survival disparity between Māori and non-Māori patients with non-Hodgkin's lymphoma (age- and sex-adjusted HR: 1.60, 95% CI 1.36–1.88).[1] Current approaches to the staging of blood cancers vary between cancer types, and tend to be include a combination of clinical imaging and blood pathology.[31,32]

Conclusions

There is strong evidence that Māori cancer patients are more likely to die of their cancer than non-Māori cancer patients, and one of the possible drivers of this inequity is differential access to timely diagnosis both through symptomatic detection and access to screening. In this manuscript we have brought together national registry and clinical notes review data, and shown that Māori are less likely to have early stage at diagnosis for several commonly diagnosed cancers; however, we have also shown that this is not the case for all cancers—which indicates that this is an area of unmet need that may be amenable to intervention. Missing stage information in our national registry undermines our ability to both a) monitor progress towards achieving early diagnosis, and b) examine and monitor the role of stage at diagnosis as a driver of survival disparities for multiple important causes of cancer death for Māori, including lung, liver and stomach cancer. Higher-quality staging information on the NZCR is likely to more accurately highlight where potential equity gaps are occurring and enable more focused policy and care interventions, in order to reduce the survival inequity between Māori and non-Māori.

Appendix

Appendix Table 1: Cancer types and associated ICD-10 codes.

Cancer type	ICD-10 Codes
Head and neck	C00-C14; C30-C32, C73
Oesophagus	C15
Stomach	C16
Small intestine	C17
Colon	C18-C19
Rectal	C20
Anus	C21
Liver	C22
Gallbladder and other biliary tract	C23-C24
Pancreas	C25
Other digestive organs	C26
Lung	C33–C34
Other respiratory and intrathoracic organs	C37-C39
Bone and articular cartilage	C40–C41
Melanoma	C43
Non-melanoma skin	C44
Mesothelial and soft tissue	C45-C49
Breast	C50
Other female genital organs	C51-C52; C57; C58
Cervix	C53
Uterus	C54–C55
Ovary	C56
Other male genital organs	C60; C63
Prostate	C61
Testis	C62
Kidney	C64
Other urinary organs	C65-C66; C68
Bladder	C67
Eye, brain and other CNS	C69-C72
Thyroid and other endocrine glands	C73-C75
Ill-defined, secondary and unspecified sites	C76-C80
Hodgkin lymphoma	C81
Non-Hodgkin lymphoma	C82–C86
Other Immunoproliferative, lymphoid and related cancers	C88; C96
Myeloma	C90
Leukaemia	C91–C95

Appendix Table 2: Māori, Pacific, Asian and European/Other New Zealanders diagnosed with cancer between 2007–2016 (NZCR), stratified by cancer type.

	Total		Māori		Pacific		Asian		Euro/Other	
Cancer type	**n**	**%[1]**	**n**	**%[1]**	**n**	**%[1]**	**n**	**%[1]**	**n**	**%[1]**
Anus	627	0.3%	66	0.3%	14	0.2%	8	0.1%	539	0.3%
Bladder	3,800	1.9%	223	1.2%	67	0.9%	72	1%	3,438	2.1%
Bone and articular cartilage	400	0.2%	70	0.4%	38	0.5%	22	0.3%	270	0.2%
Breast	29,897	15.2%	3,744	19.4%	1,399	19.1%	1,528	21.9%	23,226	14.2%
Cervix	1,611	0.8%	359	1.9%	122	1.7%	129	1.9%	1,001	0.6%
Colon	22,011	11.2%	1,153	6%	381	5.2%	650	9.3%	19,827	12.1%
Eye, brain and other CNS	3,736	1.9%	328	1.7%	146	2%	120	1.7%	3,142	1.9%
Gallbladder and other biliary tract	1,326	0.7%	180	0.9%	98	1.3%	80	1.1%	968	0.6%
Head and Neck	5,280	2.7%	497	2.6%	250	3.4%	265	3.8%	4,268	2.6%
Ill-defined, secondary and unspecified sites	4,446	2.3%	483	2.5%	200	2.7%	95	1.4%	3,668	2.2%
Kidney	5,250	2.7%	546	2.8%	164	2.2%	175	2.5%	4,365	2.7%
Liver	3,004	1.5%	611	3.2%	285	3.9%	286	4.1%	1,822	1.1%
Lung	20,651	10.5%	4,009	20.8%	889	12.1%	802	11.5%	14,951	9.1%
Melanoma	23,200	11.8%	339	1.8%	66	0.9%	39	0.6%	22,756	13.9%
Mesothelial and soft tissue	2,577	1.3%	278	1.4%	125	1.7%	75	1.1%	2,099	1.3%
Oesophagus	2,863	1.5%	257	1.3%	71	1%	55	0.8%	2,480	1.5%
Other digestive organs	1,179	0.6%	118	0.6%	38	0.5%	44	0.6%	979	0.6%
Other female genital organs	1,208	0.6%	136	0.7%	65	0.9%	49	0.7%	958	0.6%
Other male genital organs	191	0.1%	8	0%	3	0%	11	0.2%	169	0.1%
Other respiratory and intrathoracic organs	274	0.1%	58	0.3%	23	0.3%	30	0.4%	163	0.1%
Other urinary organs	707	0.4%	20	0.1%	17	0.2%	40	0.6%	630	0.4%
Ovary	2,811	1.4%	297	1.5%	164	2.2%	139	2%	2,211	1.4%
Pancreas	5,122	2.6%	574	3%	176	2.4%	196	2.8%	4,176	2.6%
Prostate	31,460	16%	1,903	9.9%	869	11.8%	719	10.3%	27,969	17.1%
Rectal	7,683	3.9%	530	2.8%	246	3.4%	308	4.4%	6,599	4%
Skin (not melanoma)	1,384	0.7%	65	0.3%	23	0.3%	14	0.2%	1,282	0.8%
Small intestine	972	0.5%	135	0.7%	61	0.8%	27	0.4%	749	0.5%
Stomach	3,831	1.9%	725	3.8%	344	4.7%	295	4.2%	2,467	1.5%
Testis	1,525	0.8%	336	1.7%	55	0.7%	40	0.6%	1,094	0.7%
Thyroid and other endocrine glands	2,990	1.5%	507	2.6%	267	3.6%	369	5.3%	1,847	1.1%
Uterus	4,951	2.5%	705	3.7%	674	9.2%	284	4.1%	3,288	2%

[1]Crude column percentage.

Appendix Table 3: Māori, Pacific, Asian and European/Other New Zealanders diagnosed with cancer between 2007–2016 (NZCR), stratified by cancer type and stage of disease.

	Total		Māori		Pacific		Asian		Euro/Other	
Cancer type and stage	n	%	n	% (95% CI)	n	%	n	%	n	%
Anus										
Local	49	8%	10	16% (6%,26%)	1	5% (-4%,13%)	1	2% (-2%,7%)	37	7% (5%,9%)
Regional	104	17%	6	9% (1%,17%)	4	20% (5%,35%)	1	28% (28%,28%)	93	17% (14%,20%)
Advanced	50	8%	10	14% (5%,23%)	4	21% (4%,38%)	3	20% (-1%,41%)	33	6% (4%,8%)
Unknown	424	68%	40	59% (46%,73%)	5	54% (38%,69%)	3	20% (-1%,41%)	376	70% (66%,74%)
Bladder										
Local	262	7%	19	8% (5%,12%)	4	6% (0%,11%)	7	9% (3%,15%)	232	8% (7%,10%)
Regional	436	11%	34	15% (10%,19%)	10	16% (7%,25%)	8	12% (6%,19%)	384	13% (12%,15%)
Advanced	440	12%	25	11% (7%,15%)	16	25% (14%,35%)	7	10% (3%,17%)	392	12% (11%,13%)
Unknown	2,662	70%	145	65% (59%,71%)	37	53% (41%,65%)	50	68% (58%,78%)	2,430	66% (64%,68%)
Bone and articular cartilage										
Local	36	9%	3	2% (0%,4%)	1	15% (-6%,35%)	1	0% (0%,0%)	31	15% (9%,20%)
Regional	104	26%	12	2% (0%,3%)	6	16% (-5%,36%)	4	15% (-4%,35%)	82	30% (23%,37%)
Advanced	76	19%	18	21% (4%,37%)	9	30% (27%,32%)	6	17% (-3%,36%)	43	16% (10%,22%)
Unknown	184	46%	37	46% (30%,62%)	22	40% (37%,43%)	11	9% (5%,12%)	114	40% (32%,48%)
Breast										
Local	15,561	52%	1,790	45% (43%,47%)	562	38% (35%,41%)	805	52% (48%,56%)	12,404	52% (51%,53%)
Regional	9,888	33%	1,400	34% (32%,36%)	526	33% (30%,37%)	521	31% (28%,35%)	7,441	31% (30%,32%)
Advanced	1,128	4%	147	5% (4%,6%)	103	9% (7%,12%)	38	3% (1%,4%)	840	4% (4%,4%)
Unknown	3,320	11%	407	16% (14%,18%)	208	19% (16%,23%)	164	14% (11%,17%)	2,541	13% (12%,13%)
Cervix										
Local	624	39%	143	23% (16%,30%)	19	8% (4%,12%)	59	25% (17%,33%)	403	22% (19%,25%)
Regional	277	17%	51	21% (12%,31%)	25	19% (8%,31%)	23	23% (10%,37%)	178	22% (19%,26%)
Advanced	183	11%	44	20% (11%,29%)	24	25% (12%,38%)	8	16% (3%,30%)	107	17% (14%,20%)
Unknown	527	33%	121	36% (26%,45%)	54	47% (32%,61%)	39	36% (20%,51%)	313	39% (34%,43%)
Colon										
Local	5,256	24%	248	21% (19%,24%)	59	15% (11%,18%)	158	24% (21%,27%)	4,791	24% (24%,25%)
Regional	9,295	42%	427	37% (35%,40%)	146	37% (32%,42%)	280	44% (40%,47%)	8,442	43% (42%,43%)
Advanced	4,932	22%	341	29% (26%,31%)	120	31% (26%,36%)	140	21% (18%,25%)	4,331	23% (23%,24%)
Unknown	2,528	11%	137	13% (11%,15%)	56	17% (13%,21%)	72	11% (9%,14%)	2,263	10% (9%,10%)
Eye, brain and other CNS										
Local	3,218	86%	272	94% (91%,98%)	119	95% (91%,98%)	106	90% (79%,101%)	2,721	87% (86%,89%)
Regional	48	1%	7	1% (0%,2%)	2	0% (0%,1%)	2	1% (-1%,4%)	37	1% (1%,1%)
Advanced	50	1%	11	0% (0%,1%)	6	1% (-1%,3%)	2	1% (-1%,2%)	31	1% (0%,1%)
Unknown	420	11%	38	5% (2%,8%)	19	4% (1%,7%)	10	8% (-3%,18%)	353	11% (10%,12%)
Gallbladder and other biliary tract										
Local	100	8%	23	13% (8%,17%)	4	4% (0%,7%)	6	8% (2%,14%)	67	8% (6%,10%)
Regional	312	24%	50	27% (20%,33%)	18	16% (10%,22%)	18	23% (13%,32%)	226	27% (23%,30%)
Advanced	457	34%	63	34% (27%,41%)	45	45% (35%,55%)	27	32% (22%,42%)	322	33% (30%,36%)
Unknown	457	34%	44	26% (19%,32%)	31	35% (26%,44%)	29	37% (27%,47%)	353	31% (28%,34%)
Head and neck										
Local	1,292	24%	76	14% (10%,17%)	38	15% (10%,21%)	50	21% (15%,28%)	1,128	27% (25%,28%)
Regional	1,690	32%	185	35% (30%,40%)	84	31% (25%,38%)	84	29% (22%,36%)	1,337	31% (29%,32%)
Advanced	369	7%	43	9% (6%,13%)	35	13% (8%,18%)	18	9% (4%,14%)	273	6% (6%,7%)
Unknown	1,929	37%	193	42% (36%,47%)	93	40% (33%,47%)	113	40% (33%,47%)	1,530	36% (35%,38%)

Appendix Table 3: Māori, Pacific, Asian and European/Other New Zealanders diagnosed with cancer between 2007–2016 (NZCR), stratified by cancer type and stage of disease (continued).

Ill-defined, secondary and unspecified sites										
Local	-	0%	-	-	-	-	-	-	-	-
Regional	15	0%	2	0% (0%,1%)	-	-	-	-	13	1% (0%,1%)
Advanced	4,142	93%	454	94% (92%,96%)	190	95% (93%,98%)	89	93% (88%,98%)	3,409	94% (94%,95%)
Unknown	289	7%	27	6% (4%,8%)	10	5% (2%,7%)	6	6% (1%,11%)	246	5% (4%,6%)
Kidney										
Local	2,237	43%	220	34% (30%,39%)	69	33% (25%,42%)	88	45% (37%,52%)	1,860	42% (41%,44%)
Regional	862	16%	79	13% (10%,16%)	24	11% (5%,17%)	29	18% (12%,24%)	730	17% (15%,18%)
Advanced	1,143	22%	134	25% (21%,30%)	25	24% (14%,34%)	26	17% (11%,23%)	958	22% (21%,23%)
Unknown	1,008	19%	113	28% (23%,32%)	46	32% (22%,42%)	32	20% (14%,27%)	817	19% (18%,20%)
Liver										
Local	282	9%	62	8% (6%,10%)	31	9% (6%,12%)	57	18% (14%,22%)	132	8% (7%,10%)
Regional	91	3%	17	2% (1%,3%)	7	2% (0%,4%)	7	2% (1%,4%)	60	4% (3%,5%)
Advanced	690	23%	140	25% (21%,28%)	61	21% (16%,26%)	46	17% (12%,21%)	443	25% (23%,27%)
Unknown	1,941	65%	392	65% (61%,70%)	186	67% (62%,73%)	176	63% (57%,69%)	1,187	63% (61%,65%)
Lung										
Local	1,279	6%	179	4% (4%,5%)	44	5% (3%,6%)	83	10% (8%,12%)	973	8% (8%,9%)
Regional	2,594	13%	558	13% (12%,14%)	107	12% (10%,14%)	125	15% (13%,18%)	1,804	13% (12%,13%)
Advanced	9,340	45%	1,763	44% (42%,46%)	488	56% (52%,59%)	388	48% (45%,51%)	6,701	46% (46%,47%)
Unknown	7,438	36%	1,509	39% (37%,40%)	250	28% (25%,31%)	206	26% (23%,29%)	5,473	33% (32%,33%)
Melanoma										
Local	19,146	83%	251	70% (64%,75%)	35	53% (41%,65%)	24	59% (42%,75%)	18,836	82% (82%,83%)
Regional	1,752	8%	33	10% (6%,13%)	9	14% (6%,22%)	9	24% (10%,38%)	1,701	8% (7%,8%)
Advanced	1,186	5%	36	13% (8%,17%)	15	22% (13%,32%)	5	15% (2%,28%)	1,130	5% (5%,5%)
Unknown	1,116	5%	19	8% (4%,11%)	7	10% (3%,18%)	1	2% (-2%,6%)	1,089	5% (5%,5%)
Mesothelial and soft tissue										
Local	386	15%	48	17% (11%,22%)	29	28% (18%,38%)	18	19% (9%,28%)	291	14% (13%,16%)
Regional	168	7%	14	4% (2%,7%)	16	7% (3%,12%)	5	3% (-1%,8%)	133	7% (6%,8%)
Advanced	594	23%	74	23% (17%,29%)	28	19% (12%,25%)	14	24% (11%,36%)	478	22% (20%,24%)
Unknown	1,429	55%	142	56% (48%,63%)	52	46% (35%,57%)	38	54% (40%,69%)	1,197	57% (55%,59%)
Oesophagus										
Local	61	2%	4	1% (0%,3%)	1	1% (-1%,3%)	1	2% (-1%,5%)	55	3% (2%,4%)
Regional	225	8%	21	7% (4%,10%)	5	7% (1%,13%)	5	8% (1%,15%)	194	9% (8%,10%)
Advanced	747	26%	83	32% (26%,37%)	23	30% (20%,40%)	14	28% (15%,41%)	627	28% (26%,30%)
Unknown	1,830	64%	149	59% (53%,65%)	42	61% (51%,72%)	35	61% (47%,75%)	1,604	59% (57%,62%)
Other digestive organs										
Local	1	0%	-	-	-	-	-	-	1	0% (0%,1%)
Regional	12	1%	1	1% (-1%,3%)	1	2% (-2%,7%)	1	2% (-2%,6%)	9	1% (0%,2%)
Advanced	655	56%	91	75% (69%,82%)	27	72% (60%,84%)	37	85% (76%,94%)	500	72% (69%,74%)
Unknown	511	43%	26	24% (17%,30%)	10	24% (12%,36%)	6	12% (4%,20%)	469	27% (24%,30%)
Other female genital organs										
Local	375	31%	32	19% (12%,25%)	9	17% (6%,27%)	9	13% (5%,20%)	325	34% (31%,37%)
Regional	176	15%	15	9% (4%,13%)	6	7% (2%,12%)	6	10% (2%,17%)	149	16% (13%,18%)
Advanced	390	32%	46	36% (27%,45%)	33	45% (32%,58%)	22	45% (30%,61%)	289	30% (27%,33%)
Unknown	267	22%	43	35% (27%,44%)	17	32% (19%,44%)	12	33% (19%,46%)	195	20% (18%,23%)

Appendix Table 3: Māori, Pacific, Asian and European/Other New Zealanders diagnosed with cancer between 2007–2016 (NZCR), stratified by cancer type and stage of disease (continued).

Other male genital organs										
Local	111	58%	4	50% (37%,63%)	1	15% (-6%,35%)	4	36% (15%,57%)	102	60% (53%,68%)
Regional	42	22%	3	34% (10%,58%)	1	12% (12%,12%)	4	40% (24%,55%)	34	20% (14%,26%)
Advanced	4	2%	1	15% (-6%,35%)	-	-	-	-	3	2% (0%,3%)
Unknown	34	18%	-	-	1	15% (-6%,35%)	3	24% (3%,44%)	30	18% (12%,24%)
Other respiratory and intrathoracic organs										
Local	20	7%	3	4% (0%,8%)	-	-	3	8% (-2%,17%)	14	9% (5%,14%)
Regional	57	21%	9	16% (4%,29%)	10	39% (18%,60%)	9	34% (10%,58%)	29	17% (12%,23%)
Advanced	80	29%	18	34% (18%,49%)	4	3% (0%,6%)	7	21% (7%,34%)	51	29% (22%,36%)
Unknown	117	43%	28	46% (30%,62%)	9	28% (7%,49%)	11	38% (13%,63%)	69	44% (36%,52%)
Other urinary organs										
Local	147	21%	3	13% (-1%,28%)	3	35% (28%,42%)	9	26% (12%,41%)	132	24% (19%,28%)
Regional	213	30%	6	26% (8%,44%)	5	16% (3%,29%)	15	31% (19%,44%)	187	29% (25%,33%)
Advanced	139	20%	5	26% (8%,45%)	5	16% (3%,29%)	8	22% (8%,35%)	121	19% (16%,23%)
Unknown	208	29%	6	21% (7%,34%)	4	19% (6%,32%)	8	20% (7%,33%)	190	27% (23%,31%)
Ovary										
Local	417	15%	71	14% (10%,18%)	34	14% (8%,21%)	27	10% (6%,14%)	285	13% (12%,14%)
Regional	496	18%	56	15% (11%,20%)	40	20% (13%,27%)	36	24% (15%,33%)	364	17% (15%,18%)
Advanced	1,692	60%	144	58% (51%,65%)	77	56% (46%,65%)	71	63% (54%,72%)	1,400	63% (61%,65%)
Unknown	206	7%	26	12% (7%,17%)	13	10% (3%,17%)	5	3% (0%,7%)	162	7% (6%,8%)
Pancreas										
Local	108	2%	19	3% (2%,4%)	5	3% (1%,5%)	11	6% (3%,9%)	73	2% (2%,3%)
Regional	421	8%	45	7% (5%,9%)	11	6% (3%,10%)	23	12% (7%,16%)	342	10% (9%,11%)
Advanced	2,761	54%	310	53% (49%,58%)	99	57% (49%,64%)	103	53% (46%,60%)	2,249	56% (54%,57%)
Unknown	1,832	36%	200	36% (32%,40%)	61	34% (28%,41%)	59	30% (23%,36%)	1,512	32% (31%,34%)
Prostate										
Local	4,484	14%	176	9% (7%,10%)	46	7% (4%,9%)	84	12% (9%,15%)	4,178	16% (16%,17%)
Regional	2,650	8%	120	5% (4%,6%)	46	6% (4%,8%)	60	7% (5%,8%)	2,424	8% (8%,8%)
Advanced	1,874	6%	179	11% (10%,13%)	95	12% (10%,15%)	34	5% (4%,7%)	1,566	6% (6%,7%)
Unknown	22,452	71%	1,428	74% (71%,76%)	682	74% (70%,78%)	541	75% (71%,79%)	19,801	69% (69%,70%)
Rectal										
Local	1,520	20%	76	14% (10%,17%)	26	11% (7%,15%)	65	21% (16%,25%)	1,353	20% (19%,21%)
Regional	1,772	23%	101	19% (16%,23%)	61	25% (19%,31%)	70	23% (18%,28%)	1,540	23% (22%,24%)
Advanced	1,090	14%	129	22% (18%,26%)	44	18% (13%,24%)	36	12% (8%,16%)	881	14% (13%,15%)
Unknown	3,301	43%	224	44% (39%,49%)	115	45% (38%,51%)	137	44% (39%,50%)	2,825	43% (42%,44%)
Skin (not melanoma)										
Local	726	52%	37	59% (47%,70%)	12	59% (42%,76%)	9	51% (31%,70%)	668	54% (51%,57%)
Regional	159	11%	7	10% (3%,16%)	3	11% (-2%,24%)	-	-	149	12% (10%,14%)
Advanced	98	7%	4	9% (0%,17%)	2	10% (-3%,23%)	1	14% (-5%,33%)	91	7% (5%,8%)
Unknown	401	29%	17	23% (14%,32%)	6	18% (4%,33%)	4	6% (1%,10%)	374	27% (24%,30%)
Small intestine										
Local	125	13%	23	17% (10%,24%)	7	10% (2%,18%)	3	12% (0%,25%)	92	12% (10%,15%)
Regional	384	40%	57	45% (36%,55%)	21	37% (24%,50%)	11	41% (23%,60%)	295	40% (36%,43%)
Advanced	285	29%	38	25% (18%,33%)	20	30% (19%,41%)	4	14% (1%,27%)	223	30% (26%,33%)
Unknown	178	18%	17	12% (6%,19%)	13	22% (11%,33%)	9	31% (15%,48%)	139	18% (16%,21%)

Appendix Table 3: Māori, Pacific, Asian and European/Other New Zealanders diagnosed with cancer between 2007–2016 (NZCR), stratified by cancer type and stage of disease (continued).

Stomach										
Local	311	8%	89	9% (7%,11%)	27	8% (5%,11%)	27	9% (6%,13%)	168	7% (6%,8%)
Regional	545	14%	131	19% (16%,22%)	45	13% (9%,17%)	51	17% (13%,21%)	318	14% (12%,15%)
Advanced	1,300	34%	267	36% (32%,40%)	125	33% (28%,38%)	107	35% (30%,41%)	801	35% (33%,37%)
Unknown	1,675	44%	238	36% (32%,40%)	147	46% (41%,51%)	110	38% (33%,44%)	1,180	45% (43%,47%)
Testis										
Local	1,178	77%	247	60% (54%,65%)	35	24% (3%,44%)	33	40% (39%,42%)	863	64% (55%,73%)
Regional	158	10%	30	5% (1%,10%)	7	16% (-4%,37%)	3	1% (0%,2%)	118	19% (9%,28%)
Advanced	158	10%	52	35% (31%,38%)	10	2% (1%,3%)	3	1% (0%,2%)	93	9% (3%,15%)
Unknown	31	2%	7	0% (0%,1%)	3	1% (0%,2%)	1	0% (0%,1%)	20	9% (1%,17%)
Thyroid and other endocrine glands										
Local	1,642	55%	270	41% (34%,48%)	135	40% (31%,50%)	203	49% (40%,58%)	1,034	51% (49%,54%)
Regional	726	24%	108	25% (18%,33%)	61	22% (14%,30%)	116	31% (22%,40%)	441	24% (21%,26%)
Advanced	249	8%	54	16% (10%,23%)	34	16% (8%,23%)	17	11% (4%,18%)	144	10% (8%,12%)
Unknown	373	12%	75	17% (11%,24%)	37	22% (13%,31%)	33	9% (4%,14%)	228	15% (13%,17%)
Uterus										
Local	3,146	64%	447	56% (52%,61%)	385	48% (43%,54%)	190	64% (55%,73%)	2,124	63% (61%,65%)
Regional	838	17%	94	12% (9%,15%)	84	14% (10%,18%)	47	16% (10%,23%)	613	19% (17%,20%)
Advanced	417	8%	76	14% (10%,18%)	77	13% (10%,17%)	16	6% (2%,11%)	248	8% (7%,9%)
Unknown	550	11%	88	18% (14%,21%)	128	24% (19%,29%)	31	13% (6%,20%)	303	10% (9%,12%)

[1]Age-standardised proportion.

Appendix Table 4: Age-adjusted odds of stage of disease between European/Other (reference) and Māori, Pacific and Asian New Zealanders, by cancer type (NZCR).

	Māori	**Pacific**	**Asian**	**Euro/Other**
Cancer type and stage	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Anus				
Local	2.65 (1.23, 5.7)	1.09 (0.14, 8.57)	2.55 (0.29, 22.34)	Reference
Regional	0.85 (0.7, 1.04)	0.76 (0.59, 0.99)	0.91 (0.72, 1.14)	Reference
Advanced	1.36 (1.07, 1.72)	0.94 (0.67, 1.33)	1.34 (0.96, 1.85)	Reference
Unknown	0.96 (0.34, 2.72)	1.45 (0.33, 6.39)	1.46 (0.18, 11.99)	Reference
Bladder				
Local	0.91 (0.55, 1.5)	0.67 (0.24, 1.89)	1.19 (0.53, 2.64)	Reference
Regional	0.74 (0.62, 0.88)	0.5 (0.41, 0.59)	0.8 (0.61, 1.04)	Reference
Advanced	0.86 (0.56, 1.32)	1.31 (0.58, 2.98)	0.73 (0.22, 2.41)	Reference
Unknown	0.86 (0.57, 1.31)	1.09 (0.62, 1.91)	0.41 (0.14, 1.18)	Reference
Bone and articular cartilage				
Local	0.41 (0.12, 1.42)	0.24 (0.03, 1.86)	0.43 (0.06, 3.34)	Reference
Regional	0.51 (0.21, 1.21)	1.97 (0.6, 6.42)	0.81 (0.1, 6.85)	Reference
Advanced	0.87 (0.68, 1.1)	0.95 (0.7, 1.29)	1.47 (1.15, 1.88)	Reference
Unknown	0.96 (0.8, 1.15)	0.98 (0.77, 1.24)	1.02 (0.79, 1.32)	Reference

Appendix Table 4: Age-adjusted odds of stage of disease between European/Other (reference) and Māori, Pacific and Asian New Zealanders, by cancer type (NZCR) (continued).

Breast				
Local	0.75 (0.7, 0.81)	0.55 (0.49, 0.61)	0.89 (0.81, 0.99)	Reference
Regional	1.17 (1.09, 1.26)	1.17 (1.04, 1.31)	0.98 (0.88, 1.1)	Reference
Advanced	1.26 (1.05, 1.51)	2.5 (2.02, 3.1)	0.83 (0.59, 1.15)	Reference
Unknown	1.38 (1.23, 1.55)	2.08 (1.77, 2.44)	1.52 (1.28, 1.8)	Reference
Cervix				
Local	0.8 (0.61, 1.04)	0.3 (0.18, 0.5)	1.29 (0.87, 1.91)	Reference
Regional	0.84 (0.6, 1.19)	1.18 (0.73, 1.88)	1.05 (0.65, 1.7)	Reference
Advanced	1.47 (1, 2.17)	2.14 (1.3, 3.52)	0.62 (0.29, 1.32)	Reference
Unknown	1.56 (1.29, 1.89)	2.12 (1.57, 2.85)	1.33 (1.03, 1.72)	Reference
Colon				
Local	0.81 (0.7, 0.94)	0.54 (0.41, 0.72)	0.97 (0.8, 1.16)	Reference
Regional	0.77 (0.68, 0.87)	0.81 (0.65, 0.99)	0.99 (0.85, 1.16)	Reference
Advanced	1.35 (1.18, 1.55)	1.46 (1.17, 1.83)	0.9 (0.75, 1.09)	Reference
Unknown	1.56 (1.29, 1.89)	2.12 (1.57, 2.85)	1.33 (1.03, 1.72)	Reference
Eye, brain and other CNS				
Local	1.09 (0.79, 1.51)	1.05 (0.67, 1.65)	1.54 (0.86, 2.73)	Reference
Regional	1.18 (0.5, 2.8)	0.7 (0.16, 3.05)	1.05 (0.25, 4.49)	Reference
Advanced	1.62 (0.77, 3.43)	1.82 (0.71, 4.67)	1.03 (0.24, 4.42)	Reference
Unknown	0.78 (0.54, 1.13)	0.85 (0.51, 1.42)	0.59 (0.3, 1.14)	Reference
Gallbladder and other biliary tract				
Local	1.59 (0.95, 2.68)	0.43 (0.15, 1.23)	0.94 (0.39, 2.25)	Reference
Regional	0.92 (0.63, 1.35)	0.48 (0.28, 0.85)	0.76 (0.43, 1.34)	Reference
Advanced	1.03 (0.73, 1.45)	1.61 (1.05, 2.48)	0.99 (0.61, 1.61)	Reference
Unknown	0.82 (0.56, 1.2)	1.28 (0.8, 2.06)	1.3 (0.79, 2.14)	Reference
Head and neck				
Local	0.48 (0.37, 0.62)	0.47 (0.33, 0.68)	0.61 (0.44, 0.84)	Reference
Regional	1.17 (0.96, 1.42)	0.99 (0.75, 1.3)	0.88 (0.67, 1.15)	Reference
Advanced	1.44 (1.02, 2.03)	2.48 (1.69, 3.65)	1.12 (0.68, 1.85)	Reference
Unknown	1.3 (1.07, 1.58)	1.23 (0.94, 1.6)	1.59 (1.23, 2.06)	Reference
Ill-defined, secondary and unspecified sites				
Local	-	-	-	Reference
Regional	-	-	-	Reference
Advanced	0.62 (0.41, 0.94)	0.8 (0.41, 1.55)	0.77 (0.33, 1.81)	Reference
Unknown	1.73 (1.12, 2.67)	1.44 (0.74, 2.81)	1.43 (0.61, 3.38)	Reference

Appendix Table 4: Age-adjusted odds of stage of disease between European/Other (reference) and Māori, Pacific and Asian New Zealanders, by cancer type (NZCR) (continued).

Kidney				
Local	0.7 (0.58, 0.84)	0.67 (0.48, 0.93)	1.07 (0.78, 1.47)	Reference
Regional	0.8 (0.62, 1.03)	0.79 (0.51, 1.23)	0.94 (0.62, 1.41)	Reference
Advanced	1.39 (1.12, 1.72)	0.81 (0.53, 1.26)	0.73 (0.48, 1.12)	Reference
Unknown	1.56 (1.24, 1.96)	2.66 (1.84, 3.83)	1.28 (0.86, 1.92)	Reference
Liver				
Local	1.08 (0.78, 1.5)	1.25 (0.82, 1.91)	2.7 (1.91, 3.82)	Reference
Regional	0.7 (0.4, 1.22)	0.64 (0.29, 1.42)	0.65 (0.29, 1.44)	Reference
Advanced	0.88 (0.7, 1.1)	0.82 (0.6, 1.11)	0.58 (0.41, 0.81)	Reference
Unknown	1.17 (0.96, 1.43)	1.17 (0.89, 1.53)	0.97 (0.75, 1.26)	Reference
Lung				
Local	0.53 (0.45, 0.63)	0.61 (0.45, 0.83)	1.37 (1.08, 1.74)	Reference
Regional	1.02 (0.92, 1.13)	0.88 (0.71, 1.08)	1.19 (0.98, 1.46)	Reference
Advanced	0.87 (0.8, 0.93)	1.37 (1.2, 1.57)	1.06 (0.92, 1.23)	Reference
Unknown	1.38 (1.28, 1.49)	0.83 (0.71, 0.97)	0.71 (0.61, 0.84)	Reference
Melanoma				
Local	0.52 (0.41, 0.67)	0.22 (0.14, 0.36)	0.3 (0.16, 0.58)	Reference
Regional	1.52 (1.06, 2.19)	2.04 (1, 4.14)	4.13 (1.94, 8.77)	Reference
Advanced	2.49 (1.75, 3.55)	5.82 (3.25, 10.4)	3.01 (1.17, 7.73)	Reference
Unknown	1.3 (0.81, 2.07)	2.43 (1.11, 5.35)	0.56 (0.08, 4.08)	Reference
Mesothelial and soft tissue				
Local	1.14 (0.81, 1.61)	1.64 (1.05, 2.55)	1.71 (0.98, 2.96)	Reference
Regional	0.66 (0.37, 1.17)	1.81 (1.03, 3.18)	0.87 (0.34, 2.22)	Reference
Advanced	1.19 (0.89, 1.6)	0.95 (0.61, 1.47)	0.75 (0.42, 1.36)	Reference
Unknown	0.91 (0.7, 1.17)	0.62 (0.43, 0.9)	0.9 (0.57, 1.44)	Reference
Oesophagus				
Local	0.45 (0.16, 1.27)	0.42 (0.06, 3.11)	0.69 (0.09, 5.12)	Reference
Regional	0.8 (0.5, 1.3)	0.7 (0.28, 1.78)	1.07 (0.42, 2.73)	Reference
Advanced	1.14 (0.85, 1.51)	1.17 (0.7, 1.96)	0.93 (0.5, 1.73)	Reference
Unknown	1.03 (0.78, 1.35)	1.04 (0.63, 1.71)	1.08 (0.61, 1.9)	Reference
Other digestive organs				
Local	-	-	-	Reference
Regional	0.85 (0.1, 7.31)	2.71 (0.31, 23.4)	2.34 (0.27, 20.06)	Reference
Advanced	1.05 (0.61, 1.79)	0.77 (0.33, 1.79)	2.6 (0.99, 6.81)	Reference
Unknown	0.98 (0.57, 1.7)	1.19 (0.5, 2.83)	0.32 (0.12, 0.89)	Reference

Appendix Table 4: Age-adjusted odds of stage of disease between European/Other (reference) and Māori, Pacific and Asian New Zealanders, by cancer type (NZCR) (continued).

Other female genital organs				
Local	0.52 (0.34, 0.8)	0.27 (0.13, 0.55)	0.38 (0.18, 0.79)	Reference
Regional	0.62 (0.35, 1.1)	0.5 (0.21, 1.2)	0.69 (0.29, 1.67)	Reference
Advanced	1.24 (0.84, 1.83)	2.52 (1.51, 4.2)	1.99 (1.11, 3.58)	Reference
Unknown	2.14 (1.43, 3.22)	1.66 (0.92, 2.98)	1.53 (0.77, 3.02)	Reference
Other male genital organs				
Local	0.65 (0.16, 2.71)	0.4 (0.03, 4.69)	0.37 (0.1, 1.31)	Reference
Regional	2.38 (0.54, 10.48)	1.9 (0.16, 22.72)	2.28 (0.63, 8.25)	Reference
Advanced	-	-	-	Reference
Unknown	-	-	-	Reference
Other respiratory and intrathoracic organs				
Local	-	-	-	Reference
Regional	0.86 (0.38, 1.94)	3.91 (1.48, 10.32)	2.09 (0.85, 5.11)	Reference
Advanced	0.97 (0.51, 1.86)	0.38 (0.12, 1.22)	0.6 (0.24, 1.51)	Reference
Unknown	1.28 (0.7, 2.34)	0.96 (0.38, 2.42)	0.83 (0.37, 1.87)	Reference
Other urinary organs				
Local	0.62 (0.18, 2.17)	0.58 (0.16, 2.06)	0.89 (0.41, 1.95)	Reference
Regional	1 (0.38, 2.63)	0.89 (0.31, 2.59)	1.34 (0.69, 2.62)	Reference
Advanced	1.4 (0.5, 3.94)	1.77 (0.6, 5.18)	1.06 (0.47, 2.36)	Reference
Unknown	1.1 (0.41, 2.95)	1.14 (0.36, 3.62)	0.71 (0.32, 1.61)	Reference
Ovary				
Local	1.16 (0.84, 1.59)	0.82 (0.53, 1.27)	0.77 (0.48, 1.24)	Reference
Regional	1 (0.72, 1.37)	1.35 (0.92, 1.99)	1.46 (0.97, 2.19)	Reference
Advanced	0.78 (0.6, 1.01)	0.77 (0.55, 1.08)	0.93 (0.65, 1.33)	Reference
Unknown	1.8 (1.14, 2.83)	1.67 (0.91, 3.06)	0.74 (0.3, 1.87)	Reference
Pancreas				
Local	1.14 (0.67, 1.94)	0.88 (0.34, 2.3)	2.27 (1.16, 4.43)	Reference
Regional	0.65 (0.47, 0.92)	0.5 (0.26, 0.94)	1.13 (0.71, 1.78)	Reference
Advanced	0.89 (0.75, 1.07)	0.99 (0.73, 1.35)	0.87 (0.65, 1.16)	Reference
Unknown	1.32 (1.09, 1.6)	1.24 (0.89, 1.72)	0.96 (0.69, 1.32)	Reference
Prostate				
Local	0.5 (0.43, 0.59)	0.29 (0.22, 0.39)	0.74 (0.59, 0.94)	Reference
Regional	0.67 (0.55, 0.81)	0.57 (0.42, 0.77)	0.96 (0.73, 1.25)	Reference
Advanced	2.35 (1.98, 2.78)	2.67 (2.12, 3.36)	0.9 (0.63, 1.29)	Reference
Unknown	1.31 (1.17, 1.46)	1.55 (1.31, 1.83)	1.26 (1.06, 1.5)	Reference

Appendix Table 4: Age-adjusted odds of stage of disease between European/Other (reference) and Māori, Pacific and Asian New Zealanders, by cancer type (NZCR) (continued).

Rectal				
Local	0.68 (0.53, 0.87)	0.48 (0.32, 0.73)	1.08 (0.81, 1.43)	Reference
Regional	0.8 (0.64, 1)	1.12 (0.83, 1.51)	0.99 (0.75, 1.3)	Reference
Advanced	1.97 (1.59, 2.45)	1.32 (0.95, 1.85)	0.82 (0.57, 1.17)	Reference
Unknown	0.96 (0.8, 1.15)	1.15 (0.89, 1.48)	1.05 (0.84, 1.33)	Reference
Skin (not melanoma)				
Local	1.1 (0.66, 1.84)	0.88 (0.38, 2.02)	1.2 (0.39, 3.71)	Reference
Regional	-	-	-	Reference
Advanced	0.96 (0.34, 2.72)	1.45 (0.33, 6.39)	1.46 (0.18, 11.99)	Reference
Unknown	0.94 (0.53, 1.67)	0.97 (0.38, 2.51)	1.32 (0.4, 4.38)	Reference
Small intestine				
Local	1.31 (0.78, 2.19)	0.84 (0.37, 1.91)	0.87 (0.26, 2.97)	Reference
Regional	1.02 (0.69, 1.49)	0.74 (0.43, 1.29)	1.04 (0.48, 2.28)	Reference
Advanced	0.86 (0.57, 1.31)	1.09 (0.62, 1.91)	0.41 (0.14, 1.18)	Reference
Unknown	0.93 (0.53, 1.63)	1.7 (0.87, 3.3)	2.47 (1.06, 5.77)	Reference
Stomach				
Local	1.46 (1.09, 1.95)	0.93 (0.6, 1.44)	1.17 (0.76, 1.8)	Reference
Regional	1.36 (1.07, 1.72)	0.94 (0.67, 1.33)	1.34 (0.96, 1.85)	Reference
Advanced	0.96 (0.8, 1.15)	0.98 (0.77, 1.24)	1.02 (0.79, 1.32)	Reference
Unknown	0.75 (0.62, 0.9)	1.11 (0.87, 1.41)	0.8 (0.62, 1.04)	Reference
Testis				
Local	0.73 (0.55, 0.98)	0.46 (0.26, 0.82)	1.24 (0.54, 2.85)	Reference
Regional	0.86 (0.56, 1.32)	1.31 (0.58, 2.98)	0.73 (0.22, 2.41)	Reference
Advanced	1.84 (1.27, 2.66)	2.17 (1.05, 4.47)	0.79 (0.24, 2.63)	Reference
Unknown	1.33 (0.55, 3.25)	3.77 (1.06, 13.43)	1.69 (0.22, 13.12)	Reference
Thyroid and other endocrine glands				
Local	0.85 (0.7, 1.04)	0.76 (0.59, 0.99)	0.91 (0.72, 1.14)	Reference
Regional	0.87 (0.68, 1.1)	0.95 (0.7, 1.29)	1.47 (1.15, 1.88)	Reference
Advanced	1.52 (1.09, 2.12)	1.86 (1.24, 2.78)	0.62 (0.37, 1.04)	Reference
Unknown	1.32 (0.99, 1.75)	1.22 (0.84, 1.78)	0.75 (0.51, 1.1)	Reference
Uterus				
Local	0.74 (0.62, 0.88)	0.5 (0.41, 0.59)	0.8 (0.61, 1.04)	Reference
Regional	0.73 (0.58, 0.93)	0.71 (0.55, 0.92)	0.98 (0.7, 1.36)	Reference
Advanced	1.78 (1.35, 2.36)	2.08 (1.56, 2.77)	0.94 (0.55, 1.59)	Reference
Unknown	1.91 (1.47, 2.48)	3.68 (2.88, 4.71)	1.83 (1.22, 2.73)	Reference

Competing interests:
Dr Jackson is medical director of the Cancer Society of New Zealand, and a member of the Advisory Council of the Cancer Control Agency.

Acknowledgements:
We would like to thank Susan Hanna from the New Zealand Cancer Registry for previously providing information about the New Zealand Cancer Registry. We would also like to thank Chris Lewis at the Ministry of Health for assistance with the data extraction for this study. This study was funded by the Health Research Council of New Zealand (reference # 18/588).

Author information:
Jason Gurney, Cancer and Chronic Conditions Research Group, Department of Public Health, University of Otago, Wellington; James Stanley, Cancer and Chronic Conditions Research Group, Department of Public Health, University of Otago, Wellington;
Chris Jackson, Southern District Health Board, Dunedin; Cancer Society of New Zealand, Wellington; Diana Sarfati, Cancer and Chronic Conditions Research Group, Department of Public Health, University of Otago, Wellington.

Corresponding author:
Jason K Gurney, Cancer and Chronic Conditions Research Group, Department of Public Health, University of Otago, PO Box 7343, Wellington.
jason.gurney@otago.ac.nz

URL:
http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2020/vol-133-no-1508-17-january-2020/8091

REFERENCES:

1. Robson B, Purdie G, Cormack D. Unequal Impact II: Māori and Non-Māori Cancer Statistics by Deprivation and Rural-Urban Status, 2002–2006. Wellington: Ministry of Health; 2010.
2. Soeberg M, Blakely T, Sarfati D, Tobias M, Costilla R, Carter K, Atkinson J. Cancer Trends: Trends in cancer survival by ethnic and socioeconomic group, New Zealand 1991–2004. . Wellington: University of Otago and Ministry of Health; 2012.
3. Brewer N, Zugna D, Daniel R, Borman B, Pearce N, Richiardi L. Which factors account for the ethnic inequalities in stage at diagnosis and cervical cancer survival in New Zealand? Cancer Epidemiology. 2012; 36(4):e251–e7.
4. Tin Tin S, Elwood JM, Brown C, Sarfati D, Campbell I, Scott N, Ramsaroop R, Seneviratne S, Harvey V, Lawrenson R. Ethnic disparities in breast cancer survival in New Zealand: which factors contribute? BMC Cancer. 2018; 18(1):58.
5. James V, Fowler C. A response to: Characteristics of lung cancers and accuracy and completeness of registration in the New Zealand Cancer Registry. N Z Med J. 2018; 131(1479):93–4.
6. Ministry of Health. New Zealand Cancer Registry Data Dictionary. Wellington, New Zealand; 2004.
7. Gurney J, Sarfati D, Stanley J, Dennett E, Johnson C, Koea J, Simpson A, Studd R. Unstaged cancer in a population-based registry: Prevalence, predictors and patient prognosis. Cancer Epidemiology. 2013; 37(4):498–504.
8. Hill S, Sarfati D, Blakely T, Robson B, Purdie G, Dennett E, Cormack D, Dew K, Ayanian JZ, Kawachi I. Ethnicity and management of colon cancer in New Zealand: Do indigenous patients get a worse deal? Cancer. 2010; 116(13):3205–14.
9. Jackson C, Sharples K, Firth M, Hinder V, Jeffery M, Keating J, Secker A, Derrett S, Atmore C, Bramley D, De Groot C, Stevens W, Sarfati D, Brown C, Hill A, Reid P, Lawrenson R, Findlay M. The PIPER Project: An Internal Examination of Colorectal Cancer Management in New Zealand. Final study report to the Health Research Council and Ministry of Health.; 2015.

10. Stevens W, Stevens G, Kolbe J, Cox B. Ethnic differences in the management of lung cancer in New Zealand. J Thorac Oncol. 2008; 3(3):237–44.
11. 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):571–9.
12. Health Information Standards Organisation. HISO 10001:2017 Ethnicity Data Protocols. Wellington, New Zealand: Ministry of Health; 2017.
13. Young J, Roffers F, Gloeckler Ries L, Fritz A, editors. SEER Summary Staging Manual - 2000: Codes and Coding Instructions. Bethesda, MD: National Cancer Institute; 2000.
14. Gurney J, Sarfati D, Stanley J. The impact of patient comorbidity on cancer stage at diagnosis. British Journal of Cancer. 2015; 113(9):1375–80.
15. Lawrenson R, Lao C, Brown L, Wong J, Middleton K, Firth M, Aitken D. Characteristics of lung cancers and accuracy and completeness of registration in the New Zealand Cancer Registry. The New Zealand Medical Journal. 2018; 131(1479):13–23.
16. Chamberlain J, Sarfati D, Cunningham R, Koea J, Gurney J, Blakely T. Incidence and management of hepatocellular carcinoma among Māori and non-Māori New Zealanders. Australian & New Zealand Journal of Public Health. 2013; 37:520–6.
17. Swart E, Sarfati D, Cunningham R, Dennett E, Signal V, Gurney J, Stanley J. Ethnicity and rectal cancer management in New Zealand. New Zealand Medical Journal. 2013; 126(1384):42–52.
18. Ruhl J, Callaghan C, Hurlbut A, Ries L, Adamo P, Dickie L, Schussler N. Summary Stage 2018: Codes and Coding Instructions. Bethesda, MD: National Cancer Institute; 2018.
19. Sarfati D, Shaw C, Simmonds S. Commentary: Inequalities in cancer screening programmes. Int J Epidemiol. 2010; 39(3):766–8.
20. Sarfati D, Hill S, Blakely T, Robson B. Is bowel cancer screening important for Maori? The New Zealand Medical Journal. 2010; 123(1320):9–12.
21. McLeod M, Kvizhinadze G, Boyd M, Barendregt J, Sarfati D, Wilson N, Blakely T. Colorectal Cancer Screening: How Health Gains and Cost-Effectiveness Vary by Ethnic Group, the Impact on Health Inequalities, and the Optimal Age Range to Screen. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology. 2017; 26(9):1391–400.
22. Obertova Z, Scott N, Brown C, Stewart A, Lawrenson R. Survival disparities between Maori and non-Maori men with prostate cancer in New Zealand. BJU international. 2015; 115 Suppl 5:24–30.
23. Roberts E, Nunes VD, Buckner S, Latchem S, Constanti M, Miller P, et al. Paracetamol: not as safe as we thought? A systematic literature review of observational studies. Ann Rheum Dis. 2015; doi:10.1136/annrheumdis-2014-206914.
24. Ilic D, Djulbegovic M, Jung JH, Hwang EC, Zhou Q, Cleves A, Agoritsas T, Dahm P. Prostate cancer screening with prostate-specific antigen (PSA) test: a systematic review and meta-analysis. BMJ (Clinical research ed). 2018; 362:k3519.
25. Tin Tin S, Elwood J, Brown C, Sarfati D, Campbell I, Scott N, Ramsaroop R, Seneviratne S, Harvey V, Lawrenson R, editors. Ethnic disparities in breast cancer survival in New Zealand: Which factors contribute? . International Epidemiological Association Word Congress of Epidemiology; 2017 19–22 August 2017; Saitama, Japan.
26. Hill S, Sarfati D, Robson B, Blakely T. Indigenous inequalities in cancer: What role for health care? ANZ journal of surgery. 2013; 83(1–2):36–41.
27. Hill S, Sarfati D, Blakely T, Robson B, Purdie G, Chen J, Dennett E, Cormack D, Cunningham R, Dew K, McCreanor T, Kawachi I. Survival disparities in Indigenous and non-Indigenous New Zealanders with colon cancer: The role of patient comorbidity, treatment and health service factors. Journal of Epidemiology and Community Health. 2010; 64(2):117–23.
28. Sarfati D, Koczwara B, Jackson C. The impact of comorbidity on cancer and its treatment. CA Cancer J Clin. 2016; 66(4):337–50.

29. Parkin DM, Bray F. Evaluation of data quality in the cancer registry: principles and methods Part II. Completeness. European journal of cancer (Oxford, England : 1990). 2009; 45(5):756–64.

30. Bray F, Parkin DM. Evaluation of data quality in the cancer registry: principles and methods. Part I: comparability, validity and timeliness. European journal of cancer (Oxford, England : 1990). 2009; 45(5):747–55.

31. Nabhan C, Rosen ST. Chronic Lymphocytic Leukemia: A Clinical Review. JAMA. 2014; 312(21):2265–76.

32. Cheson BD, Fisher RI, Barrington SF, Cavalli F, Schwartz LH, Zucca E, Lister TA. Recommendations for Initial Evaluation, Staging, and Response Assessment of Hodgkin and Non-Hodgkin Lymphoma: The Lugano Classification. Journal of Clinical Oncology. 2014; 32(27):3059–67.

ISSN 1175-8716