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Research paper

The impact of the COVID-19 pandemic on cancer diagnosis and service access in New Zealand—a country pursuing COVID-19 elimination[☆]

Jason K. Gurney^{a,b,*}, Elinor Millar^a, Alex Dunn^a, Ruth Pirie^a, Michelle Mako^a,
John Manderson^a, Claire Hardie^c, Chris G.C.A. Jackson^d, Richard North^e, Myra Ruka^f,
Nina Scott^f, Diana Sarfati^a

^a Te Aho o Te Kahu – Cancer Control Agency, Molesworth St, Wellington, New Zealand^b Department of Public Health, University of Otago, Mein St, Wellington, New Zealand^c Midcentral District Health Board, Ruahine Street, Palmerston North, New Zealand^d Department of Medicine, University of Otago, Great King St, Dunedin, New Zealand^e Bay of Plenty District Health Board, Cameron Rd, Tauranga, New Zealand^f Waikato District Health Board, Pembroke Street, Hamilton, New Zealand

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ABSTRACT

Background: The COVID-19 pandemic has disrupted cancer services globally. New Zealand has pursued an elimination strategy to COVID-19, reducing (but not eliminating) this disruption. Early in the pandemic, our national Cancer Control Agency (*Te Aho o Te Kahu*) began monitoring and reporting on service access to inform national and regional decision-making. In this manuscript we use high-quality, national-level data to describe changes in cancer registrations, diagnosis and treatment over the course of New Zealand's response to COVID-19.

Methods: Data were sourced (2018–2020) from national collections, including cancer registrations, inpatient hospitalisations and outpatient events. Cancer registrations, diagnostic testing (gastrointestinal endoscopy), surgery (colorectal, lung and prostate surgeries), medical oncology access (first specialist appointments [FSAs] and intravenous chemotherapy attendances) and radiation oncology access (FSAs and megavoltage attendances) were extracted. Descriptive analyses of count data were performed, stratified by ethnicity (Indigenous Māori, Pacific Island, non-Māori/non-Pacific).

Findings: Compared to 2018–2019, there was a 40% decline in cancer registrations during New Zealand's national shutdown in March–April 2020, increasing back to pre-shutdown levels over subsequent months. While there was a sharp decline in endoscopies, pre-shutdown volumes were achieved again by August. The impact on cancer surgery and medical oncology has been minimal, but there has been an 8% year-to-date decrease in radiation therapy attendances. With the exception of lung cancer, there is no evidence that existing inequities in service access between ethnic groups have been exacerbated by COVID-19.

Interpretation: The impact of COVID-19 on cancer care in New Zealand has been largely mitigated. The New Zealand experience may provide other agencies or organisations with a sense of the impact of the COVID-19 pandemic on cancer services within a country that has actively pursued elimination of COVID-19.

Funding: Data were provided by New Zealand's Ministry of Health, and analyses completed by Te Aho o Te Kahu staff.

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Research in Context

Evidence before this study

Early international reports on the impact of COVID-19 on access to and through cancer services have been framed within the experience of systems that are dealing with a ma-

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* Corresponding author at: Department of Public Health, University of Otago, Mein St, Wellington, New Zealand.

E-mail address: jason.gurney@otago.ac.nz (J.K. Gurney).

for COVID-19 morbidity and mortality burden. These reports have illustrated the likelihood that, in a system stretched by the health response to the pandemic, treatment delays appear inexorable and the consequent impact on mortality appears to be stark. As part of our assessment of the current international evidence on the impact of COVID-19 on cancer services, we conducted a search using the database Scopus for all manuscripts published up until 1st December 2020, using the search terms 'cancer', 'COVID-19' and 'COVID'.

Added value of this study

We examined the impact of COVID-19 on access to and through cancer services in New Zealand, a country with universal healthcare that has actively pursued an elimination strategy to COVID-19. We used national-level health data to describe changes in cancer registrations, diagnostic testing and treatment over the course of 2020 compared to 2018–2019, stratified by ethnicity. The current study provides international readers with a sense of the impact of the pandemic on cancer services in a context that has actively pursued COVID-19 elimination.

Implications of all the available evidence

While the initial downturns in service access during New Zealand's national shutdown in March–April 2020 was similar to that observed in other contexts, this impact on services were largely mitigated by 'catch-up' activities in subsequent months – a near-impossible task for those regions where COVID-19 remains endemic. The New Zealand experience has been that a) an elimination strategy to COVID-19 has also been a strong cancer control strategy, both overall and from an equity perspective; and b) rapid communication of ethnicity-stratified data around cancer service access has been a key enabler of evidence-informed decision-making during the pandemic.

1. Introduction

The COVID-19 pandemic has caused widespread disruption to cancer services globally. Particularly, in countries with widespread community transmission of COVID-19, the pandemic forced an abrupt change in how (and in what form) cancer services were delivered to patients [1]. Understandably, international reports on the impact of COVID-19 on access to and through cancer services have been framed within the experience of systems that are dealing with a major COVID-19 morbidity and mortality burden [2–5]. These reports have illustrated the likelihood that, in a system stretched by the health response to the pandemic, treatment delays appear inexorable and the consequent impact on mortality appears to be stark [3,5–12]. Analysis in the United Kingdom predicted that deaths among patients diagnosed with cancer there could rise by 20% over the next 12 months – some 6000 additional deaths – as a result of the broad impact of COVID-19 on cancer patients, and the system that serves them [7].

The burden of these additional deaths is likely to be unevenly and unfairly distributed: for example, Indigenous and other minority and/or marginalised populations are likely to bear a disproportionate impact in comparison with those already privileged by economic, social and health system structures.[13] Measuring and monitoring these inequities allows restorative and preventative actions to be established.

1.1. COVID-19 and cancer services in New Zealand

New Zealand has pursued an elimination strategy to COVID-19, which has included national stay-at-home orders, border restrictions, mandated quarantine and a centralised national testing and contact tracing programme [14]. On 26th March 2020, New Zealand entered a full national shutdown until the end of

April, after which the country achieved elimination of community transmission of COVID-19 from New Zealand [15]. The full national shutdown involved movement restrictions and a national stay-at-home order, border closure, the closure of schools and non-essential businesses, and the onset of a national testing and contact tracing programme. A regional resurgence occurred in August 2020, and was met by a regional stay-at-home order and strict travel restrictions, followed later by a mask-mandate on public transport. As of 14th January 2021, there have been no cases of community transmission of COVID-19 within New Zealand since November 2020.

As in the rest of the world, in the early stages of the pandemic, it was unclear what the implications would be for the health system in New Zealand. However, there was an early concern that the pandemic could result in increased health inequities between New Zealand's Indigenous and non-Indigenous populations – particularly in access to cancer care [16]. While the health system prepared for the possible inundation of patients unwell with COVID-19, non-COVID-19 related healthcare activities were severely disrupted. In March and April 2020, this included the temporary cessation of our three national screening programmes (breast, cervical and bowel [17]), an increase in the threshold required for referral from primary to secondary care, and a sharp reduction in some diagnostic activities including endoscopy. Given existing inequities in access to many of these services (particularly among our Indigenous Māori population), [18,19] reductions in service access threatened to exacerbate these inequities [16]. There was also early concern that patients with cancer were at increased risk of complications from COVID-19 due to their relative immunocompromised state.

Over the same period, there was a national planning effort led by Te Aho o Te Kahu (our National Cancer Control Agency) in close collaboration with the health sector to ensure that cancer treatment services were maintained consistently across the country. The national cancer response included the development of national guidance outlining treatment expectations at different hospital capacities for blood and cancer treatment services and for critical cancer diagnostic services. The focus of the guidance was on the continuity of cancer services, whilst taking every effort to ensure safety of staff and patients and preventing the spread of COVID-19. The guidance also prepared for scenarios where delivery of cancer care may be compromised. Other aspects the cancer sector's response to COVID-19 included consideration of new ways of delivering care (such as telehealth and radiotherapy hypofractionation) and close monitoring of the impact COVID-19 was having on cancer services. The national response work also focussed on ensuring that pre-existing cancer-related inequities were not exacerbated by the response to the COVID-19 crisis, and included the co-development of guidelines by Te Aho o Te Kahu and the national Māori cancer leadership group Hei Āhuru Mōwai.

The impact of the COVID-19 pandemic on the diagnosis, registration and treatment of cancer in New Zealand was measured and reported publicly throughout 2020 by Te Aho o Te Kahu, with the first report published in May (within 8 weeks of the national lockdown) [20]. Quantifying this impact informed efforts to manage cancer-related burden across the sector, including the likely magnitude of unmet need. As noted above, this reporting has also enabled us to monitor equity in outcomes, particularly for our indigenous Māori population. Finally, this reporting has also highlighted the need for (and value of) streamlined data collection and synergy across the country.

The New Zealand experience may provide other agencies or organisations around the world with a sense of the impact of the COVID-19 pandemic on cancer services within a country that has actively pursued (and largely achieved) elimination of COVID-19. As such, in this manuscript we use high-quality, national-level

health data to provide evidence of changes in cancer registrations, diagnosis and treatment activities that have occurred over the course of New Zealand's response to COVID-19.

2. Methods

2.1. Data sources and variables

New Zealand is a country with universal health care, with care delivered by 20 centrally-mandated (and funded) District Health Boards. In New Zealand, data on all publicly-funded (and most privately-funded) health care, including cancer registrations, are reported to our National Collections, which are funded by Government and managed by our Ministry of Health. In addition to public hospitals, New Zealand has a number of private hospitals that deliver elective cancer surgeries [21] (particularly for early breast and colon cancers [22]), and while the vast majority of private hospitals do report to the National Collections, the completeness of reporting of privately funded procedures varies annually [23]. The data accessed for this study were de-identified and provided by the National Collections team to the Cancer Control Agency as aggregate count data.

Data on cancer registrations were sourced from the New Zealand Cancer Registry (NZCR), a nationally-mandated register of all new diagnoses of primary malignant cancers diagnosed in New Zealand (with the exception of basal and squamous cell skin cancers) [24]. Data on diagnostic services and cancer treatment were sourced from the National Non-Admitted Patient Collection (NNPAC) and the National Minimum Dataset (NMDS). The NNPAC is a national record of publicly-funded outpatient and emergency department services in New Zealand, [25] while the NMDS is a national record of publicly-funded hospital discharges [26].

Ethnicity and cancer registration data were obtained from the NZCR. To maximise timeliness of data, registrations for this analysis included both final registrations and provisional registrations from laboratory sources. The NZCR is updated daily with new registrations as they are processed, and the most up-to-date registrations were accessed for this study. In terms of access to diagnostic services, for the sake of brevity within the current manuscript we have focussed on gastrointestinal endoscopies (gastroscopy and colonoscopy) performed in the public health system, with no limit on whether these were specifically conducted for suspicion of cancer. Data on these endoscopies was obtained from both the NNPAC (for endoscopies performed in outpatient clinics) and NMDS (for those performed during inpatient hospital admissions).

In terms of surgery, for brevity within this manuscript we have focussed on combined prostate, colorectal and lung resections, with no restriction on whether these were conducted as part of cancer services. These data were obtained from the NMDS, and included all publicly-funded resections conducted within public hospitals (see Supplementary Material 1 for procedure types). In terms of systemic therapy, we focussed on publicly-funded first specialist appointments (FSAs) for medical oncology assessment, as well as outpatient attendances for intravenous (IV) chemotherapy within the public health system. These data were obtained from the NNPAC. Similarly, in terms of radiation therapy we focussed on FSAs for radiation oncology assessment, as well as outpatient attendances for planning, simulation and treatment with radiation therapy on a linear accelerator. Radiation data were also obtained from the NNPAC.

2.2. Analysis

Crude descriptive analysis of raw numbers of patients was undertaken using the data and variables described above. We described the month-on-month and cumulative number of events

over the 2018–2020 calendar period, ceasing 30th October 2020. In some instances, we have presented a crude percentage decrease (or increase) in events (such as cancer registrations) with respect to the same time period in previous years. As well as completing descriptive analysis for the total population, we also specifically focussed on outcomes for New Zealand's indigenous Māori population as well as other ethnic groups, and have presented ethnicity-stratified data in the Figures below. Data management and analysis were completed within R for Windows (R Foundation for Statistical Computing, Austria [27]) and Microsoft Excel 2016 (Microsoft Inc., U.S.A.).

2.3. Ethics

This work was conducted by the New Zealand Government's Cancer Control Agency (Te Aho o Te Kahu), in conjunction with the Ministry of Health (as administrators of our National Collections), in adherence to New Zealand's Privacy Act 2020, [28] the Health Information Privacy Code 2020, [29] and the Health Information Governance Guidelines [30]. As such, ethical approval was not required for this study. As noted earlier, the data accessed for this study were provided to Te Aho o Te Kahu as aggregate count data, rather than unit-level data.

3. Results

3.1. Registrations

The total number of cancer registrations between 2018 and 2020 are shown in Fig. 1, for both month-by-month totals and for the cumulative total. When comparing registrations specifically in the month of April 2020 to the number of April registrations from 2019, we observed a 40% decline in registrations. Following this abrupt decline, the months following April 2020 have seen a gradual increase in the number of registrations, with the cumulative number of registrations finally surpassing that of 2019 in September 2020. We observed a similar overall decrease in cancer registrations for indigenous Māori as for other ethnic groups.

The pattern of decline in registrations followed by an increase was largely reflected across cancer types (Supplementary Material 2). The most substantial declines following the national shutdown in late-March and April were observed for breast, prostate, colorectal and melanoma/non-melanoma skin cancers, while the greatest overall impact for the year to date has been for prostate cancers, haematology/lymphoid cancers and melanomas, which have seen a 4–9% decrease.

3.2. Diagnostic services

The number of gastroscopies and colonoscopies performed over 2020 compared to 2018–2019 are shown in Fig. 2. New Zealand experienced a sharp decline in the number of gastrointestinal endoscopies performed during the national shutdown period of late-March and April 2020, followed by a gradual increase (following an intensive 'catch-up' period) back to pre-March volumes by August 2020. For the year to date, the number of gastrointestinal endoscopies performed in 2020 is the same as that performed in 2019, with the number of endoscopies performed among Indigenous Māori increasing slightly by 5% (compared to a 1% reduction for non-Māori/non-Pacific).

3.3. Surgery

The number of prostate, colorectal and lung surgeries over 2020 compared to 2018–2019 are shown in Fig. 3. While there appeared to be a slight downturn in surgeries for these cancers during the



Fig. 1. Total number of cancer registrations by month and year (top), alongside the cumulative number of cancer registrations (bottom), for the total population and stratified by ethnicity.



Fig. 2. The number of gastroscopies and colonoscopies performed over 2020 compared to 2018–2019, by month and year (top) as well as cumulative total (bottom), for the total population and stratified by ethnicity.



Fig. 3. Combined number of prostate, colorectal and lung surgeries performed over 2020 compared to 2018–2019, by month (top) as well as cumulative total (bottom), for the total population and stratified by ethnicity.

national shutdown in late-March and April 2020, the impact of COVID-19 on cancer surgery volumes has been minimal. Overall, around 1% fewer surgeries were performed in the first eight months of 2020 compared to the first eight months of 2019, finishing with a 2% increase in cancer surgeries by the end of October. Contrary to trends observed for the total population, there has been a 21% increase in these combined surgeries among indigenous Māori in the year to date compared to the same period in both 2018 and 2019. There appears to have been a persistent drop in surgeries for Pacific Islanders; however, the robustness of this observation may be influenced by the comparatively low number of procedures performed among Pacific Island patients.

3.4. Systemic therapy

The number of first specialist appointments (FSAs) with a medical oncologist conducted over 2020 compared to 2018–2019 are shown in Supplementary Material 3, while the number of intravenous (IV) chemotherapy attendances over this period are shown in Fig. 4. Overall, for the year to date the number of medical oncology FSAs and attendances for IV chemotherapy is comparable to 2019, with no obvious substantial reduction during (or subsequent to) the national shutdown in late-March and April 2020. Similar to the ethnic trends observed for surgery, there appears to have been an increase in numbers of outpatient chemotherapy attendances among Māori over 2020 compared to the same period in 2019.

3.5. Radiation therapy

The number of first specialist appointments (FSAs) with a radiation oncologist conducted over 2020 compared to 2018–2019 are shown in Supplementary Material 4, while the number of radiation therapy attendances over this period are shown in Fig. 5. Overall, for the year to date the number of radiation therapy FSAs is comparable to 2019. However, for the year to date there has been an 8% decrease in attendances for radiation therapy. A similar decrease in attendances was observed for Māori for 2020 compared to the same period in 2019.

4. Discussion

4.1. Cancer registrations

New Zealand has actively pursued an elimination strategy for COVID-19. In the early stages of the pandemic, there was substantial disruption to the health system while it prepared for the potential acute impact of the disease; and during that period, there was a considerable downturn in the number of new cancer registrations. During April – the first full month of New Zealand's social and commercial shutdown – there was a decline of 40% in cancer registrations compared to 2019. This was precipitated by a reduction in both screening-based and symptom-based cancer detection.

This decline in cancer registrations over the shutdown period is in keeping with other similar downturns in other contexts. In the United States, the weekly number of cancer registrations for six combined cancers (breast, colorectal, lung, pancreatic, gastric and oesophageal) fell by 46% from the beginning of March to the middle of April 2020 [31]. Similar downturns in cancer registrations were found in The Netherlands, [32] while in the United Kingdom [33] there was a 63% reduction in the number of referrals for suspected colorectal cancer in April 2020 compared to April 2019 [33]. There are likely commonalities across international contexts in the factors that contributed to these downturns [5,8,34–38] – in New Zealand, the four key factors were: 1) people were less likely to attend primary care during shutdown, which means that people likely delayed seeking help for symptoms that may have

been suspicious of cancer (there are no data available on blood testing during this time, but a reduction in routine blood testing also seems likely, which may have specifically reduced detection of some prostate and haematologic malignancies); 2) there was a temporary reduction in access to secondary care, as non-urgent referrals were delayed or not accepted; 3) there was a marked reduction in some diagnostic procedures, including endoscopic and radiological procedures; and 4) our national cancer screening programmes were temporarily halted. These factors were influenced by the desire to reduce risk of COVID-19 transmission to and between cancer patients.

The steady increase in registrations observed in New Zealand since June 2020 reflects a reversal of these barriers. Through intensive effort, District Health Boards (DHBs) that deliver care to regional populations have been catching-up on backlogs, particularly relating to cancer diagnosis. Screening programmes are now fully operational, and people are once again able to access primary care – although rates of primary care encounters remain lower than observed in 2019 [39].

4.2. Diagnostic procedures

When examining national-level access to endoscopy over the course of 2020, there was a stark drop in gastroscopies and colonoscopies during the national shutdown period. Endoscopy services have increased in the months since June back to pre-COVID-19 levels, and the number of cumulative procedures remains the same as that conducted in 2019 for the year to date. Endoscopy services were particularly affected during the early phases of the COVID crisis due to concerns internationally about the capacity of endoscopic procedures to create aerosol spread of COVID-19, with initial advice recommended a reduction of endoscopy in all but the most urgent patients [40]. Te Aho o Te Kahu worked with the sector to evaluate the risk of spread, resulting in a reasonably rapid and consistent return to more normal services. Other reasons for the initial downturn in endoscopies include 1) a reduction in patient access to primary and secondary services (and subsequent referral to endoscopy) among those who require an endoscopy; 2) a result of pausing the bowel cancer screening programme; and/or 3) delays to some non-urgent endoscopies during the catch-up period. We note that the fact that endoscopy delivery has largely returned to pre-COVID-19 volumes is an indication of the intensive work that has been completed across the sector, with this 'catch-up' more difficult in those countries with an ongoing endemic COVID-19 burden.

4.3. The treatment of cancer

Overall there is no evidence that the pandemic has substantially disrupted access to cancer treatment in New Zealand. While there does appear to have been a drop in surgeries during the shutdown period in late March and April 2020, this has subsequently returned to levels similar to 2019 – while systemic therapy appears to have continued largely without any reductions in services. While our clinical advisors reported some changes in prescribing patterns due to concerns about the potential impact of COVID-19 on immune suppressed patients, our data was not able to quantify whether there was a change in type of treatments delivered during the early phases of the pandemic, such as 1) selection of less myelosuppressive regimens, 2) the increased use of growth-factor support, and/or 3) less infusion-dependent regimens that reduced hospital attendance. There was some reduction in radiation therapy attendances (but not first specialist appointments). This is likely due to a shift to hypofractionation (the delivery of larger doses of radiation per treatment to deliver an equivalent dose to a standard fractionation schedule but in a shorter time period),



Fig. 4. The number of intravenous (IV) chemotherapy attendances over 2020 compared to 2018–2019, by month (top) as well as cumulative total (bottom), for the total population and stratified by ethnicity.

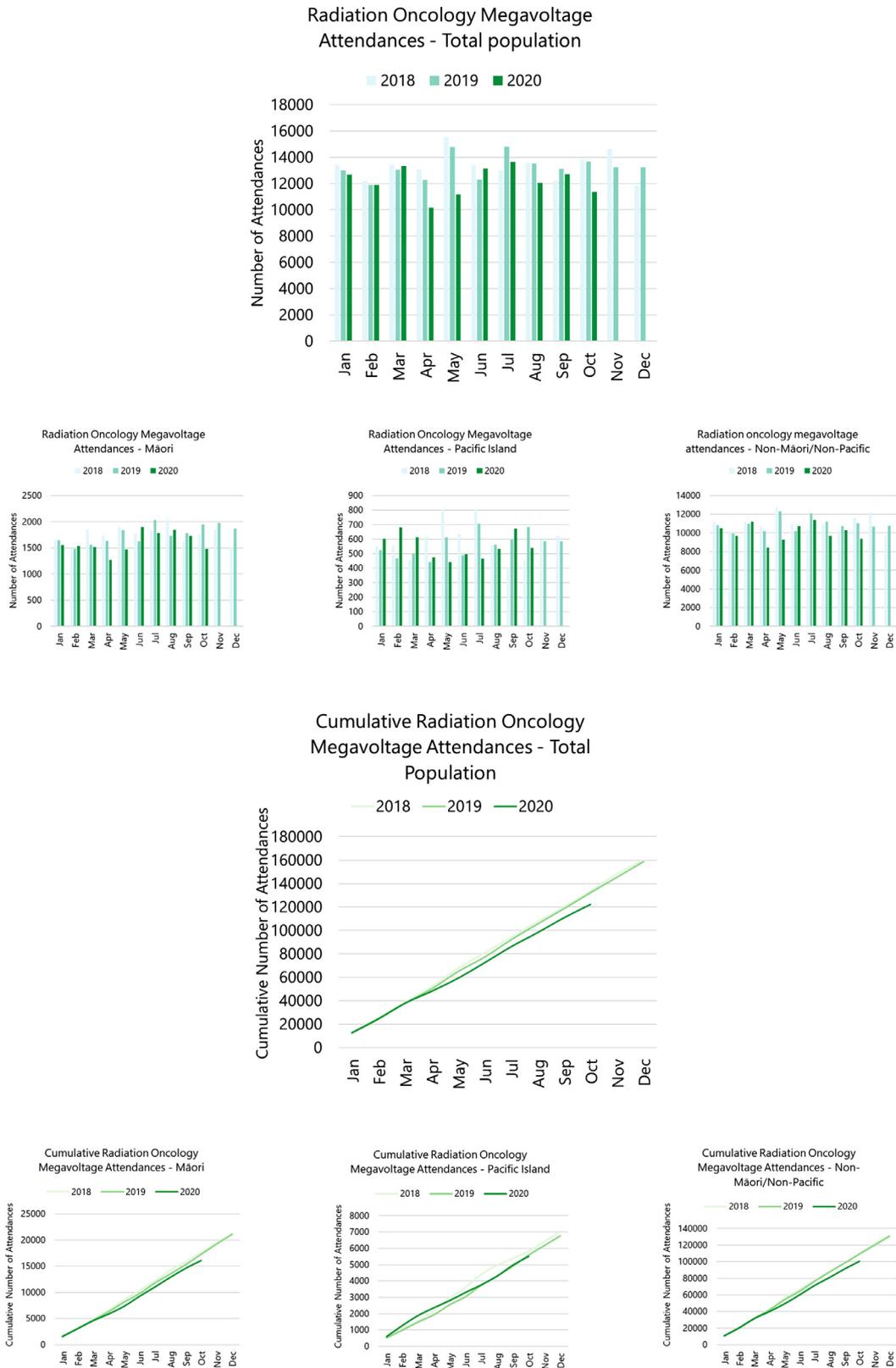


Fig. 5. The number of radiation therapy attendances over 2020 compared to 2018–2019, by month (top) as well as cumulative total (bottom), for the total population and stratified by ethnicity.

which was accelerated during the COVID-19 crisis, rather than a reduction in treatment delivery *per se*. Again, Te Aho o Te Kahu worked with the sector to ensure that services maintained treatment in a consistent way, including in the shift to hypofractionation.

While there is currently an overall lack of evidence of a widespread downturn in access to cancer services – or evidence of widespread inequities in access to services (see below) – we are mindful that it is unclear whether the early-2020 shutdown (and its impact on access to diagnostic services) will lead to an increase in the number of patients requiring care in future months. It is also unclear if shutdown-induced delays in diagnosis will cause a shift toward more advanced cancers at presentation, and therefore a reduction in cancer treatment with curative intent (with subsequent ramifications for survival outcomes). However, it is also feasible that no discernible changes in the timing of diagnosis or receipt of curative treatment will occur in New Zealand, and likely that any such changes will be relatively minor compared to countries substantially impacted by COVID-19. In the United Kingdom, substantial increases in the number of cancer deaths are expected over the coming years as a result of delays in access to diagnosis due to COVID-19; however the magnitude of the pandemic has been substantially greater in the UK than in NZ [8]. Te Aho o Te Kahu will continue to monitor diagnostic services and treatment access as part of its regular reporting, and also report on changes in trends in cancer stage at diagnosis (including ethnicity-stratified trends) once sufficient time has elapsed to make this analysis feasible.

4.4. Equity

There are longstanding inequities in cancer outcomes experienced by New Zealand's indigenous Māori population compared to our majority European population [19,41]. Equity was a core focus of Te Aho o Te Kahu both as part of planning the response to COVID-19, and monitoring the impact on cancer diagnosis, with this work completed in partnership with key Māori organisations particularly Hei Āhuru Mōwai (our national Māori Cancer Leadership Group) [20]. Regular reporting showed that there has been little evidence of differential impact of COVID-19 on access to cancer diagnosis and care between ethnic groups in New Zealand. A notable exception is lung cancer, for which access to bronchoscopy and curative surgery sharply declined for Māori compared to non-Māori, particularly during the national shutdown period: for example, bronchoscopies among Māori have reduced by nearly 28% for the year to date compared to 2019 (compared to a 15% reduction for non-Māori/non-Pacific) [20]. Given the importance of lung cancer as the most common cause of cancer death for Māori, [42] understanding this decline is a current focal point within the Agency.

4.5. Strengths and limitations

Our findings are based on mandated, national-level, frequently-updated, centrally-managed data within a context of universal health care – which means that we are confident that the data provided here accurately reflects the impact of COVID-19 on cancer service access in New Zealand. The timeliness of data availability was key to our ability to highlight the impacts on cancer services to political leaders and health officials. This enabled clear impact assessment and where needed direction of funding to ensure maximum mitigation was achieved. Delays in data availability could have severely impacted the responsiveness of catch-up planning and delivery, further exacerbating cancer outcomes and potentially exacerbating inequities. We have used a simple descriptive analysis approach that uses raw numbers of cancer registrations to inform our observations, and to provide usable data to as-

sist national decision-making over the course of the pandemic. For example, these raw data have enabled us to view, at a glance, the approximate number of individual registrations or procedures that we might have expected to occur in the absence of a pandemic (by comparing to what was observed in previous years), and swiftly communicate this data to those charged with delivering these services – both to facilitate current service planning, and inform them as to whether they might expect a 'wave' sometime soon. Importantly, formal analyses would be very unlikely to alter the broad conclusions made within this manuscript, and as such we have retained the count-data approach for our reporting here. We note that, in order to maximise the timeliness of data, we were unable to discern whether a given diagnostic procedure (e.g. endoscopy) or treatment was conducted under suspicion of cancer, or not – and as such, these can be considered proxies of the true underlying volume of cancer service provided across 2020. However, we have been careful to present procedures that are commonly (if not nearly always) performed as part of cancer care. Finally, the quality of the reported data relies on the quality of clinical coding and the completeness of reporting. For example, the use of provisional cancer registrations may result in the inclusion of some registrations that, following formal registration processes, are subsequently removed from the national register due to duplication or erroneous reporting. However, as noted above, there are multiple processes in place to ensure the robustness of our national collections data – and as such, we are confident that any inaccuracies will be minimal and not impact the key findings of this study.

4.6. What can be learned from the New Zealand experience?

The New Zealand cancer control experience during the COVID-19 pandemic has been unique. Our elimination approach has protected us from the direst consequences, for both our new and existing cancer patients and the system that serves them. However, while our experience may differ from that of other regions, there are some key learnings that we believe are transferable to other contexts:

- That an elimination approach to COVID-19 likely had a positive impact on return-to-normal for cancer services, and was likely pro-equity. While it may be too late for the current pandemic, this observation has important ramifications for future pandemics.
- That a clear focus on ensuring equitable delivery of cancer services during the shutdowns, from both the national cancer control agency and other important stakeholders, likely helped to prevent the exacerbation of existing inequities in cancer care and outcomes.
- That centralised monitoring and reporting of cancer service activities during the pandemic, stratified by ethnicity, provided essential intelligence and informed decision-making at a national and regional level. The initial drop in diagnoses was used to support the change in public messaging to ensure people knew to access health services if unwell. The ongoing reporting helped with recovery planning, and the regional reporting ensured DHBs kept the focus on maintaining services. Finally, our reporting identified areas where more work was needed in the event of resurgence (e.g. lung cancer).

5. Conclusions

New Zealand's elimination approach to the COVID-19 pandemic has protected our population and the health system that serves it from the worst consequences of the pandemic – consequences that are the current lived reality of several regions around the world. The impact of COVID-19 on the New Zealand cancer care

system has been less abrupt, but disruptive nonetheless. There was active national planning in partnership with health services and Māori cancer leadership to ensure disruptions were actively managed, with a focus on minimising disruption, nationally-consisted responses and actions to ensure existing inequities were not exacerbated. As a result, while there were steep reductions in cancer registrations and key diagnostic services during our national shutdown in late-March and April; these services have subsequently returned to near-baseline levels in subsequent months. Overall, there is no evidence of lingering disruption to cancer registration, diagnostic services or treatment following the early shutdown. Crucially, we also observed little evidence of new inequities in access to and through cancer services in general for the Indigenous Māori population – with the crucial exception of lung cancer, which is a current focal point for Te Aho o Te Kahu. These observations may provide other agencies or organisations around the world with a sense of the impact of the pandemic on cancer services within a country that has actively pursued the elimination of COVID-19.

Contributors

Jason Gurney drafted the manuscript, and revised content based on feedback. **Elinor Millar, Alex Dunn, Ruth Pirie** and **John Manderson** provided analytic support, assisted with interpretation of data and provided critical revision of drafts. **Claire Hardie, Chris Jackson, Richard North** and **Myra Ruka** provided clinical advice and support, assisted with interpretation of data and provided critical revision of drafts. **Michelle Mako** and **Nina Scott** provided equity-focussed interpretation of data, and provided critical revision of drafts. **Diana Sarfati** led the team, assisted with interpretation of data and provided critical revision of drafts.

Declaration of Competing Interest

The authors declare no conflicts of interest.

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Data Statement

The data for this study were provided by the New Zealand Ministry of Health, and may be available to other researchers who meet data access requirements. Please contact data_enquiries@moh.govt.nz for further details on eligibility and data provision.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.lanwpc.2021.100127](https://doi.org/10.1016/j.lanwpc.2021.100127).

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