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SHORT REPORT

The 'hot zone policy' for colorectal cancer screening presents unique risks and opportunities for rural Australia

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Abstract

Objective: Colorectal cancer has geographic inequities in Australia, with higher mortality rates and lower participation in the National Bowel Cancer Screening Program (NBCSP) in remote and rural areas. The at-home kit is temperature-sensitive, necessitating a 'hot zone policy' (HZP); kits are not sent when an area's average monthly temperature is above 30°C. Australians in HZP areas are susceptible to potential screening disruptions but may benefit from well-timed interventions to improve participation. This study describes the demographics of HZP areas and estimates the impacts of potential screening changes.

Methods: The number of individuals in HZP areas was estimated, as well as correlations with remoteness, socio-economic and Indigenous status. The potential impacts of screening changes were estimated.

Results: Over a million eligible Australians live in HZP areas, which are more likely to be remote/rural, have lower socio-economic status and higher Indigenous populations. Predictive modelling estimates that any 3-month screening disruption would increase CRC mortality rates up to 4.1 times more in HZP areas vs unaffected areas, while targeted intervention could decrease mortality rates 3.4 times more in HZP areas.

Conclusion: People living in affected areas would be negatively impacted by any NBCSP disruption, compounding existing inequities. However, well-timed health promotion could have a stronger impact.

KEYWORDS

models of rural service delivery, oncology, policy, public health, remote health delivery

1 | INTRODUCTION

An estimated 15 713 Australians will be diagnosed with colorectal cancer (CRC) in 2022, leading to an estimated 5326 deaths—approximately 10% of all cancer cases and deaths.[1] As with many diseases, there are geographic and socio-economic inequities in CRC outcomes.[2]

The Australian Government introduced the National Bowel Cancer Screening Program (NBCSP) in 2006 for the prevention and early detection of CRC.[3] The NBCSP provides immunochemical faecal occult blood test (iFOBT) kits by mail biennially to Australians aged 50–74, who self-collect two faecal samples and return them in the mail. Patients with positive tests are typically referred to a diagnostic colonoscopy by a GP. The program is effective at detecting blood in stool samples, an early sign of CRC, and is highly cost-effective.[4] Patients in regional areas have higher rates of CRCs and adenomas detected.[5]

People in areas classified as 'very remote'[6] had a 26.5% participation rate in NBCSP screening, compared to 43.4% for 'major cities', and a diagnostic assessment rate after a positive iFOBT of 43%, vs 64% for major cities, as of the 2022 NBCSP monitoring report.[3] There are many barriers to screening that may explain these lower participation rates.[7] In particular, it is recommended that completed kits are posted directly from a post office; in rural areas, many people may not live near a post office and may not have a fixed address or post box.[8,9] Postal collection can also be infrequent in remote and rural areas. The low diagnostic assessment rate likely reflects limited access to colonoscopy. iFOBT positivity rates were 8% in very remote areas, vs 6% in major cities, as reported in the 2022 NBCSP monitoring report.[3] Similar disparities exist for 'outer regional' and 'remote' areas, Indigenous Australians and people in low socio-economic areas. This low participation is likely to exacerbate existing health inequities.

One aspect of the NBCSP that could unavoidably contribute to these inequities is the *hot zone policy* (HZP).[10] As current evidence suggests samples deteriorate when stored at high temperatures for prolonged periods,[11] iFOBT kits are not sent to postcodes in months where the average monthly temperature would typically be over 30.5°C according to historical data from the Australian Bureau of Meteorology[12] with individuals only receiving invitations during cooler months. Affected areas may have between 1 and 11 months every year ineligible for screening, with screening kits not sent during this time. This policy began in 2009.[13] For the purposes of this manuscript, we refer to areas with at least 1 month affected by the HZP as *affected areas*, and areas where screening is delivered year-round as *unaffected areas*.

Although the HZP does not exclude individuals from screening, it does expose the program to a greater risk of disruption in these areas due to the reduced screening window. Conversely, the reduced window may mean that well-timed interventions could be more effective, as a higher proportion of people in the area will receive an iFOBT kit during the time of the intervention.

This study aimed at estimating the number of individuals affected by the HZP, and the remoteness, socio-economic, Indigenous populations and screening participation rates in these areas. Additionally, to demonstrate the difference in impact of changes in screening participation in affected areas, a microsimulation model was used to estimate the impact of both disruptions to screening and interventions to increase participation in affected areas, and compared this to the impact in unaffected areas.

What is already known on the subject

- The National Bowel Cancer Screening Program provides access to colorectal cancer screening kits for all Australians aged 50–74 and is successful in the early detection of colorectal cancer and detection and removal of precancerous lesions.
- The *hot zone policy* means that National Bowel Cancer Screening Program kits are not sent in specific areas during months when the average temperature is over 30°C.

What this paper adds

- Over a million Australians are expected to be affected by the hot zone policy; these individuals are more likely to be Indigenous, live in remote or very remote areas and live in lower-than-average socio-economic areas.
- Any disruption or temporary pause to the National Bowel Cancer Screening Program, such as those proposed in response to the COVID-19 pandemic, would have an outsized impact on hot zone policy areas. Conversely, targeted interventions to boost program participation would be more effective in hot zone policy areas than in unaffected areas.

2 | METHODS

Postcodes affected by the HZP, and eligible screening months in these areas, were identified. These postcodes were mapped to SA2 statistical local areas,[14] as the most

complete regional data on NBCSP participation (2017–18) is provided at an SA2 level.[15] SA2s are geographical designations provided by the Australian Bureau of Statistics, generally having a population between 3000 and 25 000 (though remote areas may have fewer). Generally, SA2 are smaller area levels than postcodes (also known as postal areas). In cases where an SA2 covered more than one postcode, average dates for the start and end of the eligible screening window were calculated by a weighted average of the eligible screening months of the postcodes that SA2 lies within, weighted by the relative size of the population within both the postcode and the SA2.[16,17] This was also cross-referenced with SEIFA index of relative disadvantage,[18] remoteness,[6] and Indigenous population as of 2016.[19] Correlations between these variables were calculated using statistical packages in R.

After the statistical analysis was completed, *Policy1-Bowel*, a calibrated and validated microsimulation model of CRC and screening in Australia, was used to estimate the impact of changes in participation rates for individuals in affected areas. The results were stratified by number of eligible months in the screening window. *Policy1-Bowel* has been calibrated and validated to reproduce CRC and screening outcomes in Australia for the general population,[4] and has been used to inform CRC guidelines in Australia, model priority population groups[20] and estimate the impact of interventions designed to improve participation.[21] For this study, *Policy1-Bowel* was used to estimate the relative impact of both a hypothetical pause to all NBCSP screening occurring in April–June in a particular year, as well as a hypothetical targeted increase to screening during that period. This period was chosen to demonstrate a period that would affect participation in affected areas, as they are some of the only eligible screening months in many areas. June is an eligible screening month in all areas of Australia, and May and April are eligible screening months for all but 0.6% and 3.8% of Australia, respectively. This was therefore chosen as an indicative time frame that would be disruptive to areas with a limited number of screening months, as well as being the proposed time-frame for a COVID-19-related pause to screening in 2020; results would be similar for disruptions affected July, August and/or September.

For the screening disruption (Disruption Scenario), April–June were modelled as having 0% participation, and for the intervention to increase participation (Intervention Scenario), these months were modelled at a relative 31% higher participation rate, based on the effect and duration observed during previous interventions (mass media campaigns).[21,22] Months not affected by the hot zone were modelled at usual Australian participation rates (42.5%).[3] *Policy1-Bowel* estimated the impact of changes in participation on CRCs diagnosed and CRC mortality over the lifetime of the modelled cohort (2020–2060). This is an extension of work completed for the Australian Government Department of Health.[23]

As no study participants or identifiable information has been used, no ethics approval was required.

3 | RESULTS

The main results are shown in Table 1. Over 2017–18, an estimated 1.02 million NBCSP recipients (people aged 50, 52, ..., 72, 74 in either 2017 or 2018) were living in areas affected by the HZP (20.4% of all Australians eligible for screening), with 39 600 of these living in areas with six or fewer screening months per year. Affected areas are shown in Figure 1. These areas have higher Indigenous populations (27.8% of individuals living in areas with 6 or fewer screening months vs 3.0% in all Australia), higher levels of economic disadvantage (11.4% lower SEIFA in areas with 6 or fewer screening months vs Australian average) and lower participation rates (29.9% in areas with 6 or fewer screening months vs 42.5% in all Australia), with moderate-to-strong correlations between these factors and the number of eligible screening months in an area. Areas in the Northern Territory were more likely to be impacted by the HZP.

In affected areas, the shorter screening window amplified changes in participation, as shown in Table 2. In the Disruption Scenario, screening pauses over April–June in a particular year were estimated to cause up to 4.6% reduction in CRC cases diagnosed in the same year, and up to 7.3% increase in CRC mortality over their modelled lifetime, compared to 1.1% and 1.8%, respectively, in unaffected areas. Conversely, in the Intervention Scenario, a 31% increase in participation over April–June would reduce CRC deaths in the modelled cohort by up to 2.4% in affected areas—an effect over three times larger than the equivalent in unaffected areas.

4 | DISCUSSION

This study provides overviews of the impact of the HZP on the NBCSP, and the individuals affected. Affected areas are more remote, have higher levels of economic disadvantage, higher Indigenous populations and lower screening rates. The potential risks of screening disruptions were estimated in these areas, showing disruptions to screening in winter months can have an outsized impact in affected areas, whereas well-timed interventions may provide greater health benefits in affected areas.

Low screening engagement in rural and remote areas is a complex issue, with stoicism, resignation and a sense

TABLE 1 Key outcomes regarding the demographics most affected by the NBCSP hot zone policy.

		Areas affected by hot zone—number of eligible screening months			
	All Australia	**11 or fewer**	**6 or fewer**	**3 or fewer**	**Correlation[a]**
Population	25 700 000	4 800 000	252 000	90 700	
% of Australia	*100%*	*18.7%*	*1.00%*	*0.40%*	
Individuals invited to NBCSP screening, 2017–18[b]	5 000 000	1 020 000	39 600	13 700	
% of all Australia	*100%*	*20.4%*	*0.80%*	*0.30%*	
Average participation %	42.5%	41.7%	29.9%	24.1%	0.318
% change vs *all Australia*	–	*−1.80%*	*−29.6%*	*−43.3%*	
Average SEIFA[c]	1000	970	886	811	0.233
% change vs *all Australia*	–	*−3.00%*	*−11.4%*	*−18.9%*	
Indigenous population %	3.00%	6.70%	27.8%	43.1%	−0.585
% change vs *all Australia*	–	*121%*	*820%*	*1330%*	
Number of remote/very remote area postcodes[d]	441	354	116	43	
% of all remote/very remote area postcodes	*100%*	*80.3%*	*26.3%*	*9.70%*	

Note: All numbers are shown to three significant figures.

[a]Correlation between the outcome and the number of eligible screening months across all SA2s.

[b]Individuals aged 50, 52, 54, ..., 74 in either 2017 or 2018; equivalently, those born between 1943 and 1968.

[c]ABS Index of Relative Socio-Economic Disadvantage. A lower score representing areas with higher level of socio-economic disadvantage.

[d]Number of postcodes in areas defined as 'Remote Australia' or 'Very Remote Australia' according to the ABS Remoteness Areas 2016.

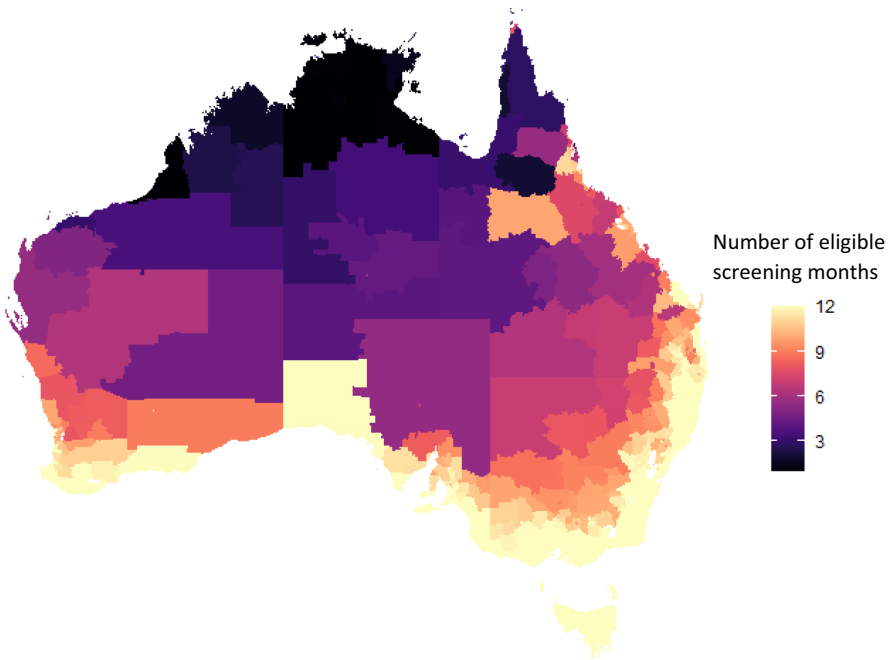

FIGURE 1 Colour-coded map of number of eligible screening months by SA2. Darker colours represent fewer eligible screening months per year.

of self-reliance identified as factors limiting screening uptake.[24] Additionally, individuals may not be able to attend diagnostic follow-up procedures, due to lack of access. Interventions focused on specific demographics, such as the Menzies National Indigenous Bowel Screening Pilot[25] targeting Indigenous Australians, have been trialled to improve NBCSP participation.

Previous studies have shown that if participation and/or diagnostic colonoscopy participation rates were higher, the health benefits of the NBCSP would improve,[4] and that interventions such as mass media campaigns or direct GP engagement can improve participation.[21] Interventions held outside the screening months in Hot Zone areas are unlikely to be effective, as elevated participation rates

TABLE 2 Estimated impact of a theoretical disruption to screening or increase in screening participation.

	Disruption scenario				Intervention scenario		
Eligible screening months[a]	Effective total screening months[b]	Effective annual screening participation[c]	Decrease in diagnosed CRC cases in disrupted year[d]	Increase in CRC deaths over cohort lifetime[d]	Effective annual screening participation[c]	Increase in diagnosed CRC cases in disrupted year[d]	Decrease in CRC deaths over cohort lifetime[d]
12 (unaffected)	9.0	31.5%	1.1%	1.8%	45.8%	0.5%	0.7%
11	8.0	30.7%	1.2%	2.0%	46.1%	0.5%	0.7%
10	7.0	29.4%	1.4%	2.2%	46.5%	0.5%	0.8%
9	6.0	28.1%	1.5%	2.4%	46.9%	0.6%	0.9%
8	5.0	26.5%	1.7%	2.7%	47.4%	0.6%	1.0%
7	4.1	25.2%	1.8%	2.9%	47.8%	0.7%	1.0%
6	3.1	24.4%	1.9%	3.1%	48.1%	0.7%	1.1%
5	3.0	21.8%	2.2%	3.5%	48.9%	0.8%	1.2%
4	2.1	21.4%	2.2%	3.6%	49.0%	0.8%	1.2%
3	**1.4**	**20.2%**	**2.4%**	**3.8%**	**49.5%**	**0.9%**	**1.3%**
2	**0.6**	**11.8%**	**3.3%**	**5.3%**	**52.0%**	**1.1%**	**1.8%**
1	**0.0**	**0.0%**	**4.6%**	**7.3%**	**55.7%**	**1.5%**	**2.4%**

Note: Over April–June, screening participation was modelled at 0% (Disruption Scenario) or 31% higher participation rates (Intervention Scenario) for individuals in areas with 12 eligible screening months (i.e. not affected by the hot zone), 11 eligible screening months, ..., 1 eligible screening month per year, and the effect on long-term health was simulated. For hot zone affected areas, April–June represents a greater proportion of the eligible screening year, and so changes in participation have a larger impact. The comparator for the CRC incidence and mortality is usual (43.5%) participation rates. Areas with more eligible screening months are indicated in blue colours; areas with fewer eligible screening months are indicated in orange colours. Areas with 3 or fewer screening months are bold.

[a]For typical years (i.e. no screening disruptions).

[b]Average total screening month across hot zone areas, including a April–June screening disruption. Different regions will have a different overlap between their 'eligible screening months' and the April–June disruption.

[c]Based on 0% participation (Disruption Scenario) or 31% increase in participation (Intervention Scenario) in April–June, and usual participation rates otherwise. For areas affected by the hot zone, participation is 0% in ineligible months.

[d]In the affected cohort, that is those eligible for screening during the year, the disruption occurred. Modelled cohort lifetime is to age 90.

typically do not persist beyond the duration of an intervention.[22] Interventions may also involve GPs, nurses and community health workers assisting with preparation of stool samples, circumventing the discomfort individuals report regarding storing samples in their home refrigerator. GP/PCP endorsement is a key motivator for screening participation. These interventions must be designed and targeted with the HZP in mind to improve the benefits of the program.

There are several limitations to this study. Health inequities, burden of disease and access to care in remote and regional areas are complex issues. This study cannot capture how these factors relate to cancer burden or screening participation. Additionally, the modelling does not capture local variations in CRC burden due to differences in the risk-factor exposure, access to medical services or NBCSP screening participation, and all modelled increases or disruptions to screening were assumed to impact all demographic groups equally, across sex, age and other factors. Although these limitations mean that this study cannot provide specific and detailed estimates for specific areas or population groups, it does provide a guide to the potential risks and benefits in affected areas.

The hot zone policy is important and necessary for the NBCSP to remain effective, especially as temperatures are projected to rise over the 21st century. Individuals in affected areas have a larger exposure to risk of screening interruptions, in addition to existing inequities in cancer burden and screening utilisation. Conversely, the shorter screening window also means that well-timed interventions can increase participation more efficiently. It is crucial that monitoring and analysis of the NBCSP, including the planning and deployment of interventions designed to increase participation, include specific and targeted consideration of hot zone areas.

AUTHOR CONTRIBUTIONS

Joachim Worthington: Conceptualization; investigation; writing – original draft; methodology; visualization; writing – review and editing; software; project administration; formal analysis; data curation. **Jie-Bin Lew:** Writing – review and editing; software; validation; methodology; resources. **Emily He:** Validation; writing – review and editing. **Kate Broun:** Investigation; validation; writing – review and editing. **Katina D'Onise:** Validation; writing – review and editing. **Paul Grogan:** Validation; writing – review and editing; supervision. **Karen Canfell:** Validation; writing – review and editing; software; supervision. **Eleonora Feletto:** Validation; writing – review and editing; writing – original draft; conceptualization; investigation; visualization; project administration; supervision.

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CONFLICT OF INTEREST STATEMENT

EF undertakes consulting work modelling outcomes of the NBSCP for the Australian Government Department of Health and has received payment from the Japanese Cancer Association and National Cancer Center of China for presentations on cancer control. KC's research is funded by the National Health and Medical Research Council (NHMRC) of Australia (Fellowship APP1194679, Centre for Research Excellence in Cervical Cancer Control 1135172). JBL's research is funded by an NHMRC Investigator grant (APP1194784). EF receives NHMRC grant funding to investigate improving participation in the NBCSP (APP2014964). The Daffodil Centre through Cancer Council Australia, which employs authors JW, JBL, EH, PG, KC and EF, has received Australian Government funding to update chapters of the national clinical practice guidelines for CRC chapters on population screening (covering the NBCSP) and risk and screening based on family history. This project is ongoing.

ETHICAL STATEMENT

This research did not contain any studies involving human participants or identifiable data. There are no human subjects in this article. All data sources are pubically available and appropriately cited. Ethical approval was not required or applicable for this article.

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