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ABSTRACT

Impact of Time of Diagnosis on Out-of-Pocket Costs of Cancer Treatment, a Side Effect of Health Insurance Design in Australia

The Extended Medicare Safety Net (EMSN) in Australia was designed to provide financial assistance to patients with high out-of-pocket (OOP) costs for medical treatment. The EMSN works on a calendar year basis. Once a patient incurs a specified amount of OOP costs, the EMSN provides additional financial benefits for the remainder of the calendar year. Its design is similar to many types of insurance products that have large deductibles and are applied on a calendar year basis. This study examines if the annual quarter within which a patient is diagnosed with cancer has an impact on the OOP costs incurred for treatment. We use administrative linked data from the Sax Institute's 45 and Up Study. Our results indicate that the timing of cancer diagnosis has a significant impact on OOP costs. Specifically, patients diagnosed in the fourth quarter of the calendar year experience significantly higher OOP costs compared to those diagnosed in the first quarter of the year. This pattern persists after controlling for different types of cancer and different stages of cancer and robustness checks. These findings have important implications for the design of the EMSN, as well as other insurance products.

JEL Classification: I13, I14, I11

Keywords: out of pocket costs, cancer, public health insurance

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1. Introduction

Cancer is a major cause of morbidity and mortality worldwide, and the financial burden of cancer is substantial for patients and their families. In Australia, the cost of cancer treatment can be particularly high, with many patients facing significant out-of-pocket (OOP) costs (Iragorri et al., 2021; Rodriguez-Acevedo et al., 2021; Slavova-Azmanova et al., 2018; Bates et al., 2018; Callander et al., 2019). To alleviate the burden of OOP costs, the Australian government introduced the Extended Medicare Safety Net (EMSN) in 2004, which provides financial assistance to patients with high OOP costs for medical treatments that are delivered in the out-of-hospital sector and eligible under the Medicare Benefit Schedule (MBS).

Under the EMSN, once a patient reaches a threshold in OOP expenses, they are eligible for a higher Medicare benefit for the remainder of the calendar year. Due to the design of the EMSN, this could imply that those patients who are diagnosed earlier in the calendar year benefit for a longer period of time than those who are diagnosed later in the year. This is particularly true for episodes of care, like cancer care, that extend over longer periods of time and where the fees charged are distributed over the entire period. The EMSN is similar to public and private insurance products where patients receive higher benefits once they have incurred a deductible amount in OOP costs.

The aim of this study is to examine the impact of the timing of cancer diagnosis on OOP costs for cancer patients in Australia. We focus on cancer because many of its treatments are delivered over an extended period of time, and also because the availability of cancer registry data allows us to obtain precise diagnosis dates.

The EMSN was introduced in 2004 and complements previously existing MBS arrangements. All Australians are eligible for MBS rebates which covers eligible medical services including general practice, and specialist consultations as well as cancer treatments such as radiation oncology and the administering of chemotherapy (though not pharmaceuticals; the cost of which are covered under a separate program).

For out-of-hospital medical services, the MBS provides patients with a fixed rebate per service. Under Australia's MBS program, doctor fees are unregulated and, as such, patients pay the gap between the doctor's fee and the MBS rebate. For many medical services, doctors choose to set their fee that is equal to the MBS rebate which means that there are no OOP costs associated with that particular service. For example, patients commonly pay no OOP costs for pathology services and general practice consultations for this reason. For specialist consultations and specialised services, however, the doctor fee is often well above the MBS rebate leaving patients with considerable OOP costs.

The EMSN was designed to alleviate patient cost burdens through additional coverage for those who have exceeded a threshold in OOP costs. To qualify for EMSN benefits, a household's OOP costs relating to out-of-hospital MBS funded services are accumulated throughout a calendar year. Once a household reaches the threshold, the EMSN provides additional benefits to patients for out-of-hospital services for the remainder of the calendar year.

There are two different EMSN threshold levels. The first is for those patients who hold a concession card (e.g. those on welfare payments including the aged pension or on low incomes) or are eligible for family tax benefits (e.g. families with young children under a certain level of income. As of January 2023, the EMSN threshold for this group was $770.30. The second EMSN threshold level is for the general population. As of January 2023,

this general threshold was $2,414. All Australians are eligible for EMSN benefits once they reach their relevant threshold.

Once a household qualifies, the EMSN covers up to 80% of the gap between the provider fee and the MBS rebate. For example, if a provider charges $100 and the MBS rebate for that service is $60, the EMSN will pay $32 (80% of the $40 gap) in benefits. If the patient had not qualified for the EMSN, their OOP cost in his example would be $40. It should be noted that In 2010, the Australian Government placed limits on EMSN benefits for some types of medical services. This meant that for those services, patients had to pay the gap once again if they visited providers whose charges exceeded the EMSN cap amount. See van Gool et al (2011) for further details.

The EMSN works on a calendar year basis. This means that once a household qualifies, it will cover all members' expenses for the remainder of the calendar year. Once a new year commences, the household must reach the threshold again before they qualify. It is this feature of the ESMN that could lead to two identical patients incurring different OOP costs over an episode of care, depending on the time of year that they were diagnosed. Table 1 illustrates such a scenario. The only difference between the two patients is that one is diagnosed on the 1 January and the other is diagnosed on the 1 July. The first patient will face an OOP cost of $3,931 over the 12 months of treatment following diagnosis whereas the second patient faces an OOP cost of $5,862. The intuition here is that the patient diagnosed in July incurs a greater proportion of their costs in the next calendar year where they have to qualify twice for the EMSN.

Whilst the Table 1 is useful for illustrative purposes, the real impact of date-of-diagnosis on OOP costs will depend on the fees charged above the MBS rebate and the timing of when those fees are charged over a twelve-month period[4]. The aim of this paper is to model these effects based on the actual experiences faced by patients who have been diagnosed with cancer.

Table 1. OOP costs under two different time diagnosis scenarios

		Patient A (diagnosed 1 Jan)		Patient B (diagnosed 1 July)	
		Fees > MBS rebate	OOP costs	Fees > MBS rebate	OOP costs
Year 1	Quarter 1	$ 2,500.00	$ 2,431.20		
	Quarter 2	$ 2,500.00	$ 500.00		
	Quarter 3	$ 2,500.00	$ 500.00	$ 2,500.00	$ 2,431.20
	Quarter 4	$ 2,500.00	$ 500.00	$ 2,500.00	$ 500.00
Year 2	Quarter 1			$ 2,500.00	$ 2,431.20
	Quarter 2			$ 2,500.00	$ 500.00
	Quarter 3				
	Quarter 4				
	Total	$ 10,000.00	$ 3,931.20	$ 10,000.00	$ 5,862.40

Identifying the impact of the EMSN is complicated by the fact that those who qualify may have higher health needs than those who do not. However, in the case of cancer patients, it is safe to assume the timing of a cancer diagnosis within a calendar year is random and patients at the start of their treatment cycle have high health care needs. Hence, by focusing on this group of

[4] The total fees charged for a cancer patient in our sample remains high up to 3 quarter following their diagnosis (figure 1 a).

patients we are able to measure the arbitrary impact of EMSN program on patient's OOP depending on the time of the year they receive the diagnosis.

2. Method

The Sax Institute's 45 and Up Study, comprising a cohort of 267,357 individuals residing in New South Wales (NSW), Australia at recruitment, serves as the primary dataset for this research. Individuals were selected at random from the Services Australia Medicare enrolment database and participated in the baseline survey between 2005 and 2009. People above the age of 80 and residents of rural and remote areas were oversampled. The study, as reported by Bleicher et al. (2022), remains ongoing. Around 19% of those invited completed the baseline survey. This sample represents approximately 11 percent of the population aged 45 and above in NSW. Its community-based sampling approach offers a comprehensive range of patient demographics, socioeconomic indicators, and health status (Johar et al., 2017). An exceptional feature of this study is its ability to link multiple administrative claims datasets, including the Medicare claims data, which serves as the gold standard for accurate data on out-of-hospital service utilization, fees, Medicare Benefits Schedule (MBS) rebates and EMSN benefits as well as patient OOP costs.

Furthermore, the 45 and Up Study is linked by the Centre for Health Record Linkage (CHeReL) to the NSW Cancer Registry using a probabilistic procedure to link records (www.cherel.org.au). Its current estimated false positive rate is 5/1,000. This enables us to identify participants within the study who have received a cancer diagnosis. At the time of this study, the cancer registry data was accessible for diagnoses made up until the end of 2015. Given that the quality of the cancer registry data was limited before 2011, we focused on identifying patients diagnosed with cancer between 2011 and 2015. For each individual with a cancer diagnosis, we examine a one-year period from the date of diagnosis. For example, if a person was diagnosed with cancer on October 15, 2015, we consider their MBS out-of-hospital claims from October 15, 2015, to October 14, 2016. This approach ensures a consistent observation period for each participant following their cancer diagnosis.

Out-of-hospital claims include GP and specialist consultations, imaging, pathology, radiation oncology, chemotherapy, and some allied health consultations. Medicare claims data for these claims includes the provider fees, OOP costs and Medicare benefits (including any EMSN benefits) and service counts. These have been aggregated as a sum of all Medicare services over a 12-months period. The dollar figures are indexed to the first quarter of 2016 using the Australian Bureau of Statistics' Consumer Price Index (CPI).

The OOP costs for the year are calculated by subtracting the Medicare claims data rebate and EMSN benefits from the fees paid. There is no private health insurance coverage available in Australia for out-of-hospital services that are covered by the MBS.

Using a linear estimation model, our analysis examines the influence of the quarter of diagnosis on OOP costs for individuals diagnosed with cancer each year. To account for potential confounding factors, we incorporate observed individual-specific characteristics into our analysis. These characteristics include whether an individual possesses private health insurance, their age (with a specific focus on individuals above 65), their residential location (metro or non-metro area), and an indicator for the socioeconomic quantile of their residence (SEIFA). Complete list of original variables used from the 45 and Up Study is available in

Appendix B. Additionally, we incorporate controls for the stages of cancer diagnosis and cancer type to address the heterogeneity in cancer severity and types.

Moreover, we produce regression results for concessional card holders and general population separately; recognizing that the impact of the EMSN may differ for individuals with concessional cards compared to those without. The differential impact of the EMSN on concession card holders may arise because of their lower EMSN threshold amount but also because concession cards are often charged lower fees by doctors (Johar et al 2017). This way we account for potential variations in the impact of the EMSN program across different patient subgroups based on their concessional card status. The units of observation are patient-level aggregates over a one-year period following the diagnosis of cancer. Furthermore, we provide the estimations for a subsample of general population with highest out of pocket costs, those who need radiation oncology. Additionally, we provide estimates based on quantile of OOP costs.

Finally, to ensure our results are robust and the effects measured are due to time of diagnosis and no other possible confounders, were estimate the model using a placebo time of diagnosis for a randomly drawn group of individuals.

3. Results

Our sample included 14253 cancer patients who had complete data on all variables of interest, out of which 3956 are general patients and rest are concessional card holders. Given the elderly status of the sample, this is not surprising. The average OOP costs per patient was $550 (SD=$776) for the 12 months following diagnosis. As shown in Table 2, we found that patients eligible for the higher EMSN threshold (general population) who were diagnosed in quarter 4 had significantly higher OOP costs compared to those diagnosed in the earlier part of the year[5]. Specifically, patients diagnosed in the last quarter had OOP costs that were $103 higher on average compared to those diagnosed in the first quarter, after controlling for patient characteristics, cancer type and stage, and calendar year. For the subsample of those who needed radiation oncology, the fourth quarter effects is larger at $334. Full estimation results are available in table 2a in online annex. For concession card holders (i.e. those eligible for the lower EMSN threshold) the *time-of-diagnosis* results were not significant.

To further investigate the extent to which patients are affected by the timing of their diagnosis, we re-estimate the model using a quantile regression. In doing so, we classify patients into groups according to the OOP costs they have incurred during the year.

The results in Table 3 suggest that the *time-of-diagnosis* effect on OOP costs is driven by patients who are already incurring OOP costs at above 75th percentile of the distribution. For these patients, being diagnosed in the fourth quarter of the year is associated with a $113 (75th percentile) and $149(90th percentile) increase in their OOP costs.

[5] We don't find any evidence that the total fees charged over a one-year episode of care varies depending on quarter of diagnosis. (table 1a)

Table 2-Impact of time of cancer diagnosis on out-of-pocket costs (OOP)

	(1)	(2)	(3)
	Non concessional		Concessional card holders
	Main sample	Radio Oncology	
VARIABLES	OOP	OOP	OOP
2nd quarter	-12.70	46.90	-16.27
	(38.55)	(124.23)	(16.87)
3rd quarter	24.95	172.34	-7.82
	(40.27)	(136.71)	(17.87)
4th quarter	102.81***	333.69***	-1.22
	(38.00)	(129.07)	(18.14)
Constant	205.67*	60.61	227.03***
	(124.57)	(327.84)	(62.21)
Observations	3,965	1,061	10,228
R-squared	0.17	0.13	0.12

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Linear regression results while controlling for year fixed effects, cancer type fixed effects, stages of cancer, measure of rurality and socioeconomics affluence of the area, and private health insurance dummy variable.

Table 3-Impact of time of cancer diagnosis on out-of-pocket costs (OOP) across quantiles

	(1)	(2)	(3)	(4)
	OOP			
	q25	q50	q75	q90
2nd quarter	-16.36	-5.30	-18.94	-68.41
	(21.90)	(30.27)	(55.89)	(53.20)
3rd quarter	0.08	-14.17	-24.19	45.06
	(21.46)	(29.66)	(54.77)	(68.61)
4th quarter	9.85	23.06	113.20**	149.41***
	(21.60)	(29.85)	(55.12)	(53.03)
Constant	102.00	284.31*	555.07*	985.29

	(120.48)	(166.53)	(307.49)	(865.40)
Observations	3,965	3,965	3,965	3,965

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Linear regression results while controlling for year fixed effects, cancer type fixed effects, stages of cancer, measure of rurality and socioeconomics affluence of the area, and private health insurance dummy variable.

4. Robustness check

To ensure our result are robust to the EMSN's impact on patients diagnosed with cancer, we drew a random group of individuals (20000 individuals) from the 45 and up survey. We randomly allocated a synthetic 'date of diagnosis' to this group. Further we merged these individuals to their Medicare claims data records and calculated an annual OOP cost for these individuals from their synthetic date of diagnosis. We then estimated the quarter of diagnosis effect for these individuals. The results are presented in the Table 4, below. As expected, there are no last quarter effect for these randomly drawn sample of individuals.

Table 4-Robustness check

	(1)	(2)
	General population	Concessional card holders
VARIABLES	OOP	OOP
2nd quarter	-26.04	-13.54
	(37.50)	(18.97)
3rd quarter	-5.85	-7.71
	(37.00)	(18.78)
4th quarter	6.09	-5.85
	(36.92)	(18.85)
Constant	358.66***	268.48***
	(51.66)	(22.60)
Observations	4,954	8,473
R-squared	0.09	0.09

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Linear regression results while controlling for year fixed effects, measure of rurality and socioeconomics affluence of the area, and private health insurance dummy variable.

In addition to the table presented above, our results remain robust to: estimating the model using the same sample of non-concessional cancer patients as in the main results and assigning a random time of diagnosis (table 3a), removing those who passed away within one year from diagnosis from the sample (table 4a) to ensure our results are not biased due to

death of those with higher OOP costs, removing cancer type controls (table 5a) to ensure the model is not over specified, and including an additional control indicating those aged above 65 (table 6a). These additional robustness results are available in the online annex.

5. Discussion

Our findings suggest that the timing of cancer diagnosis has a significant impact on OOP costs for cancer patients in Australia, with general patients diagnosed in the later part of the year experiencing significantly higher costs compared to those diagnosed earlier in the year. This pattern is consistent with the design of the EMSN, which operates on a calendar year basis. The fact that we only find 4th quarter effects is likely to be due to the uneven distribution of OOP costs over the 12 month period (figure 1a).

The robustness test confirms that our results relate to the specific cohort of patients we have identified through the cancer registries that have a protracted period of treatment. We explain this through the fact that patients diagnosed with cancer can incur significant OOP costs over a protracted period. This implies that in the year following their cancer diagnosis some patients will need to meet the EMSN threshold once and others will face the threshold twice which increases the costs they incur. Whilst our focus has been on patients with cancer, we believe that similar findings would be found for patients diagnosed with other illnesses that have a protracted period of treatment and where OOP costs are incurred throughout that period.

Our results also show that the *time-of-diagnosis* effect is not found among patients with a concession card. This result is likely to be driven by two factors. First, concession card holders face a lower EMSN threshold to qualify and therefore even those patients who have to qualify twice over two calendar years will face lower OOP costs than general patients. Second, providers are more likely to charge concession card holders lower fees and therefore they face fewer OOP costs (Johar et al 2017). This implies that the effect of the EMSN may not come in play because many concession card holders never reach the threshold.

The *time-of-diagnosis* effect was strongest in the general patient group (i.e. those without a concession card) particularly among those who incur high OOP costs. This result lends further weight to the conclusion that the *time-of-diagnosis* effect is driven by the design of the EMSN because only those patients with high OOP costs qualify for EMSN benefits. Patients whose treatment includes radiation oncology are also highly affected by their time of diagnosis. This result is consistent with recent evidence that shows that the OOP costs for radiation oncology can be high and the EMSN is playing an increasing role in funding this aspect of cancer treatments (van Gool et al., 2023; Liu et al., 2023).

Further research is warranted to investigate the impact of the EMSN on OOP costs and access to care particularly among low- and middle-income households who do not qualify for the lower EMSN threshold (e.g. non-concession card holders). For this group, the high EMSN threshold of $2,414 may mean that some health care services are out of reach if they have to reach these thresholds once, let alone twice, over an episode of care. For this group, in particular and despite the intent of the EMSN, financial barriers to access persist.

The focus of this study was on the time-of-diagnosis effect on OOP costs for services funded by the MBS. Whilst this focus is warranted due to the design of the EMSN, there are other aspects of Australia's funding system that may amplify the results found here. For example, Australia's Pharmaceutical Benefit Scheme also has a safety net arrangement that additional benefits for those patients who have incurred a certain value in OOP costs within a calendar year. Further research is warranted to examine the cumulative effect that OOP costs have on treatment choices across these different health care sectors.

6. Conclusion

Our findings have important implications for the design of the EMSN and similar insurance products where patients receive higher benefits once they have incurred a high deductible. The findings may have subsequent consequences in the way that patients interact with the health care system; particularly amongst patients who are price sensitive and more likely to be deterred in seeking the care they need because of large deductibles.

Whilst previous research has highlighted broader issues on the unintended consequences of the EMSN (van Gool et al., 2009, 2011; Yu et al., 2019), the results highlighted in this paper could be rectified by changing its design. Namely, instead of working on a calendar year basis, qualification for the EMSN could function on a rolling year aggregate. Then, regardless of when in the calendar year a patient qualifies, the patient would be eligible to receive EMSN benefits for the following twelve months.

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