

**NET COST TO THE PBS OF MEDICATION CHANGES ARISING FROM
THE IPAC INTERVENTION: METHOD USED TO ASSESS HEALTH
SYSTEM COSTS FOR ECONOMIC ANALYSIS**

Supplement to the Economic Evaluation for the IPAC Project

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Integrating Pharmacists within Aboriginal Community Controlled Health Services (ACCHSs) to improve Chronic Disease Management (IPAC) Project.

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INTRODUCTION

In this report we outline the method used to determine the net cost of changes to Pharmaceutical Benefits Scheme (PBS) medications for a subset of study participants during the follow-up period of the IPAC intervention (study period), in order to inform the economic evaluation. The net cost was calculated as the difference in the total cost of new medications prescribed from the cost of prior medications that were ceased over this period. These changes in patient medications were initiated following a medication review (medication appropriateness index, MAI, and an assessment of underutilisation, AoU). In this analysis, the costs assigned to medications pertain to the estimated cost of prescribed medications as sourced from MAI assessments.

METHOD

Participants:

Participants who were assessed for medication appropriateness with the MAI and for AoU were enrolled in the IPAC study and were a subset of all enrolled participants. Pharmacists selected patients who may best benefit from an assessment of their medications as per usual care consistent with a pragmatic trial. In a separate report, the characteristics of the MAI subset of participants did not meaningfully differ from the remaining IPAC participants based on a range of patient, demographic, and biomedical characteristics.¹

Data on 353 study participants for whom an MAI and AoU assessment was completed at baseline and again at the end of the study was used to determine the net cost of changes in prescribed medications. The flow diagram for n=353 participants is included in a separate report.² The date of the first MAI was defined as the index date for measuring prescribing changes to medicines. The baseline MAI was completed within the first 100 days of participant enrolment for almost all participants. The date of the end of the study was set for the 31st October 2019. For each participant, the follow-up MAI was completed close to the study end date (mean time to repeat MAI was 268 days and mean time to the end of the study was 308 days).

Prescribed medications:

Pharmacists completed and reported the assessments in an electronic logbook. Pharmacists were required to name every medication that was currently prescribed for the participant in order to complete this assessment. To limit the reporting burden with logbook data entries, pharmacists were not required to list the dose, number, and frequency of prescribed medication doses. Moreover, electronic prescribing data was not used to source medication lists due to the high probability this data was inaccurate. By relying on pharmacist data entry at the time of a medication review, the medication list was validated by pharmacists who had access to the participants electronic health records, as well as access to prescribers to clarify any uncertainty about medications. The pragmatic approach to data collection therefore necessitated the adoption of a method to assign a 'standard dose' per medication to enable this analysis.

Assigning medication cost:

We estimated the cost of 'new medications started' and the estimated cost-saving from 'old medications stopped' for every MAI-assessed participant. This was able to be determined by comparing medication lists from the baseline MAI assessment with the end of study MAI for each participant.

The study could inform on the number and type of 'new medication started' or 'old medication stopped', but not the dosage of medication, clinical indication, nor the date when the medication

change occurred. An assumption was made that the medication change was instigated from the date of the baseline MAI and continued until the end of the study (31st October 2019).

Using best practice prescribing recommendations contained within the Australian Medicines Handbook, a standard medication dosage for each prescribed drug was assigned by a pharmacist. Where prescribing recommendations were unclear, advice was also sourced from a clinician and hospital pharmacist to derive a conservative 'standard dosage' that was neither the maximum nor minimum dosage for the main clinical indication of each medication. The time between the baseline MAI assessment and the end of the study was reported as 'days' for each participant.

Medications were categorised as continuous-use, single- expense, or privately purchased (designated 'private'). A private prescription referred to a medication that was not on the PBS and could also be continuous-use or single-expense but would result in out-of-pocket expenses for the participant. These three categories were used to ensure that medication costs were not incorrectly assigned to the PBS, and that the duration was not expanded to encompass the whole of the intervention period if the medication was likely to be used only for acute problems or within 30 days. For example, all antibiotics were assigned to the 'single-expense' category even if the antibiotic was potentially used for the treatment of tuberculosis or recurrent urinary tract infection. This provided a conservative estimate of health system costs related to changes in prescribed medicines.

The cost of each medication change was derived using the 'dispensed price per maximum quantity' (DPMQ) for each medicine as reported for the PBS. The DPMQ "is the price for dispensing the maximum quantity of a product under a given prescribing rule and incorporates the price ex-manufacturer, all fees, mark-ups and patient contributions." The maximum quantity of a product is listed on the PBS for each medication and equates to the maximum number of units of the pharmaceutical item that may, in one prescription, be permitted to be prescribed and supplied on any one occasion.^{3 4}

At the standard dosage defined for each medication, and using the PBS defined maximum quantity of the medication that can be dispensed plus the DPMQ, the cost of each medication could be derived. Each medication that was categorised as continuous was assumed to be taken continuously for the whole study period. We also assumed complete participant adherence over this period.

Analysis:

A list of all started and stopped medicines from each participant was used to generate a master-list of unique medications and each was assigned a standard dosage.

If the medication was listed on the PBS, the unique drug code, maximum quantity, and DPMQ (as specified by the PBS) was recorded on the master-list. For non-PBS medicines (private), a DPMQ was assigned based on commercial prices publicly available.

Using the standard drug dosage, the DPMQ for a period of 30 days (DPMQ30) was able to be derived from the DPMQ for each medication. The DPMQ30 cost was assigned to every medication that was to be used continuously per participant. The formula used for the DPMQ30 was:

$$\text{DPMQ30 (\$)} = \frac{30 \times \text{DPMQ (\$)} \times \text{assigned standard number of units per day}}{\text{maximum quantity of units (number)}}$$

For most single-expense medications (e.g. antibiotics), the DPMQ was used rather than the DPMQ30. In addition, the maximum quantity for most single-expense medications either lasted for one month (e.g. promethazine) or could be continued for at least one month (e.g. antifungal creams). In these instances, the DPMQ was the same as the DPMQ30. If the supplied maximum quantity of the medicine exceeded 30 days, the DPMQ30 was derived and used to adjust the cost downwards (e.g. varenicline).

Some single-expense medicines were deemed to be required for at least one month and the DPMQ30 was then assigned (e.g. liquid antacids, steroids, prophylactic colchicine, certain benzodiazepines).

The total cost for medications used continuously for the duration of the follow-up period was summated. The formula used to determine the total cost of medicines used continuously was:

Total medication cost = number of follow-up days per participant X DPMQ30

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Private script medication costs were separated from the single-expense and continuous-use medication costs to avoid double counting.

The total medication cost, the cost of medications sourced from non-PBS (private) sources, and the cost of single-expense items was summated for both started and stopped medications. This provided an estimate of the total cost of changes made to prescription medications over the study period. The total cost of all the medications ceased were subtracted from the total cost of all the medications that were started, in order to determine the net cost of these changes. The net total estimated cost of medications to the PBS over the study period was then annualised.

No costs were assigned for participants for whom medications did not change during the follow-up period. The denominator for the cost per participant was the total MAI and AoU participant subset.

RESULTS

All new medications started, and medications stopped were assigned standard dosages and the DPMQ30 was estimated for each medication to determine medication costs over 30 days. Examples of the assigned standard dosages to determine medication costs is shown in Table 1.

A total of 1,151 medications were newly started in 300 (85.0%) participants (Table 2). A total of 1,004 medications were stopped in 304 (86.1%) participants. The mean study period for all participants in this analysis from baseline MAI to the end of the study was 308 days.

For the purposes of this study, if the medication was deemed to be for continuous use, a new medication was assumed to have been started after the baseline MAI, and to have continued until the end of the study for each participant. It was similarly assumed that if a medication was ceased, this occurred after the baseline MAI and remained ceased until the end of the study.

For both newly started and ceased medications, these prescribing changes applied to a total of 245 unique individual PBS medications for continuous use, 52 unique PBS single-expense medications, and 24 unique medications that were not on the PBS (where 5 were categorised as a single expense).

Table 1. Examples of standard medication dosages applied to selected medications

Medication name	PBS drug code	Strength	Standard dose (number of daily units)	Maximum quantity units (PBS)	DPMQ (PBS) (\$)	DPMQ30 (\$)
<i>PBS continuous use medication</i>						
Amlodipine	2752W	10mg	1	30	13.06	13.06
Frusemide	2412Y	40mg	2	100	13.16	7.90
Glibenclamide	2939Q	5mg	4	100	15.80	18.96
Metoprolol	1325R	100mg	2	60	13.91	13.91
<i>PBS single-expense medication</i>						
Clotrimazole (cream)	4004R	1%		20g	13.24	13.24
Flucloxacillin	1527J	500mg	4	24	20.17	20.17
<i>Private prescription medication</i>						
Nicotinamide	NA	250mg	3	100	26.39	23.75
Lorazepam	NA	1mg	2	50	23.99	28.79

NA: not available; PBS: Pharmaceutical Benefits Scheme; DPMQ: Dispensed price per maximum quantity; DPMQ30: DPMQ for 30 days' supply.

The estimated total cost to the PBS of newly started continuous-use medications from the MAI subset of 353 participants was \$503,316, whilst the similarly derived estimated cost-saving from ceased continuous-use medications was \$371,054 (Table 2). The estimated net increase in the cost of continuous-use PBS medications during the period of the study was \$132,262. The outcome of the prescription change following baseline medication review was an estimated net increased cost of approximately \$375 per person for continuous-use medications over the study period.

The estimated total cost to the PBS of newly started single-expense medications was \$4,208 whilst the similarly derived cost-saving from ceased single-expense medications was \$3,264 (Table 2). This is a net increase in the cost of single-expense medications during the period of the study of \$944, or approximately \$2.70 per person.

There was also an estimated net increase in participant out-of-pocket (non-PBS) costs attributed to medications of \$4,665 (Table 2). This equates to approximately \$13 per person for the whole study follow-up period. Most of these costs were for: dietary supplements such as iron, nicotinamide, and multivitamins; antacids; antihistamines; and medications that were not available on the PBS such as lorazepam (anxiety), agomelatine (antidepressant), and bumetanide (loop diuretic).

An estimated total net cost to the PBS of medication change of +\$133,206 over the study period, equates to \$157,858 when annualised from 353 participants (\$447 per participant).

Table 2: Cost of new medications started and medications that were stopped following medication review (Medication Appropriateness Index, MAI) in 353 participants. Data pertains to MAI and AoU participant subset with paired data (N=353) for a mean follow-up period of 308 days.#

	Number of participants with medication changes (N, %)	Total number of prescribed medications (N)	Range in number of prescribed medications per patient	Total cost of all continuous-use PBS medications * (\$)	Total cost of non-PBS medications (private scripts)** (\$)	Total cost of single-expense PBS medications *** (\$)	Total PBS cost (\$)
Medications started	300 (85.0%)	1,151	1-21	\$503,316	\$9,805	\$4,208	\$507,524
Medications stopped	304 (86.1%)	1,004	1-13	\$371,054	\$5,140	\$3,264	\$374,318
Net Total PBS cost (\$)				+\$132,262			+\$133,206
Net Total non-PBS cost (\$)					+\$4,665		
Net Total PBS single-expense cost (\$)						+\$944	

PBS: Pharmaceutical Benefits Scheme

Pertains to the period from the baseline MAI until the end of the study (31st October 2019).

*Based on an applied standard dose for continuous-use medications. Dispensing is assumed to continue or cease for the whole follow-up period.

**These costs are borne by either the patient or the health service.

***These PBS costs are not continuous and were assumed to represent a single expense during the follow-up period.

DISCUSSION

We estimated that the IPAC intervention increased PBS medication use by a net \$157,858 per annum for 353 participants. Medication use increased because medication review led to prior medications being replaced by alternative and more appropriate medications.⁵ This net figure excludes the costs of changes to medications that were not listed on the PBS. If this cost increase is extrapolated to the complete IPAC cohort of 1,456 participants, the estimated total net cost to the PBS of medication changes per annum would be \$651,108. In a separate analysis, the characteristics of the MAI subset of participants did not clinically meaningfully differ from other IPAC participants,⁶ which supports the generalisability of these findings more broadly.

According to the IPAC project theory of change,⁷ these increased costs are attributed to the influence of the intervention on prescriber behaviour. During the intervention period, pharmacists were integrated in health service teams with prescribers and other health service staff. Pharmacists participated in the completion of medication reviews for prescribers, participant assessment of medication adherence, the provision of education and training and medicines information, team-based collaborations such as care plans and case conferences, supported participant transitions of care for medicines reconciliation, and communication with community pharmacy.⁸

These activities were conducted across 22 health service sites (18 ACCHSs) and involved the whole IPAC cohort. In a separate analysis involving this MAI subset of participants, we showed that the intervention significantly reduced the mean MAI scores per participant ($p=0.003$); the mean MAI score per individual medication ($p=0.004$); the proportion of participants receiving medications rated as inappropriate ($p<0.001$); and the proportion of medications with the following prescribing risks: incorrect dosage, impractical directions, unacceptable therapy duration, drug-disease interactions; and unnecessary medications due to absent clinical indications, or lack of clinical effectiveness (all $p<0.05$). There was also a 34.3% relative reduction in the number of participants with medications meeting ≥ 1 medication overuse criteria. These significant changes to the quality use of medicines occurred between the baseline MAI and the repeat MAI that was completed at the end of the study – a median period of 270 (IQR 218-316) days between assessments.

In this analysis, we assumed that the medication changes continued until the end of the study for the duration that each participant was involved in the study. Together with the other cost assumptions, we are likely to have overestimated the cost of medication changes arising from the IPAC intervention.

For the Aboriginal and Torres Strait Islander population, an increased health system cost following improvements to medication appropriateness (and broader intervention impacts) is not an unexpected finding. In Australia, Aboriginal peoples and Torres Strait Islanders are five times more likely to die from chronic disease before the age of 75 years (premature mortality) than other Australians (2011-15).⁹ Yet, despite their higher burden of disease, medicines underutilisation is significant. The Indigenous Australians per person expenditure for medicines through the PBS has been a fraction (33% in 2013-14) of the expenditure for non-Indigenous Australians.¹⁰ The per-person PBS (benefit-paid) expenditure for Indigenous Australians in 2013-14 was \$182.50 compared with \$439.30 for non-Indigenous Australians but these figures are not disaggregated by age or chronic disease. If they were, we would expect higher per capita costs for both Indigenous and non-Indigenous Australians, but the gap in expenditure would remain. We reported an estimated net increase of \$447 per person per annum following improved prescribing arising from the integrated pharmacist intervention within ACCHSs, which in effect means superior health care service utilization (towards equity) by Aboriginal and Torres Strait Islander patients with chronic disease when compared to usual care.

Limitations:

This analysis focussed on the potential health system cost of dispensing the medications prescribed for this subset of IPAC participants. The cost of medications that were actually dispensed during the study period was not able to be directly ascertained as dispensing data was not collected for this study.

Consequently, assumptions were applied when estimating the cost of changes to prescription medicines. A conservative approach was taken. It is likely that each of the following assumptions had the effect of overestimating the cost of medication changes during the study period. Costs were assigned to continuous-use medicines (at a standard dosage) for: a) the whole study period; b) assumed complete participant adherence over this time; and c) assumed that prescribing changes occurred immediately following the date of the baseline medication review.

Given that there are delays in patients filling prescriptions from community pharmacy, and a usual non-adherence rate of at least 30% for Aboriginal peoples and Torres Strait Islanders,¹¹ the actual cost of medications dispensed for the whole follow-up period would most likely have been less than what was assumed. The same assumptions were applied to ceased medications to offset the cost of newly started medications. This may have overestimated the costs saved, as medications may not have been ceased immediately after the baseline MAI. The net effect of these competing assumptions would favour an overestimation of medication costs as it is easier to cease a medication than to take it.

The costs of single-expense medications may also have been overestimated by extending the cost period to 30 days for some items according to the defined standard dosages, but this applied to only a few medications. An assumption was made that these single-expense items were not prescribed at repeated intervals during the study and this may have had the effect of underestimating the costs of these type of medications. In this case, the net effect is a more balanced set of assumptions.

The PBS patient co-payment did not factor into any of the medication cost estimates as most participants were concessional and the co-payment for Aboriginal peoples and Torres Strait Islanders in this situation is waived. In addition, some participants were from remote locations sourcing their medications directly from the ACCHS under the section 100 (of the National Health Act, 1953) scheme that also waives a co-payment. The few remaining participants not in either of these situations may have paid a reduced co-payment of \$6.90 (2019 prices) per medication dispensed. If the patient contribution was able to be factored into these estimates, the direction of the net effect on patient 'out of pocket' expenses arising from the medication changes is unclear given that new medications were started as well as ceased.

These assumptions provide a conservative estimate of the costs of medication changes that may be attributed to the pharmacist intervention.

Conclusion:

Integrating pharmacists into Aboriginal community-controlled health services led to medication changes in a subset of IPAC participants who received a prescription quality review for appropriateness and an assessment for medication underutilisation. The estimated annual total net cost to the PBS of these medication changes was +\$133,206 in 353 participants (\$447 per participant per annum).

¹ Couzos, S, Smith D, Buttner P, Biros E. Final analysis of the assessment of medication appropriateness using the Medication Appropriateness Index (MAI). Report to the PSA, Feb 2020

² Couzos, S, Smith D, Buttner P, Biros E. Final analysis of the assessment of medicines underutilization in patient's assessed for the Medication Appropriateness Index (MAI). Report to the PSA, Feb 2020.

³ PBS Glossary. <https://dev.pbs.gov.au/docs/glossary/DPMQ.html> [Accessed Nov 2019]

⁴ National Health (Pharmaceutical Benefits) Regulations 2017.
<https://www.legislation.gov.au/Details/F2019C00795>

⁵ Couzos, S, Smith D, Buttner P, Biros E. Final analysis of the assessment of medication appropriateness using the Medication Appropriateness Index (MAI). Op. Cit.

⁶ Couzos, S, Smith D, Buttner P, Biros E. Final analysis of the assessment of medication appropriateness using the Medication Appropriateness Index (MAI). Op. Cit.

⁷ Couzos, S, Smith D, Stephens M, Preston R, Hendrie D, Loller H, Tremlett M, Nugent A, Vaughan F, Crowther S, Boyle D, Buettner P, Biros E. Integrating pharmacists into Aboriginal community controlled health services (IPAC Project): Protocol for an interventional, non-randomised study to improve chronic disease outcomes. *Research into Social and Administrative Pharmacy*, 2020. In Press.
<https://doi.org/10.1016/j.sapharm.2019.12.022>.

⁸ Couzos S, Smith D, Stephens M, et al. Op. Cit.

⁹ Australian Health Ministers' Advisory Council. Aboriginal and Torres Strait Islander Health Performance Framework 2017 Report, AHMAC, Canberra, 2017.

¹⁰ Australian Health Ministers' Advisory Council. Op. Cit.

¹¹ de Dassel JL, Ralph AP, Cass AA. systematic review of adherence in Indigenous Australians: an opportunity to improve chronic condition management. BMC Health Serv Res. 2017 Dec 27;17(1):845. doi: 10.1186/s12913-017-2794-y.

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