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Penicillin Allergy Delabeling Program:

an exploratory economic evaluation in the Australian context

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Penicillin Allergy Delabeling Program:

an exploratory economic evaluation in the Australian context

Abstract

Background: Internationally, clinical and economic advantages of low-risk penicillin delabeling have been explored, supporting changes to healthcare delivery systems where penicillin delabeling is embedded into inpatient usual care.

Aim: To determine if economic advantages of low-risk inpatient penicillin delabeling, described in the international literature, are realised in the Australian context.

Methods: This explorative economic evaluation had prospective patient data collection between January and August 2019, across two Australian health services. Part-1: Determine the cost per effectively delabeled patient for Penicillin Allergy Delabeling Program inpatients (PADP cohort) compared to Outpatient Antibiotic Allergy Testing Service outpatients (OAATS cohort). Part-2: A cost analysis to compare hospital costs for inpatients with low-risk penicillin allergy who did (PADP cohort) and did not (usual care cohort) undergo PADP delabeling.

Results: Part-1: The PADP (n=350) and OAATS (n=27 patients, n=36 individual visits) cohorts were comparable. In PADP, costs/proportion delabeled was $20.10/0.98, equating to $20.51 per effectively delabeled patient; in OAATS, it was $181.24/0.50, equating to $362. Compared to OAATS, PADP was associated with savings of $341.97 per effectively delabeled patient; indicating the outpatient testing was the dominated strategy, being more costly and less effective. Part-2: The PADP (n=218) and usual care (n=32) cohorts were

comparable. Significantly favouring the delabeled PADP cohort, mean difference per patient was -4.41 days (95%CI -7.64, -1.18) and -$9,467.72 (95%CI -$15,419.98, -$3,515.46).

Conclusions: Consistent with international literature, delabeling low-risk penicillin allergies in the inpatient setting had economic advantages in the Australian context. Fully powered economic evaluations are urgently required to consolidate these findings.

Key words

Delabeling; Antibiotics; Economic

Abbreviations

CI: confidence interval

DD: direct delabeling

MD: mean difference

OAATS: outpatient antibiotic allergy testing service

OC: oral challenge

PADP: Penicillin Allergy Delabeling Program

SD: standard deviation

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Main text

Introduction

While self-reported penicillin allergy is associated with inferior health outcomes[1-3] and increased health care costs[4-7], a significant proportion of these allergy labels can be safely removed through penicillin allergy delabeling interventions[2, 7-9]. A recent systematic review comparing patients with and without a self-reported penicillin allergy, found that cost savings were realised for inpatients and outpatients without a self-reported penicillin allergy [4].

In Australia, three studies were identified which reported the economic impact of a penicillin allergy label in the inpatient setting. The first reported inpatients with a penicillin allergy had a longer length of stay and higher antibiotic and total health care costs, compared to inpatients without a penicillin allergy[10]. The second reported inpatients with a reported penicillin allergy who underwent drug provocation testing had a shorter length of stay, reduced re-admissions and less antibiotic and total health care costs, compared to inpatients with a penicillin allergy who did not undergo testing[5]. The third study was published in 2020 and is linked to the current economic evaluation[11]. It was a cost analysis of the direct delabeling (DD; removal of penicillin allergy via medical history reconciliation), oral challenge (OC; single-dose oral penicillin challenge) and skin testing (skin prick and intradermal testing) delabeling interventions in the inpatient and outpatient setting. In the inpatient setting there was reduced costs for DD and OC interventions, and greater costs for skin testing.

In Australia, it is the most vulnerable patients who present with the highest prevalence of antibiotic allergy labels (19-24%), and this includes patients with chronic illness, cancer or alternate immunosuppression[3, 12], with similar numbers reported internationally[13]. These

vulnerable patients with an antibiotic allergy label also consume a greater quantity of health service and antibiotic resources compared to their non-antibiotic allergy counterparts[12].

With a paucity of literature describing the economic impact of penicillin allergy in the Australian context, the current economic evaluation aimed to explore the economic advantages of an inpatient Penicillin Allergy Delabeling Program (PADP) in Australia. This economic evaluation addressed a number of previously published methodological recommendations for antibiotic allergy economic evaluations by including a cost-effectiveness analyses, direct health care costs, cost for the delabeling interventions and productivity opportunity cost to the patient and carer[4], as well as including vulnerable patients with a cancer diagnosis.

The purpose of this study was to determine if the economic advantages of low-risk inpatient penicillin delabeling, described in the international literature, are realised in the Australian context, supporting changes to healthcare delivery systems. This explorative economic evaluation aimed to complete two main analyses; (i) determine the cost per effectively delabeled patient for the inpatient PADP cohort compared to the Outpatient Antibiotic Allergy Testing Service (OAATS) cohort for outpatients with a low-risk penicillin allergy; and (ii) a cost analysis reporting the antibiotic costs and total hospital admission costs for inpatients with low-risk penicillin allergy who accessed PADP and underwent penicillin allergy delabeling, compared to inpatients with a low-risk penicillin allergy who did not access PADP (therefore not delabeled).

Methods

This economic evaluation was developed in line with the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) for an economic evaluation[14]. All costs were

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inflated by consumer price index (CPI) and presented as 2019/2020 Australian dollars ($AUD) (https://www.abs.gov.au/ausstats/abs@.nsf/mf/6401.0). Ethics committee approval was granted (47585-Austin-2018).

Setting and intervention

A whole-of-hospital inpatient PADP commenced at Austin Health and Peter MacCallum Cancer Centre, Melbourne, Australia in January 2019[11, 15]. Existing OAATS at both hospitals had been operating since 2015. In brief, patients identified with a low-risk penicillin allergy were offered an OC, DD or skin test intervention, as appropriate[11]. Patients in the inpatient setting participated in the PADP, and patients in the outpatient setting participated in the OAATS.

Part-1: cost per effectively delabeled patient for PADP versus OAATS

Part-1 compared an inpatient PADP cohort to an outpatient OAATS cohort. The costs included the delabeling intervention and effect was the proportion of patients delabeled, with intervention cost details previously published (https://doi.org/10.1093/cid/ciaa653)[11]. Prospective patients with a penicillin allergy label who accessed PADP between January to August 2019 (PADP cohort) were compared to patients with a penicillin allergy label who accessed OAATS between April and May 2019, or April and May 2020 (OAATS cohort).

Effect was reported as the proportion of patients with a reported penicillin allergy label who were appropriately delabeled. This was deemed an appropriate measure of effect as a high delabeling enables safe and effective use of appropriate penicillins and beta-lactams post testing, desirable to clinicians and patients [16, 17].

Part-2: cost-comparison of inpatient admissions with and without access to PADP

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Part-2 used a before and after study design comparing inpatients with a low-risk penicillin allergy, with an infective diagnosis, who underwent delabeling via PADP (PADP cohort), with retrospective inpatients with a reported penicillin allergy who did not access PADP (usual care cohort). Inpatients from the PADP cohort admitted during the month of March 2019 were 1:1 matched with retrospective inpatients admitted during the month of May 2015. The retrospective inpatients were matched for antibiotic allergy label, age, sex, admitting unit, number of admissions, with patients that had undergone antibiotic allergy testing during the nominated period. The patients were required to have at least one admission during the study period and during this index admission report an antibiotic allergy in Cerner (health service database). Long stay patients (>60 days) were excluded. 180 matched patients were initially identified and from this cohort a final cohort of 32 were ascertained which reported a low risk penicillin allergy and an infective diagnosis during the index admission (excluding surgical prophylaxis). The final analysis included the matched retrospective patients and the whole PADP cohort (January to August 2019).

The primary economic outcome was the total cost of the inpatient admission, with the cost of antibiotic utilisation and consumables detailed separately. Data collection for the retrospective group was via medical record audit and via the health service Business Intelligence Unit which provided individual patient level cost data, and this was used to establish an average cost for an emergency department admission and for an acute admission on a per diem basis. These costs were applied to each resource utilised by the PADP cohort, as individual patient level cost data was not available at the time of the analysis. Individual antibiotic utilisation data was collected for both groups according to the antibiotic type, typical dosing regimen and route. It is noted that antibiotic cost was a component of the total admission costs, not in addition to the total admission costs.

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Minimising the cohort effect

Cohort effects are variations over time in the characteristics of individuals. To minimise a potential cohort effect in "Part-1", there is overlap in the timing of the data collection for the two cohorts. To account for a potential cohort effect in the before and after study design applied to "Part-2", where there was no overlap in the timing of the data collection for the two cohorts, the cohorts were matched on potential characteristics which may have changed over time, with long stay patients also excluded (>60 days). In addition, a key variation over time was identified and applied as an exclusion criterion. This specifically refers to the exclusion of patients without an infective diagnosis from the prospective cohort who underwent delabeling via PADP (PADP cohort).

Statistical Analysis

Part-1: cost per effectively delabeled patient for PADP versus OAATS

A health care sector perspective was used for the reference case analysis (direct health care costs only) and a limited societal perspective was used for the secondary reference case analysis (direct health care costs as well as patient and carer travel costs, and patient and carer opportunity costs for time lost)[18]. Costs were determined for each strategy when conducted in the inpatient setting with PADP, and when conducted in the outpatient setting for OAATS, and this detailed costing model has been previously published[11]. Patients who did not attend on the day were costed with an intention to treat, as clinic resources had been allocated to that patient. Mean cost difference was determined between the two groups using an independent t-test to report statistical significance. Effect was measured as the proportion of patients delabeled using a Chi-squared test. A point estimate was presented and the confidence ellipses around the point estimate were calculated using the bootstrap method (5,000 repetitions) detailed in Nixon et al. (2010) [19] which accounts for a small sample size and skewed data.

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This methodology was repeated in the secondary reference case analysis. Patient and carer time to attend a visit in the OAATS was based on the following time assumptions: a skin test took 4 hours, an oral penicillin challenge took 4 hours, the direct delabel strategy took 45 minutes and a visit where a test was not performed (e.g., a review appointment to discuss the results) also took 45 minutes (i.e., the same time as a visit for direct delabeling). These time estimates were based on feedback by OAATS clinical staff and account for average waiting times, clinical interactions and nursing observation time for potential reactions. Travel costs and time were based on a return trip to the hospital from the patients home. It was assumed that participation in the PADP during a separate health care inpatient admission was opportunistic and therefore had no additional travel or productivity opportunity cost to the patient and their carer. However, in the outpatient setting this is a stand-alone health care intervention where the patient attends the OAATS specifically to manage a low-risk penicillin allergy therefore consuming additional travel and productivity opportunity cost, to the patient and their carer (Table 1).

Part-2: cost-comparison of inpatient admissions with and without access to PADP

A health care sector perspective was used for the reference case analysis (direct health care costs only), however there was no additional reference case analysis from a broader perspective[18]. The MD in the cost-comparison analysis was determined between the two groups using an independent t-test to report statistical significance.

For Part-1 and Part-2, one-way sensitivity analyses were completed to assess whether the results were robust to changes in the overall modelled cost estimations. Individual model parameters were not modified in the sensitivity analyses as the multiple perspective presented

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in the primary analyses (health care sector perspective and limited societal perspective) gave insights as to the impact of the individual model parameters.

Analyses were completed using IBM SPSS Statistics Version 21[20] and customised software in Microsoft Excel[19]. All statistical tests were conducted at 5% level of significance with 95% confidence intervals (CI) and confidence ellipses (CE) reported.

Results

Part-1: cost per effectively delabeled patient for PADP versus OAATS

For the PADP cohort, 1,225 patients reported a penicillin allergy during their hospital admission. Of these, 667 patients were excluded due to a high-risk penicillin allergy assessment by program staff and 208 patients were excluded due to their refusal to consent in a penicillin allergy delabeling strategy. This resulted in the inclusion of 350 inpatients with a low-risk penicillin allergy who consented to participate in a penicillin allergy delabeling strategy through the PADP (Figure 1). Of the 350 included patients, the mean age was 66.0 years (SD 17.3) and 195 (55.7%) were female.

The audit of the OAATS identified 170 individual patients who attended 247 visits, with each patient visiting between 1 and 5 times during the data collection period. 128 visits were between April and May 2019, 119 visits were between April and May 2020. For the combined 247 visits aimed at removing a penicillin allergy, 36 visits had a confirmed low-risk penicillin allergy and were included in this analysis. It is noted that while the 36 visits included 27 individual patients, the results are based on the number of visits (n=36) to determine the cost per visit, and effectiveness per visit. OAATS outpatients comprised 27 patients with 36 individual visits; mean age 55.4 years (SD 17.1) and 20 (74%) were female.

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For the health care sector perspective, the proportion of penicillin allergies delabeled through PADP was 0.98 (n=344/350) and through OAATS was 0.50 (n=18/36) significantly favouring PADP ((p<0.001). The lower proportion delabeled through OAATS was due to patients not attending their appointment (n=4/36 visits, 11%), and patients requiring additional appointments for detailed penicillin allergy assessment and/or discussion of test results (n=6/36 visits, 17%). Details of the delabeling types are in Figure 1. Mean delabeling intervention cost was $20.10 (SD$17.43) for PADP, versus $181.24 (SD$39.06) for OAATS. This corresponds, in PADP, to costs of $20.51 per effectively delabeled patient (i.e., $20.10/0.98) and, in OAATS, to costs of $362.48 per effectively delabeled patient (i.e., $181.24/0.50). In comparing costs per effectively delabeled patient PADP was associated with savings of $341.97 per effectively labelled patient indicating the outpatient testing was the dominated strategy, being more costly and less effective. (Figure 2A).

The one-way sensitivity analysis, for the health care sector perspective, reported that the results were robust to reduction in cost of up to 75% for the OAATS cohort. A significant cost difference remained for the PADP cohort when the OAATS costs were reduced between 5% and 75% (p<0.001), but not when they were reduced by 90% (p=0.498).

For the limited societal perspective, travel costs and the opportunity cost of time for the patient and carer were added to the health care sector costs. Per the reference case analysis, effect remained the same for both groups and the cost remained the same for the PADP cohort. However, for the 36 visits in the outpatient setting, the mean cost increased to $336.44 (SD $178.88). This corresponds, in PADP, to costs of $20.51 per effectively delabeled patient (i.e., $20.10/0.98) and, in OAATS, to costs of $672.88 per effectively delabeled patient (i.e., $336.44/0.50). In comparing costs per effectively delabeled patient PADP was associated with savings of $652.37 per effectively labelled, again indicating the

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outpatient testing was the dominated strategy, being more costly and less effective (Figure 2B).

Part-2: cost-comparison of inpatient admissions with and without access to PADP

The PADP delabeled cohort (n=218) had a mean age of 65.7 years (SD17.3) and 119 (54.6%) were female. The usual care non-delabeled cohort (n=32) was comparable and had a mean age of 63.1 years (SD15.9) and 18 (56.3%) were female. Admission and antibiotic costs and utilisation are detailed in Table 2. The delabeled PADP cohort (n=218) had a mean total length of stay of 5.62 days (SD7.36) and the cost of their inpatient stay was $10,546.66 (SD$13,994.30), compared to the non-delabeled usual care cohort (n=32), who had a mean length of stay of 10.03 days (SD14.85) and admission cost of $20,014.38 (SD$25,844.15). For length of stay and cost, the MD per patient was -4.41 days (95%CI -7.64, -1.18; p=0.008) and -$9,467.72 (95%CI -$15,419.98, -$3,515.46; p=0.002) respectively, significantly favouring the delabeled PADP cohort (Table 2). Per diem, combined antibiotic and IV route consumable costs for the index admission were $28.74 (SD$78.46) for the delabeled PADP cohort, compared to $45.69 (SD$94.29) for the non-delabeled usual care cohort. This resulted in a daily MD of -$16.95 (95%CI -$47.01, -$13.11; p=0.268), which non-significantly favoured the delabeled PADP cohort (Table 2).

The one-way sensitivity analysis reported that the results were robust to reduction in cost of up to 10% for the patient group without access to PADP. A significant cost difference remained for the inpatient admissions with access to PADP when the costs for the group without access to PADP were reduced by 5% and 10% (p=0.005 and p=0.011, respectively), but not when they were reduced by 25% (p=0.112). This sensitivity analysis was not repeated for LOS as LOS was used to model costs for the prospective inpatient admissions with access to PADP, however it is noted that between 2015 and 2019 the average public health acute

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overnight LOS reduced by 5% (https://www.aihw.gov.au/reports-data/myhospitals/content/data-downloads) and this informed inclusion of a cost reduction of 5% in the sensitivity analyses for the group without access to PADP.

Discussion

While self-reported penicillin allergy is associated with inferior health outcomes[1-3] and increased health care costs[4-7], a significant proportion of these allergy labels can be safely removed through penicillin allergy delabeling interventions[2, 7-9]. A recent systematic review comparing patients with and without a self-reported penicillin allergy, found that cost savings were realised for patients without a self-reported penicillin allergy for the inpatient costs, as well as for the outpatient prescription costs[4].

This explorative economic evaluation found that the economic advantages of low-risk inpatient penicillin allergy delabeling via oral penicillin challenge testing or direct delabeling in the inpatient Australian context were consistent with international literature[4, 21]. Empirical economic studies[4], together with economic decision models[22], consistently demonstrate cost-savings associated with penicillin allergy delabeling compared to no delabeling, as is the case for the current study. The current study also found penicillin delabeling via OC or DD in the inpatient setting was a more cost effective method for successful penicillin allergy delabeling compared to the outpatient setting. These advantages extended beyond direct health-care costs to include patient and carer travel and time costs.

A significantly higher proportion of patients had their penicillin allergy delabeled in the inpatient PADP setting compared to the outpatient OATTS. There are multiple factors which adversely influenced the proportion of patients successfully delabeled through the OAATS including failed to attend (11%), visits separated for assessment and testing (17%). In

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contrast, inpatients who underwent penicillin allergy delabeling via PADP received penicillin allergy assessment, testing and communication of results within the index admission without a need for further clinic appointments. Multiple factors have influenced the lower costs related to delivering low risk penicillin allergy delabeling services in the inpatient setting (PADP) relative to the outpatient setting (OAATS), including reduced medical, pharmacy, nursing and administrative staffing costs, a zero (or a minimal) did-not-attend rate, and reduced capital costs, as most of the inpatient delabeling interventions are provided in-kind during a fully resourced inpatient admission.

A fundamental difference between the PADP and the OAATS is the immediacy of changes to health care. In the inpatient setting the chance of receiving a penicillin course is much higher and therefore the impact may more readily measurable. Whilst "point of care" inpatient delabeling (PADP cohort) enables immediate use of penicillins, frequently outpatient appointments are also driven by a current infective indication or need (OAATS cohort).

It is emphasised that OAATS remains a vital service for patients who cannot access the inpatient PADP, or have moderate to high risk penicillin allergies, where skin testing may be required[21]. Skin testing in the Australian setting routinely utilises penicilloyl polylysine (PPL) and minor determinant mixture (MDM) (Diater), in addition to standard penicillins (i.e. ampicillin, benzylpenicillin) routinely manufactured byhospital pharmacy sterile stores, with a fixed price for up to eight patients. Scheduling multiple skin tests during a single clinic session effectively reduces per patient costs. This is compared to the inpatient setting where skin testing is rarely required to evaluate low-risk penicillin allergies, and when it is required, it is usually only for one patient at a time, resulting in one patient being attributed the fixed price (for up to eight patients). It is hypothesised that the cost results may have differed for the OAATS program should patients have their initial consult, penicillin testing and

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challenge within the same visit, preferred but not always practical. It is noted that the current study only considered short term economic implications, and that future studies should prospectively follow outpatients delabeled in the context of OAATS and assess estimate underlying future savings with a particular focus on hospital admissions and antibiotic utilisation.

This study also found that inpatients with a reported penicillin allergy who accessed PADP and underwent penicillin allergy delabeling had a shorter length of stay and less antibiotic and total health care costs, compared to inpatients with a penicillin allergy who did not access PADP or undergo penicillin allergy delabeling, consistent with a previous Australian study[5].

Limitations

The generalisability of the results from this explorative economic evaluation are limited by the small comparative group sizes and inherent limitations of comparing prospective and retrospective patient cohorts. While work has been done to control for potential cohort effects associated with differenced in the data collection timeframes, it is noted that this is an explorative economic evaluation, not a completely controlled or fully powered study, however explorative economic evaluations provide essential information for future fully powered evaluations[23]. In addition, this study includes a diverse patient population from general acute care hospital and a cancer hospital. It does not separate out the results as the pragmatic study was designed and implemented across these two health settings as a combined initiative, and further subgroup analysis was limited by small patient numbers. Further limitations include an absence of extended follow up period to capture hospital re-admissions and differences in demographics of OAATS group (i.e., younger age). Moreover, whilst this study did not examine "relabelling" post discharge, in a separate analysis the rate of relabelling post challenge was noted to be low with 95% patients willing to take

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penicillin[24]. Despite the limitations, the results from this evaluation are consistent with previous evidence demonstrating that inpatient penicillin allergy testing is a cost effective model for optimising penicillin allergy care[4, 11]. The authors strongly recommend that robustly designed and fully powered economic evaluations examining penicillin delabeling are undertaken to substantiate these findings.

Conclusions

Consistent with international literature, delabeling low-risk penicillin allergy in the inpatient setting had economic advantages in the Australian context. For patients already admitted to hospital, penicillin delabeling via direct delabeling or an oral challenge is a more cost effective way of delivering penicillin allergy testing compared to attending an outpatient clinic following discharge from hospital, or compared to no penicillin delabeling in the inpatient setting. While robustly designed and fully powered economic evaluations examining penicillin delabeling are urgently required to substantiate these findings, the consistency in the literature indicates that health services should be encouraged to implement similar programs and examine the cost advantages in their setting.

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Figure legends

Figure 1 – Part-1: Cost-effectiveness of inpatient PADP versus outpatient OAATS models of care - comparison of delabeling costs and effect in the inpatient and outpatient settings

Figure 2 – Part-1: Cost-effectiveness of inpatient PADP versus outpatient OAATS models of care for a low-risk penicillin allergy: (A) Health Care Sector Perspective; (B) Limited Societal Perspective

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Table 1 – Part-1: Cost-effectiveness of inpatient PADP versus outpatient OAATS models of care: resource definition

Resource	Inpatient Setting	Outpatient Setting
Health Service Perspective		
Direct health service costs	Detailed in supplementary material within a previous publication [11]	Detailed in supplementary material within a previous publication [11]
Patient Perspective		
Car travel: cost of the car[A]	As the PADP was opportunistic for patients in the inpatient setting, there was no additional car travel costs, lost time for the patient +/- carer, or parking costs; nor did it hold up discharge or other planned procedures. Therefore, no additional costs have been attributed to the inpatient patient perspective analysis.	It was assumed that all outpatients attended the clinic via a car. The cost of travel in a car was based on the 2019 Australian Taxation Office rate of 68c per km.
Car travel: calculating the time and distance[B]		The distance and the time taken to travel was based on use of Google Maps where the quickest path with no tolls was chosen to represent the distance and the time. The home location was based on a postcode, not on an actual address. The reported Google Map distance and the time was doubled to represent a return trip.
Opportunity cost: the value of time[C]		All time was valued at the 2019 minimum wage of $19.49 per hour or $0.32 per minute. Both the patient and the carer's time are valued equally, regardless of the opportunity missed, for example: paid work, unpaid work, caring for others and leisure time. Attendance by a carer was observed by the reception staff over a 1-week period. It was reported that 80% of patients had a carer in attendance. This rate of 80% informed the allocation of carers within the economic evaluation.
Parking[D]		While time for parking the car was not included, the cost of parking in the Austin Health car park was included using current parking rates.
Cost of follow up consultations to discuss results	In the inpatient setting these follow up consultations / conversations were within usual duties for the staff involved. There were no direct additional costs.	In the outpatient setting there were appointments that were booked specifically as follow up consultations to discuss results. This presented a real cost for both the health service and for the patient +/- carer. Therefore, these costs for the health service and for the patient +/- carer are included. This also explains why the outpatient setting analysis is based on the number of outpatient clinic visits, whereas the inpatient setting is based on the number of patients who had all follow-up consultations included as part of the index hospital admission.

[A] https://www.ato.gov.au/Business/Income-and-deductions-for-business/Deductions/Deductions-for-motor-vehicle-expenses/Cents-per-kilometre-method/
[B] Google Maps
[C] https://www.fairwork.gov.au/pay/minimum-wages#:~:text=As%20of%201%20July%202019,than%20the%20National%20Minimum%20Wage
[D] https://www.austin.org.au/patients-and-visitors/austin-hospital-parking/

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Table 2 – Part-2: cost-comparison of inpatient admissions pre and post PADP: hospital admission and antibiotic costs

TOTAL COHORT			
	Patients who accessed PADP (n=218) Mean (SD)	**Patients admitted pre PADP (usual care) (n=32) Mean (SD)**	**Mean Difference ("Patients who accessed PADP" cohort minus "Patients admitted pre PADP" usual care cohort)**
ED (incl. antibiotics)			
Days	0.10 (SD 0.30)	0.50 (SD 0.51)	-0.40 (95% CI -0.53 to -0.28; p<0.000)
Cost	$92.48 (SD $286.80)	$517.80 (SD $625.50)	-$425.32 (95%CI -$554.95 to -$295.69; p<0.000)
Acute (incl. antibiotics)			
Days	5.52 (SD 7.41)	9.53 (SD 14.80)	-4.00 (95% CI -7.25 to -0.77; p=0.015)
Cost	$10,454.19 (SD $14,047.97)	$19,496.58 (SD $25,718.13)	-$9,042.40 (95% CI -$15,000.55 to -$3,084.24; p=0.003)
Total admission (ED and Acute incl. antibiotics)			
Combined Days	5.62 (SD 7.36)	10.03 (SD 14.85)	-4.41 (95% CI -7.64 to -1.18; p=0.008)
Cost	$10,546.66 (SD $13,994.30)	$20,014.38 (SD $25,844.15)	-$9,467.72 (95% CI -$15,419.98 to -$3,515.46; p=0.002)
Cost for total IV route consumables	$51.50 (SD $125.45)	$125.18 (SD $295.08)	-$73.69 (95% CI -$132.23 to -$15.14; p=0.014)
Cost for total antibiotics	$17.21 (SD $30.35)	$35.23 (SD $78.48)	-$18.02 (95% CI -$32.82 to -$3.22; p=0.017)
Combined cost for total IV route consumables and antibiotics	$68.71 (SD $147.16)	$160.42 (SD $369.30)	-$91.71 (95% CI -$162.45 to -$20.97; p=0.011)
Cost per day for IV route consumables	$21.94 (SD $69.08)	$34.13 (SD $73.56)	-$12.20 (95% CI -$38.17 to $13.78; p=0.356)
Cost per day for antibiotics	$6.81 (SD $12.97)	$11.56 (SD $22.43)	-$4.75 (95% CI -$10.16 to $0.65; p=0.085)
Combined cost per day for IV route consumables and antibiotics	$28.74 (SD $78.46)	$45.69 (SD $94.29)	-$16.95 (95% CI -$47.01 to -$13.11; p=0.268)

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Penicillin Allergy Delabeling Program:

an exploratory economic evaluation in the Australian context

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Abbreviated title: Penicillin Allergy Health Economic Study

Keywords – Antibiotic management, cost-effectiveness, health service research

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Declaration – This data has not been previously presented or published

Competing interests – All authors declare no real or perceived competing interest

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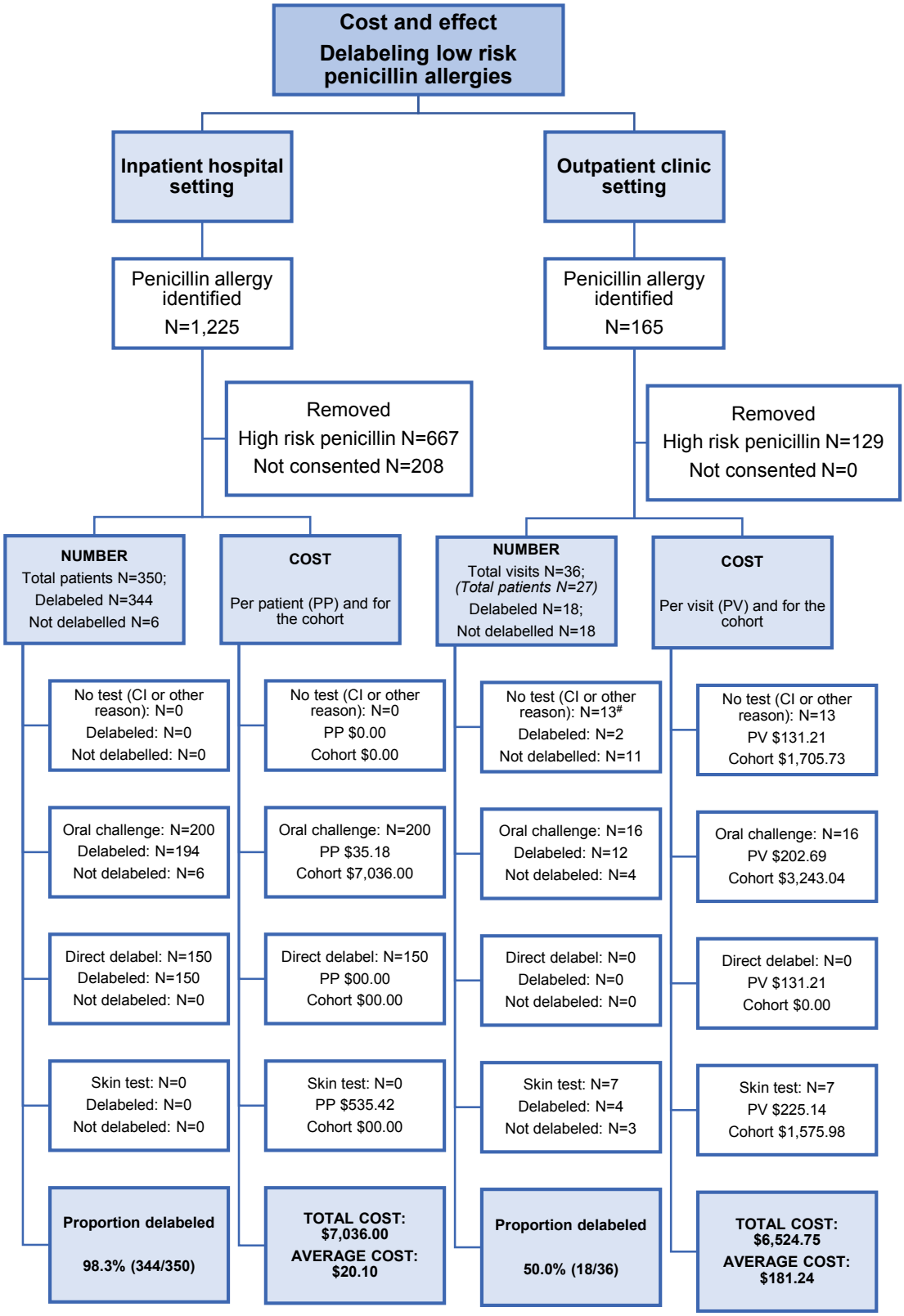

Of the n=13 visits with no test performed, n=1 was for a patient having the test contraindicated, n=6 was for patients attending appointments for discussion only, n=2 for patients who were delabeled based on an intervention from a previous visit, and n=4 was for patients who did not attend.

Figure 1: Cost-effectiveness of inpatient PADP versus outpatient OAATS models of care - comparison of delabeling costs and effect in the inpatient and outpatient settings

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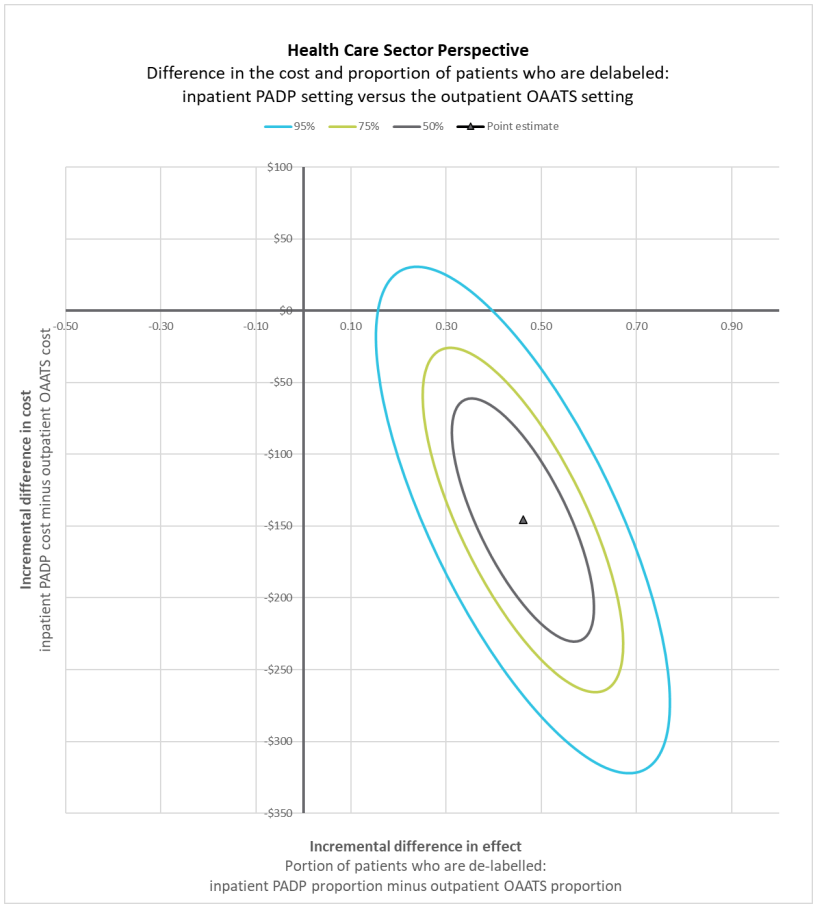

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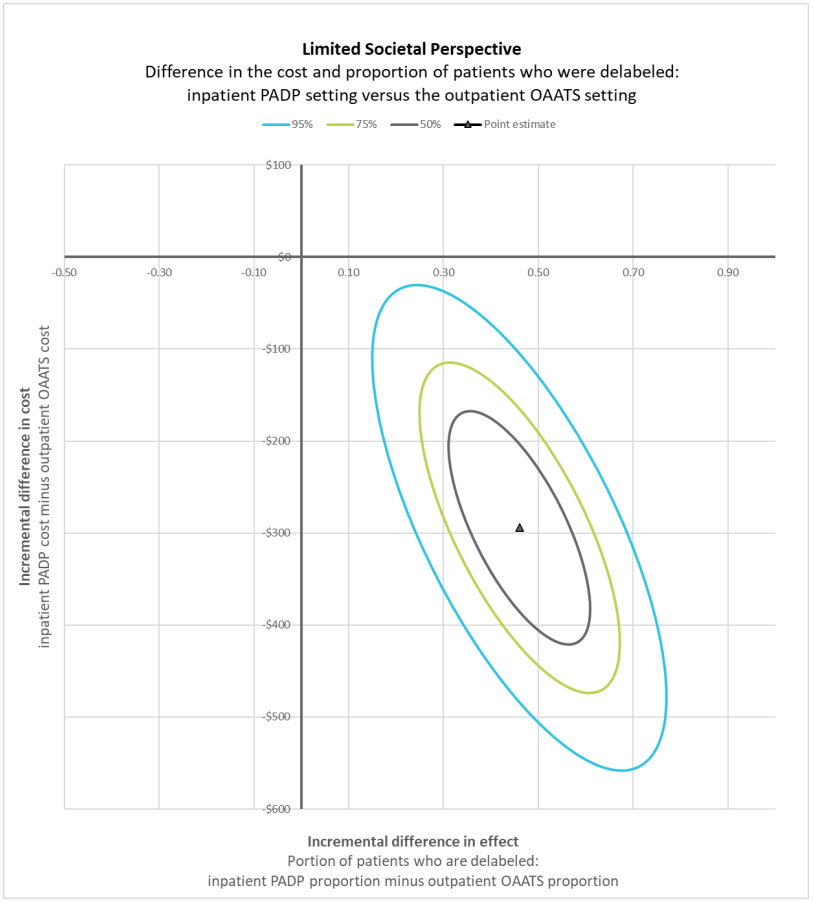

2B)

Key: Vertical axis indicates the cost difference between the PADP and the OAATS, with a negative value indicating that the PADP was less cost. Horizontal axis indicates the effectiveness difference between the PADP and the OAATS, with a positive value indicating that the PADP was more effective (higher proportion of delabelling). Both 1A and 1B have a point estimate in the lower right quadrant (dominant quadrant) indicating that the PADP was less cost and more effetive when compared to the OAATS.

Figure 2: Cost-effectiveness of inpatient PADP versus outpatient OAATS models of care for a low-risk penicillin allergy: (A) Health Care Sector Perspective; (B) Limited Societal Perspective

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