Cost implications of the delivery of pharmaceutical care services through Australian community pharmacies

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Objective — To conduct a cost analysis of the Community Pharmacy Model Practices project in South Australia.
Method — As part of a prospective participatory action research programme, the cost analysis identified the main items of fixed and variable costs and of potential cost savings, and expressed them in a framework to aid decision-making.
Setting — Ten community pharmacy practices in primary care: five provided generalist medication management, two diabetes care, two asthma care, and one wound management. Services were provided to 411 pharmacy patients (median age 75; 70 per cent female) in the community, resident in a range of nursing home and hostel accommodation, or patients in hospital. There was a maximum of 11 months' observation.
Key findings — All the five medication management pharmacies, one of the asthma management pharmacies, and the wound management pharmacy, but neither of the diabetes management pharmacies, were able to generate potential resource savings greater than their total variable costs, so that net resource savings were available to make a contribution to absorbing fixed costs.
Conclusions — The provision of medication management services by community pharmacies working to a well-defined, systematic process of patient care within a primary care setting can be expected to reduce overall direct costs to the health system. Similar findings are likely with wound management in pharmacy care, but the results are less certain for asthma management and diabetes management. These results, when considered in the light of possible gains in survival and quality of life, are of significant interest to policymakers concerned with controlling health system costs.

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Int J Pharm Pract 2001;9:23-30

DESPITE the significant contribution that effective drugs have made towards the improved management of both acute and chronic diseases, and the resulting impact upon the length and quality of patient lives, the adverse outcomes of drug therapy must also be recognised.[1,2] Adverse outcomes of medication misadventure have resulted in an increase in the utilisation of additional health care resources such as general practitioner visits, specialist services, emergency hospital admissions and increased length of hospital stay.[3] Many of these additional services could have been avoided, and consequently efforts towards this end are of considerable importance to policymakers concerned with controlling health care expenditure.[4]

Pharmaceutical care is an approach to pharmacy practice which is designed to address medication misadventure.[5] In this approach, pharmacists work with the patient, and other health professions, to prevent and resolve drug-therapy problems and to improve the patient's quality of life. The pharmacist accepts responsibility for assisting the patient to achieve the desired outcomes, which may be (i) cure of a disease, (ii) elimination or reduction of symptoms, (iii) arresting or slowing a disease process, or (iv) preventing a disease or symptoms.[6]

Although there has been support for the adoption of pharmaceutical care in Australia, it is not widely practised. The Community Pharmacy Model Practices project was undertaken to define, implement and evaluate a service delivery model for pharmaceutical care in community pharmacies in Australia using a participatory action research methodology. Funded by the Commonwealth Government of Australia, the focus of the project was to determine whether the community pharmacy practice model would be able to demonstrate savings to the health system while maintaining or improving health outcomes. An important aspect was the incorpora-

tion of a cost analysis from the perspective of the overall health system as part of the evaluation of the project in order to determine whether the potential cost savings were greater than the costs. This paper reports on that cost analysis.

Method

A service based on the principles of pharmaceutical care was developed and evaluated in 10 community pharmacies, using a participatory action research methodology. In phase one, pharmacists defined the service in consultation with consumers, medical practitioners and professional pharmacy organisations. Agreed characteristics of the service were patient selection criteria, a structured patient care process, systematic documentation, a quality assurance process and complementarity with services of other health professionals. The methodology for this project has been previously published.[7] Phase two involved implementation and evaluation of the services, including a cost analysis.

Framework for the cost analysis The basic tenet of economics is that society's resources, being scarce, are insufficient to meet the demands placed upon them. Thus choices have to be made about how best to allocate limited resources among alternative uses in order to maximise social welfare. The analysis of economic efficiency therefore involves comparing the costs of using scarce resources with the benefits.[8]

Conceptually, a cost analysis — the economic method deployed in this study — involves comparing the costs of implementing a programme with the health care resources that are consequently saved. For such an analysis to provide unequivocal findings, the health outcomes associated with the new programme must be at least maintained or improved. With a cost analysis, therefore, only those programmes that result in potential savings to the health system will be accepted. Evaluating programmes that increase overall costs but also improve health outcomes is outside the scope of this form of analysis. Notwithstanding this limitation, a cost analysis does provide a useful framework, because it identifies programmes that can lead to savings to the health system providing health outcomes are at least maintained.

Scope of the study Given the limited number of patients (within each specific site) and the relatively short duration of data collection (11 months), opportunities to undertake a comprehensive economic analysis, particularly for measuring health outcomes, were restricted. Consequently, the analysis was confined to a cost-comparison. The objective was to compare, from the perspective of the health system overall, the establishment and running costs of the programme with the estimated health expenditures that were saved — namely, pharmaceutical costs, medical costs and hospital costs that potentially could have occurred had the pharmacist not intervened.

The results for outcome measures for five pharmacies focusing on medication management, namely, the number of medication-related problems identified and resolved, and the acceptability of the service to consumers, have been reported previously.[7] Eighty-seven per cent of patients had one or more medication or health-related problems. Follow-up was available for 432 of the 526 problems identified by pharmacists, and 75 per cent of these problems were well managed by the end of the study. A survey of consumers indicated that 85 per cent believed the service had made a "significant" or "great" contribution to their health and 64 per cent thought that their knowledge of their medications had improved.[7]

Setting A convenience sample of 10 community pharmacies was used to develop the service. The pharmacies were located within South Australia at both city and rural sites, each with different practice characteristics (see Table 1). Each participating pharmacy selected a clinical focus and developed patient selection criteria based on this focus. The project started in autumn, 1996.

Five pharmacies (A-E) developed the service with a focus on medication management where people across the full range of health conditions were eligible for the service. Their patient selection criteria included being over 18 years of age, able to understand and consent to the service, and satisfying one or more of the following criteria: using three or more medications; using a medication of low therapeutic index; confusion about medication; displaying possible drug-related adverse effects; living alone and solely responsible for their own medications; having a disability that could interfere with their capacity to use medications effectively; or having a recent or frequent hospital admission(s).

A further five pharmacies chose a specific therapeutic area in which to develop the service, with two offering the service to people with asthma (F, G), two to people with diabetes (H, I) and one (J) to people requiring assistance with wound management. There was no age restriction in the selection criteria for the patients enrolled in these five pharmacies.

Of the 10 pharmacies, two (E, I) joined the project three months after its initiation. The inclusion of these "second generation" community pharmacies allowed an exploration of the further training requirements and support required, and the ease of incorporating the service into pharmacies that had not received the intensive developmental programme the original pharmacies experienced. The established pharmacies provided a role model for each of the new participants, who spent time observing and dis-

Table 1: Characteristics of pharmacies providing pharmaceutical care services

Pharmacy	Clinical focus	Duty pharmacist*	Business site†	Business position‡	Site of service delivery§				
					Pharmacy	Home	Hospital	Nursing home	Hostel
A	Medication management	2	Inner suburban	Local S/C		XX			X
B	Medication management	1	Inner suburban	Regional S/C	X	XX			
C	Medication management	2	Inner suburban	Local S/C		X			XX
D	Medication management	1-2	Rural	Local S/C	XX	X			X
E¶	Medication management	1	Rural	Town S/C	XX		XX		
F	Asthma management	1	Rural	Stand alone	XX	X			
G	Asthma management	2	Outer suburban	Regional S/C	XXX				
H	Diabetes management	1	Inner suburban	Local S/C	XX	X			
I¶	Diabetes management	1	Outer suburban	Local S/C	XXX				
J	Wound management	1	Inner suburban	Local S/C				XX	XX

* Number of pharmacists regularly employed in dispensary during the day prior to commencement of project
† Business site definitions: Inner suburban = pharmacy situated within 8km of Adelaide General Post Office; outer suburban = pharmacy situated outside 8km; rural = pharmacy situated outside boundary of metropolitan Adelaide
‡ Regional S/C = pharmacy situated in a large regional shopping centre; local S/C = pharmacy situated in a group of shops in a local shopping precinct; town S/C = pharmacy situated in the main street shopping precinct of a country town; stand alone = pharmacy site not associated with any other shops
§ Site of service delivery: XXX = all service delivery at site category, XX = some service delivery at site category, X = occasional service delivery at site category
¶ Second generation pharmacies added to project three months after project initiation

cussing the service model with the experienced pharmacists.

Data collection Only the additional direct costs and cost savings, over and above the usual standard of pharmacy practice, were included in the analysis. These incremental costs and cost savings were directly attributable to the pharmacists working within the pharmaceutical care paradigm. Demographic, cost and practice data were collected from patient records kept by pharmacists, who also kept a diary of their time spent on project activities. To enable consistent data collection across all pharmacies, standardised documentation pro-forma were devised. Regular visits from two liaison pharmacists from the research team checked the quality of note taking and data recording. Where information was missing or unclear, clarification was sought from the participating pharmacists.

Costs and cost savings presented in this study are expressed in 1997 Australian dollars ($A). Protocol costs associated with monitoring and evaluating the models for research and reporting purposes have not been included in cost calculations, since they do not represent costs associated with establishing and running the service under ordinary circumstances. Ethics approval for the overall study was received from the University of South Australia Human Research Ethics Committee.

Costs Costs associated with implementing and running the service can be divided into two broad cost categories: fixed costs and variable costs. Fixed costs are those costs relating to the initial set-up of the service that do not vary with the number of clients or consultations given. Fixed costs include expenditure on computer hardware and software, furniture and pharmacy redesign, service development and professional development. Service development refers to costs incurred in developing the new process within the pharmacy and liaising with relevant stakeholders. Professional development refers to initial costs incurred in education and training of the pharmacist in preparation for providing the service. All fixed costs were calculated on the basis of reimbursements claimed from the project office. Although fixed set-up costs of each of the pharmacies form a major component of overall costs, they were not apportioned on either a per client or per consultation basis, as it was unclear what would constitute optimum capacity utilisation. The problems in estimating the optimal capacity are the scale of this service relative to the overall size of the pharmacy, the short time horizon, and lack of information as to what constitutes "best practice."

Variable costs are related directly to the number of clients and/or the number of consultations provided by the community pharmacists. They are costs of a recurrent nature. The average variable cost per client and per consultation reflected both the initial consultation and several shorter follow-up consultations. The limited time horizon prevented disaggregating variable costs of consultations beyond the simple average cost on a per client and per consultation basis.

The most significant variable cost is the opportunity cost of the pharmacist's time while involved in providing professional cognitive

Table 2: Example calculation of potential health care costs avoided in terms of GP, specialist and hospital services — Pharmacy X

Probability	GP services at $A24.50 per visit	Specialist services at $A110.75 per visit	Hospital admissions at DRGs	Expected total cost — lower range	Expected total cost — upper range
< 1 per cent	$A74	$A0	$A0	$A0	$A1
1-10 per cent	$A392	$A111	$A0	$A5	$A50
11-35 per cent	$A147	$A0	$A0	$A16	$A51
36-65 per cent	$A294	$A0	$A7,266	$A2,722	$A4,914
66-90 per cent	$A368	$A222	$A1,646	$A1,476	$A2,012
> 90 per cent	$A98	$A111	$A3,821	$A3,667	$A4,030
Total expected cost				$A7,886	$A11,058
Midpoint estimate of total expected costs avoided				$A9,472	

DRGs = diagnosis related groups

services to clients. This includes the cost of providing a replacement pharmacist (to undertake standard pharmacy activities) plus an allowance for the costs associated with cancellations, ongoing client recruitment, late appointments, and other associated down-time costs normally incurred in patient-based practices. To cover these, the best estimate of experienced practising community pharmacists was that the opportunity cost of the pharmacist's time would be $A60 per hour, this being an extra 100 per cent on the community pharmacists' award rate of $A30 per hour (including on costs).

The total consultation time included pharmacist time in preparation, time with other professionals directly related to clients, travelling time, actual visit time and time for recording data after the visit.

Non client-specific variable costs include stationery, postage and photocopying, telephone and facsimile, continuing professional education and other consumables attributable to the pharmacy itself, but not directly related to any specific client. Costs incurred for continuing professional education that were of a regular or maintenance nature, and that were expected to be ongoing over time, were also included as non-client-specific variable costs.

Cost savings Cost savings were defined as the potential additional health care costs that would have occurred had the community pharmacist not intervened. Those considered were decreases in general medical practitioner services, medical specialist services, hospitalisation, and pharmaceuticals.

In order to estimate the potential costs that may have been avoided as a result of pharmacist intervention, a technique used in other similar studies was adopted.[4,9] Using a standardised protocol, two research pharmacists made an assessment of the nature of potential adverse outcomes had appropriate action not been initiated, the probability that such adverse outcomes would have occurred, and the value of the resources which would have been required to treat such outcomes. An independent panel consisting of two medical practitioners, a community pharmacist and a clinical pharmacist was used to validate the researchers' assessments. They were provided with 30 case studies chosen to represent the range of problems presented to pharmacists. They were asked to rate each case, using the same categories as the researchers, for potential adverse outcome, probability of occurrence, and resources required to treat such an occurrence. Their scores were matched with those allocated by the researchers for the same cases.

The inter-rater reliability coefficients for the probability scale ($r = 0.72$, $P<0.0001$) and for the resource scale ($r = 0.67$, $P< 0.001$) indicate good concordance between the researchers and the reviewer panel.[10] Retrospective analysis of the items on which the independent raters' scores varied from the researchers' scores by more than 1 rank indicated that the researchers were consistently more conservative in their ratings than the independent reviewers.

The two research pharmacists initially developed a consensus view on these matters. These judgments were based on their professional experience and took into account information available to them from the patient notes. Where there was disagreement between the two research pharmacists about the allocation of resources, the more conservative value was chosen. For example, people who have asthma should have an asthma management and action plan.[11] In the case of a person with severe asthma who did not have an asthma action plan, both research pharmacists agreed that the probability of an adverse outcome for this patient was in the range 11-35 per cent. However, one researcher considered that the resource necessary to treat this adverse outcome was admission to a hospital, while the second considered that a visit to the general practitioner would be the likely response. In such a case, the more conservative response of the general practitioner visit was allocated as the resource required to manage this patient.

The unit prices of general practitioner consultations ($A24.50) and specialist consultations ($A110.75) were based on the (Australian) Medicare schedule fee, and hospital admissions were classified according to the South Australian Government casemix funding model (1996/97), which establishes unit costs in accordance with

Australian national diagnosis related groups (DRGs). The expected cost savings were then estimated by applying the midpoint of the relevant step in the probability range of the adverse outcome to the unit price of the service avoided. An example of this calculation is depicted in Table 2.

Another potential resource saving arises from changes in prescribed medications as a result of pharmacist interventions. The number of medications taken by each patient was recorded at the beginning of data collection and again at the conclusion of the project. Savings (positive or negative) in relation to changes in prescribed medication resulting from pharmacist intervention were calculated using the Australian Pharmaceutical Benefits Schedule. These potential savings were then added to the health services resource savings presented in Table 2.

Results

The 10 pharmacies enrolled a total of 411 patients, 125 male (30 per cent) and 286 female (70 per cent). Their median age was 75 years (range 3-98 years). Pharmacists provided 1,492 consultations to patients. Of these, 318 consultations (21 per cent) were provided in the patient's home, 306 (20 per cent) in residential aged-care facilities, 55 (4 per cent) in hospitals and 813 (55 per cent) in the pharmacy (see Table 3).

A summary of the incremental fixed and variable costs is shown in Table 4. The extra fixed costs incurred in establishing pharmaceutical care ranged from $A4,043 to $A19,530. The average variable cost per patient ranged from $A99 to $A308.

As indicated earlier, determining optimum capacity utilisation for the purpose of allocating fixed costs is highly problematical. Consequently, separating out fixed costs enabled the potential resource savings at each pharmacy site to be compared with their respective variable costs to determine whether there has been a positive contribution towards the recovery of fixed costs. Thus, conceptually, positive net resource savings would imply that there could be a scale of operation in which total savings associated with particular pharmacy services are greater than their associated costs.

The net expected resource savings for each pharmacy, in relation to utilisation of general practitioners and medical specialists, hospital admissions and use of pharmaceuticals, are shown in Table 5.

The results from Table 4 regarding costs and Table 5 regarding potential cost savings are summarised in Table 6 to show the expected net surplus (or deficit) per patient available to cover total fixed costs. Within the limited time frame of this study, all five medication management pharmacies, one of the asthma management pharmacies and the wound management pharmacy were able to generate potential resource savings greater than their total variable costs, so that net resource savings were available to make a contribution to absorbing fixed costs. Neither of the diabetes pharmacies generated potential resource savings greater than total variable costs.

Although a conservative approach was adopted in estimating the probability of an adverse outcome, and, similarly, for the opportunity cost of the pharmacist's time, a sensitivity analysis was nevertheless performed to test for robustness. Rather than the midpoint of the relevant step in the probability range, the lower and upper bounds of that step were incorporated into the calculation in order to assess the impact on resource savings relative to the base figures presented in Table 6. Similarly, the opportunity cost of the pharmacist's time was varied by 25 per cent below and above the base rate of $A60 per hour (ie, $A45 and $A75 respectively). The results from varying the resource savings and cost parameters are presented in Table 7.

The sensitivity analysis revealed that, regard-

Table 3: Number of patients and patient consultations, median age and average time per consultation

Clinical focus and pharmacy	Number of patients	Median age (years)	Number of consultations	Average time per consultation (minutes)
Medication management				
Pharmacy A	39	82	140	57
Pharmacy B	29	74	147	33
Pharmacy C	83	82	164	48
Pharmacy D	40	65	142	25
Pharmacy E	14	76	85	22
Asthma management				
Pharmacy F	32	46	93	27
Pharmacy G	37	33	117	27
Diabetes management				
Pharmacy H	87	66	370	42
Pharmacy I	18	65	58	53
Wound management				
Pharmacy J	32	84	176	23

Table 4: Summary of incremental costs ($A) per pharmacy

Clinical focus and pharmacy	Fixed costs	Variable costs	Average variable cost per patient
Medication management			
Pharmacy A	$A11,320	$A12,007	$A308
Pharmacy B	$A14,230	$A5,825	$A201
Pharmacy C	$A9,398	$A9,070	$A109
Pharmacy D	$A5,822	$A4,862	$A122
Pharmacy E	$A4,043	$A2,720	$A194
Asthma management			
Pharmacy F	$A13,208	$A4,201	$A131
Pharmacy G	$A10,897	$A3,654	$A99
Diabetes management			
Pharmacy H	$A19,530	$A21,222	$A244
Pharmacy I	$A5,189	$A3,432	$A191
Wound management			
Pharmacy J	$A10,433	$A7,606	$A238

Table 5: Summary of potential resource savings (or deficit) per pharmacy						
Clinical focus and pharmacy	General practitioner	Medical specialist	Hospital admissions	Pharmaceuticals	Total cost saving	Cost saving per patient
Medication management						
Pharmacy A	$A841	$A520	$A16,498	($A300)	$A17,559	$A450
Pharmacy B	$A472	$A520	$A12,423	$A1,440	$A14,855	$A512
Pharmacy C	$A677	$A466	$A16,124	($A2,568)	$A14,699	$A177
Pharmacy D	$A335		$A4,133	$A2,004	$A6,472	$A162
Pharmacy E	$A248	$A106	$A3,763	$A300	$A4,417	$A316
Asthma management						
Pharmacy F	$A894		$A1,181	$A696	$A2,771	$A87
Pharmacy G	$A616		$A1,181	$A4,740	$A6,537	$A177
Diabetes management						
Pharmacy H	$A1,454	$A872	$A9,151	$A1,032	$A12,509	$A144
Pharmacy I	$A241		$A1,516	$A660	$A2,417	$A134
Wound management						
Pharmacy J	$A363	$A250	$A45,586		$A46,199	$A1,444

less of the probability point chosen within the step, the sign of the results was unchanged. That is, all those projects which originally recorded positive resource savings (as depicted in Table 6) remained in surplus. Similarly, those projects with resource deficits remained in deficit. The same situation also arose on varying the costs of the pharmacist's time. Irrespective of the unit cost of time chosen, projects with net resource savings originally still recorded savings and those in deficit remained in deficit.

Table 6: Net surplus (or deficit) per patient available to cover total fixed costs			
Clinical focus and pharmacy	Average cost saving per patient	Average variable cost per patient	Net surplus (or deficit) per patient
Medication management			
Pharmacy A	$A450	$A308	$A142
Pharmacy B	$A512	$A201	$A311
Pharmacy C	$A177	$A109	$A68
Pharmacy D	$A162	$A122	$A40
Pharmacy E	$A316	$A194	$A122
Asthma management			
Pharmacy F	$A87	$A131	($A44)
Pharmacy G	$A177	$A99	$A78
Diabetes management			
Pharmacy H	$A144	$A244	($A100)
Pharmacy I	$A134	$A191	($A57)
Wound management			
Pharmacy J	$A1,444	$A238	$A1,206

Net surplus = cost saving minus variable cost (each expressed per patient)

Discussion

From an economic perspective, the value of pharmaceutical care to society depends on the health outcomes obtained in relation to the amount of resources required. So far, the pharmaceutical care model has not been tested in a randomised controlled trial. There was a need for the theoretical model of pharmaceutical care first to be converted into practice within community pharmacies. Evaluation of the model at this stage has provided policymakers with information concerning the potential sustainability of the service from economic, pharmacist and consumer viewpoints.

The present study indicates that, conceptually, for those pharmacies recording expected resource savings greater than variable costs, there may be an optimum scale of operation based on the number of clients, the time frame and the adoption of best-practice protocols whereby net health resource savings to the community can be achieved. However, it was not possible to gauge what this optimum scale would be, given the diversity of clinical practice, differences in client numbers and commencement dates, and the action research "learning-by-doing" environment in which the study was conducted. This is accentuated by the considerable variation in both costs and savings structures across the various models, which renders it difficult to make meaningful comparisons across pharmacies. This variation in costs and savings might be attributed to factors such as: the size and location of the pharmacy; the balance of services between within-home, within-pharmacy and within-hospital; the length of time of operation of the service; time spent in refreshing clinical skills; the relative level of non-contact time spent in documentation; and time spent with mentors and in consultation with other health professionals.

Results from the consumer evaluation undertaken as part of the overall project evaluation support the view that there were substantial improvements in patients' perceived quality of life.[7] Similarly, qualitative information on the resolution of defined patient problems indicated high success rates.[7] It should be acknowledged that this type of qualitative information is indicative rather than conclusive. Both the short time frame and the level of available financial resources did not allow for the placing of a quantitative estimate on the quality of life outcomes.

However, as discussed earlier, as long as health outcomes are at least maintained, the problematic task of valuing these benefits can be avoided within a cost analysis framework, where the aim is to identify cost savings to the health system. Since the available evidence suggests that health outcomes have not only been maintained but possibly improved, then the cost analysis suggests that, at least for those pharmacies where

Table 7: Sensitivity analysis of net surplus (or deficit) per patient available to cover total fixed costs

Clinical focus and pharmacy	Net surplus (or deficit) per patient Lower bound probability	*Net surplus (or deficit) per patient Mid-point	Net surplus (or deficit) per patient Upper bound probability	Net surplus (or deficit) per patient Mid-point	Net surplus (or deficit) per patient Mid-point
	$A60/hour pharmacist rate	$A60/hour pharmacist rate	$A60/hour pharmacist rate	$A45/hour pharmacist rate	$A75/hour pharmacist rate
Medication management					
Pharmacy A	$A75	$A142	$A209	$A193	$A91
Pharmacy B	$A230	$A311	$A392	$A353	$A270
Pharmacy C	$A22	$A68	$A114	$A91	$A44
Pharmacy D	$A27	$A40	$A53	$A63	$A18
Pharmacy E	$A88	$A122	$A156	$A155	$A89
Asthma management					
Pharmacy F	($A56)	($A44)	($A34)	($A24)	($A64)
Pharmacy G	$A68	$A78	$A88	$A99	$A57
Diabetes management					
Pharmacy H	($A112)	($A100)	($A88)	($A55)	($A145)
Pharmacy I	($A90)	($A57)	($A24)	($A14)	($A100)
Wound management					
Pharmacy J	$A942	$A1,206	$A1,470	$A1,238	$A1,175

Net surplus = cost saving minus variable cost (each expressed per patient)
*The results in this column represent the baseline calculations (presented in Table 6), from which comparisons can be made

net cost savings have been realised, there has been an overall positive contribution to social welfare.

As indicated earlier, the claimed cost savings were based on assessments of the probability that particular adverse outcomes would have occurred and the resource consequence of this had the pharmacist not intervened. The validation exercise indicated that the pharmacist researchers adopted a conservative approach in assigning cost savings.

Another conservative aspect to the measure of resource savings was that although it is probable that some patients may have been saved multiple visits, only one incident of attendance to a general practitioner, medical specialist, or hospital was assigned in calculating the potential costs avoided. Furthermore, other potential resource savings identified by researchers that were of a continuous nature rather than episodic, such as delays in nursing home admissions, were not included as it was difficult to interpret the probability of the adverse outcome. Similarly, a conservative value was attributed to the opportunity cost of the pharmacist's time, based on the professional opinion of four highly experienced community pharmacy owners, such that it was costed at 100 per cent above the replacement pharmacist costs.

Most of the potential cost savings were attributable to a reduction in inpatient hospital admission, the unit prices of which are at least one order of magnitude greater than the unit prices of medical practitioner and specialist consultations. This suggests that there should be further exploration of the accuracy of the research pharmacists' and the independent expert panel's estimations of the probability of hospitalisation.

Notwithstanding the conservative approach adopted, results of the sensitivity analysis suggest that varying the parameter estimates of the pharmacist's opportunity cost of time and the probability of an adverse event occurring does not alter the relative performance of the individual pharmacies in comparison to original baseline calculations. The results of the sensitivity analysis did not vary markedly from the original baseline calculations. This tends to suggest there is a certain degree of robustness in the baseline results presented.

The results of the study suggest that the medication management and wound management models are capable of generating cost savings greater than their direct costs. However, the results for diabetes management suggest cost savings are less likely to be realised — although how these models perform as pharmacists gain experience in implementing "best practice protocols" requires further investigation. This latter point is particularly pertinent to the asthma programme, since one pharmacy consistently generated resource savings in the sensitivity analysis.

The relatively small number of patients and the short length of the study limit the ability to generalise to other settings, and thus the results (in terms of absolute dollar figures) should be interpreted with caution. Limitations include the fact that participating pharmacists were chosen for their willingness to change current practice and to incorporate the needs of consumers into their practice and their demonstrated ability in building interprofessional relationships. As such, they may not be representative of all pharmacists. Other qualifications include the fact that

the selected pharmacies' cost structures may not be representative of all pharmacies, that the probabilities attached to adverse outcomes may not be a realistic reflection of actual events, and that the averaging of costs over initial and subsequent pharmacist consultations may not provide an appropriate assessment of costs. Ideally, it would be desirable to estimate the distribution in which costs and resource savings occur over time, to be able to determine "best practice" protocols, and to ascertain an optimum scale of operation.

Conclusion

Notwithstanding the qualifications discussed, the results presented in this study do provide sufficient evidence to suggest that substantial savings could be achieved in the provision of services by some community pharmacies operating within a primary care setting. The results of this study are therefore of importance to policymakers who are concerned with controlling health system costs.

These initial positive evaluations have helped to convince policymakers to support further exploration and refinement of this service model, leading to allocation of funding for the provision of these services in the wider community by the Commonwealth Government of Australia.[12] A number of different models are being developed, with accredited pharmacists eligible for service funding.

ACKNOWLEDGMENT Funding for this research was provided by the Australian Commonwealth Department of Health and Aged Care.

References

1. Manasse Jr HR. Medication use in an imperfect world: drug misadventuring as an issue of public policy, part 1. Am J Hosp Pharm 1989;46:929-44.
2. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. Am J Hosp Pharm 1990;47:533-43.
3. Roughead EE, Gilbert AL, Primrose JG, Sansom LN. Drug-related hospital admissions: a review of Australian studies published 1988-1996. Med J Aust 1998;168:405-8.
4. Caleo S, Benrimoj S, Collins D, Hall J, Lauchlan R, Stewart K. Pharmacists' clinical interventions: A cost analysis. Aust Pharm 1996;15:118-21.
5. Hepler CD, Grainger-Rousseau TJ. Pharmaceutical care versus traditional drug treatment: is there a difference? Drugs 1995;49:1-10.
6. Hepler CD, Strand LM, Morley PC. Comprehensive pharmaceutical care. Toronto: McGraw-Hill; 1998.
7. March G, Gilbert A, Roughead E, Quintrell N. Developing and evaluating a model for pharmaceutical care in Australian community pharmacies. Int J Pharm Pract 1999;7:220-9.
8. Drummond MF, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd ed. New York: Oxford University Press; 1997.
9. Rupp M. Value of community pharmacists' interventions to correct prescribing errors. Ann Pharmacother 1992;26:1580-4.
10. Morton AP, Dobson AJ. Assessing agreement. Med J Aust 1989;150:384-7.
11. Woolcock A, Rubinfeld M, Seale P, Landau LL, Antic R, Mitchell C, Rea HH, Zimmerman P. Asthma management plan, 1989. Med J Aust 1989;151:650-3.
12. Third Community Pharmacy Agreement between the Commonwealth of Australia and the Pharmacy Guild of Australia, 2000. http://www.guild.org.au/thirdagreement/thirdagreement.pdf (accessed September 18, 2000).

Date article received 24.2.00; returned to author for revision 22.5.00; accepted for publication 30.10.00