Program budgeting and marginal analysis: A case study in chronic airflow limitation

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Abstract

Program budgeting and marginal analysis is a method of priority-setting in health care. This article describes how this method was applied to the management of a disease-specific group, chronic airflow limitation. A sub-program flow chart clarified the major cost drivers. After assessment of the technical efficiency of the sub-programs and careful and detailed analysis, incremental and decremental wish lists of activities were established. Program budgeting and marginal analysis provides a framework for rational resource allocation. The nurturing of a vigorous program management group, with members representing all participants in the process (including patients/consumers), is the key to a successful outcome.

Introduction

Program budgeting and marginal analysis (PBMA) is a straightforward method of priority-setting in health care, derived from fundamental economic principles (see glossary). This method does not appear to have been used at the first level of health resource allocation (where the government distributes resources to the States). Overseas experience of PBMA has been at the second level of resource allocation (where purchasing decisions have been made by health authorities) (Cohen 1995; Twaddle & Walker 1995). Despite this, there appeared to be no reason why the method could not

be applied by clinical staff to set priorities within their own services (that is, implement a disease-specific PBMA). Hospital clinician teams face a continuing challenge to achieve maximum health gains for their patients with limited resources.

PBMA requires that the activities of the hospital under study be described in a program format. Adjustment between these activities is identified at the margin (that is, incrementally) in order to improve patient care. It is a way of organising information, and can be seen as a counterpart or extension of meta-analysis and evidence-based medicine. Within the PBMA exercise, sub-program and outcomes identification precedes program budgeting (Mooney, Jan & Seymour 1994; Madden et al. 1995; South Australian Health Commission 1996). As a resource allocation strategy, PBMA evaluates local conditions and can be considered sound business sense. It is a transparent, explicit, decision-making process.

Chronic airflow limitation (CAL) refers to a group of disorders characterised by persistent impairment of expiratory airflow, including chronic bronchitis and emphysema. CAL is a major cause of mortality, morbidity and impaired quality of life in Australia. It was the fourth highest cause of death in 1995 (6400 deaths) behind cancer, ischaemic heart disease and cerebrovascular disease (Australian Bureau of Statistics 1997).

The aim of this article is to describe how the PBMA process has been applied to the management of a disease-specific group (CAL patients) in a metropolitan teaching hospital (Flinders Medical Centre).

Method

This pilot project was structured on the disease-specific group CAL, which represents the major proportion of the work of the respiratory unit. CAL is also a common feature of admissions to other units within the medical division of the hospital.

The program budgeting phase of this study was confined to resources over which Flinders Medical Centre and the respiratory unit had control. The program structure began with the presentation of the patient to the hospital, but reached back to identify the referral role of the general practitioner.

Two committees were formed to manage the project within Flinders. The steering committee consisted of the Executive Director of the hospital's Corporate and Clinical Support Service, a representative from the South Australian Health Commission, a representative of the Southern Division of General Practice, an academic consultant in health economics, the Medical Division's Business Manager, a respiratory physician, the Project Manager and Project Officer and a representative from a coordinated care trial in CAL (Healthplus, Southern Region Demonstration Unit). The principal tasks for the steering committee were to provide leadership to the project, to authorise the work program and timetable, to agree on evaluation plans and to facilitate implementation.

The Project Manager and Project Officer reported to, and received regular feedback from, a group of health care professionals and consumers (the program management group). This group consisted of respiratory unit physicians, nurses, allied health professionals, a patient/consumer representative, the Project Manager and Project Officer. The major tasks for the program management group were:

- to identify and describe the sub-programs within the overall CAL program, taking a health system-wide perspective
- to include the links between Flinders Medical Centre and its catchment area
- to agree on the values, principles and equity definitions used throughout the exercise, and
- to determine the identifiable outputs, objectives and respective expenditures of the sub-programs.

All patient separations from Flinders, where the patient was over 18 years of age, with a diagnosis (not necessarily the primary one) of CAL as an active problem, were identified by the hospital's clinical coding service using its inpatient separation software ISIS/ISAAC. The included codes were AN-DRG-3 code 177 and/or International Classification of Diseases, Ninth Revision (ICD-9) codes 496, 493.21, 493.20, 492.8, 518.81 and 486. The number of presentations to the hospital's emergency department and the data for the outcomes of these presentations were provided by the emergency department. The study period was the 12-month interval from 1 December 1996 to 30 November 1997.

In order to construct a program and sub-program budget, costing data obtained using the Casemix Analysis And Patient Costing System (TRENDSTAR©) were collected by the Project Officer for all patient separations identified above. For statistical analysis, the personal computer version of the Statistical Products and Service Solutions (SPSS; Chicago, USA) for Windows (Version 7.5) was used.

The program management group decided that the minimum set of information required for each of the sub-programs should include:

- a detailed description of the sub-program
- identification of objectives and outcomes – implied if not formally stated (health outcomes were based on evidence-based review, survival data and quality of life measures)
- the relationship with joint provision of services for other sets of interacting programs
- utilisation of hospital-based health resources for the period of the study (for example, admissions)
- the total cost per patient for each episode of intervention.

This study was conducted according to the resource allocation principles promulgated by the South Australian Health Commission (1996). The Commission goals adopted were those of health advancement, effectiveness, allocative efficiency, equity of access, and non-discrimination against health-risk behaviour (particularly smoking in this instance).

Results

Identification of sub-programs

The project management group met on 13 separate occasions, a minimum of 26 hours of contact time for each of the group members, to describe the services (programs and sub-programs) provided for CAL patients, to place these services within a program budget framework, to consider provision of additional services, to identify areas for a possible reduction in services and to discuss priorities so that changes could be considered at the margin.

The sub-programs identified by the project management group included:

- standard care (treatment for CAL only, with no co-morbidities requiring active treatment)
- special care (treatment for CAL plus treatment for additional active co-morbidities)
- intensive or critical care treatment
- surgery (either lung transplant surgery or lung reduction surgery), and
- palliative care (where the patient was considered to have been admitted to Flinders for palliation only).

The sub-program structure for the treatment of CAL, as described by the project management group, is shown in Figure 1. Several drafts of the structure were worked through by the group until they were satisfied that this was a 'best fit' description of the main patient-flows requiring analysis.

Of the admissions to Flinders during the study period, 1793 were identified with CAL as an active problem. Peak activity occurred during the August to October period. Most of the admissions were emergencies. The emergency admission rate where CAL was an active, but not the primary, problem was 82.5% with 7.5% of admissions being elective and 10.0% pre-booked through a booking list system. The majority of the admissions (76.8%) were classified as requiring special care treatment, with an additional 9.2% of admissions requiring intensive care. Only 13.5% of admissions could be classified as standard care with 0.5% considered to be palliative care only.

Emergency department attendances/admissions for ICD-9 496

All attendances to the emergency department at Flinders are triaged by an experienced emergency department nurse and given a priority rating from 1 to 5:

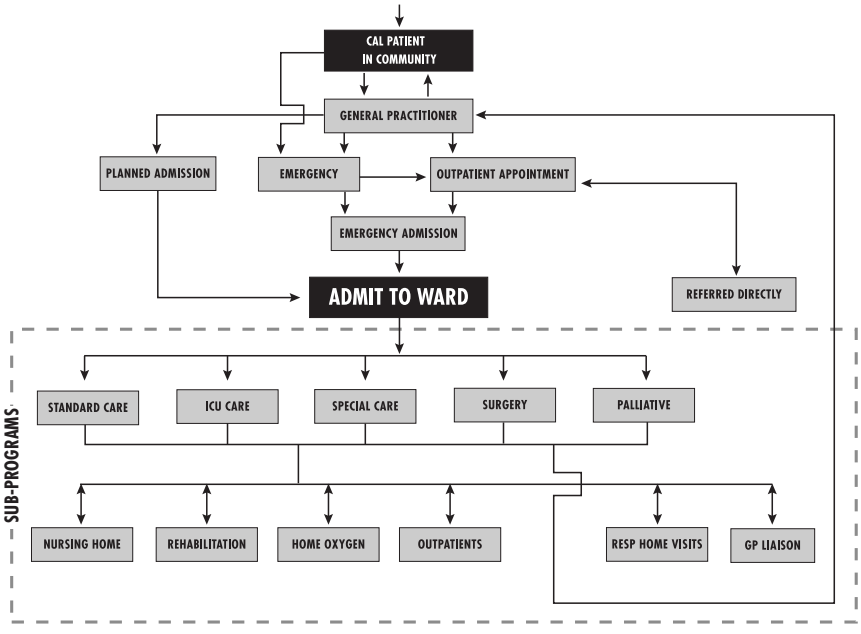
1 – refers to patients who need to be resuscitated

2 – emergency, refers to patients who need to be seen in less than ten minutes

3 – urgent, refers to patients who need to be seen in less than 30 minutes

4 – semi-urgent, refers to patients who need to be seen in less than one hour

5 – non-urgent.



Standard care: Care for patients with CAL, no co-morbidities requiring active care

Special care: Care of patients with severe active co-morbidities at the time of admission

Abbreviations:

CAL: Chronic airflow limitation

ICU: Intensive or critical care

RESP: Respiratory

GP: General practitioner

Figure 1: Sub-program structure of the Flinders Medical Centre's PBMA project in CAL

The majority of attendances to the emergency department (85.7%) for ICD-9 496 were classified as needing to be seen in less than one hour, with 54% needing to be seen in less than 30 minutes, which indicates the severity of airways disease present in these patients.

Of the attendances to the emergency department with chronic airway obstruction, 81.6% (364/446) were admitted to the hospital.

Pattern of separation

The majority of separations for CAL as an active problem (77.0% or 1378/1793) were to home, with an in-hospital death rate of 5.4% (97/1793). Seven per cent of the separations (125) were to nursing home or hostel accommodation whilst 10.4% (198) were to another hospital or health care facility.

Readmission to Flinders Medical Centre

There were 567 (33.4%) readmissions out of 1696 separations (total separations minus inpatient deaths) for CAL as an active problem during the 12-month study period, with 42.7% (242) of the readmissions occurring within 28 days, 75.8% (430) within 90 days and 93.7% (531) within 180 days.

Development of the incremental and decremental wish lists

To facilitate priority-setting, the project management group developed a provisional list of interventions that were currently not available but which, by consensus, the group 'wanted more of'. This was known as the incremental wish list. In terms of priority, these items were the 'most wished for' if resources were available. Conversely, a decremental wish list indicated those activities most readily given up or reduced if resources had to be reallocated elsewhere (Table 1).

Table 1: Incremental and decremental wish lists (provisional)

Incremental	Decremental
• rehabilitation/education program to encompass: 1. intensive smoking cessation program 2. improved general practitioner liaison/education • vaccination (influenza, pneumococcal) • enhanced discharge planning • non-invasive ventilation in respiratory wards • additional staff (respiratory unit) • lung volume reduction surgery • post-transplant care/post-acute care	• decrease in avoidable admissions/ readmissions • decrease in unnecessary days of inpatient stay • decrease in inappropriate prescriptions of home oxygen • modifications of care 1. drugs and drug delivery (for example, bronchodilators) 2. arterial blood gases 3. inpatient doctor visits 4. physiotherapy in acute care 5. x-rays 6. computer-assisted tomography scans • outpatient follow-up (reduction in frequency) • bronchoscopies (reduction in frequency)

Each item on the provisional wish lists was the subject of extensive literature searches for evidence-based medicine to support or refute inclusion on the list, and detailed costing analysis. Funding for one item on the incremental list (transplant coordinator) was made available by the purchasing office of the South Australian Health Commission towards the end of the study period, so this item was deleted from the list. An example of the costing analysis of wish list items is given below for rehabilitation.

Costs

Attempts were made to obtain the total direct cost of each individual admission with CAL as an active problem. Costs were identified for a seven-month period from 1 December 1996 to 30 June 1997. An approximate cost-to-reimbursement discrepancy (estimated total cost minus casemix funding) of $978 636 (unfavourable) was found for the 956 patients admitted with CAL as an active problem over this seven-month period. Although site-specific grants and efficiencies in the treatment of other disease categories relative to casemix funding may make up some of this shortfall, the matter warrants further detailed investigation.

The cost estimates used in this study are, at best, underestimates of the true cost of each individual admission.

Rehabilitation and education program with smoking cessation program: An example of the analysis of a wish list item

An extensive and systematic review of the literature revealed the following (Lacasse et al. 1996; Kanner 1996; Celli 1997; Albert 1997):

1. Rehabilitation programs have been shown to reduce the length of inpatient stay by a range of 1.5–10 days.
2. Several uncontrolled studies suggest that pulmonary rehabilitation decreases hospitalisation rates for CAL patients (range 0–44%) (Celli 1997). However, in controlled trials the findings have been less clear and some studies have enrolled patients with disease states ranging from mild to severe CAL. We have estimated the minimum cost of a rehabilitation program with follow-up every fortnight to be approximately $1200 per patient per year. The mean cost per day of inpatient stay for ICD-9 code 496 (CAL) is estimated to be about $455.
3. For a rehabilitation program to pay for itself a reduction in length of inpatient stay of approximately three days or a reduction in admissions of about 30% (that is, 281 admissions for ICD-9 496 per year with a mean cost of $3455) would be required (Table 2). The latter case is based on the annual cost of providing the program to all patients (n = 214) with an ICD-9 primary diagnosis of 496. The net saving from achieving a 30% reduction in admissions is only small ($33 420). If we were able to target those patients who would obtain the most benefit from a rehabilitation program, the cost of providing the program would decrease.

However, this analysis does not take into consideration other benefits which could accrue from a rehabilitation program, such as a reduction in the use of other health services or an improvement in the patient's quality of life.

4. The major benefits appear to be improved exercise endurance and reduction in the sensation of dyspnoea. Relapse is likely to occur within 18 months if there is no follow-up program.

The above process was applied to all other items on the wish lists.

Table 2: Cost analysis of a rehabilitation program for ICD-9 496 as the primary diagnosis

Reduction in admissions	10%	20%	30%	40%
Number of reduced admissions	28	56	84	112
Cost savings for prevented admissions ($)	96 740	193 480	290 220	385 710
Cost of rehabilitation* ($)	256 800	256 800	256 800	256 800
Net cost saving ($) (prevented admissions – rehabilitation)	–160 060	–63 320	33 420	128 910

* based on an estimated annual number of admissions of n = 281 for ICD-9 496, 214 patients and a mean cost of $3455 per admission

Incremental and decremental lists of priorities

After a consideration of all of the available evidence, estimates of the costing of each item on the provisional wish lists and pairwise comparisons of items, the project management group drafted a list of priorities, as shown in Table 3. The incremental list of priorities contained those items that were considered to be 'best buy' options if additional funding were provided. The project management group considered that funds for some incremental list items could be made available by the implementation of a project to address the two items on the decremental list of priorities.

Table 3: Incremental and decremental lists of priorities

Incremental	Decremental
• rehabilitation/education program to encompass: 1. intensive smoking cessation program 2. improved general practitioner liaison/education • vaccination	• decrease in avoidable admissions/ readmissions • decrease in unnecessary days of inpatient stay

Discussion

This project identified a relatively large number of elderly patients with CAL as an active problem with significant co-morbidities and a high rate of readmission presenting to the hospital's emergency department and admitted as emergency admissions.

The study was time-consuming, involving 12 months of intense discussion, research, data collection, literature searching and contact with other health professionals and consumers. Data collection was often difficult, with some data unavailable and other data inaccurate. A multidisciplinary team approach was used, with consumers providing a valuable contribution in the management group. The project provided a framework of specific proposals, identifying how, under a 'no growth budget', an improvement in overall health outcomes could be obtained by reducing some items on the decremental wish list. The study also identified the 'best buy' options if the budget were expanded. Producing an incremental wish list was a relatively easy task for the project management group. However the group found it much more difficult to identify items for a genuine decremental wish list. This list was derived after assessing the technical efficiency of the sub-programs. Placing an item on the incremental wish list did not necessarily mean that it would be implemented (or expanded). Similarly, being on the decremental list did not automatically mean that it would be cut (or abolished), but rather that it would be reviewed sensitively.

For this PBMA project to be credible, there needed to be a similar number of convincing items on both decremental and incremental lists. It may be necessary to fund the incremental list of priorities by finding operational efficiencies amongst existing projects. These opportunities may be limited, however, since many would have already been identified during the previous several years of financial stringency and current practices would have already been refined to reach the limits of technical efficiency.

The sub-programs identified from the mapping of the treatment of CAL were those that best described the practice of care in our particular health care facility and the surrounding local community area. Other studies in different locations may well produce different lists.

The PBMA project was based in a clinical service and clinical decision-makers (medical specialists, general practitioners, nurses, allied health workers and a consumer) fulfilled

a key role. Due to this mix of representatives, there was a wide range of perspectives and input. It was, therefore, partly a test of what evidence and argument the project management group members found acceptable and convincing in a resource allocation context. The program structure was chosen because it made clinical sense. The PBMA project structure was output-orientated with some of the data for sub-programs (for example, home oxygen therapy) relatively easily obtained. However, little information in the form of evidence-based medicine was available for other identifiable sub-programs, even after extensive literature searches. The extrapolation of results of randomised controlled trials, involving homogeneous study populations where clinically complicated cases are excluded, particularly aged patients or patients with co-morbidity, to the clinical setting in a tertiary teaching hospital is also of doubtful validity (Knottnerus & Dinant 1997). However it is important to note for future exercises in clinical areas that more accurate information could have been obtained with additional project resources, by:

- extending clinical trials already in existence
- having contact with other health service providers within the region
- developing protocols for the studies necessary to obtain the relevant information, and
- achieving expert consensus based on structured methods.

Imperfections in some of the sources of data prevented a detailed and accurate analysis of costs. A major benefit of this study has been the highlighting of inadequacies in the databases, which are currently being resolved. The PBMA process can cope with imperfect information provided the marginal costs and benefits can be estimated with accuracy. Cost estimates were obtained for the first item on the incremental wish list – rehabilitation. The marginal analysis showed that a reduction in admissions by about 30% would be required for patients with a primary diagnosis of ICD-9 496. The benefits of a rehabilitation program remain controversial (Albert 1997; Celli 1997).

Other PBMA studies reported in the literature usually involve reallocation of line items within the overall budget. It has become apparent that in the Flinders PBMA study, reallocations are between items from different types of financing and budgeting systems, namely between separately funded line-item budget and casemix-funded items. Technical problems in achieving this can be foreseen.

Any efficiencies we generate by addressing items on the decremental wish list mean that in a hospital with an above-80% emergency admission rate there will always be patients in the emergency department waiting to fill the first bed available. If the requirement for respiratory unit beds is reduced due to improved efficiency, other units will be able to admit more patients without the need for the hospital to open additional beds. One of the advantages of our PBMA study is its identification of these issues.

The main difference between an economic and a financial perspective should be highlighted. The virtues of PBMA may be eroded in a financial budgeting environment.

PBMA indicates how to reallocate resources for greater health gain, but in the presence of unmet demand for care, expenditure savings are unlikely. The volume of resources allocated to the hospital may not be diminished, but the health gain they generate can be increased.

An additional benefit of the PBMA study was the provision of reliable information to other projects, for example, the Evaluation Quality Improvement Program, the Australian Council of Health Care Standards Accreditation Process and the Discharge Planning Group.

The cost of this project has not been estimated but would need to include the cost of the time of each of the members of the project management group.

Lessons for the future of PBMA

1. Success of the PBMA process is dependent on a dedicated team with responsive leadership, with all 'players', from physicians through to patients, involved in all of the discussions and deliberations.
2. The technical efficiency of the identified sub-programs needs to be assessed prior to discussion of allocative efficiency.
3. Many of the identified interventions for CAL lacked high-level evidence for their use. Thus the application of evidence-based medicine was confined predominantly to lower levels of evidence. A 'value judgement' was made by consensus of the members of the project management group after careful review and debate of the evidence available.
4. Physicians need to be encouraged to have two views (Abrams 1993):
   - consideration of the patient's advocacy before community interests
   - a broader perspective focused on community interests before patient advocacy.
5. It is doubtful that there would ever be resources available to improve evidence-based medicine by implementing all the randomised controlled trials that are required for high-level evidence. The uptake of a new intervention should be delayed until adequate information from evidence-based medicine is available.
6. Despite the progress of information technology in recent years, databases were found to be fragmented and inadequate.
7. Benchmarking between institutions was extremely difficult due to differences in patient populations, differences in the set-up and structure of databases, and in some cases a reluctance to share information.
8. The conflict between some aspects of South Australia's model of casemix funding and PBMA needs to be resolved. Any reduction in admissions has the potential to reduce the income of the health care facility. In a hospital where demand constantly outstrips the workload targets set by the health authority, PBMA may provide useful information for managing this discrepancy.

Conclusion

PBMA provides a framework for resource allocation and makes explicit a thought process that is by no means unknown to clinical decision-makers. It also highlights ways of improving technical efficiency. This study confirms Donaldson's (1994) observations that PBMA can be time-consuming and requires a multidisciplinary team approach. At the clinic–patient interface more accurate and detailed information systems need to be developed. The question of whose values should prevail in the final discussion process remains controversial. The values adopted in this study were those devised by the State health authority after active consultation. The nurturing of a vigorous project management group whose members represent all participants in the process (including patients/consumers) is the key to a successful outcome.

Glossary

Allocative efficiency: maximising benefits to society with the resources available.

Effectiveness: the program/service or intervention addresses a need or issue so as to advance the health of the population being served.

Equity: equality of provision/access to programs/services on the basis of equal need.

Health advancement: to demonstrate an improvement in the health status of the population being served, as an outcome of a given program/service.

Margin: refers to the next additional unit produced.

Marginal cost: is the cost of producing one extra unit of output.

Marginal analysis: investigates the effects of varying the output of various services in an attempt to obtain the best return for the resources allocated. Given the existing resources available, could some redeployment of these resources result in a total benefit from the program? If additional resources were available, how could these be deployed to ensure the greatest increase in benefit from the program?

Program budget: lists intended resource use in categories and outcomes, rather than the more usual line-item budget, which lists inputs.

Technical efficiency: the ability to best meet a given objective at least cost.

Value judgement: embodies the values of the person making the judgement.

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