The cost of hyperbaric therapy at the Prince of Wales Hospital, Sydney

Jorge D Gomez-Castillo and Michael H Bennett

Key words
Hyperbaric oxygen, hyperbaric facilities, economics

Abstract

(Gomez-Castillo JD, Bennett MH. The cost of hyperbaric therapy at the Prince of Wales Hospital, Sydney. *SPUMS J*. 2005; 35: 194-8.)
We need formal economic analyses in the field of hyperbaric medicine. As the first step in a staged approach to full cost-effectiveness analysis for major indications, we present an analysis of the true cost of treatment and the cost of treatment per diagnosis in our unit. Following explicit definitions of cost, accounting cost objects, cost objectives and cost categories, we calculated all costs involving the treatment of patients during the financial year 2003–2004. Dollar costs were taken from a detailed examination of itemised spending provided through the hospital accounting system. Patients were classified into diagnostic groups and included both those who did and those who did not receive hyperbaric oxygen therapy (HBOT). The latter were mainly wound care patients. We then calculated the individual cost for each diagnosis. All costs are expressed in Australian dollars. We treated a total of 304 patients with 1,333 compression cycles using both monoplace and multiplace compression vessels. The total number of individual patient compressions was 3,446. The overall cost for the year of operation was $1,195,197. The average cost of therapy for each patient having HBOT was $4,159, while for those having only wound care the average cost was $2,832. The overall average cost to deliver one HBOT session for an individual patient was $325. These figures will assist us in accurately representing the likely costs of future therapy and in discussions with third-party payers. It is our intention to use these data to inform cost-effectiveness studies currently under way in our facility.

Introduction

Cost is a major factor in any rational assessment of the place of a therapy in practice. Marginally effective therapies with high delivery costs may be unacceptable to many medical systems, particularly in the developing world, while highly effective therapies that are also cheaper than the alternative treatment are likely to be enthusiastically adopted. Increasing healthcare expenditure is of significant concern to healthcare providers, administrators, politicians and the general public.

Despite emerging technologies, personnel and hospital costs usually constitute the bulk of expenditure in healthcare.[1] This is likely to be so with the provision of hyperbaric oxygen therapy (HBOT). While the health economics literature in general has grown over the last 10 years, many of the published articles are of low quality, and this appears to be particularly so in the area of diving and hyperbaric medicine. Poor economic evaluations are not only wasteful of scarce resources but also misleading.[2]

Although there are an increasing number of publications regarding the effectiveness of HBOT, there are very few publications available to assist resource allocation at the societal level. An extensive search for economic analyses of HBOT in fact generated only one article that met Drummond's criteria as a true economic evaluation.[3] Given worldwide health resource constraints and an increasing demand for economic information, economic analyses will become critical for future rational clinical use.[4]

Cost analyses are usually conducted to assist the appropriate allocation of funds and there are several well-described methods to assess the expenses related to a particular clinical condition or treatment. The four approaches most commonly described are cost-benefit analysis, cost-effectiveness analysis, cost-minimisation analysis, and cost-utility analysis.[5] While all these methods can provide specific and useful assessments, they are difficult to perform without competent advice on heath economics. Perhaps because of this, articles that purport to accurately quantify and compare costs of treatments frequently fall short of the mark.[6]

Recognising this problem, we have not attempted formal economic analysis with this paper and have not assessed the impact of therapy on outcome or utility. We have attempted only to accurately quantify costs, intending more formal economic analysis when further effectiveness data and the assistance of a health economist are available.

Methods

We calculated the financial cost of HBOT sessions and the total HBOT costs per diagnosis, defining the financial cost as the expenditure on goods and services purchased. Costs are thus described in terms of how much money has been paid for the resources used by the Department of Diving and Hyperbaric Medicine (DDHM) at the Prince of Wales

Hospital (POWH) in Sydney. We included the costs of occupying an appropriate bed when the individuals were formally admitted overnight. All estimations and calculations have been made in Australian dollars (AUSD) and for the financial year from 1 July 2003 to 30 June 2004.

First we identified all types of costs and classified them into three broad categories: capital, recurrent and other, as detailed in Table 1. Individual items were costed using financial statements generated at the POWH, resource usage records from the DDHM patient database and administrative records. Staff-time allocations were estimated from a consensus opinion among the staff working in the DDHM and included all activities undertaken including clinical, administrative and training duties. All data were entered into an electronic spreadsheet and decision tree model Treeage® (Treeage Software, Williamstown, MA).

Using this information, we then calculated the individual consumption of resources by carefully assigning units of time and specific resource allocation for the different diagnostic categories. The total cost for each diagnostic category thus represents the cost of producing all therapy administered in the DDHM for each particular diagnosis. The average cost could then be calculated per treatment and per diagnosis by dividing the total cost by the number of patients or the number of therapy sessions, as appropriate. This average cost was independent of which pressure vessel was used for any individual patient, and is therefore an estimate that represents our actual chamber usage rather than hypothesising a particular chamber for each diagnosis. This process is illustrated by the flow diagram in Figure 1, while the data collection processes are summarised in Figures 2 and 3. We did not attempt sensitivity analysis for any errors in cost assumptions. The overall total cost of operation for the DDHM included some patients not treated (clinic patients found not suitable, candidates examined for fitness to dive and wound-care only patients). These costs were excluded from the calculation of costs for each diagnostic category except where wound care was administered to patients having HBOT.

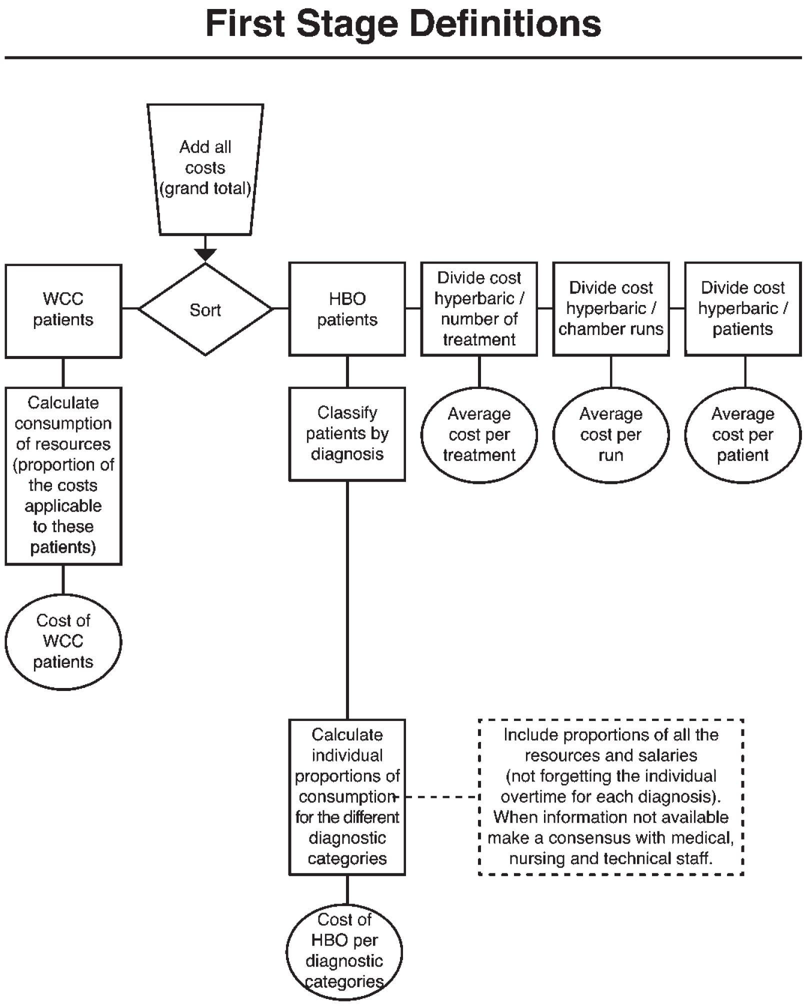
Table 1
Classification of costs by input

Capital costs	**Included items**
Chambers:	*monoplace, multiplace*
Equipment:	*hyperbaric systems, hospital systems, administrative (e.g., computers)*
Buildings:	*hyperbaric unit*
Recurrent costs	
Personnel:	*doctors, nurses, technicians*
Supplies:	*hyperbaric delivery system, medical consumables, administrative consumables*
Operation and maintenance:	*hyperbaric system, administrative, medical*
Buildings:	*operations and maintenance, utilities*
Other operating costs	
Financial administration and management	

Table 2
Costs for provision of service by diagnostic category. Total cost for a diagnosis in one year may include fractions of a completed individual due to patients with a partially completed course at the end of the review period. All figures have been rounded to nearest whole dollar and apparent arithmetic errors in the total cost column are due to using actual costs to calculate these figures. (ORN – osteoradionecrosis)

Diagnostic category	Average number of compressions per patient	Cost for a single compression (AUSD)	Total average cost of treatment course (AUSD)	Total cost to facility in one year (AUSD)
Prevention of ORN	37	304	11,248	274,119
Soft-tissue radiation injury	23	311	7,153	273,838
Chronic wounds	12	311	3,732	188,010
Osteoradionecrosis	15	304	4,560	133,569
Diving injuries	2	720	1,440	58,295
Acute ischaemic conditions, flaps and grafts	4	406	1,624	41,857
Other conditions	4	304	1,216	32,482
Chronic osteomyelitis	18	304	5,472	27,017
Acute necrotising infections	10	398	3,980	23,486
Other infections	7	354	2,478	23,369
Ophthalmological conditions	11	399	4,389	13,959
Toxic gas poisoning	2	396	792	10,284
Neurological conditions	23	406	9,338	9,338
Osteonecrosis	30	304	9,107	9,107
Wound clinic patients	—	—	2,832	76,467
Total				**1,195,197**

Figure 1
Flow diagram of methodology for calculating costs in this study (WCC – wound care clinic; HBO – hyperbaric oxygen)



In addition to average costs, we also calculated the cost required to treat one additional patient for each of the diagnostic categories. Such costs took account of consumed resources only and assumed no additional capital or other fixed costs such as wages. The diagnosis classification we used was the one used by the POWH DDHM patient database, and this appears in Table 2. All costs were calculated using Treeage® and are presented rounded to the nearest whole dollar.

Results

In the financial year July 2003 to June 2004 we treated a total of 304 patients. Thirty-five of these were not compressed (27 wound clinic patients and eight others), leaving 269 patients who were compressed with 1,333 compression cycles. Of these cycles, 732 were in a monoplace chamber and 586 in our multiplace chamber, and the total number of individual patient compressions was 3,446. The total chamber compression time was 2,477 hours.

Excluding the eight patients who were neither compressed nor treated in the wound clinic, the overall cost for the year of operation was $1,195,197. The average cost of therapy for each patient having HBOT was $4,159, while for those having wound care only the average cost was $2,832. The overall average cost to deliver one HBOT session for an individual patient was $325. Table 2 shows the costs for each individual diagnosis using the same methodology as that for the overall costs, while Figure 4 shows the cost details by category for the compressed and wound clinic patients.

Excluding all fixed costs and making no attempt to differentiate costs for the use of monoplace or multiplace treatment, the incremental costs of an additional patient were $188 per treatment. This figure assumes an ability to expand treatment numbers without employing extra staff or increasing the number of chamber runs required. Detailed incremental costs by diagnostic category are presented in Table 3.

Figures 2 and 3. Summary of data collection and cost classification. Data collection is summarised on the left, and the right-hand figure shows different approaches to cost categories.

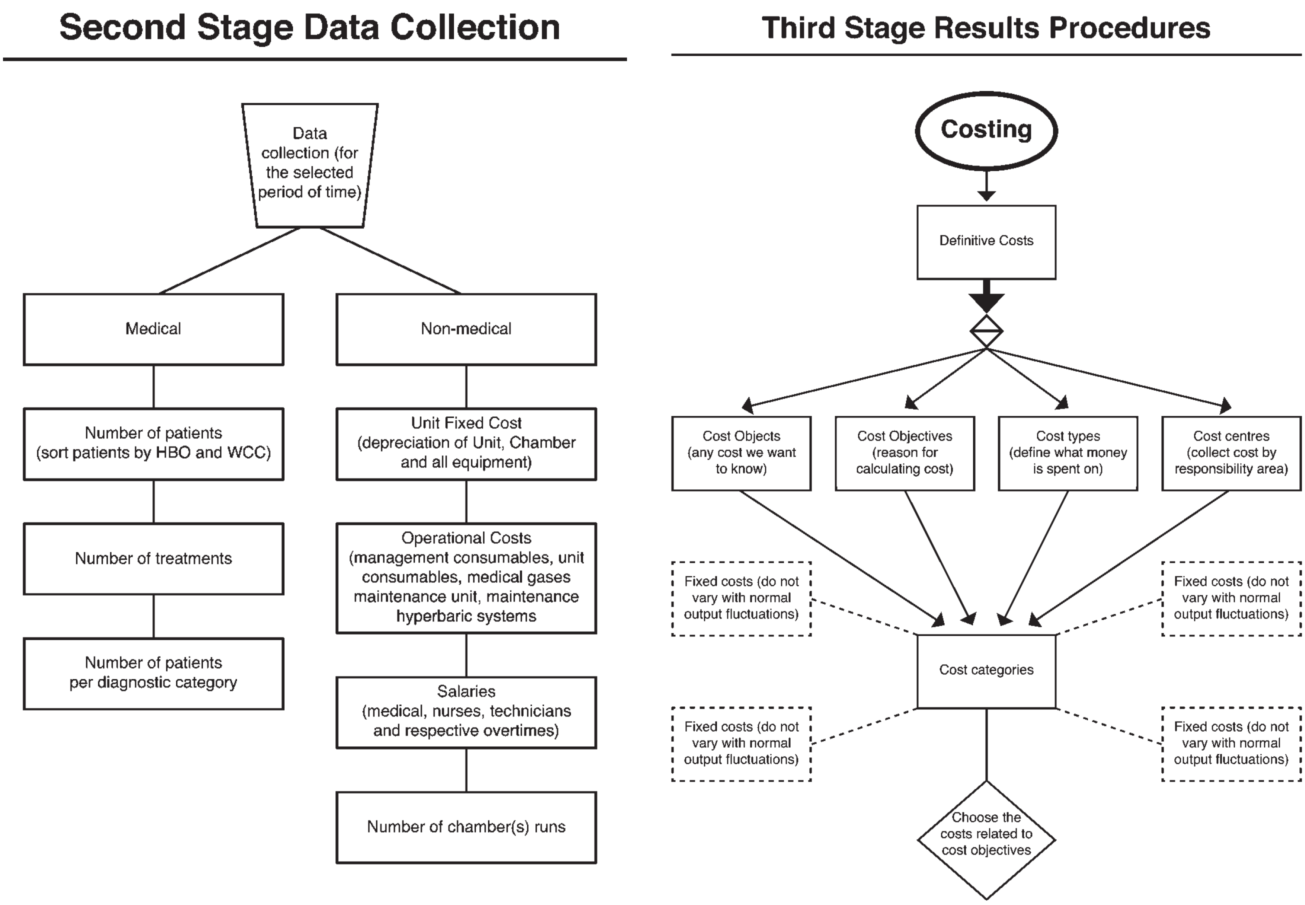


Figure 4. Costs for hyperbaric and wound care patients, financial year 2003–2004 (AUSD)

Total cost of Department operations for one year
$1,195,197

(n = 304; 8 patients neither wound clinic nor compressed)

Hyperbaric activity
$1,118,730 (n = 269)

Chamber depreciation	$50,000
Equipment depreciation	$15,120
Mono-place depreciation	$1,200
Unit depreciation	$67,500
Consumables	$40,452
Maintenance	$16,854
Management	$13,500
Medical gases	$10,000
Nurse overtime	$41,629
Technician overtime	$19,658
Salaries – doctors	$358,458
Salaries – management	$50,400
Salaries – nursing	$270,059
Salaries – technicians	$163,900

Wound care clinic
$76,467 (n = 27)

Equipment depreciation	$1,680
Unit depreciation	$7,500
Consumables	$4,495
Management	$1,500
Salaries – doctors	$18,866
Salaries – management	$5,600
Salaries – nursing	$36,826

Average cost per wound clinic patient
$2,832

Table 3
Incremental cost of one further patient by diagnostic category (ORN – osteoradionecrosis)

Diagnostic category	Incremental cost of additional patient (AUSD) per treatment
Prevention of ORN	177
Soft-tissue radiation injury	180
Chronic wounds	178
Osteoradionecrosis	177
Diving injuries	415
Acute ischaemic conditions	235
Others	176
Chronic osteomyelitis	177
Acute necrotising infections	229
Other infections	203
Ophthalmological conditions	229
Toxic gas poisoning	227
Neurological conditions	233

Discussion

With this cost study we have measured the cost of provision of care to patients in our unit, both overall and for individual diagnostic categories. These figures will assist us in accurately representing the likely costs of future therapy and in discussions with third-party payers.

Our figures are, of course, based on actual costs and should not be directly compared with hospital hyperbaric charges or Medicare expenditure. For example, our medical staff are all salaried specialist practitioners, and altering the mix of both seniority and employment contracts would alter our cost estimates.

Maximising the efficiency of healthcare delivery is dependent upon maximising benefit for the lowest possible cost. To estimate our efficiency at POWH, information on both resource use and health benefits of hyperbaric versus alternative therapies is needed. By estimating the relative benefits of HBOT versus alternative therapies in a series of Cochrane meta-analyses, we are working toward an estimate of cost benefit in a series of publications currently under preparation in our unit.

For example, in a Cochrane review of the randomised evidence for the effectiveness of HBOT for the treatment of diabetic feet,[7] meta-analysis suggests that the number needed to treat (NNT) to avoid one major leg amputation is four (95% CI 3 to 11). Using our cost data above, at POWH each chronic wound patient receiving HBOT costs on average $3,732. We can calculate, therefore, that our unit will spend on average $14,928 for each major amputation avoided if our results are consistent with those described in published randomised trials. If the assumptions made are valid, we can be 95% confident that the true cost lies between $11,196 and $41,052. The actual extra cost for HBOT in these patients will depend on health costs for treatment excluding HBOT, but including the costs associated with amputation and rehabilitation. It is possible that HBOT may actually save money in this context.

Our figures suggest that HBOT can be delivered at relatively modest cost. We now need to use these figures to inform an accurate analysis of cost versus effectiveness compared with alternative therapeutic strategies. Further analyses based on independent estimates of effectiveness are under way and will be reported in due course.

Acknowledgments

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Jorge D Gomez-Castillo, MD, is Fellow in Hyperbaric Medicine and Michael Bennett was Medical Director in the Department of Diving and Hyperbaric Medicine, The Prince of Wales Hospital, Sydney, at the time of the study.

Corresponding author:
Michael H Bennett, FANZCA
Department of Diving and Hyperbaric Medicine,
The Prince of Wales Hospital, Randwick,
NSW 2031, Australia
Phone: *+61-(0)2-9382-3880*
Fax: *+61-(0)2-9382-3882*
E-mail: *<m.bennett@unsw.edu.au>*