Costs of Screening Bowel Cancer: A Case Study of Bowelscan

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Abstract

The total costs (direct and indirect) associated with the operation of an Australian community based screening program for colorectal cancer were estimated. One-year economic costs of the program were estimated to be $A1,011,348 to screen 24,000 participants. This corresponded to $A6,653 per polyp and $A23,520 per cancer detected.

INTRODUCTION

Colorectal cancer (CRC) is a leading cause of death throughout the Western world. In Australia, it is the second most common cause of cancer death with 4100 deaths in 1988 and in the same year it was the most commonly occurring cancer with 8200 new cases (10).

In February 1995 the Rotary Clubs of District 9650, covering the Mid North Coast and North West Regions of New South Wales, undertook their annual bowel (colorectal) cancer screening program (Bowelscan). Rotary is a voluntary organisation consisting mainly of businesspersons who undertake charitable activities in their local communities. Bowelscan has operated in the region since 1984.

The aim of the program is to detect polyps and cancers of the colon at an early stage. This early identification of cancers is predicated on reducing mortality rates from CRC in the screen population. The program involved the selling of fecal occult blood test (FOBT) kits to the target group - all adults aged 40 years and over. There were 24,000 FOBT kits sold during the week long program. Stalls were set up in high profile positions, like shopping arcades and pedestrian malls, which guaranteed large numbers of passersby. Advertising in local print and electronic media was conducted in the two preceding weeks and the current week to increase public awareness of the activity. The participants names and addresses were recorded for each specific kit sold to facilitate later contact if the test proved positive. Participants also recorded their age, gender and family history of CRC and details of any irregularities in bowel habits.

FOBT is one of the main recognised tests to detect CRC. In the Bowelscan program, Hemoccult II Slide Kits are sold to the public at a nominal fee. The test is designed to

detect hidden blood in the stool if at the time of testing the cancer or polyp is bleeding. Sales were conducted by Rotary volunteers at no charge to the program for their labour. The test involves placing fecal smears on three guaiac-impregnated slides obtained from three consecutive stools after following a high fibre diet for 48 hours. The kits are accompanied by instructions concerning appropriate diet prior to collecting stool samples, and participants are warned not to take the test during menstruation, or if suffering from rectal bleeding. The kits were returned to participating doctor's surgeries or pharmacies for forwarding on to pathology for evaluation, at no additional cost to participants. For those tests which were negative, no further action was taken. However, for those tests which proved positive, the medical coordinator of Rotary contacted the patient informing them of the need to have follow up treatment.

The aim of this paper is to calculate the total economic costs to Australian society of the 1995 Bowelscan screening program. These include the cost of test kits and their processing and the subsequent costs of treating test-positive participants. This enables the estimation of a cost per polyp and per cancer detected by the program. It is the early detection of polyps and cancers which are the main benefits of undertaking screening programs for CRC. The costs of detection are of interest to governments contemplating funding larger programs which would cover the cost of testing a sub-population of society who maybe at higher risk of contracting CRC.

There is currently a vigorous debate in Australia about whether or not to introduce population based screening for CRC (9, 17, 18, 20, 22). There has been a lack of evidence as to the effectiveness of screening in large populations in terms of reduced mortality and also the cost-effectiveness of those programs.

The results of three large randomised controlled trials (RCT) in the United States, England and Denmark, suggest reductions in mortality of 33%, 15% and 18%, respectively, as a result of undertaking large scale screening programs for CRC (8, 12, 15). It has been claimed that this is clear evidence that screening with FOBT is better than no screening in terms of reduced mortality (14).

As to the cost-effectiveness side, a prospective study has estimated the cost-effectiveness ratio in Australia to be $A24,660 per life year saved (18). There has also been one attempt to measure the costs of a screening program using FOBT in Australia. In the Weller et al study (22) of the IMVS screening program in South Australia in 1990-91 it was found that the average cost per cancer detected was $A18,924.

In this analysis, the costs of Bowelscan and the earlier screening program in Australia are presented and discussed in light of the debate outlined briefly above. All costs are in 1995 Australian dollars. The prevailing exchange rate at the end of 1995 was one Australian dollar equivalent to £0.48 and US$0.73.

METHOD

Late in 1995 a survey instrument was sent by postal mail to all those who received positive results to their FOBT. The instrument aimed to collect cost information associated with their subsequent medical treatment following the FOBT test. The survey was constructed by the author and distributed by the Medical Coordinator of the Bowelscan program. An addressed freepost envelope was included to enhance survey return rates.

Actual incidences of medical treatment and the associated costs were supplied by participants. Where costs were not included by respondents, the Medicare schedule fee for

the procedure was substituted (6). Medicare is the universal health insurance program available to all Australians. The schedule fee is determined by the Federal Government and is the reference base for Medicare rebates paid to patients. The amount of time off work to undertake follow-up treatment as well as the income foregone was also collected from test-positive participants.

COSTS

Cost of Participating in Bowelscan (All Participants)

FOBT kits were sold for $4 each. Given that the kit was sold mainly in shopping centres where potential participants were engaging in other activities, the cost of the kit is assumed to be the only cost in obtaining the kit i.e. transport costs of purchase were ignored. The travel cost of returning the kits to pharmacists or doctor's surgeries is assumed to be $4 each. Data was not collected on these costs and this value is taken from (22). The pathology cost of processing each kit is assumed to be $9. This figure is the Medicare schedule fee for the service (6). The other costs of administering the voluntary Rotary program (management, advertising etc.) are assumed to be zero.

Costs of Test-Negative Participants

Thus the direct resource costs of a test-negative participant are $17. No information was collected on the extra costs (if any) of these participants and it is assumed that follow-up medical costs of test-negative participants are zero. In support of this assumption Weller et al (22) found that only 3.9% of test-negative participants reported extra visits to their GP as a result of participation in the IMVS program.

Costs of Test-Positive Participants

On its own FOBT is a relatively inexpensive method by which to detect potential polyps and cancer in the colon. However, these costs increase dramatically when a test-positive result is obtained and follow-up treatment is necessary. In this study these costs are split into two categories: direct (medical) and indirect (time off work and travel costs).

The medical costs include extra visits to their general practitioner (GP), specialist colorectal physician consultations, radiology (barium enema), sigmoidoscopy, colonoscopy investigation and its attendant costs like hospital charges, anaesthetic and pathology and also surgery for those with cancer present.

The indirect costs are mainly the opportunity costs of undertaking treatment in terms of time off work and the loss of income that resulted. A limitation of this study is the ignoring of travel costs. These costs may have been considerable given the remote location of the program and the attendant long distances (up to 200 km) some participants would have needed to travel to consult colorectal specialist physicians.

An attempt was made to elicit from test-positive participants the psychological or intangible costs of participating in the screening program. These costs may be significant and may sometimes be large enough to undermine the support for and benefits of screening (16). Unfortunately, the results obtained were less than satisfactory using a mail survey format. It would seem that a direct interview using the techniques of contingent valuation may provide a useful method for eliciting these values.

Total Economic Costs

The total costs of the program are thus: the total number of kits sold and their processing cost; and the direct (medical) and indirect costs of test-positive participants over a one year period.

RESULTS

Of the 24,000 test kits sold, 520 participants tested positive to blood being present in their stool sample. At this time, the diagnosis details are not available for 44 of these test positive participants. Of the remaining 476 participants there were discovered 43 cancers in 40 participants (one participant had two cancers and another participant had three cancers) and another 152 participants had polyps present in the colon. Of the 520 participants, 342 or 65.7% had returned their completed surveys within one year of the original FOBT i.e. by the end of February 1996.

Table 1 displays the clinical treatment of participants following their test-positive result. As expected, almost all people visited their GP following advice by the Rotary Medical Coordinator of their result. The coordinator also advises the person's GP directly. In most instances the GP visit was as an information gathering exercise and for referral to a colorectal specialist physician. The radiological followup treatment for a test-positive result is double contrast barium enema, and this was utilised by 21% of people. Sigmoidoscopy was performed upon only nine per cent of people. Colonoscopy was performed upon 85% of test-positive people. This latter procedure is the 'gold standard' in clinical treatment with a 99% effectiveness in detecting polyps and cancers.

The treatment protocol followed by a majority was: visit their GP, then visit a colorectal specialist physician, followed by colonoscopy for examination and, if applicable, removal

of polyps. Cancer removal usually required further hospitalisation (day and inpatient) and subsequent convalescence, often involving time off work and loss of income.

Table 1 here

The test-positive participants indicated medical costs as outlined in Table 2. The majority of medical costs were associated with receiving colonoscopy. The costs of colonoscopy include other associated costs of the procedure, like sedation or anaesthetic fees, and hospital charges like bed fees.

If we assume a similar distribution of clinical pathways and associated costs for the 178 test-positive participants (34.3%) who did not respond to the survey instrument, then total medical costs would increase by $178,428 to $521,251 for all test-positive participants.

Table 2 here

Table 3 reports the indirect costs of 84 test-positive people who through their result were forced to take time off work to receive treatment. There were a large number of retired people who recorded test-positive results and hence the overall incidence of occurrence of indirect costs is relatively low (i.e. only 24.5% of respondents). This is also a function of distance. Given the regional setting of the program and the location of colorectal specialists only in major towns, time off work was significant for some of the 84 people.

The loss of income as a result of treatment and travel ranged quite significantly as shown in the table.

Table 3 here

Assuming a similar pattern of lost income for the remaining 178 test-positive participants who did not respond to the survey instrument (i.e. 24.5% of them), then indirect costs for an additional 44 people need to be estimated, and indirect costs would increase by $44,308 to $128,897. The average lost income per test-positive participant was $247.

Table 4 here

Cost Per Screened Participant (20400)	= $50
Cost Per Test-Positive Result (520)	= $1,945
Cost Per Neoplasm (195)	= $5,186
Cost Per Polyp (152)	= $6,653
Cost Per Cancer (43)	= $23,520

In Table 4 the total economic costs which resulted from the 1995 Bowelscan program are estimated. About 36% of the total costs are attributable to the program itself. The remaining 64% of costs are associated with medical follow-up costs (51%) and indirect costs (13%). Indirect costs have regularly been ignored in previous studies and this value it probably an underestimate of indirect costs induced by the program, as travel costs for test-positive participants were not collected. The return rate of FOBT kits for processing was 85%.

Sensitivity Analysis

A summary of the sensitivity analysis is presented in Table 5. The main parameters of interest whose costs would be expected to vary were: costs of processing FOBT kits; labour costs of operating the program; travel costs of test-positive participants and the percentage of FOBT kits processed.

Table 5 here

It is estimated that the cost of producing, distributing and processing FOBT test kits is $17 each. Salkeld et al (18) assumed a cost of $16 which included the cost of the kit, mailing and processing cost. The costs of producing and processing the FOBT kit are fairly certain. However, the estimate of the travel costs of returning the kit ($4) are taken from the IMVS program. This value will probably be an underestimate given the regional setting of this program compared to the urban setting of Weller et al (22). The travel costs of test-negative participants are ignored however and only the costs of travel for test-positive

participants are adjusted. These latter costs may be significant given the spatial distribution of the test population and the location of colorectal specialist physicians only in major population areas in the region. The average travel costs for test-positive participants in the IMVS program was $17 for a return trip of 10 kilometers. Here it is assumed that average travel costs for test-positive participants are $100. The estimated cost per polyp and cancer detected increase by 5.1% as a result of the inclusion of these costs, to $6,995 and $24,729, respectively.

Given the voluntary nature of the program the labour costs of administering Bowelscan are not observable. In a non-voluntary program these costs may be significant. However, to make the program administration costs realistic and thus comparable to what would occur in a population based screening program run by medical professionals, the costs of the organisation and management of the program need to be estimated and included in the analysis. These costs will increase the costs per polyp and per cancer detected. Weller et al (22) provide the only case study in Australia of these potential costs. In the IMVS program the estimated average cost per screen to administer the program was $16.50 (total cost of $119,304 for 7247 tests). When these labour costs are included the estimated cost per polyp and cancer detected increase by 33.2% to $8,868 and $31,347, respectively. The change from voluntary to professional management of the program would result in a substantial increase in the total cost of the screening program.

Another assumption that could be made is that all 24,000 kits purchased were returned for pathology processing. This assumption upwardly biases the estimates of the cost per polyp and cancer detected to, $6,962 and $24,608, respectively.

Changing the clinical treatment pathways would also obviously affect the costs of detection. However, the observed overall pattern of medical follow-up corresponds fairly

closely to best clinical practice. Colonoscopy utilisation in this program was 85% of test-positive participants which is in line with the 83% usage observed elsewhere (17). Obviously, further use of colonoscopy would increase the overall and thus average costs of detection.

DISCUSSION

The cost of the Bowelscan screening program is $6,653 per polyp and $23,520 per cancer detected. This is close to the estimate of the total costs generated by the IMVS screening program in South Australia up to the point of diagnosis over a 2 year period. Weller et al (22) estimated costs of $18,924 (1990 $A) per cancer detected. This is equivalent to $21,445 (1995 $A) adjusted for inflation (1). In that study the indirect costs which were equivalent to 13% of costs here were ignored. Including those would result in a cost per cancer detected of $24,233 which is close to the value estimated in this program.

In this study, the cost of colonoscopic investigations was equivalent to 75% of medical costs of test-positive participants and accounted for 39% of overall costs of the program. This compares favourably with Weller et al (22) who found that colonoscopy accounted for almost half the total costs in their study. Obviously, the cost of colonoscopy is a significant factor in the follow up costs and as such caution needs to be taken in recommending specific strategies which entail the use of them.

There exists no clear evidence as to the most cost-effective strategy for follow-up investigations of test-positive participants. Brown and Burrows (5) in a prospective study of the cost-effectiveness of different CRC strategies in Australia found two that were most efficient, they being: (1) repeat FOBT, sigmoidoscopy and barium enema; and (2) sigmoidoscopy and colonoscopy. Salkeld et al (18) also examined the cost-effectiveness of

CRC screening in Australia. Utilising mortality data from the Mandel et al (15) study it was estimated that the cost-effectiveness of annual FOBT screening with follow up of positives by colonoscopy was $24,660 per life year saved.

Existing recommendations for screening (before recent RCT data became available) are divided. The Working Party of the Australian Gastroenterology Institute and the Australian Cancer Society stated that "routine screening for people aged 50 years or over who have no symptoms and no special risk is not recommended" (2). This position contrasts with The Gut Foundation who recommends annual screening by FOBT, commencing after the age of 40 years (19).

The recent Australian public health literature has been almost unanimously against recommending the operation of population based screening programs (9, 17, 18, 20, 22). This opposition has been based upon two main factors: first, the efficacy of screening, and second, the benefits outweighing the costs.

The evidence as to reduce mortality arising from CRC screening from three population based RCTs would now seem irrefutable. Lieberman and Sleisenger (14) quoting the RCT evidence stated that:

"there is clear evidence that screening can reduce mortality....even though the (FOBT) tests have considerable limitations. Waiting for perfect screening tests will mean that every year thousands of patients will need care for colorectal cancer - suffering that could be prevented in many patients with today's knowledge. The time has come to encourage colon screening, despite its limitations, while continuing to research ways to improve identification of high-risk subgroups, increase complicance, reduce costs, and develop better screening methods".

The question which now remains to be answered is whether society is willing to pay for population based programs to screen CRC?. As this paper has shown this will be a function of many factors. The cost-effectiveness of CRC screening is uncertain and is primarily a function of the efficacy of screening protocols and the follow up clinical strategies chosen.

In Australia this is still unknown as the results of a Federal Government initiated review undertaken by the Australian Health Technology Advisory Committee of the National Health and Medical Research Council has not yet reported. The terms of reference for the committee are: (1) to review the evidence on benefits, risks and costs of colorectal cancer screening; and (2) to provide advice on CRC screening to the Minister for Health and Human Services.

However in the United States the picture is rather clearer. The U.S. Preventive Services Task Force in late 1995 recommended to the U.S. Department of Health and Human Services that screening for CRC take place in a primary care environment (21). The task force report quoted the strong new evidence as to the efficacy of FOBT and sigmoidoscopy in reducing mortality rates. The recommendation was for all persons aged 50 and older to be tested with annual FOBT or sigmoidoscopy (periodicity unspecified), or both. This recommendation has also been endorsed by the American Cancer Society and nearly all of the medical gastrointestinal societies (13). Elsewhere, the French Working Group on Colorectal Cancer Screening recommended and the French Health Minister agreed that a program of CRC screening should be implemented. This has begun on a trial basis in limited geographical areas (7).

There now exists clear evidence that FOBT screening reduces CRC mortality rates. This is in contrast to the position previously adopted (9, 17, 18, 20, 22) which concluded that screening for CRC in Australia should not be implemented on a population basis as there is not sufficient evidence of its effectiveness. The clinical evidence now exists and this study provides more detail about the costs involved in undertaking large scale screening projects for CRC.

This study as well as the Weller et al (22) study provides further information as to the costs of CRC screening programs in Australia. The base line costs in both these programs are of a similar magnitude in terms of cost per cancer detected. The epidemiology evidence as well as these studies should impel the Federal Government to undertake further investigations as to the best form and least cost method of implementing CRC screening on a population basis. This has been done previously by the Australian Institute of Health in the case of both breast cancer and cervical cancer screening (3,4). These studies focussed upon providing cost effective delivery of screening services to all Australian women.

Rotary has much experience in undertaking these programs and they are likely to wish to continue their involvement in this area given their energy and initiative in establishing Bowelscan. Community based screening programs like Bowelscan provide important information as to the form that a national program may take.

The results discussed in this paper provide detailed information as to the costs involved in carrying out such a program on a limited basis, including an insight into the indirect costs, which the literature suggests may be significant but which has failed to provide details as to their magnitude.

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Table 1

Clinical Treatment Following Advice of Test-Positive Result (n = 342)

	Visited GP		Barium Enema		Sigmoidoscopy		Colonoscopy	
	Number	%	Number	%	Number	%	Number	%
Yes	329	(96)	72	(21)	31	(9)	290	(85)
No	2	(1)	257	(75)	297	(87)	40	(12)
Don't Know	11	(3)	13	(4)	14	(4)	12	(3)

Table 2

Direct (Medical) Costs of Test-Positive Participants (n = 342)

	$
GPs and Specialists	8,969
Barium Enema	8,122
Sigmoidoscopy	3,268
Colonoscopy	258,089
Tests	11,122
Other	53,253
Total	$342,823
Average Medical Cost	$1,002

Table 3

Estimated Lost Income of Test-Positive Participants (Indirect Costs) (n = 84)

Total	$84,589
Average	$1,007
Range	$7,350 - $39

Table 4

Total Costs of 1995 Bowelscan Program

		$	%
Kits - Processed	20,400 @ $17/kit	346, 800	
- Not Processed	3,600 @ $4/kit	14, 400	35.7
Direct (Medical)		521, 251	51.5
Indirect		128, 897	12.7
Total		$1,011, 348	100

Table 5

Sensitivity Analysis for 1995 Bowelscan Program

Adjustment	Total Costs $	Cost Per Polyp Detected $	Cost Per Cancer Detected $
Nil	1,011,348	6,653	23,520
Include Imputed Labor Costs of Operating Bowelscan into FOBT kit cost ($16-50 per kit)	1,347,948 (up 33.2%)	8,868	31,347
Include Travel Costs of $100 per Test-Positive Participant	1,063,348 (up 5.1%)	6,995	24,729
Increase Processing Rates of FOBT Kits to 100% or 24,000	1,058,148 (up 4.6%)	6,962	24,608
Include All Three Adjustments	1,446,948 (up 43.0%)	9,520	33,650

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